The Council of the City of Sydney

Bondi Junction to City Cycleway Traffic Modelling

Traffic modelling report

13 November 2015

PARSONS BRINCKERHOFF

Document information

Client: The Council of the City of Sydney
Title: Bondi Junction to City Cycleway Traffic Modelling
Subtitle: Traffic modelling report
Document No: 2196872A-ITP-RPT-001-RevE
Date: 13 November 2015

Rev	Date	Details
	01/07/2015	Draft
A	03/08/2015	Revised Draft
B	13/08/2015	Revised Draft – addressing City of Sydney's comments
C	15/09/2015	Revised Draft v2 – addressing RMS comments
D	13/10/2015	Include options testing
E	13/11/2015	Include options testing (address RMS comments)

Author, Reviewer and Approver details

Prepared by:	Phil Guo John Trieu	Date: 13/11/2015	Signature:
Reviewed by:	Callan Stirzaker	Date: 13/11/2015	Signature:
Approved by:	Callan Stirzaker	Date: 13/11/2015	Signature:

Distribution

The Council of the City of Sydney, Parsons Brinckerhoff file, Parsons Brinckerhoff Library

Document owner

Parsons Brinckerhoff Australia Pty Limited

ABN 80 078 004 798

Level 27 Ernst & Young Centre
680 George Street
Sydney NSW 2000
GPO Box 5394
Sydney NSW 2001
Australia
Tel: +61 2 9272 5100
Fax: +61 2 9272 5101
www.pbworld.com

Certified to ISO 9001, ISO 14001, OHSAS 18001

Contents

List of tables

Page number

List of figures

Page number

List of appendices

Executive summary

A dedicated bicycle lane between Oxford Street and Bourke Street, predominantly along Moore Park Road in Moore Park is proposed. To assess the implications of the potential implementation, traffic modelling was conducted. The corridor under investigation is part of a longer route connecting Bondi Junction with the Sydney CBD, and is identified in Transport for NSW (TfNSW) Sydney's Cycling Future as a strategic bicycle corridor within the TfNSW Eastern Suburbs link.

Two alignment options of dedicated bicycle lanes were provided by the City of Sydney (CoS) for this assessment.

- Option 1: Moore Park Road – Fitzroy Street Route
- Option 2: Moore Park Road – Flinders Street – Albion Street Route.

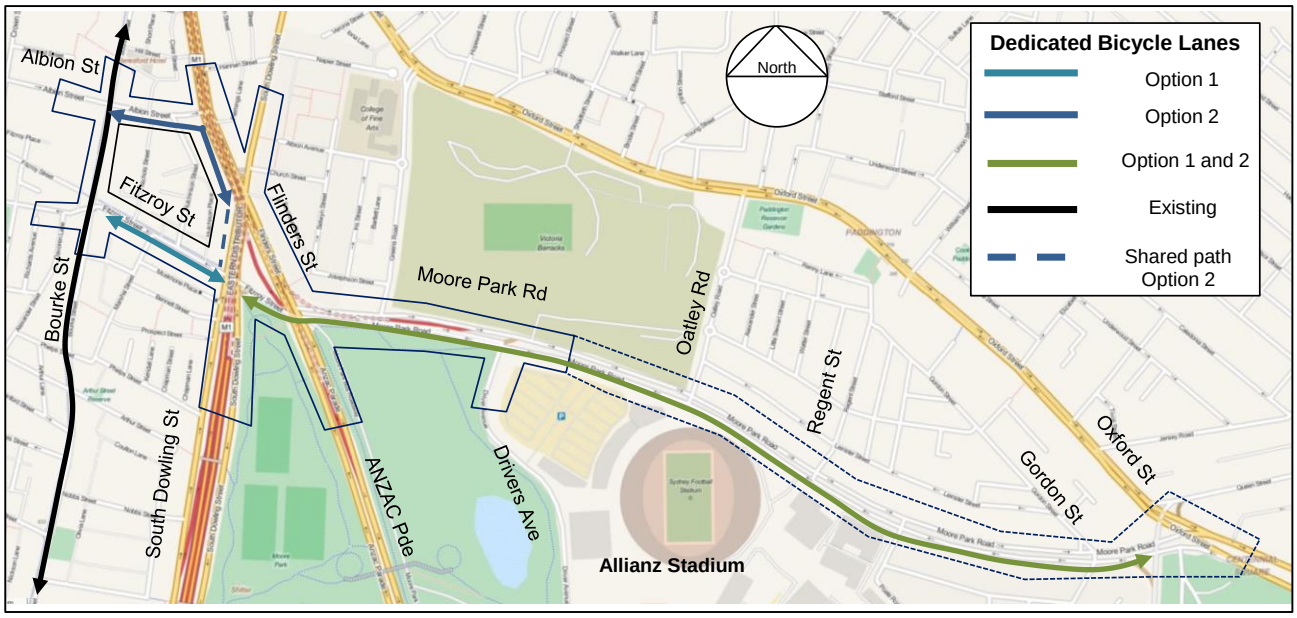


Figure 1.1 Proposed cycleway alignment options

Intersection modelling was conducted in SIDRA to assess the operational performance of the intersections on Moore Park Road east of the Driver Avenue, including:

- Moore Park Road, Oxford Street, Queen Street and Lang Road intersection
- Moore Park Road and Gordon Street intersection
- Moore Park Road and Regent Street intersection
- Moore Park Road and Oatley Road intersection
- Moore Park Road and Driver Avenue intersection.

The microsimulation VISSIM base model was developed to provide a basis for the intersections in the project area west of the Driver Avenue, including the following:

- Moore Park Road and Driver Avenue intersection
- Moore Park Road and Greens Road intersection
- Moore Park Road, Anzac Parade and Flinders Street intersection (part of the Driver's Triangle)

- Fitzroy Street and South Dowling Street intersection (part of the Driver's Triangle)
- Flinders Street and South Dowling Street intersection (part of the Driver's Triangle)
- Flinders Street and Albion Street intersection
- Albion Street and Bourke Street intersection
- Fitzroy Street and Bourke Street intersection.

The models were calibrated and validated in the both AM and PM peak periods, by meeting the following criteria of traffic counts, travel time and queue length (comparison only) in Roads and Maritime 2013*Traffic Modelling Guidelines.*

Sensitivity test was undertaken on the peak 3 hours (9.00 pm to 12.00 am) of the ICC semi-final day using the provided traffic data and assumptions. Based on the comments provided by the Roads and Maritime upon the review of the event day model results, this model is no longer required in the options testing stage.

Table 8.1 presented the results of the operational performance of intersections along Moore Park Road as assed using Sidra. Table 8.2 summarises the intersection operational performance for intersections tested within the VISSIM model.

Table ES.1 Summary of intersection performance along Moore Park Road (SIDRA)

Intersection performance SIDRA model (LoS)**	Base AM peak hour	Option 1&2 AM peak hour	Base PM peak hour	Option 1&2 PM peak hour
Moore Park Road, Oxford Street and Lang Road	C	C	E	E
Moore Park Road, Cook Road and Gordon Street	A	A	A	A
Moore Park Road and Regent Street*	A	A	A	A
Moore Park Road and Oatley Road*	A	A	A	A
Moore Park Road and Driver Avenue**	A	A	A	A

*Assessed as isolated intersection in SIDRA

** Does not consider the downstream intersection impact so the results differ with VISSIM

Table ES.2 Summary of intersection performance of Option 1 and 2 west of Driver Avenue (VISSIM)

Intersection performance VISSIM model (LoS)	AM peak hour			PM peak hour		
	Base	Option 1	Option 2	Base	Option 1	Option 2
Moore Park Road and Driver Avenue	C	D	C	A	A	A
Moore Park Road and Greens Road	C	C	C	A	A	A
Moore Park Road, Anzac Parade and Flinders Street	D	E/F*	D	C	D	C
Fitzroy Street and South Dowling Street	B	C	B	B	C	C
Flinders Street and South Dowling Street	C	C	C	B	C	C

Intersection performance VISSIM model (LoS)	AM peak hour			PM peak hour		
	Base	Option 1	Option 2	Base	Option 1	Option 2
Flinders Street and Albion Street	B	B	B	D	D	C
Albion Street and Bourke Street	B	B	C	F	F	E
Fitzroy Street and Bourke Street	B	D	B	A	C	A

Conclusions made from the modelling of the two cycleway options were:

- Option 2 is shown to perform significantly better than Option 1 and has the potential to provide a dedicated cycling facility without any significant disruptions to general traffic. Option 2 represents the preferred option for further design development.
- Base on the modelling results, Option 1 proposal causes significant disruptions, particularly due to the significant capacity reduction along Fitzroy Street. By removing the retained bus lane between South Dowling Street and Bourke Street, it would improve performance to general traffic in this area, however at the determent to bus users.
- Further development of Option 2 could be considered with appropriate RMS reviews. The modelling results and site visit observations suggest that the Albion Street and Flinders Street intersection are worthwhile of further investigations with the proposed changes to the intersection layout in Option 2. The modelling results show that negligible impacts to general traffic is experienced under the Option 2 scenario.
- Some minor investigations along Flinders Street and at the intersections of South Dowling and Albion Street along Flinders Street is encouraged where the northbound bus lane is proposed to be removed. During the AM peak there is a significant cyclist demand along this section and directing them into the proposed cycleway is likely to improve general traffic in this area.
- Further investigations into the operations of the intersection of Albion Street and Bourke Street, in Option 2 (with the proposed cycleway) is recommended. A number of alternative operational arrangements could be considered including a scramble cyclist phase.

1. Introduction

1.1 Background

Parsons Brinckerhoff was commissioned by the Council of the City of Sydney (CoS) to undertake traffic modelling for the purpose of assessing the traffic impact associated with the implementation of a dedicated bicycle lane between Oxford Street and Bourke Street, predominantly along Moore Park Road in Moore Park. The corridor under investigation is part of a longer route connecting Bondi Junction with the Sydney CBD, and is identified in TfNSW's Sydney's Cycling Future as a strategic bicycle corridor within the TfNSW Eastern Suburbs link.

The objective of the proposed bicycle lane is to improve road safety and accessibility for the cyclists, especially for the many commuting trips between the eastern suburbs and central Sydney. The scope of this project was to undertake traffic modelling of the proposed design schemes with a particular focus the intersection of Moore Park Road, Flinders Street, Anzac Parade and South Dowling Street, Moore Park (commonly referred to as Drivers Triangle). Two alternative routes connecting to the Bourke Street cycleway have been developed, one via Fitzroy Street and the other via Albion Street. A comparative assessment of each route has be undertaken as part of the modelling task.

1.2 Modelling objectives

The objectives of the traffic modelling of this project are:

1. Replicate the existing conditions in the base model including congestion and driver behaviour, during the both AM and PM peak periods on a typical week day, as well as on a known event day.
2. Assess the operational performance of the proposed separated cycleway, provided by CoS; and the impact on the other transport modes, in particular light, heavy vehicles and buses.

This report documents the details of the development, calibration and validation of the base models (or Objective 1) and it also presents findings from the cycleway scenarios (or Objective 2).

1.3 Report structure

This report is comprises the following sections:

- Section 2: Summarises the observations of the existing conditions and traffic data collected in preparing the traffic models.
- Section 3: Summarises the details of the proposed bicycle lane schemes of each option.
- Section 4: Provides the results of the intersection modelling of the five signalised intersections on Moore Park Road (east of Driver Avenue), of the both existing condition and the proposed cycleway.
- Section 5: Details the activities undertaken during the AM and PM microsimulation base model development.
- Section 6: Details the activities undertaken during the AM and PM microsimulation base model calibration and validation, and how the model reflects the observed existing conditions.
- Section 7: Provides the assessment results under the proposed bicycle lane schemes using the microsimulation models.
- Section 8: Summary and conclusion.

2. Existing situation

2.1 Road network

The study area is illustrated in Figure 2.1. It includes Bourke Street and Albion Street corridor options in the West and the central Moore Park Road corridor between Drivers Triangle and Oxford Street. The modelling has been broken into two sections based on the modelling approach undertaken for each:

- Section I, five signalised intersections east of Driver Avenue, is modelled using SIDRA, an intersection modelling tool developed by SIDRA SOLUTION.
- Section II, eight signalised intersections west of Driver Avenue, is modelled using VISSIM, a microsimulation tool developed by PTV group; and

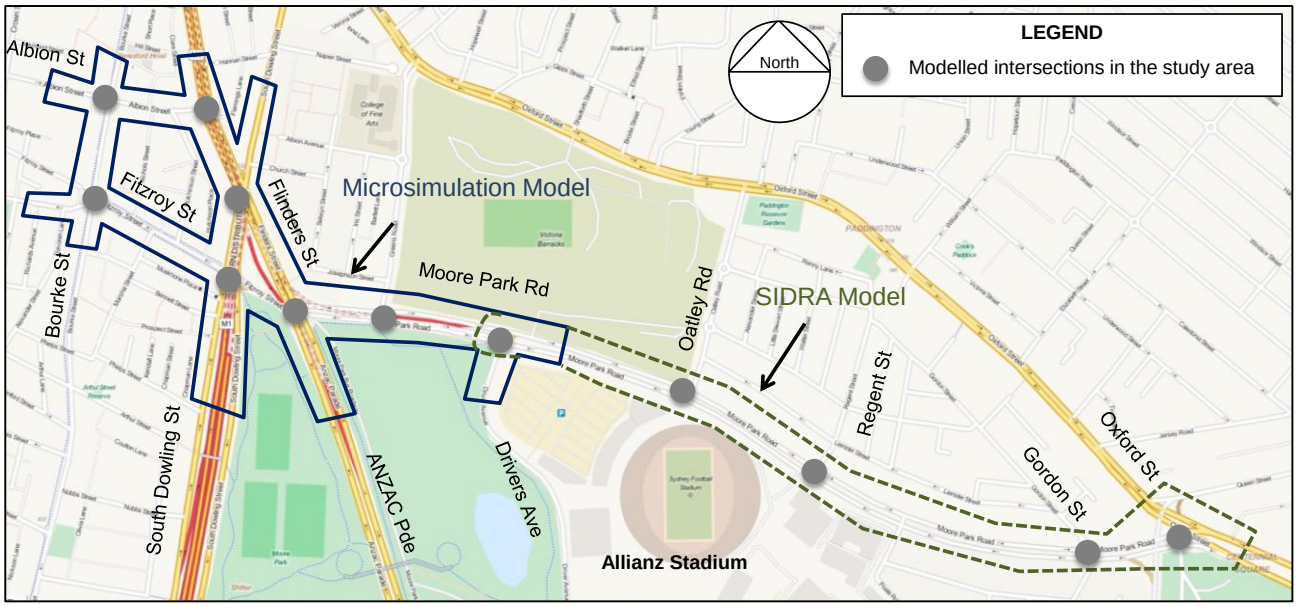


Figure 2.1 Project study area (highlighted microsimulation model scope)

Moore Park Road is a multi-lane two way road which extends between Cook Road in the east and Anzac Parade in the west. The road forms part of an arterial corridor which provides connection between the eastern suburbs and the southern areas of the Sydney CBD. The road is generally configured with two lanes in each direction as well as kerbside parking on both sides. Additional lane capacity is provided on the approach to a number of the signalised intersections to facilitate turning movements. A shared path is provided on the southern side of Moore Park Road between Cook Road and Anzac Parade. The speed limit on Moore Park Road is 50 km/h. The portal to the northbound on-ramp to the Eastern Distributor is on Moore Park Road immediately west of Anzac Parade whilst an egress portal form the Eastern Distributor southbound carriageway is provided on Moore Park Road between Greens Road and Driver Avenue.

Anzac Parade is a north/south arterial road connecting between Darlinghurst/Moore Park and La Perouse via Kensington and Maroubra. In the Moore Park area, Anzac Parade is a six lane divided road with a sign posted speed limit of 60 km/h. A separated bus roadway runs parallel to Anzac Parade and connects with the general road network at the Anzac Parade/Moore Park Road/Flinders Street intersection.

Flinders Street is a multi-lane arterial road which connects between Oxford Street and Moore Park Road. Kerbside Bus Lanes are provided in both directions whilst the sign posted speed limit is 60 km/h.
South Dowling Street is a two-lane major street in north and south direction. It is a key connection between the south, the Sydney Airport and the Eastern Suburbs, parallel with the Eastern Distributor. The speed limit on South Dowling Street is 60 km/h.

Fitzroy Street extends from Moore Park Road as a three-lane one-way arterial road in westbound direction. It has a kerbside bus lane. The speed limit on Fitzroy Street is 50 km/h.

Albion Street is parallel with Fitzroy Street and runs in (one-way) eastbound direction. It has a kerbside bus lane and connected with Bourke Street and Flinders Street. The speed limit on Albion Street is 50 km/h.

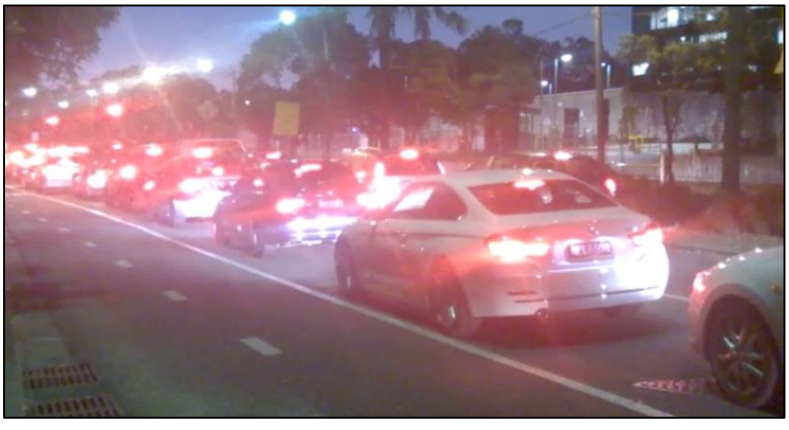
Bourke Street is a multi-lane local north/south street. On street parking is prevalent along the corridor which often restricts operations to one lane in each direction by general traffic. There is a separated bicycle lane alongside the western kerb. The speed limit on Bourke Street is 40 km/h.

2.2 Traffic conditions

Site visits were conducted by Parsons Brinckerhoff on 14 Thursday May 2015, to identify the existing traffic conditions within the study area. Table 2.1 summarises the observations from the site visit.

Table 2.1 Summary of observations from the site visits

Location of observation	Time of observation	Observations made
Moore Park Road east of Flinders Street – westbound direction (to City)	AM peak (7.30 to 8.30 am)	 Excessive queuing was noticed on Moore Park Road after 8.00 am. The westbound queue extended back to Driver Avenue and resulted to significant delays on the corridor. The queuing was primarily a result of the high volume of traffic on Moore Park Road in the city bound direction (being approximately 1400 vehicles in the peak hour). The site observation also indicated a one and half minute difference in travel time between using the kerb and median-side lane since the latter was constantly blocked back from the signal controlled entry to the Eastern Distributor.

Location of observation	Time of observation	Observations made
Flinders Street between Albion Street and South Dowling Street	AM peak (7.30 to 8.30 am)	 Considerable queueing was noticed on Flinders Street between Albion Street and South Dowling Street in the AM peak. This queuing is due to the traffic signal capacity constraint. The queues built up quickly due to the traffic signal delay and it was discharged most cycles.
Fitzroy Street between South Dowling Street and Flinders Street	AM peak (730 to 8.30 am)	 Considerable queuing was noticed on Fitzroy Street between South Dowling Street and Flinders Street. Similar to the queueing on Flinders Street, it was built up due to the limited queue storage space (approximately 120 m) and the traffic signal constraints. The coordination between the traffic signals was observed to provide effective coordination ('green-wave') for the westbound through movement on Moore Park Road, and in turn resulted to the start-stop and the consequent queuing of those vehicles turning left from Anzac Parade.
Moore Park Road east of Flinders Street – westbound direction	PM peak (5.30 to 6.30 pm)	 Similar to AM peak, a stationary queue was observed on Moore Park Road (westbound direction of travel), due to the reduction of green time provided for this movement. The queue was regularly observed to block black to beyond Driver Avenue.

Location of observation	Time of observation	Observations made
Flinders Street between Albion Street and South Dowling Street	PM peak (5.30 to 6.30 pm)	 Excessive queuing was noticed on Flinders Street between Albion Street and South Dowling Street. This was primarily due to the limited lane storage space between the intersections and the signal coordination within the Driver's Triangle. Illegal use of bus lane by the general vehicles was also noticed, due to the congestion which prevented those from merging onto the kerbside lane to turn left.

In summary, Figure 2.2 highlights the location and the approximate extent of typical queues observed.

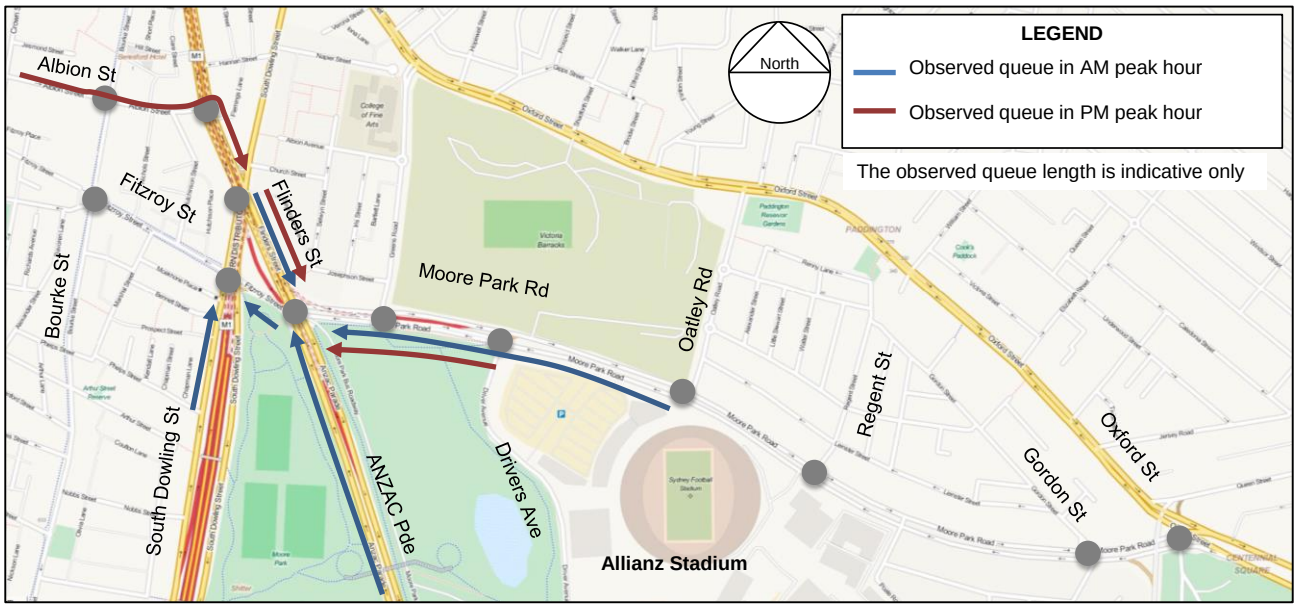


Figure 2.2 Identified areas of congestion

2.3 Existing facilities for cyclists

Figure 2.3 and Figure 2.4 summarise the existing facilities for cyclists in the study area. These are summarised as:

- The on-street bicycle lane on Moore Park Road originates from west of Cook Road to Driver Avenue. Dissimilar to the typical cycle path alignment discussed in *Guide to the Road Design Part 6A: Pedestrian and Cyclist Paths (*Austroads*)*, this is a directional one-way path next to the on-street car spaces. This alignment is perceived to increase the potential risk of collision between the cyclist and the parked vehicle due to a minimum clearance of 2.8 m (between the kerb and the cycle path boundary) not being provided.
- The two-way shared path using the existing footpath on Moore Park Road between Driver Avenue and Flinders Street/Anzac Parade. This shared path was observed to have considerable cyclist volumes during the both AM and PM peak hours. Whilst it does continue to provide the off-street facilities for the cyclists on Moore Park Road, the likelihood of an accident was perceived to exist due to the nature of the shared path and the local land use characteristics (e.g. park lands and senior pedestrians).
- The two-way separated bicycle lane alongside Bourke Street. This provides the key connection for the dedicated cycling movement between the City and southern suburbs such as Zetland, Green Square and Mascot.
- There is no existing separated or shared bicycle lane on Fitzroy Street, Flinders Street and Albion Street. Cyclist on these road the cyclists need to share the general traffic lanes or bus lanes with the other vehicles, or share footpath facilities with pedestrians.

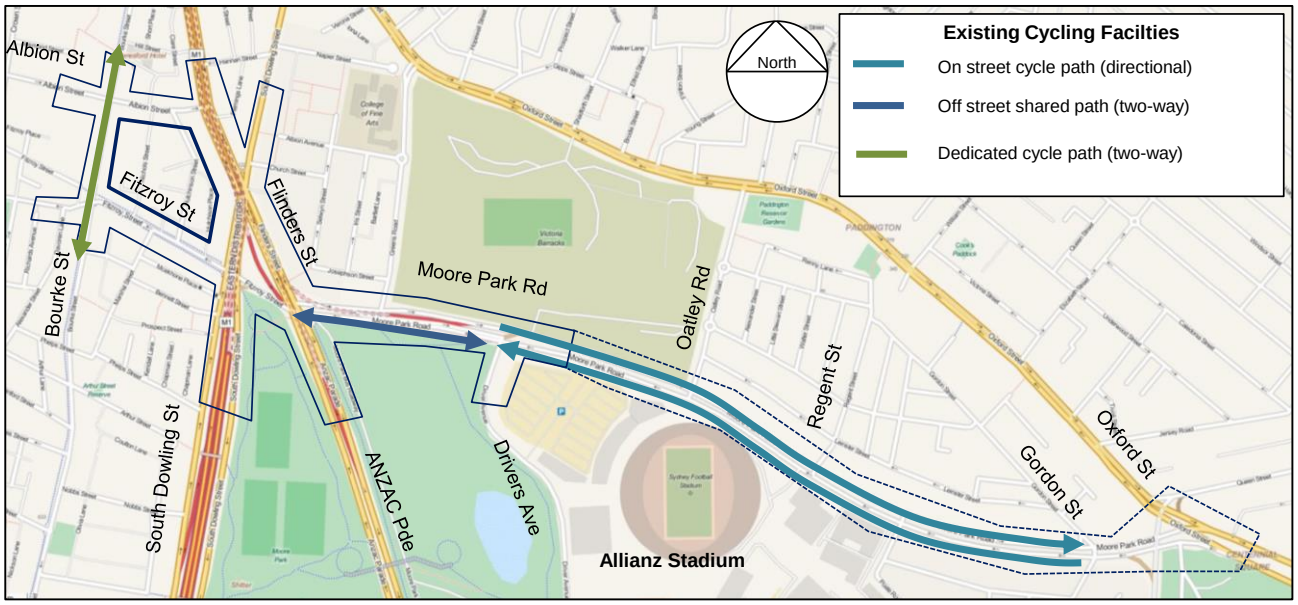
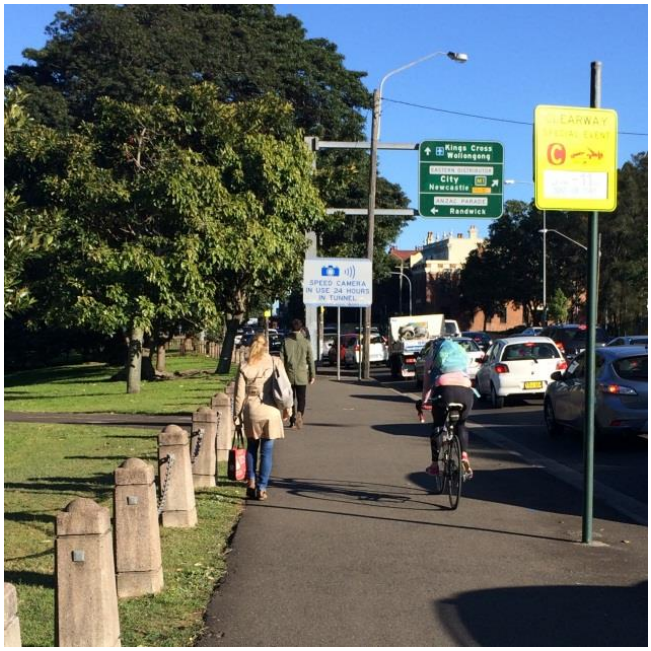


Figure 2.3 Existing facilities for the cyclists

Within the existing environment, cyclists riding from the City to the eastern suburbs (such as Bondi Junction) and not sharing road space with general traffic would be required to walk across the pedestrian crossing at Greens Road, prior to continuing their journey on the northern side of Moore Park Road.

Cyclist movements within study area

a) bicycle lane on Moore Park Road east of Driver Avenue



b) Shared Path on Moore Park Road east of Flinders Street

c) Separated bicycle lane on Bourke Street (Source: Sydney Cycleways)

d) On-street cycling on Fitzroy Street (absence of cycle path)

Figure 2.4 Existing cycling movements within the study area

2.4 Traffic data collection and analysis

2.4.1 Classified intersection counts

Classified turning counts at selected intersections on Tuesday 16 September 2014 and Wednesday 25 March 2015 were provided by the City of Sydney. Traffic volumes were collected for both AM and PM peak periods in 15 minute segments, in the morning from 6.30 to 9.30, and evening from 3.30 to 6.30 on both days (hereafter referred to as '2014/15 turning counts'). Vehicle classifications were grouped into four classes; light vehicles, rigid trucks, articulated trucks and buses. Figure 2.5 shows the locations of the classified intersection counts.

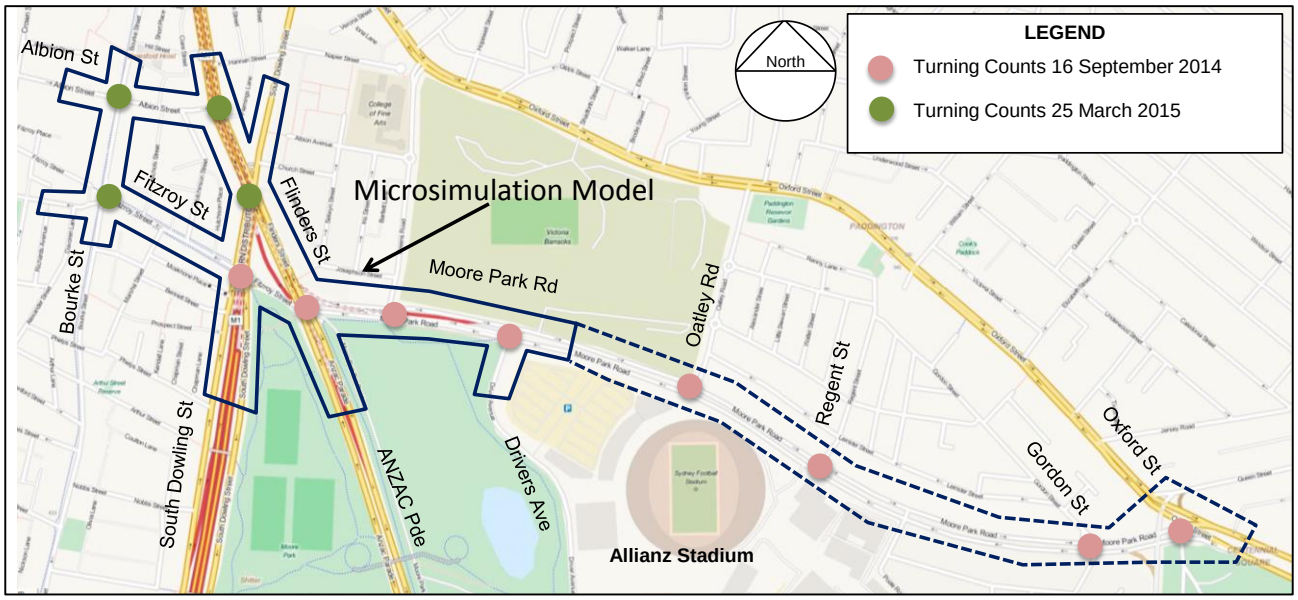


Figure 2.5 Collected traffic data locations

Classified turning movement counts were also provided for 26 March 2015, as a known event day (ICC semi-final).

The classified intersection counts were primarily used as the benchmark for the calibration of the modelled traffic flow at the intersections. They were also used to inform the traffic demand inputs for the both SIDRA and VISSIM models. The detailed traffic flow diagrams are attached in Appendix A1.

2.4.2 SCATS detector data and counts

SCATS counts were provided by the Roads and Maritime at each signalised intersection, for the 17 September 2014. The data covered both the AM and PM peak periods and provided the details of signal phasing, timings and the traffic counts of each detected turning movement.

The signal IDM data were later provided for Tuesday 2 June 2015 (AM and PM) and Wednesday 24 June 2015 (AM only), and these were used as a basis to replicate the intersection operation during both the AM and PM peak periods. The supplied SCATS data are attached in Appendix A2.

2.4.3 Travel time data

The travel time results were recorded during the site visit undertaken by Parsons Brinckerhoff on 14 Thursday May 2015, using the route shown in Figure 2.6. The travel times were recorded for the area being modelled by VISSIM only.

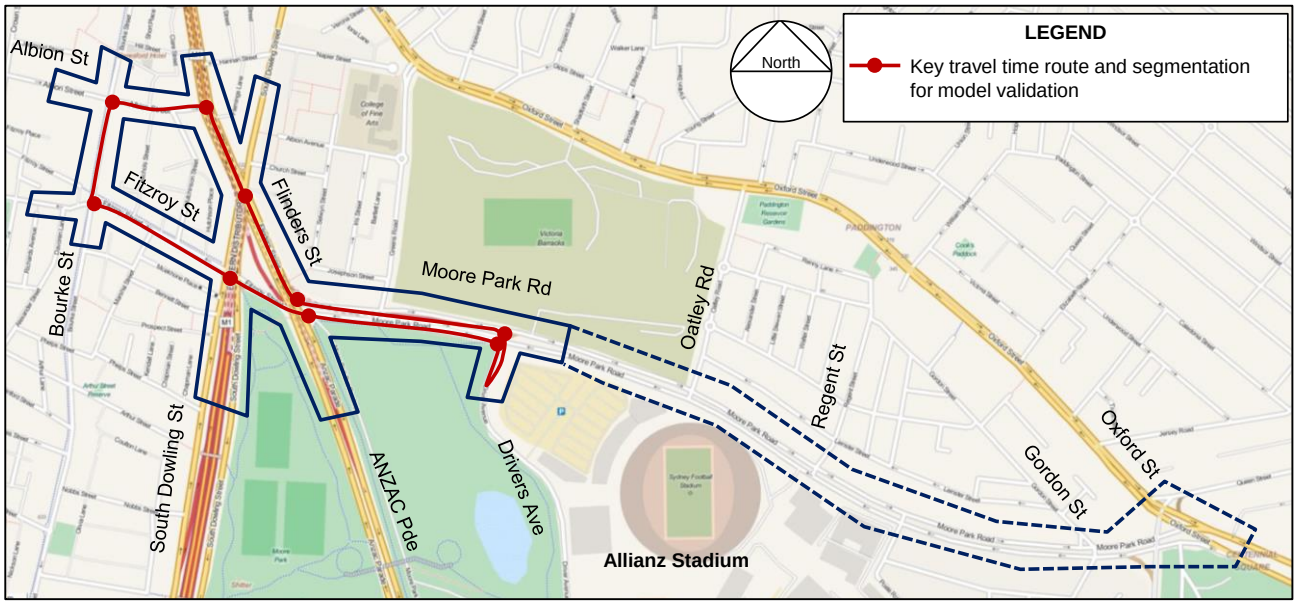


Figure 2.6 Recorded travel time route

A total of seven runs were completed for the travel time collection; having three in the AM peak and four in the PM peak as shown in Table 2.2.

Table 2.2 Results of the travel time survey

Travel time results	AM peak (7.50–8.20 am)	PM peak (4.50–5.40 pm)
Run 1	7:07	5:20
Run 2	6:35*	5:45
Run 3	7:01	7:03*
Run 4	-	8:36
Average	**6:54**	**6:41**

* Used left lane on Moore Park Road east of Flinders Street

Table 2.3 Average results of the travel time survey by sections

Location	AM peak (average)	PM peak (average)
Moore Park Road/Driver Avenue	0	0
Moore Park Road/Flinders Street	2:44	1:36
Fitzroy Street/Bourke Street	0:39	0:53
Bourke Street/Albion Street		0:56
Albion Street/Flinders Street	1:39	1:11
Flinders Street/Moore Park Road	1:12	1:25
Moore Park Road/Driver Avenue	0:41	0:41
Total	**6:54**	**6:41**

The results indicate a high level of variation exists during the PM peak of up to three minutes. This was especially noticeable when considering times for both the kerb and median-side lanes on the Moore Park Road section, east of Flinders Street. The median-side lane was perceived to be significantly impacted by the vehicle blocking back from the signalised entry to the Eastern Distributor, particularly in the AM peak. During the PM peak, the queue and the consequential delays started to rise noticeably after 5.00 pm.

The average values of the travel time shown above were used in the base model validation.

2.4.4 Queue length observation

The vehicle queue length survey was observed during the site visit undertaken by Parsons Brinckerhoff. As summarised in section 2.3 and shown in Figure 2.2, queuing was noticed during the AM and PM peak hours in the following location:

- westbound queue on Moore Park Road, east of Flinders Street. The queue was observed to extend back beyond Driver Avenue during the both AM and PM peak hours
- southbound Flinders Street between Moore Park Road and South Dowling Street. The queue was observed to occasionally extend back to the upstream intersection, in the both AM and PM peak hours
- westbound queue on Fitzroy Street between South Dowling Street and Flinders Street, particularly in the AM peak hour. This queue was observed to be quickly built up and constantly occupy the entire length (80 m) of the storage space between the two intersections
- northbound queue on South Dowling Street south of Fitzroy Street, particularly in the AM peak hour. The queue was observed to go beyond the length of the left-hand side short lane and extend to be at least 100 m.

The above observed records of queue length were used in the base model validation.

2.4.5 Limitations of the traffic data collection

Due to the nature of this project, traffic data, including the classified turning counts, SCATS loop data, SCATS signal IDM data, site observations and travel time recordings were all collected on different days across 2014 and 2015. Table 2.4 summarises these differences.

Table 2.4 Limitation of data collection

Data collection	Provider	Collected date	Limitations/Deficiency
Classified vehicle turning counts	City of Sydney/ Roads and Maritime	16 September 2014 (AM&PM) 25 March 2015 (AM&PM) 26 March 2015 (event day)	The entire corridor does not rely on a consistent day. Did not differentiate the bus and the truck classes, especially on the event day.
Cycling counts	City of Sydney/ Roads and Maritime	19 March 2014 (AM&PM)	Not the same day as SCATS data or classified counts.
SCATS counts	City of Sydney/ Roads and Maritime	17 September 2014	Not the same day as the classified vehicle turning counts. Not on the same day as IDM data.
IDM data	City of Sydney/ Roads and Maritime	2 June 2015 (AM&PM) 24 June 2015 (AM)	Traffic signal operations during the AM peak from 2 June was faulty. 24 June AM data required for use in models. Inconsistent dates compared to traffic volume surveys
Queue length	Parsons Brinckerhoff	14 May 2015 (AM&PM)	Observed only during the site visit.
Travel time	Parsons Brinckerhoff	14 May 2015 (AM&PM)	Recorded only during the site visit.

Since the 2014/15 turning counts were the most complete and these were the primary dataset. It was imperative to make adjustments to the rest of the datasets for the purposes of base model calibration and validation purposes. Reasonable efforts were made in the following data manipulation, including:

- reasonable adjustments to the traffic turning counts by balancing the midblock counts
- slight adjustments to the existing signal timings used in the models, based on the site visit records
- assumptions on bus and truck volumes from the surveyed ‘heavy vehicle’ demands based utilising bus timetable information.

3. Proposed bicycle lane alignments

3.1 Overview of proposed bicycle lane alignments

Two alignment options of dedicated bicycle lanes were provided by the City of Sydney for this assessment.

- Option 1: Moore Park Road – Fitzroy Street Route
- Option 2: Moore Park Road – Flinders Street – Albion Street Route.

Both options provide dedicated bicycle lanes connecting with the existing bicycle lane on Bourke Street, with a common section along Moore Park Road. Option 1 continues along Fitzroy Street to Bourke Street, whilst Option 2 would requires bicycle riders dismount at South Dowling Street, use a shared path before re-joining a cycleway facility on Flinders Street to Albion Street. The alignment of each option is presented on Figure 3.1 and the details attached in Appendix C1.

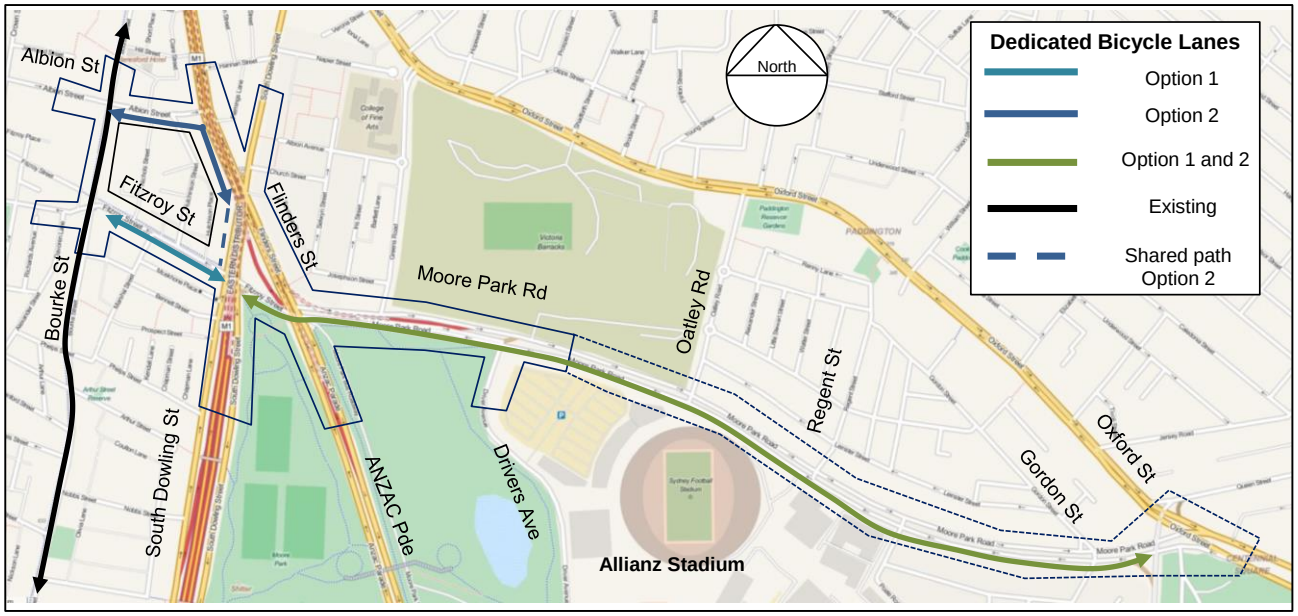


Figure 3.1 Proposed cycleway alignment options

3.2 Summary of transport network changes

A summary of the proposed changes to the transport network, of which are reflected in the traffic modelling, is presented in Table 3.1.

Table 3.1 Summary of transport network changes

Description of change (from east to west)	Option 1	Option 2	Model
Remove traffic island on Moore Park Road (westbound) at Lang Road	Y	Y	SIDRA
Remove left-turn slip lane from Lang Road. Convert lane 1 to shared through/left movement	Y	Y	SIDRA
Remove traffic island on Moore Park Road (westbound) at Cook Road	Y	Y	SIDRA
Remove left-turn lane on Moore Park Road (eastbound) at Regent Street. Convert lane 1 to shared through/left movement	Y	Y	SIDRA
Remove left-turn lane on Moore Park Road (eastbound) at Oatley Street. Convert lane 1 to shared through/left movement	Y	Y	SIDRA
New bicycle lane on Moore Park Road, between Lang Road and Driver Avenue, eastbound and westbound	Y	Y	SIDRA
New bicycle lane on Moore Park Road, between Driver Avenue and South Dowling Street, eastbound and westbound	Y	Y	VISSIM
New bicycle lane on Fitzroy Street between Anzac Parade and South Dowling Street, eastbound and westbound	Y	Y	VISSIM
Remove westbound left turn slip lane and re-align traffic island at South Dowling Street and Fitzroy Street intersection	Y	Y	VISSIM
New bicycle lane on Fitzroy Street between South Dowling Street and Bourke Street, eastbound and westbound	Y		VISSIM
Convert general traffic lane to bus lane on Fitzroy Street between South Dowling Street and Bourke Street, eastbound and westbound	Y		VISSIM
Bus stop and shared path on Fitzroy Street	Y		VISSIM
Add right-turn lane to north and south approaches of Bourke Street cycleway at Fitzroy Street	Y		VISSIM
New bicycle lane on Flinders Street, northbound and southbound		Y	VISSIM
New bicycle lane on Albion Street, eastbound and westbound		Y	VISSIM
Add right-turn lane to north and south approaches of Bourke Street cycleway at Albion Street		Y	VISSIM
Relocate bus stop on Flinders Street to north side of Albion Street		Y	VISSIM
Reduction in travel lanes northbound on Flinders Street		Y	VISSIM
Extend right-turn lane bay to full length on South Dowling Street approaching Fitzroy Street		Y	VISSIM

*The above changes are reflected in the traffic modelling; for all the details of the design refer to CoS design drawings in Appendix C1.

4. SIDRA intersection modelling

SIDRA version 6.0 was used to assess the performance of the signalised intersections on Moore Park Road, east of the Driver Avenue. This section details the intersection layouts modelled and their performance in AM and PM peak hour.

4.1 Intersection assessed

The intersection modelling in SIDRA assessed the operational performance of the intersections east of the Driver Avenue, including:

- Moore Park Road and Driver Avenue intersection
- Moore Park Road and Oatley Road intersection
- Moore Park Road and Regent Street intersection
- Moore Park Road and Gordon Street intersection
- Moore Park Road, Oxford Street, Queen Street and Lang Road intersection.

Level of Service (LoS) is a basic performance parameter used to describe the operation of an intersection. The LoS range from A to F based on the operational performance primarily determined by the average traffic delay at the signalised intersection as indicated in Table 3.1. The results of the degree of saturation and the 95th percentile queue length were also assessed at each approach.

Table 4.1 Level of service criteria for signalised intersections

Level of Service	Average delay (seconds per vehicle)	Traffic signals
A	Less than 14	Good operation
B	15 to 28	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Operating near capacity
E	57 to 70	At capacity and incident would cause excessive delays.
F	Greater than 71	Unsatisfactory with excessive queuing

Source: Roads and Maritime 2002 *Guide to Traffic Generating Developments*

The following assumptions were made in the development of the intersections models:

- the traffic demands between 7.45 and 8.45 am in the AM peak hour were used in the AM peak SIDRA intersection model
- the traffic demands between 5.30 and 6.30 pm in the PM peak hour were used in the PM peak SIDRA intersection model
- slight adjustments were made to the signal timings provided by CoS given the different days for traffic volumes and signal operational information.

4.2 Intersection performance results – Existing condition

4.2.1 Moore Park Road and Driver Avenue

Figure 4.1 shows the existing layout at Moore Park Road and Driver Avenue intersection.

Figure 4.1 Moore Park Road and Driver Avenue intersection layout

The results in Table 4.2 demonstrated that when assessed as an individual intersection, this intersection was estimated to have a performance of LoS A and operates within capacity in the AM peak hour. The maximum queue was estimated to be approximately 21 vehicles or 153 m at Moore Park Road westbound approach.

Table 4.2 Moore Park Road and Driver Avenue – Base AM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Driver Avenue	0.7	57	E	27
Moore Park Road (westbound)	0.6	9	A	153
Moore Park Road (eastbound)	0.8	13	A	46
Intersection	**0.8**	**13**	**A**	**153**

The results in Table 4.3 demonstrated that when assessed as an individual intersection, this intersection was estimated to have a performance of LoS A and operates within capacity in the PM peak hour. The maximum queue was estimated to be approximately 10 vehicles or 72 m at Moore Park Road westbound approach.

Table 4.3 Moore Park Road and Driver Avenue – Base PM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Driver Avenue	0.8	45	D	35
Moore Park Road (westbound)	0.4	9	A	72
Moore Park Road (eastbound)	0.4	3	A	18
Intersection	**0.8**	**8**	**A**	**72**

4.2.2 Moore Park Road and Oatley Road

Figure 4.2 shows the existing layout at Moore Park Road and Oatley Road intersection.

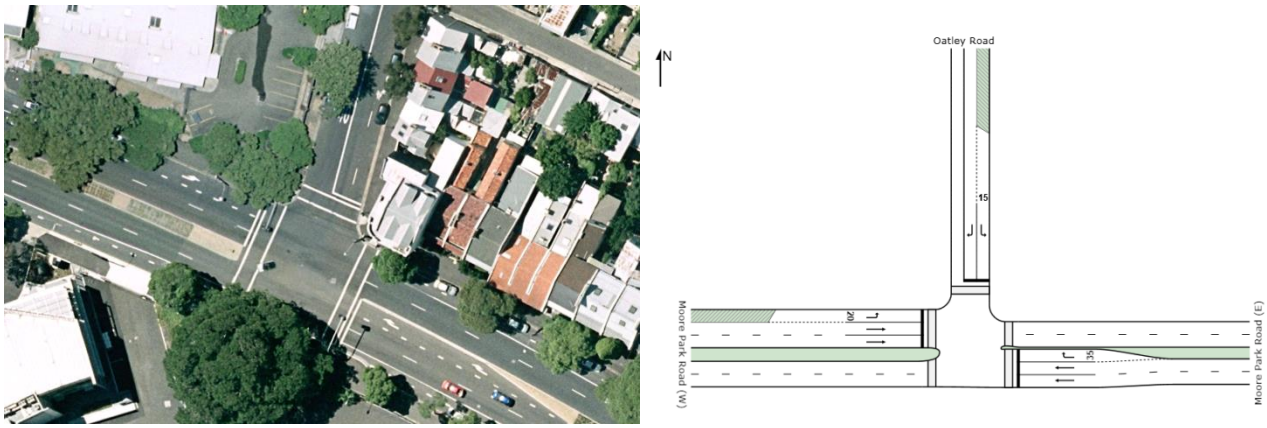


Figure 4.2 Moore Park Road and Oatley Road intersection layout

The results in Table 4.4 demonstrated that when assessed as an individual intersection, this intersection was estimated to have a performance of LoS A and operates within capacity in the AM peak hour. The maximum queue was estimated to be approximately 20 vehicles or 146 m at Moore Park Road westbound approach.

Table 4.4 Moore Park Road and Oatley Road – Base AM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Oatley Road	0.7	57	E	61
Moore Park Road (westbound)	0.6	8	A	146
Moore Park Road (eastbound)	0.3	6	A	62
Intersection	**0.7**	**10**	**A**	**146**

The results in Table 4.5 demonstrated that when assessed as an individual intersection, this intersection has a performance of LoS A and operates within capacity in the PM peak hour. The maximum queue was estimated to be approximately 26 vehicles or 180 m at Moore Park Road eastbound approach.

Table 4.5 Moore Park Road and Oatley Road – Base PM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Oatley Road	0.4	51	D	45
Moore Park Road (westbound)	0.3	8	A	63
Moore Park Road (eastbound)	0.6	9	A	180
Intersection	**0.6**	**11**	**A**	**180**

4.2.3 Moore Park Road and Regent Street

Figure 4.3 shows the existing layout at Moore Park Road and Regent Street intersection.

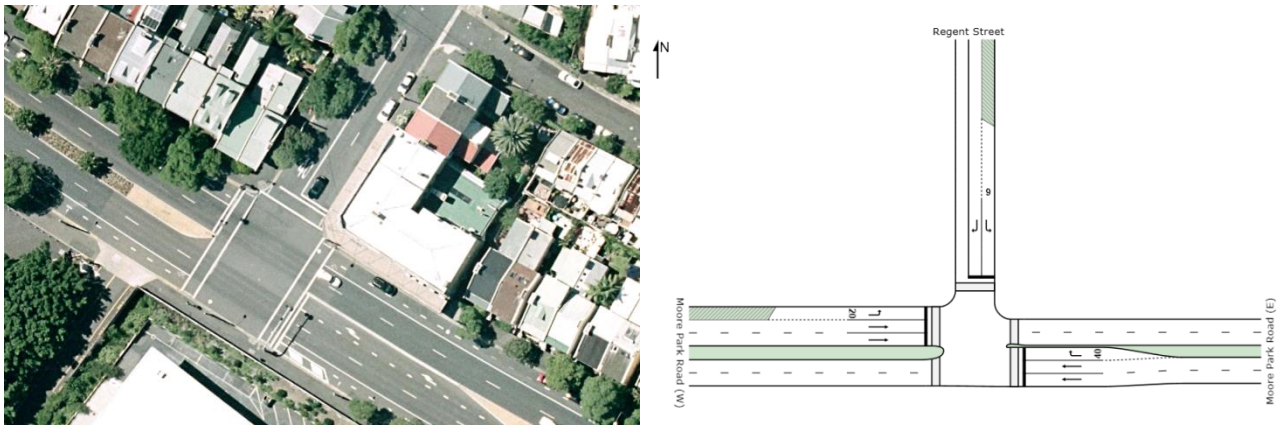


Figure 4.3 Moore Park Road and Regent Street intersection layout

The results in Table 4.6 demonstrated that when assessed as an individual intersection, this intersection was estimated to have a performance of LoS A and operates within capacity in the AM peak hour. The maximum queue was estimated to be approximately 12 vehicles or 87 m at Moore Park Road westbound approach.

Table 4.6 Moore Park Road and Regent Street – Base AM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Regent Street	0.6	61	E	23
Moore Park Road (westbound)	0.5	5	A	87
Moore Park Road (eastbound)	0.4	7	A	76
Intersection	**0.6**	**7**	**A**	**87**

The results in Table 4.7 demonstrated that when assessed as an individual intersection, this intersection was estimated to have a performance of LoS A and operates within capacity in the PM peak hour. The maximum queue was estimated to be approximately 15 vehicles or 108 m at Moore Park Road eastbound approach.

Table 4.7 Moore Park Road and Regent Street – Base PM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Regent Street	0.3	61	E	15
Moore Park Road (westbound)	0.3	4	A	49
Moore Park Road (eastbound)	0.5	5	A	108
Intersection	**0.5**	**6**	**A**	**108**

4.2.4 Moore Park Road, Cook Road and Gordon Street

Figure 4.4 shows the existing layout at Moore Park Road, Cook Road and Gordon Street intersection. This intersection was assessed together with the Moore Park Road and Lang Road intersection as a corridor network.

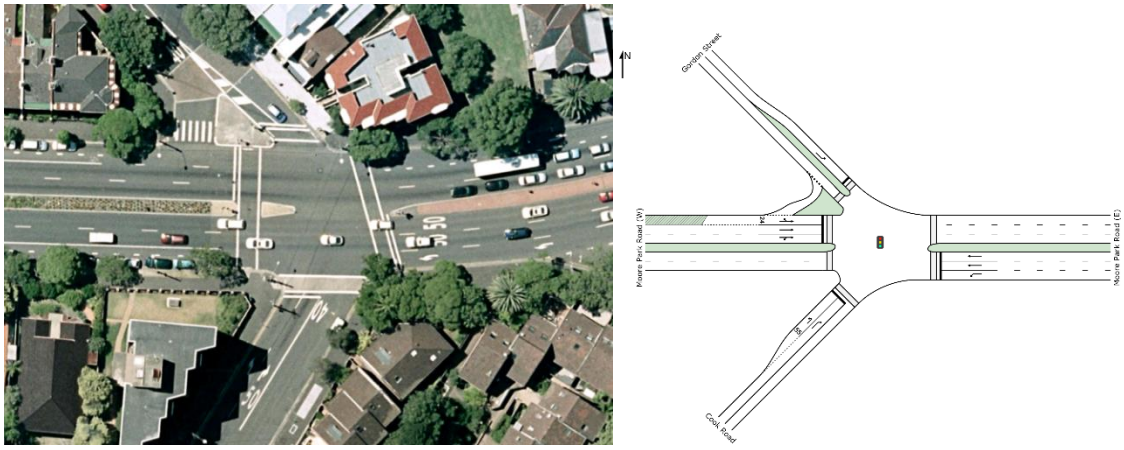


Figure 4.4 Moore Park Road and Gordon Street intersection layout

The results in Table 4.8 demonstrated that when assessed in combination with the nearby Moore Park Road and Lang Road intersection, this intersection was estimated to have a performance of LoS A and operates within capacity in the AM peak hour. The maximum queue was estimated to be approximately 16 vehicles or 117 m at Moore Park Road westbound approach.

Table 4.8 Moore Park Road and Gordon Street – Base AM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Gordon Street	0.2	53	D	25
Moore Park Road (westbound)	0.5	7	A	117
Moore Park Road (eastbound)	0.2	6	A	38
Cook Road	0.4	55	D	37
Intersection	**0.5**	**11**	**A**	**117**

The results in Table 4.9 demonstrated that when assessed as being impacted by the nearby Moore Park Road and Lang Road intersection, this intersection was estimated to have a performance of LoS A and operates within capacity in the PM peak hour. The maximum queue was estimated to be approximately 10 vehicles or 71 m at Moore Park Road eastbound approach.

Table 4.9 Moore Park Road and Gordon Street – Base PM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Gordon Street	0.3	53	D	26
Moore Park Road (westbound)	0.3	6	A	56
Moore Park Road (eastbound)	0.4	6	A	71
Cook Road	0.6	55	D	63
Intersection	**0.6**	**11**	**A**	**71**

4.2.5 Moore Park Road, Oxford Street, Queen Street and Lang Road

Figure 4.5 shows the existing layout at Moore Park Road, Oxford Street, Queen Street and Lang Road. This intersection was assessed together with the Moore Park Road and Cook Road intersection as a corridor network. The remainder of the Oxford Street intersections were omitted from the SIDRA modelling.

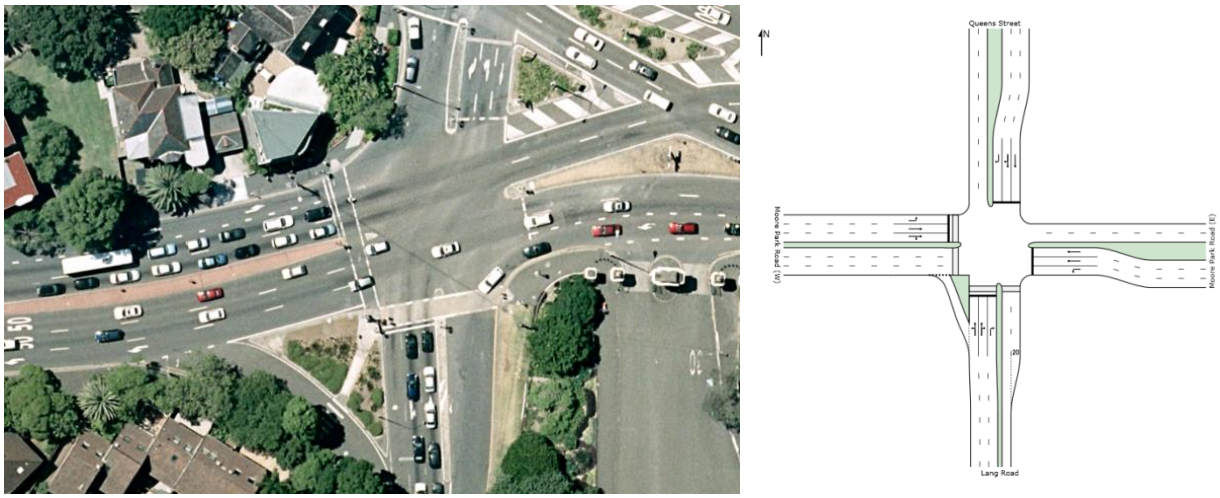


Figure 4.5 Moore Park Road, Oxford Street and Queen Street intersection layout

The results in Table 4.10 demonstrated that when assessed as being impacted by the nearby Moore Park Road and Gordon Street intersection, this intersection was estimated to have a performance of LoS C and operates within capacity in the AM peak hour. The maximum queue was estimated to be approximately 32 vehicles or 226 m at Moore Park Road westbound approach which suggests queuing extending into Oxford Street.

Table 4.10 Moore Park Road and Queen Street – Base AM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Queen Street	0.8	54	D	103
Moore Park Road (westbound)	0.7	23	B	226
Moore Park Road (eastbound)	0.9	60	E	186
Lang Road	0.6	50	D	95
Intersection	**0.9**	**39**	**C**	**226**

Table 4.11 Moore Park Road and Oxford Street – Base PM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Queen Street	0.9	61	E	95
Moore Park Road (westbound)	0.4	15	B	93
Moore Park Road (eastbound)	1.0	99	F	454
Lang Road	0.9	60	E	143
Intersection	**1.0**	**62**	**E**	**454**

The results in Table 4.11 demonstrate that when assessed with the nearby Moore Park Road and Gordon Street intersection, this intersection was estimated to have a performance of LoS E during the PM peak and operates outside capacity (LoS F) on Moore Park Road eastbound approach in the PM peak hour. The maximum queue was estimated to be approximately 64 vehicles or 454 m at Moore Park Road eastbound approach, which would impact on the Oxford Street intersections (not considered as part of this commission).

For the PM peak we also tested if this intersection operates with an improved level of service by allowing the model (SIDRA) to modify the phase times. The performance of this intersection is summarised in Table 4.12 and indicates that the intersection is predicted to be considerably improved (from LoS E to D); with the maximum queue reduced by 90 m on the Moore Park Road. This however would be subject to interactions with intersections operating along Oxford Street.

Table 4.12 Moore Park Road and Queen Street – Base PM peak optimised Moore Park Road (W)

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Queen Street	0.9	80	F	119
Moore Park Road (westbound)	0.4	14	A	88
Moore Park Road (eastbound)	0.9	63	E	367
Lang Road	0.9	66	E	152
Intersection	**0.9**	**51**	**D**	**367**

4.2.6 Summary of intersection performance results (east of Driver Avenue) – Existing condition

The results of the operational assessment on the intersections on Moore Park Road (east of Driver Avenue) demonstrate that:

- Given the intersections were assessed individually, all the intersections were predicted to operate within capacity, with Level of Service (LoS) ranging between A and D as summarised in Table 4.13. The exception to this is the intersection of Moore Park Road/Oxford Street/Lang Road which would exceed capacity at LoS E and a degree of saturation of 1.03. It is noted that the performance of this intersection could be improved through the optimisation of the phase timings.
  Some critical approach arms also experienced a LoS beyond the range of LoS A–D.
- The maximum queuing on Moore Park Road was estimated to be between 85 to 230 m on the westbound approach (inbound) during the AM peak hour, and 70 m to 455 m on the eastbound approach (outbound) during the PM peak hour; the indicative queue lengths were presented in Figure 4.6 and Figure 4.7.

Table 4.13 Summary of intersection performance and maximum queue length

Intersection	Level of Service (AM)	Maximum queue on westbound approach (AM)	Level of Service (PM)	Maximum queue on eastbound approach (PM)
Moore Park Road and Driver Avenue	A	155 m	A	70 m
Moore Park Road and Oatley Road	A	145 m	A	180 m
Moore Park Road and Regent Street	A	85 m	A	110 m
Moore Park Road, Cook Road and Gordon Street	A	115 m	A	70 m
Moore Park Road, Oxford Street and Lang Road	C	225 m	E	455 m

* the queue lengths were rounded to the nearest 5 m

Figure 4.6 Summary of the indicate maximum queue length – AM peak hour

It was deemed the extensive westbound queuing on Moore Park Road in the AM peak was primarily resulted by the congestion impact extended from the downstream road network, particularly at Moore Park Road, Flinders Street and Anzac Parade intersection.

Figure 4.7 Summary of the indicate maximum queue length – PM peak hour

4.3 Intersection Performance results – with proposed bicycle lanes

For the purposes of modelling the traffic impacts of the proposed bicycle lanes, the same signal phase timings from the base model have been utilised to provide a comparative analysis of the changes in the traffic network operation. Where signal settings have been adjusted to account for the operation of the cycleway, these changes have been documented.

4.3.1 Moore Park Road/Driver Avenue

The proposed bicycle lane will be located on the southern side of Moore Park Road, whilst maintaining the existing lane configuration at the intersection of Moore Park Road/Driver Avenue. As a result, there are no changes to the SIDRA Intersection layout (from Figure 3.1) for the modelling of the impacts of the proposed cycleway. However, an additional signal phase was modelled in SIDRA Intersection to reflect the need to hold left-turning traffic from Moore Park Road (east) to Driver Avenue, whilst the bicycle traffic traverses the intersection.

The results in Table 4.14 and Table 4.15 indicate that the result of holding left-turning traffic is a small increase in average delay at the intersection of Moore Park Road/Driver Avenue, particularly on the westbound approach. However, the intersection would continue to operate at LoS A in both of the AM and PM peak periods.

Table 4.14 Moore Park Road and Driver Avenue – with Cycleway AM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Driver Avenue	0.7	57	E	27
Moore Park Road (westbound)	0.6	11	A	164
Moore Park Road (eastbound)	0.8	13	A	46
Intersection	**0.8**	**14**	**A**	**164**

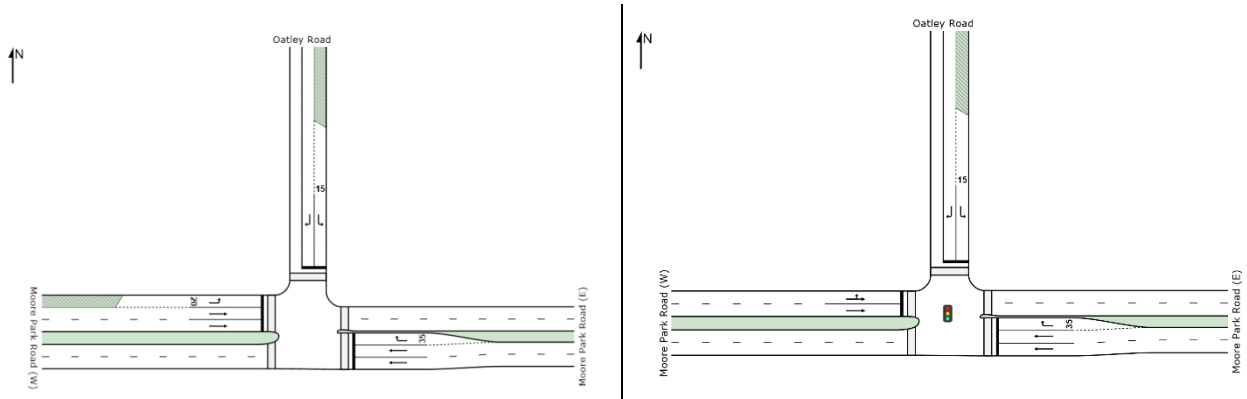
Table 4.15 Moore Park Road and Driver Avenue – with Cycleway PM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Driver Avenue	0.8	45	D	35
Moore Park Road (westbound)	0.4	11	A	80
Moore Park Road (eastbound)	0.4	4	A	18
Intersection	**0.8**	**9**	**A**	**80**

4.3.2 Moore Park Road/Oatley Road

The proposed bicycle lane will be located on the southern side of Moore Park Road and will result in the removal of the existing short left-turn lane on Moore Park Road (west). The removal of the left-turn lane maintains the existing crossing distance across Moore Park Road for pedestrians. Other than the removal of this short turning lane, there are no other changes to the geometry of the intersection of Moore Park Road/ Oatley Road. The proposed configuration would cause left-turning vehicles from Moore Park Road (west) to obstruct eastbound through traffic whilst waiting for pedestrians to cross Oatley Road.

A comparison of the existing and proposed intersection configurations are presented in Figure 4.8.



(a) Existing configuration **(b) Proposed configuration**

Figure 4.8 Moore Park Road and Oatley Road intersection layout

The results for the AM and PM peak periods in Table 4.16 and Table 4.17 (respectively) indicate that there is an increase in average delay in both of the AM and PM peak periods. This is as a result of the obstruction to through traffic on Moore Park Road (west) whilst left-turning vehicles wait for pedestrians to cross Oatley Road. However, the intersection continues to operate at LoS A in each of the peak periods.

Table 4.16 Moore Park Road and Oatley Road – with Cycleway AM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Oatley Road	0.7	58	E	61
Moore Park Road (westbound)	0.6	8	A	147
Moore Park Road (eastbound)	0.4	7	A	74
Intersection	**0.7**	**11**	**A**	**147**

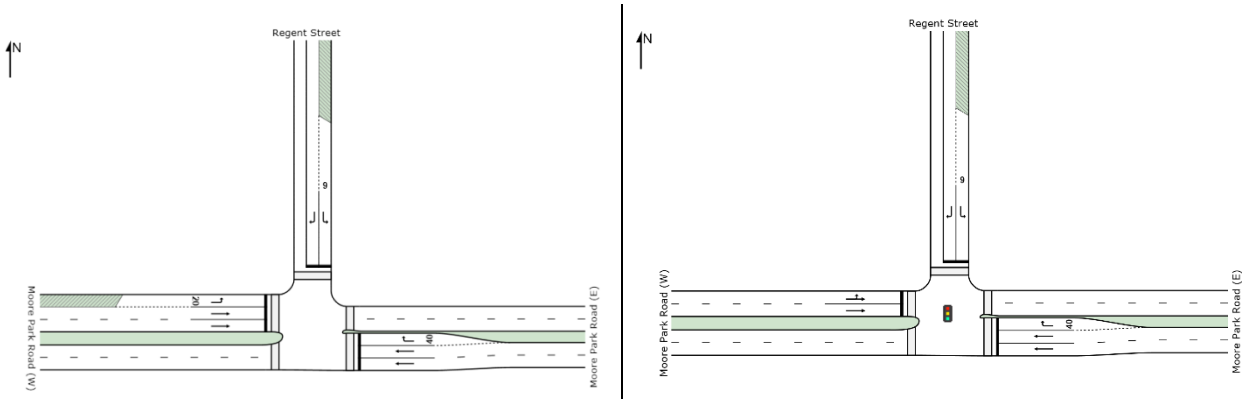
Table 4.17 Moore Park Road and Oatley Road – with Cycleway PM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Oatley Road	0.4	51	D	45
Moore Park Road (westbound)	0.3	8	A	63
Moore Park Road (eastbound)	0.7	12	A	196
Intersection	**0.7**	**13**	**A**	**196**

4.3.3 Moore Park Road/Regent Street

The proposed bicycle lane is located on the southern side of Moore Park Road and will result in the removal of the existing short left-turn lane on Moore Park Road (west). Other than the removal of this short turning lane, there are no other changes to the configuration of the intersection of Moore Park Road/Regent Street. The proposed configuration would cause left-turning vehicles from Moore Park Road (west) to obstruct eastbound through traffic whilst waiting for pedestrians to cross Regent Street. In addition, there is an increase in the crossing distance for pedestrians across Moore Park Road as a result of the implementation of the cycleway. Consequently, additional signal phase time was allowed for in the relevant phase to ensure that pedestrians are able to cross the full width of Moore Park Road.

A comparison of the existing and proposed intersection configurations are presented in Figure 4.9.



(a) Existing configuration **(b) Proposed configuration**

Figure 4.9 Moore Park Road and Regent Street intersection layout

The increase in phase time for the pedestrian crossing movement across Moore Park Road results in a small increase in the average delay experienced by vehicles at the intersection of Moore Park Road/Regent Street. However, the intersection continues to operate at LoS A in each of the AM and PM peak periods (Table 4.18 and Table 4.19, respectively).

Table 4.18 Moore Park Road and Regent Street – with Cycleway AM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Regent Street	0.6	61	E	23
Moore Park Road (westbound)	0.4	5	A	87
Moore Park Road (eastbound)	0.4	7	A	79
Intersection	**0.6**	**8**	**A**	**87**

Table 4.19 Moore Park Road and Regent Street – with Cycleway PM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Regent Street	0.3	61	E	15
Moore Park Road (westbound)	0.4	4	A	49
Moore Park Road (eastbound)	0.5	5	A	110
Intersection	**0.5**	**6**	**A**	**110**

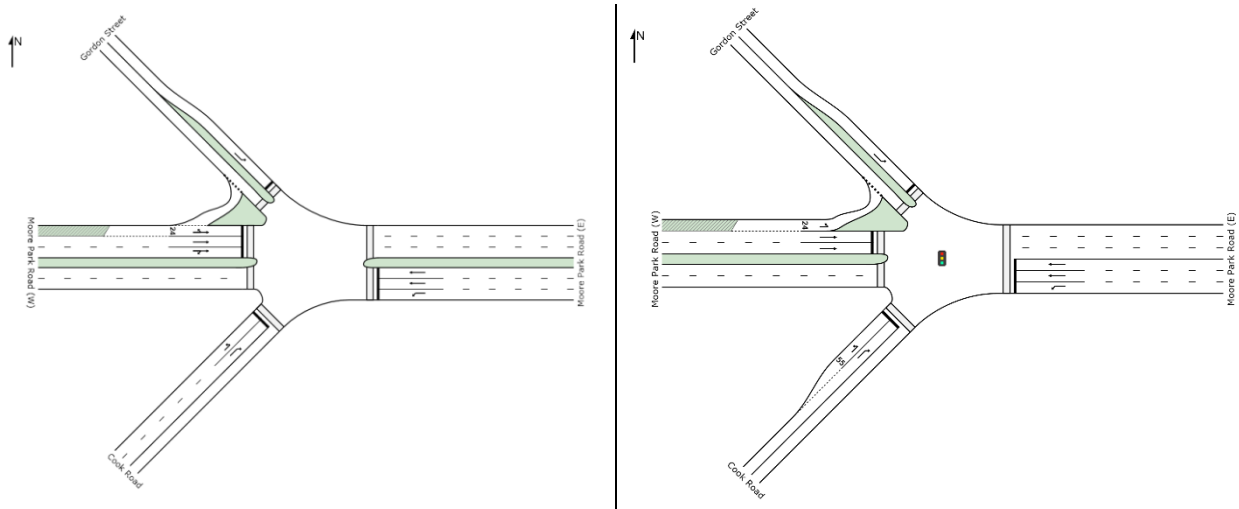
4.3.4 Moore Park Road/Gordon Street

The proposed bicycle lane is located on the southern side of Moore Park Road and will result in the following changes to general traffic:

- banning of the right-turn movement from Moore Park Road (west) to Cook Road
- reduction of eastbound through lanes, from three lanes to two lanes
- left turn slip-lane from Moore Park Road (west) to Gordon Street to be provided as a dedicated short lane
- removal of the median on Moore Park Road (east).

As a result of the cycleway, an additional signal phase was modelled in SIDRA Intersection to reflect the need to hold left-turning traffic from Moore Park Road (east) to Cook Street, whilst the bicycle traffic traverses the intersection.

A comparison of the existing and proposed intersection configurations are presented in Figure 4.10.



(a) Existing configuration **(b) Proposed configuration**

Figure 4.10 Moore Park Road and Gordon Street intersection layout

The results in Table 4.20 and Table 4.21 indicate that the result of holding left-turning traffic is a small increase in average delay at the intersection of Moore Park Road/Driver Avenue, particularly on the westbound approach. However, the intersection continues to operate at LoS A in both of the AM and PM peak periods.

Table 4.20 Moore Park Road and Gordon Street – with Cycleway AM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Gordon Street	0.2	51	D	24
Moore Park Road (westbound)	0.6	9	A	132
Moore Park Road (eastbound)	0.3	6	A	55
Cook Road	0.4	53	D	36
Intersection	**0.6**	**12**	**A**	**132**

Table 4.21 Moore Park Road and Gordon Street – with Cycleway PM peak

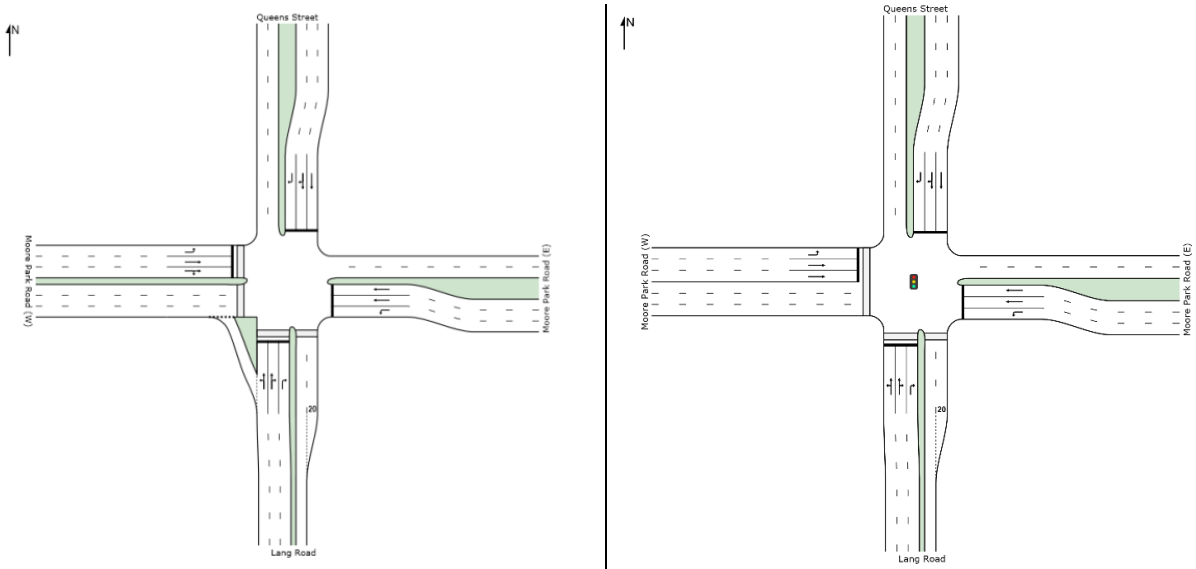
Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Gordon Street	0.3	53	D	27
Moore Park Road (westbound)	0.3	7	A	58
Moore Park Road (eastbound)	0.5	7	A	113
Cook Road	0.6	56	D	64
Intersection	**0.6**	**12**	**A**	**113**

4.3.5 Moore Park Road/Oxford Street/Queen Street/Lang Road

The proposed bicycle lane will be located on the southern side of Moore Park Road and will result in the following changes:

- removal of the left turn slip-lane from Lang Road to Moore Park Road (west)
- removal of the median on Moore Park Road (west).

A comparison of the existing and proposed intersection configurations are presented in Figure 4.11.



(a) Existing configuration **(b) Proposed configuration**

Figure 4.11 Moore Park Road, Oxford Street and Queen Street intersection layout

The results shown in Table 4.22 and Table 4.23 indicate that for the respective AM and PM peak periods, there is an overall decrease in the average delay. The decrease in average delay is a result of the banning of the right-turn from Moore Park Road to Lang Road. Despite this improvement in intersection performance, the intersection continues to operate at LoS C in the AM peak period and LoS E in the PM peak period.

The maximum queue for the commuter demands; westbound during the AM peak period and eastbound during the PM peak period was 226 m and 437 m respectively. As with the existing case analysis in Section 4.2.5, the impact of this queueing on upstream intersections has not been considered. The optimisation of the signal timing was also considered for the PM peak period (Table 4.24) with the performance found to improve overall to LoS D and a reduction in the maximum queue on Moore Park Road eastbound of approximately 80 m. This analysis is contingent upon the interactions with intersections operating along Oxford Street where impacts are likely in this scenario.

Table 4.22 Moore Park Road and Queen Street – with Cycleway AM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Queen Street	0.8	54	D	103
Moore Park Road (westbound)	0.7	23	B	226
Moore Park Road (eastbound)	0.9	55	D	172
Lang Road	0.6	49	D	95
Intersection	**0.9**	**38**	**C**	**226**

Table 4.23 Moore Park Road and Oxford Street – with Cycleway PM peak

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Queen Street	0.9	61	E	95
Moore Park Road (westbound)	0.4	15	B	93
Moore Park Road (eastbound)	1.0	93	F	437
Lang Road	0.9	60	E	143
Intersection	**1.0**	**60**	**E**	**437**

Table 4.24 Moore Park Road and Oxford Street – with Cycleway PM peak (optimised)

Approach	Degree of Saturation	Average traffic delay (seconds)	Level of Service	95th percentile queue length (m)
Queen Street	0.9	80	F	120
Moore Park Road (westbound)	0.4	14	A	88
Moore Park Road (eastbound)	0.9	59	E	354
Lang Road	0.9	65	E	152
Intersection	**0.9**	**49**	**D**	**354**

4.3.6 Summary of intersection performance results (east of Driver Avenue) – with proposed bicycle lanes

The results of the operational assessment on the intersections on Moore Park Road (east of Driver Avenue) demonstrate that:

- Given the intersections were assessed individually, all the intersections were predicted to operate within capacity, with Level of Service (LoS) ranging between A and D as summarised in Table 4.25. The exception to this is the intersection of Moore Park Road/Oxford Street/Lang Road which would exceed capacity at LoS E and a degree of saturation of 1.02. It is noted that the performance of this intersection could be improved through the optimisation of the phase timings.
  Some critical approach arms also experienced a LoS beyond the range of LoS A–D.
- The maximum queuing on Moore Park Road was estimated to be between 85 to 225 m on the westbound approach (inbound) during the AM peak hour, and 80 m to 435 m on the eastbound approach (outbound) during the PM peak hour; the indicative queue lengths were presented in Figure 4.12 and Figure 4.13.

Table 4.25 Summary of intersection performance and maximum queue length

Intersection	Level of Service (AM)	Maximum queue on westbound approach (AM)	Level of Service (PM)	Maximum queue on eastbound approach (PM)
Moore Park Road and Driver Avenue	A	165 m	A	80 m
Moore Park Road and Oatley Road	A	150 m	A	195 m
Moore Park Road and Regent Street	A	85 m	A	110 m
Moore Park Road, Cook Road and Gordon Street	A	130 m	A	115 m
Moore Park Road, Oxford Street and Lang Road	C	225 m	E	435 m

* the queue lengths were rounded to 5 m

Figure 4.12 Summary of the indicative maximum queue length (with Cycleway) – AM peak hour

Figure 4.13 Summary of the indicative maximum queue length (with Cycleway) – PM peak hour

4.4 Summary of the bicycle lane impact (east of Driver Avenue)

A comparison of performance between the existing conditions and with proposed cycleway for the AM and PM peak periods is provided in Table 4.26 and Table 4.27.

Overall, the proposed cycleway would result in small increases in average vehicle delay and queueing on Moore Park Road, east of Greens Road. These increases are a result of the alignment of the cycleway which would require the removal of the eastbound dedicated left-turn short lanes. As a result, the through movement on Moore Park Road is reduced to one lane whilst left-turning vehicles are waiting for pedestrians to cross the respective side-street. This reduces the throughput of the intersection and therefore results in small increases to the average vehicle delay and the extent of the queueing.

At Driver Avenue, Oatley Road, Regent Street and Gordon Street, the increase in average vehicle delay will be on the order of 1–2 seconds. As a result, these intersections are expected to continue to operate at LoS A. These 95th percentile queue at these intersections is also expected to increase by approximately 10–45 metres in the peak traffic flow direction (i.e. westbound in the AM peak period and eastbound in the PM peak period).

At the intersection of Moore Park Road/Oxford Street/Lang Road, there is expected to be a small improvement in the LoS and queueing outcomes. This is a result of the removal of the right-turn movement from Moore Park Road (west) into Lang Road, which allows for two dedicated through lanes to be provided eastbound. This increases the capacity of this movement and therefore reduces the average delay by approximately 1–3 seconds and reduces the queueing by up to 20 metres. It is noted that the existing intersection arrangement would operate at LoS E and a degree of saturation of 1.03, which indicates that the existing traffic demand exceeds the capacity of the intersection. The proposed intersection configuration would therefore provide a marginal improvement to the intersection operation. The intersection could potentially operate at LoS D and a degree of saturation of 0.99 in the event the signal phasing was rebalanced to provide more green time to Moore Park Road.

Table 4.26 Comparison between existing conditions and with proposed conditions – AM peak

Intersection	Direction	Existing conditions		With cycleway	
		Level of Service	Maximum queue on approach (m)	Level of Service	Maximum queue on approach (m)
Moore Park Road and Driver Avenue	Westbound	**A**	**155**	**A**	**165**
	Eastbound	A	45	A	45
Moore Park Road and Oatley Road	Westbound	**A**	**145**	**A**	**150**
	Eastbound	A	60	A	75
Moore Park Road and Regent Street	Westbound	**A**	**85**	**A**	**85**
	Eastbound	A	75	A	80
Moore Park Road, Cook Road and Gordon Street	Westbound	**A**	**115**	**A**	**130**
	Eastbound	A	40	A	55
Moore Park Road, Oxford Street and Lang Road	Westbound	**B**	**225**	**B**	**225**
	Eastbound	E	185	D	170

* the queue lengths were rounded to 5 m; peak direction results in bold font

Table 4.27 Comparison between existing conditions and with proposed conditions – PM peak

Intersection	Direction	Existing conditions		With cycleway	
		Level of Service	Maximum queue on approach (m)	Level of Service	Maximum queue on approach (m)
Moore Park Road and Driver Avenue	Westbound	A	18	A	18
	Eastbound	**A**	**70**	**A**	**80**
Moore Park Road and Oatley Road	Westbound	A	63	A	63
	Eastbound	**A**	**180**	**A**	**195**
Moore Park Road and Regent Street	Westbound	A	49	A	49
	Eastbound	**A**	**110**	**A**	**110**
Moore Park Road, Cook Road and Gordon Street	Westbound	A	56	A	58
	Eastbound	**A**	**70**	**A**	**115**
Moore Park Road, Oxford Street and Lang Road	Westbound	A	88	A	88
	Eastbound	**E**	**455**	**E**	**435**

* the queue lengths were rounded to 5 m; peak direction results in bold font

5. VISSIM base model development

This section details the development of the VISSIM microsimulation base models.

5.1 Modelling software

The microsimulation modelling of this project was undertaken in VISSIM (Version 7), a transport modelling package developed by PTV Group. Since the completion of the base mode VISSIM (Version 8) h.

The choice of using VISSIM was based upon the features it provides which best fit the project purpose and methodology, especially the signal co-ordination and interaction between the vehicles, pedestrians and cyclists. The Roads and Maritime Service (2013) *Traffic Modelling Guidelines* has been used as a reference in developing the Moore Park Road Cycle path base models in VISSIM.

5.2 Modelling methodology

Figure 5.1 summarises the key steps in the modelling methodology. The following report sections align to each of the modelling steps.

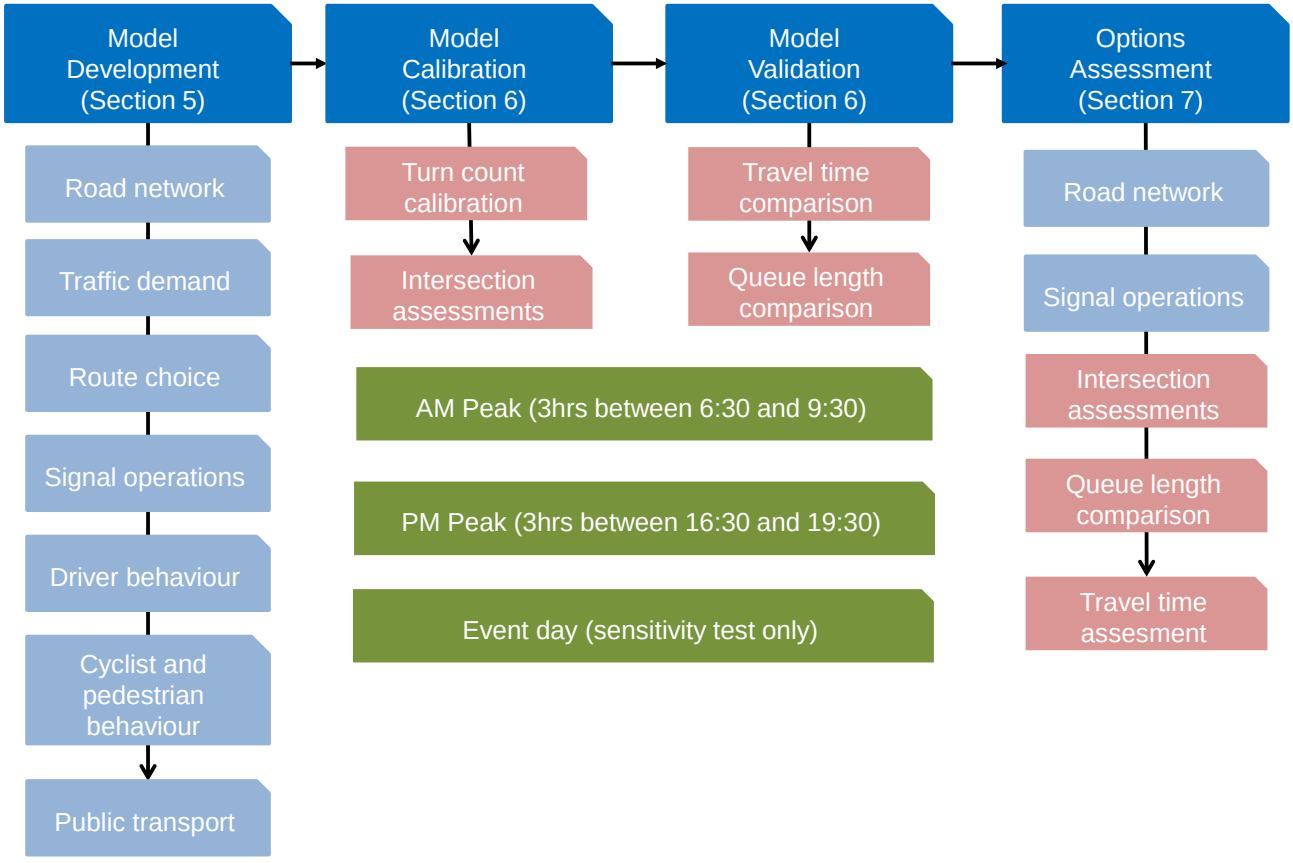


Figure 5.1 Model development, calibration, validation and network assessment process

5.3 VISSIM base model development

5.3.1 Road network coding

Aerial photograph provided by the City of Sydney was used to update the details of network coding inside the study area prior to the site visits. The observations and notes from the both site visits were then used to refine and confirm the network. The VISSIM base model includes following eight signalised intersections:

- Moore Park Road and Driver Avenue intersection
- Moore Park Road and Greens Road intersection
- Moore Park Road, Anzac Parade and Flinders Street intersection (part of the Driver's Triangle)
- Fitzroy Street and South Dowling Street intersection (part of the Driver's Triangle)
- Flinders Street and South Dowling Street intersection (part of the Driver's Triangle)
- Flinders Street and Albion Street intersection
- Albion Street and Bourke Street intersection
- Fitzroy Street and Bourke Street intersection.

The refined model network included the following features:

- the number of lanes as recorded during the site visit and shown on the aerial photographs
- the lane widths measured on the aerial photographs
- the turn bans recorded during the site visit
- the speed limits recorded during the site visit
- the lane markings at intersections observed during the site visit; the adjustments were made to some lane marking to reflect the vehicle behaviour such as the lane utilisation
- the separated cycling path on Bourke Street; in the base model the separated cycling path shares the signal capacity (by having dedicated cycling phase) with the general traffic at this intersection
- the shared path alongside Moore Park Road; the interaction between the vehicles and cyclists on Fitzroy Street where the shared path finishes
- the pedestrian crossing movements were modelled with the assumed demands
- the locations of the bus lanes and timetables of bus stops recorded during the site visit
- parking restrictions recorded during the site visit; this was coded as the on-street traffic lane reduction.

The road type values in Table 5.1 were used in the base model and Figure 5.2 shows the model road network.

Table 5.1 Key road type and speed limit in the base model

Road name	Road type	Speed limit	Key network features
Moore Park Road	Major arterial road	50 km/h	Turn bans, shared path, parking restrictions
Anzac Parade	Major arterial road	60 km/h	Turn bans
South Dowling Street	Major street	50 km/h	Turn bans, reduced lane width
Fitzroy Street	Major street	50 km/h	Bus lane, turn bans, bus stop
Flinders Street	Major street	50 km/h	Bus lane, turn bans, bus stops

Road name	Road type	Speed limit	Key network features
Albion Street	Major street	50 km/h	Bus lane, turn bans
Bourke Street	Local Street	40 km/h	Separated cycling path, low speed limit

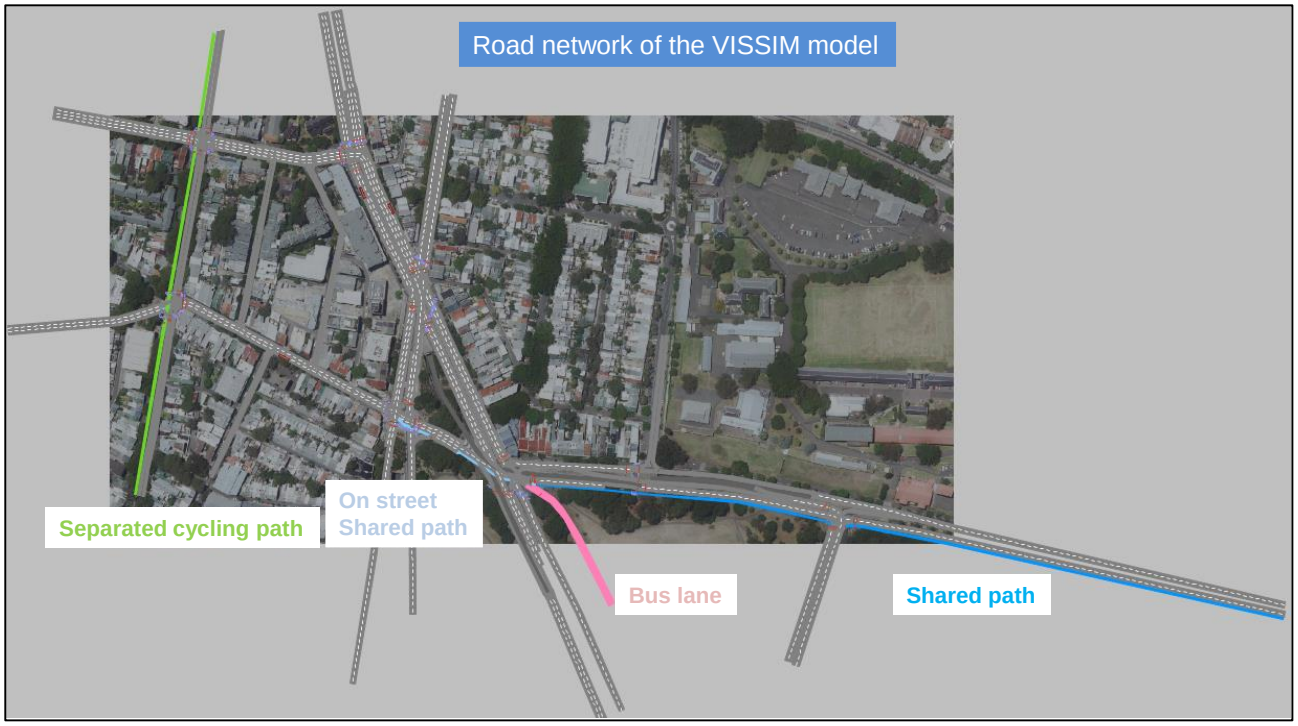


Figure 5.2 Road network of the VISSIM model

5.3.2 Traffic demand and route choice

The traffic demand development was undertaken with the following steps:

1. production of prior traffic matrices using turning counts collected provided by CoS, for each vehicle class in each peak hour
2. manually adjust the estimated matrices to minimise the difference between the observed counts at the mid-blocks between adjacent intersections
3. assign the static route choice using the proportional traffic split originated from each link end and the midblock where the turning counts are available.

The traffic volumes of the both AM and PM peak periods on the key network roads were used in the development of the base model demand, as shown in Table 5.2. The traffic demands of event day model are discussed in section 6.

Table 5.2 Midblock vehicle volumes used in the base models

Vehicle volumes on key roads	AM cars (7.30 to 8.30 am)	PM cars (5.30 to 6.30 pm)	AM trucks (7.30 to 8.30 am)	PM trucks (5.30 to 6.30 pm)
Moore Park Road eastbound	630	900	50	20
Moore Park Road westbound	1300	700	40	49
South Dowling Street northbound	760	770	40	15
South Dowling Street southbound	650	800	30	20
Flinders Street northbound	610	330	40	30
Flinders Street southbound	900	1500	90	100
Bourke Street northbound	60	90	<10	<10
Bourke Street southbound	200	270	16	<10

* the traffic volumes were rounded to the nearest 10 and might be slightly different with the exact numbers in the model

The on-street cyclists were modelled and the demands were estimated based on the turning counts provided by the City of Sydney Council (as shown in Table 5.3). There are noticeable differences at the mid-blocks between the upstream and downstream intersections due to the cyclists move from (or to) on-street to (or from) off-street paths.

Table 5.3 Midblock cyclist volumes used in the base models

On-street cyclist volumes on key roads	AM cyclists (peak hour 7.30 to 8.30 am)	PM cyclists (peak hour 5.30 to 6.30 pm)
Fitzroy Street	80	<10
Flinders Street northbound	160	10
Flinders Street southbound	20	40
Bourke Street northbound	140	50
Bourke Street southbound	50	100

* the cyclists volumes were rounded to the nearest 10 and might be slightly different with the exact numbers in the model

The traffic volumes entering and exiting the Eastern Distributor were not explicitly recorded and were assumed based on the SCATS traffic data as well as the difference of the mid-block counts at the upstream and downstream intersections. The following assumptions were made with the absence of the detailed breakdown in the turning counts provided by CoS.

Table 5.4 Assumption of the traffic flows using the Eastern Distributor in the base models

Movements	Entering the Eastern Distributor		Exiting the Eastern Distributor	
Locations	AM peak hour	PM peak hour	AM peak hour	PM peak hour
Moore Park Road	490	360	430	570
Anzac Parade	780	480	-	-

* the traffic volumes were rounded to the nearest 10 and might be slightly different with the exact numbers in the model

5.3.3 Traffic composition

The characteristics of different vehicle types can affect lane choice and localised network capacity. The following transport modes have been included in the base year model:

- cars, of which the traffic flow percentages were based on the classified turning counts 2014/15
- trucks, of which the traffic flow percentages were based on the classified turning counts 2014/15
- cyclists, of which the traffic flows were based on the classified turning counts 2014/15
- pedestrians with assumed demands
- buses, which were modelled with fixed routes.

5.3.4 Time periods and temporal profiles

The Moore Park Road cycleway microsimulation model covers the following time periods for the both AM and PM base year model.

Table 5.5 Modelled time periods of base models

Description and time periods	Shoulder peak hour Warm up	Peak hour	Shoulder peak hour Cool down
AM Base Model	6.30 to 7.30 am	7.30 to 8.30 am	8.30 to 9.30 am
PM Base Model	15.30 to 16.30 pm	16.30 to 17.30 pm	17.30 to 18.30 pm

The above peak periods were determined from the assessment of the traffic count data utilised for the study area. Each of the AM and PM base models contain three hours; the shoulder peak hours also serve as the 'warm up' hour ensures that peak hour traffic demand enters a realistic representation of the traffic condition (as opposed to an empty network that would otherwise produce overly optimistic results) and the 'cool down' period ensures the unloading and reduction of traffic demand on the modelled network after the peak hour.

5.3.5 Traffic signal coding

Traffic signals have been coded according to the IDM (Intersection Diagnostic Monitor) data from SCATS which were collected by the Roads and Maritime on traffic survey days. Eight signalised intersections exist within the microsimulation study area and three of them are operating on Moore Park Road.

The traffic signal operational information was analysed for peak period variances during the both AM and PM peak periods. Fixed time signal plans were implemented into the VISSIM model based on average signal timing information for each hourly period in the base models. Minor modifications were made to the average phase times to ensure consistent cycle lengths and coordination between adjacent signals. Traffic signal timing and co-ordination along the Moore Park Road was manually adjusted to ensure flows in the direction of major corridor were coordinated based on site visit recordings. The assumptions of traffic signal operation of event day will be discussed in section 6.

Supplementary SCATS IDM data was also provided for the AM peak period of Wednesday 24 June 2015 as a result of concerns regarding the representativeness of the signal operation data from the morning of 2 June 2015. Overall, the differences between in the average signal timings are as follows:

- there are small changes in the phase timings at most intersections
- the average cycle time at the intersection of South Dowling Street/Flinders Street increases from 60 seconds to 120 seconds

- the average cycle time at the intersection of Moore Park Road/Driver Avenue decreases from 105 seconds to 90 seconds.

The differences in the average traffic signal timings are summarised in Table 5.6.

Table 5.6 Changes in average IDM signal phase timings (AM peak)

Phase	TCS26	TCS27	TCS44	TCS126	TCS333	TCS422	TCS439	TCS3016
2 June 2015								
A	19s	16s	51s	22s	96s	90s	39s	79s
B	41s	25s	16s	86s	24s	30s	24s	14s
C	5s	19s	53s	12s			42s	12s
D							15s	
Total	**65s**	**60s**	**120s**	**120s**	**120s**	**120s**	**120s**	**105s**
24 June 2015								
A	20s	32s	53s	22s	95s	82s	39s	65s
B	42s	43s	15s	86s	25s	38s	25s	13s
C	6s	45s	52s	12s			42s	12s
D							14s	
Total	**67s***	**120s**	**120s**	**120s**	**120s**	**120s**	**120s**	**90s**
Differences								
A	+1s	+16s	+2s	0s	-3s	-8s	0s	-14s
B	+1s	+18s	-1s	0s	+3s	+8s	+1s	-1s
C	0s	+26s	-1s	0s			0s	0s
D							-1s	
Total	**+2s**	**+60s**	**0s**	**0s**	**0s**	**0s**	**0s**	**-15s**

*signal setting at this intersection was adjusted as two cycle lengths combined into one (in total 120 seconds) and remove the existing dedicated cyclists phase based on the envisaged changes provided by the CoS

5.3.6 Driver behaviour coding

The following driver behaviour features were coded in the both AM and PM base models:

- Desired speed decisions; this was coded at the beginning of each road link on which the speed limit is different with the upstream link. This parameter enforced the vehicle to travel below the speed limit with a default speed distribution profile provided by VISSIM.
- Reduced speed area; this was coded at the curved links where the vehicles need to slow down to make a turn. The majority of the turning movements were coded as 20 km/h within the network.
- Give way as the filter right turn movement; this was coded to truly reflect the filter right turn opposed by the through movements at the signalised intersections, by using the ‘conflict area’ feature in VISSIM.
- Clearance area at the intersections; this was coded to prevent the vehicle to queue at the middle of the intersection by enforcing the realistic clearance area.
- Stop sign at the priority intersections; this was coded to truly reflect the give way behaviour of the drivers at the minor street to make a turning movement onto the main roads.

- Reaction factor within the congested network; the parameters were adjusted for the drivers to observe more vehicles in the front regarding the stop-start and lane change decisions, particularly on a congested corridor such as on Moore Park Road.

5.3.7 Cyclist behaviour coding

Cycling movements were modelled, including:

1. the shared path alongside Moore Park Road in the east-west directions (Figure 5.3)
2. the separated bicycle lane alongside Bourke Street in the north-south directions (Figure 5.4)
3. the interaction between the vehicles and the cyclists merging onto Fitzroy Street (Figure 5.5).

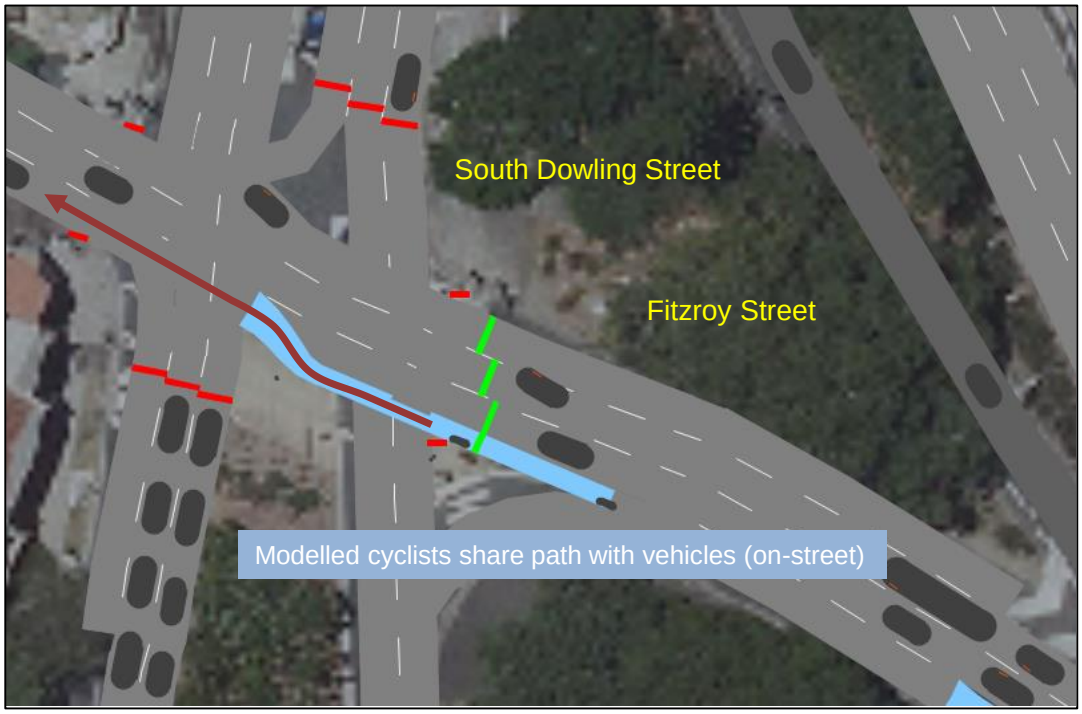


Figure 5.3 Modelled cyclists using on-street share path

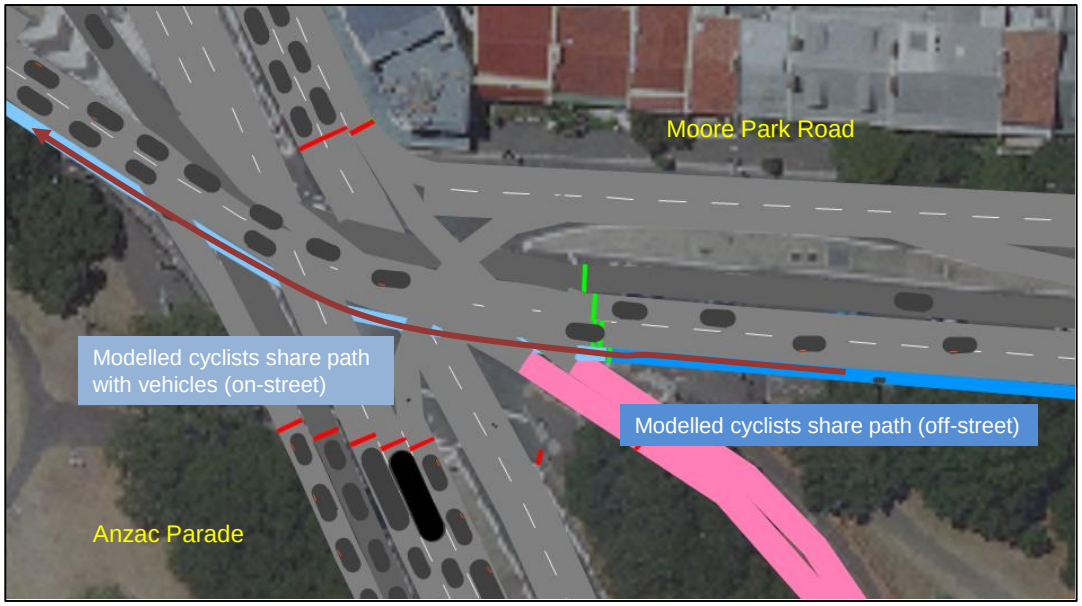


Figure 5.4 Modelled cyclists on and off-street share path

It should be noted that the modelled interaction between the cyclists and the vehicles might not exactly replicate the behaviours on site, due to the variability in the behaviours of the cyclists. The purpose of coding the cycling movements in the VISSIM models is primarily to visually present the on-street interaction or the conflicts (each resulted to the loss of time and the delay) between two trip modes, compared to the free-flowing trips made on the separated cycle path.

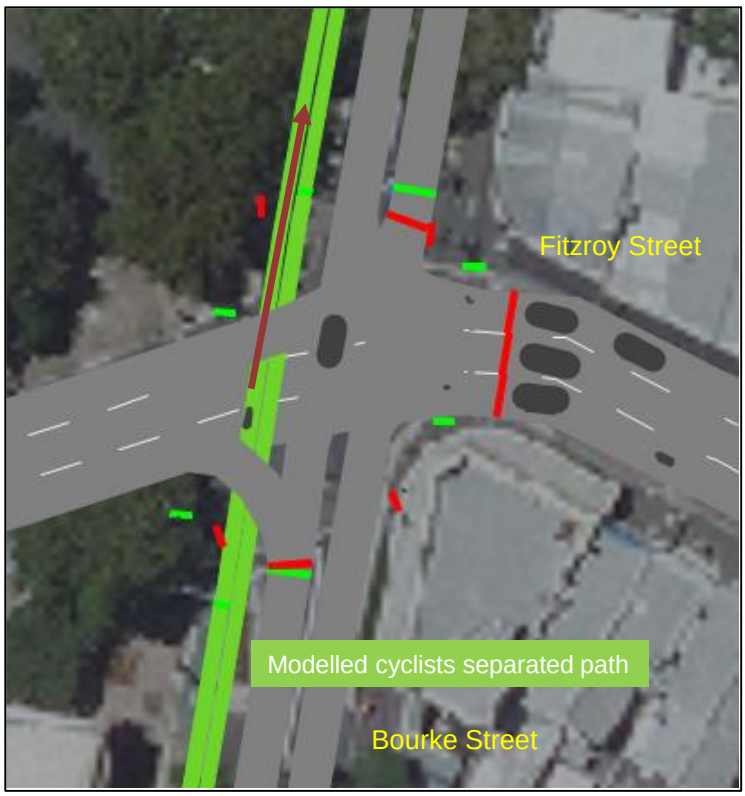


Figure 5.5 Modelled cyclists on separated cycling path

5.3.8 Pedestrian coding

The pedestrian movements were also modelled at key intersections, in particular during the clearance time while the turning vehicles give way to the pedestrians. The impact of the pedestrian movements in this part of the road network, to a lesser extent within the Driver's Triangle, was perceived as considerable. Figure 5.6 shows an example of the modelled interaction between the vehicle and the pedestrian movements, which results to reduction of the turning capacity at this intersection.

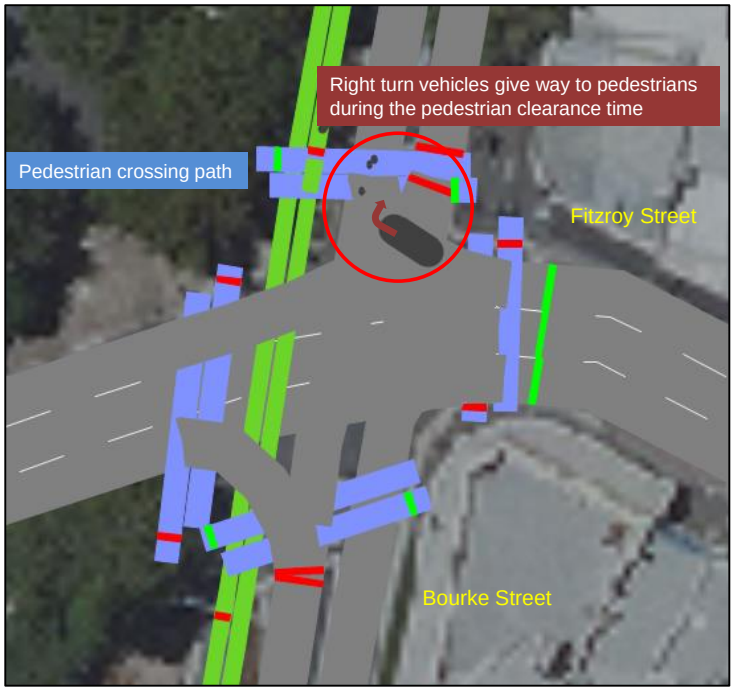


Figure 5.6 Example of vehicle and pedestrian interaction

5.3.9 Public transport coding

The Moore Park Road corridor and the Driver's triangle are served by several bus routes. The bus operation, with relatively slower moving speed and the frequent stop-start, was deemed as a key model input as it was observed as having an impact on the travel time and the traffic delay on the road network. It should be noted that the arrival and the departure time of the buses were normalised according to the frequency within each hour, during the both AM and PM peak periods. The public transport operation of event day will be discussed in section 6.

The stoppage time at each bus stop was assumed between 20 to 30 seconds, a typical value for urban environments. The bus lanes and the two bus stops on Flinders Street and the one on Fitzroy Street were coded in the base models as shown in Figure 5.7.

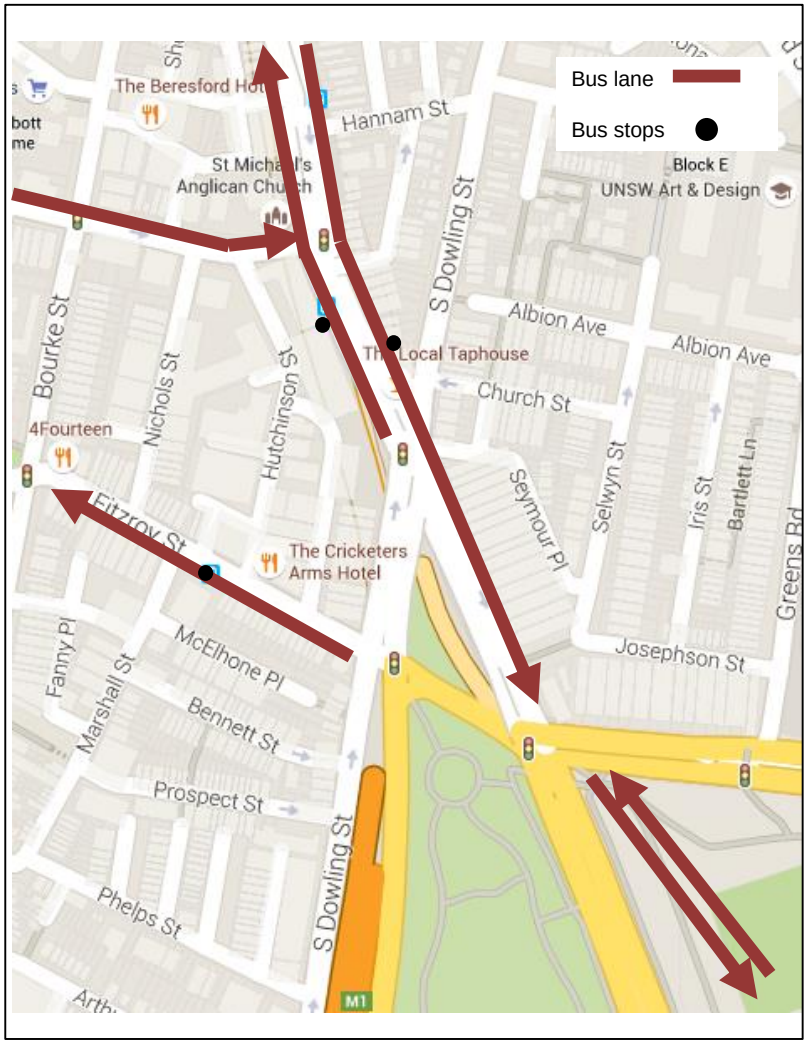


Figure 5.7 Bus lanes and stops in the base models

The details of the modelled public transport routes were provided in Appendix A3.

6. VISSIM base model calibration and validation

6.1 Model stability

The stability of the both AM and PM base models were checked by plotting the vehicle distance travelled (VDT), and vehicle hours travelled (VHT) in each modelled hour with different see values. The variance of each index was deemed to be acceptable, indicating a high level of model stability as shown in Appendix B1.

6.2 Model calibration

The VISSIM base model has been calibrated using the turning movements against the observed traffic counts, for the both AM and PM 3-hour peak periods. All the results presented in this section are the average of 5 seed values unless otherwise stated.

6.2.1 Intersection turn count calibration

The traffic flows of each modelled peak hour were calibrated against the 2014/15 turning counts provided by CoS. Table 6.1 and Table 6.2 summarised the calibration results in the respective AM and PM peak periods.

Table 6.1 Base model traffic turning flows calibration results – AM peak

Traffic flows (all vehicles)	Calibration criteria	% of counts meet criteria (6.30–7.30 am)	% of counts meet criteria (7.30–8.30 am)	% of counts meet criteria (8.30–9.30 am)
Percentage of turn volumes with GEH <= 5	>=85%	99%	99%	99%
Percentage of turn volumes with GEH <= 10	100%	100%	100%	100%

Table 6.2 Base model traffic turning flows calibration results – PM peak

Traffic flows (all vehicles)	Calibration criteria	% of counts meet criteria (3.30–4.30 pm)	% of counts meet criteria (4.30–5.30 pm)	% of counts meet criteria (5.30–6.30 pm)
Percentage of turn volumes with GEH <= 5	>=85%	100%	100%	99%
Percentage of turn volumes with GEH <= 10	100%	100%	100%	99%

The model turn calibration shows that:

- The average GEH value is below 5 for 51 (or 99%) of all the 52 turning movements in the AM peak 3-hour periods.
- The average GEH value is below 5 for 51 (or 99%) of all the 52 turning movements in the PM peak 3-hour periods.

- The GEHs are below 10 for all of the 52 tuning movements in each hour of the both AM and PM peak periods.
- The R-square values are over 0.98 for all the turning movements in each, for the both AM and PM peak periods; the regression plots are shown below in Figure 6.1 and in Appendix B1.

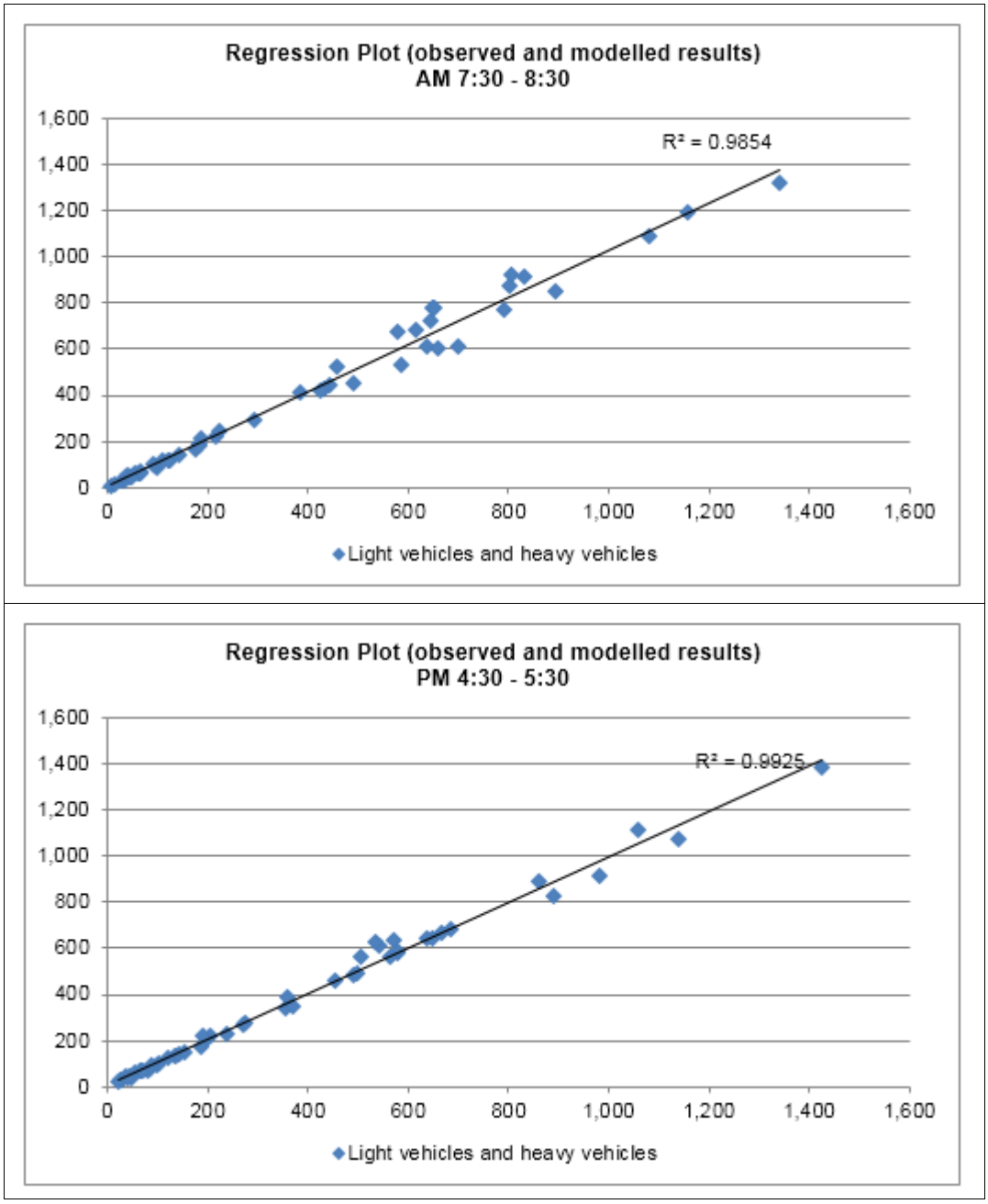


Figure 6.1 AM and PM peak hour turn calibration regression plots

The details of the turning calibration results in each vehicle class are provided in Appendix B1. The traffic flows of the base models are therefore deemed to meet the traffic flow calibration criteria in the Roads and Maritime 2013 *Traffic Modelling Guidelines.*

6.3 Model validation

The VISSIM base model has been validated and compared against the following information for the both AM and PM peak hour:

- validation of the observed travel time
- comparison of the observed qualitative queue length results at the Driver's triangle.

All the results presented in this section are the average of 5 seed values (28, 560, 2849, 7771, 86524 instructed in *Traffic Modelling Guidelines)* unless otherwise stated. The driver's behaviours discussed in section 4.3.4 were primarily adjusted to achieve the model validation.

6.3.1 Travel time validation

The travel time results have been collected from the base models in the both AM and PM peak periods, on the two routes shown in Figure 6.2:

- Route 1: westbound trip on Moore Park Road and Fitzroy Street, between Driver Avenue and Bourke Street
- Route 2: northbound and eastbound trip on Albion Street and Moore Park Road, between Bourke Street and Driver Avenue.

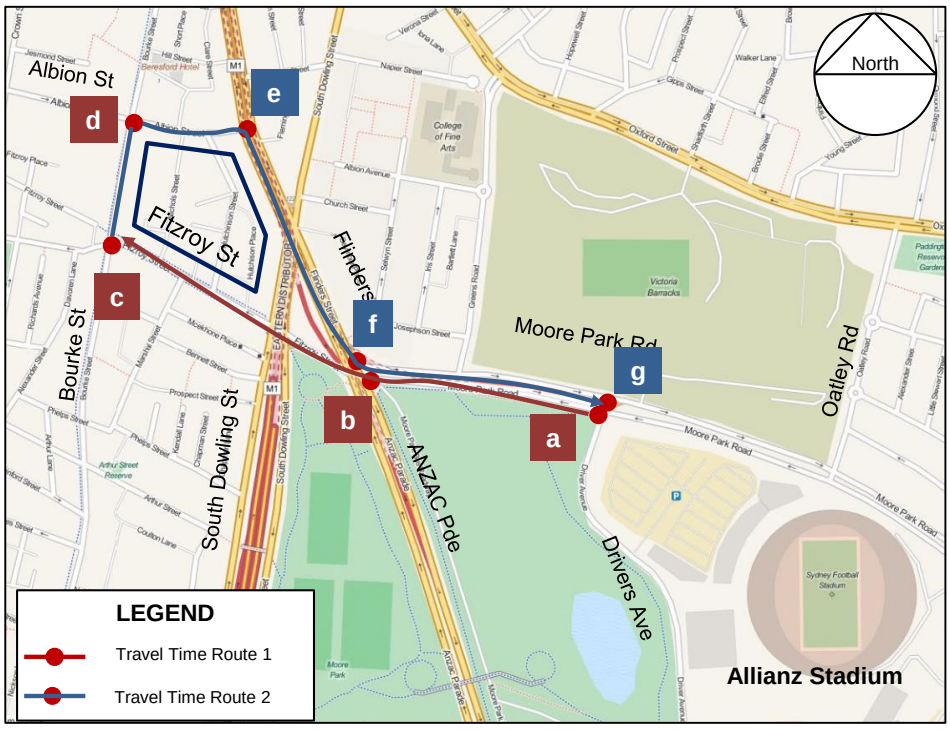


Figure 6.2 Recorded travel time route

The results demonstrated that:

- the difference is 6 seconds (or 2%) between the average observed and model results in the AM peak hour (7.30–8.30) for Route 1, as shown in Figure 6.3
- the difference is 19 seconds (or 13%), between the average observed and model results in the PM peak hour (4.30–5.30) for Route 1, as shown in Figure 6.4

- the difference is 74 seconds (or 35%), between the average observed and model results in the AM peak hour (7.30–8.30) for Route 2; however, the modelled result has only 14 seconds difference with the 3rd iteration of the observed results (which was recorded after 8 am), as shown in Figure 6.5
- the difference is 18 seconds (or 5%), between the average observed and model results in the PM peak hour (4.30–3.30) for Route 2, as shown in Figure 6.6.

The base models have met the travel time validation criteria in the Roads and Maritime 2013 *Traffic Modelling Guidelines,* by having less than 1 minute difference between the survey results and modelled outputs. The detailed statistics of each survey run and the average model results are in Appendix B3 for each route in the respective AM and PM peak hour.

Figure 6.3 Comparison of observed and modelled travel time results – Route 1 – AM peak

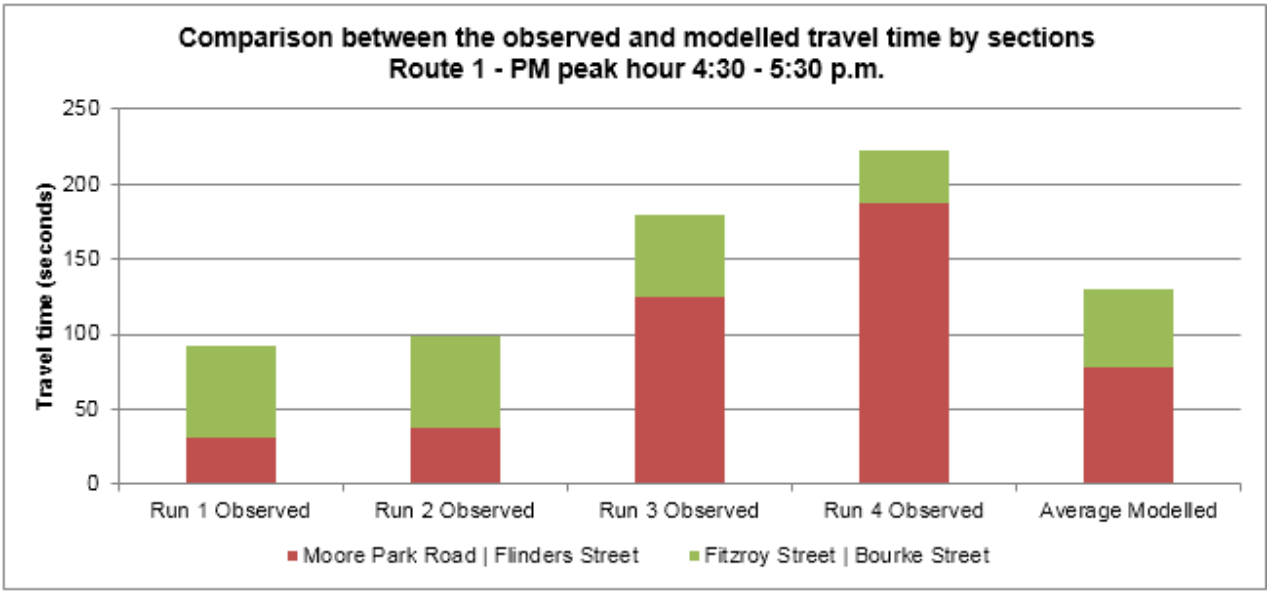


Figure 6.4 Comparison of observed and modelled travel time results – Route 1 – PM peak

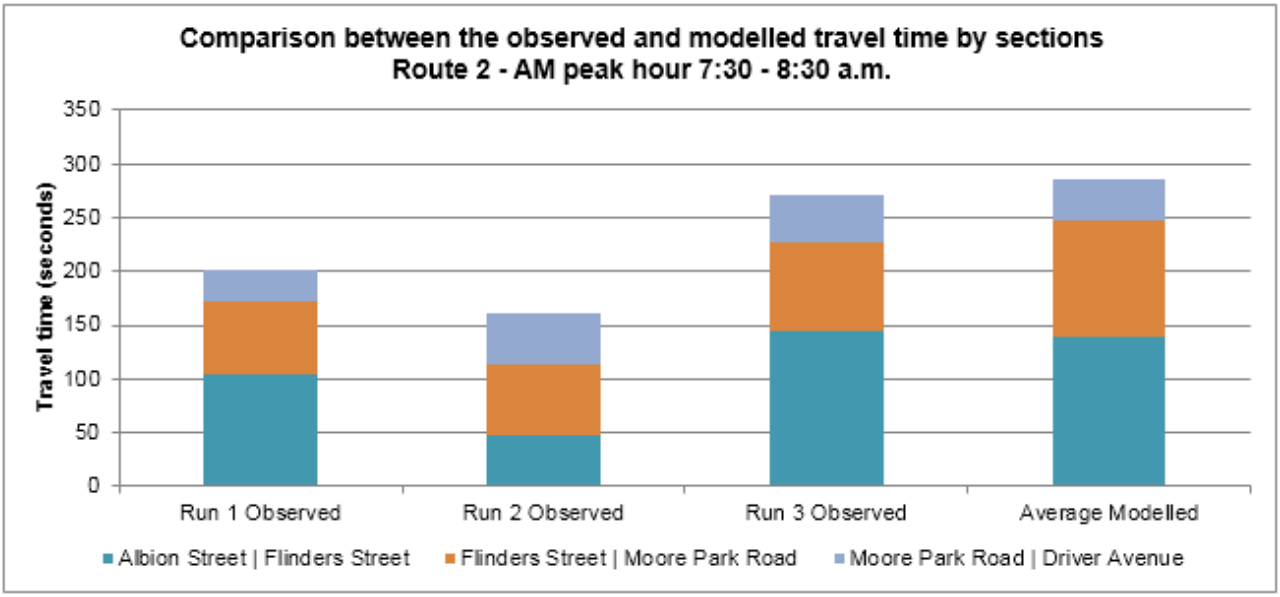


Figure 6.5 Comparison of observed and modelled travel time results – Route 2 – AM peak

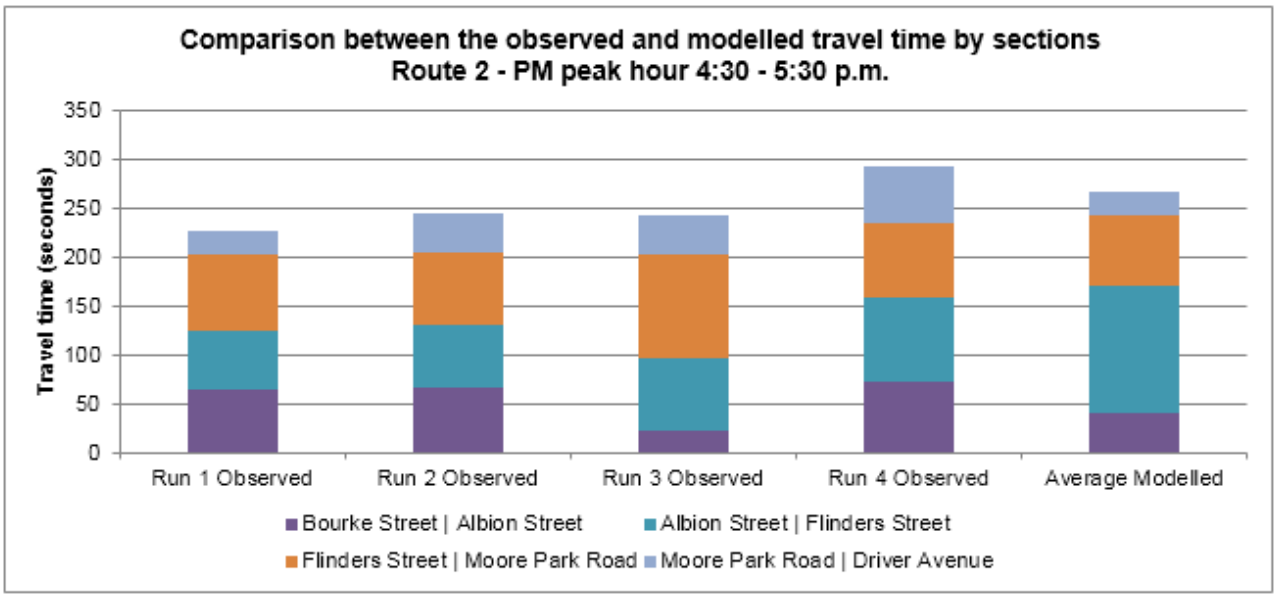


Figure 6.6 Comparison of observed and modelled travel time results – Route 2 – PM peak

6.3.2 Queue length comparison

The modelled 95th percentile queue was compared to the observed record during the AM and PM peak periods. The snapshots were captured through the model simulation using seed value 28.

The 95th percentile queue is defined to be the queue length (in vehicles) which was perceived to have only a 5% probability of being exceeded during the analysis time period. As the queue length is subject to the individual's perception (e.g. one might count a slow-moving vehicle as in the queue whilst another might not) and it is often built up or discharged within an instant moment, the 95th percentile queue length is acceptable as the maximum queue length for the nature of the validation purpose.

6.3.2.1 Queue length comparison in AM peak

The following queues were validated in the AM peak periods:

- westbound queue on Moore Park Road, east of Flinders Street
- westbound queue on Fitzroy Street between South Dowling Street and Flinders Street
- southbound Flinders Street between Moore Park Road and South Dowling Street
- northbound queue on South Dowling Street south of Fitzroy Street, particularly in the AM peak hour.

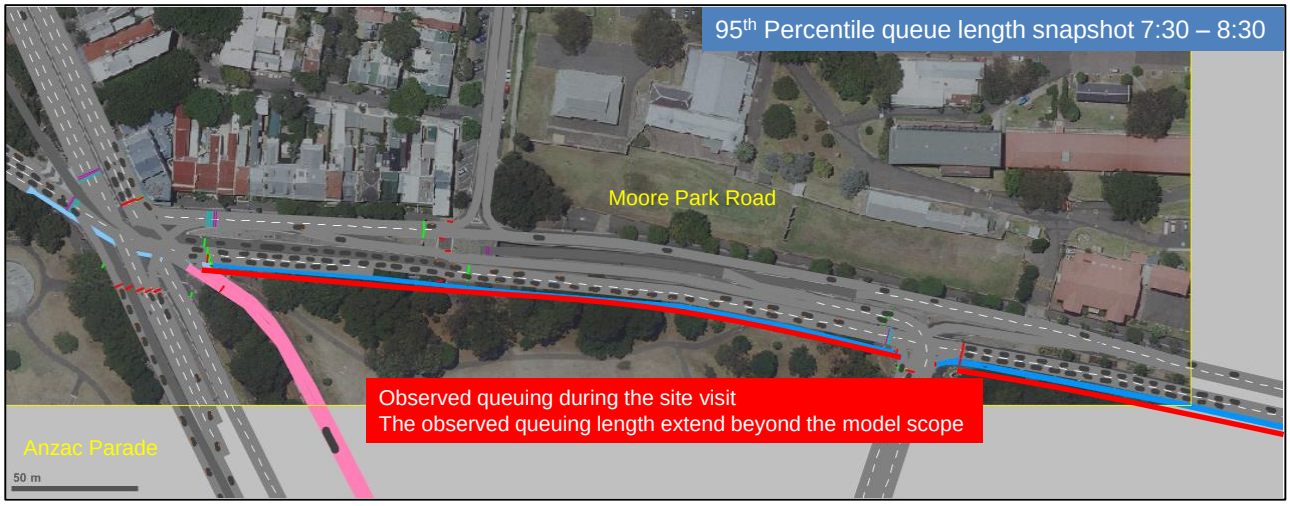


Figure 6.7 Comparison of maximum queue length on Moore Park Road – AM peak

Figure 6.7 shows the snapshot which sees the 95th percentile westbound queuing, which extends back to the Driver Avenue and further in the AM base model. The resultant delay was estimated to be at least 2 minutes between Driver Avenue and Flinders Road. This queue was resulted by the excessive westbound traffic demands (approximately 1400 veh/hr and majority heading towards the CBD), and those accessing the Eastern distributor using the median-side lane; the queue on the median-side lane constantly blocked back and constrained the through movement.

This queue also had a considerable impact on the upstream intersections which are outside the microsimulation scope. A higher level of look-ahead and lane changing factors were assigned on some sections on Moore Park Road, to reflect the reduced reaction time of drivers on a congested urban road.

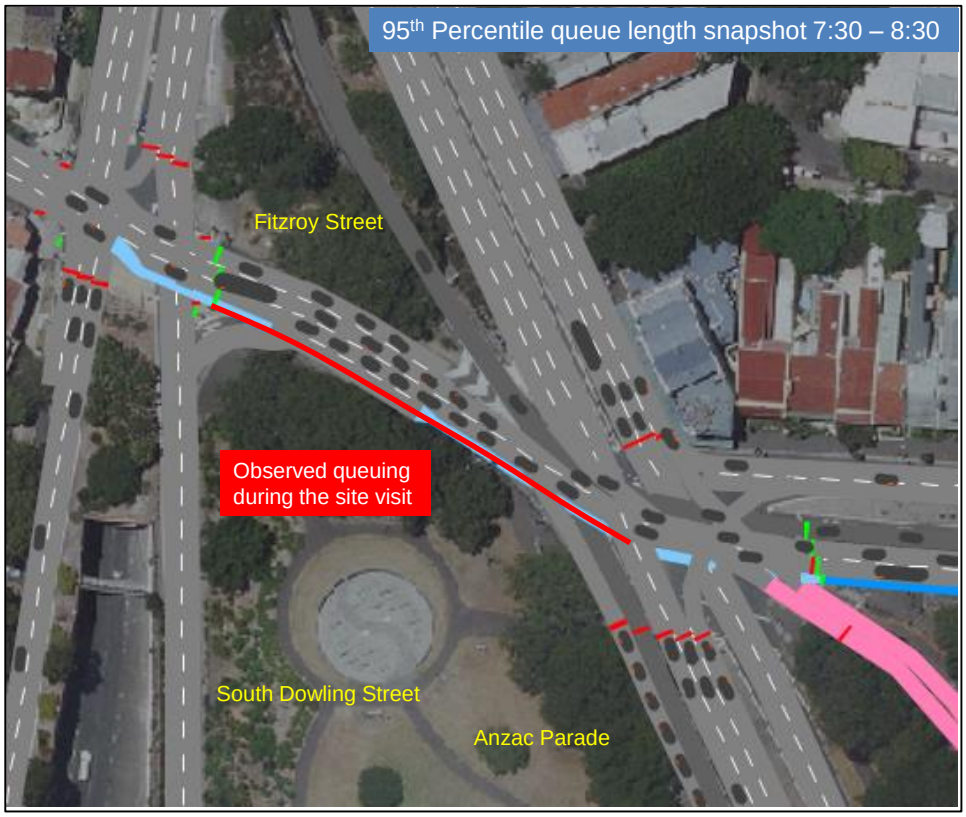


Figure 6.8 Comparison of maximum queue length on Fitzroy Street – AM peak

Figure 6.8 shows the snapshot which sees the 95th percentile westbound queue length on Fitzroy Street between the Anzac Parade and South Dowling Street. The queuing regularly extends back to Moore Park Road. In line with the site observation, the queueing was resulted by the northbound movements from the Anzac Parade approach, of which the traffic signals do not co-ordinate with the downstream signal at South Dowling Street. However, the green-wave (or effective co-ordination) was observed along Moore Park Road and Fitzroy Street, and consequently this queue was able to be discharged during almost every cycle.

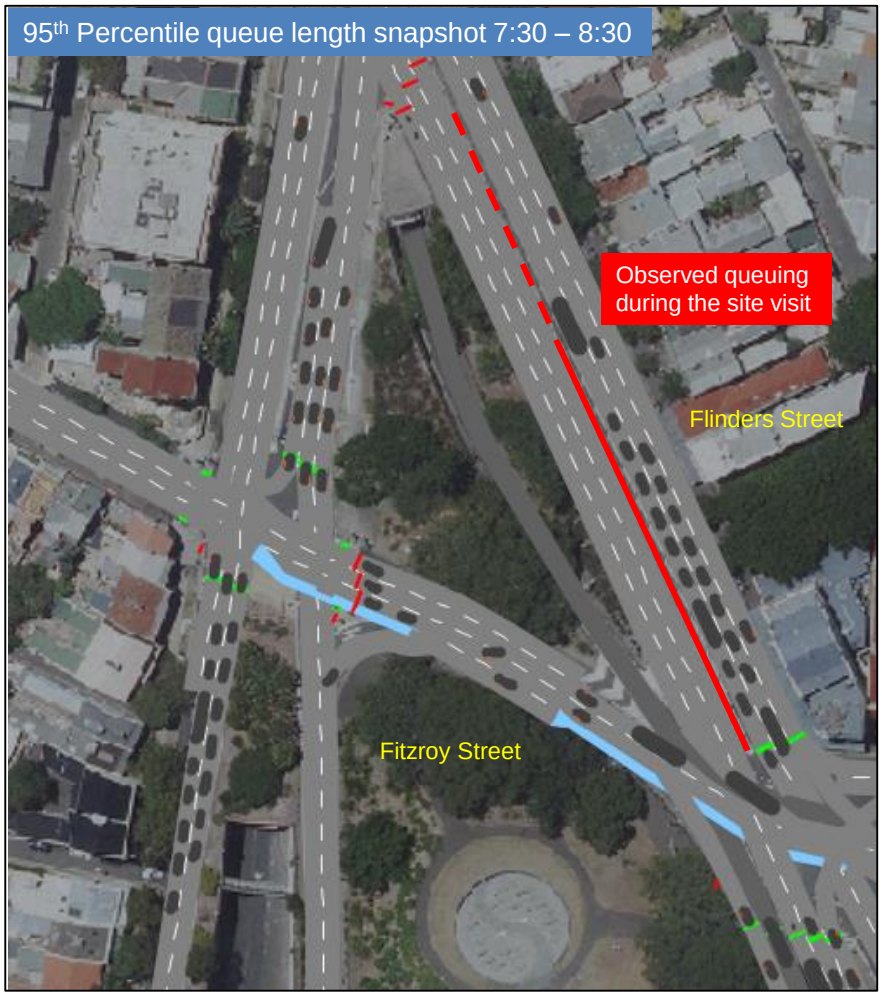


Figure 6.9 Comparison of maximum queue length on Flinders Street – AM peak

Figure 6.9 shows the snapshot which sees the 95th percentile southbound queue length on Flinders Street, between South Dowling Street and Fitzroy Street. This was resulted by the signal capacity constraint in the AM peak periods. The modelled queueing was discharged almost every cycle (120 seconds), being correlated with the observation on site.

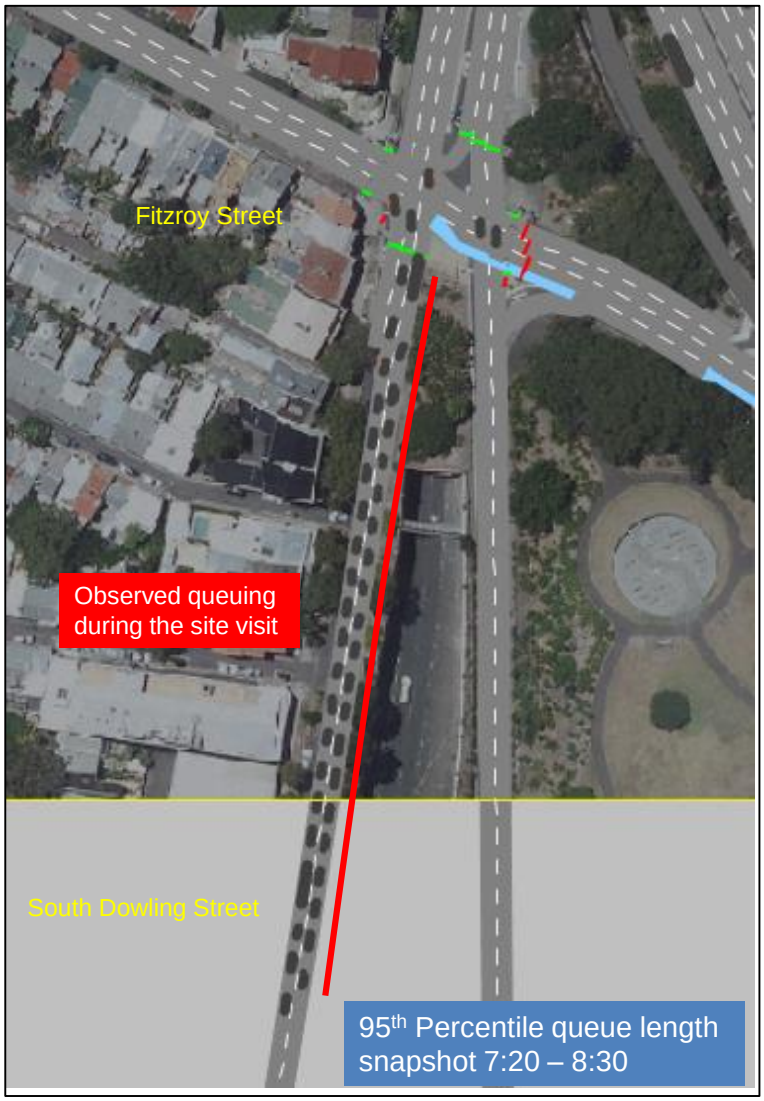


Figure 6.10 Comparison of maximum queue length on South Dowling Street – AM peak

Figure 6.10 shows the snapshot which sees the 95th percentile northbound queue length on South Dowling Street, south of Fitzroy Street. The queue was the result of the high traffic demand heading to the CBD and the constrained traffic signal capacity at this intersection. It is noted that this queue is approximately 30 metres shorter than the observed queues. This was a result of changes in the signal phase timings from the supplementary SCATS IDM data (Table 4.6) which provided an additional two seconds of green time to the northbound movement. Overall, the coordination between the traffic signals was perceived to be less effective while the traffic demands are close to the capacity at more than one approach (in this case, being both Fitzroy Street westbound approach and South Dowling Street northbound approach). Based on the traffic demand profile in 2014/15 turning counts, this queue was deemed to be most excessive between around 7.30 am.

6.3.2.2 Queue length comparison in PM peak

The following queues were validated in the PM peak periods:

- westbound queue on Moore Park Road, east of Flinders Street
- southbound Flinders Street between Moore Park Road and South Dowling Street.

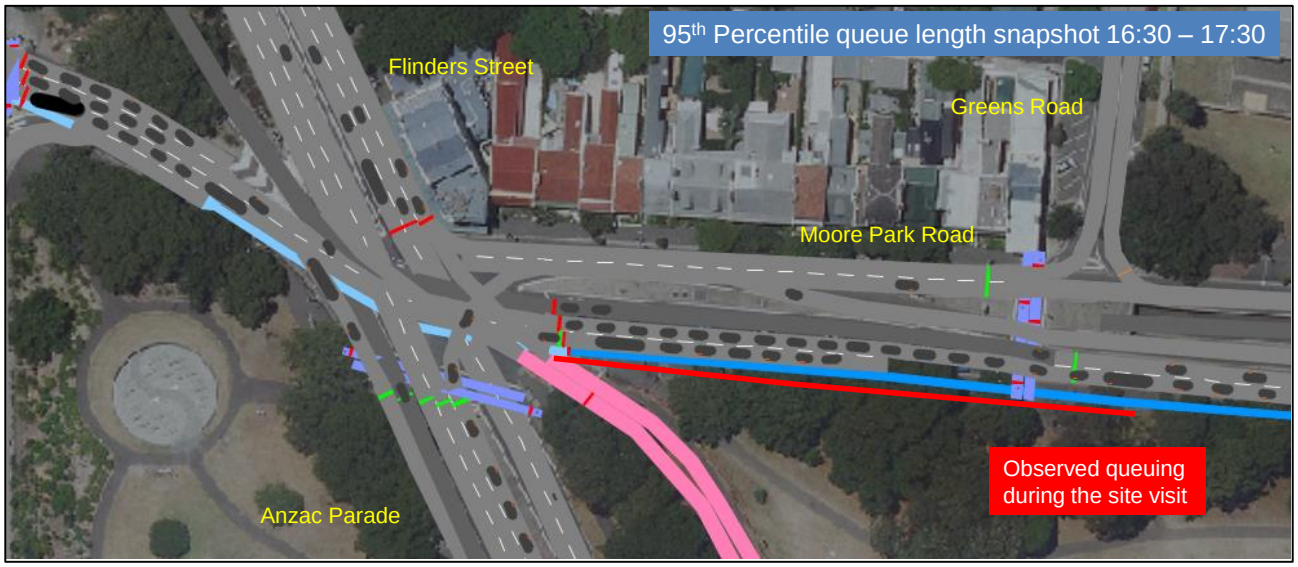


Figure 6.11 Comparison of maximum queue length on Moore Park Road – PM peak

Figure 6.11 shows the snapshot which sees the 95th percentile westbound queue length on Moore Park Road, extending back to the Greens Road and further in the PM base model. Similar to the queuing in the AM peak, this was resulted by the considerable westbound traffic volumes and the constrained signal capacity at this intersection.

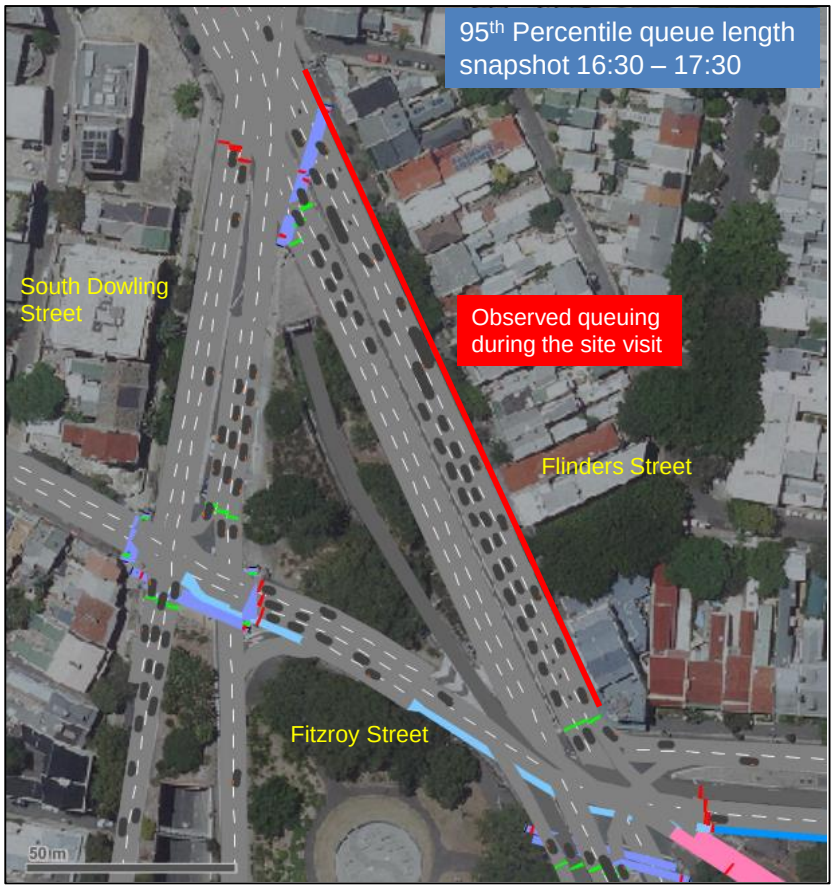


Figure 6.12 Comparison of maximum queue length on Flinders Street – PM peak

Figure 6.12 shows the snapshot which sees the 95th percentile southbound queue length on Flinders Street in the PM base model. This queuing was resulted by the higher southbound traffic volumes heading away from the CBD and the traffic signal constrain at this intersection.

6.3.3 Unreleased trips

Within the model there are unreleased trips in the AM base model on Anzac Parade (South) at the end of the model period. It is considered that these unreleased trips are the result of the extensive commuter traffic volumes on Anzac parade heading to CBD and the north. It reflects the observed queuing on Anzac Parade which extends beyond the scope of the model in the AM peak hour. The number of unreleased trips varies between simulation seed values within the range between 200 and 250 vehicles. In the PM base model, there are a maximum 150 vehicles unreleased trips on Albion Street. This was created due to priority provided to the Flinders Street movement at the Albion Street and Flinders Street intersection and replicated in the model.

6.4 Summary of calibration and validation

Table 6.3 summarises the calibration and validation of the AM and PM base models and demonstrate that by meeting the criteria in Roads and Maritime 2013 *Traffic Modelling Guidelines*, the VISSIM base model was calibrated and validated in the both AM and PM peak periods. It was deemed to be fit for the purpose of testing the impact of the proposed provision of separated cycling path (by in turn reducing the general traffic lane capacity) within the Moore Park study area.

Table 6.3 Summary of base model calibration and validation results

Criteria	AM peak model		PM peak model	
	Performance	Meets criteria	Performance	Meets criteria
Model calibration				
Intersection turning counts calibration	99% of all the 52 turning counts are below GEH 5	Y	99% of all the 52 turning counts are below GEH 5	Y
	All of them are below GEH 10	Y	All of them are below GEH 10	Y
	the R-square values are over 0.9	Y	the R-square values are over 0.9	Y
Model validation				
Travel time validation	Difference less than 1 minute	N*	Difference less than1 minute	Y
Queue length validation	Comparable for all of the key movements	Y	Comparable for all of the key movements	Y

*observed travel time results has very high variance of up to two minutes for this route; the modelled travel time is within 5% difference of the maximum recorded value

As discussed in section 2.4.5 there are differences between the survey days for traffic volumes, traffic signal operations, travel time recordings and general site observations. The VISSIM model is representative of typical commuting conditions based on the data available for model calibration and validation.

6.5 Summary of intersection performance results from VISSIM base model

Table 6.4 and Table 6.5 summarise the intersection performance results produced by the VISSIM base models for both the AM and PM peak hour. The results provided are for the total intersection performance.

As with the SIDRA modelling, Level of Service (LoS) results are based on delay at intersections. Delay has been recorded through utilising the analysis of 'node' delay within the VISSIM model.

Table 6.4 Summary of intersection delay and operational performance – AM peak

Intersection performance AM peak periods	Average Delay (6.30–7.30)	Level of Service (6.30–3.30)	Average Delay (7.30–8.30)	Level of Service (7.30–8.30)	Average Delay (8.30–9.30)	Level of Service (8.30–9.30)
Moore Park Road and Driver Avenue	8	A	41	C	28	C
Moore Park Road and Greens Road	11	A	32	C	23	B
Moore Park Road, Anzac Parade and Flinders Street	40	C	52	D	51	D
Fitzroy Street and South Dowling Street	24	B	26	B	26	B
Flinders Street and South Dowling Street	25	B	29	C	30	C
Flinders Street and Albion Street	15	B	18	B	21	B
Albion Street and Bourke Street	20	B	27	B	28	B
Fitzroy Street and Bourke Street	20	B	27	B	29	C

Table 6.5 Summary of intersection delay and operational performance – PM peak

Intersection performance PM peak periods	Average Delay (3.30–4.30)	Level of Service (3.30–4.30)	Average Delay (4.30–5.30)	Level of Service (4.30–5.30)	Average Delay (5.30–6.30)	Level of Service (5.30–6.30)
Moore Park Road and Driver Avenue	9	A	10	A	10	A
Moore Park Road and Greens Road	12	B	9	A	4	A
Moore Park Road, Anzac Parade and Flinders Street	31	C	31	C	33	C
Fitzroy Street and South Dowling Street	26	B	28	B	29	C
Flinders Street and South Dowling Street	17	C	28	B	34	C
Flinders Street and Albion Street	21	C	51	D	61	E

Intersection performance PM peak periods	Average Delay (3.30–4.30)	Level of Service (3.30–4.30)	Average Delay (4.30–5.30)	Level of Service (4.30–5.30)	Average Delay (5.30–6.30)	Level of Service (5.30–6.30)
Albion Street and Bourke Street	24	B	72	F	188	F
Fitzroy Street and Bourke Street	11	A	12	A	12	A

The results demonstrate that:

- In the AM peak periods, all of the assessed intersections operate within capacity and with Level of Service ranging between A and D; Moore Park Road, Anzac Parade and Flinders Street intersection was estimated to have a delay of 52 seconds during the AM peak hour. The northbound left turning movement from Anzac Parade to Fitzroy Street was estimated to have an average delay of over 100 seconds (LoS F), due to the downstream blockage resulted by the signal coordination and limited space between the westbound stop-lines at Anzac Parade and South Dowling Street.
- In the AM peak hour, the average delay of westbound through movement from Moore Park Road was estimated to be approximately 52 seconds, as a Level of Service D (refer to Appendix B4).
- In the PM peak periods, Bourke Street and Albion Street intersection was estimated to have an average delay of over 70 seconds between 4.30 and 6.30 pm. This is due to the signal capacity constrain at the downstream eastbound approach at Albion Street and Flinders Street intersection.
- The traffic delay results (42 seconds) at Moore Park Road/Driver Avenue intersection were estimated to be higher than those produced by SIDRA (13 seconds); this due to the feature of VISSIM microsimulation which considers the blockage impact from the downstream queuing.

6.6 Sensitivity base model – Event day

The purpose of the Event Day model is to provide a basis for assessing the impact of the proposed scheme on Moore Park Road and Fitzroy Street on an event day which sees a different travel pattern, a significant rise of bus volumes within the study area and manual traffic control (by police officers) at several locations.

The event day VISSIM model was developed using:

- classified turning counts on the ICC Cricket World Cup semi-final day provided by CoS
- known traffic management strategy on that day (consulted with CoS).

The results of the event day model are extracted to provide a basis of options testing. The results demonstrated that all the intersections were estimated to operate within capacity, with a Level of Service ranging between A and C.

Based on the comments provided by the Roads and Maritime upon the review of the event day model results, this model is no longer required in the options testing stage.

The details of the development of the event day model and the results are attached in Appendix B5.

7. VISSIM model bicycle lane options assessment

7.1 Introduction

Two route alignments (presented in Figure 7.1) were assessed with design drawings provided by the City of Sydney (detailed in section 3).

- Option 1: Moore Park Road – Fitzroy Street Route
- Option 2: Moore Park Road – Flinders Street – Albion Street Route.

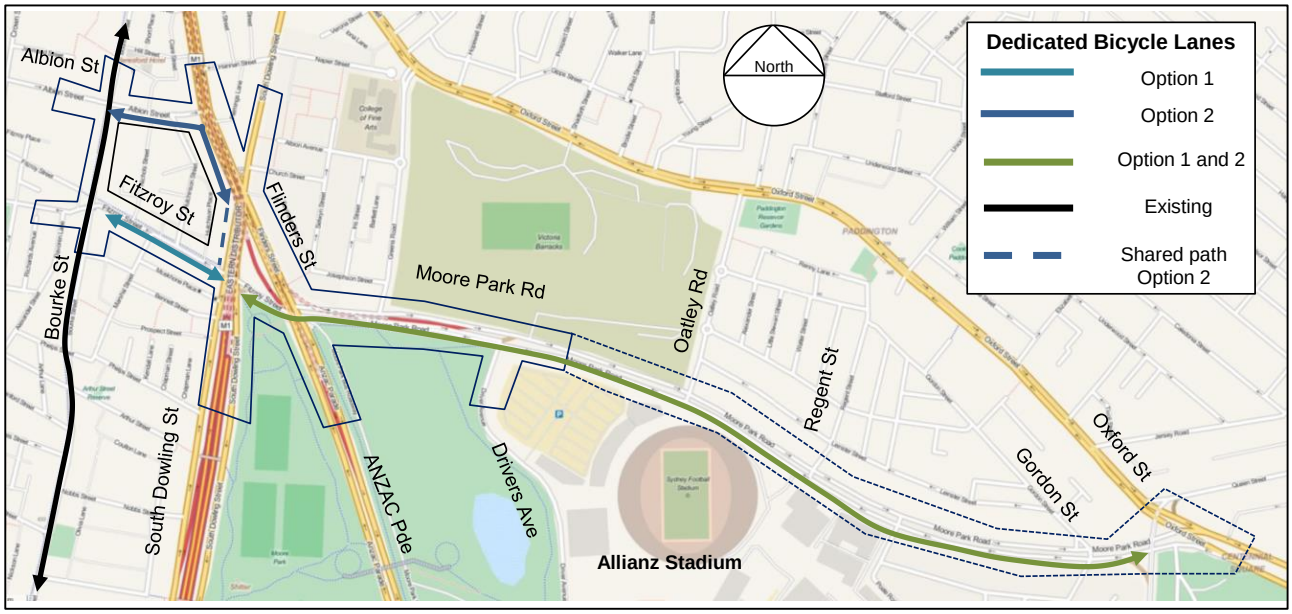


Figure 7.1 Proposed bicycle lane alignments

7.2 General modelling assumptions

The following modelling assumptions have been made for both the Option 1 and Option 2 models.

7.2.1 Traffic demands

With the proposed dedicated bicycle lanes on Moore Park Road through Fitzroy Street (or Albion Street and Flinders Street) to Bourke Street, cyclist volumes could be expected to increase. However, no such forecast have been made and under advice from the City of Sydney existing cyclist demands (provided by the CoS/RMS and documented in section 2.4) have been used for the assessment.

The following assumptions were however made for general and bicycle traffic under the option assessment scenarios:

- All the motorised vehicle volumes are the same as those in the base models, including route choice.

- 33% of northbound cyclists currently using the Bourke Street cycle lane are re-assigned to undertake a right turn towards Moore Park Road.
- 67% of westbound cyclists currently using the Moore Park Road facilities continue on the new facilities and turn right onto the Bourke Street cycleway. The remaining cyclists travel southbound along Bourke Street or via existing paths.

4. No changes were made regarding route choice for cyclists currently using Flinders Street and Anzac Parade.

Further sensitivity tests might be required to investigate the performance of the proposed options with increased and/or changed cycling demands with the proposed facilities.

7.2.2 Traffic signals at Greens Road

The east-west signalised pedestrian crossing proposed at Greens Road has been implemented into the VISSIM models. With the introduction of this pedestrian crossing, an eastbound left turn arrow was assumed in the signal phasing. The left-turn demand into Greens Road during the AM and PM peak hour periods was observed as 110 and 88 respectively. This is less than one vehicle per 30 seconds.

The intersection performance results with the new pedestrian crossing show that there are minimal impacts because of the pedestrian crossing. Results are provided in section 7.3 and section 7.4 and show that average vehicle delays and average vehicle queue lengths do not change by any significant amount.

7.3 Option 1 – Moore Park Road and Fitzroy Street route

7.3.1 Road network coding

The following road network changes were reflected in the model as shown in Figure 7.2 based on the design drawing provided by CoS:

- new bicycle lane on Moore Park Road, between Driver Avenue and South Dowling Street, in both directions
- new bicycle lane on Fitzroy Street between Anzac Parade and South Dowling Street, in both directions
- removal of westbound left turn slip lane and re-align traffic island at South Dowling Street and Fitzroy Street intersection
- new bicycle lane on Fitzroy Street between South Dowling Street and Bourke Street, in both directions, and continue onto Bourke Street
- conversion of general traffic lane to bus lane on Fitzroy Street between South Dowling Street and Bourke Street
- relocation of the bus stop on Fitzroy Street
- provision of additional short turn lanes to the existing northbound and southbound bicycle lanes on Bourke Street at Fitzroy Street intersection.

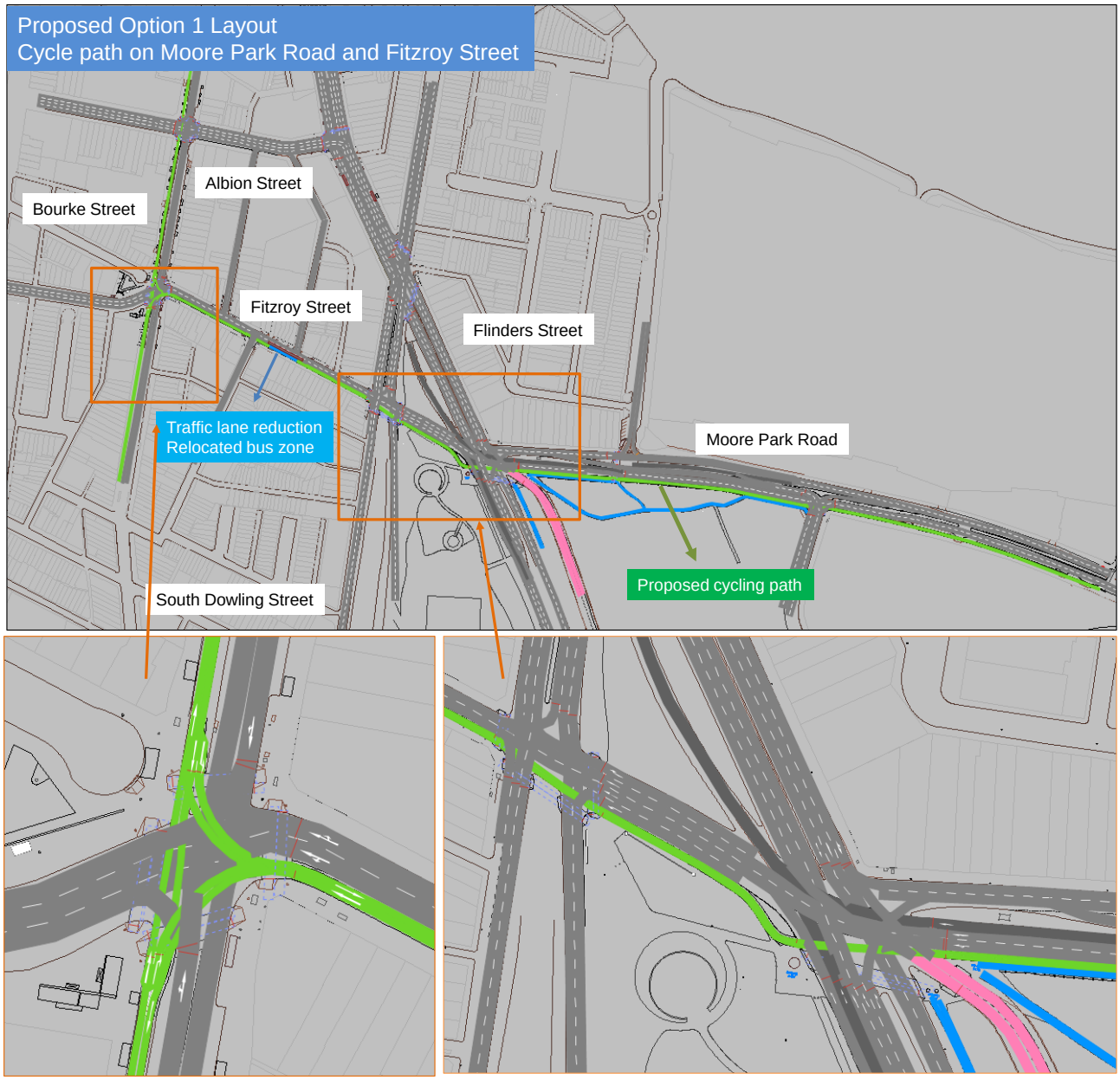


Figure 7.2 Proposed Option 1 layout in VISSIM model

The design drawing provided by CoS has a kerbside westbound bus lane on Fitzroy Street between Bourke Street and South Dowling Street. The assumption was made in the model to provide reasonable downstream merging space for general traffic. Downstream at the Bourke Street intersection, to reflect the left turn and (likely) through movements anticipated on the kerbside lane (shown in Figure 7.3) a short section was modelled as a general traffic lane.

The westbound movement on Fitzroy Street, between Bourke Street and South Dowling Street, is a critical capacity constraint in this option, with the reduction of general traffic lane from two to one. The traffic conditions during the AM peak is the period most at risk to experience significant disruption.

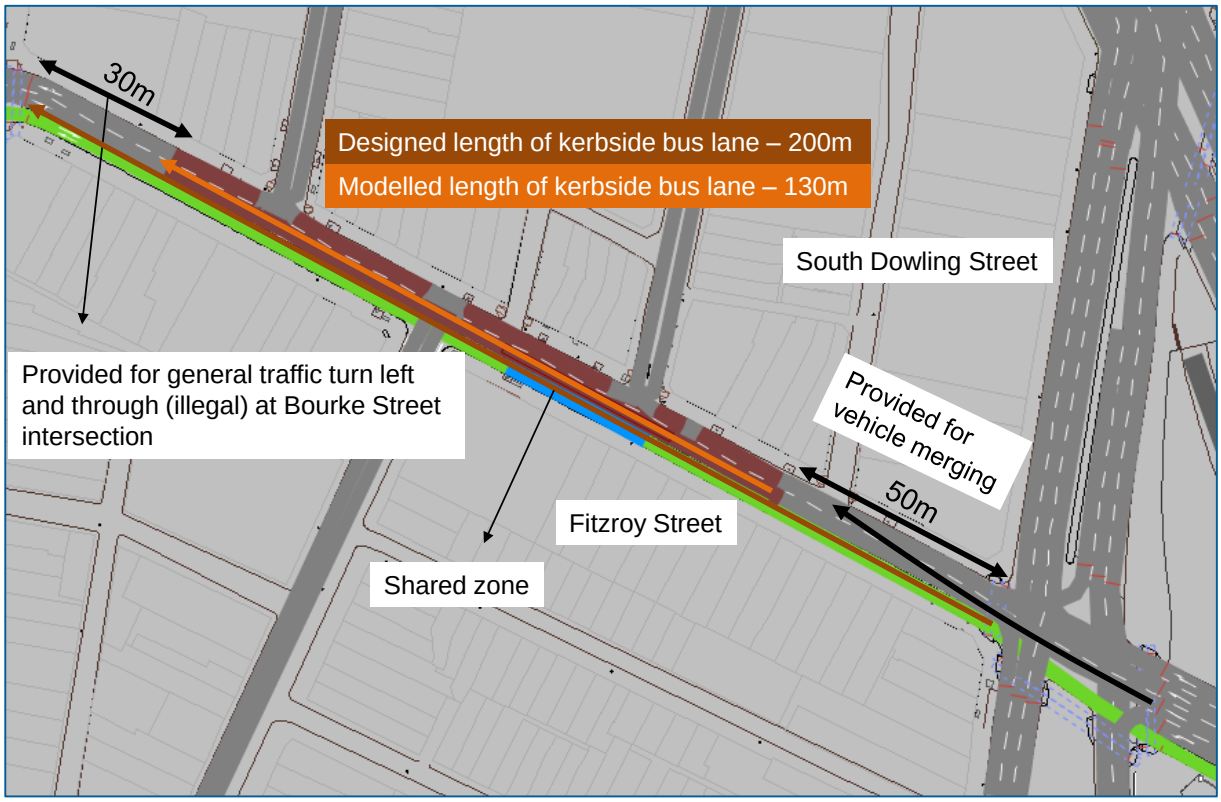


Figure 7.3 Modelled layout of kerbside bus lane on Fitzroy Street

Also, a section of off-street cycleway has been designated shared path near the relocated bus stop as the cyclists would give way to the passengers waiting or boarding the bus within this shared path. Although this is not commonly seen in Australia, a similar treatment is found on Swanton Street in the Melbourne CBD where cyclists need to stop behind the trams within a shared zone (Figure 7.4).

Source: Google Street View

Figure 7.4 Cyclists stop behind trams (Swanton Street, Melbourne)

7.3.2 Traffic signal coding

Traffic signals were updated at the following four intersections in Option 1.

Table 7.1 Proposed changes to the traffic signals with the proposed bicycle lane – Option 1

Intersections	Proposed changes to the traffic signal phasing and timing
Moore Park Road and Driver Avenue	Arrow controlled left turns used at the westbound approach (discussed in section 7.4.2.1).
Moore Park Road and Greens Road	Proposed local changes explained in section 7.3. Proposed bicycle lane has minimal impact on the signal operation, since the cyclists run parallel with the vehicular traffic.
Moore Park Road, Flinders Street and Anzac Parade	Proposed bicycle lane has minimal impact on the signal operation, since the cyclists run parallel with the vehicular traffic.
Fitzroy Street and South Dowling Street	Additional green time were given to the westbound movements due to the downstream capacity reduction and the removal of the left turn slip lane; Arrow controlled left turns at the westbound approach (discussed in section 7.4.2.1).
Bourke Street and Fitzroy Street	Dedicated cycling phases used by expanding the cycle time length (discussed in section 7.4.2.2).

The signal phasing and timings at the rest intersections are assumed to be consistent with the existing operation in the base models.

7.3.2.1 Arrow controlled left turns

Arrow controlled left turns were used at the westbound approach at the following three intersections:

- Moore Park Road and Driver Avenue intersection
- Moore Park Road and Anzac Parade intersection (existing control to avoid the conflict between buses and pedestrians)
- Fitzroy Street and South Dowling Street intersection (with the proposed removal of the left turn slip lane).

The main purpose of this proposed treatment is to ensure that the vehicles can turn left without conflicting with the cyclists on the proposed kerbside bicycle lane. A similar example could be found at King Street and Kent Street intersection in Sydney CBD, where both left turn and right turn vehicular movements are controlled by the signals and have a late start trailing the (otherwise conflicting) cycling phase and the pedestrian crossing (refer to Figure 7.5).

Arrow controlled left turns were modelled in VISSIM by placing a secondary traffic signal stopline, to enable a controlled left turn phase (by a minimum of 12 seconds) at each of the three intersections.

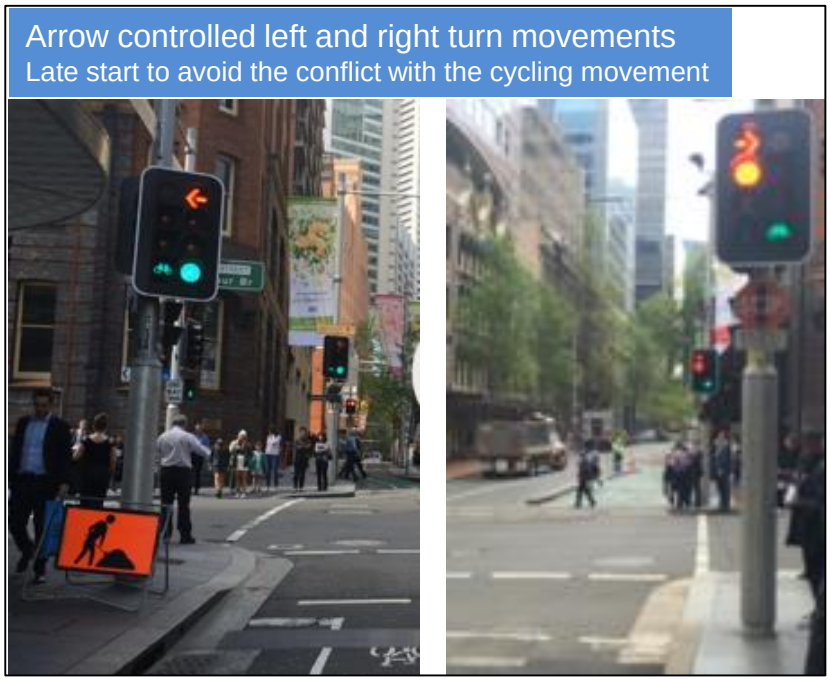


Figure 7.5 Arrow controlled turns example (Kent Street, Sydney)

7.3.2.2 Dedicated cycling phases at Bourke Street and Fitzroy Street intersection

At the Bourke Street and Fitzroy Street intersection, two dedicated cycling phases were proposed where an all red phase for vehicular traffic is required enabling cycle only phases to facilitate the following movements.

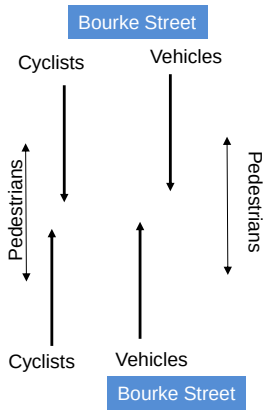
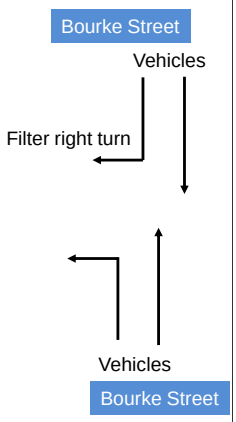
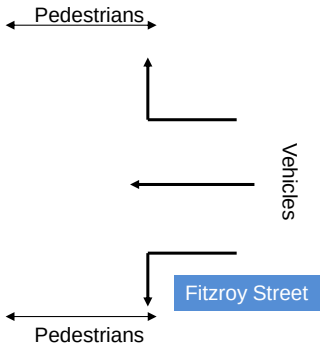
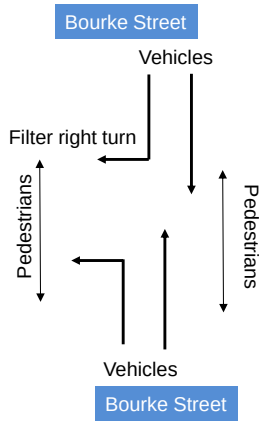
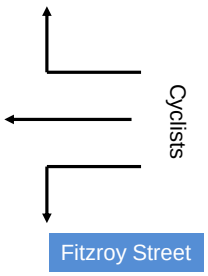
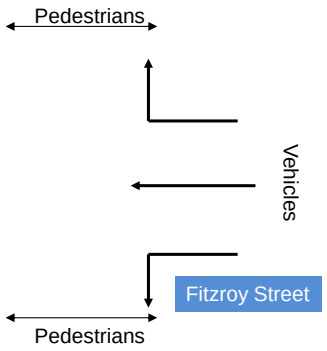
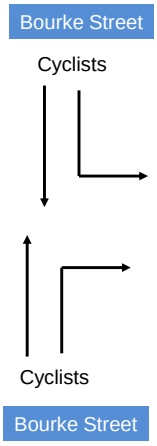
- existing north-south through cycling movements and turning movements from Bourke Street to the new bicycle lane on Fitzroy Street
- new through and turning movements from the new bicycle lane on Fitzroy Street to Bourke Street.

The perceived benefits of using dedicated phases for cyclists at this intersection were:

- address the strong diagonal (left and right turn) cycling demands at this intersection with the proposed cycling lane
- utilise the spare capacity at this intersection (limited queuing observed in both AM and PM peak periods); the spare capacity (green time) could be allocated to the dedicated cycling phases by expanding the cycle time length.

During the dedicated cycling phases, the turning movements would need to yield to the through movements; this was reflected in the VISSIM model by placing the ‘conflict areas’ for the conflicting movements. Table 7.2 shows the modelled signal phasing and timing at this intersection for Option 1, compared to those in the base models.

Table 7.2 Existing and proposed signal phasing at Bourke Street and Fitzroy Street intersection

	Phase A	Phase B	Phase C	Phase D
Base (120s cycle time)				n/a
AM peak	22 seconds	12 seconds	86 seconds	
PM peak	19 seconds (12s cyclists)	31 seconds	70 seconds	
Option 2 (144s cycle time)				
AM peak	34 seconds*	10 seconds	86 seconds	14 seconds
PM peak	50 seconds*	10 seconds	70 seconds	14 seconds

* Late start of turning movements by 6 seconds

For the modelling the 'with cycleway' scenarios assumed that the phase lengths for existing phases would be retained and the overall cycle length would expand to include the dedicated cycling phases. This assumption was made based on advise from CoS to retain existing phase lengths. The model also assumes a fixed time operations at this location and that cyclists will call cycling phases on every cycle. The operational nature of the SCATS-based traffic signal system however would be adaptive to demands in the network. At this location, the SCATS history information showed that the signals often operate at less than 120 seconds cycle length, especially outside of the peak 15 minute periods.

For the purposes of the concept assessment these assumptions are reasonable, however should this option proceed than, in the detailed design stage and traffic signal design stage, traffic signal should be reviewed and retested as necessary.

7.3.3 Intersection performance

The intersection performances of Option 1 were assessed and compared to the base model results (existing condition). The results in Table 7.3 and Table 7.4 revealed the following traffic delay differences in both AM and PM peak hours respectively.

Table 7.3 Comparison of intersection performance – Option 1 vs base – AM peak hour

Intersection performance AM peak periods	Base Delay (7.30–8.30)	Base Level of Service (7.30–8.30)	Option 1 Delay (7.30–8.30)	Option 1 Level of Service (7.30–8.30)
Moore Park Road and Driver Avenue	41	C	47	D
Moore Park Road and Greens Road	32	C	35	C
Moore Park Road, Anzac Parade and Flinders Street	52	D	67	E
Fitzroy Street and South Dowling Street	26	B	38	C
Flinders Street and South Dowling Street	29	C	31	C
Flinders Street and Albion Street	18	B	21	B
Albion Street and Bourke Street	27	B	24	B
Fitzroy Street and Bourke Street	27	B	47	D

Table 7.4 Comparison of intersection performance – Option 1 vs base – PM peak hour

Intersection performance AM peak periods	Base Delay (4.30–5.30)	Base Level of Service (4.30–5.30)	Option 1 Delay (4.30–5.30)	Option 1 Level of Service (4.30–5.30)
Moore Park Road and Driver Avenue	10	A	10	A
Moore Park Road and Greens Road	9	A	8	A
Moore Park Road, Anzac Parade and Flinders Street	31	C	59	D
Fitzroy Street and South Dowling Street	28	B	39	C
Flinders Street and South Dowling Street	28	B	29	C
Flinders Street and Albion Street	51	D	51	D
Albion Street and Bourke Street	72	F	75	F

Intersection performance AM peak periods	Base Delay (4.30–5.30)	Base Level of Service (4.30–5.30)	Option 1 Delay (4.30–5.30)	Option 1 Level of Service (4.30–5.30)
Fitzroy Street and Bourke Street	12	A	51	D

Additional delay is anticipated to occur at several locations with the proposed Option 1 cycleway scheme, including:

- Fitzroy Street and Bourke Street
- Fitzroy Street and South Dowling Street
- Fitzroy Street, Anzac Parade and Moore Park Road
- Moore Park Road and Driver Avenue.

The primary source of the additional delay is caused by the proposed traffic lane reduction on Fitzroy Street between South Dowling Street and Bourke Street. The capacity reduction from two general traffic lanes results in queues extending throughout the already congested network in both AM and PM peak periods.

The full results of intersection performance in both AM and PM peak periods (3 hours) are provided in Appendix C2.

7.3.4 Impacts on travel time

The travel time impacts for the general vehicle classes were assessed and compared to base model results, for the routes shown in Figure 7.6.

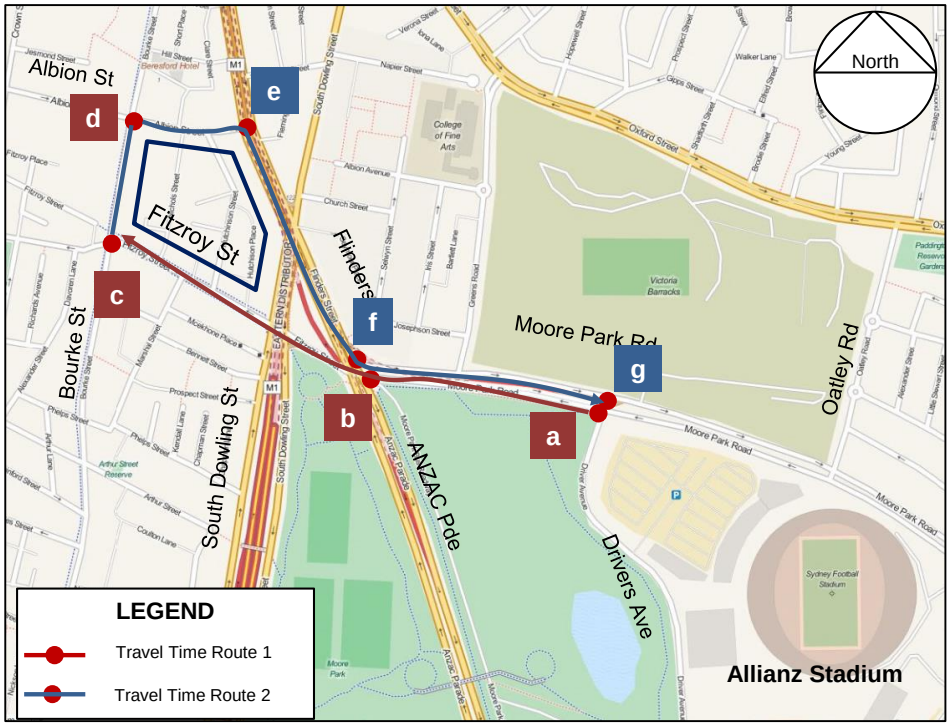


Figure 7.6 Modelled travel time route

The results in Table 7.5 and Table 7.6 demonstrate the travel time impacts with the implementation of the Option 1 cycleway.

Table 7.5 Travel time impact Option 1 vs Base – AM peak hour

Travel time comparison (sec)	Base average	Option 1 average	Difference
a) Moore Park Road/Driver Avenue	-	-	-
b) Moore Park Road/Flinders Street	125	134	+9
c) Fitzroy Street/Bourke Street	72	106	+34
Route 1 Total	**197**	**240**	**+43**
d & e) Bourke Street/Flinders Street	138	122	-16
f) Flinders Street/Moore Park Road	108	112	+4
g) Moore Park Road/Driver Avenue	39	38	-1
Route 2 Total	**286**	**272**	**-14**

Table 7.6 Travel time impact Option 1 vs Base – PM peak hour

Travel time comparison (sec)	Base Average	Option 1 Average	Difference
a) Moore Park Road/Driver Avenue	-	-	-
b) Moore Park Road/Flinders Street	80	79	-1
c) Fitzroy Street/Bourke Street	49	115	+65
Route 1 Total	**130**	**194**	**+64**
d) Bourke Street/Albion Street	40	39	-1
e) Albion Street/Flinders Street	131	130	-1
f) Flinders Street/Moore Park Road	72	72	0
g) Moore Park Road/Driver Avenue	23	23	0
Route 2 Total	**267**	**264**	**-3**

During both the AM and PM peaks, additional delay is experienced by city bound commuters between Anzac Parade and Bourke Street with negligible impacts on other routes.

The travel time of the cyclists using the new dedicated bicycle lanes was also assessed in both AM and PM peak hours. The travel time counters were set between Moore Park Road (250 m east of Driver Avenue) and Bourke Street (90 m north of Albion Street). The westbound/northbound travel time was predicted to be 7.5 minutes in both peak hours. The travel time for the eastbound/southbound cyclist was estimated to be 8 minutes.

7.3.5 Impacts on queue length

Table 7.7 and Table 7.8 summarise predicted queue length results in Option 1 with a comparison to the base models in both AM and PM peak hours.

Table 7.7 Queue length comparison on key approaches – AM peak hour – Option 1

Predicted queue length average (maximum)* in metres	Base 7.30–8.30 am	Option 1 7.30–8.30 am	Difference 7.30–8.30 am
Moore Park Road east of Driver Avenue (WB)	200 (430)	255 (440)	+55 (+10)
Moore Park Road east of Greens Road (WB)	120 (205)	125 (205)	+5 (-)
Moore Park Road east of Anzac Parade (WB)	50 (110)	55 (110)	+5 (-)
Fitzroy Street east of South Dowling Street (WB)	55 (160)	95 (160)	+40 (-)
Fitzroy Street east of Bourke Street (WB)	20 (115)	100 (250)	+80 (+135)
Anzac Parade south of Moore Park Road (NB)	**305 (510)**	**460 (510)**	**+155 (-*)**
Bourke Street north of Fitzroy Street (SB)	15 (60)	15 (70)	- (+10)
Bourke Street south of Fitzroy Street (NB)	5 (30)	5 (35)	- (+5)

*queue extends to the model boundary

Table 7.8 Queue length comparison on key approaches – PM peak hour – Option 1

Predicted queue length average (maximum) in metres	Base 4.30–5.30 pm	Option 1 4.30–5.30 pm	Difference 4.30–5.30 pm
Moore Park Road east of Driver Avenue (WB)	5 (60)	5 (55)	- (-5)
Moore Park Road east of Greens Road (WB)	20 (150)	15 (155)	-5 (+5)
Moore Park Road east of Anzac Parade (WB)	30 (110)	30 (110)	- (-)
Fitzroy Street east of South Dowling Street (WB)	35 (140)	75 (155)	+40 (+15)
Fitzroy Street east of Bourke Street (WB)	5 (50)	120 (250)	+115 (+200)
Anzac Parade south of Moore Park Road (NB)	**20 (160)**	**325 (490)**	**+305 (+330)**
Bourke Street north of Fitzroy Street (SB)	10 (70)	15 (80)	+5 (+10)
Bourke Street south of Fitzroy Street (NB)	5 (25)	5 (40)	- (+15)

The results in the above tables demonstrate that:

- Significant increase in queue length (155 m and 305 m) is predicted on Anzac Parade northbound approach at Moore Park Road intersection in both the AM and PM peak hours will occur after the implementation of the cycleway. The congestion on this approach (which also exist in the base models) is predicted to significantly worsen by the downstream slow moving queue (1,300 vehicles per hour on Fitzroy Street).
- Queuing on Fitzroy Street from the Bourke Street intersection often extends to and beyond the South Dowling Street intersection.

The traffic lane reduction on Fitzroy Street is the primary source of congestion within the network.

7.3.6 Impacts on wider network

The network statistics results provide an indicative impact assessment on the entire road network within the VISSIM model scope.

Table 7.9 Network wide statistics (all vehicle classes including cyclists) – Option 1

Network statistics	Base 7.30–8.30 am	Option 1 7.30–8.30 am	Base 4.30–5.30 pm	Option 1 4.30–5.30 pm
Unreleased vehicles	210	2180	110	135
Network average delay	108 seconds	179 seconds	79 seconds	136 seconds
Vehicle distance travelled	7670 km	6190 km	6700 km	6720 km
Vehicle hour travelled	444 hours	554 hours	330 hours	476 hours

The results in Table 7.9 demonstrate that the average vehicle delay for all vehicles (including cyclists) would increase by 71 seconds and 59 seconds in Option 1 matching the increase in vehicle hour travelled (VHT) results (110 hours in the AM peak hour and 146 hours in the PM peak hour).

During the AM peak period, where there is significant city-bound general traffic, an increase in unreleased trips in the model demonstrates the reduced capacity of the network under this option.

In summary, the impact of the capacity reduction on Fitzroy Street in Option 1 extends congestion and delay beyond the local network.

7.4 Option 2 – Moore Park Road, Flinders Street and Albion Street route

7.4.1 Road network coding

The road network was updated based on the design drawing provided by the CoS. The following road network changes of Option 2 were modelled as shown in Figure 7.7:

- New bicycle lane on Moore Park Road, between Driver Avenue and South Dowling Street, in both directions (Section I of the proposed bicycle lane).
- Remove westbound left turn slip lane and re-align traffic island at South Dowling Street and Fitzroy Street intersection.
- Reduction in northbound traffic lanes on Flinders Street.
- Extend right-turn lane bay to full length on South Dowling Street approaching Fitzroy Street.
- New bicycle lane on Flinders Street between South Dowling Street and Albion street, and continue onto Albion Street between Bourke Street and Flinders Street, in both directions (Section II of the proposed bicycle lane).
- Proposed off-street shared path parallel to South Dowling Street, which provides the connection between Section I and II of the proposed bicycle lanes.
- Relocate bus stop on Flinders Street to north side of Albion Street.
- Add short turn lane to the existing north and southbound approaches of Bourke Street bicycle lanes at Albion Street intersection.

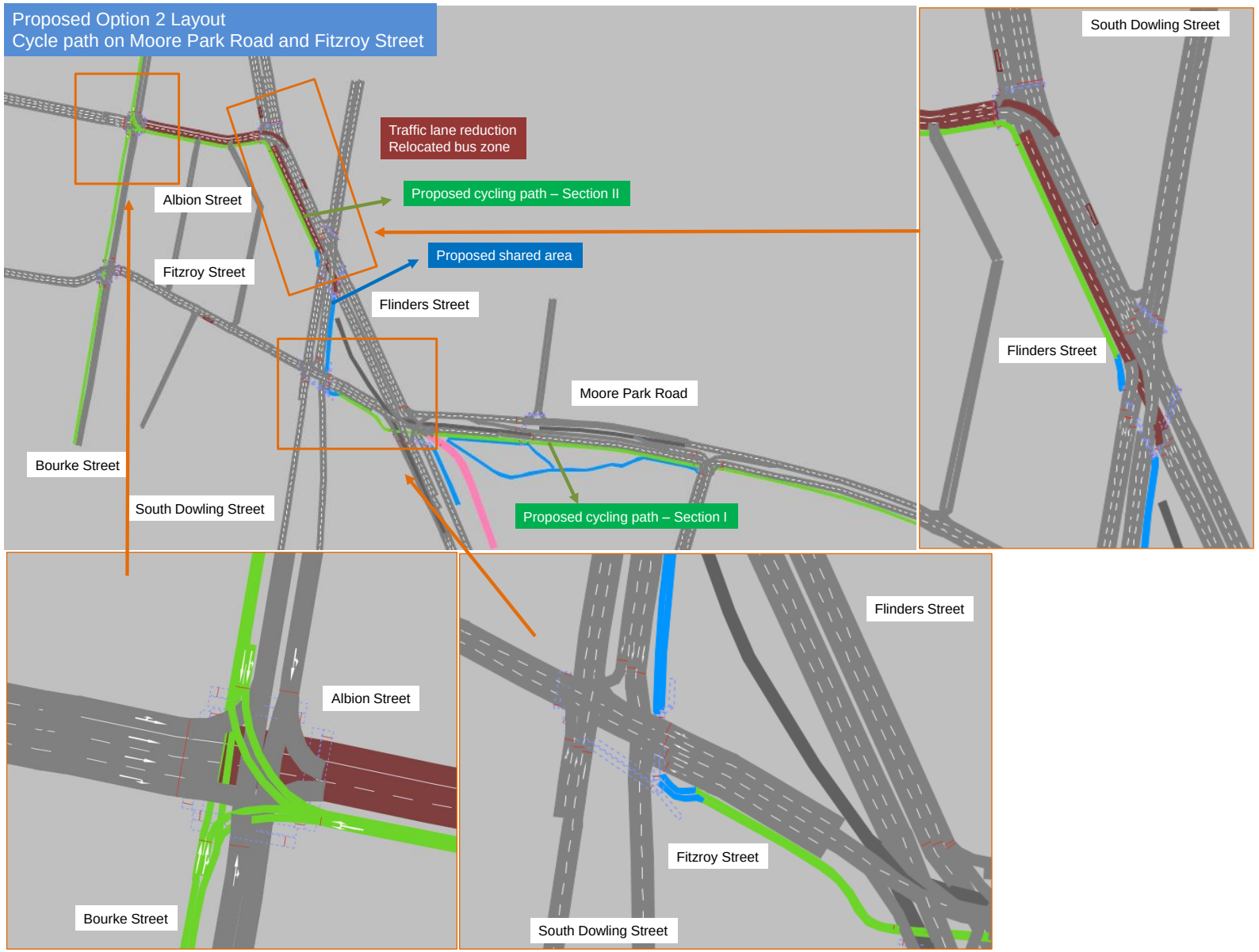


Figure 7.7 Proposed Option 2 layout in VISSIM model

7.4.2 Traffic signal coding

The traffic signals were updated at the following seven intersections in Option 2.

Table 7.10 Proposed changes to the traffic signals with the proposed bicycle lane – Option 2

Intersections	Proposed changes to the traffic signal phasing and timing
Moore Park Road and Driver Avenue	Arrow controlled left turns used at the westbound approach.
Moore Park Road and Greens Road	Proposed local changes explained in section 7.3. Proposed bicycle lane has minimal impact on the signal operation, since the cyclists run parallel with the vehicular traffic.
Moore Park Road, Flinders Street and Anzac Parade	Proposed bicycle lane has minimal impact on the signal operation, since the cyclists run parallel with the vehicular traffic.
Fitzroy Street and South Dowling Street	Additional Signal controlled left turn used, with the removal of the left turn slip lane at the eastbound approach on Fitzroy Street.
Flinders Street and South Dowling Street	Proposed additional north-south pedestrian crossing which has a long clearance (red-flash) time (30 seconds). Northbound bus jump phase used to address the capacity the downstream lane reduction (discontinued bus lane) on Flinders Street.
Flinders Street and Albion Street	Increase the green time assigned to the eastbound movement on Albion Street, due to the proposed lane reduction (from three to two lanes) on this section.
Bourke Street and Albion Street	Dedicated cycling phases were proposed; cycle time length was expanded to include the dedicated cycling phase, without reduce the green time for the movements on Bourke Street and Albion Street.

The signal phasing and timings at the rest intersections were consistent with the existing operation.

7.4.2.1 Arrow controlled left turns

Similar to Option 1, arrow controlled left turns would be used at the westbound approach at the following two intersections, to ensure that the vehicles can turn left without conflicting with the cyclists on the proposed kerbside bicycle lane in Option 2.

- Moore Park Road and Driver Avenue intersection
- Moore Park Road and Anzac Parade intersection (existing for control the conflict with buses and pedestrians).

Arrow controlled left turns were modelled in VISSIM by placing a secondary traffic signal stopline, to enable a controlled left turn phase (by a minimum of 12 seconds) at the above intersections.

7.4.2.2 Dedicated cycling phases at Bourke Street and Albion Street intersection

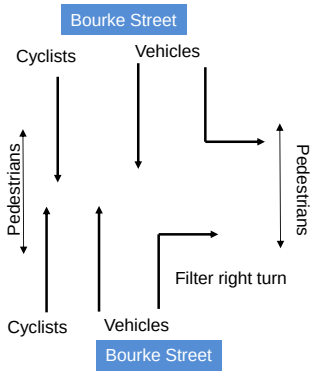
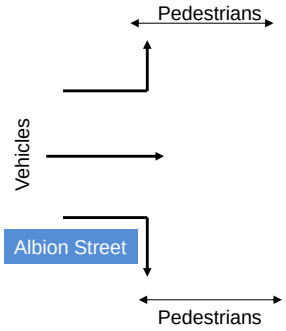
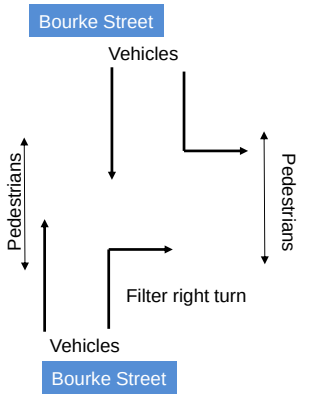
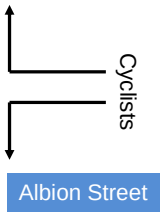
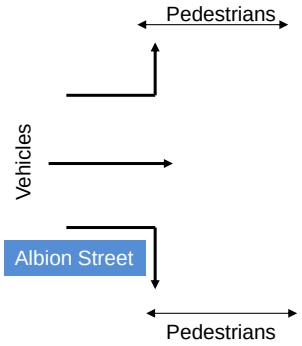
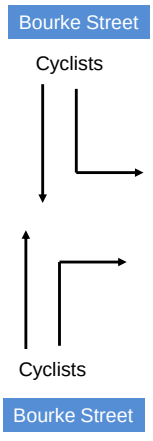
At the Bourke Street and Albion Street intersection, two dedicated cycling phases were proposed where all the vehicular traffic faces a red light while a cycling only phase runs to facilitate the following movements respectively:

- existing north-south through cycling movements and the turning movements from Bourke Street to the new bicycle lane on Albion Street
- turning movements from the new bicycle lane on Albion Street to Bourke Street.

Similar to Option1, the dedicated cycling phases were proposed by the CoS to address the strong turning cycling demands between Albion Street and Bourke Street, in light of the existing spare capacity at this intersection.

Table 7.11 shows the modelled signal phasing and timing at this intersection for Option 2, compared to those in the base models.

Table 7.11 Existing and proposed signal phasing at Bourke Street and Albion Street intersection

	Phase A	Phase B	Phase C	Phase D
Base (120s cycle time)		n/a		n/a
AM peak	86 seconds		34 seconds	
PM peak	71 seconds		49 seconds	
Option 2 (144s cycle time)				
AM peak	86 seconds	9 seconds	34 seconds	15 seconds
PM peak	71 seconds	9 seconds	49 seconds	15 seconds

As with Option 1, for the modelling the 'with cycleway' scenarios it was assumed that the phase lengths for existing phases would be retained and the overall cycle length would expand to include the dedicated cycling phases. This assumption was made based on advise from CoS to retain existing phase lengths.

For the purposes of the concept assessment these assumptions are reasonable, however should this option proceed than, in the detailed design stage and traffic signal design stage, traffic signal should be reviewed and retested as necessary.

7.4.3 Intersection performances

The intersection performances of Option 2 were assessed and compared to the base model results. The results are provided in Table 7.12 and Table 7.13.

Table 7.12 Comparison of intersection performance – Option 2 vs Base – AM peak hour

Intersection performance AM peak periods	Base Delay (7.30–8.30)	Base Level of Service (7.30–8.30)	Option 2 Delay (7.30–8.30)	Option 2 Level of Service (7.30–8.30)
Moore Park Road and Driver Avenue	41	C	36	C
Moore Park Road and Greens Road	32	C	30	B
Moore Park Road, Anzac Parade and Flinders Street	52	D	51	D
Fitzroy Street and South Dowling Street	26	B	27	B
Flinders Street and South Dowling Street	29	C	42	C
Flinders Street and Albion Street	18	B	20	B
Albion Street and Bourke Street	27	B	40	C
Fitzroy Street and Bourke Street	27	B	26	B

Table 7.13 Comparison of intersection performance – Option 2 vs Base – PM peak hour

Intersection performance AM peak periods	Base Delay (4.30–5.30)	Base Level of Service (4.30–5.30)	Option 2 Delay (4.30–5.30)	Option 2 Level of Service (4.30–5.30)
Moore Park Road and Driver Avenue	10	A	6	A
Moore Park Road and Greens Road	9	A	9	A
Moore Park Road, Anzac Parade and Flinders Street	31	C	34	C
Fitzroy Street and South Dowling Street	28	B	31	C
Flinders Street and South Dowling Street	28	B	34	C
Flinders Street and Albion Street	51	D	34	C
Albion Street and Bourke Street	72	F	66	E
Fitzroy Street and Bourke Street	12	A	14	A

During the AM peak hour, for the most part intersections are predicted to operate, with the Option 2 cycleway, at a similar level of performance to the base traffic model. There will be some additional delay anticipated at the Flinders Street and South Dowling Street, and Albion and Bourke Street intersections, however they will remain within a reasonable level of service. Some improvements can be achieved along Moore Park Road as the proposed option provides control for conflicting pedestrians and cyclists at the South Dowling Street which otherwise have the potential to disrupt flow leading to queuing on Moore Park Road and Anzac Parade.

During the PM peak hour, the modelling of the operations suggests some improvements at intersections along Albion Street. The modelling undertaken with the cycleway has rebalanced phase times at these locations and much of the improvements made have been as a result of re-distributed green time in the base case scenario.

The full results of intersection performance in both AM and PM peak periods (three hours) are provided in Appendix C3.

7.4.4 Impacts on travel time

The travel time impact on the general vehicle classes were assessed and compared to base model results. With the results provided in Table 7.14 and Table 7.15.

Table 7.14 Travel time impact Option 2 vs Base – AM peak hour

Travel time comparison (sec)	Base average	Option 2 average	Difference
a) Moore Park Road/Driver Avenue	-	-	-
b) Moore Park Road/Flinders Street	125	118	-7
c) Fitzroy Street/Bourke Street	72	67	-5
Route 1 Total	**197**	**186**	**-11**
d & e) Bourke Street/Flinders Street	138	130	-8
f) Flinders Street/Moore Park Road	108	114	+6
g) Moore Park Road/Driver Avenue	39	40	+1
Route 2 Total	**286**	**289**	**+3**

Table 7.15 Travel time impact Option 2 vs Base – PM peak hour

Travel time comparison (sec)	Base average	Option 2 average	Difference
a) Moore Park Road/Driver Avenue	-	-	-
b) Moore Park Road/Flinders Street	80	82	-2
c) Fitzroy Street/Bourke Street	49	51	+2
Route 1 Total	**130**	**133**	**-3**
d) Bourke Street/Albion Street	40	59	-1
e) Albion Street/Flinders Street	131	57	-64
f) Flinders Street/Moore Park Road	72	91	+19
g) Moore Park Road/Driver Avenue	23	23	0
Route 2 Total	**267**	**230**	**-37**

Overall, the travel time assessment for general traffic shows that some improvements can be made to the general commuter traffic. During the AM peak, controlling the pedestrian demands at South Dowling Street can improve the travel time in this direction slightly.

The majority of the improvements within the Option 2 model are however experienced at the Albion Street and Flinders Street intersection, with a re-balance of green time assumed at this location. This additional throughput at this location does increase delay at the next downstream intersection, however there is an overall net improvement.

The travel time of the cyclists using the new dedicated bicycle lanes was assessed in the both AM and PM peak hours. The travel time counters were set between Moore Park Road (250 m east of Driver Avenue) and Bourke Street (90 m north of Albion Street). The westbound/northbound travel time of cyclists was estimated to be between 6 and 8.5 minutes in both AM and PM peak hours. The travel time for the eastbound/southbound cyclists would be between 7.5 and 8.5 minutes.

7.4.5 Impacts on queue length

The proposed alignment of Option 2 would affect the vehicular queue length on general traffic lanes. Table 7.16 and Table 7.17 summarise the predicted queue length results and compare them to the base models in both AM and PM peak hours.

Table 7.16 Queue length comparison on key approaches – AM peak hour – Option 2

Predicted queue length average (maximum) in metres	Base 7.30–8.30 am	Option 2 7.30–8.30 am	Difference 7.30–8.30 am
Moore Park Road east of Driver Avenue (WB)	200 (430)	175 (415)	-25 (-15)
Moore Park Road east of Greens Road (WB)	120 (205)	115 (205)	-5 (-)
Moore Park Road east of Anzac Parade (WB)	50 (110)	50 (110)	-5 (-)
Fitzroy Street east of South Dowling Street (WB)	55 (160)	45 (160)	-10 (-)
South Dowling Street south of Flinders Street (NB)	25 (105)	25 (120)	- (+15)
Flinders Street south of Albion Street (NB)	20 (80)	5 (40)	-15 (-40)
Flinders Street north of Albion Street (SB)	5 (30)	5 (30)	- (-)
Albion Street west of Flinders Street (EB)	20 (80)	35 (135)	+15 (+55)
Bourke Street north of Albion Street (SB)	15 (80)	20 (95)	+5 (+15)
Bourke Street south of Albion Street (NB)	5 (45)	10 (60)	+5 (+15)
Albion Street west of Bourke Street (EB)	10 (45)	10 (85)	- (+40)

Table 7.17 Queue length comparison on key approaches – PM peak hour – Option 2

Predicted queue length average (maximum) in metres	Base 4.30–5.30 pm	Option 2 4.30–5.30 pm	Difference 4.30–5.30 pm
Moore Park Road east of Driver Avenue (WB)	5 (60)	5 (60)	- (-)
Moore Park Road east of Greens Road (WB)	20 (150)	15 (135)	-5 (-15)
Moore Park Road east of Anzac Parade (WB)	30 (110)	30 (110)	- (-)
Fitzroy Street east of South Dowling Street (WB)	35(140)	40 (150)	+5 (+10)
South Dowling Street south of Flinders Street (NB)	30 (120)	30 (125)	- (+5)
Flinders Street south of Albion Street (NB)	5 (45)	20 (100)	+15 (+55)
Flinders Street north of Albion Street (SB)	5 (45)	10 (55)	+5 (+10)
Albion Street west of Flinders Street (EB)	80 (150)	70 (150)	-10 (-)
Bourke Street north of Albion Street (SB)	15 (90)	30 (95)	+15 (+5)
Bourke Street south of Albion Street (NB)	5 (40)	5 (50)	- (+10)
Albion Street west of Bourke Street (EB)	75 (255)	75 (220)	- (-35)

The results in the above tables demonstrated that the proposed changes in Option 2 would not have significant impact on the queuing in the network. Whilst some locations, such as on Flinders Street at Albion Street will experience additional queuing the overall changes are negligible under the scenarios tested.

7.4.6 Impacts on wider network

The network statistics results provide an indicative assessment of the proposed network changes on the entire road network within the VISSIM model scope.

Table 7.18 Network wide statistics (all vehicle classes including cyclists) – Option 2

Network statistics	Base 7.30–8.30 am	Option 2 7.30–8.30 am	Base 4.30–5.30 pm	Option 2 4.30–5.30 pm
Unreleased vehicles	210	0	110	0
Network average delay	108 seconds	105 seconds	79 seconds	78 seconds
Vehicle distance travelled	7670 km	7875 km	6700 km	6780 km
Vehicle hour travelled	444 hours	438 hours	330 hours	329 hours

The results in Table 7.18 demonstrated that the proposed changes in Option 2 would not have noticeable impact on the wider network with the potential review of the traffic signal operation at Albion Street and Flinders Street intersection by RMS.

8. Summary and conclusions

8.1 Summary of results

Two alignment options of dedicated bicycle lanes were provided by the City of Sydney for this assessment.

- Option 1: Moore Park Road – Fitzroy Street Route
- Option 2: Moore Park Road – Flinders Street – Albion Street Route.

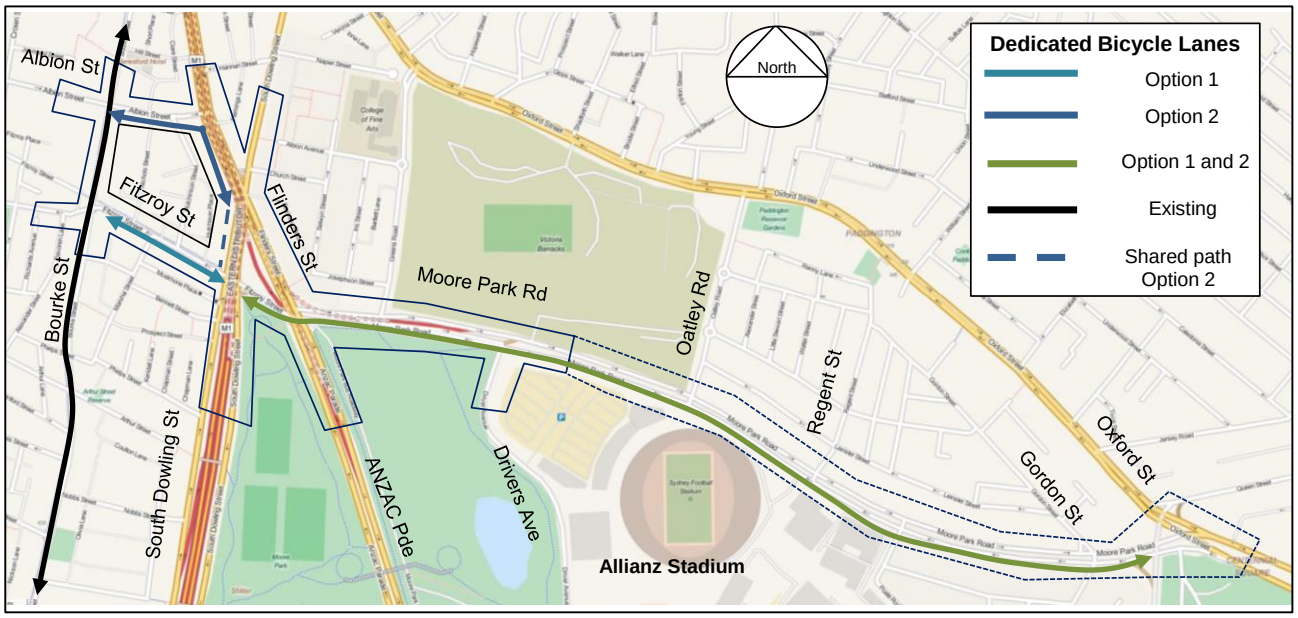


Figure 8.1 Proposed cycleway alignment options

Intersection modelling was conducted in SIDRA to assess the operational performance of the intersections on Moore Park Road east of the Driver Avenue, including:

- Moore Park Road, Oxford Street, Queen Street and Lang Road intersection
- Moore Park Road and Gordon Street intersection
- Moore Park Road and Regent Street intersection
- Moore Park Road and Oatley Road intersection
- Moore Park Road and Driver Avenue intersection.

The microsimulation VISSIM base model was developed to provide a basis for the intersections in the project area west of the Driver Avenue, including the following:

- Moore Park Road and Driver Avenue intersection
- Moore Park Road and Greens Road intersection
- Moore Park Road, Anzac Parade and Flinders Street intersection (part of the Driver's Triangle)
- Fitzroy Street and South Dowling Street intersection (part of the Driver's Triangle)
- Flinders Street and South Dowling Street intersection (part of the Driver's Triangle)
- Flinders Street and Albion Street intersection

- Albion Street and Bourke Street intersection
- Fitzroy Street and Bourke Street intersection.

The models were calibrated and validated in the both AM and PM peak periods, by meeting the following criteria of traffic counts, travel time and queue length (comparison only) in Roads and Maritime 2013*Traffic Modelling Guidelines.*

Sensitivity test was undertaken on the peak 3 hours (9.00 pm to 12.00 am) of the ICC semi-final day using the provided traffic data and assumptions. Based on the comments provided by the Roads and Maritime upon the review of the event day model results, this model is no longer required in the options testing stage.

Table 8.1 presented the results of the operational performance of intersections along Moore Park Road as assed using Sidra. Table 8.2 summarises the intersection operational performance for intersections tested within the VISSIM model.

Table 8.1 Summary of intersection performance along Moore Park Road (SIDRA)

Intersection performance SIDRA model (LoS)**	Base AM peak hour	Option 1&2 AM peak hour	Base PM peak hour	Option 1&2 PM peak hour
Moore Park Road, Oxford Street and Lang Road	C	C	E	E
Moore Park Road, Cook Road and Gordon Street	A	A	A	A
Moore Park Road and Regent Street*	A	A	A	A
Moore Park Road and Oatley Road*	A	A	A	A
Moore Park Road and Driver Avenue**	A	A	A	A

*Assessed as isolated intersection in SIDRA

** Does not consider the downstream intersection impact so the results differ with VISSIM

Table 8.2 Summary of intersection performance of Option 1 and 2 west of Driver Avenue (VISSIM)

Intersection performance VISSIM model (LoS)	AM peak hour			PM peak hour		
	Base	Option 1	Option 2	Base	Option 1	Option 2
Moore Park Road and Driver Avenue	C	D	C	A	A	A
Moore Park Road and Greens Road	C	C	C	A	A	A
Moore Park Road, Anzac Parade and Flinders Street	D	E/F*	D	C	D	C
Fitzroy Street and South Dowling Street	B	C	B	B	C	C
Flinders Street and South Dowling Street	C	C	C	B	C	C
Flinders Street and Albion Street	B	B	B	D	D	C

Intersection performance VISSIM model (LoS)	AM peak hour			PM peak hour		
	Base	Option 1	Option 2	Base	Option 1	Option 2
Albion Street and Bourke Street	B	B	C	F	F	E
Fitzroy Street and Bourke Street	B	D	B	A	C	A

8.2 Conclusion

Conclusions made from the modelling of the two cycleway options were:

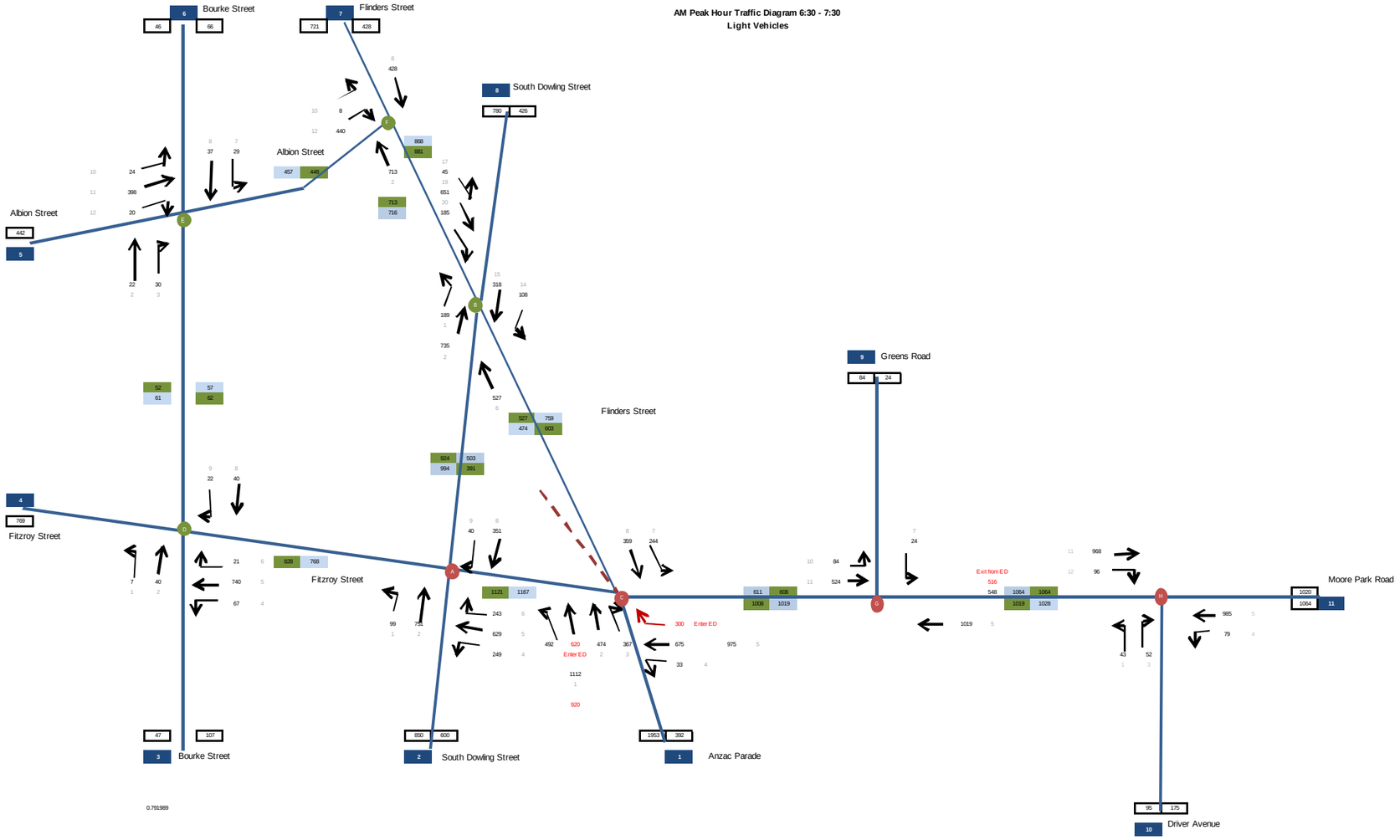
- Option 2 is shown to perform significantly better than Option 1 and has the potential to provide a dedicated cycling facility without any significant disruptions to general traffic. Option 2 represents the preferred option for further design development.
- Base on the modelling results, Option 1 proposal causes significant disruptions, particularly due to the significant capacity reduction along Fitzroy Street. By removing the retained bus lane between South Dowling Street and Bourke Street, it would improve performance to general traffic in this area, however at the determent to bus users.
- Further development of Option 2 could be considered with appropriate RMS reviews. The modelling results and site visit observations suggest that the Albion Street and Flinders Street intersection are worthwhile of further investigations with the proposed changes to the intersection layout in Option 2. The modelling results show that negligible impacts to general traffic is experienced under the Option 2 scenario.
- Some minor investigations along Flinders Street and at the intersections of South Dowling and Albion Street along Flinders Street is encouraged where the northbound bus lane is proposed to be removed. During the AM peak there is a significant cyclist demand along this section and directing them into the proposed cycleway is likely to improve general traffic in this area.
- Further investigations into the operations of the intersection of Albion Street and Bourke Street, in Option 2 (with the proposed cycleway) is recommended. A number of alternative operational arrangements could be considered including a scramble cyclist phase.

Appendix A

Traffic surveys and analysis

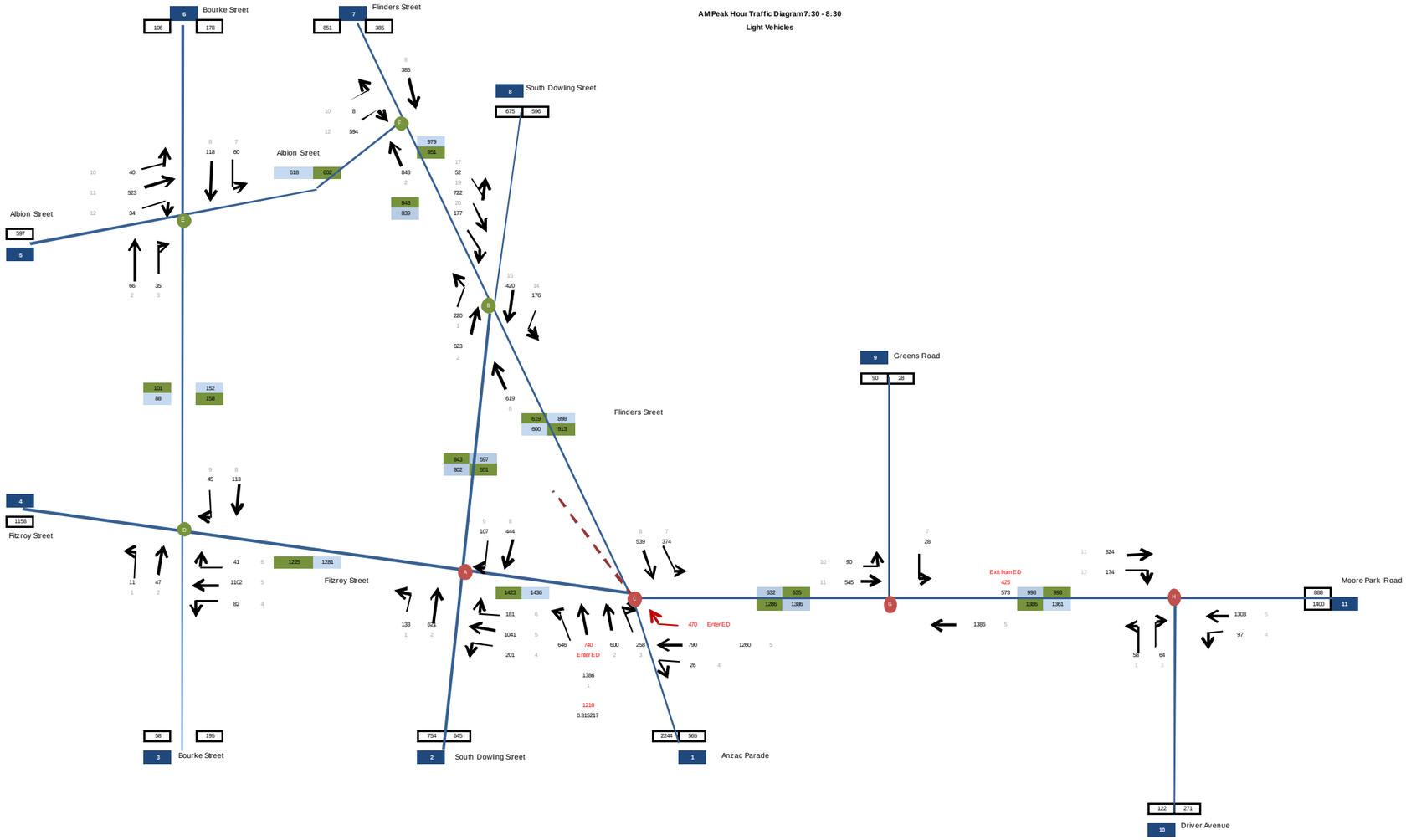
A1. Intersection turn count summary

AM Peak Hour Traffic Diagram 6:30 - 7:30
Light Vehicles

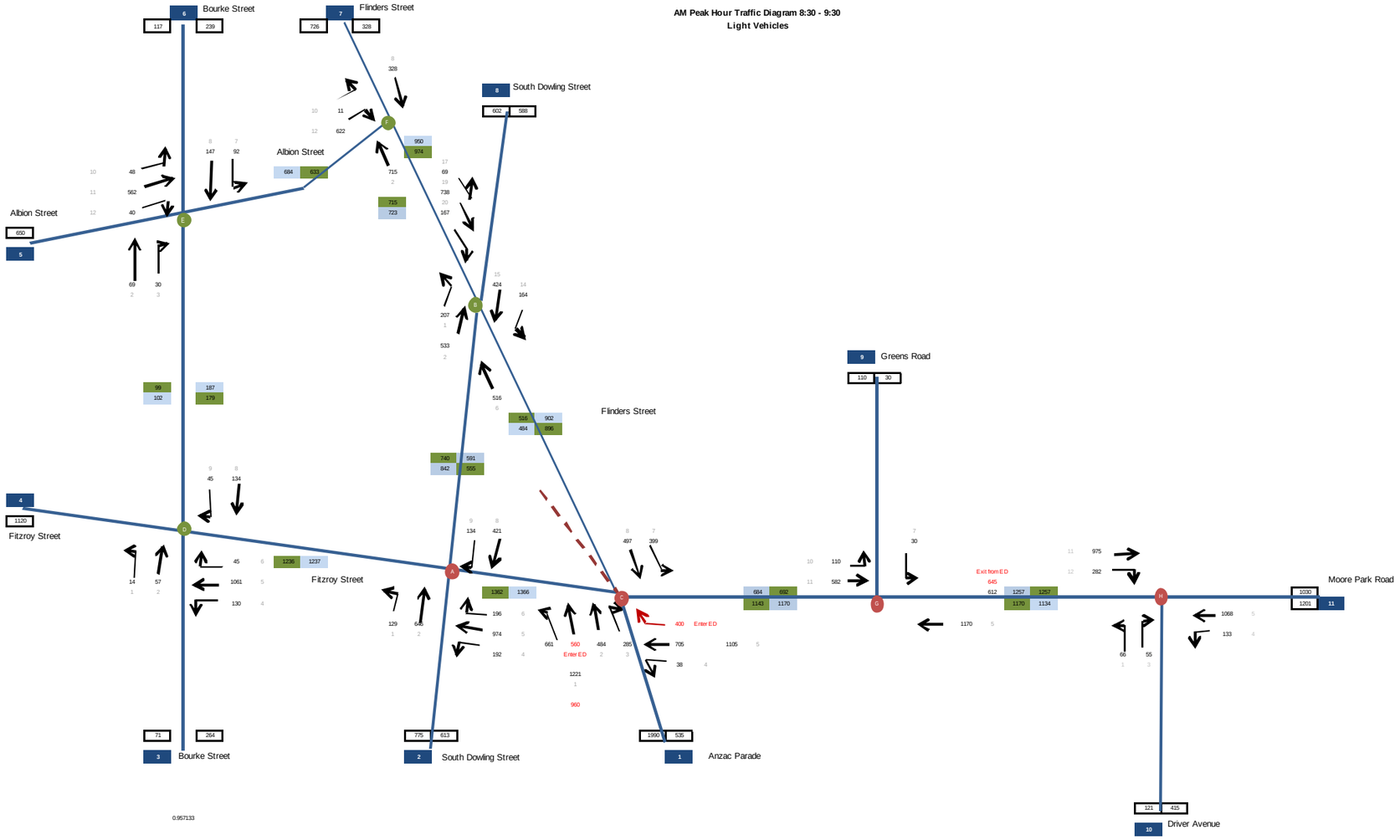


AM Peak Hour Traffic Diagram 7:30 - 8:30

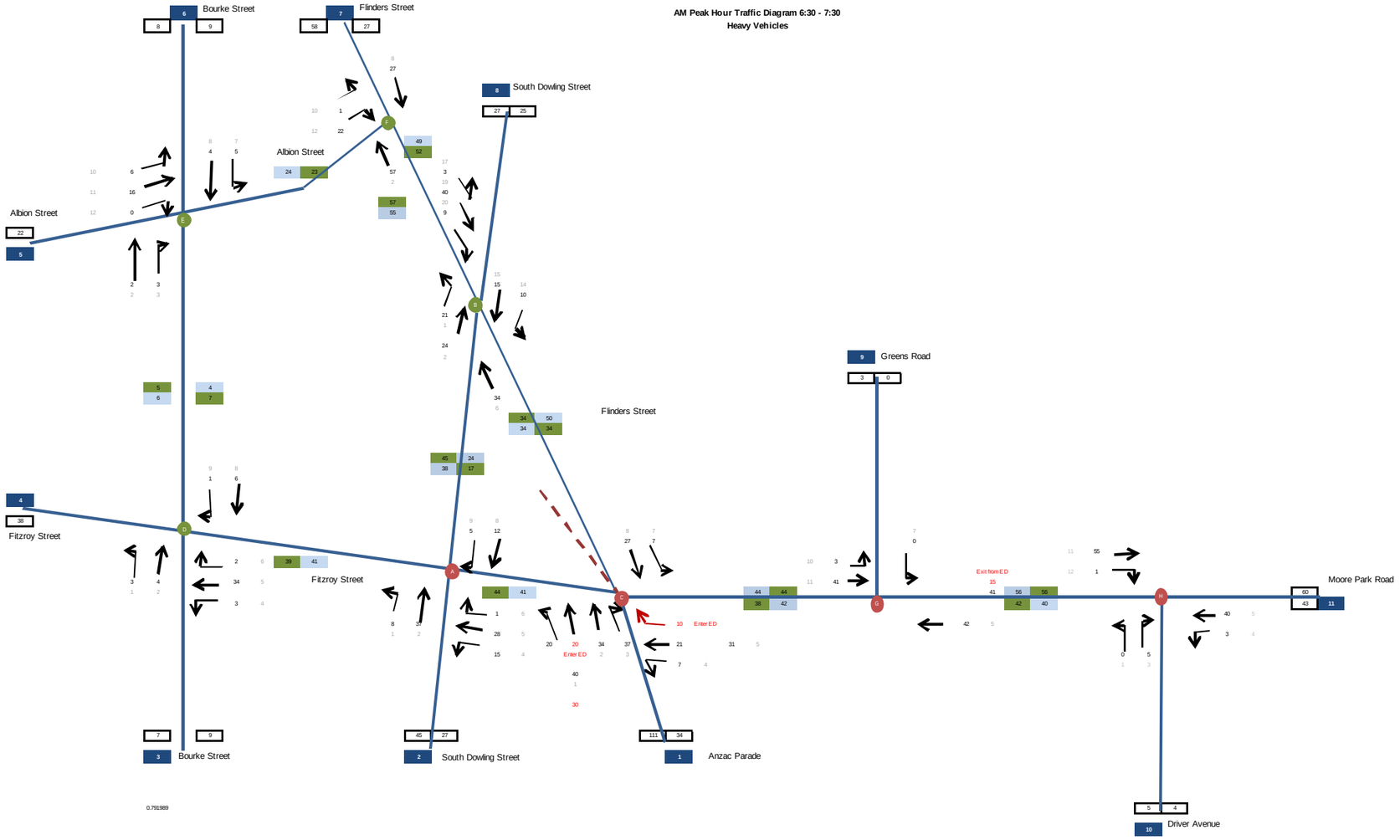
Light Vehicles



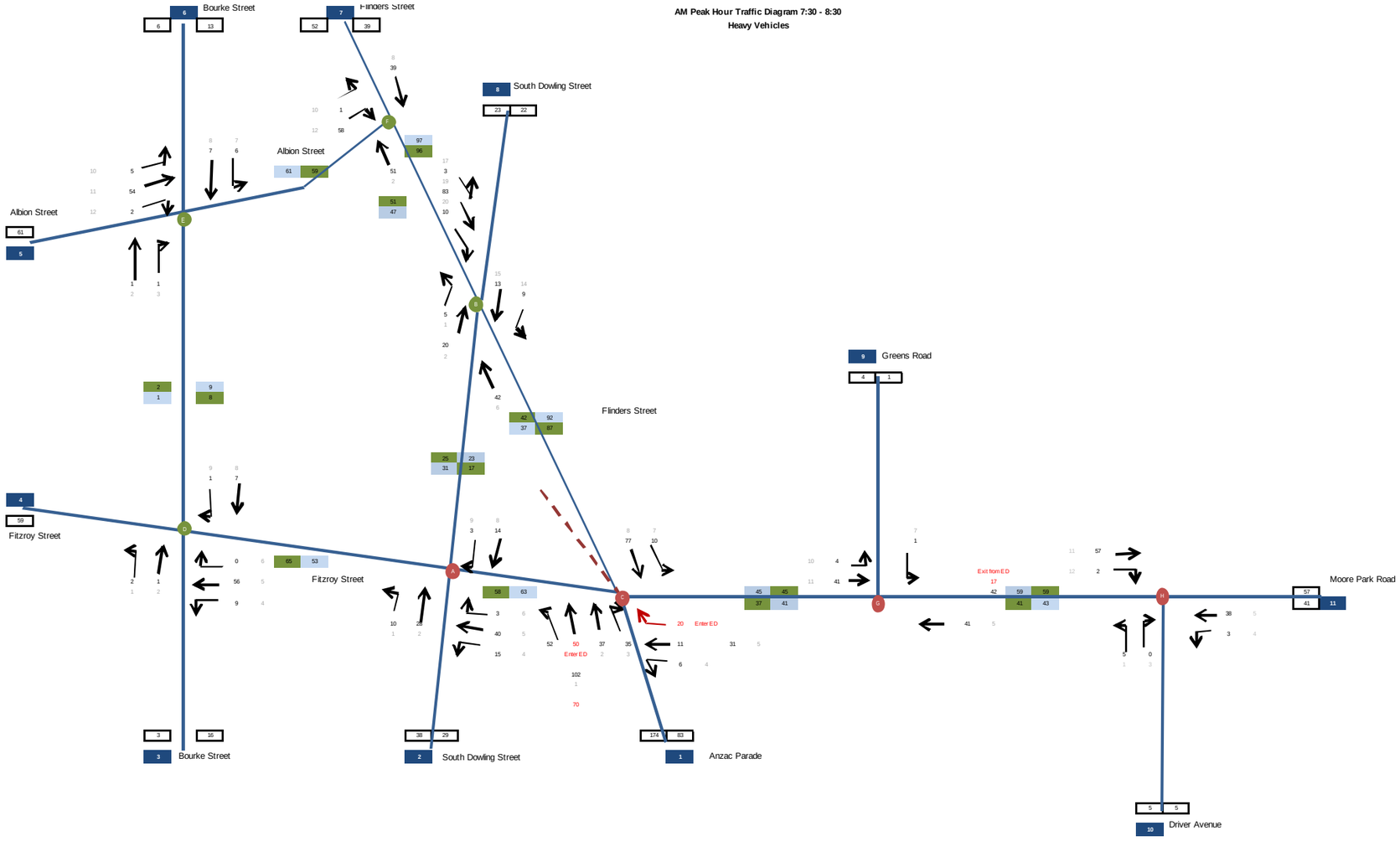
AM Peak Hour Traffic Diagram 8:30 - 9:30
Light Vehicles



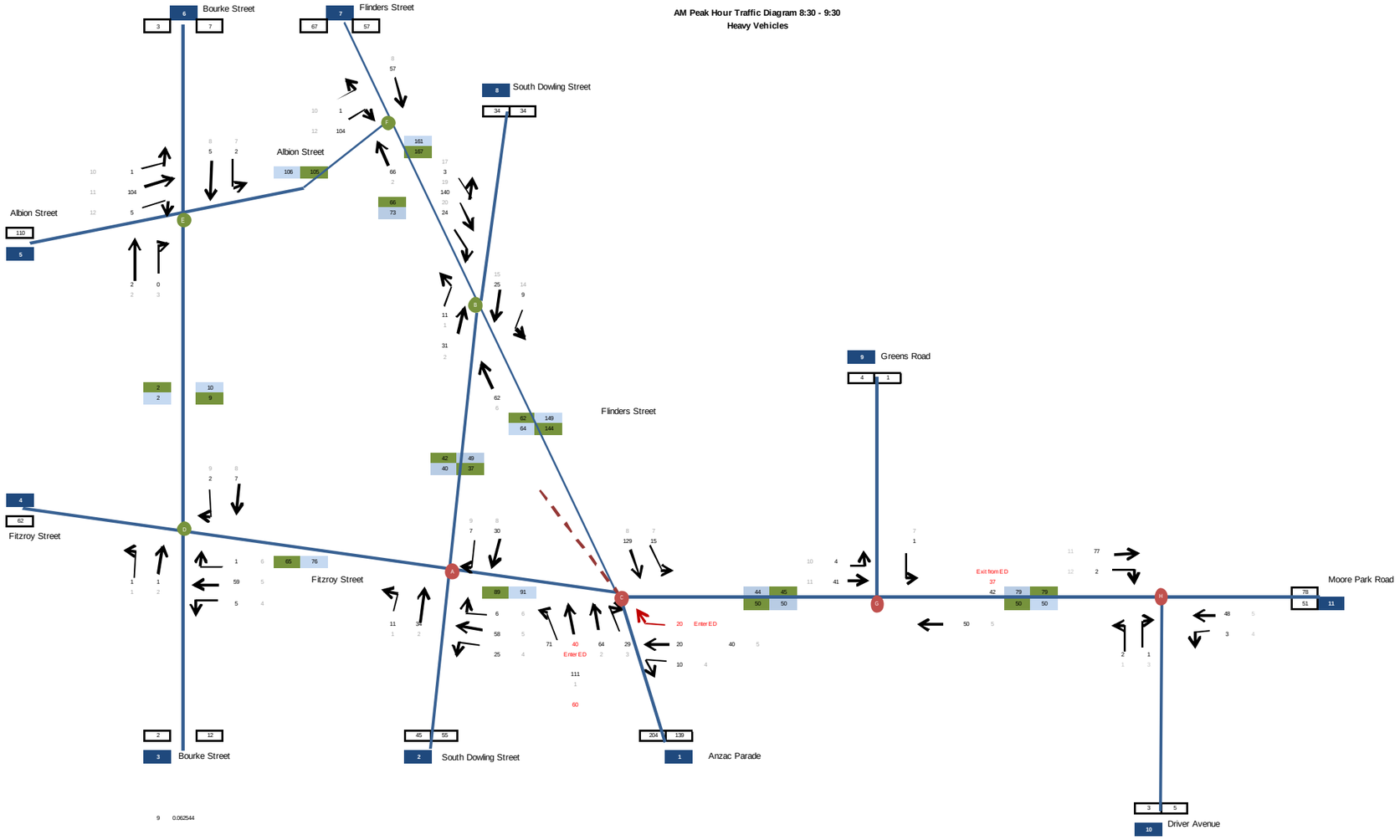
AM Peak Hour Traffic Diagram 6:30 - 7:30
Heavy Vehicles



AM Peak Hour Traffic Diagram 7:30 - 8:30
Heavy Vehicles

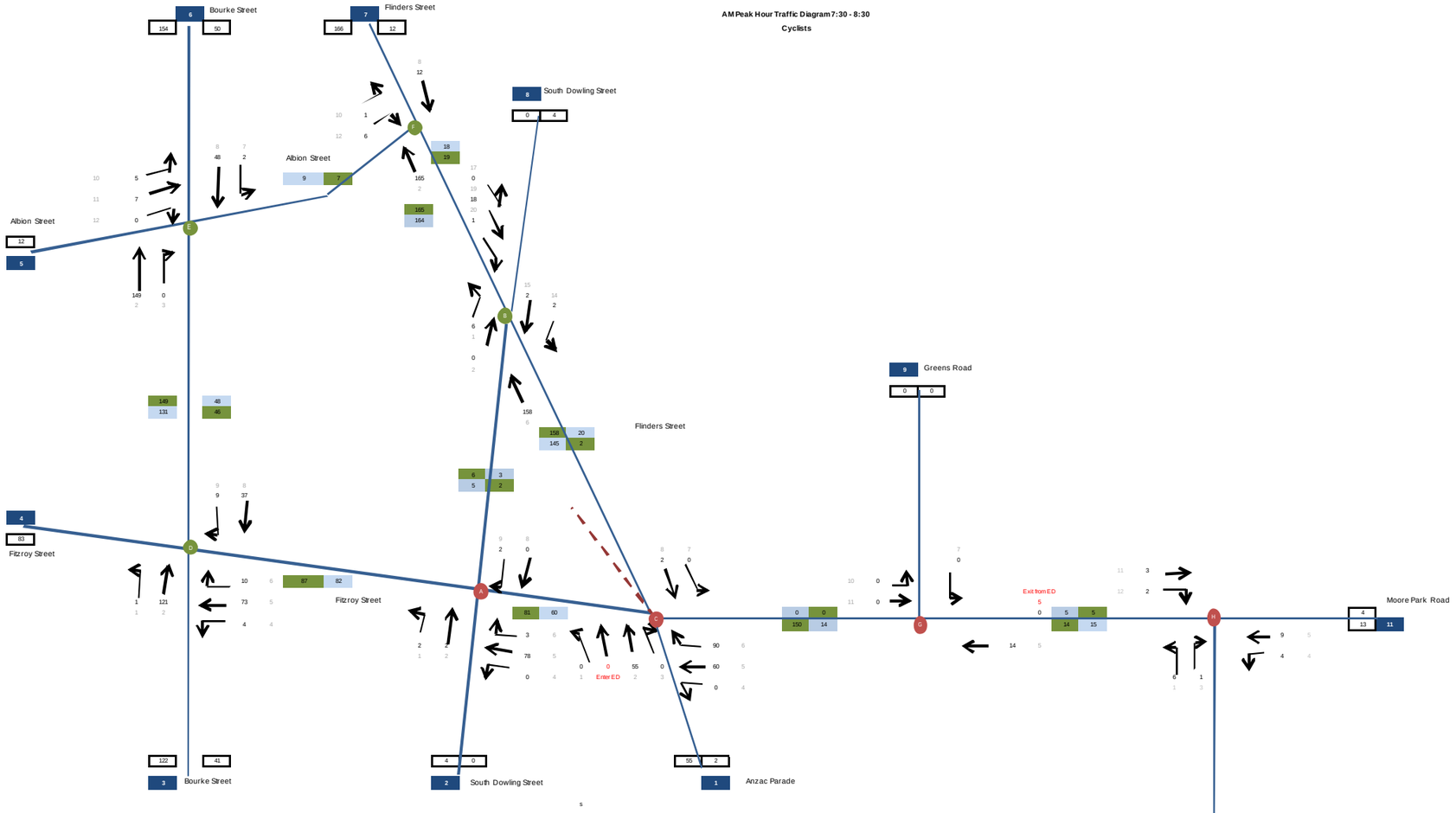


AM Peak Hour Traffic Diagram 8:30 - 9:30
Heavy Vehicles



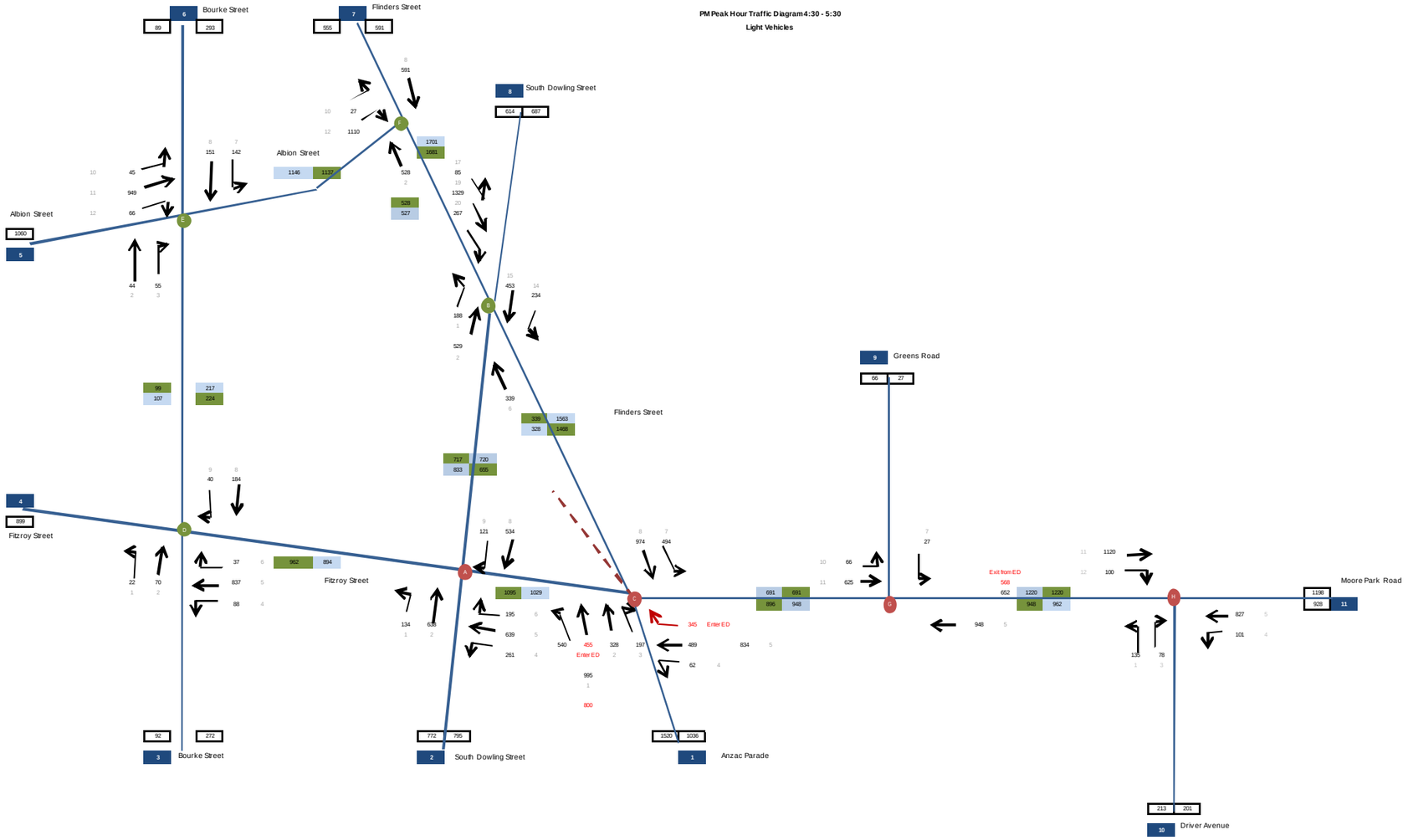
AM Peak Hour Traffic Diagram 7:30 - 8:30

Cyclists

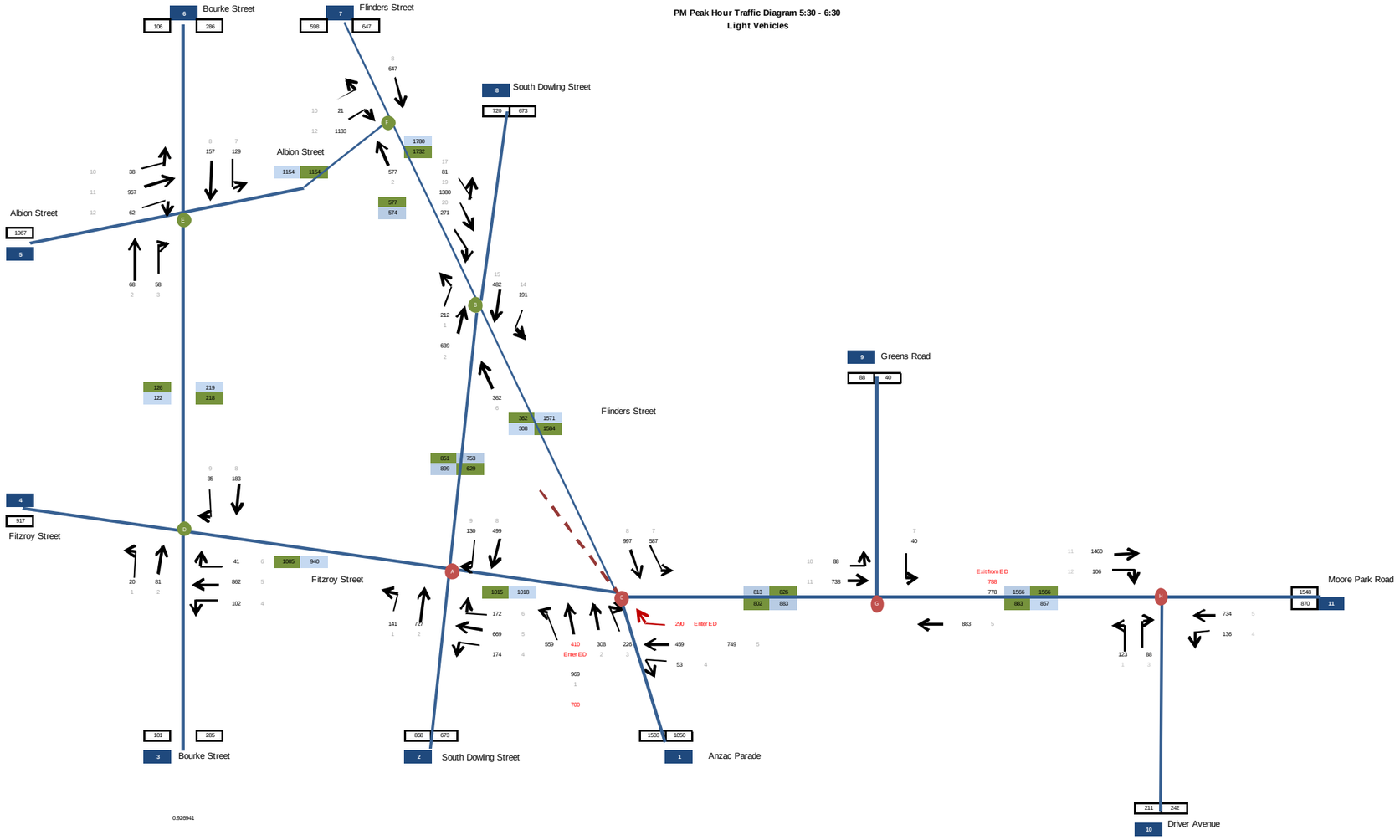


PM Peak Hour Traffic Diagram 4:30 - 5:30

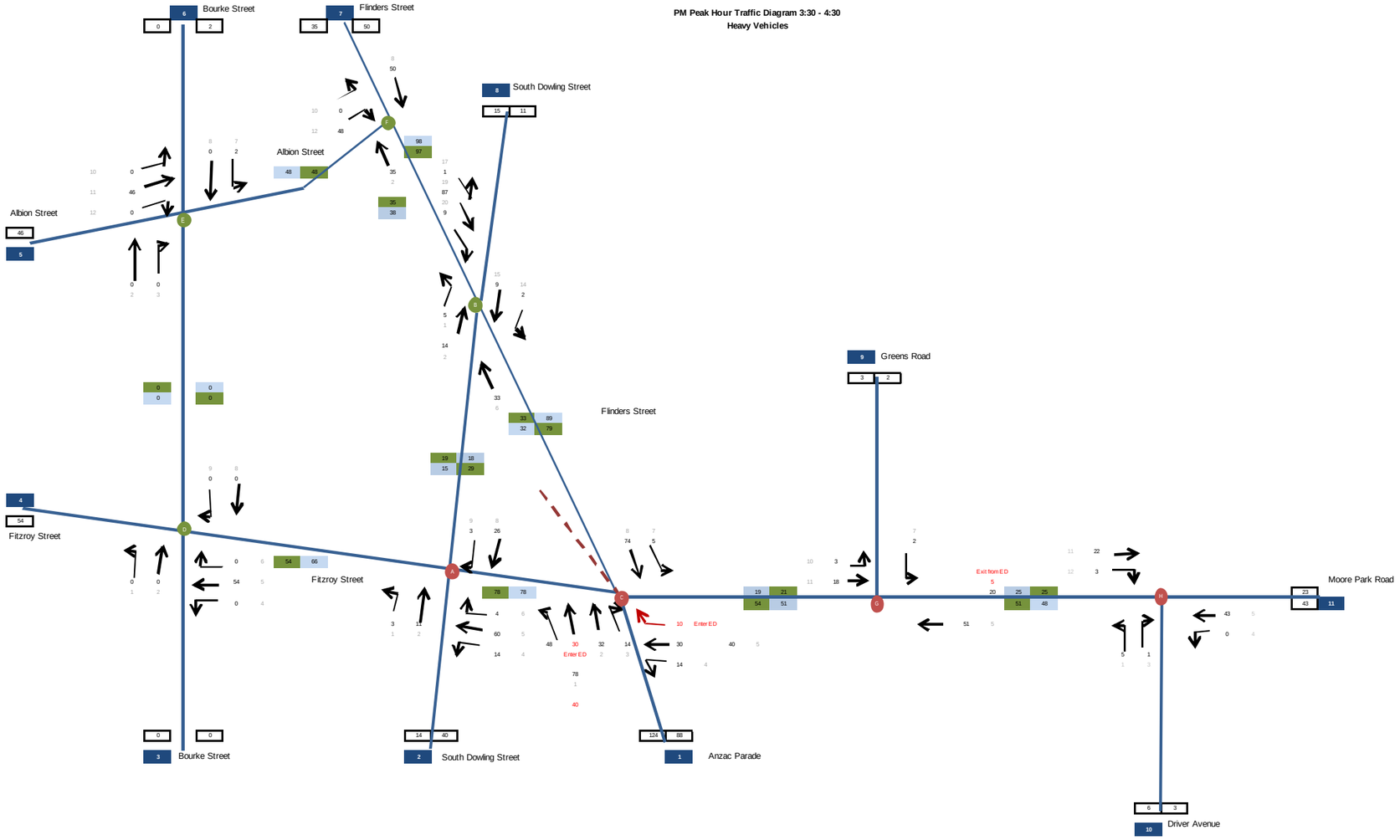
Light Vehicles



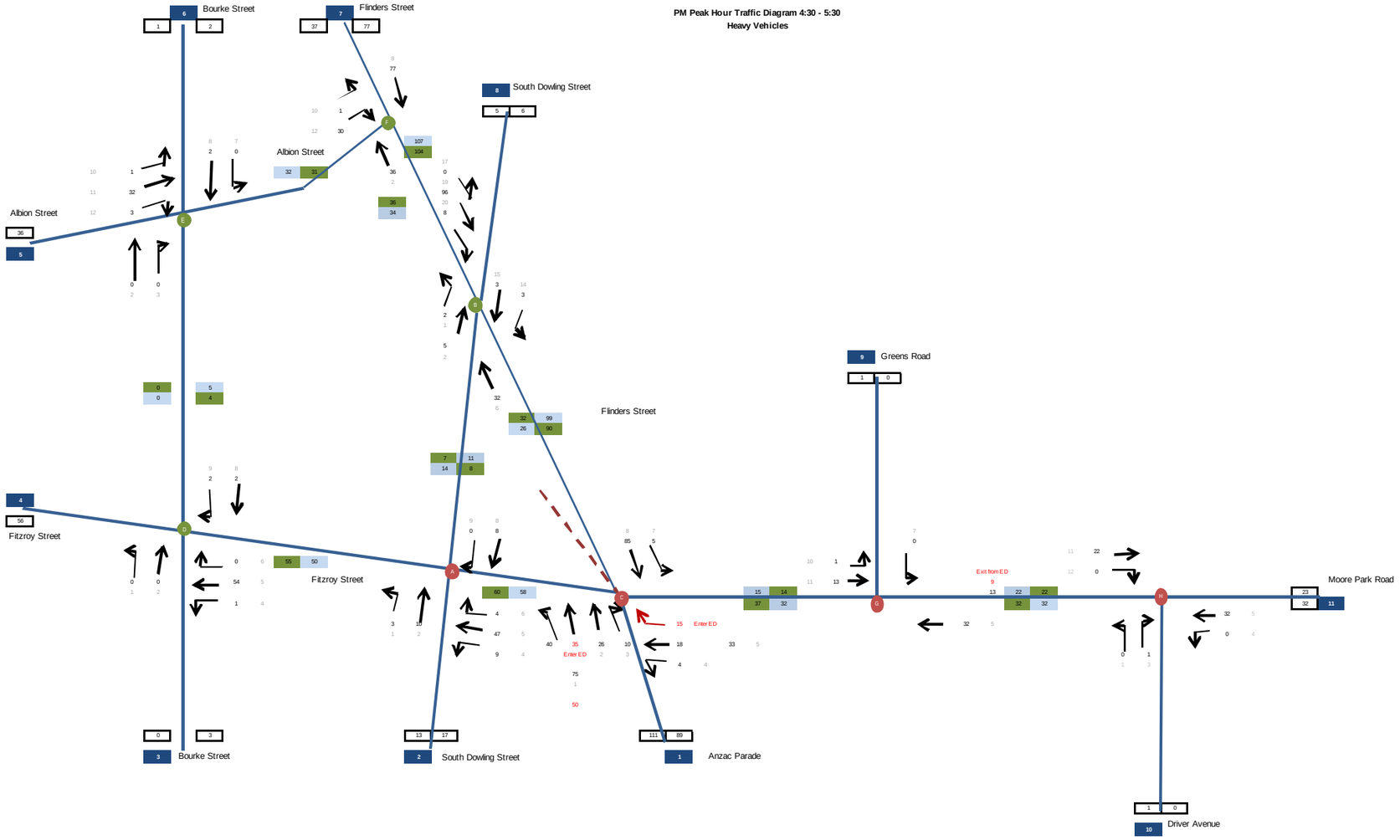
PM Peak Hour Traffic Diagram 5:30 - 6:30
Light Vehicles



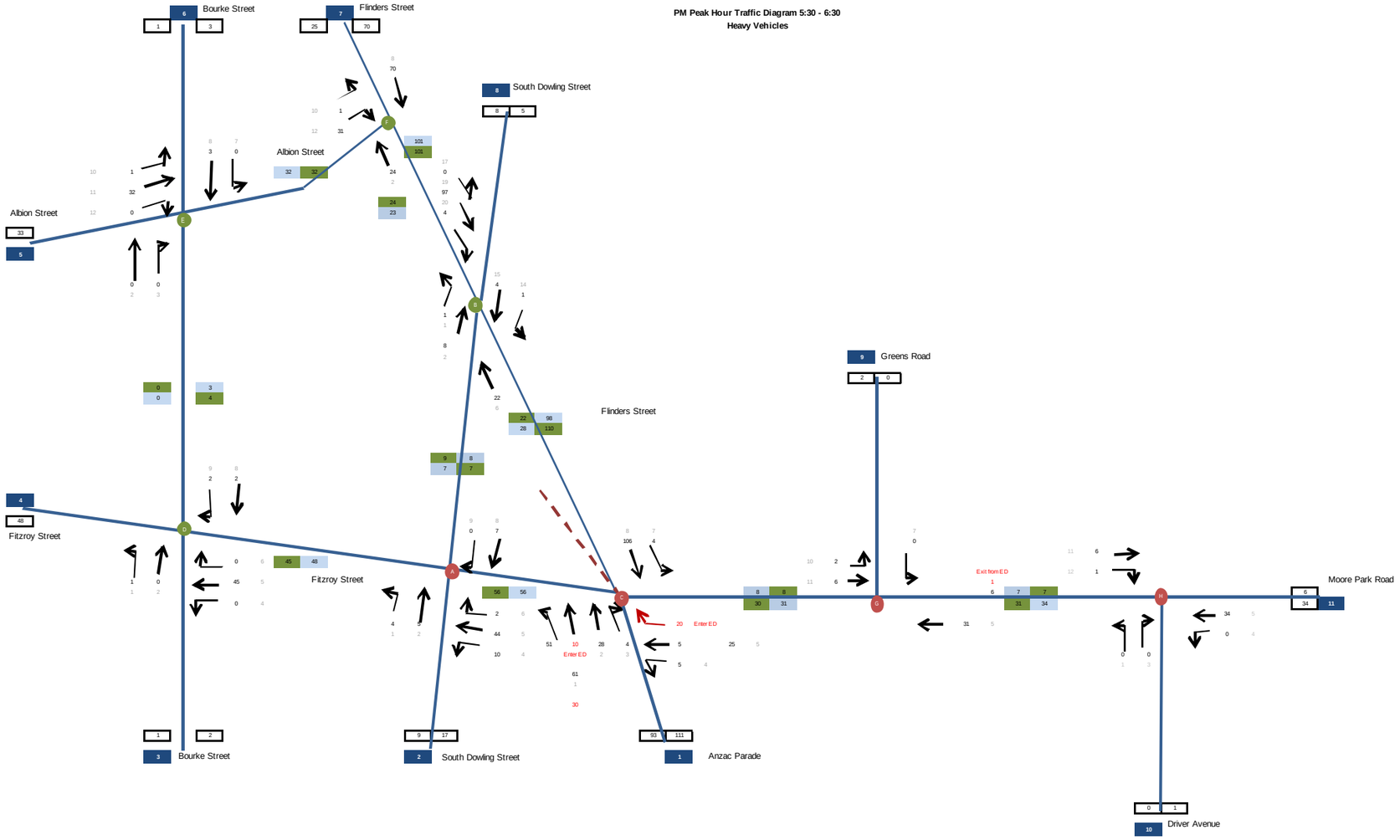
PM Peak Hour Traffic Diagram 3:30 - 4:30
Heavy Vehicles



PM Peak Hour Traffic Diagram 4:30 - 5:30
Heavy Vehicles

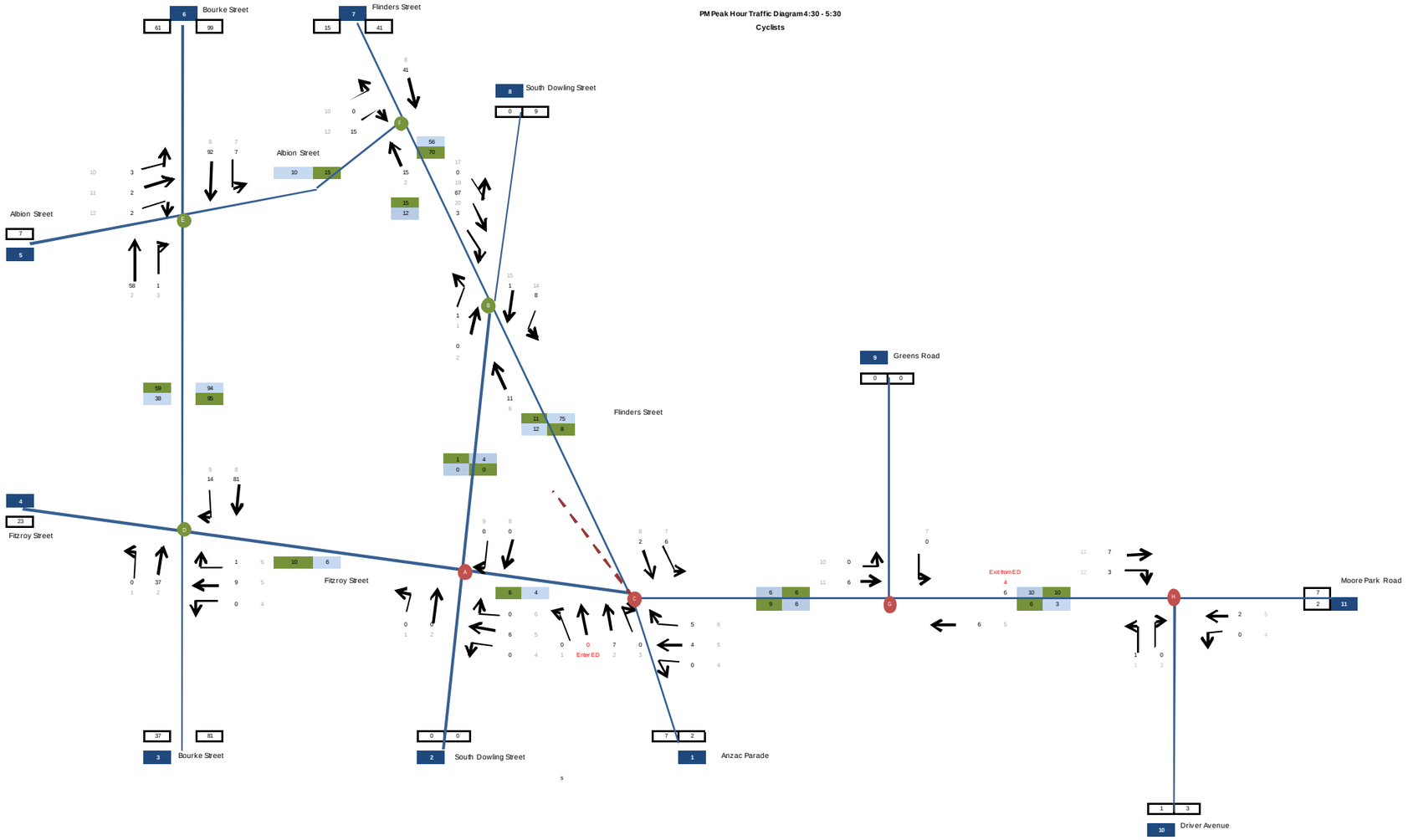


PM Peak Hour Traffic Diagram 5:30 - 6:30
Heavy Vehicles

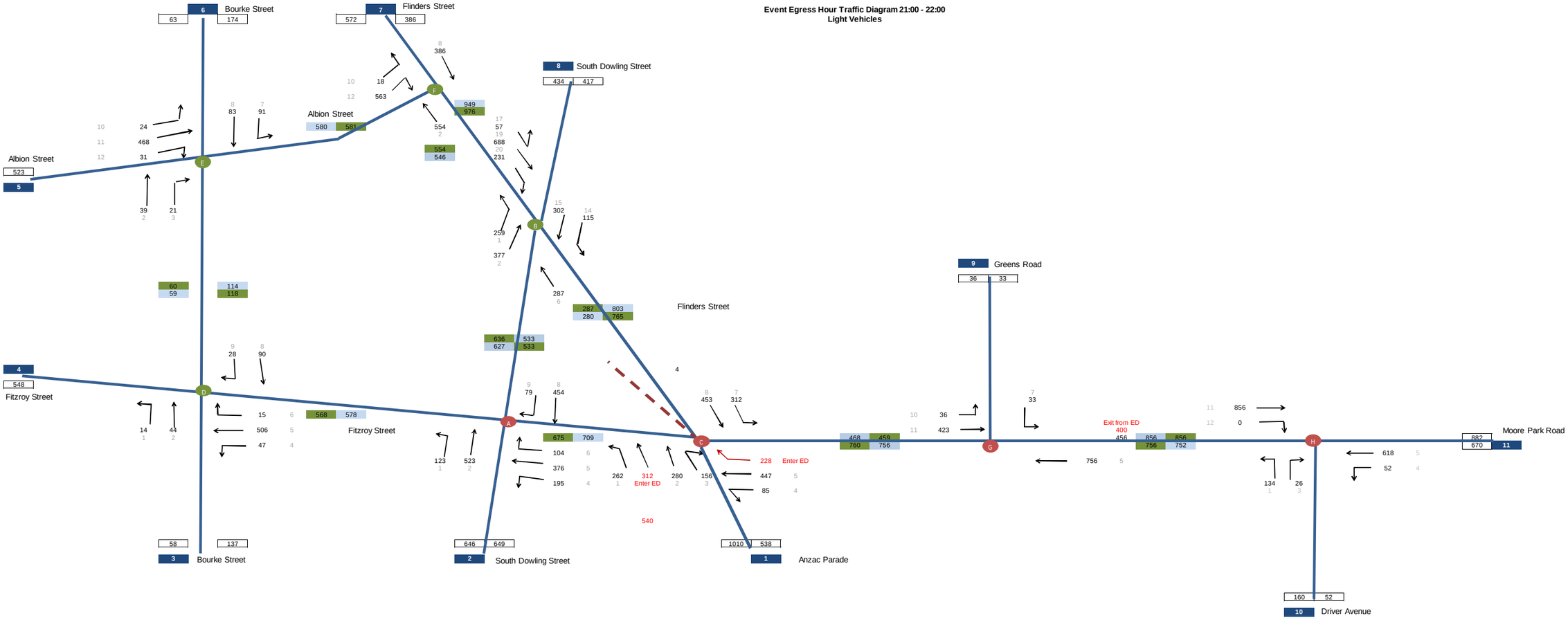


PM Peak Hour Traffic Diagram 4:30 - 5:30

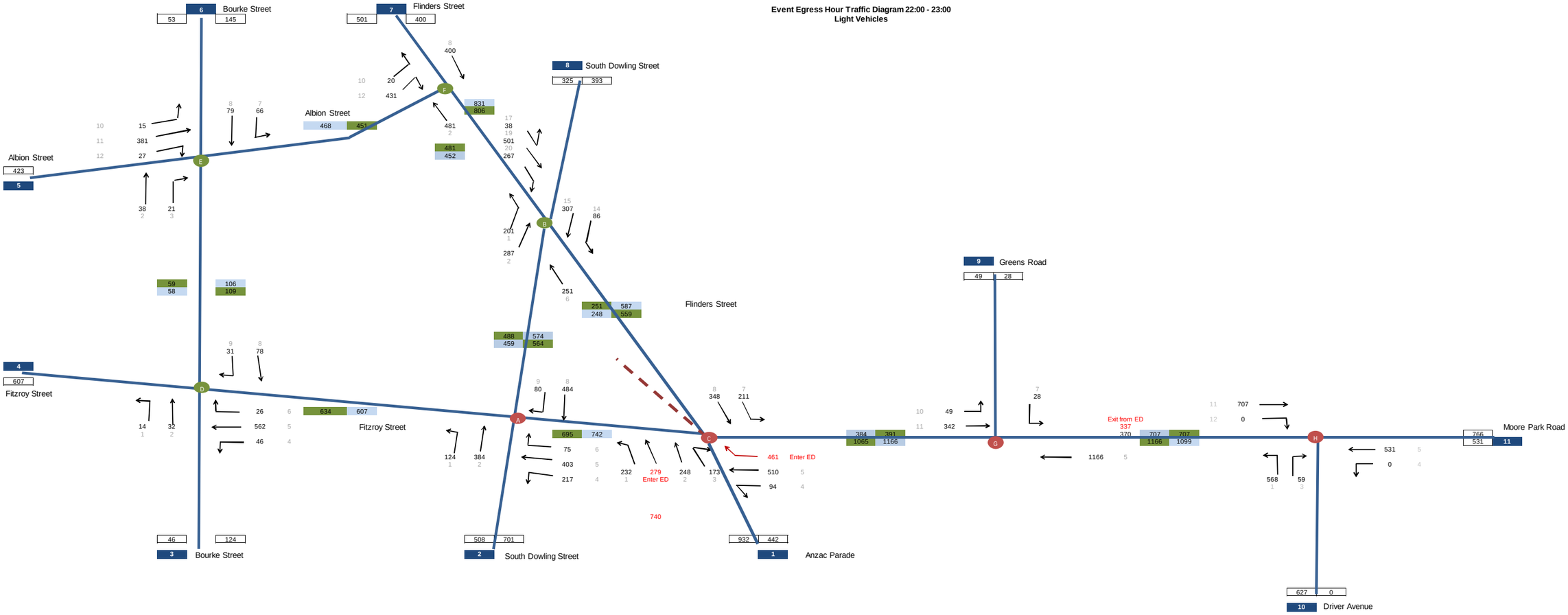
Cyclists



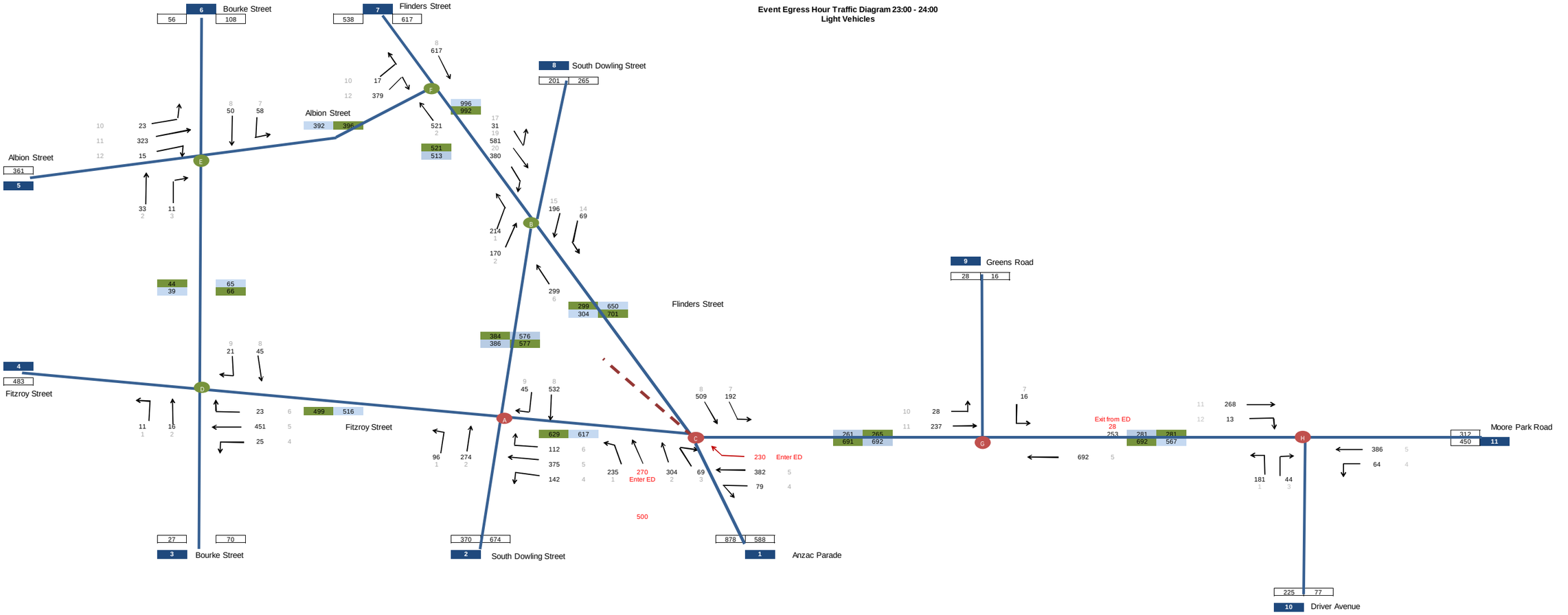
Event Egress Hour Traffic Diagram 21:00 - 22:00
Light Vehicles



Event Egress Hour Traffic Diagram 22:00 - 23:00
Light Vehicles

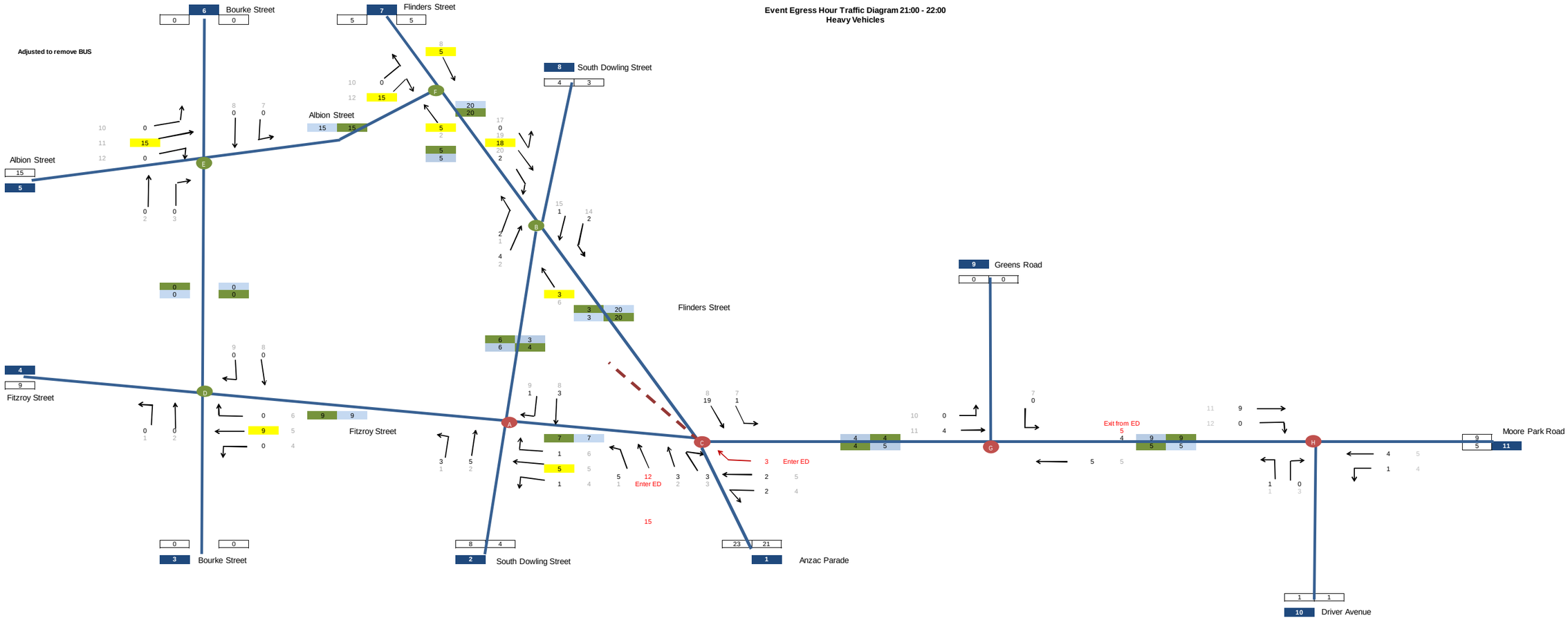


Event Egress Hour Traffic Diagram 23:00 - 24:00
Light Vehicles



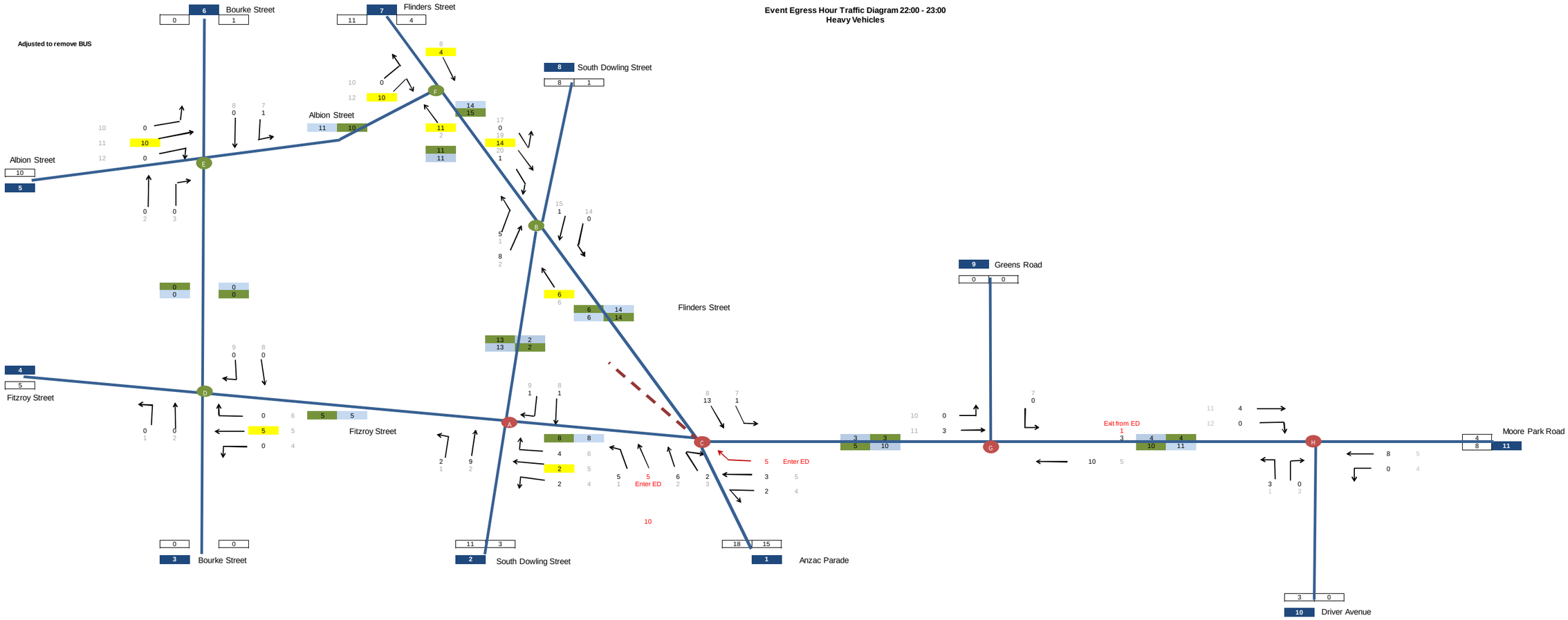
Event Egress Hour Traffic Diagram 21:00 - 22:00
Heavy Vehicles

Adjusted to remove BUS



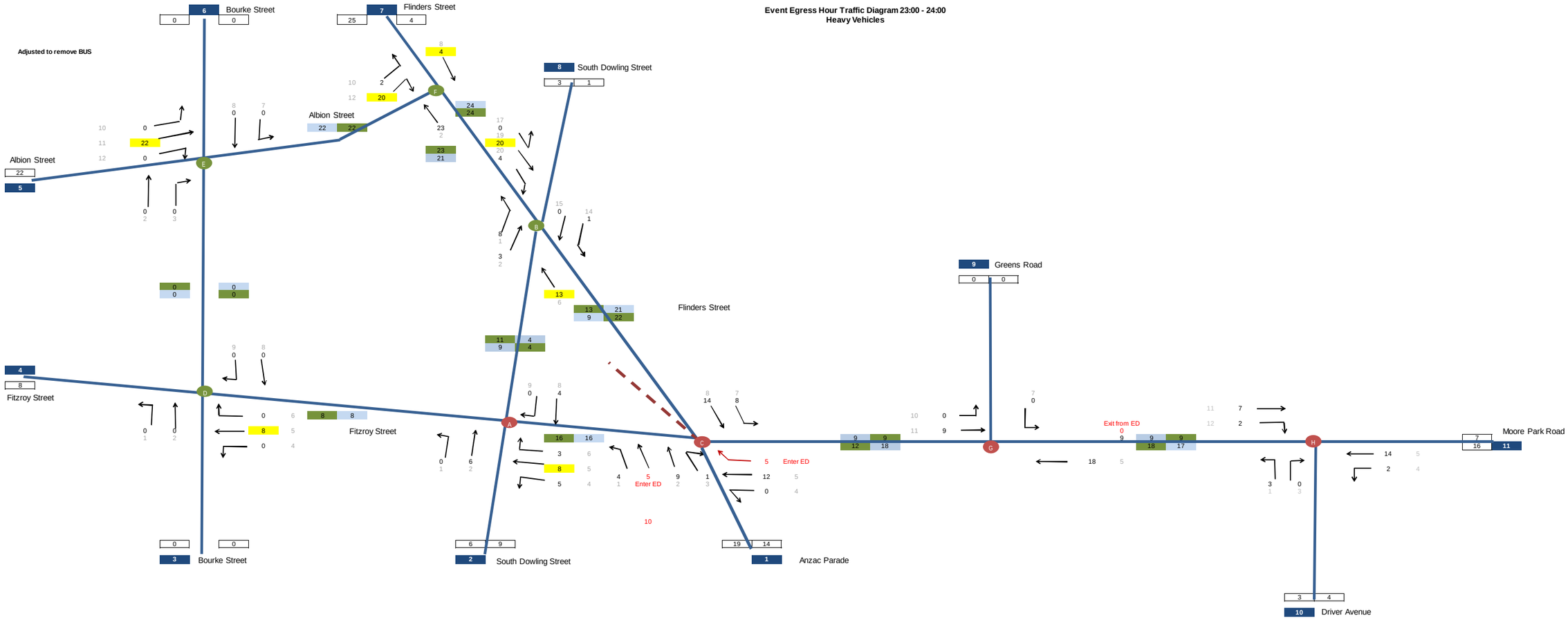
Event Egress Hour Traffic Diagram 22:00 - 23:00
Heavy Vehicles

Adjusted to remove BUS

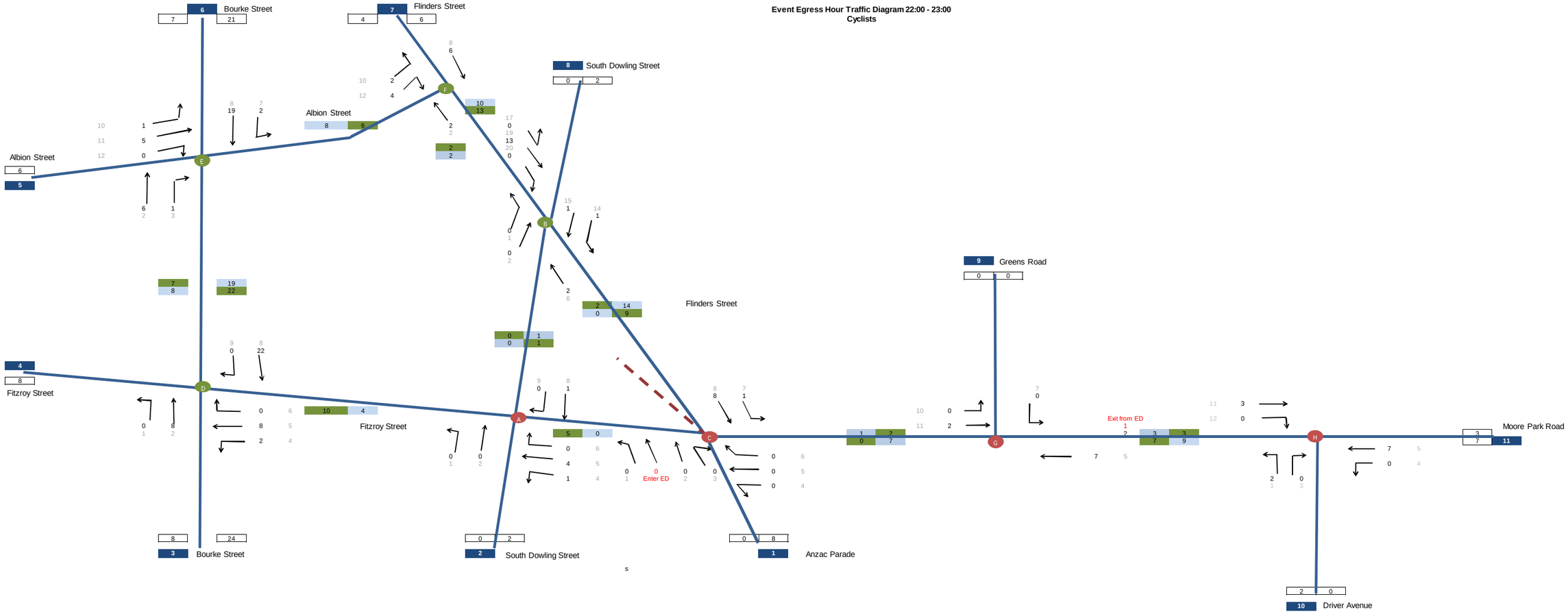


Event Egress Hour Traffic Diagram 23:00 - 24:00
Heavy Vehicles

Adjusted to remove BUS



Event Egress Hour Traffic Diagram 22:00 - 23:00
Cyclists



A2. Summary of SCATS signal phasing and timing

from	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
Phase A	16	15	18	17	19	18	23	20	23	22	21	24
Phase B	47	44	44	41	38	42	47	40	37	38	36	51
Phase C	1	4	3	6	6	5	5	7	9	7	6	7
Total	64	63	64	64	64	66	75	67	69	67	63	82

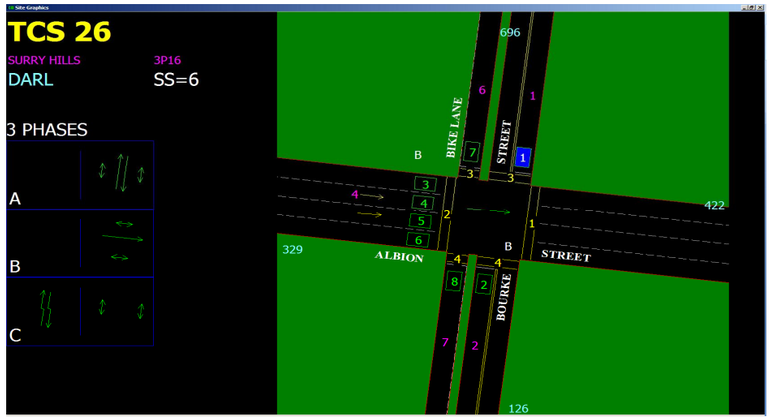
AM	6:30-7:30	7:30-8:30	8:30-9:30
Phase A	17	20	22
Phase B	44	42	40
Phase C	3	6	8
Total	64	68	70

AM	Normalised		Base Input
Phase A	20	35	34
Phase B	42	75	86
Phase C	6	10	
Total	67	120	120

from	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15
Phase A	26	22	21	22	20	20	19	19	20	18	17	20
Phase B	53	41	33	41	35	37	36	32	33	34	34	33
Phase C	5	3	3	5	5	4	4	8	6	9	6	8
Total	84	68	57	68	60	60	59	60	59	61	58	60

PM	15:30-16:30	16:30-17:30	17:30-18:30
Phase A	23	20	19
Phase B	42	35	34
Phase C	4	5	7
Total	69	60	60

PM	Normalised		Base Input
Phase A	20	39	49
Phase B	37	71	71
Phase C	5	10	
Total	63	120	120



from	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
Phase A	25	26	29	31	32	36	32	31	33	35	31	26
Phase B	35	32	40	37	40	40	43	50	50	44	45	42
Phase C	47	46	46	45	43	44	41	38	39	41	43	40
Total	107	104	115	113	115	120	116	118	121	120	119	107

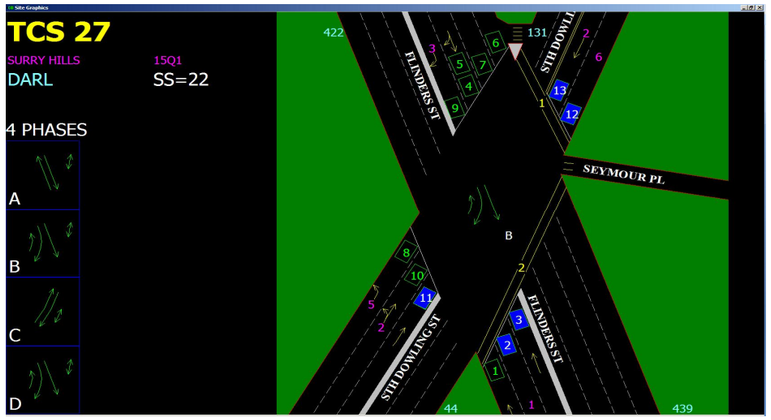
AM	6:30-7:30	7:30-8:30	8:30-9:30
Phase A	27	33	31
Phase B	36	43	45
Phase C	46	41	40
Total	110	117	117

AM	Normalised	Base Input
Phase A	30	32
Phase B	42	43
Phase C	43	45
Total	115	120

from	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15
Phase A	13	12	12	15	13	13	27	25	23	24	26	24
Phase B	15	17	17	12	17	17	27	25	26	28	21	25
Phase C	24	22	20	21	22	22	41	46	48	46	48	48
Phase D	9	8	12	13	12	11	22	22	23	23	22	23
Total	61	59	61	61	64	64	118	118	119	122	117	119

PM	15:30-16:30	16:30-17:30	17:30-18:30
Phase A	13	20	24
Phase B	15	21	25
Phase C	22	33	47
Phase D	10	17	23
Total	61	91	119
2X cycles	15:30-16:30	16:30-17:30	17:30-18:30
Phase A	26	26	24
Phase B	31	30	25
Phase C	44	44	47
Phase D	21	22	23
Total	121	123	119

PM	Normalised	Base Input
Phase A	25	25
Phase B	29	29
Phase C	45	45
Phase D	22	21
Total	121	120



from	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
Phase A	12	17	16	18	21	23	20	25	23	32	29	26
Phase B	49	44	48	56	89	94	85	85	90	84	83	73
Phase C	3	4	3	6	6	4	10	8	9	4	7	5
Total	64	65	66	80	115	120	115	118	122	120	119	104

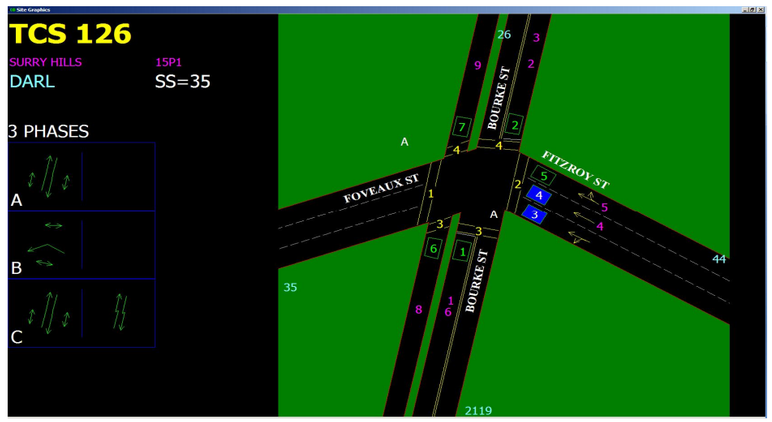
AM	6:30-7:30	7:30-8:30	8:30-9:30
Phase A	16	22	28
Phase B	49	88	83
Phase C	4	7	6
Total	69	117	116

AM	Normalised	Base Input
Phase A	25	22
Phase B	85	86
Phase C	7	12
Total	117	120

from	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15
Phase A	20	19	18	19	16	16	17	17	17	17	35	38
Phase B	38	39	35	37	40	36	31	37	38	37	76	72
Phase C	2	2	5	5	4	6	8	5	4	6	6	10
Total	60	60	59	60	60	58	55	60	59	61	117	120

PM	15:30-16:30	16:30-17:30	17:30-18:30
Phase A	19	16	27
Phase B	37	36	56
Phase C	4	6	6
Total	60	58	89

PM	Normalised	dual cycles Base Cycle 1 Input	Base Cycle 2 Input
Phase A	18	19	31
Phase B	37	35	35
Phase C	5	0	12
Total	59	54	66
		120	



from	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
Phase A	64	60	63	56	55	44	46	36	41	44	54	42
Phase B	6	9	9	13	13	18	15	18	19	19	13	16
Phase C	36	36	43	43	47	58	54	63	61	56	53	48
Total	106	105	115	112	114	120	115	117	121	120	121	106

AM	6:30-7:30	7:30-8:30	8:30-9:30
Phase A	61	45	46
Phase B	10	16	17
Phase C	39	55	54
Total	110	117	117

AM	Normalised	Base Input
Phase A	51	51
Phase B	14	17
Phase C	50	52
Total	114	120

from	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15
Phase A	58	60	59	60	59	56	53	55	47	57	50	46
Phase B	18	16	18	16	18	19	16	18	20	21	16	22
Phase C	44	44	43	44	43	44	39	47	51	46	50	53
Total	120	120	120	120	120	120	109	120	118	123	117	120

PM	15:30-16:30	16:30-17:30	17:30-18:30
Phase A	59	56	50
Phase B	17	18	20
Phase C	44	43	50
Total	120	117	120

PM	Normalised	Base Input
Phase A	55	56
Phase B	18	18
Phase C	46	46
Total	119	120

from	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
Phase A	101	87	87	87	85	92	92	90	92	94	100	85
Phase B	9	14	28	24	28	28	25	28	28	28	19	26
Total	110	101	115	111	113	120	117	118	120	122	119	111

AM	6:30-7:30	7:30-8:30	8:30-9:30
Phase A	91	90	93
Phase B	19	27	25
Total	109	117	118

AM	Normalised	Base Input
Phase A	91	95
Phase B	24	25
Total	115	120

from	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15
Phase A	102	111	91	98	96	83	77	93	97	92	97	89
Phase B	18	12	21	28	24	28	29	28	21	21	24	25
Total	120	123	112	126	120	111	106	121	118	113	121	114

PM	15:30-16:30	16:30-17:30	17:30-18:30
Phase A	100	87	94
Phase B	20	27	23
Total	120	115	117

PM	Normalised	Base Input
Phase A	94	97
Phase B	23	23
Total	117	120

from	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
Phase A	83	76	80	80	84	87	80	84	80	75	83	84
Phase B	25	31	30	28	32	32	39	36	40	44	38	31
Total	108	107	110	108	116	119	119	120	120	119	121	115

AM	6:30-7:30	7:30-8:30	8:30-9:30
Phase A			81
Phase B			38
Total			119

AM	Normalised	Base Input
Phase A	81	82
Phase B	38	38
Total	119	120

from	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15
Phase A	96	98	90	89	70	93	95	96	95	95	95	97
Phase B	24	25	22	28	48	30	24	24	24	24	24	24
Total	120	123	112	117	118	123	119	120	119	119	119	121

PM	15:30-16:30	16:30-17:30	17:30-18:30
Phase A	93	89	96
Phase B	25	31	24
Total	118	120	120

PM	Normalised	Base Input
Phase A	92	85
Phase B	27	35
Total	119	120

from	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
Phase A	62	39	35	33	33	31	36	37	40	36	42	46
Phase B	5	23	31	27	29	31	28	18	20	25	24	19
Phase C	34	32	38	42	41	42	40	45	44	41	37	38
Phase D	5	8	10	11	11	16	12	19	15	19	15	4
Total	105	102	114	113	114	120	115	119	119	120	119	108

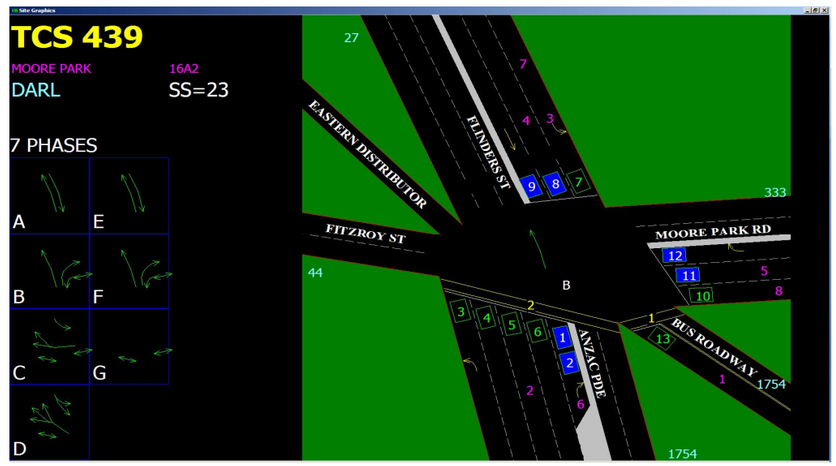
AM	6:30-7:30	7:30-8:30	8:30-9:30
Phase A	42	34	41
Phase B	22	26	22
Phase C	36	42	40
Phase D	9	14	14
Total	109	117	117

AM	Normalised	Base Input
Phase A	39	39
Phase B	23	25
Phase C	39	42
Phase D	12	14
Total	114	120

from	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15
Phase A	48	47	48	53	48	41	46	44	41	50	49	49
Phase B	25	26	26	22	25	27	26	24	25	21	23	23
Phase C	38	37	40	37	36	34	31	37	44	38	40	41
Phase D	8	10	7	8	11	11	8	14	8	8	7	7
Total	120	120	120	120	120	114	111	120	118	119	120	120

PM	15:30-16:30	16:30-17:30	17:30-18:30
Phase A	49	45	47
Phase B	25	26	23
Phase C	38	35	41
Phase D	8	11	8
Total	120	116	119

PM	Normalised	Base Input
Phase A	47	47
Phase B	24	23
Phase C	38	38
Phase D	9	12
Total	119	120



from	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
Phase A	56	57	55	61	65	67	70	73	81	63	90	72
Phase B	13	14	13	11	13	14	16	17	20	16	20	17
Phase C	5	5	8	9	8	8	10	9	11	11	8	10
Total	74	75	76	81	85	89	96	99	112	90	119	99

AM	6:30-7:30	7:30-8:30	8:30-9:30
Phase A	57	69	77
Phase B	13	15	18
Phase C	7	9	10
Total	77	92	105

AM	Normalised	Base Input
Phase A	67	65
Phase B	15	13
Phase C	8	12
Total	91	90

from	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15
Phase A	86	87	97	97	95	90	85	96	77	54	72	68
Phase B	14	13	12	12	13	13	16	15	15	11	14	12
Phase C	9	11	11	11	11	9	11	11	10	11	12	11
Total	109	112	120	120	119	112	112	121	102	75	97	90

PM	15:30-16:30	16:30-17:30	17:30-18:30
Phase A	92	91	67
Phase B	13	14	13
Phase C	10	10	11
Total	115	116	91

PM	Normalised	Base Input
Phase A	84	84
Phase B	13	14
Phase C	11	12
Total	107	110

A3. Summary of modelled bus routes

Appendix B

Model calibration and validation

B1. Model stability results

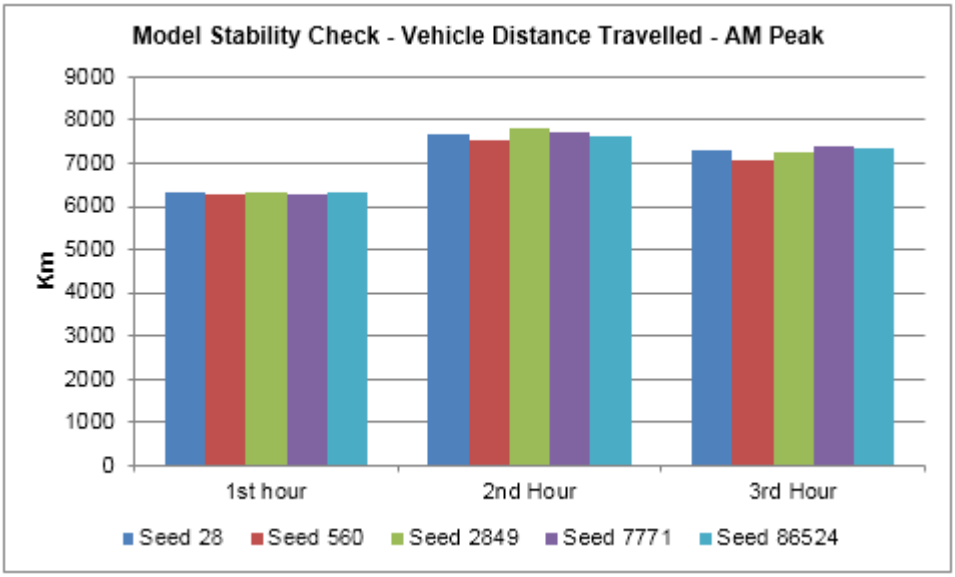


Figure B1.1 AM base model stability check – VKT

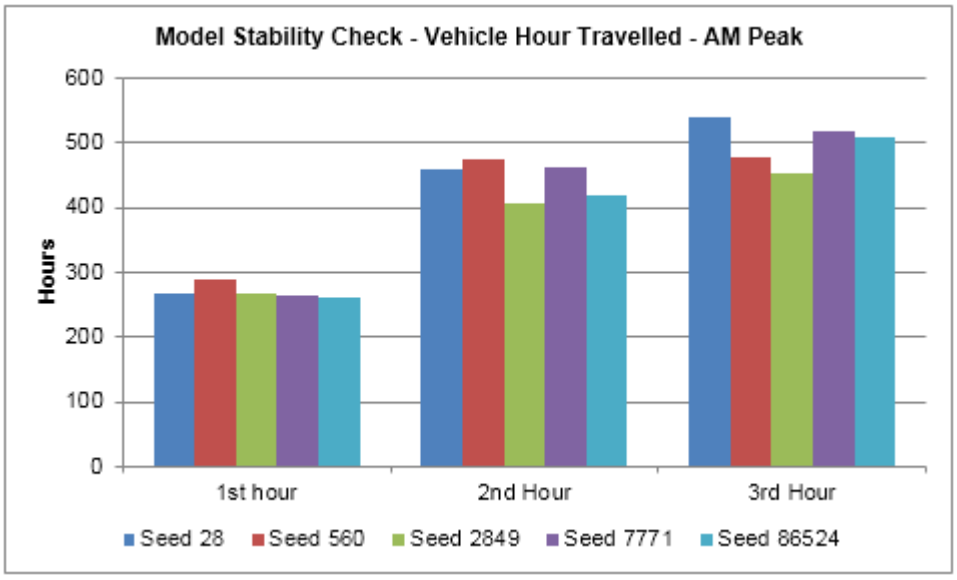


Figure B1.2 AM base model stability check – VHT

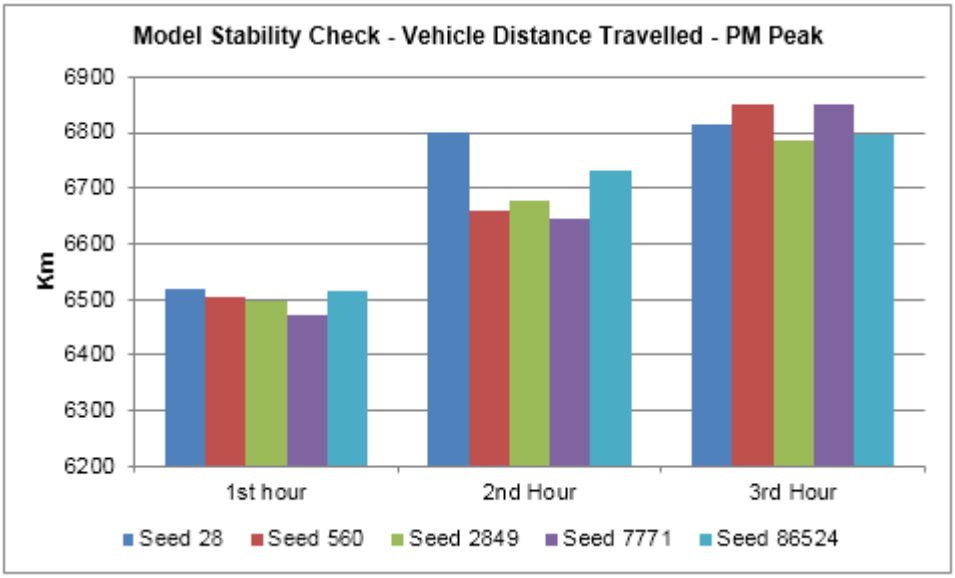


Figure B1.3 PM base model stability check – VKT

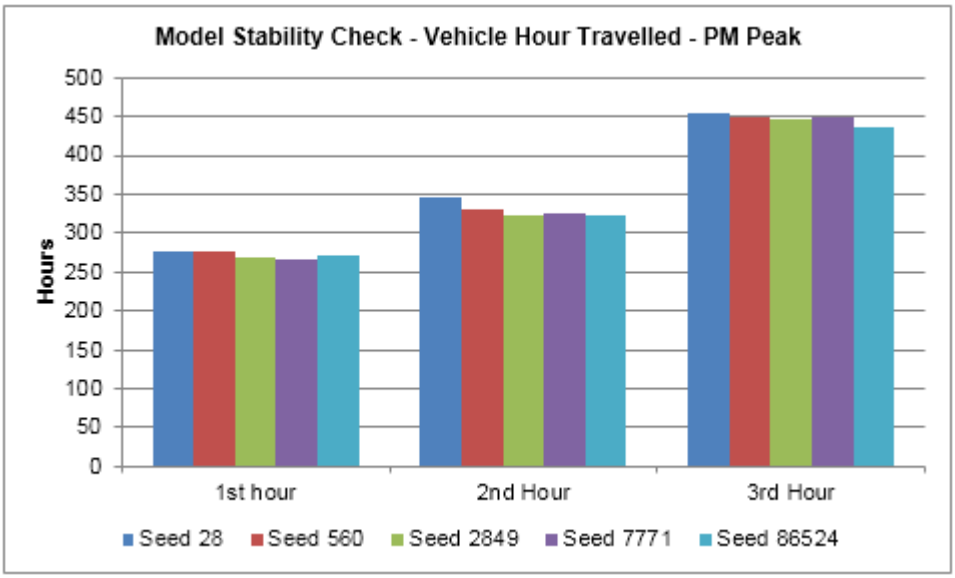


Figure B1.4 PM base model stability check – VHT

Light vehicles and heavy vehicles

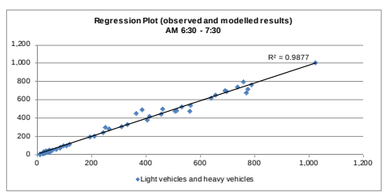
					1 6:30 - 7:30	1 6:30 - 7:30	1 6:30 - 7:30	2 7:30 - 8:30	2 7:30 - 8:30	2 7:30 - 8:30	3 8:30 - 9:30	3 8:30 - 9:30	3 8:30 - 9:30
Data point (grouped)	Intersection	Approach	Direction	Movement	Observed	Modelled	GEH	Observed	Modelled	GEH	Observed	Modelled	GEH
1	Moore Park Road	Driver Avenue	Moore Park Road	westbound	through	1,025	1,011	0.4	1,341	1,321	0.5	1,116	1,211	2.8
3	Moore Park Road	Driver Avenue	Moore Park Road	westbound	left turn	82	80	0.2	100	91	1.0	136	144	0.7
4	Moore Park Road	Driver Avenue	Driver Avenue	northbound	right turn	57	54	0.4	64	65	0.1	56	52	0.5
5	Moore Park Road	Driver Avenue	Driver Avenue	northbound	left turn	43	46	0.4	63	62	0.2	68	71	0.4
6	Moore Park Road	Driver Avenue	Moore Park Road	eastbound	right turn	97	103	0.6	176	169	0.5	284	267	1.0
8	Moore Park Road	Greens Road	Moore Park Road	westbound	through	736	739	0.1	833	914	2.8	773	826	1.9
9	Moore Park Road	Greens Road	Moore Park Road	westbound	through to ED	310	312	0.1	490	452	1.8	420	470	2.4
11	Moore Park Road	Greens Road	Moore Park Road	eastbound	through	565	539	1.1	586	531	2.3	623	472	6.4
12	Moore Park Road	Greens Road	Moore Park Road	eastbound	left turn	87	83	0.5	94	98	0.4	114	105	0.9
13	Moore Park Road	Greens Road	Greens Road	southbound	left turn	24	24	0.0	29	29	0.0	31	31	0.0
14	Eastern Distributor		Exit to Moore Park Road	eastbound	through	531	529	0.1	442	442	0.0	682	683	0.0
15	Moore Park Road	Flinders Street	Moore Park Road	westbound	left turn	40	41	0.2	32	30	0.4	48	53	0.6
16	Moore Park Road	Flinders Street	Moore Park Road	westbound	through	696	693	0.1	801	877	2.6	725	778	1.9
18	Moore Park Road	Flinders Street	Anzac Parade	northbound	right turn	404	383	1.1	293	296	0.2	314	279	2.0
19	Moore Park Road	Flinders Street	Anzac Parade	northbound	through	508	475	1.5	637	609	1.1	548	495	2.3
22	Moore Park Road	Flinders Street	Anzac Parade	northbound	through to ED	640	623	0.7	790	769	0.7	600	555	1.9
23	Moore Park Road	Flinders Street	Anzac Parade	northbound	left turn	512	490	1.0	698	616	3.2	732	664	2.6
24	Moore Park Road	Flinders Street	Flinders Street	southbound	left turn	251	301	3.0	384	415	1.5	414	422	0.4
26	Moore Park Road	Flinders Street	Flinders Street	southbound	through	386	497	5.3	616	682	2.6	626	654	1.1
28	South Dowling Street	Fitzroy Street	Fitzroy Street	westbound	left turn	264	282	1.1	216	219	0.2	217	210	0.5
29	South Dowling Street	Fitzroy Street	Fitzroy Street	westbound	through	657	654	0.1	1,081	1,087	0.2	1,032	1,034	0.1
32	South Dowling Street	Fitzroy Street	Fitzroy Street	westbound	right turn	244	243	0.1	184	187	0.2	202	199	0.2
33	South Dowling Street	Fitzroy Street	South Dowling Street	northbound	through	788	770	0.6	649	783	5.0	680	667	0.5
35	South Dowling Street	Fitzroy Street	South Dowling Street	northbound	left turn	107	103	0.4	143	140	0.2	140	154	1.1
36	South Dowling Street	Fitzroy Street	South Dowling Street	southbound	right turn	45	54	1.3	110	122	1.1	141	141	0.0
37	South Dowling Street	Fitzroy Street	South Dowling Street	southbound	through	363	458	4.7	458	522	2.9	451	506	2.5
39	South Dowling Street	Flinders Street	Flinders Street	westbound	through	561	474	3.8	661	606	2.2	578	496	3.5
42	South Dowling Street	Flinders Street	South Dowling Street	northbound	through	759	801	1.5	643	722	3.0	564	608	1.8
44	South Dowling Street	Flinders Street	South Dowling Street	northbound	left turn	210	209	0.1	225	245	1.3	218	254	2.4
46	South Dowling Street	Flinders Street	Flinders Street	eastbound	right turn	194	194	0.0	187	214	1.9	191	206	1.1
48	South Dowling Street	Flinders Street	Flinders Street	eastbound	through	691	701	0.4	805	920	3.9	878	894	0.5
86	South Dowling Street	Flinders Street	Flinders Street	eastbound	left turn	48	49	0.1	55	60	0.6	72	79	0.8
51	South Dowling Street	Flinders Street	South Dowling Street	southbound	through	333	331	0.1	433	431	0.1	449	442	0.3
53	South Dowling Street	Flinders Street	South Dowling Street	southbound	left turn	118	119	0.1	185	186	0.0	173	180	0.5
54	Flinders Street	Albion Street	Flinders Street	southbound	through	455	448	0.3	424	424	0.0	385	386	0.1
58	Flinders Street	Albion Street	Albion Street	eastbound	right turn	462	503	1.8	652	781	4.8	726	793	2.4
61	Flinders Street	Albion Street	Albion Street	eastbound	left turn	9	6	1.2	9	10	0.4	12	12	0.1
82	Flinders Street	Albion Street	Flinders Street	northbound	through	770	681	3.3	894	851	1.5	781	752	1.0
62	Bourke Street	Albion Street	Bourke Street	southbound	left turn	34	35	0.1	66	67	0.1	94	94	0.0
63	Bourke Street	Albion Street	Bourke Street	southbound	through	41	39	0.3	125	120	0.4	152	151	0.0
64	Bourke Street	Albion Street	Bourke Street	northbound	right turn	33	46	2.1	36	36	0.1	30	34	0.7
65	Bourke Street	Albion Street	Bourke Street	northbound	through	24	29	0.9	67	62	0.6	71	77	0.7
67	Bourke Street	Albion Street	Albion Street	eastbound	right turn	20	15	1.2	36	47	1.8	45	48	0.4
68	Bourke Street	Albion Street	Albion Street	eastbound	through	414	421	0.3	577	677	4.0	666	666	0.0
72	Bourke Street	Albion Street	Albion Street	eastbound	left turn	30	24	1.1	45	47	0.3	49	47	0.3
73	Bourke Street	Fitzroy Street	Fitzroy Street	westbound	left turn	70	64	0.7	91	100	0.9	135	134	0.1
74	Bourke Street	Fitzroy Street	Fitzroy Street	westbound	through	774	715	2.2	1,158	1,196	1.1	1,120	1,157	1.1
77	Bourke Street	Fitzroy Street	Fitzroy Street	westbound	right turn	23	33	2.0	41	52	1.7	46	54	1.1
78	Bourke Street	Fitzroy Street	Bourke Street	northbound	through	44	45	0.1	48	45	0.4	58	58	0.0
79	Bourke Street	Fitzroy Street	Bourke Street	northbound	left turn	10	9	0.2	13	14	0.4	15	17	0.4
83	Bourke Street	Fitzroy Street	Bourke Street	southbound	right turn	23	23	0.0	46	45	0.1	47	49	0.3
84	Bourke Street	Fitzroy Street	Bourke Street	southbound	through	46	31	2.3	120	119	0.1	141	147	0.5

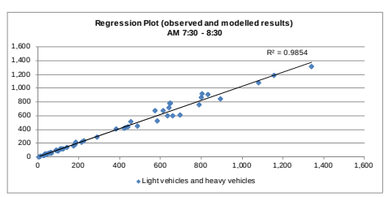
	1 6:30 - 7:30	1 6:30 - 7:30	1 6:30 - 7:30	1 6:30 - 7:30	1 6:30 - 7:30	1 6:30 - 7:30	2 7:30 - 8:30	2 7:30 - 8:30	2 7:30 - 8:30	2 7:30 - 8:30	2 7:30 - 8:30	2 7:30 - 8:30	3 8:30 - 9:30	3 8:30 - 9:30	3 8:30 - 9:30	3 8:30 - 9:30	3 8:30 - 9:30	3 8:30 - 9:30
	Observed LV	Modelled LV	GEH	Observed HV	Modelled HV	GEH	Observed LV	Modelled LV	GEH	Observed HV	Modelled HV	GEH	Observed LV	Modelled LV	GEH	Observed HV	Modelled HV	GEH
	985	970	0.5	40	42	0.3	1,303	1,282	0.6	38	39	0.2	1,068	1,157	2.7	48	54	0.8
	79	80	0.1	3	0	2.4	97	91	0.7	3	0	2.4	133	144	1.0	3	0	2.4
	52	52	0.0	5	2	1.6	64	63	0.2	0	2	1.9	55	51	0.5	1	1	0.4
	43	43	0.0	0	3	2.4	58	58	0.1	5	3	0.9	66	70	0.5	2	2	0.3
	96	103	0.7	1	0	1.4	174	169	0.4	2	0	2.0	282	267	0.9	2	0	2.0
	708	708	0.0	28	31	0.6	816	892	2.6	17	22	1.2	743	789	1.7	30	37	1.2
	300	301	0.1	10	11	0.2	470	436	1.6	20	16	0.9	400	453	2.6	20	18	0.6
	524	489	1.5	41	49	1.2	545	489	2.5	41	42	0.2	582	438	6.4	41	34	1.1
	84	83	0.1	3	0	2.4	90	98	0.8	4	0	2.8	110	105	0.5	4	0	2.8
	24	24	0.0	0	0	0.0	28	28	0.0	1	1	0.0	30	30	0.0	1	1	0.0
	516	514	0.1	15	15	0.0	425	426	0.0	17	17	0.1	645	645	0.0	37	37	0.1
	33	34	0.1	7	7	0.1	26	25	0.2	6	5	0.4	38	40	0.4	10	12	0.7
	675	669	0.2	21	24	0.6	790	860	2.4	11	17	1.5	705	754	1.8	20	24	0.9
-53	367	346	1.1	37	37	0.0	258	262	0.3	35	34	0.2	285	259	1.6	29	20	1.9
-114	474	447	1.3	34	28	1.0	600	573	1.1	37	36	0.2	484	449	1.6	64	46	2.5
-82	620	607	0.5	20	17	0.8	740	716	0.9	50	53	0.4	560	524	1.5	40	31	1.5
-173	492	467	1.1	20	23	0.6	646	571	3.0	52	45	1.0	661	606	2.2	71	58	1.6
	244	289	2.7	7	13	1.8	374	406	1.6	10	8	0.5	399	408	0.5	15	14	0.2
	359	460	5.0	27	37	1.8	539	599	2.5	77	84	0.8	497	527	1.3	129	127	0.2
	249	266	1.1	15	16	0.4	201	203	0.1	15	16	0.2	192	186	0.4	25	23	0.3
	629	626	0.1	28	29	0.2	1,041	1,043	0.1	40	43	0.5	974	982	0.2	58	52	0.8
	243	242	0.1	1	1	0.0	181	185	0.3	3	2	0.4	196	192	0.3	6	7	0.2
	751	732	0.7	37	38	0.1	621	755	5.1	28	27	0.1	646	634	0.5	34	32	0.3
	99	96	0.3	8	7	0.5	133	130	0.2	10	10	0.0	129	140	1.0	11	13	0.6
	40	46	0.9	5	8	1.1	107	117	0.9	3	5	1.1	134	135	0.1	7	6	0.3
	351	443	4.6	12	14	0.7	444	503	2.7	14	19	1.2	421	469	2.3	30	37	1.2
	527	446	3.7	34	28	1.0	619	570	2.0	42	36	1.0	516	451	3.0	62	45	2.3
	735	781	1.7	24	20	0.9	623	697	2.9	20	25	1.1	533	581	2.0	31	27	0.7
	189	190	0.1	21	19	0.5	220	241	1.4	5	4	0.3	207	243	2.4	11	12	0.2
	185	183	0.1	9	11	0.6	177	203	1.9	10	11	0.3	167	184	1.3	24	23	0.3
	651	662	0.4	40	39	0.1	722	836	4.1	83	85	0.2	738	763	0.9	140	131	0.8
	45	44	0.1	3	5	0.8	52	57	0.7	3	3	0.1	69	72	0.4	3	7	1.6
	318	319	0.1	15	12	0.8	420	418	0.1	13	13	0.1	424	422	0.1	25	20	1.0
	108	106	0.2	10	13	0.8	176	177	0.1	9	9	0.1	164	166	0.2	9	14	1.4
	428	421	0.4	27	27	0.0	385	385	0.0	39	39	0.1	328	329	0.1	57	57	0.1
	440	474	1.6	22	28	1.3	594	720	4.9	58	61	0.3	622	687	2.5	104	106	0.2
	8	6	0.8	1	0	1.4	8	10	0.7	1	0	1.4	11	12	0.4	1	0	1.4
	713	634	3.1	57	47	1.4	843	810	1.1	51	40	1.6	715	696	0.7	66	56	1.2
	29	28	0.1	5	6	0.6	60	61	0.2	6	6	0.2	92	91	0.1	2	2	0.3
	37	37	0.0	4	3	0.8	118	113	0.5	7	7	0.1	147	147	0.0	5	4	0.4
	30	41	1.9	3	5	1.1	35	35	0.1	1	0	1.0	30	34	0.7	0	0	0.0
	22	27	1.0	2	2	0.3	66	62	0.5	1	0	1.0	69	75	0.7	2	2	0.3
	20	15	1.2	0	0	0.0	34	46	1.8	2	2	0.1	40	43	0.4	5	5	0.1
	398	404	0.3	16	17	0.2	523	622	4.1	54	55	0.1	562	562	0.0	104	104	0.0
	24	19	1.0	6	5	0.4	40	43	0.5	5	4	0.6	48	46	0.4	1	1	0.4
	67	62	0.7	3	3	0.1	82	91	1.0	9	9	0.0	130	129	0.1	5	5	0.2
	740	678	2.3	34	37	0.5	1,102	1,146	1.3	56	50	0.9	1,061	1,092	0.9	59	65	0.8
	21	30	1.9	2	3	0.6	41	52	1.7	0	0	0.0	45	53	1.1	1	1	0.2
	40	41	0.1	4	4	0.1	47	45	0.4	1	0	0.7	57	57	0.0	1	1	0.0
	7	6	0.3	3	3	0.1	11	12	0.2	2	3	0.4	14	16	0.4	1	1	0.0
	22	22	0.1	1	1	0.4	45	44	0.2	1	1	0.4	45	47	0.3	2	2	0.1
	40	29	1.8	6	2	2.0	113	112	0.1	7	8	0.3	134	140	0.5	7	6	0.2

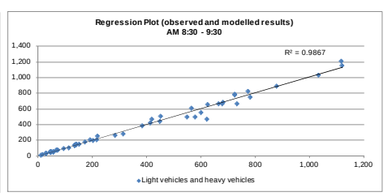
	6:30 - 7:30	7:30 - 8:30	8:30 - 9:30
Total	52	52	52
GEH<5	51	51	51
GEH<10	52	52	52
	98%	98%	98%

98%
100%

	Intersection	0-3600 Average Delay (AM)	3600-7200 Average Delay (AM)	7200-10800 Average Delay (AM)
8	Moore Park Road and Drivers Avenue	8	41	28
1	Moore Park Road and Greens Road	11	32	23
2	Moore Park Road, Anzac Parade and Flinders Street	39	52	51
3	Fitzroy Street and South Dowling Street	24	26	26
4	Flinders Street and South Dowling Street	25	29	30
5	Flinders Street and Albion Street	15	18	21
6	Albion Street and Bourke Street	20	27	28
7	Fitzroy Street and Bourke Street	20	27	29





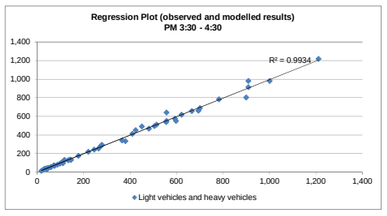


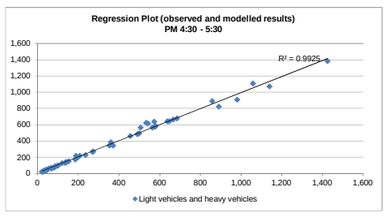
Light vehicles and heavy vehicles					1	1	1	2	2	2	3	3	3
					15:30 - 16:30	15:30 - 16:30	15:30 - 16:30	16:30 - 17:30	16:30 - 17:30	16:30 - 17:30	17:30 - 18:30	17:30 - 18:30	17:30 - 18:30
Data point (grouped)	Intersection	Approach	Direction	Movement	Observed	Modelled	GEH	Observed	Modelled	GEH	Observed	Modelled	GEH
1	Moore Park Road | Driver Avenue	Moore Park Road	westbound	through	1,001	985	0.5	859	891	1.1	768	767	0.0
3	Moore Park Road | Driver Avenue	Moore Park Road	westbound	left turn	98	95	0.3	101	104	0.3	136	140	0.4
4	Moore Park Road | Driver Avenue	Driver Avenue	northbound	right turn	72	74	0.2	79	74	0.6	88	87	0.1
5	Moore Park Road | Driver Avenue	Driver Avenue	northbound	left turn	107	105	0.2	135	134	0.1	123	127	0.3
6	Moore Park Road | Driver Avenue	Moore Park Road	eastbound	right turn	74	70	0.5	100	97	0.3	107	98	0.8
8	Moore Park Road | Greens Road	Moore Park Road	westbound	through	665	659	0.2	573	638	2.6	522	550	1.2
9	Moore Park Road | Greens Road	Moore Park Road	westbound	through to ED	410	414	0.2	360	388	1.4	310	344	1.9
11	Moore Park Road | Greens Road	Moore Park Road	eastbound	through	621	622	0.0	638	643	0.2	744	673	2.7
12	Moore Park Road | Greens Road	Moore Park Road	eastbound	left turn	88	85	0.3	67	70	0.4	90	82	0.9
13	Moore Park Road | Greens Road	Greens Road	southbound	left turn	38	38	0.0	27	27	0.0	40	40	0.0
14	Eastern Distributor	Exit to Moore Park Road	eastbound	through	514	513	0.1	577	577	0.0	789	789	0.0
15	Moore Park Road | Flinders Street	Moore Park Road	westbound	left turn	108	106	0.2	66	71	0.6	58	61	0.4
16	Moore Park Road | Flinders Street	Moore Park Road	westbound	through	557	552	0.2	507	567	2.6	464	489	1.1
18	Moore Park Road | Flinders Street	Anzac Parade	northbound	right turn	265	255	0.6	207	218	0.8	230	223	0.5
19	Moore Park Road | Flinders Street	Anzac Parade	northbound	through	366	344	1.2	354	344	0.5	336	345	0.5
22	Moore Park Road | Flinders Street	Anzac Parade	northbound	through to ED	480	471	0.4	490	487	0.1	420	422	0.1
23	Moore Park Road | Flinders Street	Anzac Parade	northbound	left turn	593	576	0.7	580	585	0.2	610	604	0.2
24	Moore Park Road | Flinders Street	Flinders Street	southbound	left turn	424	456	1.5	499	495	0.2	591	532	2.5
26	Moore Park Road | Flinders Street	Flinders Street	southbound	through	909	982	2.4	1,059	1,112	1.6	1,103	1,031	2.2
28	South Dowling Street | Fitzroy Street	Fitzroy Street	westbound	left turn	274	285	0.6	270	269	0.0	184	192	0.6
29	South Dowling Street | Fitzroy Street	Fitzroy Street	westbound	through	694	665	1.1	686	680	0.2	713	721	0.3
32	South Dowling Street | Fitzroy Street	Fitzroy Street	westbound	right turn	177	177	0.0	199	203	0.3	174	180	0.5
33	South Dowling Street | Fitzroy Street	South Dowling Street	northbound	through	555	540	0.6	648	646	0.1	732	723	0.3
35	South Dowling Street | Fitzroy Street	South Dowling Street	northbound	left turn	141	140	0.1	137	137	0.0	145	150	0.4
36	South Dowling Street | Fitzroy Street	South Dowling Street	southbound	right turn	118	134	1.4	121	128	0.6	130	149	1.6
37	South Dowling Street | Fitzroy Street	South Dowling Street	southbound	through	557	643	3.5	542	616	3.1	506	603	4.1
39	South Dowling Street | Flinders Street	Flinders Street	westbound	through	379	335	2.3	371	346	1.3	384	344	2.1
42	South Dowling Street | Flinders Street	South Dowling Street	northbound	through	451	494	2.0	534	627	3.8	647	668	0.8
44	South Dowling Street | Flinders Street	South Dowling Street	northbound	left turn	220	221	0.1	190	221	2.2	213	236	1.5
46	South Dowling Street | Flinders Street	Flinders Street	eastbound	right turn	279	297	1.0	275	274	0.0	275	256	1.2
48	South Dowling Street | Flinders Street	Flinders Street	eastbound	through	1,210	1,219	0.3	1,425	1,384	1.1	1,477	1,384	2.4
86	South Dowling Street | Flinders Street	Flinders Street	eastbound	left turn	75	73	0.3	85	77	0.8	81	79	0.2
51	South Dowling Street | Fitzroy Street	South Dowling Street	southbound	through	505	499	0.2	456	464	0.4	486	496	0.5
53	South Dowling Street | Flinders Street	South Dowling Street	southbound	left turn	246	245	0.0	237	229	0.5	192	183	0.7
54	Flinders Street | Albion Street	Flinders Street	southbound	through	701	690	0.4	668	669	0.0	717	715	0.1
58	Flinders Street | Albion Street	Albion Street	eastbound	right turn	909	915	0.2	1,140	1,075	2.0	1,164	1,008	4.7
61	Flinders Street | Albion Street	Albion Street	eastbound	left turn	26	28	0.4	28	27	0.2	22	20	0.3
82	Flinders Street | Albion Street	Flinders Street	northbound	through	597	554	1.8	564	567	0.1	601	581	0.8
62	Bourke Street | Albion Street	Bourke Street	southbound	left turn	110	111	0.1	142	141	0.1	129	126	0.3
63	Bourke Street | Albion Street	Bourke Street	southbound	through	133	130	0.3	153	150	0.2	160	164	0.3
64	Bourke Street | Albion Street	Bourke Street	northbound	right turn	41	42	0.2	55	62	1.0	58	61	0.4
65	Bourke Street | Albion Street	Bourke Street	northbound	through	57	55	0.3	44	48	0.5	68	68	0.0
67	Bourke Street | Albion Street	Albion Street	eastbound	right turn	48	45	0.4	69	68	0.1	62	47	2.1
68	Bourke Street | Albion Street	Albion Street	eastbound	through	782	784	0.1	981	913	2.2	999	837	5.4
72	Bourke Street | Albion Street	Albion Street	eastbound	left turn	43	37	1.0	46	39	1.0	39	35	0.7
73	Bourke Street | Fitzroy Street	Fitzroy Street	westbound	left turn	111	98	1.2	89	91	0.2	102	95	0.7
74	Bourke Street | Fitzroy Street	Fitzroy Street	westbound	through	900	806	3.2	891	825	2.3	907	888	0.6
77	Bourke Street | Fitzroy Street	Fitzroy Street	westbound	through	32	38	1.1	37	44	1.1	41	46	0.7
78	Bourke Street | Fitzroy Street	Bourke Street	northbound	through	60	60	0.0	70	67	0.4	81	84	0.3
79	Bourke Street | Fitzroy Street	Bourke Street	northbound	left turn	18	17	0.2	22	24	0.5	21	19	0.4
83	Bourke Street | Fitzroy Street	Bourke Street	southbound	right turn	42	39	0.4	42	42	0.0	37	29	1.3
84	Bourke Street | Fitzroy Street	Bourke Street	southbound	through	145	134	1.0	186	176	0.7	185	182	0.2

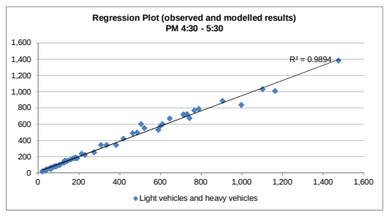
1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3
15:30 - 16:30	15:30 - 16:30	15:30 - 16:30	15:30 - 16:30	15:30 - 16:30	15:30 - 16:30	15:30 - 16:30	16:30 - 17:30	16:30 - 17:30	16:30 - 17:30	16:30 - 17:30	16:30 - 17:30	16:30 - 17:30	17:30 - 18:30	17:30 - 18:30	17:30 - 18:30	17:30 - 18:30	17:30 - 18:30	17:30 - 18:30
Observed LV	Modelled LV	GEH	Observed HV	Modelled HV	GEH	Observed LV	Modelled LV	GEH	Observed HV	Modelled HV	GEH	Observed LV	Modelled LV	GEH	Observed HV	Modelled HV	GEH
958	944	0.5	43	41	0.2	827	858	1.1	32	33	0.2	734	733	0.0	34	34	0.0
98	95	0.3	0	0	0.0	101	104	0.3	0	0	0.0	136	140	0.4	0	0	0.0
71	72	0.1	1	1	0.0	78	73	0.6	1	1	0.2	88	87	0.1	0	0	0.0
102	101	0.1	5	5	0.2	135	134	0.1	0	0	0.6	123	127	0.3	0	0	0.0
71	70	0.1	3	0	2.4	100	97	0.3	0	0	0.0	106	98	0.8	1	0	1.4
621	626	0.2	44	33	1.7	551	619	2.8	22	19	0.7	512	537	1.1	10	13	0.8
400	406	0.3	10	8	0.7	345	374	1.5	15	14	0.3	290	323	1.9	20	21	0.3
603	603	0.0	18	19	0.2	625	628	0.1	13	15	0.4	738	665	2.8	6	8	0.7
85	85	0.0	3	0	2.4	66	70	0.5	1	0	1.4	88	82	0.7	2	0	2.0
36	36	0.0	2	2	0.0	27	27	0.0	0	0	0.0	40	40	0.0	0	0	0.0
509	508	0.1	5	5	0.0	568	568	0.0	9	9	0.1	788	788	0.0	1	1	0.2
94	96	0.2	14	10	1.0	62	68	0.7	4	3	0.4	53	55	0.2	5	7	0.7
527	529	0.1	30	23	1.4	489	551	2.7	18	16	0.6	459	482	1.1	5	6	0.5
251	241	0.6	14	14	0.1	197	208	0.8	10	10	0.1	226	219	0.5	4	4	0.1
334	311	1.3	32	32	0.1	328	320	0.4	26	24	0.4	308	311	0.2	28	34	1.1
450	443	0.3	30	27	0.5	455	454	0.1	35	33	0.3	410	412	0.1	10	10	0.1
545	530	0.6	48	46	0.3	540	540	0.0	40	45	0.8	559	559	0.0	51	45	0.9
419	450	1.5	5	5	0.1	494	491	0.1	5	4	0.4	587	528	2.5	4	4	0.2
835	907	2.4	74	76	0.2	974	1,018	1.4	85	94	0.9	997	941	1.8	106	90	1.6
260	270	0.6	14	15	0.3	261	260	0.1	9	10	0.3	174	182	0.6	10	9	0.3
634	614	0.8	60	51	1.3	639	635	0.2	47	45	0.3	669	681	0.5	44	40	0.7
173	174	0.0	4	3	0.4	195	197	0.2	4	6	0.9	172	178	0.5	2	2	0.1
544	528	0.7	11	12	0.2	638	636	0.1	10	10	0.1	727	717	0.4	5	6	0.6
138	138	0.0	3	2	0.9	134	134	0.0	3	4	0.3	141	147	0.5	4	3	0.7
115	132	1.5	3	2	0.6	121	128	0.6	0	0	0.0	130	149	1.6	0	0	0.0
531	624	3.9	26	19	1.5	534	601	2.8	8	15	2.0	499	594	4.1	7	9	0.6
346	304	2.3	33	31	0.3	339	321	1.0	32	25	1.3	362	311	2.8	22	33	2.1
437	484	2.2	14	10	1.2	529	615	3.6	5	11	2.2	639	660	0.8	8	8	0.0
215	216	0.1	5	5	0.0	188	217	2.0	2	4	1.3	212	235	1.6	1	1	0.2
270	286	0.9	9	11	0.6	267	266	0.0	8	8	0.1	271	253	1.1	4	3	0.4
1,123	1,135	0.4	87	83	0.4	1,329	1,287	1.2	96	97	0.1	1,380	1,289	2.5	97	95	0.2
74	72	0.3	1	1	0.2	85	77	0.8	0	0	0.0	81	79	0.2	0	0	0.0
496	488	0.3	9	11	0.6	453	459	0.3	3	6	1.3	482	491	0.4	4	5	0.6
244	245	0.1	2	0	2.0	234	229	0.3	3	0	2.4	191	183	0.6	1	0	1.4
651	640	0.4	50	49	0.1	591	592	0.0	77	77	0.0	647	644	0.1	70	70	0.0
861	867	0.2	48	48	0.1	1,110	1,047	1.9	30	28	0.4	1,133	979	4.7	31	29	0.3
26	28	0.4	0	0	0.0	27	27	0.0	1	0	1.4	21	20	0.3	1	0	1.4
562	518	1.9	35	36	0.2	528	538	0.4	36	29	1.2	577	547	1.3	24	34	1.9
108	109	0.1	2	2	0.0	142	141	0.1	0	0	0.0	129	126	0.3	0	0	0.0
133	130	0.3	0	0	0.0	151	148	0.2	2	2	0.0	157	161	0.3	3	3	0.1
41	42	0.2	0	0	0.0	55	62	1.0	0	0	0.0	58	61	0.4	0	0	0.0
57	55	0.3	0	0	0.0	44	48	0.5	0	0	0.0	68	68	0.0	0	0	0.0
48	45	0.4	0	0	0.0	66	65	0.1	3	3	0.0	62	46	2.1	0	0	0.9
736	738	0.1	46	46	0.0	949	884	2.1	32	28	0.7	967	808	5.3	32	29	0.6
43	37	1.0	0	0	0.0	45	38	1.1	1	1	0.2	38	34	0.7	1	1	0.0
111	98	1.2	0	0	0.0	88	90	0.2	1	1	0.2	102	95	0.7	0	0	0.0
846	752	3.3	54	54	0.1	837	777	2.1	54	48	0.9	862	846	0.6	45	43	0.4
32	38	1.1	0	0	0.0	37	44	1.1	0	0	0.0	41	46	0.7	0	0	0.0
60	60	0.0	0	0	0.0	70	67	0.4	0	0	0.0	81	84	0.3	0	0	0.0
18	17	0.2	0	0	0.0	22	24	0.5	0	0	0.0	20	18	0.5	1	1	0.0
42	39	0.4	0	0	0.0	40	39	0.1	2	3	0.4	35	28	1.2	2	1	0.5
145	134	1.0	0	0	0.0	184	174	0.7	2	2	0.1	183	180	0.2	2	2	0.0

	6:30 - 7:30	7:30 - 8:30	8:30 - 9:30	
Total	52	52	52	
GEH<5	52	52	51	99%
GEH<10	52	52	52	100%
	100%	100%	98%	

	Intersection	0-3600 Average Delay (PM)	3600-7200 Average Delay (PM)	7200-10800 Average Delay (PM)
8	Moore Park Road and Drivers Avenue	9	10	10
1	Moore Park Road and Greens Road	12	9	4
2	Moore Park Road, Anzac Parade and Flinders Street	31	31	33
3	Fitzroy Street and South Dowling Street	26	28	29
4	Flinders Street and South Dowling Street	27	28	34
5	Flinders Street and Albion Street	21	51	61
6	Albion Street and Bourke Street	24	72	188
7	Fitzroy Street and Bourke Street	11	12	12







B2. Intersection turn count calibration detailed results

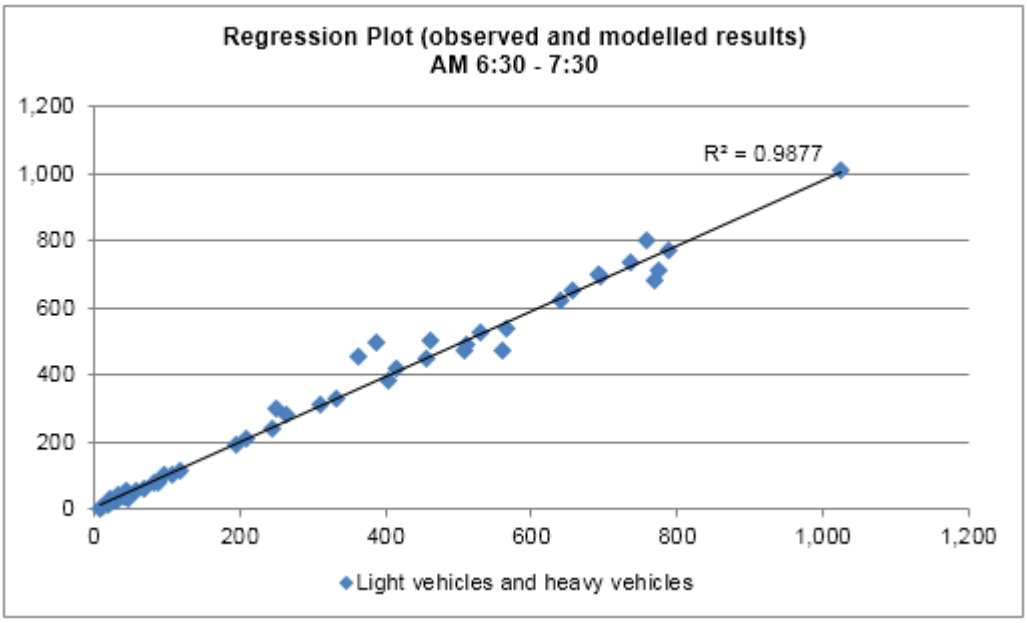


Figure B2.1 Regression plot of observed and modelled results – 6.30–7.30 am

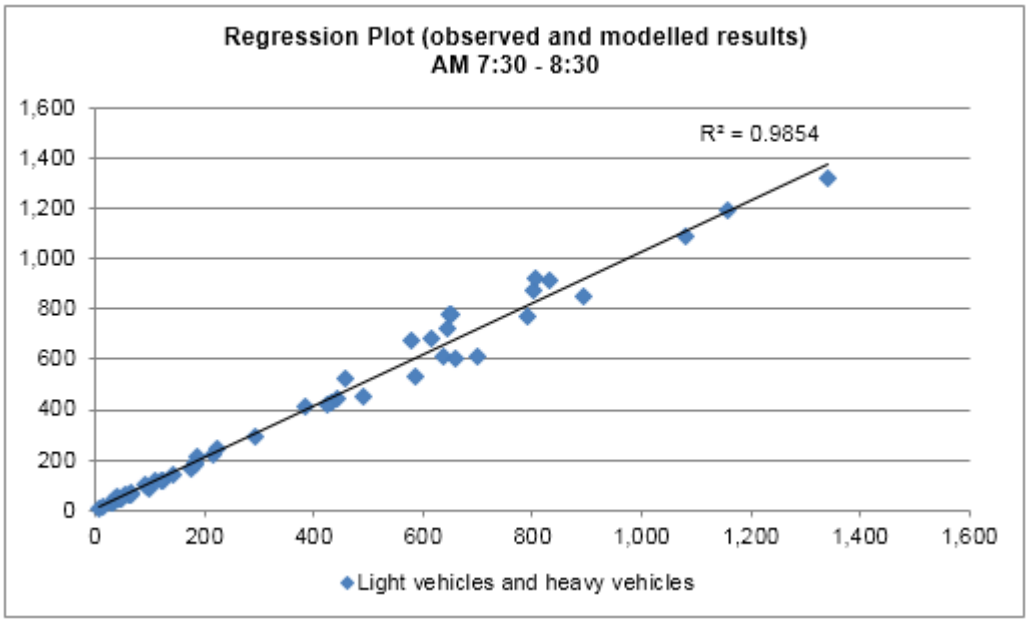


Figure B2.2 Regression plot of observed and modelled results – 7.30–8.30 am

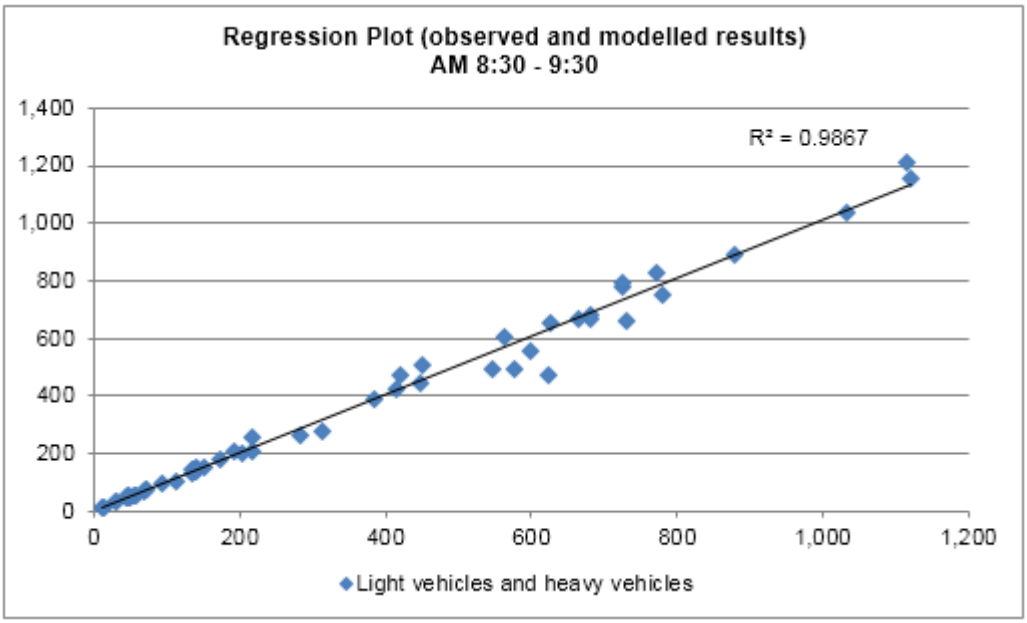


Figure B2.3 Regression plot of observed and modelled results – 8.30–9.30 am

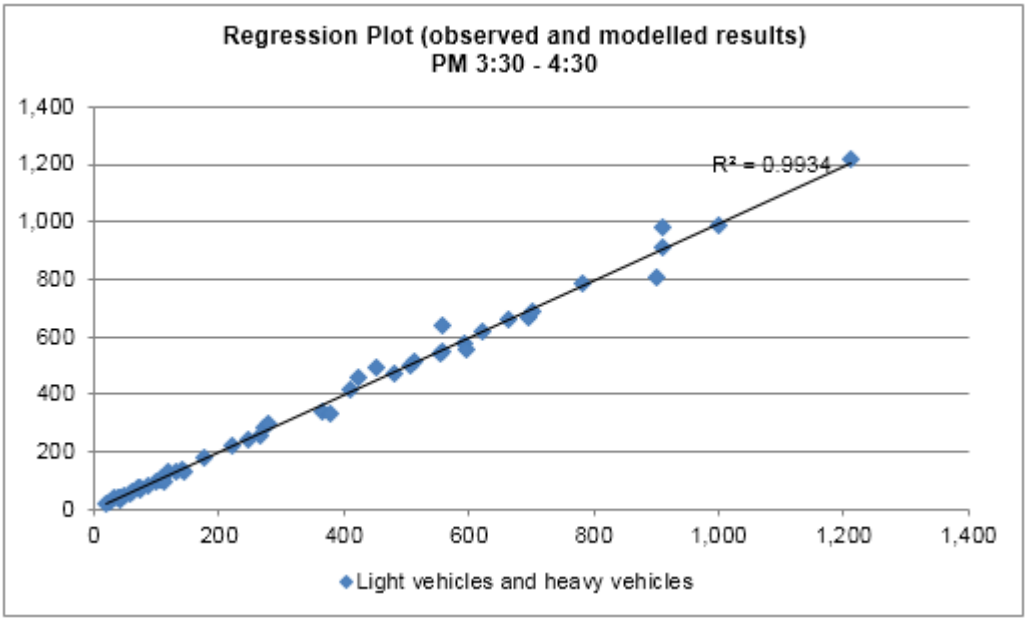


Figure B2.4 Regression plot of observed and modelled results – 3.30–4.30 pm

Figure B2.5 Regression plot of observed and modelled results – 4.30–5.30 pm

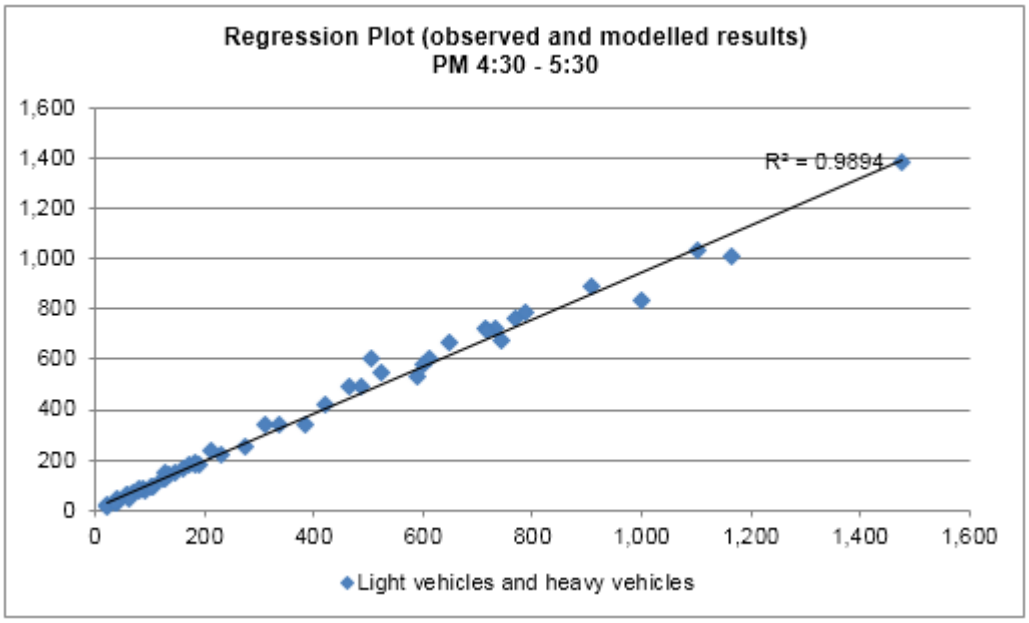


Figure B2.6 Regression plot of observed and modelled results – 5.30–6.30 pm

B3. Travel time detailed results

Table B3.1 Travel time comparison in AM peak hour Route 1 – 7.30–8.30

Travel time comparison (sec)	Survey run 1	Survey run 2	Survey run 3	Survey average	Model average	Difference average
a) Moore Park Road/ Driver Avenue	-	-	-	-	-	-
b) Moore Park Road/ Flinders Street	198	191	102	164	125	-39
c) Fitzroy Street/ Bourke Street	28	42	47	39	72	33
Route 1 Total	226	233	149	203	197	-6

Table B3.2 Travel time comparison in PM peak hour Route 1 – 4.30–5.30

Travel time comparison (sec)	Survey run 1	Survey run 2	Survey run 3	Survey run 4	Survey average	Model average	Difference average
a) Moore Park Road/ Driver Avenue	-	-	-	-	-	-	-
b) Moore Park Road/ Flinders Street	31	38	125	188	96	80	-15
c) Fitzroy Street/ Bourke Street	61	61	55	34	53	49	-3
Route 1 Total	92	99	180	222	148	130	-19

Table B3.3 Travel time comparison in AM peak hour Route 2 – 7.30–8.30

Travel time comparison (sec)	Survey run 1	Survey run 2	Survey run 3	Survey average	Model average	Difference average
c) Fitzroy Street/ Bourke Street	-	-	-	-	-	-
d & e) Albion Street/ Flinders Street	105	48	144	99	138	39
f) Flinders Street/ Moore Park Road	68	65	83	72	108	36
g) Moore Park Road/ Driver Avenue	28	49	45	41	39	-1
Route 2 Total	201	162	272	212	286	74

Table B3.4 Travel time comparison in PM peak hour Route 2 – 16.30–17.30

Travel time comparison (sec)	Survey run 1	Survey run 2	Survey run 3	Survey run 4	Survey average	Model average	Difference average
c) Fitzroy Street/ Bourke Street	-	-	-	-	-	-	-
d) Bourke Street/ Albion Street	65	66	22	72	56	40	-16
e) Albion Street/ Flinders Street	60	64	74	87	71	131	59
f) Flinders Street/ Moore Park Road	79	75	108	76	85	72	-12
g) Moore Park Road/ Driver Avenue	24	41	39	59	41	23	-18
Route 2 Total	228	246	243	294	253	267	14

B4. Sensitivity base model – Event day

B4.1 Introduction and assumptions

The purpose of the Event Day model is to provide a basis for assessing the impact of the proposed scheme on Moore Park Road and Fitzroy Street on an event day which sees a different travel pattern, a significant rise of bus volumes within the study area and manual traffic control (by police officers) at several locations.

The event day VISSIM model was developed using:

- the classified turning counts on the ICC Cricket World Cup semi-final day provided by CoS
- the known traffic management strategy on that day (consulted with CoS).

The results of the event day model are extracted to provide a basis of options testing. The results demonstrated that all the intersections were estimated to operate within capacity, with a Level of Service ranging between A and C.

Based on the comments provided by the Roads and Maritime upon the review of the Event day model and results, this model is no longer required in the options testing stage.

The details of the development of this Event day model and the results are attached in Appendix C.

B4.2 Limitations with model

A number of limitations exist with the Event Day model. These include:

- No specific traffic signal data was supplied for the Event Day being modelled. Some intersections, such as Driver Avenue and Moore Park Road are managed manually by police.
- The provided turning counts (which did not differentiate the bus with the trucks).
- There was no available datasets to validate the model (such as travel times and/or queue length).

The following assumptions were made during the event day model development:

- A reasonable effort to replicate the on-site traffic management control and to adjust the signal timing to accommodate the altered traffic patterns, such as the excessive bus volumes has been made based on the PM peak signal information.
- Based on the classified turning counts, the three hours form 9.00 pm to 12.00 am (3 hours) were defined as the busiest period on the ICC Cricket World Cup semi-final day; the peak hour was identified as 10.00 to 11.00 pm as the game finished at 10.00 pm. This event is not considered a ‘busy’ event due to the prolonged ending to the game and an extended period in which the crowd left the stadium.
- The temporal manual traffic control at Moore Park and Driver Avenue intersection; this enforces the turning ban on the Moore Park Road into the Driver Avenue, whilst provides dual left turn and single right turn from Driver Avenue to accommodate the traffic exiting the stadium. This manual traffic control was implemented between 10.00 and 11.00 pm.

- The differences of the heavy vehicle flows between the upstream and downstream intersections were used to estimate the event bus flows; the bus schedules were normalised based on the estimated bus flows.
- The traffic data in the PM peak on a typical workday was used to provide a basis for the traffic signal phasings and timings used in the busiest three hours; the adjustment to the traffic signal operation was made, such as providing additional green times to accommodate the excessive event bus flows on the Anzac Parade busways.
- Pedestrian egress movements were modelled on Fitzroy Street heading to the Central Station. It was assumed approximately 2,000 pedestrians following this path between 10.00 and 11.00 pm.
- Manual traffic control was assumed to be place at the footpath at the Fitzroy Street westbound approach at the South Dowling Street intersection; this provides staged permission for the vehicles to turn left by halting the crossing pedestrians.

Nevertheless, the Event Day model, given the calibration and validation of the AM and PM weekday peak models provide for a suitable platform to qualify and compare proposed cycleway options. Road users within the study area during periods when crowds leave the nearby stadiums often expect delays and general disruptions.

B4.3 Model stability check

The stability of the event model were checked by plotting the vehicle distance travelled (VDT), and vehicle hours travelled (VHT) in each modelled hour with different see values. The variance of each index was deemed to be acceptable, indicating a high level of model stability as shown in Figure 6.1 and 6.2.

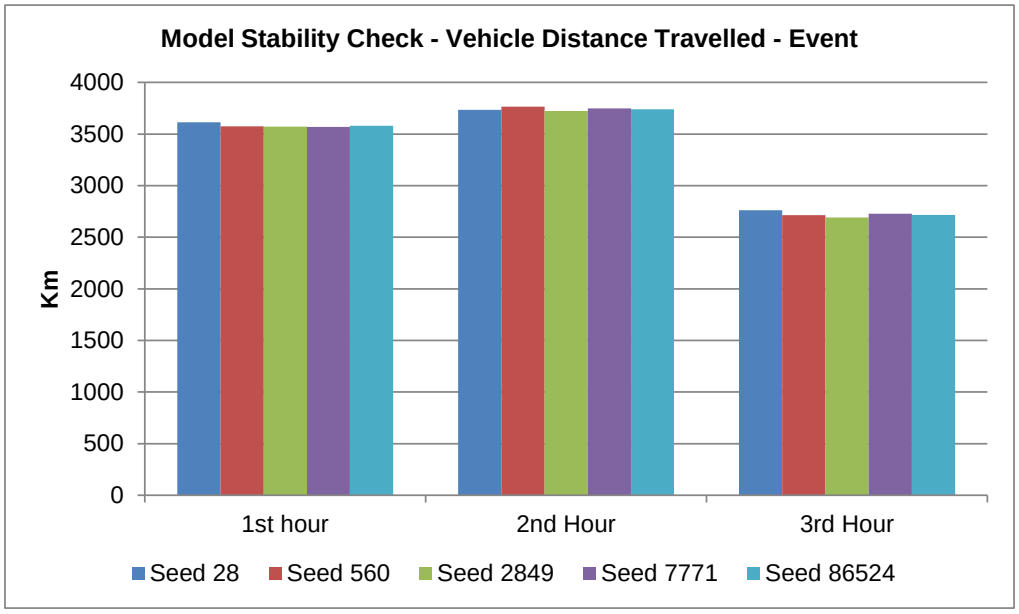


Figure B4.1 Event day stability check – VKT

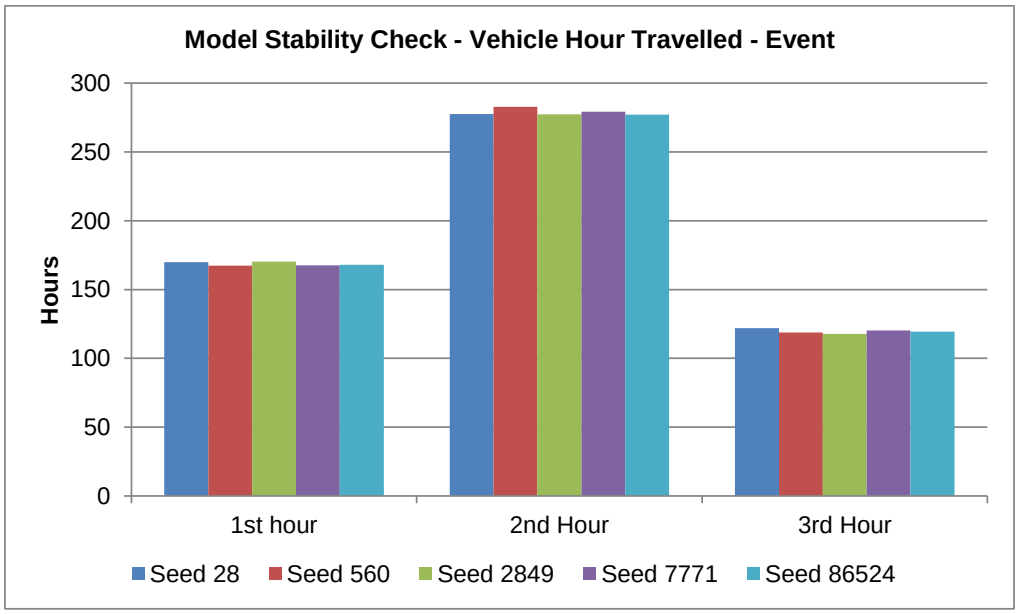


Figure B4.2 Event day stability check – VHT

B4.4 Traffic flow calibration

The traffic flows were calibrated against the turning counts provided by CoS on the event day as shown in Table 6.2. The results demonstrated that:

- the average GEH value is below 5 for 52 of all the 52 turning movements in the three-hour periods
- the R-square values are over 0.99 for all the turning movements in each, for the both AM and PM peak periods; the regression plots are shown in Figure 6.3–Figure 6.5.

The heavy vehicle counts were adjusted to exclude the event buses which flow the fix bus routes.

Table B4.1 Base model traffic turning flows calibration results – Event day

Traffic flows (all vehicles)	Calibration criteria	% of counts meet criteria (9.00–10.00 pm)	% of counts meet criteria (10.00–11.00 pm)	% of counts meet criteria (11.00–12.00 am)
Percentage of turn volumes with GEH <= 5	>=85%	100%	100%	100%
Percentage of turn volumes with GEH <= 10	100%	100%	100%	100%

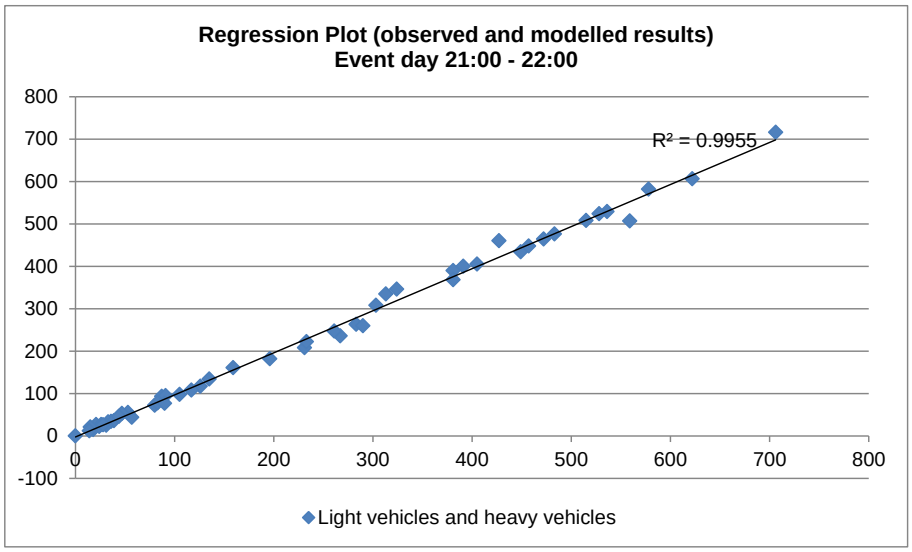


Figure B4.3 Regression plot of observed and modelled results – Event day 21.00–22.00

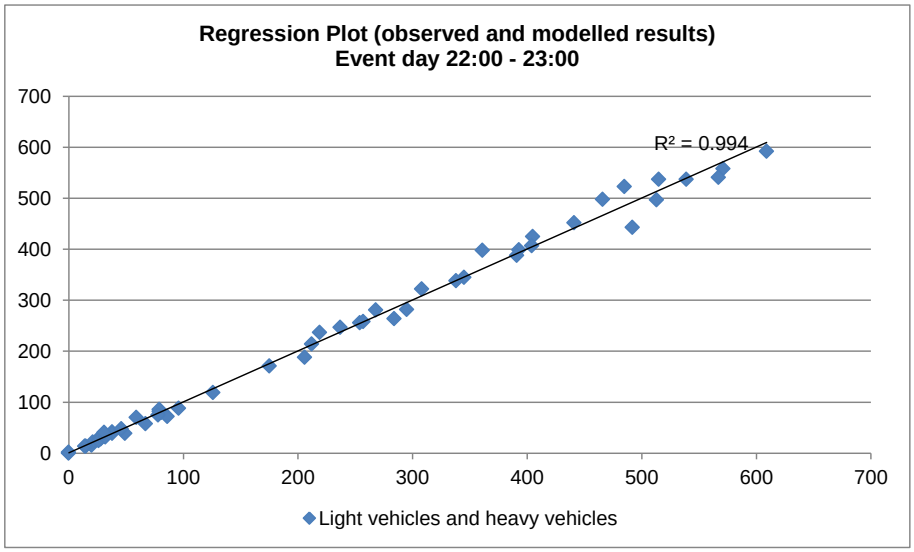


Figure B4.4 Regression plot of observed and modelled results – Event day 22.00–23.00

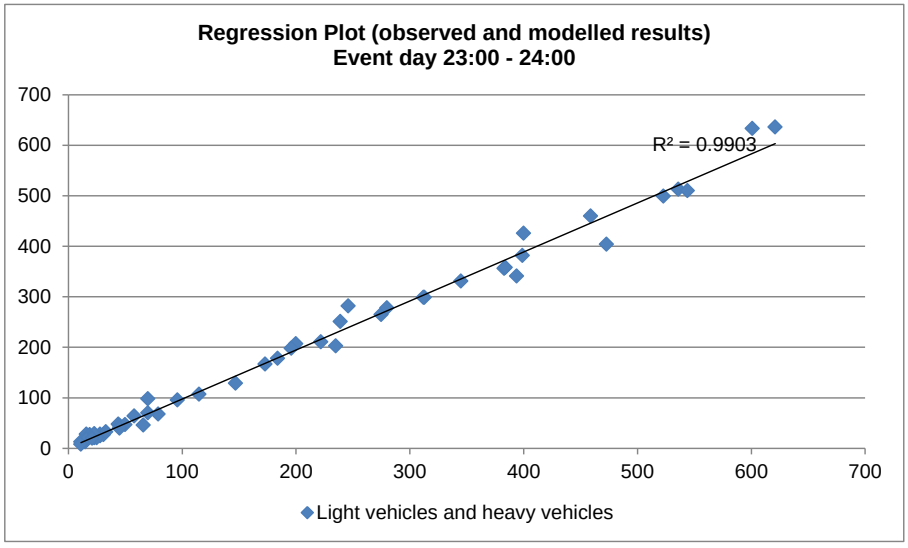


Figure B4.5 Regression plot of observed and modelled results – Event day 23.00–24.00

B4.5 Model validation

Model validation is not possible for this model.

B4.6 Event day results

The results of the event day model are extracted to provide a basis of options testing. The results in Table 6.2 demonstrated that all the intersections were estimated to operate within capacity, with a Level of Service ranging between A and C.

Table B4.2 Base model traffic turning flows calibration results – Event day

Intersection	Average Delay (Event day 10.00–11.00 pm)	Level of Service (Event day 10.00–11.00 pm)
Moore Park Road and Driver Avenue	16.3	B
Moore Park Road and Greens Road	11.7	A
Moore Park Road, Anzac Parade and Flinders Street	35.4	C
Fitzroy Street and South Dowling Street	22.9	B
Flinders Street and South Dowling Street	24.6	B
Flinders Street and Albion Street	28.3	C
Albion Street and Bourke Street	12.0	A
Fitzroy Street and Bourke Street	13.1	A

Based on the comments provided by the Roads and Maritime upon the review of the Event day model and results, this model is no longer required in the options testing stage.

Appendix C

Option Testing Results

BONDI JUNCTION TO CITY CYCLEWAY

FEASIBILITY STUDY
MODELLING CONCEPTS

1 KEY PLAN
1:8000 @ A3

SHEET	TITLE	SCALE	OPTION
L001	KEY PLAN	1:8000 @ A3	-
L002	ROUTE CONTEXT DIAGRAM	1:10,000 @ A3	A
L003	MOORE PARK RD SECTION	1:100 @ A3	A
L004	MOORE PARK RD SECTION	1:100 @ A3	A
L005	FITZROY ST SECTION	1:100 @ A3	A
L006	FITZROY ST SECTION	1:100 @ A3	A
L007	FLINDERS ST SECTION	1:100 @ A3	A
L008	FLINDERS ST SECTION	1:100 @ A3	A
L009	ALBION ST SECTION	1:100 @ A3	A
L010	ALBION ST SECTION	1:100 @ A3	A
L101	MOORE PARK / FITZROY ST	1:400 @ A3	A
L102	MOORE PARK / FITZROY ST	1:400 @ A3	A/B
L103	MOORE PARK / FITZROY ST	1:400 @ A3	A/B
L104	MOORE PARK / FITZROY ST	1:400 @ A3	A
L105	MOORE PARK / FITZROY ST	1:400 @ A3	A/B
L106	MOORE PARK / FITZROY ST	1:400 @ A3	A
L107	MOORE PARK / FITZROY ST	1:400 @ A3	A
L108	MOORE PARK / FITZROY ST	1:400 @ A3	A
L109	MOORE PARK / FITZROY ST	1:400 @ A3	A
L110	MOORE PARK / FITZROY ST	1:400 @ A3	A
L111	MOORE PARK / FITZROY ST	1:400 @ A3	A
L112	MOORE PARK / FITZROY ST	1:400 @ A3	A
L113	MOORE PARK / FITZROY ST	1:400 @ A3	A/B
L201	MOORE PARK / FLINDERS / ALBION	1:400 @ A3	A
L202	MOORE PARK / FLINDERS / ALBION	1:400 @ A3	A
L203	MOORE PARK / FLINDERS / ALBION	1:400 @ A3	A
L204	MOORE PARK / FLINDERS / ALBION	1:400 @ A3	A

REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com
LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

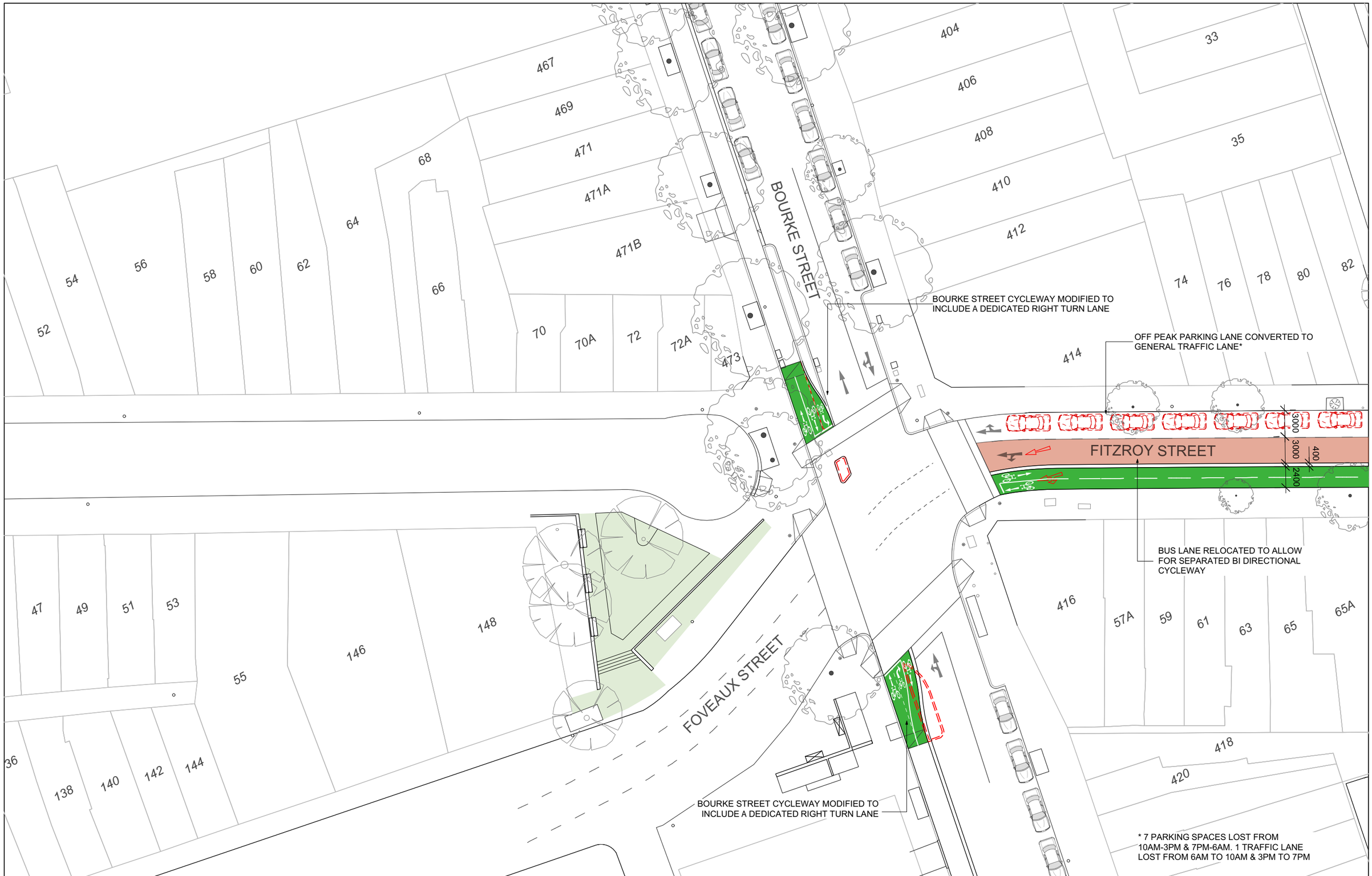
BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L001

DRAWING
KEY PLAN

OPTION



REV	DESCRIPTION	DR	CHKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

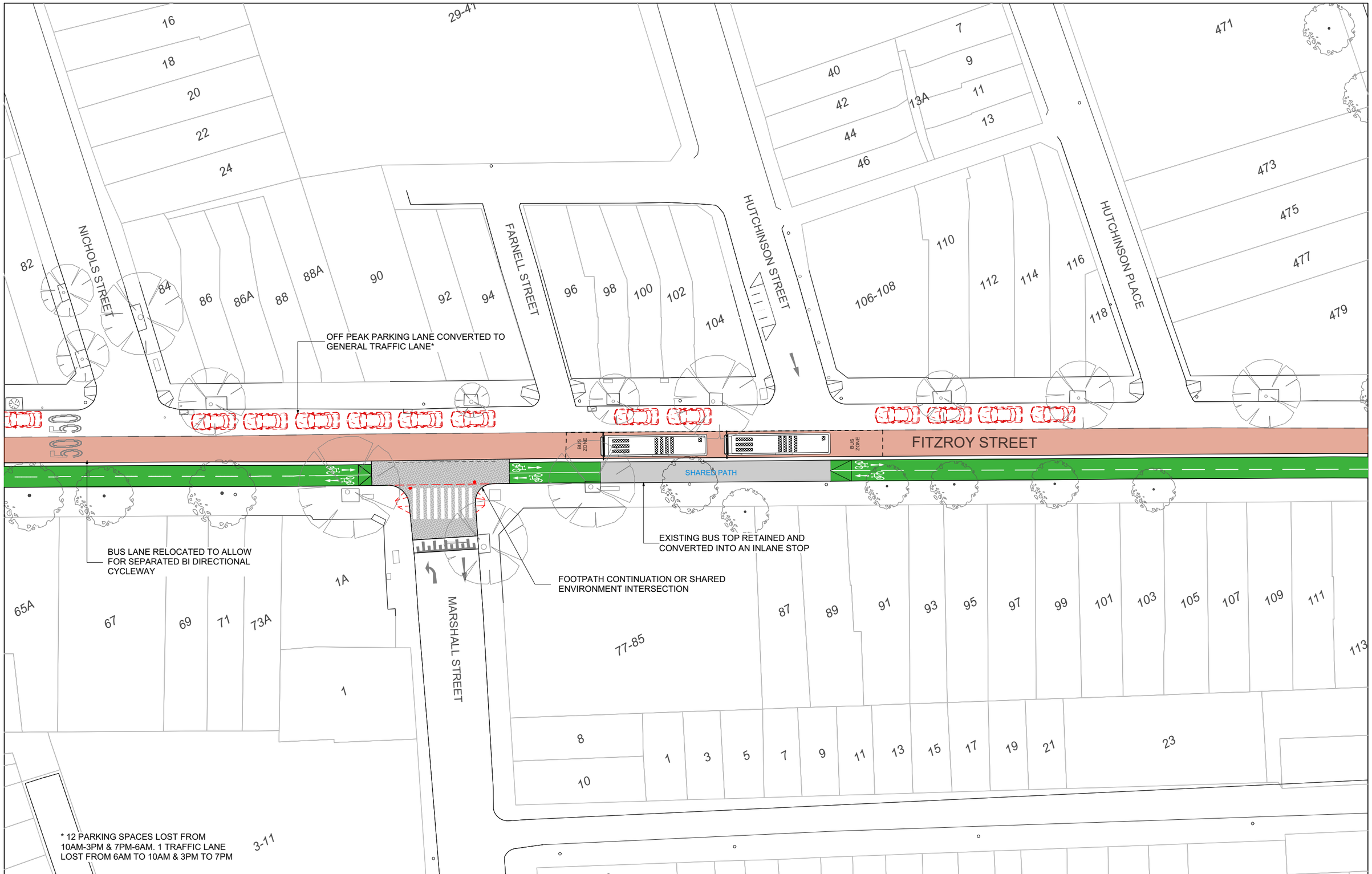
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L101

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A



REV	AMENDMENT DESCRIPTION	DRAWN	CHKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

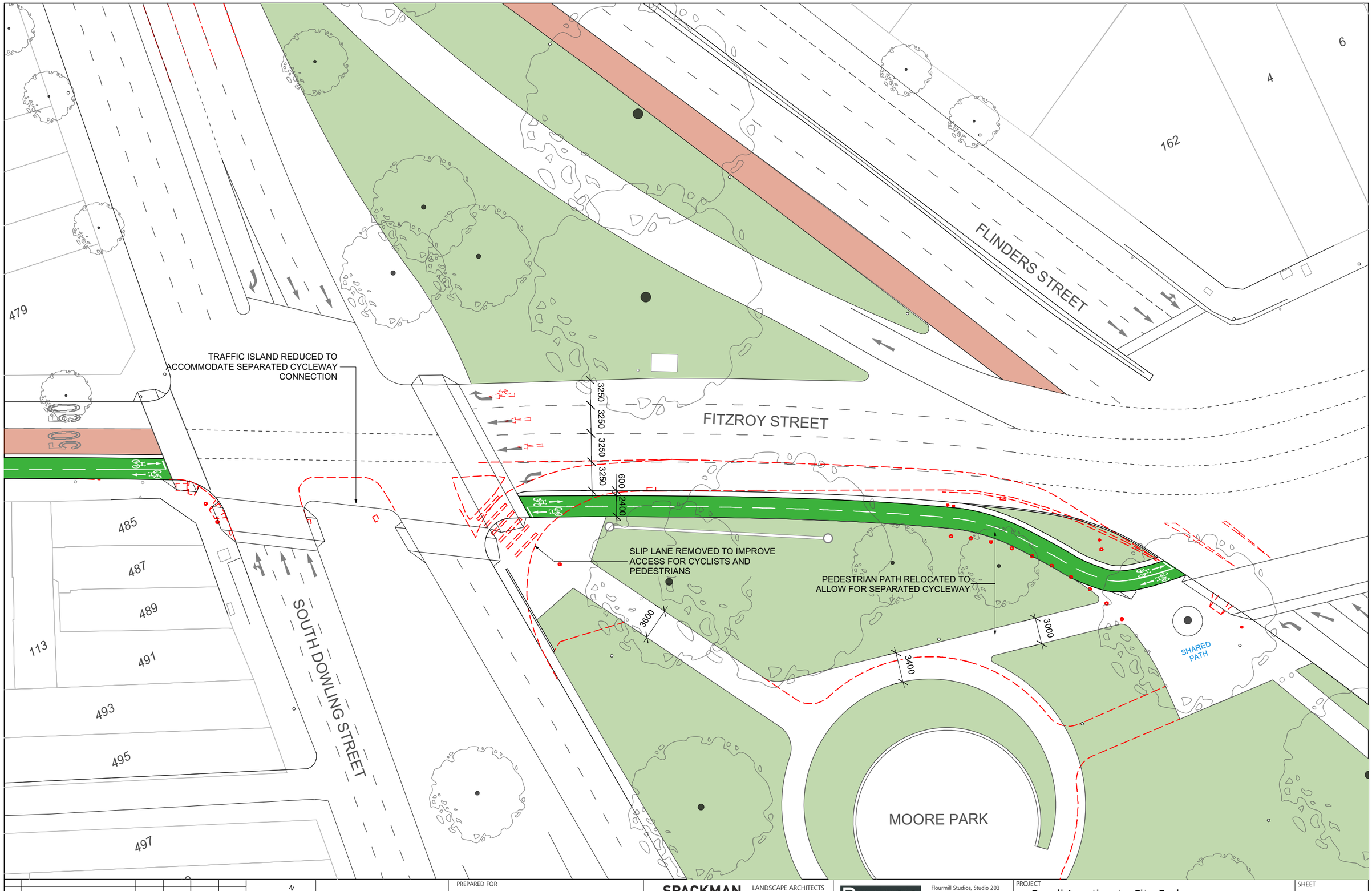
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L102

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A



REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)
SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com
LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

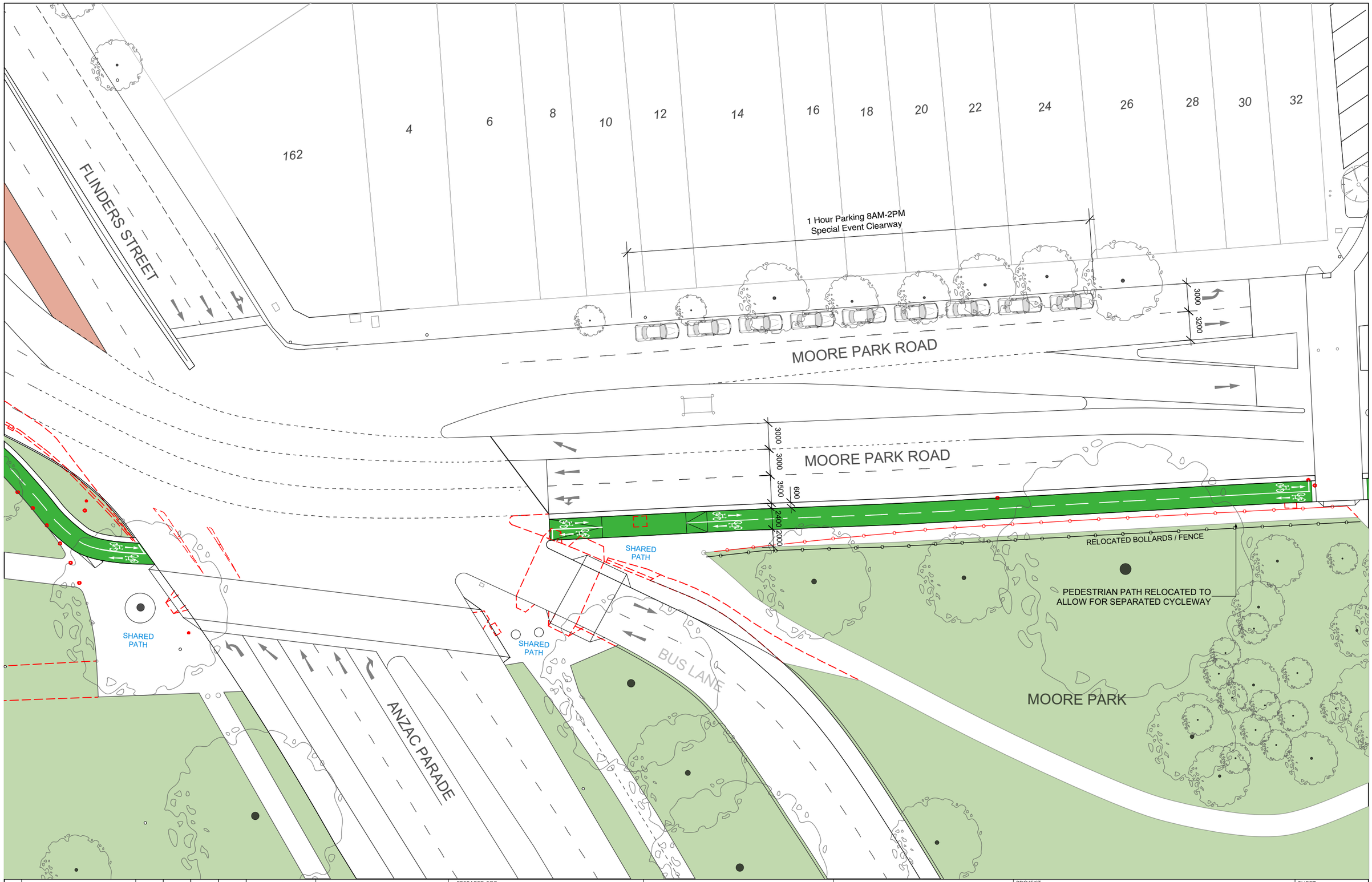
BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L103

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A



REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

N W E S NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)
SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

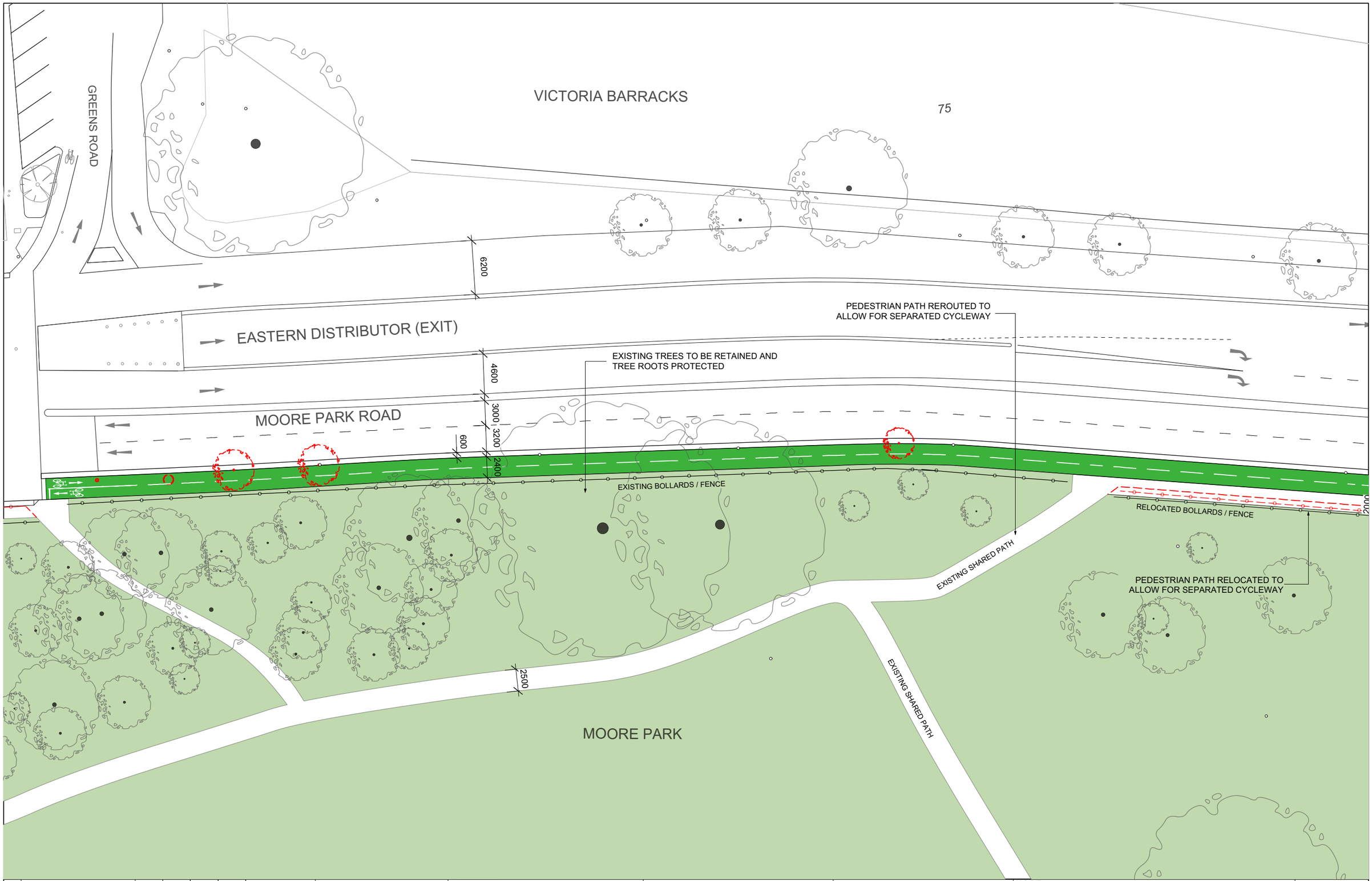
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L104

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A



REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)
SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com
LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L105

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A

34A

CENTENNIAL PARK SIGN RETAINED AND PROTECTED

TRAFFIC ISLAND, TREES AND PLANTING RELOCATED TO ALLOW FOR CYCLEWAY

ALL TRAFFIC LANES RECONFIGURED TO ALLOW FOR CYCLEWAY

600
3200
3200
2400
2000
6550
3250
2250
3250
3250
2400
2810
3115
2440
2090
2320
2650

EXISTING FOOTPATH

DRIVER AVENUE

MOORE PARK

ALLIANZ STADIUM GROUNDS

REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR

CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

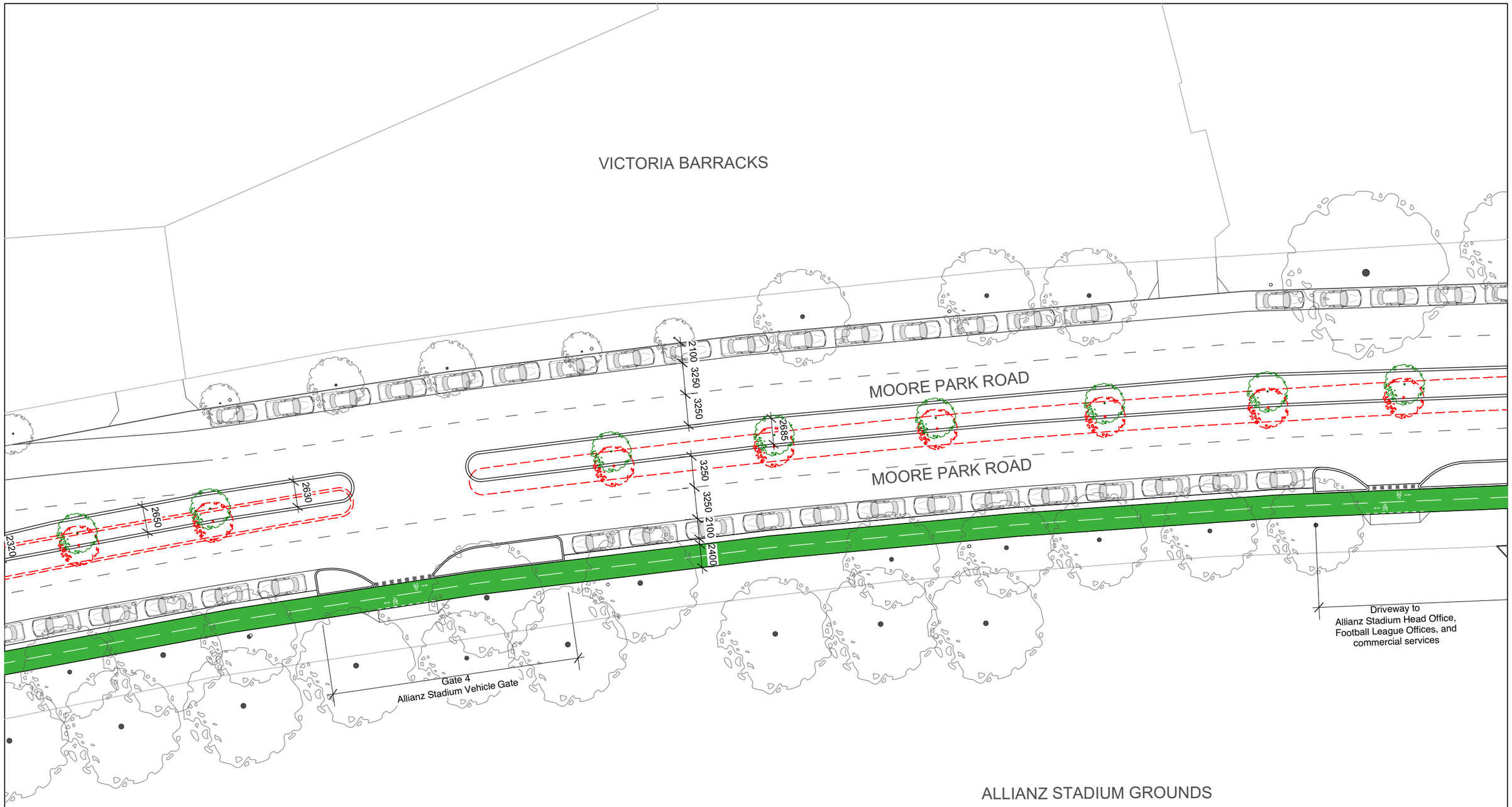
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L106

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A



REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR

CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

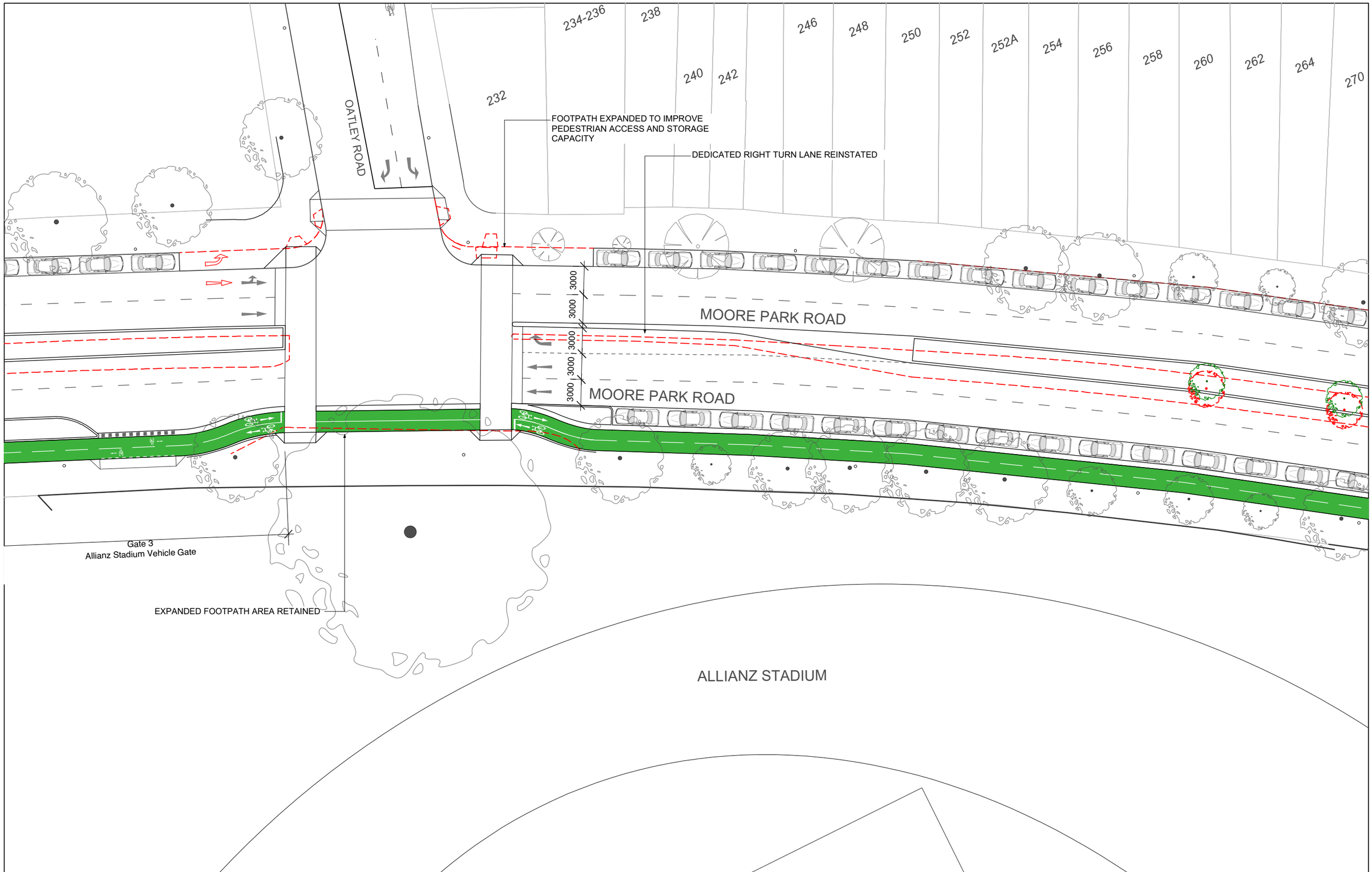
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L107

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A



REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L108

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A

REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L109

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A

REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR

CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

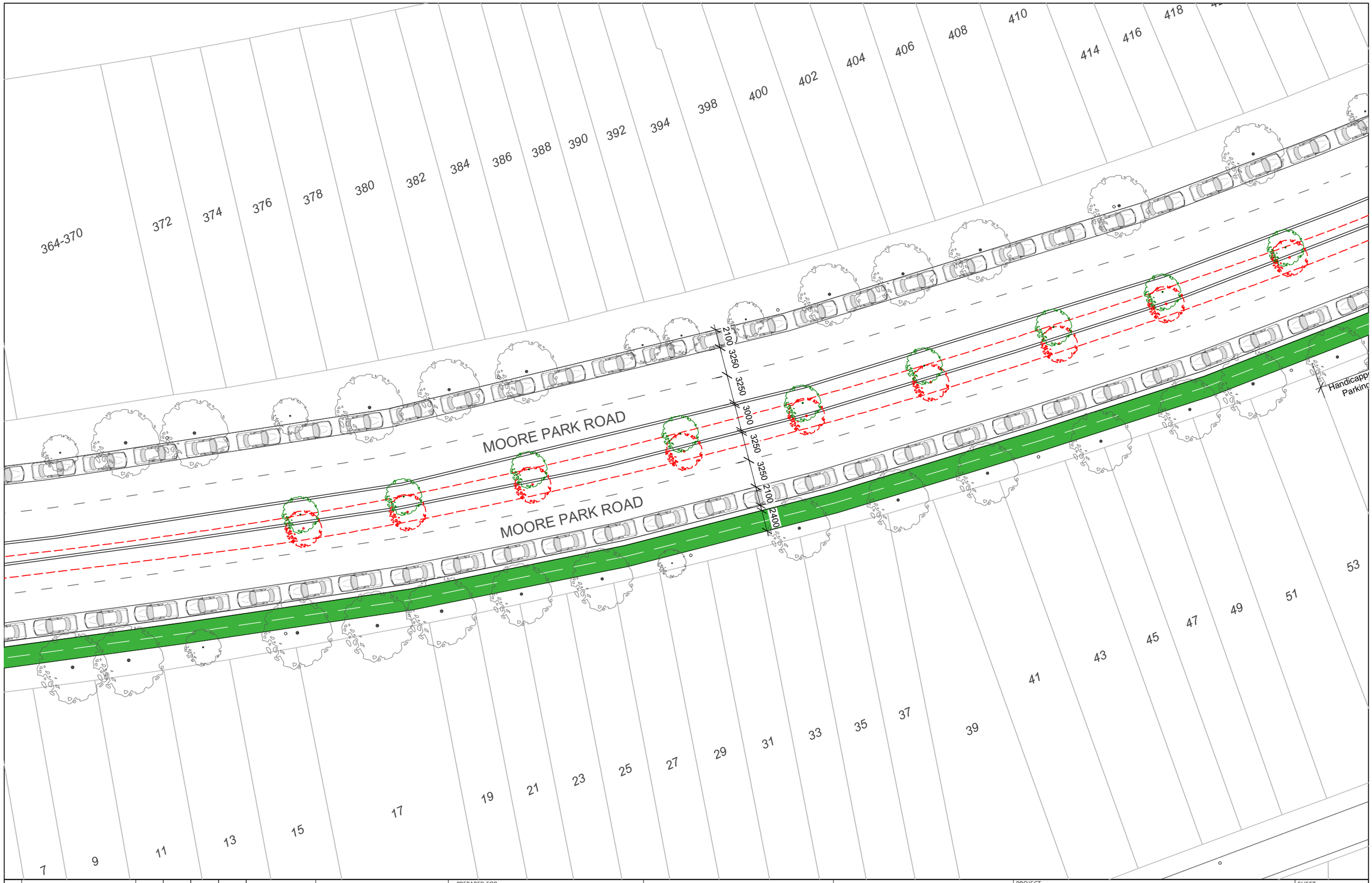
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L110

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A



REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

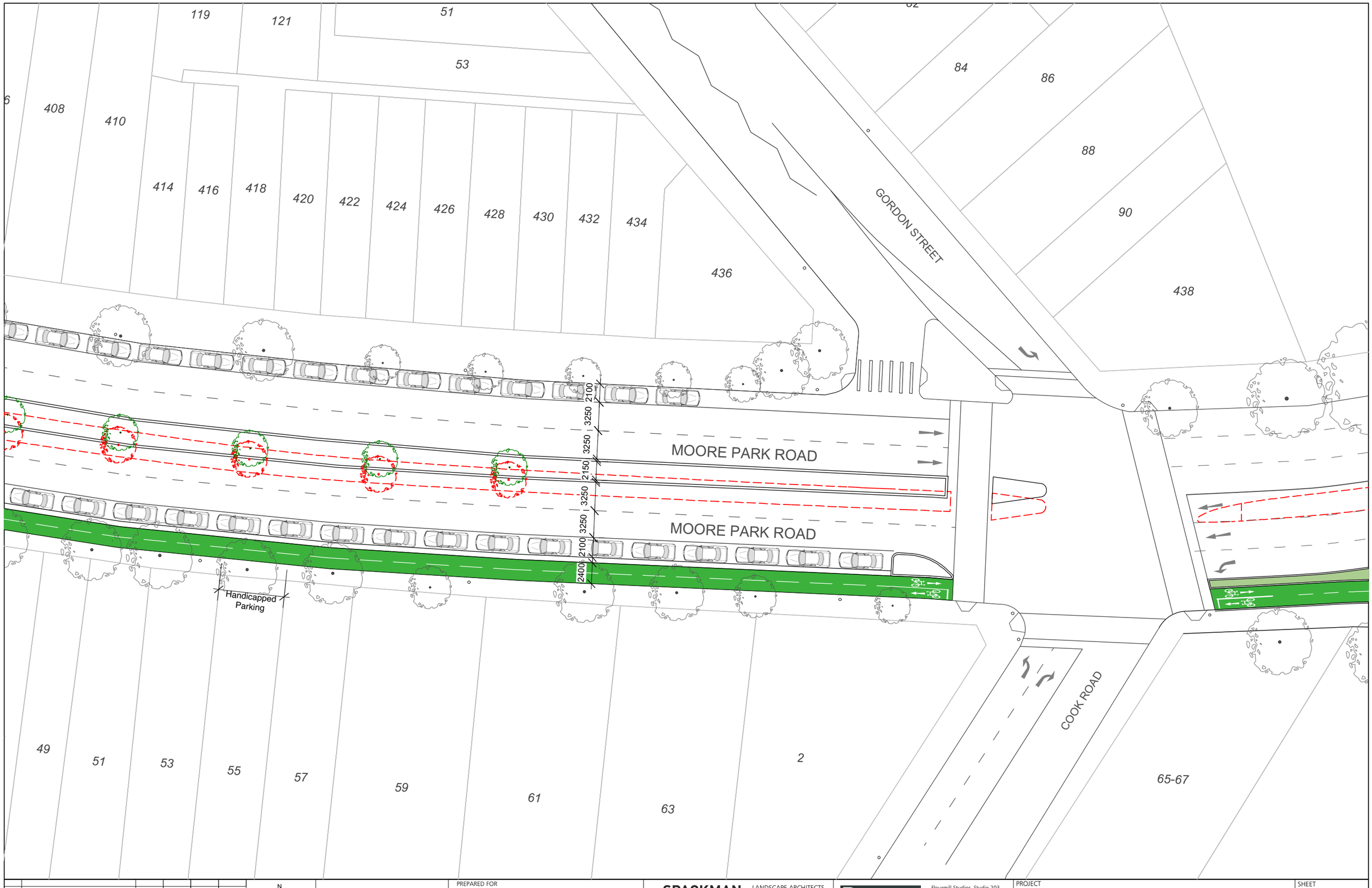
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L111

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A



REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

N
W E
S
NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)
SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

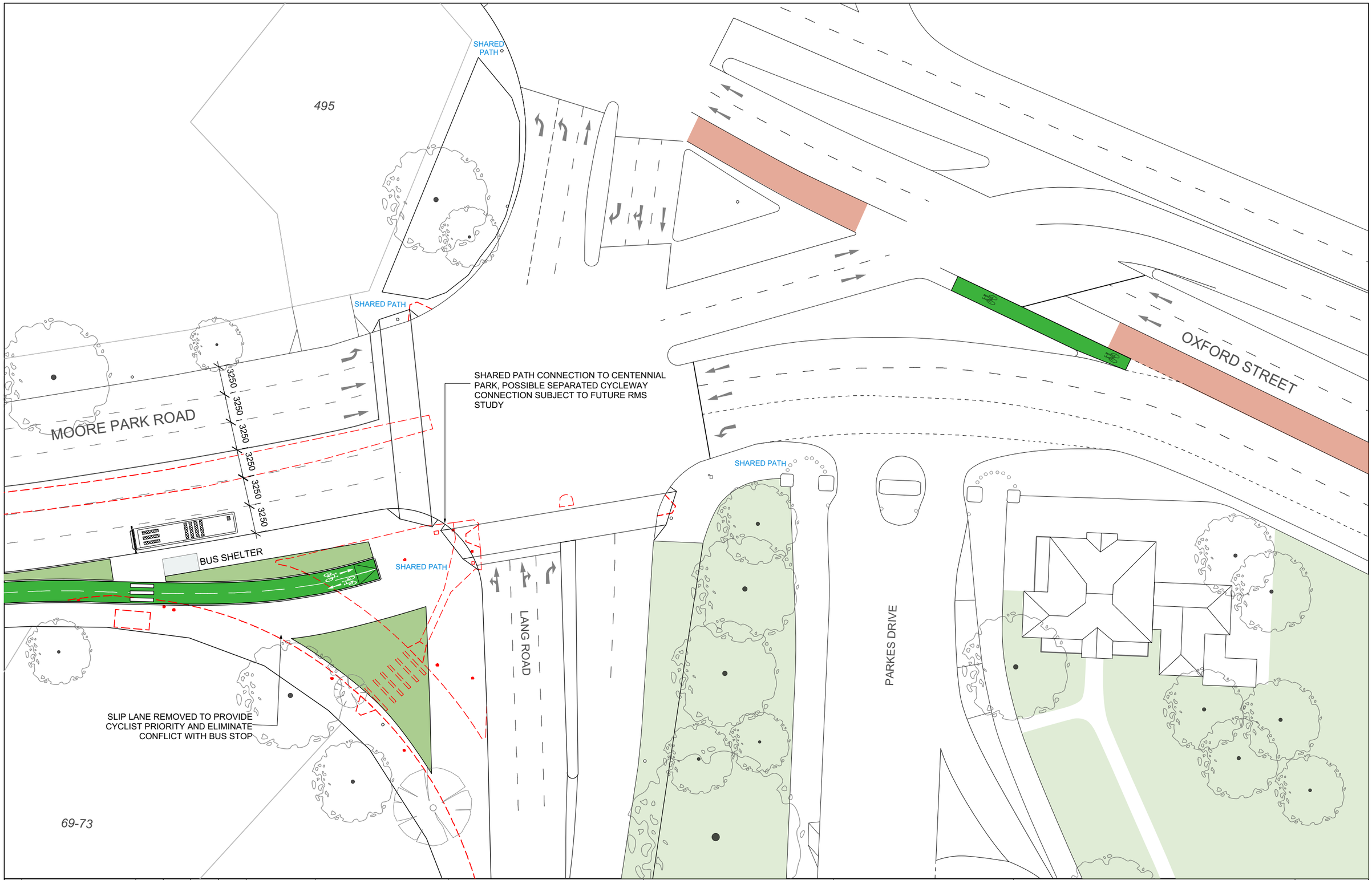
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L112

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A



REV	DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR

CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

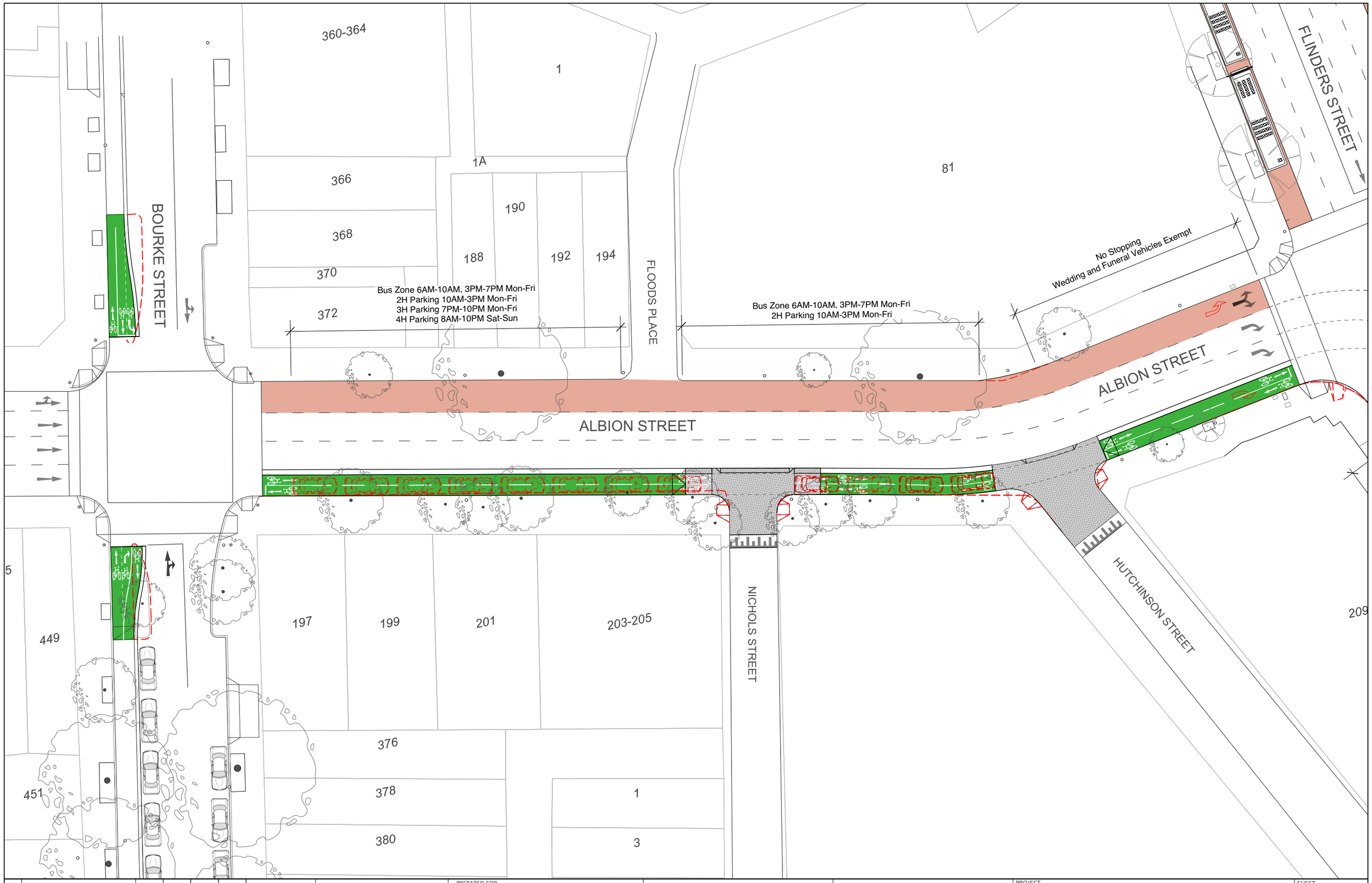
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L113

DRAWING
MOORE PARK / FITZROY ST OPTION

OPTION
A



REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR

CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING

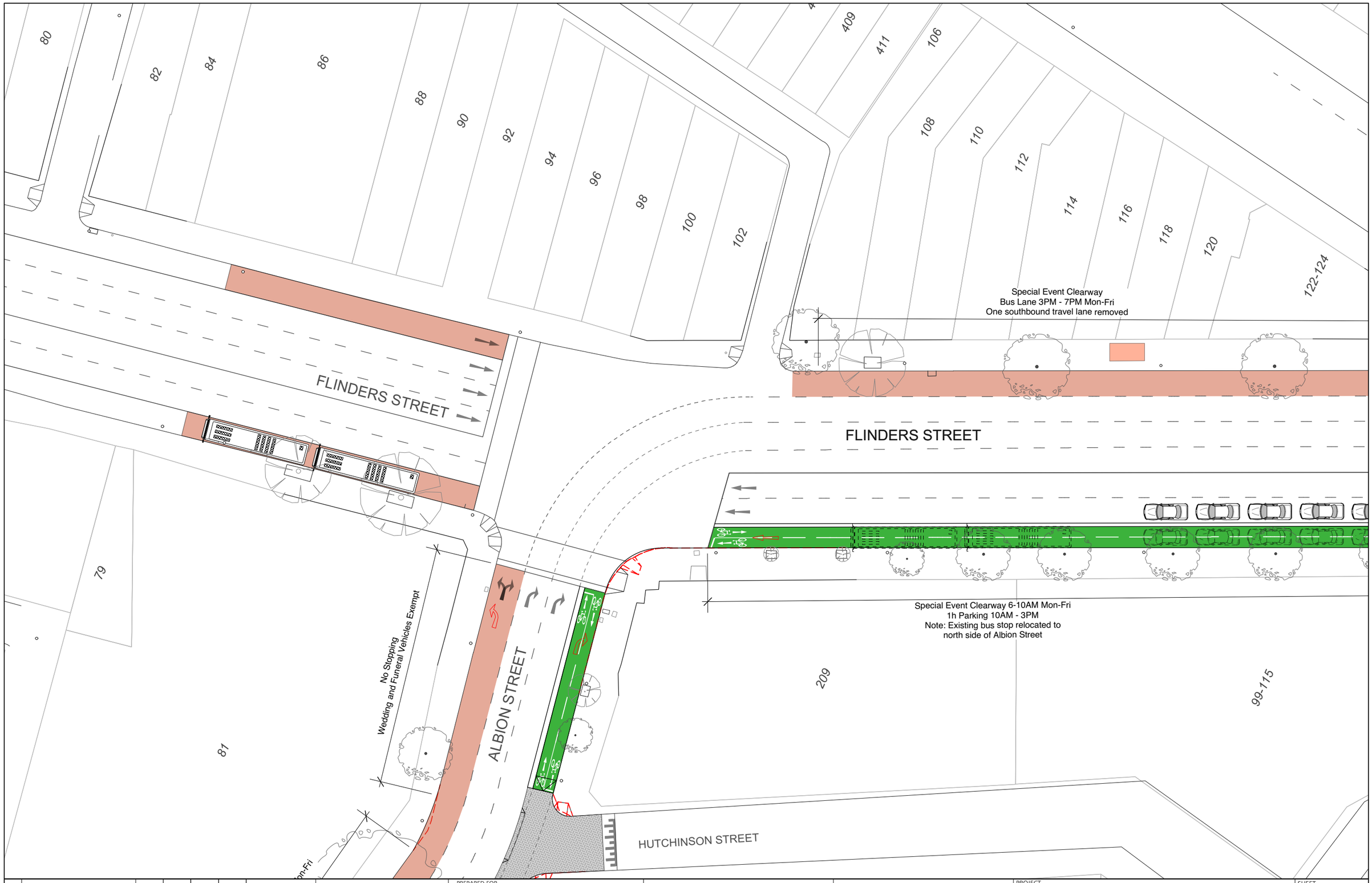
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L201

DRAWING
MOORE PARK / FLINDERS / ALBION ST OPTION

OPTION
A



REV	DESCRIPTION	DR	MD	MS	DATE
H	ISSUE TO TRAFFIC				18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)

SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com

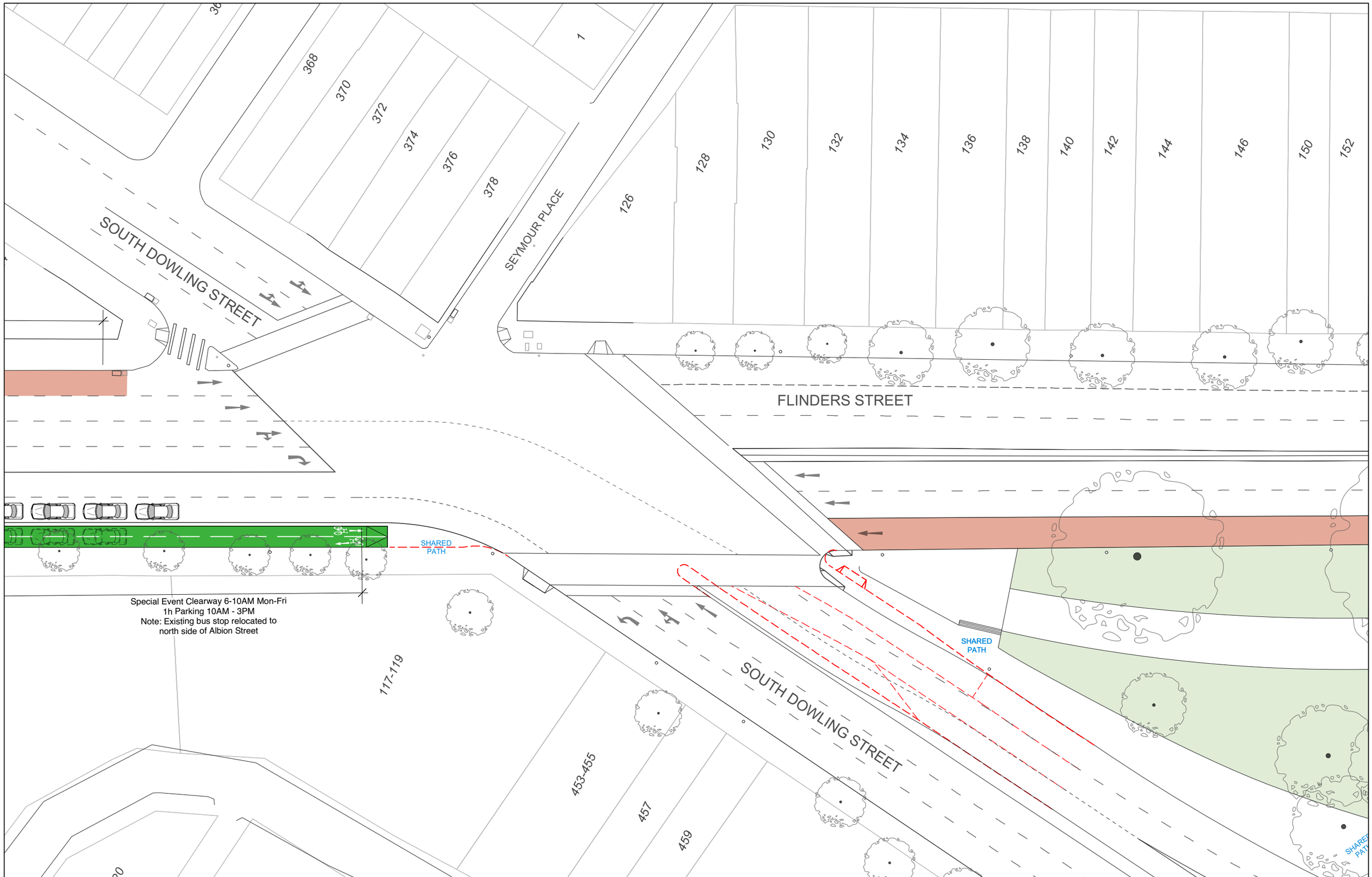
BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L202

DRAWING
MOORE PARK / FLINDERS / ALBION ST OPTION

OPTION
A



REV	AMENDMENT DESCRIPTION	DRAWN	CHKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)
SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com
LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

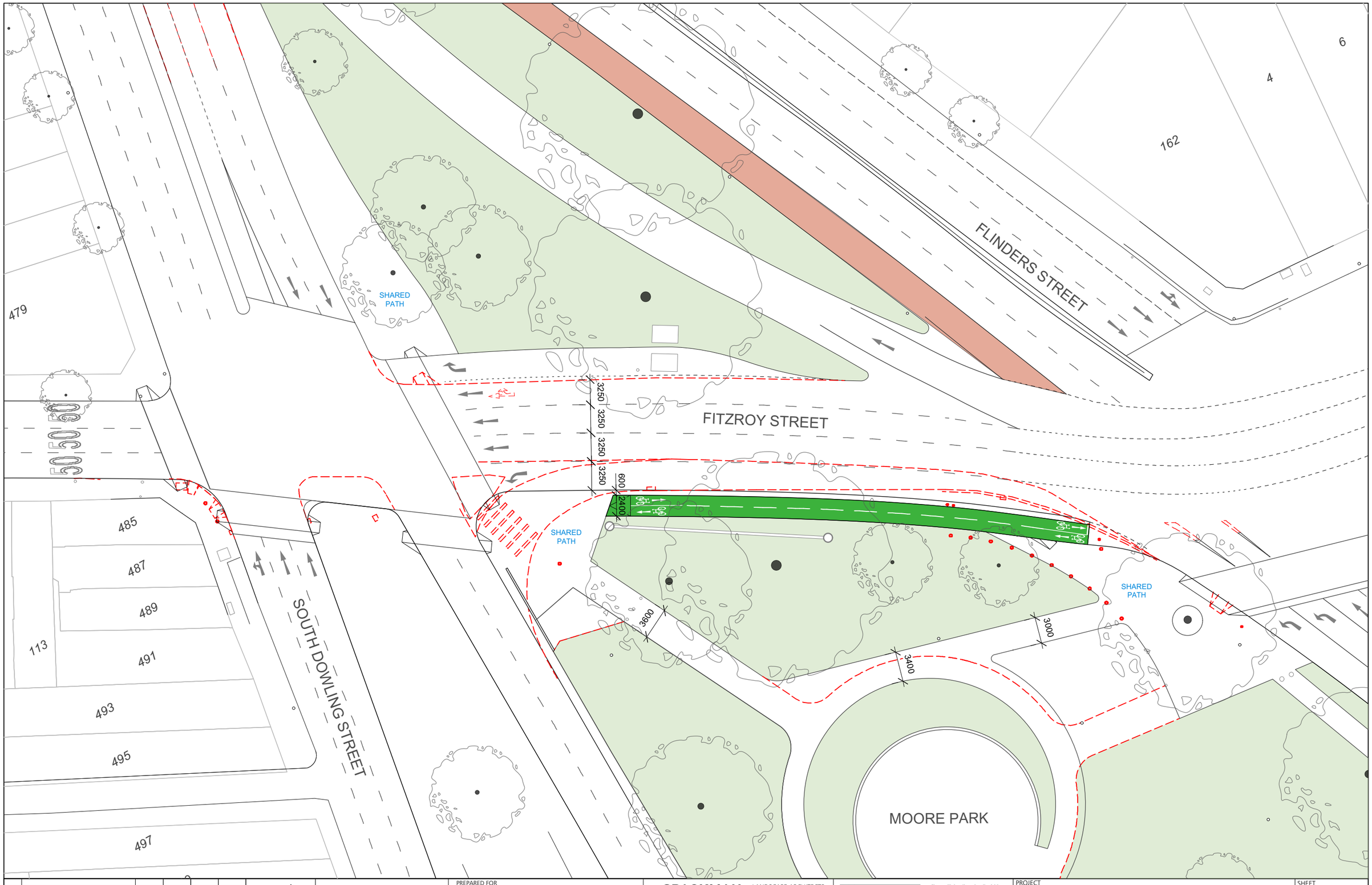
BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L203

DRAWING
MOORE PARK / FLINDERS / ALBION ST OPTION

OPTION
A



REV	AMENDMENT DESCRIPTION	DRAWN	CHCKD	APRVD	DATE
H	ISSUE TO TRAFFIC	DR	MD	MS	18.05.15

NORTH

0m 5m 10m
1:200 (A1) 1:400 (A3)
SCALE 1:400 @ A3

PREPARED FOR
CITY OF SYDNEY

SPACKMAN MOSSOP AND MICHAELS
PTY LTD ABN 65 065 578 985
www.spackmanmossopmichaels.com
LANDSCAPE ARCHITECTS
P.O. Box 880
Darlinghurst NSW 1300
T: 02 9361 4549
F: 02 9361 4569
info@sm2group.com.au

BITZIOS consulting
TRAFFIC ENGINEERING & TRANSPORT PLANNING
Flourmill Studios, Studio 203
3 Gladstone Street, Newtown
NSW 2042
bitziosconsulting.com.au
T: 02 9557 6202
F: 02 9557 6219
admin@bitziosconsulting.com.au

PROJECT
Bondi Junction to City Cycleway
MODELLING CONCEPTS

SHEET
L204

DRAWING
MOORE PARK / FLINDERS / ALBION ST OPTION

OPTION
A

C2. Detailed VISSIM model results of Option 1

Table C2.1 Intersection performance results – AM peak – Option 1

Intersection performance AM peak periods	Average Delay (6.30–7.30)	Level of Service (6.30–7.30)	Average Delay (7.30–8.30)	Level of Service (7.30–8.30)	Average Delay (8.30–9.30)	Level of Service (8.30–9.30)
Moore Park Road and Driver Avenue	9	A	47	D	45	D
Moore Park Road and Greens Road	11	A	35	C	33	C
Moore Park Road, Anzac Parade and Flinders Street	46	D	67	E	65	E
Fitzroy Street and South Dowling Street	32	C	38	C	39	C
Flinders Street and South Dowling Street	26	B	31	C	32	C
Flinders Street and Albion Street	15	B	21	B	24	B
Albion Street and Bourke Street	23	B	24	B	26	B
Fitzroy Street and Bourke Street	34	C	47	D	60	E

Table C2.2 Intersection performance results – PM peak – Option 1

Intersection performance PM peak periods	Average Delay (3.30–4.30)	Level of Service (3.30–4.30)	Average Delay (3.30–4.30)	Level of Service (3.30–4.30)	Average Delay (3.30–4.30)	Level of Service (3.30–4.30)
Moore Park Road and Driver Avenue	10	A	10	A	11	A
Moore Park Road and Greens Road	14	A	8	A	5	A
Moore Park Road, Anzac Parade and Flinders Street	44	D	59	E	53	D
Fitzroy Street and South Dowling Street	37	C	39	C	44	D
Flinders Street and South Dowling Street	28	B	29	C	35	C
Flinders Street and Albion Street	22	B	51	D	64	E
Albion Street and Bourke Street	23	B	75	F	199	F
Fitzroy Street and Bourke Street	47	D	51	D	90	F

C3. Detailed VISSIM model results of Option 2

Table C3.1 Intersection performance results – AM peak – Option 2

Intersection performance AM peak periods	Average Delay (6.30–7.30)	Level of Service (6.30–7.30)	Average Delay (7.30–8.30)	Level of Service (7.30–8.30)	Average Delay (8.30–9.30)	Level of Service (8.30–9.30)
Moore Park Road and Driver Avenue	9	A	36	C	25	B
Moore Park Road and Greens Road	10	A	30	C	19	B
Moore Park Road, Anzac Parade and Flinders Street	40	C	51	D	53	E
Fitzroy Street and South Dowling Street	27	B	27	B	29	C
Flinders Street and South Dowling Street	29	C	41	C	39	C
Flinders Street and Albion Street	15	B	20	B	21	B
Albion Street and Bourke Street	34	C	40	C	56	E
Fitzroy Street and Bourke Street	20	B	26	B	26	B

Table C3.2 Intersection performance results – PM peak – Option 2

Intersection performance PM peak periods	Average Delay (3.30–4.30)	Level of Service (3.30–4.30)	Average Delay (3.30–4.30)	Level of Service (3.30–4.30)	Average Delay (3.30–4.30)	Level of Service (3.30–4.30)
Moore Park Road and Driver Avenue	6	A	6	A	5	A
Moore Park Road and Greens Road	15	B	9	A	5	A
Moore Park Road, Anzac Parade and Flinders Street	36	C	34	C	34	C
Fitzroy Street and South Dowling Street	32	C	31	C	32	C
Flinders Street and South Dowling Street	32	C	34	C	41	C
Flinders Street and Albion Street	29	CC	34	C	40	C
Albion Street and Bourke Street	39	C	66	E	163	F
Fitzroy Street and Bourke Street	12	A	14	A	15	A