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Traffic Report – Microsimulation Analysis

City Section 100 Traffic Study Update

Prepared for Morris Property Group
18 June 2021

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TRAFFIC REPORT – MICROSIMULATION ANALYSIS
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1   Introduction

SMEC was commissioned by Morris Property Group (MPG) to conduct a traffic study for a proposed development in Section 100, Canberra City. The proposed development includes commercial space and retail space.

The Section 100 development is a redevelopment of the land currently occupied by a surface car park, which is accessed by the intersection at London Circuit and Gordon Street. The proposed development will provide publicly accessible parking to replace the existing surface parking available at the site.

This study includes traffic generation based on trip generation rates agreed with TCCS, traffic distribution using the Canberra Strategic Transport Model (CSTM) and network microsimulation analysis using Aimsun.

1.1   Project Location

The context and study areas covered by this study are shown in Figure 1.
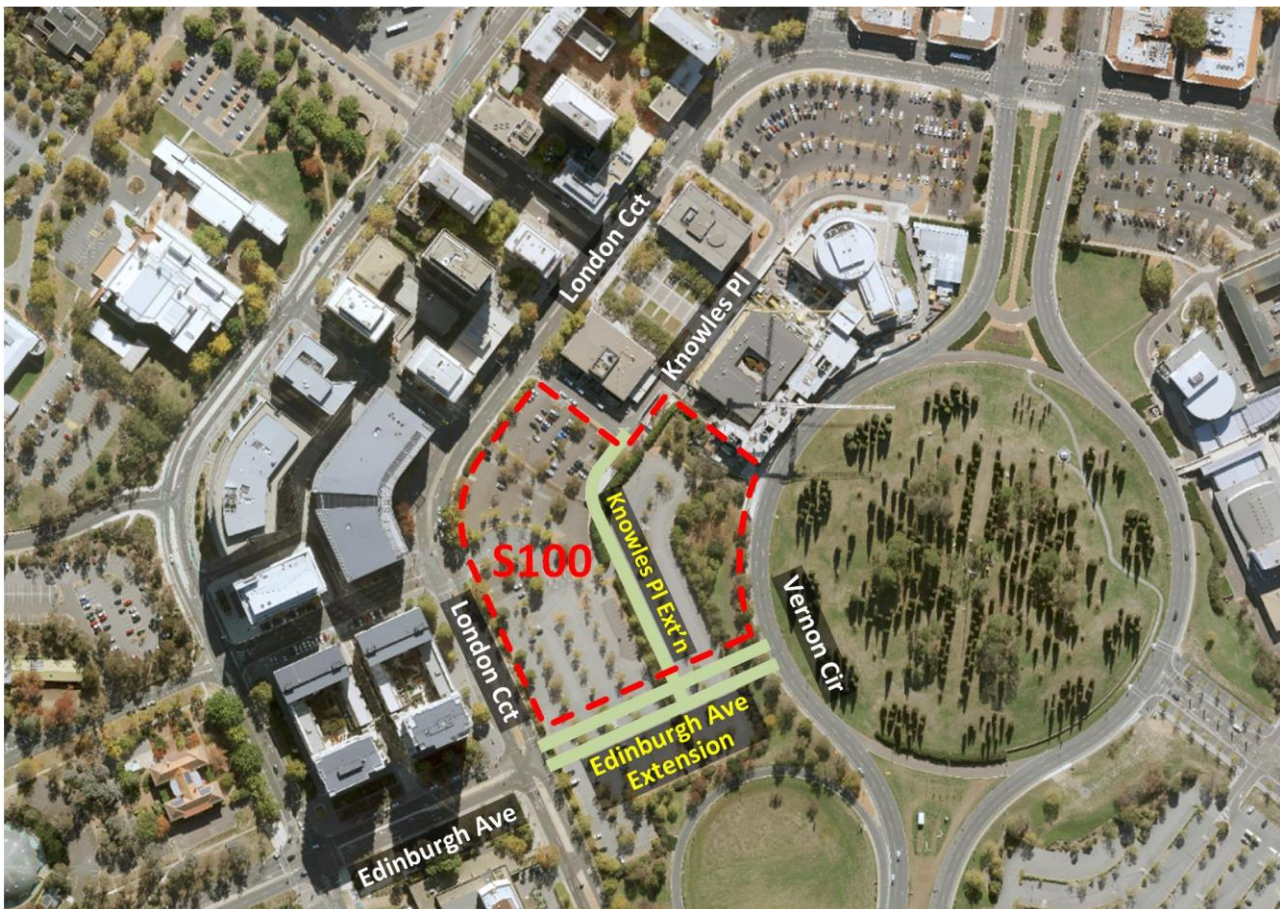
*Figure 1: Context and Study Area*

1.2   Objectives

The objectives of this study are to:

- Review existing traffic volumes
- Assess future traffic operations with and without the proposed development
- Provide recommendations about the appropriate intersection arrangements at the proposed development access points and the Edinburgh Avenue extension intersections with London Circuit and Vernon Circle

2 Existing Conditions and Proposed Development

2.1 Site Description and Existing Land Use

City Section 100 has a total area of approximately 25,000 m² and is zoned as a designated area under the National Capital Plan. The site is located in the City Hill precinct and is currently used as a car park, with 730 parking spaces (shown in Figure 1). Under the City Hill precinct controls, the site allows a range of land uses, including residential, retail and commercial.

2.2 Existing Road Network and Study Area

Section 100 is currently bounded by the following roads:

- London Circuit
- Vernon Circle
- Knowles Place

Current access to Section 100 is via Gordon Street, into the large public car park, and Knowles Place, into the private AFP parking area. The Gordon Street access point is a four-way signalised intersection. Knowles Place operates one-way southbound so vehicles accessing the police car park, at the southern side of the police station, enter at the northern end of Knowles Place and then travel past the ACT Supreme Court to the car park.

Other key roads in the area include:

- Edinburgh Avenue, and its extension to Vernon Circle
- Gordon Street
- Farrell Place
- University Avenue

The hierarchy of the roads around the study area is shown in Figure 2. The arterial roads, which allow high capacity travel between districts, are Northbourne Avenue, Commonwealth Avenue, Vernon Circle, Constitution Avenue, Edinburgh Avenue and Parkes Way. Marcus Clarke Street and London Circuit are classified as major collectors, which are intended to connect the arterial network to local districts and should only carry traffic originating or terminating in the local area.

University Avenue, McCoy Circuit and Ellery Crescent are classified as minor collectors, which link access streets to the major collector network. All other roads in the area are access streets, which should only carry traffic originating or terminating at land uses on those streets and should not carry any through traffic.

The area shown in green in Figure 2 covers a travel distance of two kilometres from the proposed Section 100 development (shown in red). Further details of the traffic impact and assessment methodology inside this study area are presented later in this report.
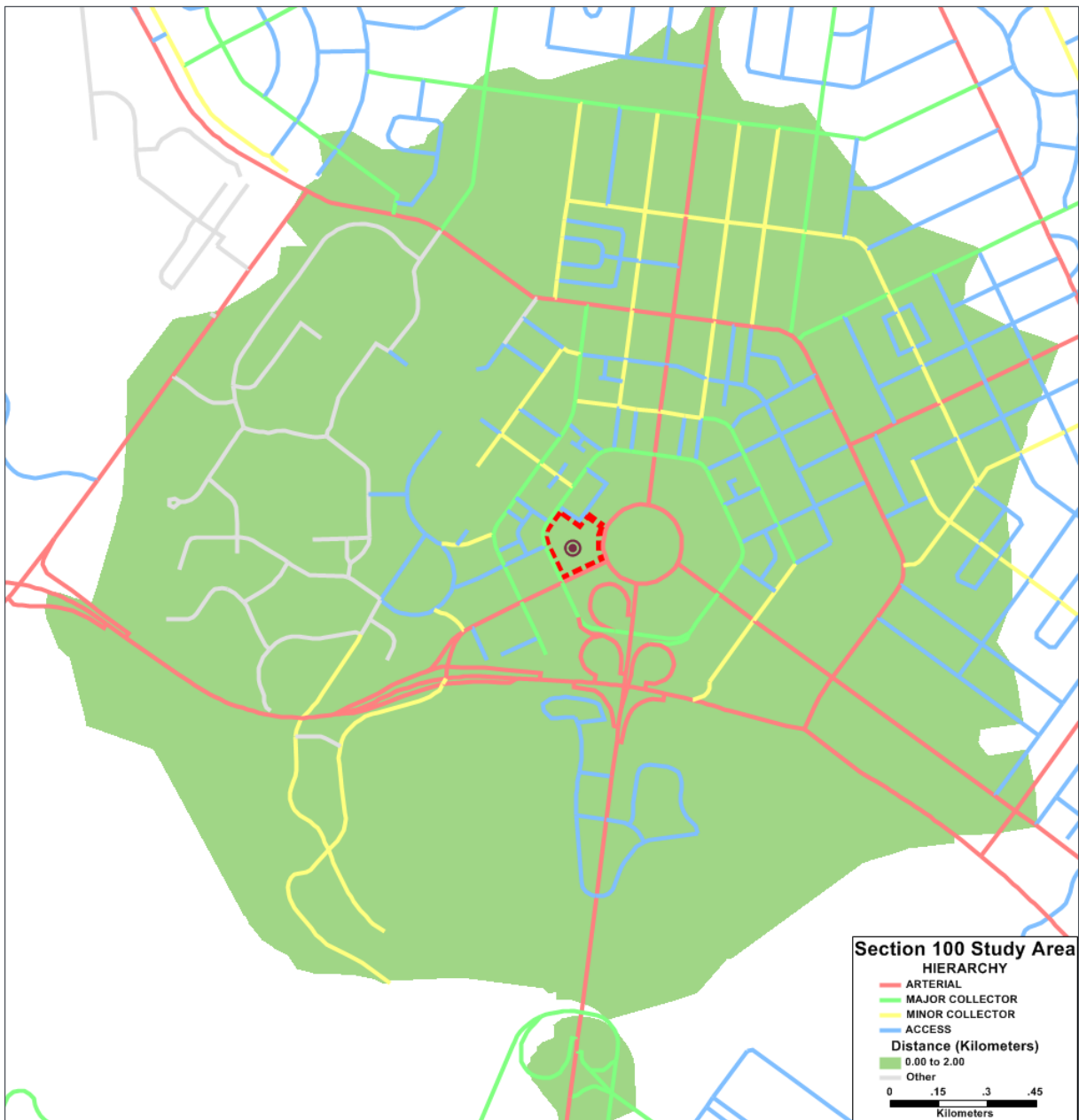
Figure 2: Road Hierarchy and Study Area

2.3 Proposed Development Land Use

The proposed City Section 100 development includes the land use shown in Table 1.

Table 1: Proposed Section 100 Land Use

FLOORSPACE	COMMERCIAL (OFFICE)	RETAIL	PARKING SPACES
One City Hill	34,000 m²	1,008 m²	867
The Barracks	65,609 m²	2,308 m²	1,093
Total	99,609 m²	3,316 m²	1,960

As noted previously, the existing public parking supply on Section 100 will be incorporated into the basement parking in the proposed development and will remain publicly accessible.

2.4   Proposed Site Access and Internal Road Network

The Section 100 development will be accessible via two separate access points:

- Knowles Place
- London Circuit – Gordon Street intersection (existing access point)

The provided public parking will be distributed across both basements and will be accessed from both entry points. Knowles Place will be extended south of its existing termination and will connect to the Edinburgh Avenue extension.

Preliminary modelling indicated that Knowles Place extension could be over-utilised by vehicles rat-running between London Circuit and Vernon Circle. These vehicles would cause significant issues at the intersections of Knowles Place extension with Knowles Place and Edinburgh Avenue. To minimise traffic through the area, which is intended to be a shared zone laneway with a pedestrian focus, it is proposed that Knowles Place extension will only be used by traffic associated with Section 100 (controlled by Local Traffic Only signs). At the intersection of Edinburgh Avenue extension and Knowles Place extension, there will also be no right turns allowed from Knowles Place extension. Right turns from Edinburgh Avenue extension into Knowles Place extension will still be allowed.

There will not be any driveway access to the development from Edinburgh Avenue extension or Vernon Circle, and access to the development from London Circuit will be at the signalised intersection with Gordon Street.

The layout of the development is shown in Figure 3.
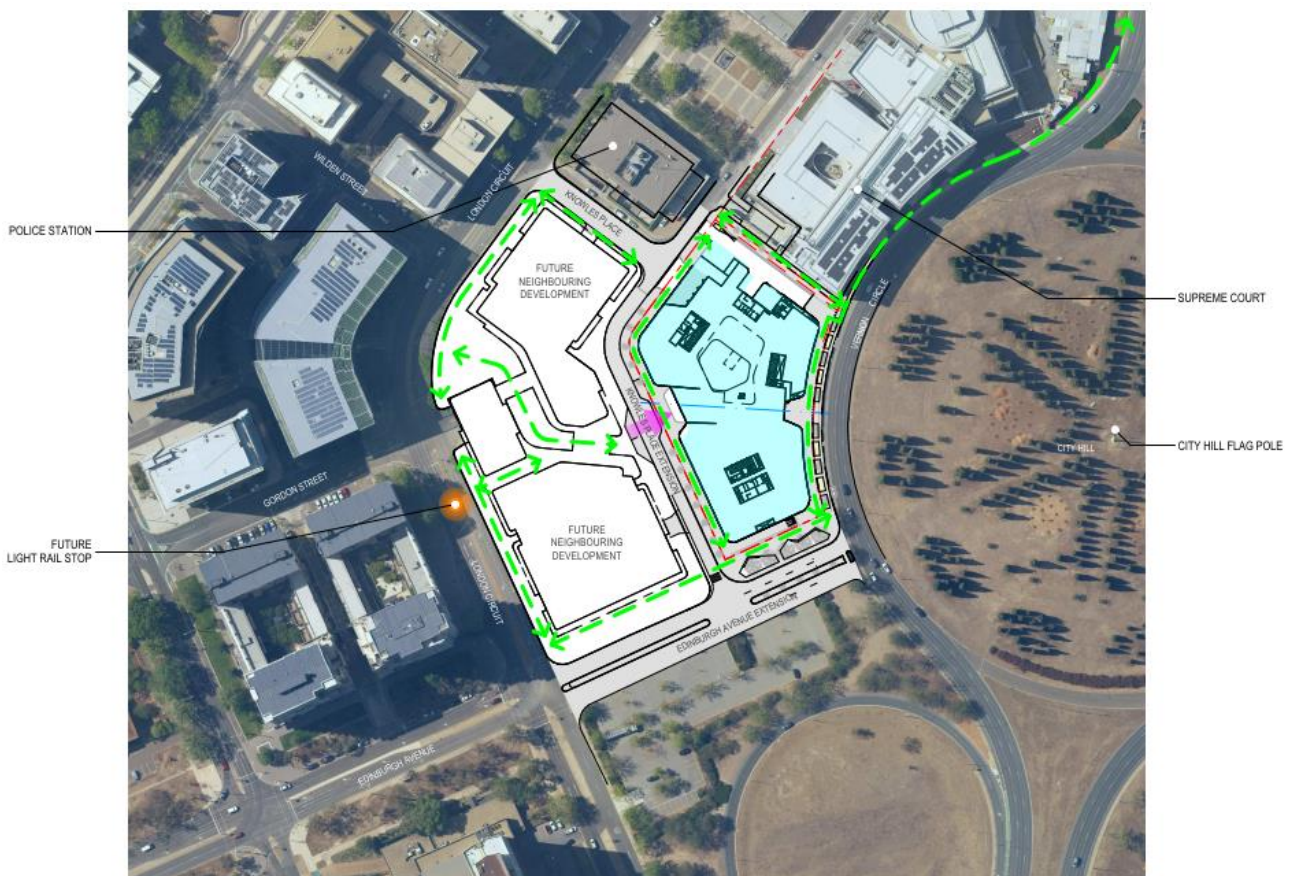
Figure 3: City Section 100 Layout (Source: MPG)

3 Traffic Generation

Traffic generated by the City Section 100 development has been calculated using traffic generation rates from the *Guide to Traffic Generating Developments* (RMS, 2002). AM and PM peak proportions have been sourced from the Guide to Traffic Generating Developments and the Institute of Transportation Engineers (ITE) *Trip Generation Manual*. Directional ratios for vehicles entering and exiting the development in each peak period have been sourced from the ITE Trip Generation Manual. The vehicle trip rates, directional splits and traffic generated by the development are shown in Table 2.

Table 2: Traffic Generated by Section 100

Land Use	Yield	Peak Period	Trip Rate	Peak Direction	Peak Split	Trips	Notes
Commercial	99,609 m²	AM	1.45 /100 m²	In	0.88	1,267	Rate: RMS Office and Commercial (daily rate), ITE 710 General Office Building (peak proportions)
				Out	0.12	173	
		PM	1.39 /100 m²	In	0.17	235	Direction: ITE 710 General Office Building
				Out	0.83	1,146	
Retail	3,316 m²	AM	6.27 /100 m²	In	0.48	100	Rate: RMS Shopping Centre (specialty shop component)
				Out	0.52	108	Direction: ITE 826 Specialty Retail Centre
		PM	4.60 /100 m²	In	0.56	85	
				Out	0.44	67	
Total		**AM**		**In**		**1,367**	
				Out		**281**	
				Total		**1,648**	
		PM		**In**		**320**	
				Out		**1,213**	
				Total		**1,533**	

Note: All trips generated in the table refer to vehicle trips

The vehicle trips generated by the retail component of the development have been calculated using published rates from RMS. Due to the location, surrounding landuses and public transport accessibility, this trip generation represents a conservative estimate.

4 Strategic Transport Modelling

The trip distribution has been conducted using the Canberra Strategic Transport Model (CSTM), which was most recently updated in 2019 using the 2016 Census and 2017 Household Travel Survey. This model contains a complete representation of the ACT's road network, including travel by car, bus and bicycle. Park & Ride, where travellers drive to a car park and then continue by bus to their destination, is also considered.

The model is an equilibrium model, in which travel decisions (origin/destination, mode choice, travel route etc.) are related to cost, where the cost of travel is minimised for every road user. As such, any changes to the model inputs and assumptions can have impacts far from where the change was made, with the severity of the change decreasing with distance, as the traffic adjusts and redistributes to minimise the average user cost.

The modelling was conducted for the AM and PM peak periods in the 2016 and 2031 model years. The strategic modelling outputs have been used to calculate growth and distribution of traffic volumes for the intersections surrounding the development. 2031 was selected as the future assessment year as it represents approximately 10 years after completion of the proposed development.

4.1.1 Model Scenarios

Modelling was conducted for the following scenarios:

- **2016 Base Case**: Land use and transport network for 2016 (calibrated base CSTM scenario).
- **2031 Do Minimum**: All land use and network assumptions already in the CSTM for 2031 but with the Edinburgh Avenue extension included.
- **2031 Section 100**: All land use and network assumptions already in the CSTM for 2031 with the Edinburgh Avenue extension and proposed Section 100 land use and car park access locations included.

Each of these scenarios was tested for both the AM and PM peak periods.

4.2   Model Assumptions

4.2.1   Zone Structure

The City Section 100 development area falls within the existing CSTM Zone 010125, as shown on the 2016 Base Case road network in Figure 4. The exact location of the Section 100 development area is also shown.
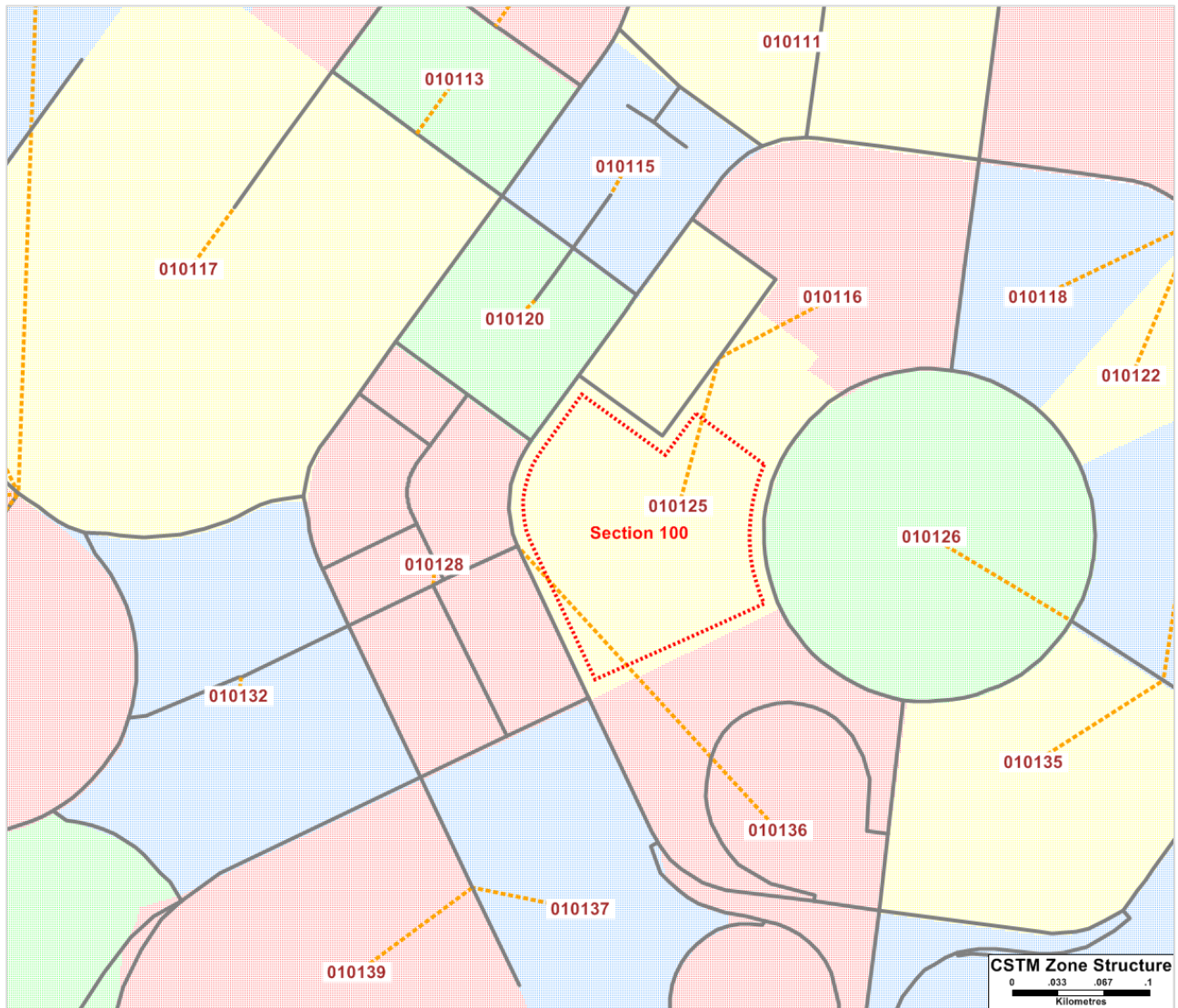
Figure 4: CSTM Zones in Development Area

For the 2031 Section 100 scenarios, shown in Figure 5, the proposed developments within Section 100 required the addition of a new zones (Zones 010142, 010143, 010144 and 010145, shown in Figure 5) to the CSTM. Zone 010125 is connected to Knowles Place and Zone 010136 is connected to Edinburgh Avenue extension, at its intersection with Knowles Place extension. Zone 010142 includes the commercial land use, 010145 includes the retail land use and zones 010143 and 010144 are not used in this scenario.
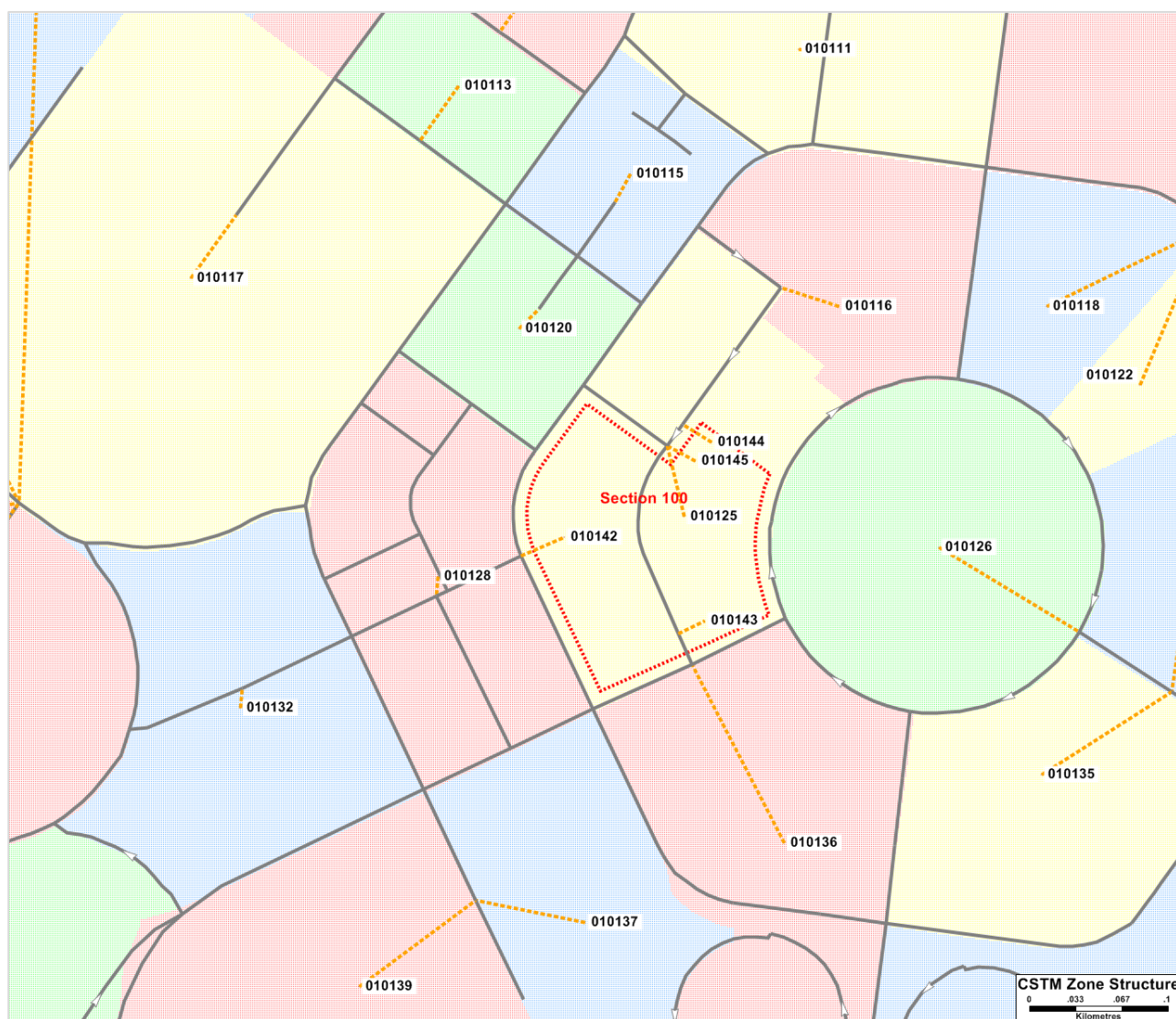
Figure 5: Updated Zone Connectors

4.2.2 Road Network

The incremental road network infrastructure improvements assumed to be present in each year from 2021 to 2031 were confirmed with TCCS in 2018, during calibration of the current version of the CSTM. Diagrams and tables showing the upgrades in 2021, 2026 and 2031 are included in Appendix A. The 2031 model includes all road upgrades shown in 2021 and 2026.

Intersections are represented in the CSTM at a high level, with those that require vehicles to stop or give way being modelled through a reduction in capacity on the approaching roads. No discrimination is made by intersection control method.

4.2.3 Public Transport

The public transport network in 2021 onwards is based on ACTION's proposed Network 2018 provided to SMEC in March 2017, with the addition of Light Rail Stage 1 (LRS1) and the removal of bus routes operating along the LRS1 corridor. While Light Rail Stage 2 (LRS2) is planned for 2031, it is not included in the future models as the route and impact on the road network is not yet known. The traffic benefits of LRS2 are therefore not included in the model.

4.2.4   Parking Capacity

The CSTM contains parking capacity for each of the zones within the City, so that car trips to and from the City are distributed only to locations where parking is available. The existing parking capacity has been retained in zones 010125 and 010136. New zones (Zone 010142, 010143, 010144 and 010145) were created for Section 100, and are not part of this parking distribution. As such, the traffic generated by Section 100 travels to and from the new zones and existing zones are unchanged in terms of land use and parking capacity.

4.2.5   Land Use

The base land use data was provided by TCCS and is dated 6 December 2018. The land use assumption for the *2031 Do Minimum* scenario is shown in Table 3. For this scenario, Zone 010125 is assumed to be still operating as a surface car park with no development on the site. Zone 010136 (City Block 20 Section 63, in between Edinburgh Avenue extension and Commonwealth Avenue) is assumed to be developed by 2031.

Table 3: CSTM 2031 Do Minimum Land Use

Zone	Description	Population	Employment	Retail Space	School Enrolments	Tertiary Enrolments
010125	City	0	284	0	0	0
010136	City	0	323	0	0	0

For the *2031 Section 100* scenario, the base land use in Zones 010125 and 010136 is the same as in *2031 Do Minimum*. New zones were created to contain the Section 100 land use and to generate the number of car trips calculated in Table 2. Due to the way the CSTM operates, this modelled land use is not identical to the proposed land use in Table 2, but does generate the required number of car trips after the CSTM's specific trip generation and mode split calculations have been completed.

4.3   Strategic Transport Modelling Results

Diagrams extracted from the CSTM for each scenario are shown in the following sections. These show the hourly peak volumes and volume/capacity ratios, as well as peak volume differences between scenarios. The peak traffic difference (compared to the Base Case) are included for the 2031 With Section 100 scenario.

4.3.1   2016 Base Case

The *2016 Base Case* hourly flow diagrams for AM and PM are shown in Figure 6 and Figure 7, respectively.

In the 2016 AM peak period, most of the road network around the Section 100 site operates well, with a few roads operating near capacity. Edinburgh Avenue, west of Hales Street, is near capacity, while the eastbound exit ramp from Parkes Way is over capacity. Marcus Clarke Street between Edinburgh Avenue and Gordon Street, the ramps between London Circuit, Parkes Way and Commonwealth Avenue, Northbourne Avenue north of London Circuit and most of Vernon Circle operate close to their capacity. London Circuit between Edinburgh Avenue and Northbourne Avenue operates below 70% of its capacity.
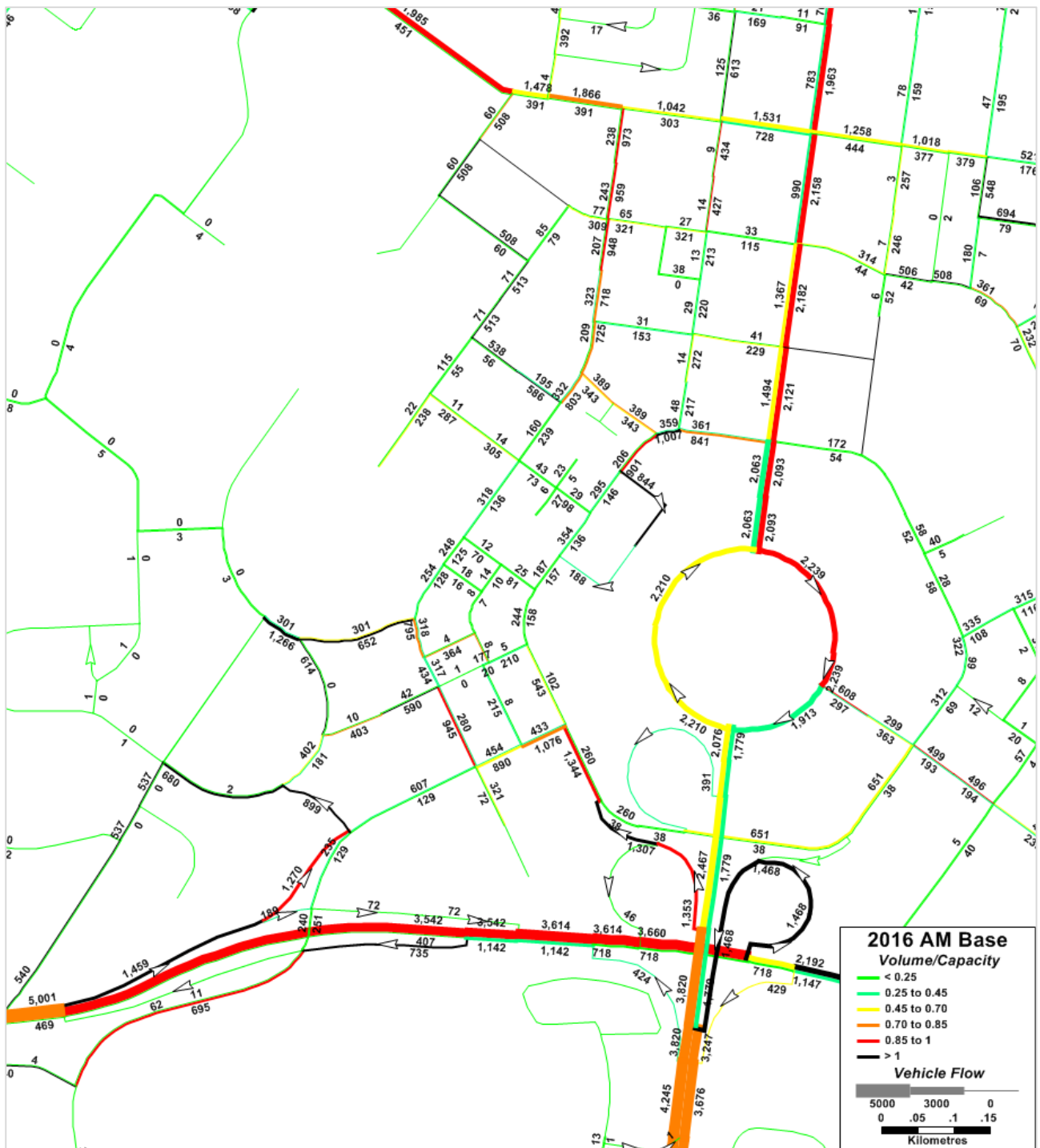
Figure 6: 2016 Base Case AM Hourly Flow and V/C

In the 2016 PM peak period, all of the local network operates well, except for Vernon Circle southbound, which operates near its modelled capacity, which is 2,300 vehicles per hour. Some small sections of Marcus Clark Street northbound operate near capacity, as does Edinburgh Avenue and Parkes Way.
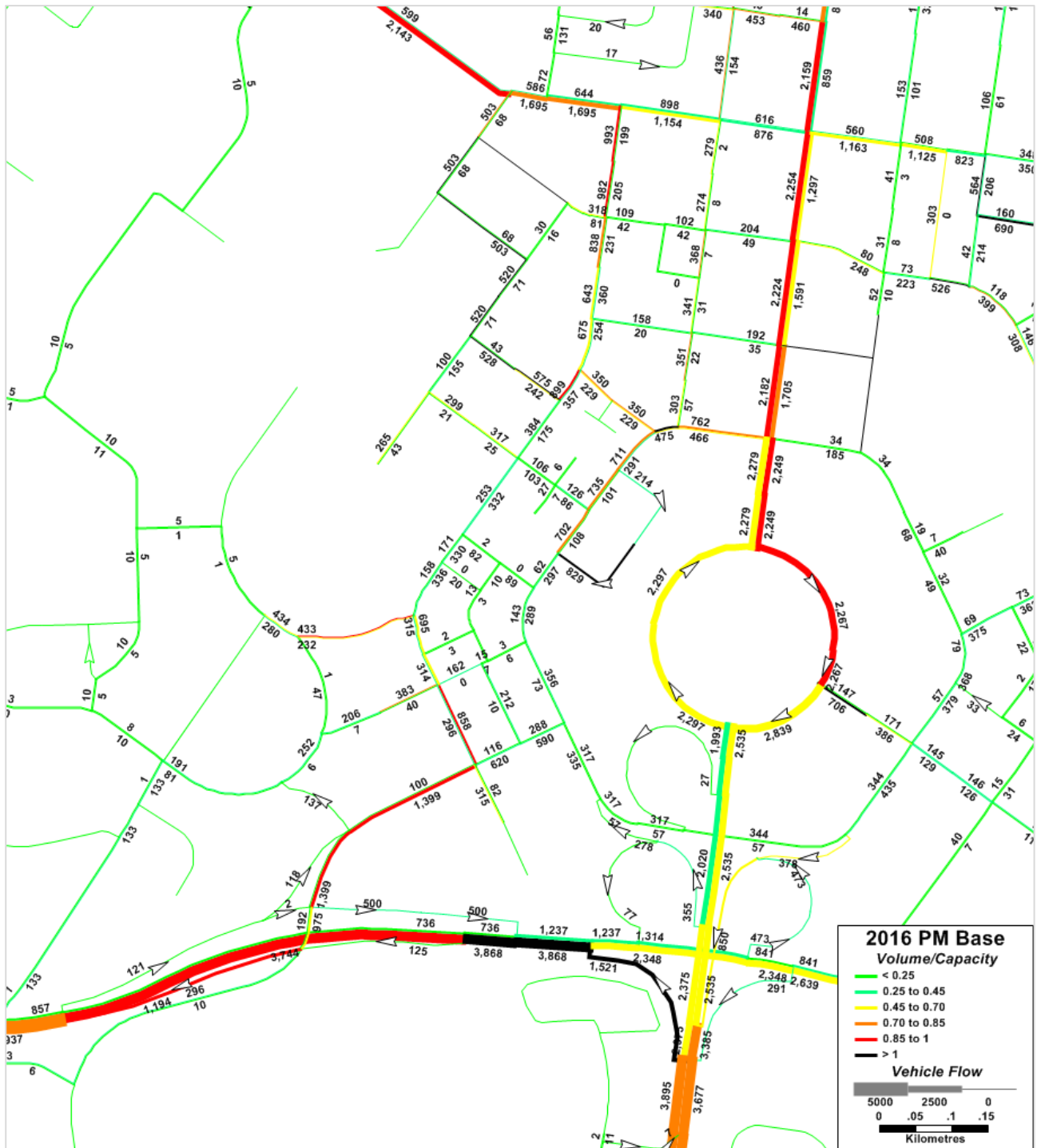
Figure 7: 2016 Base Case PM Hourly Flow and V/C

4.3.2   2031 Do Minimum

The *2031 Do Minimum* scenario, shown in Figure 8, includes the extension of Edinburgh Avenue from London Circuit to Vernon Circle, which leads to some traffic redistribution around the study area.

There appears to be some travel from east to west from Constitution Avenue to Edinburgh Avenue via Vernon Circle. This movement requires many lane changes across a short distance and is likely to be unsafe under the current intersection layout. Hales Street, McCoy Circuit, Gordon Street and Ellery Crescent are all over capacity in some locations. London Circuit is generally below 70% of capacity, with some sections near Northbourne Avenue and Commonwealth Avenue operating around 85% of capacity. The key access routes to Section 100, being Edinburgh Avenue and London Circuit, have spare capacity.
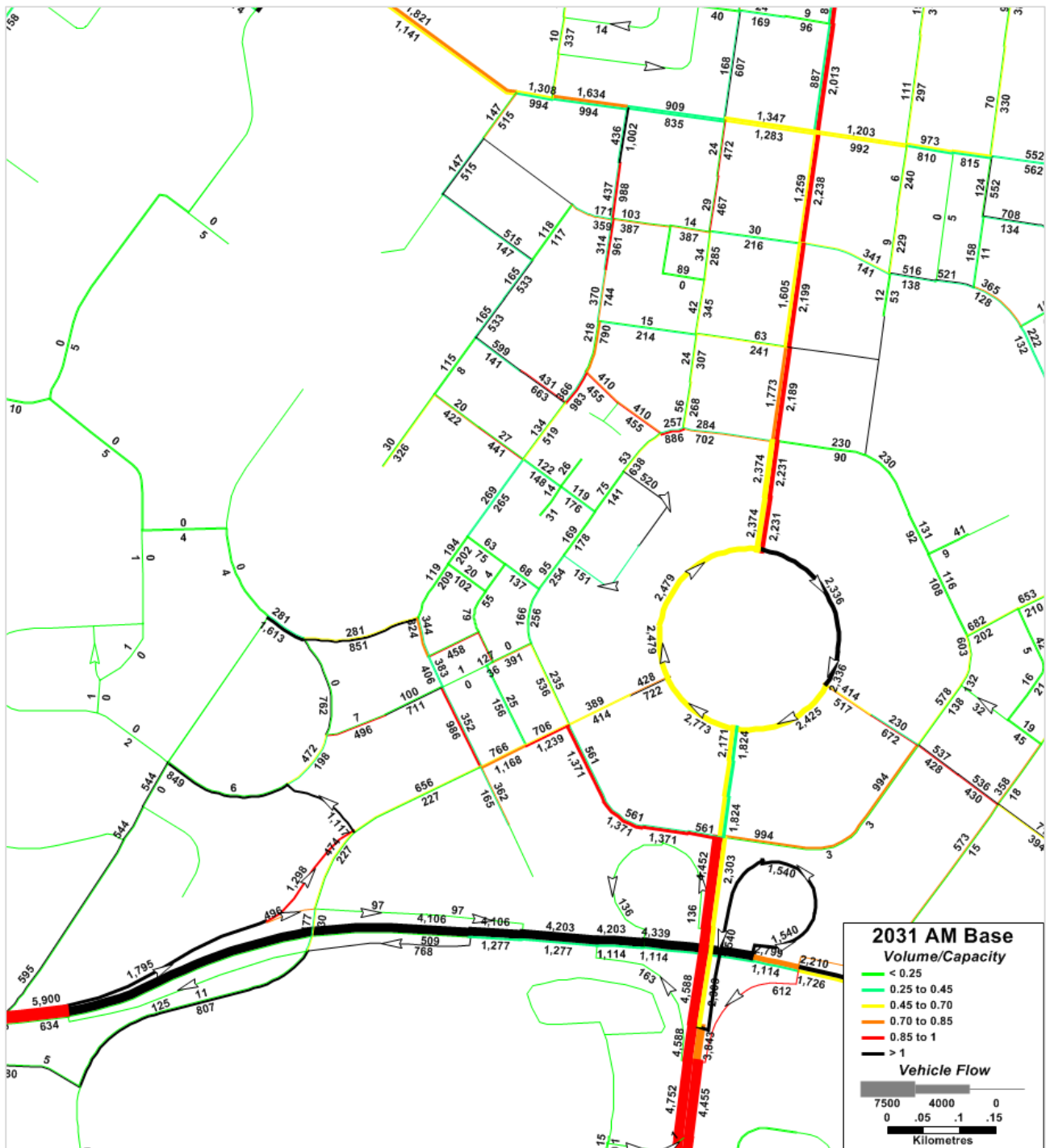
Figure 8: 2031 Do Minimum AM Hourly Flow and V/C

In the 2031 Do Minimum PM peak shown in Figure 9, Edinburgh Avenue, west of London Circuit, operates between 45-100% of capacity, as does London Circuit, between Commonwealth Avenue and Edinburgh Avenue. The Edinburgh Avenue extension operates very well northbound and below 70% of capacity southbound. The key southbound routes away from Section 100, being Edinburgh Avenue and London Circuit, operate very close to capacity. Northbound routes from Section 100 include Marcus Clarke Street, Barry Drive and Northbourne Avenue, all of which operate at or over capacity in some areas.
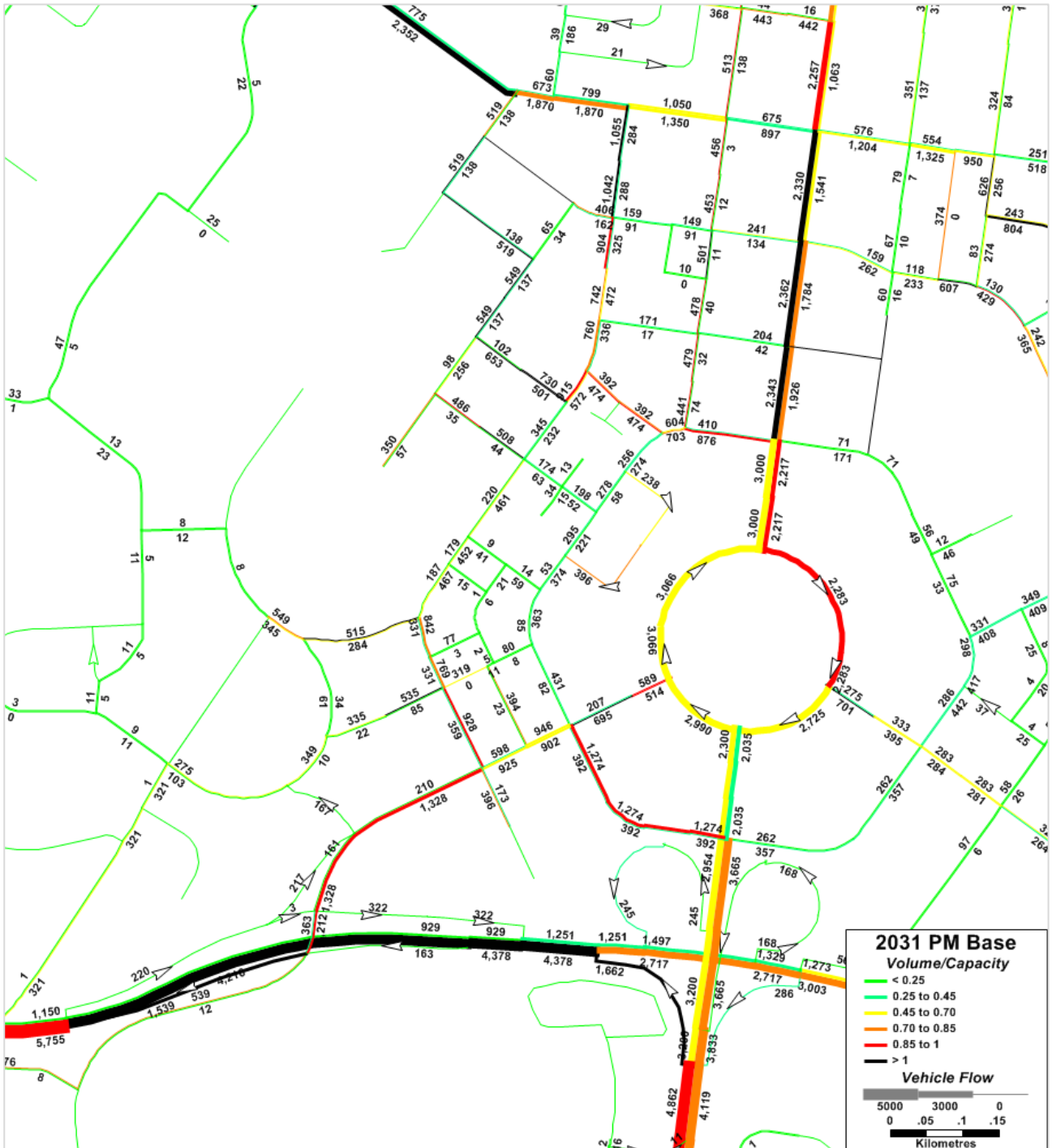
Figure 9: 2031 Do Minimum PM Hourly Flow and V/C

4.3.3   2031 Section 100

The *2031 Section 100* scenario includes the extension of Knowles Place to intersect the Edinburgh Avenue extension and converts the existing southern part of Knowles Place to two-way operation.

In the 2031 With Section 100 AM peak period, shown in Figure 10, there is an increase in congestion around the study area. Knowles Place operates near capacity at both the northern and southern ends. The section of Vernon Circle (southbound) between Northbourne Avenue and Constitution Avenue operates near capacity but the rest of Vernon Circle has spare capacity. Edinburgh Avenue extension, between Vernon Circle and Knowles Place extension operates at capacity. London Circuit, between Commonwealth Avenue and Edinburgh Avenue operates over capacity. Parkes Way, and some ramps at Edinburgh Avenue and Commonwealth Avenue, operate over capacity.
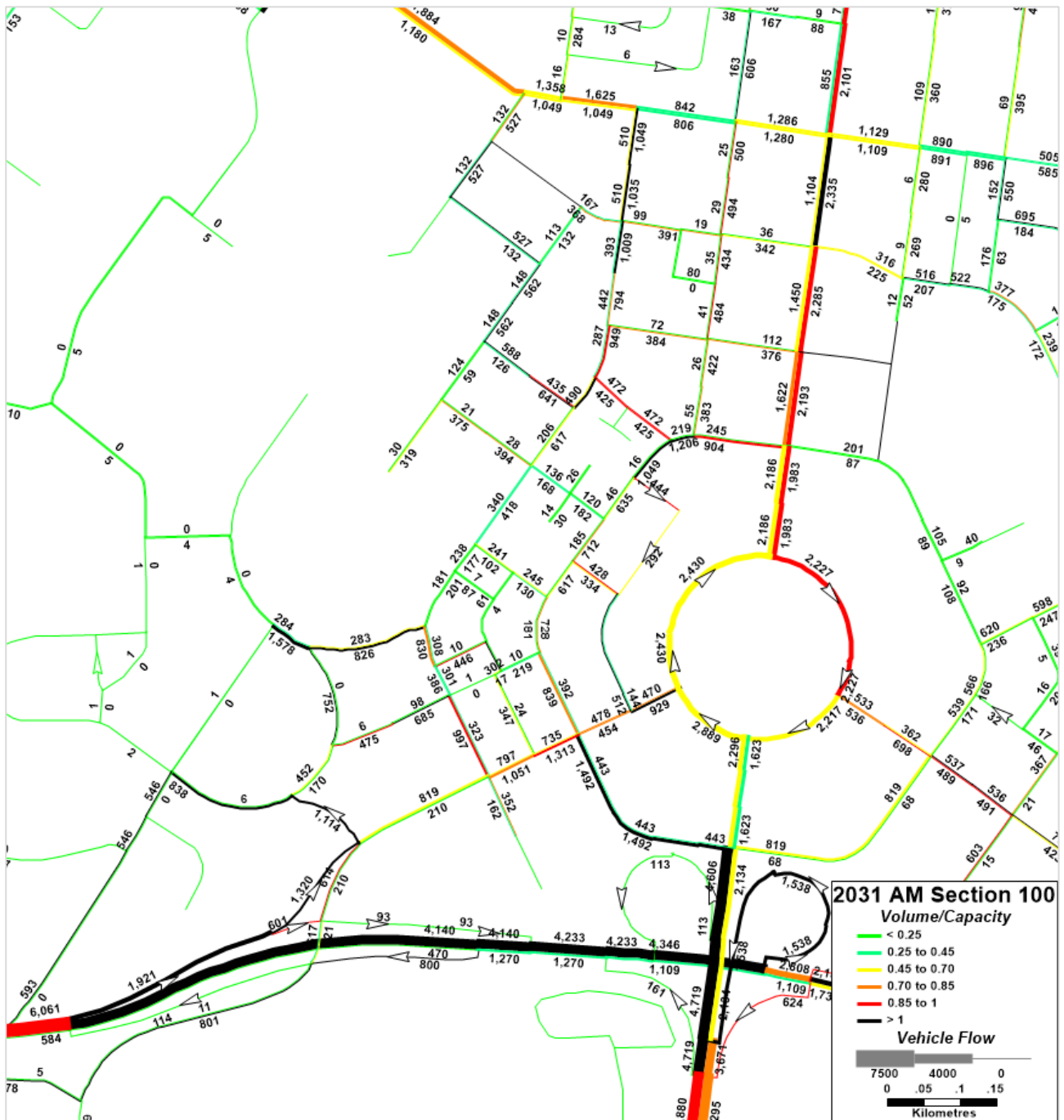
Figure 10: 2031 With Section 100 AM Hourly Flow and V/C

Figure 11 shows the flow differences between 2031 Do Minimum and 2031 Section 100 in the AM peak period. There is a small increase in traffic on Vernon Circle northbound between Commonwealth Avenue and Edinburgh Avenue, with a decrease between Edinburgh Avenue and Northbourne Avenue. There are small increases to traffic volumes on Commonwealth Avenue northbound, Edinburgh Avenue extension, Knowles Place, Knowles Place extension, Farrell Place, University Avenue and parts of Marcus Clarke Street and London Circuit, likely from traffic travelling between Section 100 and Belconnen. Outside of the immediate area shown in Figure 11, volume changes on roads are typically less than 50 vehicles per hour.
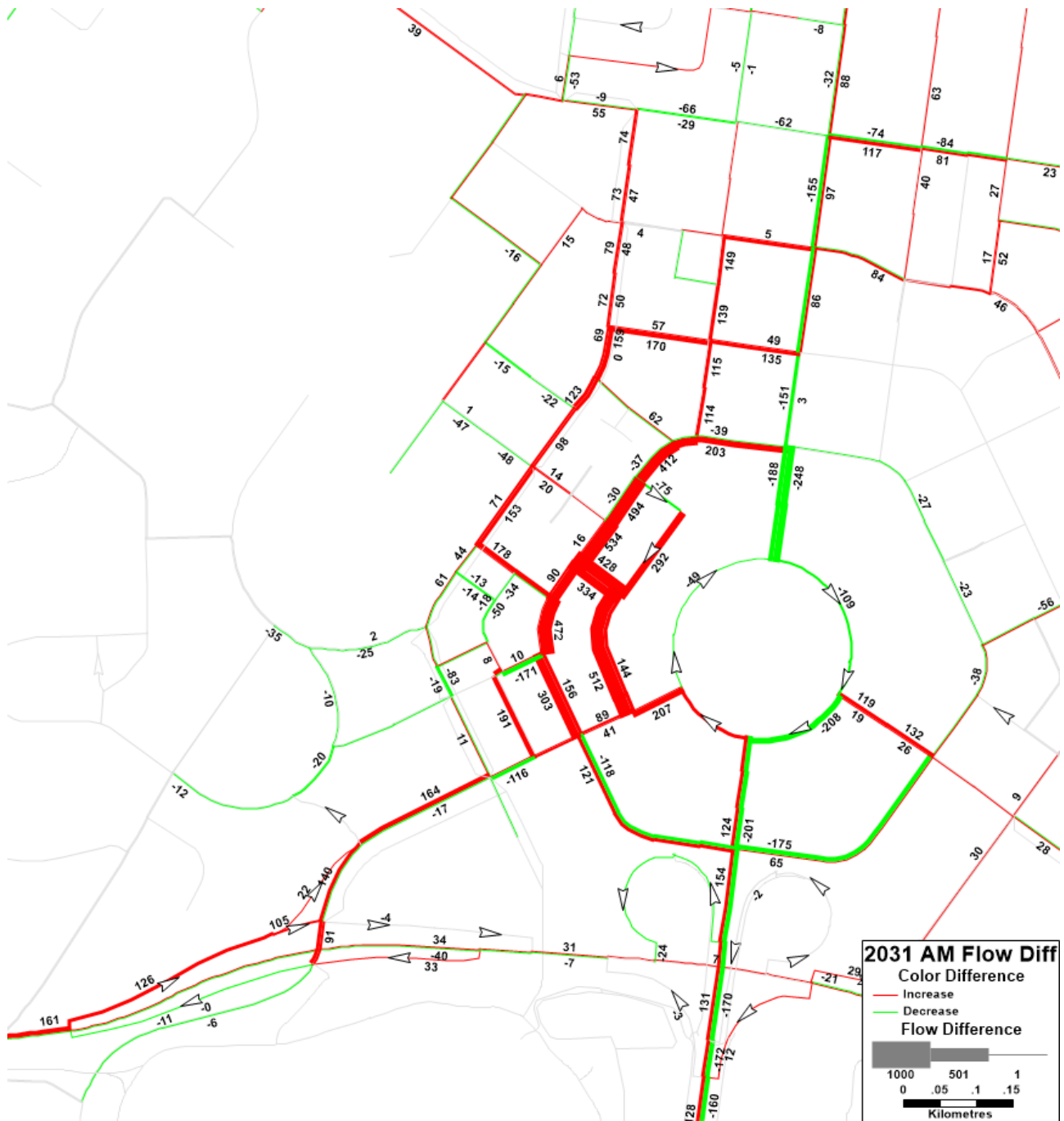
Figure 11: 2031 Section 100 Compared to 2031 Do Minimum AM Hourly Flow Difference

In the 2031 With Section 100 PM peak period, shown in Figure 12, the western (northbound) section of Vernon Circle operates well, but sections of Knowles Place, Knowles Place extension and Edinburgh Avenue extension operate over capacity. Edinburgh Avenue and London Circuit generally operate near capacity with some sections over capacity. Northbourne Avenue northbound and Barry Drive Westbound also operate over capacity. Parts of Parkes Way also operate over capacity.
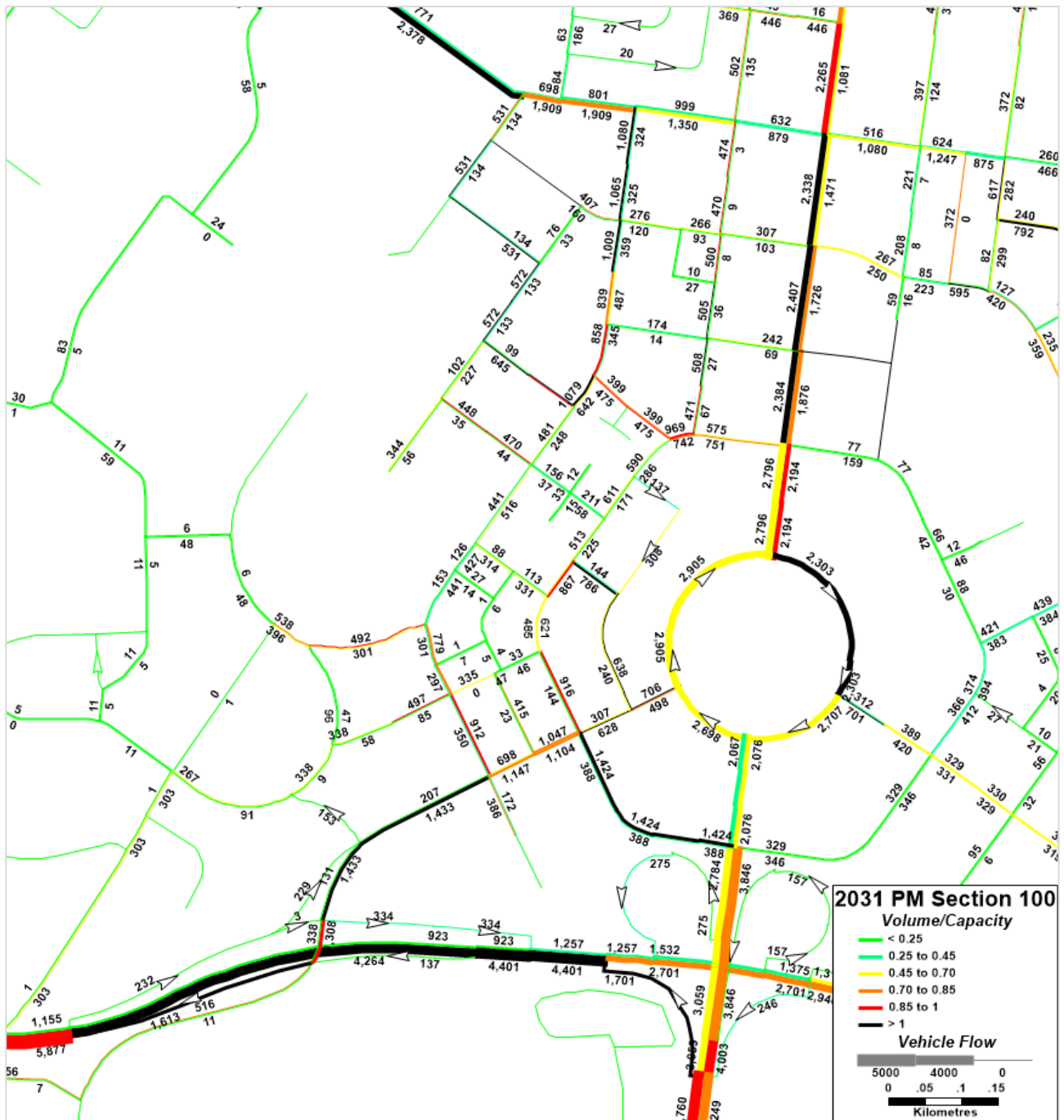
Figure 12: 2031 With Section 100 PM Hourly Flow and V/C

Figure 13 shows the traffic volume differences in the 2031 PM peak period with Section 100 compared to the Do Minimum scenario. Volume differences are typically moderate, with growth on Knowles Place, Knowles Place extension, Edinburgh Avenue, Edinburgh Avenue extension, London Circuit, Farrell Place and Marcus Clarke Street. There is a reduction in traffic on Northbourne Avenue and Vernon Circle. The traffic volume changes suggest that the major origin/destinations of traffic travelling to and from Section 100 are to the south and west. Outside of the immediate area shown in Figure 13, differences are less than 100 vehicles per hour.
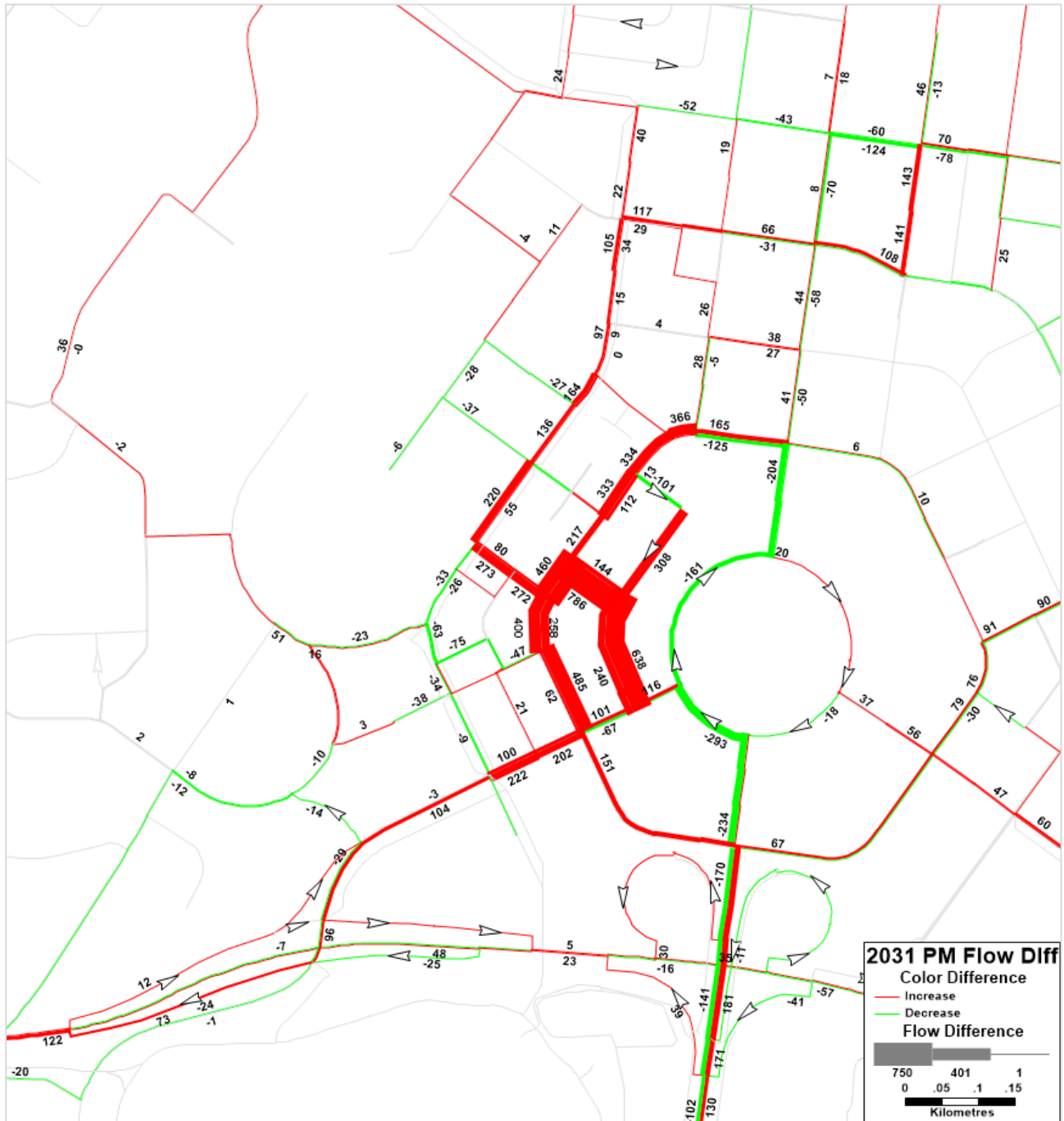
Figure 13: 2031 With Section 100 Compared to Do Minimum 2031 PM Hourly Flow Difference

4.3.4 Strategic Transport Modelling Summary

The strategic transport modelling carried out has shown the expected growth from 2016 to 2031 and the likely impact of the traffic generated by Section 100 on the local road network. Increased traffic volumes and delays on some roads, including Edinburgh Avenue, London Circuit and Marcus Clarke Street, has led to reductions in traffic on other roads connected to those roads, including Northbourne Avenue and Commonwealth Avenue.

For most of the roads that are expected to have an increase in traffic, the additional traffic does not cause the roads to operate over capacity, except for small sections of London Circuit and Marcus Clarke Street. In the 2031 PM peak, the development of Section 100 causes parts of London Circuit, Edinburgh Avenue, and Marcus Clarke Street to operate over capacity. All other roads are expected to be able to cater for the additional Section 100 traffic without going over capacity.

The findings of the strategic modelling process offer an indicative assessment of the impacts of the proposed development on the local road network. A detailed microsimulation assessment of the impact has been carried out using Aimsun, results of which are presented in the following chapter.

5 Micro-Simulation Modelling

The microsimulation model has been developed to fully understand the impacts of traffic generated by the proposed development in Section 100 on the surrounding road network in the AM and PM peak periods in 2031.

Aimsun version 8.3 was used for this study. The final models use the microsimulation functionality.

A summary of the model development, calibration and validation process is presented here. Further details of this process are included in the Model Calibration Report, attached as Appendix B to this report.

5.1 Model Development

5.1.1 Model Periods

The modelling was conducted for the weekday AM and PM peak periods, which were:

- AM Peak: 08:00 to 09:00
- PM Peak: 17:00 to 18:00

A 30 minute warm-up period was used before the modelled period.

5.1.2 Model Study Area

The area modelled for this study was agreed with TCCS and comprises the roads immediately surrounding Section 100, as well as major roads in the area, as shown in Figure 14.
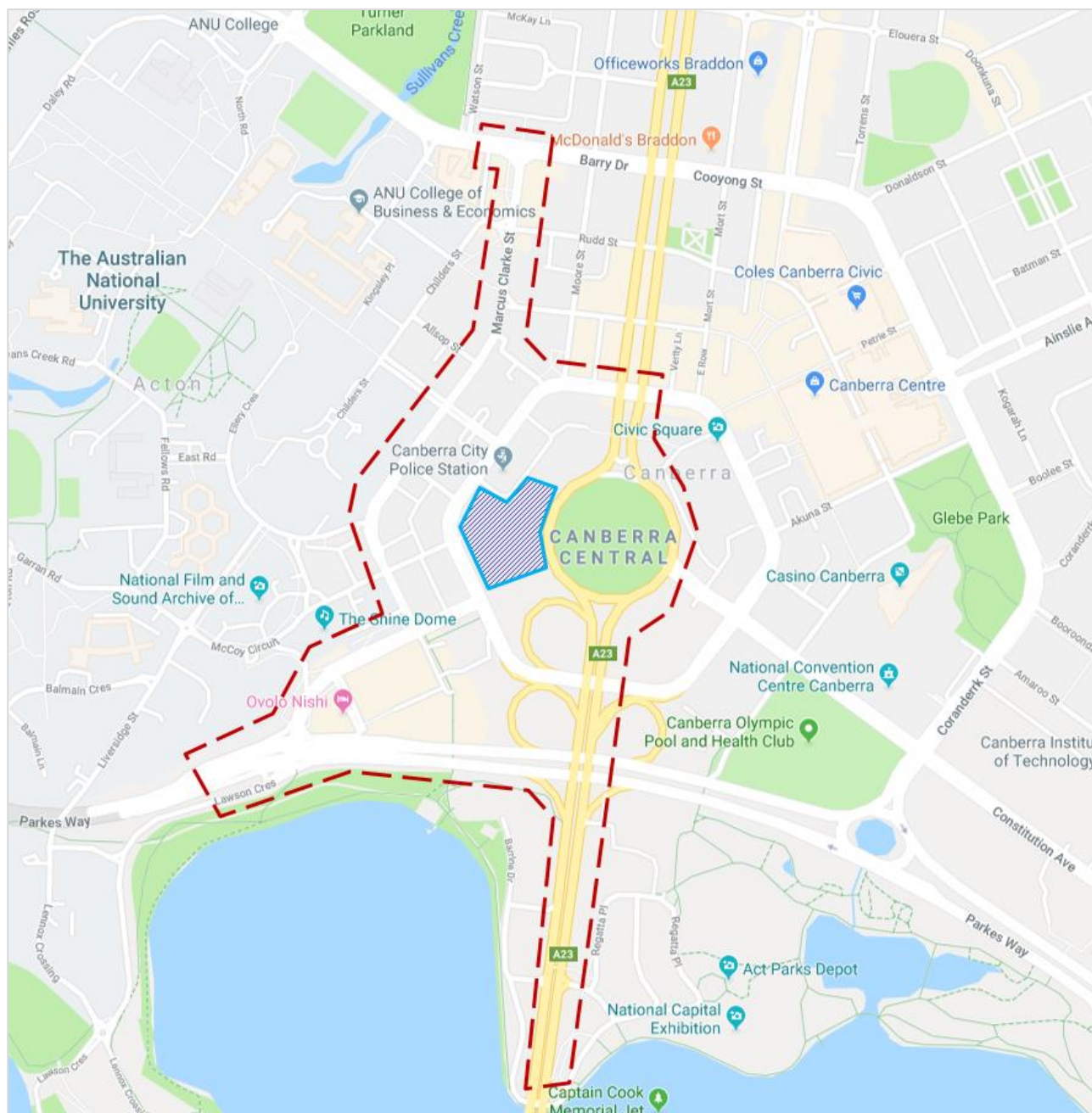
Figure 14: Model Area (Source: TCCS)

5.2 Data Collection

Traffic surveys were undertaken to inform the calibration and validation steps of the traffic modelling process. These surveys are fundamental to validity of the model and comprised the following:

- Intersection counts:
    - Manual counts (AM and PM peak video survey) for 21 locations
    - SCATS loop detector data (24-hour, 7-day data) for five locations

5.3 Network Development

5.3.1 Base Model Network

The model network is shown in Figure 15. The model has been coded to a microsimulation standard within this area and the assignment takes place entirely within it.
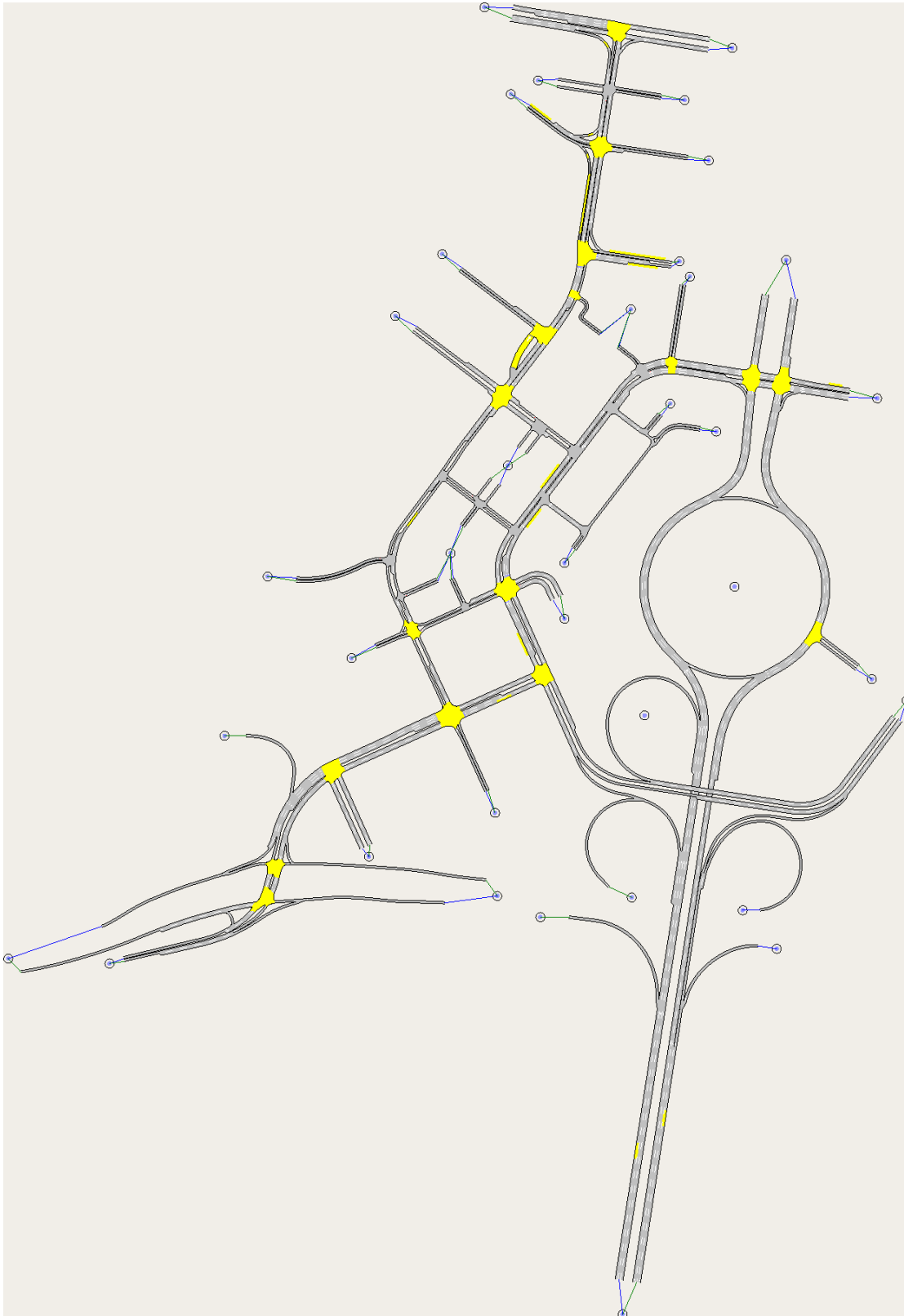
Figure 15: Aimsun Model Area

5.3.2 Model Geometry

The model has been coded to micro-simulation standard, with all roads represented, except for some minor local streets which do not carry significant through traffic. All intersections in the area have been coded. This was coded using recent aerial imagery from ACTMapi and TCD Grid drawings from TCCS.

5.3.3 Modelled Vehicles

The model uses default vehicle types. These vehicle types are intended to represent a typical urban network in ACT or NSW.

5.3.4 Speed Limits

All speed within the study area have been coded according to the road speed limits as listed below:

- 80 km/h
    - Parkes Way Ramps
- 70 km/h
    - Commonwealth Avenue
- 60 km/h
    - London Circuit (parts)
    - Northbourne Avenue
    - Edinburgh Avenue
    - Vernon Circle
- 40 km/h
    - Marcus Clarke Street
    - London Circuit (parts)
- All others 50km/h

5.3.5 Traffic Signals

There are 14 signalised sites in the model area, which are:

- Barry Drive/Marcus Clarke Street
- Marcus Clarke Street/Rudd Street/Rimmer Street
- Marcus Clarke Street/Alinga Street
- Marcus Clarke Street/Allsop Street
- Northbourne Avenue/London Circuit
- Marcus Clarke Street/University Avenue
- London Circuit/Gordon Street
- Vernon Circle/Constitution Avenue
- London Circuit/Edinburgh Avenue
- Marcus Clarke Street/Edinburgh Avenue
- Edinburgh Avenue/Phillip Law Street
- Parkes Way/Edinburgh Avenue (North)
- Parkes Way/Edinburgh Avenue (South)
- Commonwealth Avenue pedestrian crossing

TCCS provided traffic signal data to inform the configuration of the traffic signals within the model. The following data were supplied for each intersection:

All intersections have been coded with fixed time operation. The phase and cycle times were based on the times supplied by TCCS, with minor variations to improve performance, if required.

All the signal phase operations and phase times in the model have been manually configured based on the SCATS data. This data indicates which signal phases ran during the peak periods and the average duration for which each phase ran. This information was then used as the basis for creating the signal plans in the base model. The average phase times supplied by TCCS are presented in the following sections. The actual modelled phase times have been adjusted to match adjacent intersections if the average is less than the sum of minimum green time and inter-green time (typically 12 to 16 seconds).

5.4 Demand Development

The traffic demand on the network is driven by the trip matrices, which form an input into the Aimsun model. This section describes the development of the base year trip matrices for calibration of the network assignment model.

The data used to develop existing base case demand matrices are from two key sources:

- Demand matrices from the CSTM
- Traffic counts, including SCATS volumes and manual intersection counts.

Initial trip matrices were extracted from the CSTM. These matrices represent the number of vehicles travelling into, out of and through the model sub-area cordon shown in Figure 14 as modelled in the CSTM. The base model matrices represent the morning and evening peak periods for a typical weekday in 2016.

The counts were carried out during February 2019, providing AM and PM peak traffic demand on the roads and through intersections in the area.

The traffic demand for the road network was estimated as a zone to zone trip matrix for each of the peak periods. The development of these matrices is described in the following subsections.

For each of the peak periods, a sub-area pattern matrix was generated using the static traversal tool in Aimsun as a basis for generating each final 2019 traffic demand matrix. The pattern matrices were then modified using Aimsun's static adjustment tool to match the observed traffic counts. The process was as follows:

- Identified, for each count location, the origin-destination pairs whose traffic would pass through the count location
- Expressed an estimate of the count as the sum of the volumes in the identified origin-destination pairs
- Compared the estimated volumes with the counted volumes and average the GEH statistic of the differences
- Adjusted the values of the prior matrices to minimise the average of the GEH statistic of the differences.

This methodology is carried out by Aimsun during the OD matrix adjustment process. It undertakes the process iteratively, progressively refining the outcome. The output is a matrix that, when assigned to the network, much more closely matches the observed counts than the input matrix.

The traffic assignment is a dynamic, microscopic simulation with Stochastic Route Choice (SRC). The SRC method begins by calculating the initial shortest path for each OD pair using the defined initial costs. In the case of this model, a prior path assignment must be generated for each microsimulation scenario. This has been done because the OD matrix adjustment was conducted using the static assignment method. After the 30 minute warmup period, the travel times are calculated at the end of the warmup period. The route choice cycle is 15 minutes and 100% of vehicles are allowed to adjust their routes.

5.5 Model Calibration

The RMS *Traffic Modelling Guideline, Version 1, February 2013* ("RMS guidelines") was used as a main guideline for base year model development and calibration process.

The RMS guidelines specify statistical criteria that can be used to assess whether a microsimulation model is adequately representing existing:

- Traffic volumes
- Signal timings

The traffic surveys conducted during February 2019 form the basis of the traffic volume calibration.

The traffic volumes are calibrated on a network wide basis using the GEH statistic as per calibration criteria given in the RMS guidelines. The GEH statistic is calculated for each surveyed intersection turning movement to compare the model and observed traffic volumes.

To achieve calibration, the RMS guidelines stipulate that, for the entire network, the following calibration targets should be achieved:

- 85 per cent of count sites with a GEH statistic less than five
- Sites with GEH statistic greater than 10 are undesirable and require explanation if they exist
- Coefficient of determination (R^2) should be greater than 0.9

In addition, the slope of the relationship between counted and modelled sites should be within 0.05 of unity.

Table 4 shows the summary data for the validation for the AM and PM peak models.

Table 4: Traffic volume validation summary (overall)

MODEL PERIOD	NUMBER OF CALIBRATION COUNT SITES	GEH <5	GEH <10	AVERAGE GEH	R^2	SLOPE
AM Peak	166	148 (89%)	166 (100%)	2.3	0.99	0.99
PM Peak	166	144 (87%)	166 (100%)	2.6	0.98	0.98

The results indicate that nearly 90% of locations have a GEH statistic of less than five and no locations have a GEH statistic greater than 10. Therefore, the AM and PM peak models are considered sufficiently calibrated to the observed traffic volumes. Based on this result, it is very likely that the future year models would provide a good representation of traffic operations where similar levels of model coding and accuracy are applied.

5.6   Future Model Scenarios

Two future scenarios were modelled for this impact assessment:

- 2031 Do Minimum
- 2031 Section 100

5.6.1   2031 Do Minimum

The *2031 Do Minimum* network is shown in Figure 16. This scenario represents the 2031 study area road network, with only the following changes:

- Base case land use assumptions for 2031 AM and PM
- Deletion of all ramps between Commonwealth Avenue and London Circuit
- Extension of Edinburgh Avenue to Vernon Circle with signal control, see Figure 17
- At-grade connection of Commonwealth Avenue and London Circuit with signal control, see Figure 18

For the at-grade intersection of Commonwealth Avenue and London Circuit, the new intersection has been configured in a manner that allows it to operate acceptably in the model. The design of this intersection will be subject of other future projects.
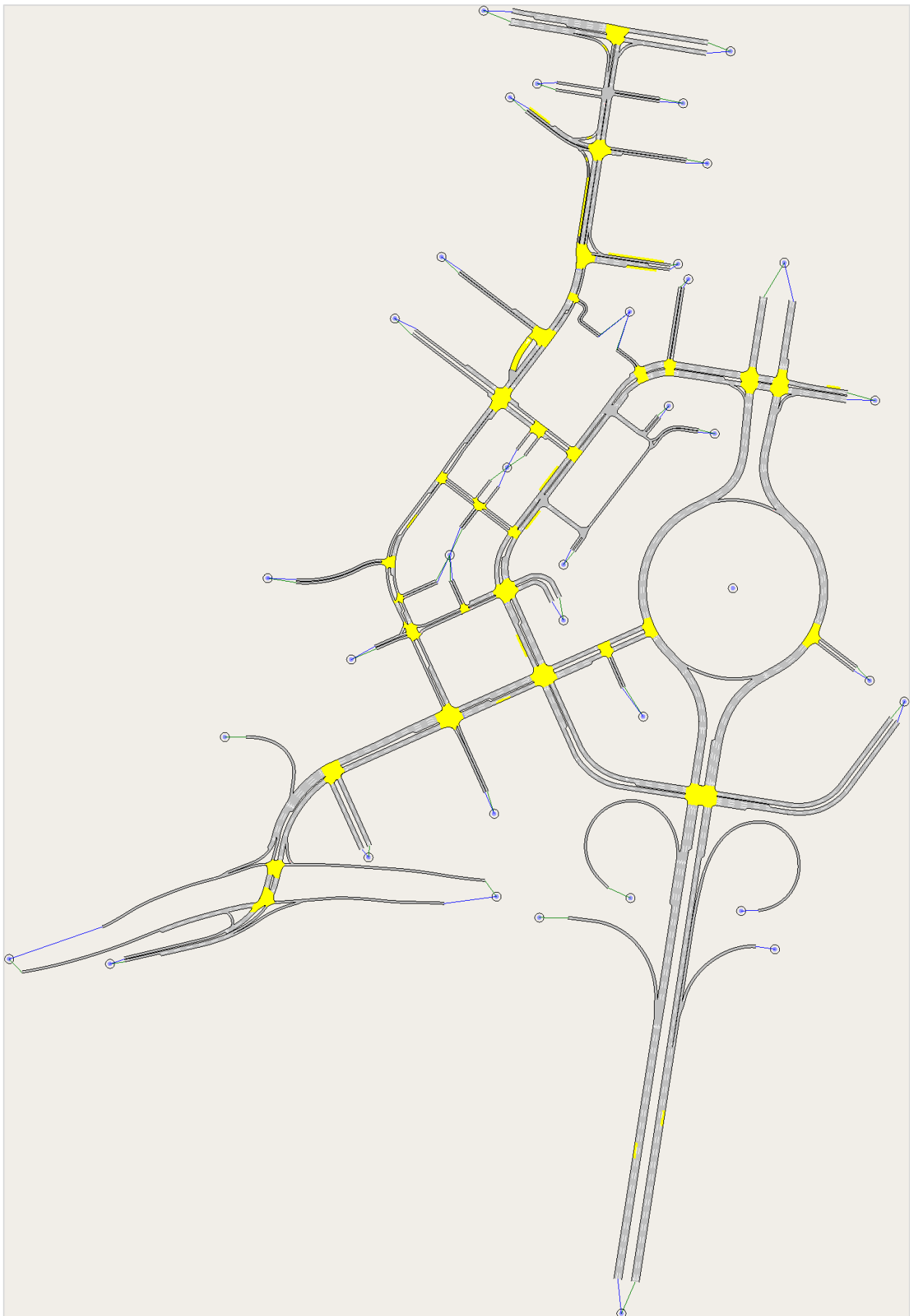
Figure 16: 2031 Do Minimum network layout

Figure 17: Edinburgh Avenue Extension layout
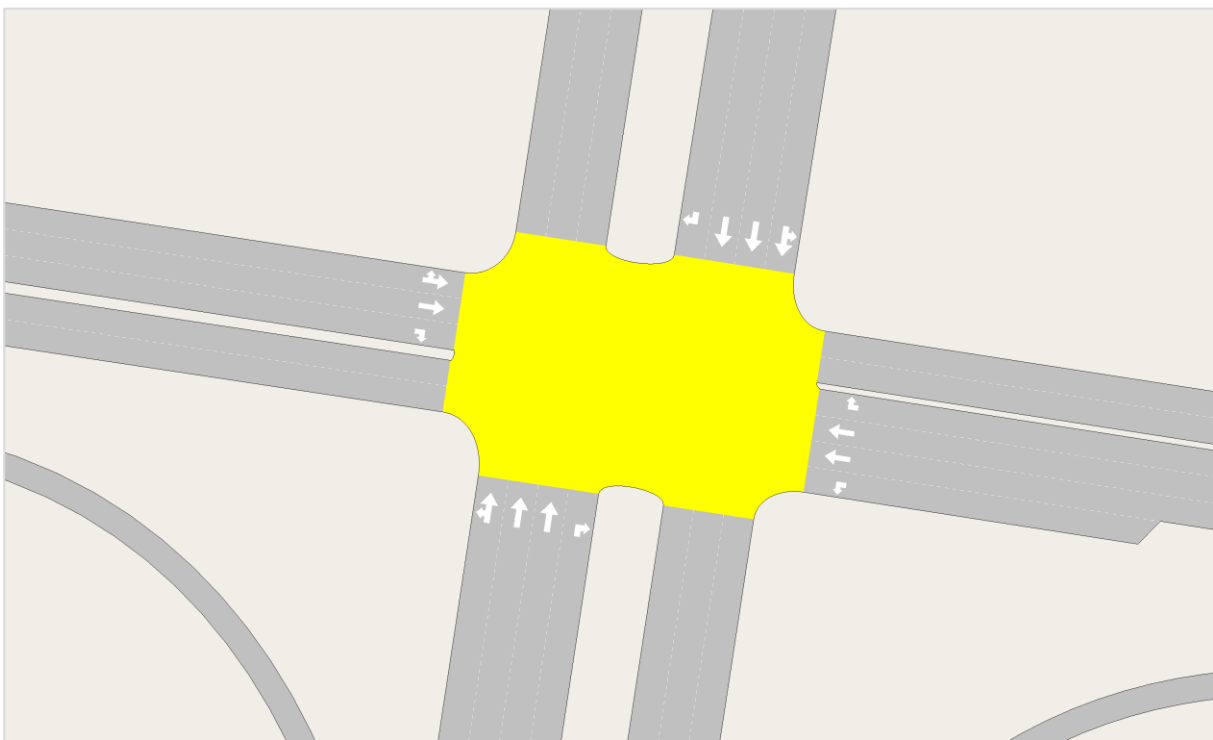
Figure 18:London Circuit – Commonwealth Avenue At-grade layout

5.6.2   2031 Section 100

The *2031 Section 100* network is shown in Figure 19. This includes the following network changes from *2031 Do Minimum* necessary to support the Section 100 development:

- Extension of Knowles Place to Edinburgh Avenue, which allows a right turn into Knowles Place from Edinburgh Avenue but not a right turn out of Knowles Place
- Modification to Gordon Street to allow access to a new basement car park.
- Conversion of Knowles Place (south) to two-way operation, with left-in/left-out access only at its intersection with London Circuit

- A two-way driveway at the intersection of Knowles Place and Knowles Place Extension. This intersection should be signalised to comply with the requirements of AS/NZS2890.1, which do not allow a driveway on the back of a T-intersection, however such signalisation would not be required should Knowles Place Central be "blocked-off" and converted into pedestrian mall or similar.

- Knowles Place extension is signposted at 10 km/h in the proposed shared zone and allows all traffic.

Figure 19: 2031 Section 100 network layout

5.7   Model Results

Microsimulation model results are presented here for the general network, as well as individual intersections. For the network, the Vehicle Kilometres Travelled (VKT) and Vehicle Hours Travelled (VHT) statistics are measures of the overall effect on the road network of network modifications and upgrades. In addition, the average speed of travel within the study area network is determined from the VKT and VHT. Also reported for each scenario are number of vehicles, number of stops, average time per vehicle, average distance per vehicle and number of stops per vehicle.

The intersection performance has been calculated using the outputs of the Aimsun model. This considers the impact of queuing, platooning, signal coordination and other interactions between intersections on the performance of each intersection in the network. The performance is measured by average delay in seconds, Level of Service (determined from average delay) and queue (50th percentile). Level of Service thresholds are shown in Table 5.

Table 5: Intersection Level of Service Criteria (Delay and HCM 2010 Method)

LEVEL OF SERVICE	GIVE-WAY / ROUNDABOUT	SIGNAL CONTROL
A	D ≤ 10s	D ≤ 10s
B	10s < D ≤ 15s	10s < D ≤ 20s
C	15s < D ≤ 25s	20s < D ≤ 35s
D	25s < D ≤ 35s	35s < D ≤ 50s
E	35s < D ≤ 50s	55s < D ≤ 80s
F	D ≥ 50s	D ≥ 80s

Intersection performance results were calculated for the following intersections:

1.   Barry Drive – Marcus Clarke Street
2.   Marcus Clarke Street – Rudd Street – Rimmer Street
3.   Marcus Clarke Street – Alinga Street
4.   Marcus Clarke Street – Hobart Place
5.   Marcus Clarke Street – Allsop Street
6.   London Circuit – West Row
7.   Northbourne Avenue – London Circuit
8.   London Circuit – Hobart Place
9.   Marcus Clarke Street – University Avenue
10.   London Circuit – Knowles Place (North)
11.   London Circuit – University Avenue
12.   Marcus Clarke Street – Farrell Place
13.   London Circuit – Knowles Place (South)
14.   London Circuit – Farrell Place
15.   Marcus Clarke Street – Ellery Crescent
16.   London Circuit – Gordon Street
17.   Vernon Circle – Constitution Avenue
18.   Marcus Clarke Street – Gordon Street
19.   London Circuit – Edinburgh Avenue
20.   Marcus Clarke Street – Edinburgh Avenue
21.   Commonwealth Avenue – London Circuit (2031 Only)
22.   Edinburgh Avenue – Phillip Law Street

23. Parkes Way – Edinburgh Avenue (North)
24. Parkes Way – Edinburgh Avenue (South)
25. Edinburgh Avenue Extension – Knowles Place (2031 Only)
26. Vernon Circle – Edinburgh Avenue Extension (2031 Only)
27. Knowles Place – Knowles Place Extension (2031 Only)

The Aimsun model outputs are discussed in the following sections and detailed outputs are included in Appendix C.

5.7.1   2019 Base Case

Bulk statistics for the 2019 Base Case are shown in Table 6.

Table 6: 2019 Base Case Bulk Travel Statistics

PERIOD	VEHICLES	VKT	VHT	AVERAGE SPEED	TOTAL STOPS	DISTANCE/ VEHICLE	TIME/ VEHICLE	STOPS/ VEHICLE
2019 Base Case AM	12,966	10,717	381	28.1	16,690	0.8	106	1.3
2019 Base Case PM	12,719	10,111	350	28.9	16,793	0.8	99	1.3

The summary of intersection results for the 2019 Base Case scenario is shown in Table 7. The 2019 models indicate a good level of performance under current conditions.

Table 7: 2019 Base Case Intersection Performance Summary

INTERSECTION		AM PEAK			PM PEAK		
		DELAY	LOS	QUEUE	DELAY	LOS	QUEUE
1	Barry Drive – Marcus Clarke Street	18.8	B	18.8	15.7	B	20.1
2	Marcus Clarke Street – Rudd Street/Rimmer Street	19.1	B	10.0	25.4	C	11.3
3	Marcus Clarke Street – Alinga Street	23.3	C	21.7	17.4	B	16.4
4	Marcus Clarke Street – Hobart Place	2.7	A	1.5	2.6	A	1.1
5	Marcus Clarke Street – Allsop Street	11.8	B	7.0	19.9	B	11.3
6	London Circuit – West Row	3.1	A	2.2	4.1	A	6.3
7	Northbourne Avenue – London Circuit	20.2	C	21.7	20.0	C	22.3
8	London Circuit – Hobart Place	0.3	A	7.0	0.2	A	0.1
9	Marcus Clarke Street – University Avenue	19.8	B	16.5	30.9	C	18.3
10	London Circuit – Knowles Place (North)	0.5	A	0.1	0.5	A	0.2
11	London Circuit – University Avenue	2.4	A	1.9	4.8	A	6.2
12	Marcus Clarke Street – Farrell Place	1.2	A	0.4	2.3	A	1.9
13	London Circuit – Knowles Place (South)	0.8	A	0.6	0.8	A	0.7
14	London Circuit – Farrell Place	1.5	A	0.9	2.7	A	3.2
15	Marcus Clarke Street – Ellery Crescent	5.5	A	6.0	5.5	A	5.2
16	London Circuit – Gordon Street	24.8	C	17.8	19.6	B	9.8

	INTERSECTION	AM PEAK			PM PEAK		
		DELAY	LOS	QUEUE	DELAY	LOS	QUEUE
17	Vernon Circle – Constitution Avenue	6.7	A	6.5	8.5	A	11.0
18	Marcus Clarke Street – Gordon Street	2.6	A	3.3	1.9	A	1.5
19	London Circuit – Edinburgh Avenue	29.4	C	30.4	31.6	C	32.9
20	Marcus Clarke Street – Edinburgh Avenue	50.4	D	241.8	40.3	D	26.4
22	Edinburgh Avenue – Phillip Law Street	19.8	B	9.9	12.4	B	14.7
23	Parkes Way – Edinburgh Avenue (North)	13.9	B	16.3	13.1	B	14.8
24	Parkes Way – Edinburgh Avenue (South)	17.3	B	18.2	10.5	B	14.6

5.7.2   2031 Do Minimum

Bulk statistics for the 2031 Do Minimum case are shown in Table 8. Compared to 2019, these statistics show a significant degradation in network performance.

Table 8: 2031 Do Minimum Bulk Travel Statistics

PERIOD	VEHICLES	VKT	VHT	AVERAGE SPEED	TOTAL STOPS	DISTANCE/ VEHICLE	TIME/ VEHICLE	STOPS/ VEHICLE
2031 Do Minimum AM	15,825	12,834	633	20.3	31,757	0.8	144	2.0
2031 Do Minimum PM	15,711	12,412	667	18.6	34,698	0.8	153	2.2

The summary of intersection results for the 2031 Do Minimum scenario is shown in Table 9. The 2031 models indicate worse performance than in 2019. Only the Commonwealth Avenue – London Circuit intersection operates at LOS E in the PM peak, with all other intersections operating at a LOS of D or better in either peak.

Table 9: 2031 Do Minimum Intersection Performance Summary

	INTERSECTION	AM PEAK			PM PEAK		
		DELAY	LOS	QUEUE	DELAY	LOS	QUEUE
1	Barry Drive – Marcus Clarke Street	16.9	B	20.2	19.5	B	38.4
2	Marcus Clarke Street – Rudd Street/Rimmer Street	20.7	C	9.6	25.5	C	13.4
3	Marcus Clarke Street – Alinga Street	16.2	B	19.0	18.8	B	19.0
4	Marcus Clarke Street – Hobart Place	3.0	A	4.0	5.8	A	5.2
5	Marcus Clarke Street – Allsop Street	13.9	B	7.5	22.4	C	25.1
6	London Circuit – West Row	2.8	A	3.8	11.3	B	27.8
7	Northbourne Avenue – London Circuit	27.1	C	43.6	35.0	D	51.9
8	London Circuit – Hobart Place	1.5	A	1.5	1.8	A	1.6
9	Marcus Clarke Street – University Avenue	30.8	C	24.0	39.5	D	25.9
10	London Circuit – Knowles Place (North)	3.0	A	2.4	6.8	A	8.0

INTERSECTION		AM PEAK			PM PEAK		
		DELAY	LOS	QUEUE	DELAY	LOS	QUEUE
11	London Circuit – University Avenue	14.3	B	40.4	21.8	C	122.8
12	Marcus Clarke Street – Farrell Place	9.3	A	9.4	8.7	A	15.3
13	London Circuit – Knowles Place (South)	0.9	A	0.8	1.5	A	1.5
14	London Circuit – Farrell Place	2.6	A	2.3	4.0	A	2.9
15	Marcus Clarke Street – Ellery Crescent	5.5	A	5.4	4.0	A	3.3
16	London Circuit – Gordon Street	33.9	C	25.4	40.8	D	15.9
17	Vernon Circle – Constitution Avenue	6.2	A	7.5	14.7	B	13.6
18	Marcus Clarke Street – Gordon Street	5.1	A	3.3	3.7	A	2.8
19	London Circuit – Edinburgh Avenue	47.9	D	57.1	33.8	C	19.5
20	Marcus Clarke Street – Edinburgh Avenue	50.4	D	33.9	51.1	D	28.1
21	Commonwealth Avenue – London Circuit	51.5	D	90.6	60.8	E	101.0
22	Edinburgh Avenue – Phillip Law Street	27.6	C	33.6	27.4	C	97.9
23	Parkes Way – Edinburgh Avenue (North)	10.3	B	17.5	9.5	A	16.3
24	Parkes Way – Edinburgh Avenue (South)	13.5	B	16.7	13.7	B	24.5
25	Edinburgh Avenue Extension – Knowles Place	0.9	A	0.2	1.9	A	1.8
26	Vernon Circle – Edinburgh Avenue Extension	6.8	A	53.5	8.7	A	19.0
27	Knowles Place – Knowles Place Extension	-	-	-	-	-	-

5.7.3   2031 Section 100

Bulk statistics for the *2031 Section 100* are shown in Table 10. Compared to the *2031 Do Minimum*, there is a slight decrease in travel speed both peaks. The number of stops per vehicle is higher in both the AM and PM peaks. The total number of vehicles increases by approximately 700 in the AM peak and 800 in the PM peak.

Table 10: 2031 Section 100 Bulk Travel Statistics

PERIOD	VEHICLES	VKT	VHT	AVERAGE SPEED	TOTAL STOPS	DISTANCE/ VEHICLE	TIME/ VEHICLE	STOPS/ VEHICLE
2031 Section 100 AM	17,572	13,433	880	15.3	47,230	0.8	180	2.7
2031 Section 100 PM	17,701	13,277	1,089	12.2	61,618	0.8	221	3.5

The summary of intersection results for *2031 Section 100* is shown in Table 11. The results show that the following intersections operate at LOS E:

- Marcus Clark Street – University Avenue (Both Peaks)
- London Circuit – Edinburgh Avenue (AM Peak only)
- Marcus Clarke Street – Edinburgh Avenue (Both Peaks)
- Commonwealth Avenue – London Circuit (Both peaks)

No intersections operate at LOS F in either peak period.

Table 11: 2031 Section 100 Intersection Performance Summary

	INTERSECTION	AM PEAK			PM PEAK		
		DELAY	LOS	QUEUE	DELAY	LOS	QUEUE
1	Barry Drive – Marcus Clarke Street	39.5	D	42.8	29.5	C	62.2
2	Marcus Clarke Street – Rudd Street/Rimmer Street	37.2	D	33.7	53.8	D	56.9
3	Marcus Clarke Street – Alinga Street	30.7	C	30.5	19.3	B	21.1
4	Marcus Clarke Street – Hobart Place	18.2	C	42.5	8.9	A	11.2
5	Marcus Clarke Street – Allsop Street	20.1	C	13.1	35.9	D	44.2
6	London Circuit – West Row	30.7	D	80.5	25.5	D	27.0
7	Northbourne Avenue – London Circuit	40.8	D	108.0	42.5	D	87.6
8	London Circuit – Hobart Place	5.3	A	5.9	10.3	B	14.1
9	Marcus Clarke Street – University Avenue	56.7	E	58.8	79.8	E	78.2
10	London Circuit – Knowles Place (North)	9.2	A	13.1	20.7	C	28.1
11	London Circuit – University Avenue	19.6	C	48.8	28.2	D	85.6
12	Marcus Clarke Street – Farrell Place	14.7	B	14.1	16.0	C	29.6
13	London Circuit – Knowles Place (South)	6.5	A	10.6	10.0	B	18.0
14	London Circuit – Farrell Place	9.1	A	6.2	15.5	C	14.0
15	Marcus Clarke Street – Ellery Crescent	7.4	A	7.7	8.1	A	9.9
16	London Circuit – Gordon Street	47.4	D	88.1	52.5	D	54.1

INTERSECTION		AM PEAK			PM PEAK		
		DELAY	LOS	QUEUE	DELAY	LOS	QUEUE
17	Vernon Circle – Constitution Avenue	24.0	C	75.5	44.1	D	25.5
18	Marcus Clarke Street – Gordon Street	6.0	A	5.2	15.2	C	41.6
19	London Circuit – Edinburgh Avenue	61.6	E	79.3	40.8	D	40.3
20	Marcus Clarke Street – Edinburgh Avenue	58.7	E	60.4	76.6	E	99.3
21	Commonwealth Avenue – London Circuit	36.9	D	40.2	65.8	E	94.1
22	Edinburgh Avenue – Phillip Law Street	28.3	C	42.7	19.4	B	46.9
23	Parkes Way – Edinburgh Avenue (North)	8.6	A	13.0	8.4	A	16.2
24	Parkes Way – Edinburgh Avenue (South)	13.2	B	16.4	12.9	B	19.6
25	Edinburgh Avenue Extension – Knowles Place	7.1	A	4.5	9.3	A	15.7
26	Vernon Circle – Edinburgh Avenue Extension	15.7	B	67.0	27.5	C	27.2
27	Knowles Place – Knowles Place Extension	42.5	D	41.0	30.1	C	16.2

5.7.4 Modelling Summary

Table 12 shows the bulk travel statistics for the scenarios modelled. The results show a degradation in average speed between 2019 and both 2031 scenarios. Of the 2031 scenarios, *2031 Do Minimum* has the highest travel speed in both the AM and PM peaks. Total stops per vehicle doubles between 2019 and 2031 and is higher still in the *2031 Section 100* scenario compared to *2031 Do Minimum*. Overall, there appears to be a small difference between *2031 Do Minimum* and *2031 Section 100* in the AM peak and a slightly larger difference in the PM peak.

Table 12: Comparison of Travel Statistics for all Scenarios

PERIOD	VEHICLES	VKT	VHT	AVERAGE SPEED	TOTAL STOPS	DISTANCE/ VEHICLE	TIME/ VEHICLE	STOPS/ VEHICLE
2019 Base Case AM	12,966	10,717	381	28.1	16690	0.8	106	1.3
2019 Base Case PM	12,719	10,111	350	28.9	16793	0.8	99	1.3
2031 Do Minimum AM	15,825	12,834	633	20.3	31,757	0.8	144	2.0
2031 Do Minimum PM	15,711	12,412	667	18.6	34,698	0.8	153	2.2
2031 Section 100 AM	17,572	13,433	880	15.3	47,230	0.8	180	2.7
2031 Section 100 PM	17,701	13,277	1,089	12.2	61,618	0.8	221	3.5

Table 13 shows a comparison of the overall intersection results for the 2031 AM peak period. No intersections operate at LOS F in either scenario. The following intersections operate at LOS E in the Section 100 model, but not in the Do Minimum:

- Marcus Clark Street – University Avenue
- London Circuit – Edinburgh Avenue)
- Marcus Clarke Street – Edinburgh Avenue

All other intersections operate at LOS D or better in the 2031 AM peak for the Section 100 scenario.

Table 13: 2031 AM Intersection Performance Summary Comparison

INTERSECTION		AM PEAK			
		DO MIN		S100 SCEN 1	
		DELAY	LOS	DELAY	LOS
1	Barry Drive – Marcus Clarke Street	16.9	B	39.5	D
2	Marcus Clarke Street – Rudd Street/Rimmer Street	20.7	C	37.2	D
3	Marcus Clarke Street – Alinga Street	16.2	B	30.7	C
4	Marcus Clarke Street – Hobart Place	3.0	A	18.2	C
5	Marcus Clarke Street – Allsop Street	13.9	B	20.1	C
6	London Circuit – West Row	2.8	A	30.7	D
7	Northbourne Avenue – London Circuit	27.1	C	40.8	D
8	London Circuit – Hobart Place	1.5	A	5.3	A
9	Marcus Clarke Street – University Avenue	30.8	C	56.7	E
10	London Circuit – Knowles Place (North)	3.0	A	9.2	A
11	London Circuit – University Avenue	14.3	B	19.6	C
12	Marcus Clarke Street – Farrell Place	9.3	A	14.7	B
13	London Circuit – Knowles Place (South)	0.9	A	6.5	A
14	London Circuit – Farrell Place	2.6	A	9.1	A
15	Marcus Clarke Street – Ellery Crescent	5.5	A	7.4	A
16	London Circuit – Gordon Street	33.9	C	47.4	D
17	Vernon Circle – Constitution Avenue	6.2	A	24.0	C
18	Marcus Clarke Street – Gordon Street	5.1	A	6.0	A
19	London Circuit – Edinburgh Avenue	47.9	D	61.6	E
20	Marcus Clarke Street – Edinburgh Avenue	50.4	D	58.7	E
21	Commonwealth Avenue – London Circuit	51.5	D	36.9	D
22	Edinburgh Avenue – Phillip Law Street	27.6	C	28.3	C
23	Parkes Way – Edinburgh Avenue (North)	10.3	B	8.6	A
24	Parkes Way – Edinburgh Avenue (South)	13.5	B	13.2	B
25	Edinburgh Avenue Extension – Knowles Place	0.9	A	7.1	A
26	Vernon Circle – Edinburgh Avenue Extension	6.8	A	15.7	B
27	Knowles Place – Knowles Place Extension			42.5	D

Table 14 shows a comparison of the overall intersection results for each scenario in the 2031 PM peak period. No intersections operate at LOS F in either scenario. The following intersections operate at LOS E in the Section 100 model, but not in the Do Minimum:

- Marcus Clark Street – University Avenue (Both Peaks)
- Marcus Clarke Street – Edinburgh Avenue (Both Peaks)

All other intersections operate at LOS D or better in the 2031 AM peak for the Section 100 scenario.

Table 14: 2031 PM Intersection Performance Summary Comparison

| | INTERSECTION | PM PEAK | | | |
| | | DO MIN | | S100 SCEN 1 | |
		DELAY	LOS	DELAY	LOS
1	Barry Drive – Marcus Clarke Street	19.5	B	29.5	C
2	Marcus Clarke Street – Rudd Street/Rimmer Street	25.5	C	53.8	D
3	Marcus Clarke Street – Alinga Street	18.8	B	19.3	B
4	Marcus Clarke Street – Hobart Place	5.8	A	8.9	A
5	Marcus Clarke Street – Allsop Street	22.4	C	35.9	D
6	London Circuit – West Row	11.3	B	25.5	D
7	Northbourne Avenue – London Circuit	35.0	D	42.5	D
8	London Circuit – Hobart Place	1.8	A	10.3	B
9	Marcus Clarke Street – University Avenue	39.5	D	79.8	E
10	London Circuit – Knowles Place (North)	6.8	A	20.7	C
11	London Circuit – University Avenue	21.8	C	28.2	D
12	Marcus Clarke Street – Farrell Place	8.7	A	16.0	C
13	London Circuit – Knowles Place (South)	1.5	A	10.0	B
14	London Circuit – Farrell Place	4.0	A	15.5	C
15	Marcus Clarke Street – Ellery Crescent	4.0	A	8.1	A
16	London Circuit – Gordon Street	40.8	D	52.5	D
17	Vernon Circle – Constitution Avenue	14.7	B	44.1	D
18	Marcus Clarke Street – Gordon Street	3.7	A	15.2	C
19	London Circuit – Edinburgh Avenue	33.8	C	40.8	D
20	Marcus Clarke Street – Edinburgh Avenue	51.1	D	76.6	E
21	Commonwealth Avenue – London Circuit	60.8	E	65.8	E
22	Edinburgh Avenue – Phillip Law Street	27.4	C	19.4	B
23	Parkes Way – Edinburgh Avenue (North)	9.5	A	8.4	A
24	Parkes Way – Edinburgh Avenue (South)	13.7	B	12.9	B

	INTERSECTION	PM PEAK			
		DO MIN		S100 SCEN 1	
		DELAY	LOS	DELAY	LOS
25	Edinburgh Avenue Extension – Knowles Place	1.9	A	9.3	A
26	Vernon Circle – Edinburgh Avenue Extension	8.7	A	27.5	C
27	Knowles Place – Knowles Place Extension	-	-	30.1	C

These results indicate that development of Section 100 causes a small degradation in network and intersection performance, with the development having a greater impact on the PM peak.

6   Conclusions

SMEC was engaged by MPG to undertake an assessment of the impact of traffic generated by a proposed development in City Section 100 on the surrounding road network. The proposed development includes commercial (office) and retail land uses. The development would be accessed via a new extension of Knowles Place, connecting the existing Knowles Place to the proposed Edinburgh Avenue extension to Vernon Circle, and via the existing intersection of London Circuit and Gordon Street. The existing car parking on the site, currently accessed via Gordon Street, would be accessed via both of these new access points.

SMEC generated traffic volumes in accordance with ACT and RMS published generation rates. The traffic was divided into entering and exiting volumes using ITE published proportions. The generated traffic was assigned to the Canberra road network using the CSTM, which distributes trips across the whole urban area. This process allows the redistribution of trips caused by increased congestion or displaced trip ends to be accurately modelled.

The CSTM results show that the increased traffic is confined to a relatively small area on the western side of Civic and Acton. For most of the roads that are expected to have an increase in traffic, the additional traffic does not cause the roads to operate over capacity, except for small sections of London Circuit and Marcus Clarke Street. In the 2031 PM peak, the development of Section 100 causes parts of London Circuit, Edinburgh Avenue and Marcus Clarke Street to operate over capacity. All other roads are expected to be able to cater for the additional Section 100 traffic without going over capacity.

The CSTM outputs were used in conjunction with traffic counts supplied by TCCS and undertaken by Matrix to conduct microsimulation modelling using Aimsun for the 2019 and 2031 AM and PM peak periods. For 2031, two scenarios were modelled:

- 2031 Do Minimum
- 2031 Section 100

Intersection layouts for the future scenarios were developed based on preliminary designs agreed to by the ACT Government and NCA. Pedestrian safety and amenity have been emphasised by omitting left-turn slip lanes. Details of the at-grade intersection of London Circuit and Commonwealth Avenue were not currently known, so assumptions were made to ensure the intersection allowed traffic through to the rest of the network. The road network changes due to Light Rail Stage 2 are also not known, so Light Rail Stage 2 has been omitted from the strategic modelling and microsimulation modelling.

Assumptions for key roads and intersections in the study include:

- In the CSTM, Knowles Place extension is assumed to only be used by traffic travelling to and from Section 100. In the Aimsun model, Knowles Place extension operates as a shared zone that allows all traffic, but is not heavily used by rat-running traffic due to the low signposted speed.
- Edinburgh Avenue extension – Knowles Place extension: two lanes each way on Edinburgh Avenue with right turns into Knowles Place extension allowed. Right turns out of Knowles Place extension are banned on both sides (i.e. Section 100 and Section 63).
- Edinburgh Avenue – London Circuit: Three approach lanes on each leg with two exit lanes. London circuit allows a diamond overlap while Edinburgh Avenue runs split phasing.
- London Circuit – Knowles Place (south): No change from existing layout in Do Minimum. Knowles Place converted to two-way operation with left-in/left-out at London Circuit in the Section 100 scenario.
- London Circuit – Knowles Place (north): No change from existing layout in Do Minimum and Section 100 scenarios.
- Knowles Place – Knowles Place Extension: This intersection does not exist in the Do Minimum model. In the Section 100 scenario, it comprises one lane each way on the north and south approaches. The east and west approaches have two lanes each way, entering and exiting the car park. The highest volume movements are between Knowles Place (south) and the proposed Section 100 car park (which incorporates some of the public car parking currently available on Section 100). This intersection is modelled as a two-phase signalised intersection to comply with the requirements of AS/NZS2890.1, which do not allow a driveway on the back of a T-intersection.

- London Circuit – Gordon Street: In the Section 100 scenario, this intersection is retained as a four-leg intersection with the eastern leg of Gordon Street used to access parking, both for the proposed commercial development and public parking.

The Aimsun analysis showed that the local road network operates well in 2019 but degrades in 2031, with relatively small differences between 2031 Do Minimum and 2031 Section 100 scenarios. In the 2031 Do Minimum scenario, the Commonwealth Avenue – London Circuit intersection operates poorly, resulting in a LOS of E in the PM peak. With the proposed Section 100 development, operation of this intersection degrades slightly, resulting in a LOS E in both peaks. The section 100 development also causes the LOS at the Marcus Clarke Street – Edinburgh Avenue intersection to degrade from a D to an E in the PM peak only.

A comparison of the bulk statistics for the model found that the development of Section 100 caused a small decrease in average travel speed in the 2031 AM and PM peaks. The average number of stops increases in both peak periods if Section 100 is developed.

The analysis conducted for this report utilised traffic generation rates based on current publications and surveys. It is expected that future higher density developments and internal trip capture for retail and commercial land uses around the Section 100 study area would lead to a decrease in car usage as more origins and destinations would be within walking or cycling distance. In addition, the transformative effects of light rail, in particular Light Rail Stage 2, and other transport policies are not considered in the current traffic generation rates and travel behaviours.

Overall, it is considered that the development of Section 100 would cause a small decrease in network performance in 2031. The development generally does not cause significant additional congestion or delay. The Section 100 scenario tested for this analysis includes the following road network changes:

- **Knowles Place (south)**: Convert existing one-way street into a two-way street from London Circuit to the intersection of Knowles Place and Knowles Place (extension). Provide left-in and left-out access only at the intersection of Knowles Place (south) and London Circuit. Provision should be made for the right turn from Knowles Place (south) into London Circuit (northbound) for emergency vehicles only.

- **Knowles Place Extension**: Construct new road connecting existing Knowles Place to Edinburgh Avenue extension, which will provide access to commercial and public parking supply in Section 100 at the intersection of Knowles Place and Knowles Place extension. Knowles Place extension (between its intersections with Knowles Place and Edinburgh Avenue Extension) should be constructed as a pedestrian-friendly shared zone that discourages rat-running and high vehicle volumes.

- **Knowles Place Extension – Edinburgh Avenue Extension**: Connect Knowles Place extension to Edinburgh Avenue extension with limited movements available. The right turns out of Knowles Place across Edinburgh Avenue should be banned but the right turn into Knowles Place extension from Edinburgh Avenue should be allowed.

- **London Circuit – Gordon Street**: This intersection should be retained as a four-way signalised intersection with the current phasing and layout. The eastern leg of the intersection will provide access to Section 100 parking.

Appendix A   Future Road Network Assumptions

Taylor Local Roads

New Road South of Valley Avenue (Camilleri Way)

The Valley Avenue Extension

Ernest Cavanagh Street Extension

Gundaroo Drive Duplication Stage 1

Gundaroo Drive Duplication Stage 2

Throsby Local Roads

Lawson Local Roads

Horse Park Drive Duplication

UC-Aikman Drive Access Road

Aikman Drive Duplication

Manning Clark Crescent Extension

Cape Street Extension

West Belconnen Stage 1

Light Rail Stage 1

Parkes Way to Allara Street Exit

Molonglo Roads Stage 2

Spitfire Avenue Link Road

Cotter Road Duplication Stage 2

Monaro Highway Widening

Ashley Drive Duplication

Tompsitt Drive Extension (Ellerton Drive)

Tralee Roads

2021 Road Network Upgrades

2021 Assumed Road Network Improvements

Network Item	Description
Taylor Local Roads	Added
Horse Park Drive Duplication	Duplication of Horse Park Drive between Federal Highway and Roden Cutler Drive- for 2018 completion. Anthony Rolfe Avenue to Well Station Drive
Hibberson Street pedestrian and light rail zone	Pedestrian and light rail only zone between Kate Crace Street and Gungahlin Place
Hibberson Street one-way shared zone	Shared zone between pedestrians and vehicles on Hibberson Street between Gungahlin Place and Gozzard Street
Manning Clark Crescent Extension	New road connecting Flemington Road to Anthony Rolfe Avenue
Ernest Cavanagh Street Extension	Extension of Ernest Cavanagh Street from Hinder Street to Manning Clark Crescent
The Valley Avenue Extension and Manning Clark Crescent Extension	Extension of The Valley Avenue from Kate Crace Street to Manning Clark Crescent and the extension of Manning Clark Cres from Flemington Rd to Anthony Rolfe Avenue
New road to the south of The Valley Avenue	Following up SLA (Darren Benson) for details where it connects to including extension of Gungahlin Place and 4th leg of Valley Avenue/Kate Crace St intersection (both intersections now signalised
Light Rail Stage 1	Light rail from Gungahlin to City
Flemington Road changes due to Light Rail Stage 1	Lane configuration changes between Well Station Drive and Federal Highway
Throsby Local Roads	Added (Copied from speed zones shapefile)
Gundaroo Drive Duplication Stage 1	Duplication between Gungahlin Drive and Mirrabei Drive/Anthony Rolfe Avenue
Gundaroo Drive Duplication Stage 2	Duplication between Gungahlin Drive and Barton Highway Roundabout.
Kuringa Drive/Owen Dixon Drive Signalisation	Intersection signalisation
Lawson Local Roads	Added (Copied from speed zones shapefile)
University of Canberra Hospital Access Road off Aikman Drive	A new road and associated intersection works to provide access to the hospital
Aikman Drive Duplication	Duplication between Ginninderra Drive and Emu Bank
Southern Cross Drive/Starke Street Signalisation	Intersection signalisation
Dickson Group Centre intersection upgrade	Antill Street/Cowper Street and Cowper Street/Dickson shops access road works, plus signalisation of Antill St/Badham St
Cape Street Extension	Extension of Cape Street from Challis Street to Northbourne Avenue – (Bus Access Only)

Network Item	Description
Northbourne Avenue/ London Circuit Intersection	Intersection upgrade
Parkes Way to Allara Street Exit	Added
West Belconnen Stage 1	New arterial road (Road 100) northwest of Stockdill Drive including multiple intersections located along the new arterial road. Also include other works proposed along Drake Brockmann Drive and Stockdill Drive
John Gorton Drive Stage 3	New roadworks providing access to Whitlam including signalisation of John Gorton Drive/William Hovell Drive/Coulter Drive intersection. (John Gorton Drive-William Hovell Drive Intersection Layout awaiting)
Molonglo Roads Stage 2	New roadways providing access to residential development
Weston Creek Group Centre	Brierly Street and Trenerry Square upgrade
Launceston Street / Irving Street Signalisation	Intersection signalisation
Cotter Road Duplication	Duplication from Tuggeranong Parkway to Yarralumla Creek
Dudley Street upgrade	Dudley St upgrade and Canberra Brickworks precinct access road from Dudley Street via a roundabout to boundary of new estate development
IKEA Northern Access Road	Mustang Avenue extension to north of IKEA called 'Dharaban Road'
Majura link road (Spitfire Avenue)	Link road between Majura Road and Majura Parkway Construction called 'Meddhung Road'
Tompsitt Drive Extension	Connect Tompsitt Drive to Yass Road (Ellerton Drive) in Queanbeyan
Monaro Highway – additional northbound lane	From Isabella Drive to Lanyon Drive
Hindmarsh Drive intersection upgrades	Signalisation at intersection with Launceston Street and Eggleston Crescent
Ashley Drive Duplication	Duplication of Ashley Drive from Erindale Drive to Johnson Drive
Anketell Street Upgrade	
Googong/Tralee Link	Connect Googong/Tralee area to Lanyon Drive West of Tompsitt Street Agreed
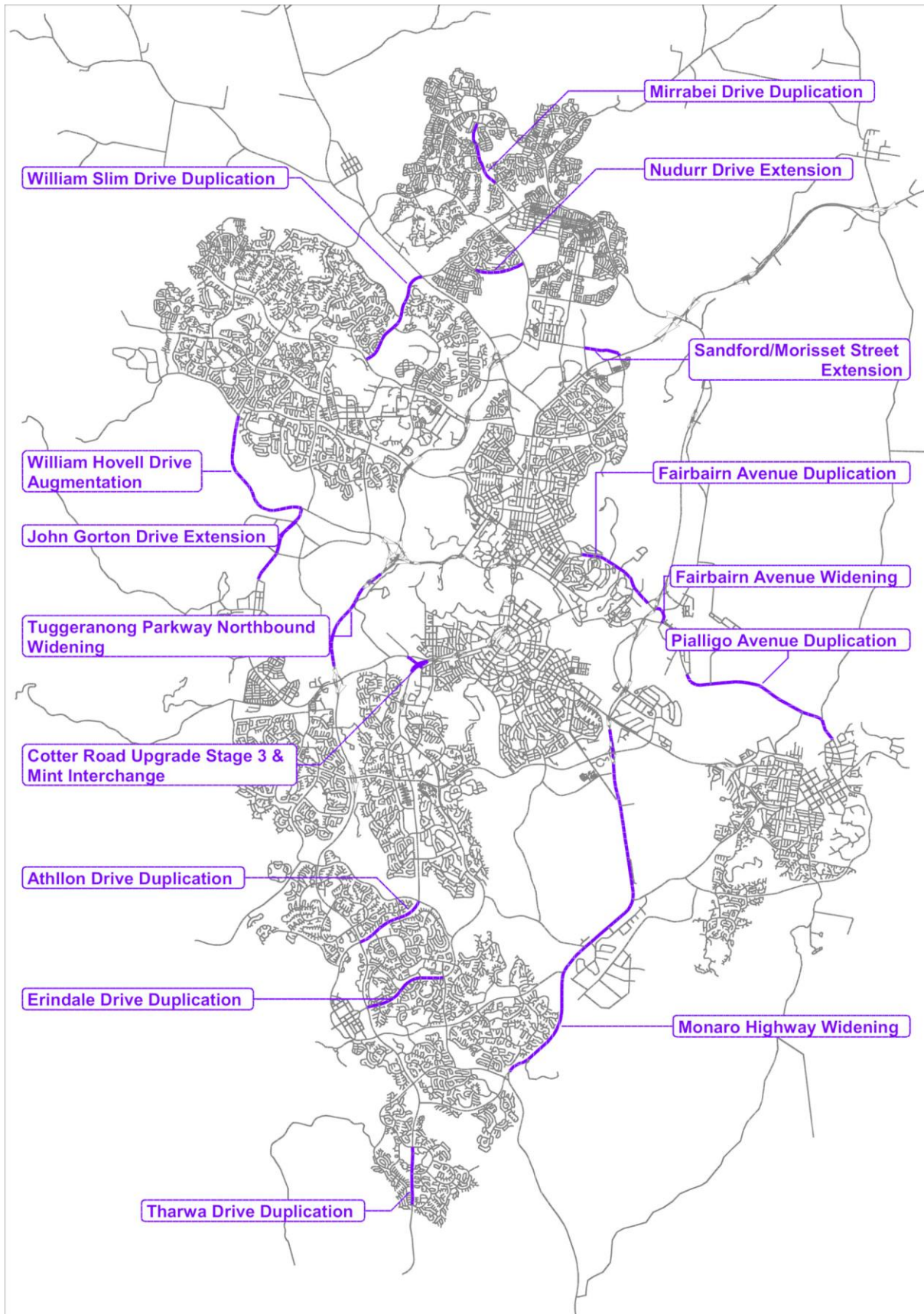
2026 Road Network Upgrades

2026 Assumed Road Network Improvements

Network Item	Description
Horse Park Drive Duplication	From Mulligans Flat Road to Roden Cutler Drive
Mirrabei Drive Duplication (parts)	From Paul Coe Crescent to Yama Way (Mirrabei Drive corridor upgrade (including Shoalhaven intersection signalisation))
Old Well Station Road Upgrade	Old Well Station Road Upgrade between Federal Highway and Morisset Road
Sandford/Morisset Street Extension	Extension of Morisset Road to Federal Highway (Watson roundabout)
Nudurr Drive Extension	Connect Nudurr Drive from Grampians Street to Gungahlin Drive
Mouat Street, Lyneham	Additional lane for public transport including queue jump lane. (Mouat Street duplication (between Challis Street &Ginninderra Drive))
William Slim Drive Upgrade	Duplication from Barton Highway to Ginninderra Drive
Belconnen Way/ Springvale Drive Signalisation	Intersection signalisation
William Hovell Drive augmentation	New roadworks duplicating William Hovell Drive from John Gorton Drive to Drake Brockman Drive (William Hovell Drive northbound widening (Drake-Brockman Dr to Coppins Crossing Road))
John Gorton Drive Extension and Molonglo River Bridge	John Gorton Drive Arterial Road Approaches and Bridge Crossing of the Molonglo River
Fairbairn Avenue – additional westbound lane	From Majura Road to Majura Parkway
Fairbairn Avenue Augmentation	Additional Lane on Fairbairn Avenue Between Majura Parkway and Nomad Drive (Fairbairn Avenue additional lane (Majura Parkway to Majura Road))
Fairbairn Avenue Duplication	Duplication from Treloar Crescent to Majura Parkway (Fairbairn Avenue Duplication (between Majura Parkway and Northcott Drive))
Pialligo Avenue Duplication	Duplication between Airport (Brindabella Circuit) and NSW Border (including Sutton Road Drivers Training Centre entry) (East- West Corridor Study/Pialligo Avenue Duplication (Airport to NSW Border))
Monaro Highway – additional lanes	From Canberra Avenue to Johnson Drive (both directions) (Monaro Highway Duplication from Canberra Ave to Johnson Dr as part of North-South Corridor study)
Cotter Road – Stage 3	From Dunrossil Dr to Adelaide Avenue (including the Mint Interchange) – by 2031 to link with Light Rail

Network Item	Description
Tuggeranong Parkway – additional northbound lane	From Cotter Road to the Glenloch Interchange
Athllon Drive Duplication	Athllon Drive Duplication between Sulwood Drive and Drakeford Drive –
Erindale Drive Duplication	From Ashley Drive to Drakeford Drive
Tharwa Drive Duplication	Tharwa Drive Duplication between Woodcock Drive and Pocket Avenue
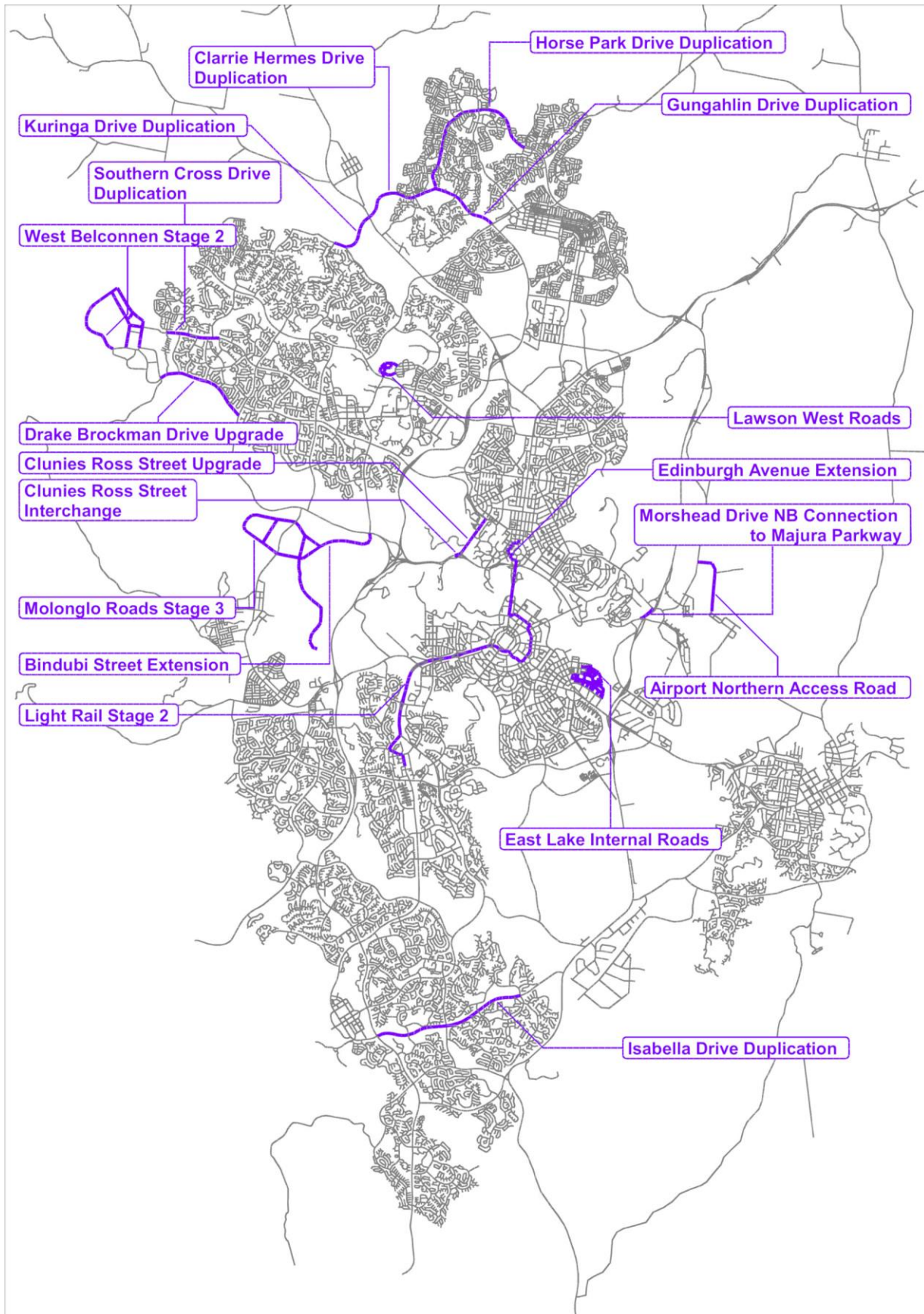
2031 Road Network Upgrades

2031 Assumed Road Network Improvements

Network Item	Description
Horse Park Drive Duplication	From Roden Cutler Drive to Clarrie Hermes Drive
CSIRO Access Roads	Access roads to CSIRO development; no access via Barton Highway
Gungahlin Drive Duplication	From Gundaroo Drive to Horse Park drive (Gungahlin Drive augmentation (Horse Pak Drive to The Valley Avenue))
Clarrie Hermes Drive Duplication	From Horse Park Drive to the Barton Highway (Clarrie Hermes Drive Duplication (Gunghalin Drive to Barton Highway))
Barton Highway Interchange	Grade separation of Barton Highway and Gundaroo Drive
Lawson West Road Network	Road network in Lawson West, linking Lawson to the Ginninderra Drive – Aikman Drive intersection
Bindubi Street Extension	New roadworks linking John Gorton Drive and Bindubi Street
Kuringa Drive Duplication	Kuringa Drive Duplication between Kingsford Smith and Barton Highway
West Belconnen Stage 2	Roads to service West Belconnen Stage 2; link to Parkwood Drive (Duplication of part of Parkwood Road and Southern Cross Drive up to Florey Drive)
Drake Brockman Drive Upgrade	Duplication of Drake Brockman Drive
Southern Cross Drive Duplication	From Moyes Crescent to Spofforth Street
Molonglo Stage 3 Collector Roads	New roads providing access to the suburbs of Molonglo Stage 3
Commonwealth Avenue / Albert Street Signalisation	Staggered T arrangement with northbound to eastbound right turns at Albert Street. (Turn penalties to allow and ban the mentioned movements) Part of City to the Lake, Parkes Way upgrade and associated new roads.
Commonwealth Avenue / Corkhill Street Signalisation	Staggered T arrangement with south to west right turns at Corkhill Street. (Turn penalties to allow and ban the mentioned movements) Part of City to the Lake, Parkes Way upgrade and associated new roads
Edinburgh Avenue extensions to Vernon Circle	Part of City to the Lake, Parkes Way upgrade and associated new roads
New at-grade intersection between Commonwealth Avenue and London Circuit	Part of City to the Lake, Parkes Way upgrade and associated new roads
Removal of the Commonwealth Avenue to London Circuit loop ramp	Part of City to the Lake, Parkes Way upgrade and associated new roads
New west facing ramps at the Parkes Way/Clunies Ross Street interchange	Part of City to the Lake, Parkes Way upgrade and associated new roads

Network Item	Description
Clunies Ross Street Upgrade	Duplication of Clunies Ross Street between Barry Drive and Parkes Way
Sturt Avenue/MacMillan Crescent Signalisation	Intersection signalisation
East Lake Internal Roads	Primary transport access connections from Wentworth Avenue and Canberra Avenue Access/egress: extension of Dawes Street/Sandalwood Street, Cunningham Street, Burke Crescent and extension of the Causeway to a connection at Mildura Street
Morshead Drive	Northbound connection to the Majura Parkway
Airport Northern Access Road	Connect Glenora Drive to Majura Road (Northern Access to RAAF Fairbairn (Canberra Airport as part of Canberra Airport Master Plan 2014-2034 p181)
Isabella Drive Duplication	From Hambidge Crescent to Drakeford Drive (Isabella Drive Duplication (from Drakeford Drive to Chisholm Shops))

Appendix B Model Calibration Report

![SMEC logo — Member of the Surbana Jurong Group]

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Microsimulation Calibration Report

City Section 100 Traffic Study

Prepared for Spiire
21 May 2019

Document Control

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City Section 100 Traffic Study
Prepared for Spiire

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1 Introduction

1.1 Project Background

SMEC was commissioned by Spiire Australia Pty Ltd (Spiire) to conduct a traffic study for a proposed development in Section 100, Canberra City. The proposed development includes residential units, commercial space and retail space.

The Section 100 development is a redevelopment of the land currently occupied by a surface car park, which is accessed by the intersection at London Circuit and Gordon Street. The proposed development will provide publicly accessible parking to replace the existing surface parking available at the site.

This study includes traffic generation based on trip generation rates agreed with TCCS, traffic distribution using the Canberra Strategic Transport Model (CSTM) and networked intersection analysis using SIDRA Intersection.

1.2 Model Purpose

The microsimulation model has been developed to fully understand the impacts of traffic generated by the proposed development in Section 100 on the surrounding road network in the AM and PM peak periods in 2031. As part of the assessment, options relating to traffic operations on Knowles Place will be assessed.

1.3 Software Package

Aimsun version 8.3 was used for this study. All modelling was conducted using the microsimulation functionality.

1.4 Model Periods

The modelling was conducted for the weekday AM and PM peak periods, which were:

- AM Peak: 08:00 to 09:00
- PM Peak: 17:00 to 18:00

A 30 minute warm-up period was used before the model period.

1.5 Project Location

The project area, Section 100, is located in Canberra City between London Circuit to the west and Vernon Circle to the east. The site is bounded by Edinburgh Avenue extension to the south and Knowles Place to the north. Section 100 and the surrounding road network are shown in Figure 1.
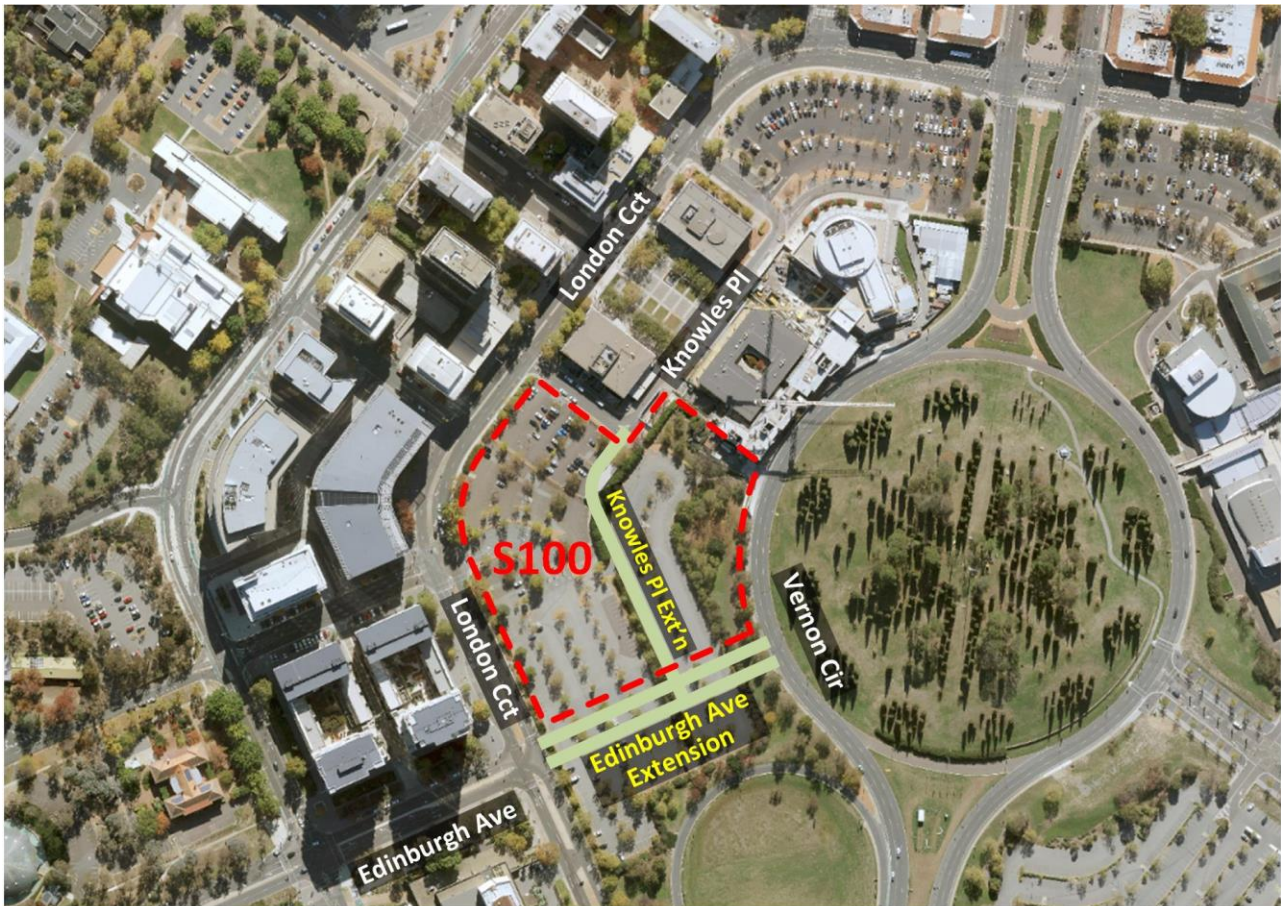
Figure 1: Context and Study Area

1.6   Model Study Area

The area modelled for this study was agreed with TCCS and comprises the roads immediately surrounding Section 100, as well as major roads in the area, including:

- Marcus Clarke Street
- Edinburgh Avenue
- Vernon Circle
- Commonwealth Avenue
- Northbourne Avenue

The Aimsun model area is shown in Figure 2.
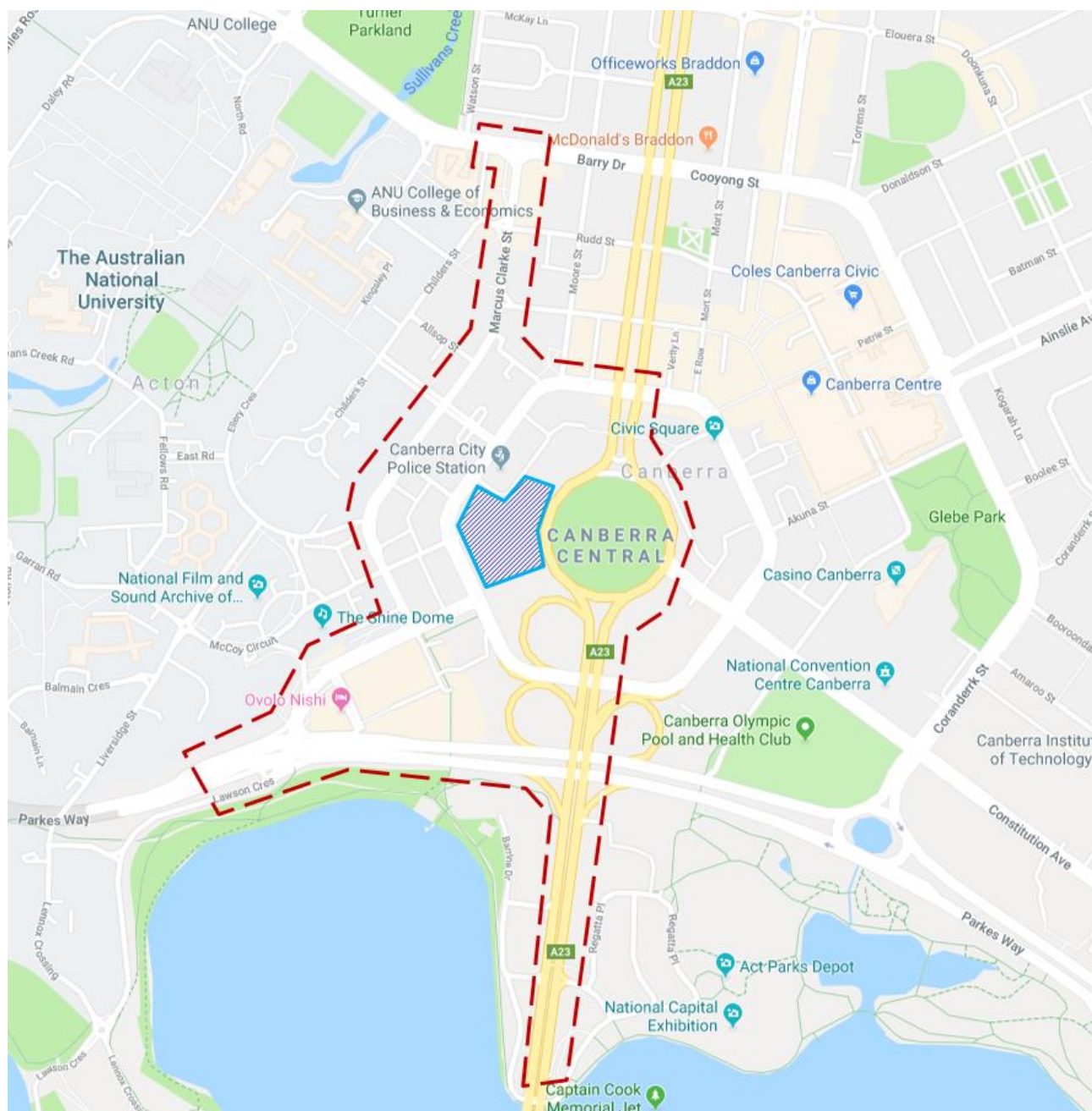
Figure 2: Model Area (Source: TCCS)

2 Data Collection

Traffic surveys were undertaken to inform the calibration and validation steps of the traffic modelling process. These surveys are fundamental to validity of the model and comprised the following:

- Intersection counts:
    - Manual counts (AM and PM peak video survey)
    - SCATS loop detector data (24-hour, 7-day data)

2.1 Intersection Counts

Counts of turning movements, classified into light and heavy vehicles, at the following intersections were conducted in the AM and PM peak periods on 13 February 2019:

- Manual Counts:
    - Barry Drive/Marcus Clarke Street
    - Marcus Clarke Street/Rudd Street/Rimmer Street
    - Marcus Clarke Street/Hobart Place
    - Marcus Clarke Street/Allsop Street
    - London Circuit/West Row
    - Northbourne Avenue/London Circuit
    - London Circuit/Hobart Place
    - Marcus Clarke Street/University Avenue
    - London Circuit/Knowles Place (North)
    - London Circuit/University Avenue
    - Marcus Clarke Street/Farrell Place
    - London Circuit/Knowles Place (South)
    - London Circuit/Farrell Place
    - Marcus Clarke Street/Ellery Crescent
    - London Circuit/Gordon Street
    - Marcus Clarke Street/Gordon Street
    - Marcus Clarke Street/Edinburgh Avenue
    - Commonwealth Avenue/London Circuit (all ramps and loops as well as through movements on London Circuit and Commonwealth Avenue)
    - Parkes Way/Edinburgh Avenue (North)
    - Parkes Way/Edinburgh Avenue (South)
    - Parkes Way/Commonwealth Avenue (all ramps and loops as well as through movements on Parkes Way and Commonwealth Avenue)

Counts of movements across loop detectors at the following intersections were conducted for seven days between 7-13 February 2019:

- SCATS Counts
    - Marcus Clarke Street/Alinga Street (SCATS)
    - Vernon Circle/Constitution Avenue (SCATS)
    - London Circuit/Edinburgh Avenue (SCATS)
    - Edinburgh Avenue/Phillip Law Street (SCATS)
    - Commonwealth Avenue pedestrian crossing (SCATS)

3   Network Development

3.1   Base Model Network

The model network is shown in Figure 3. The model has been coded to a microsimulation standard within this area and the assignment takes place entirely within it.
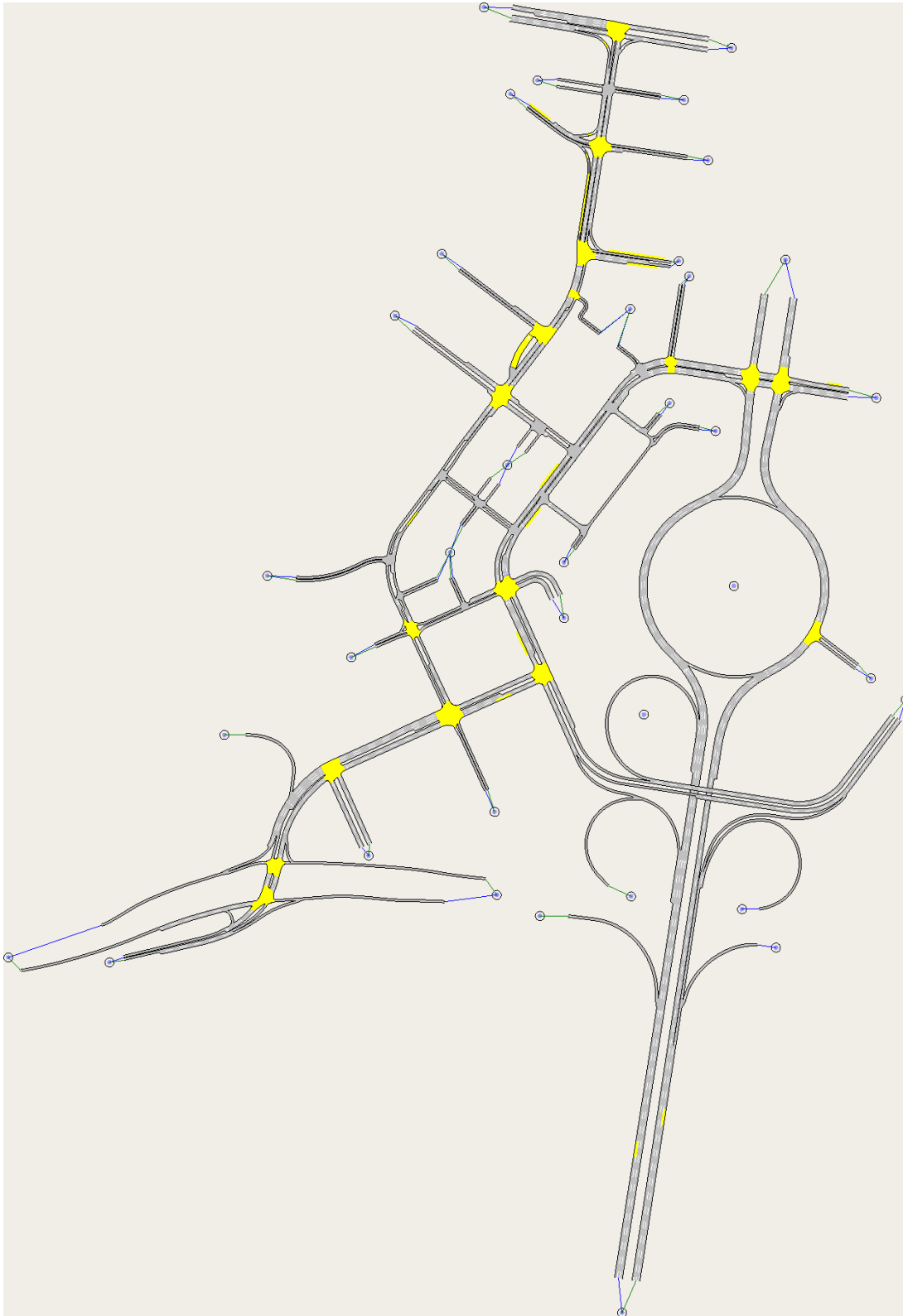
Figure 3: Aimsun Model Area

3.2   Model Geometry

The model has been coded to micro-simulation standard, with all roads represented, except for some minor local streets which do not carry significant through traffic. All intersections in the area have been coded. This was coded using recent aerial imagery from ACTMapi and TCD Grid drawings from TCCS.

3.3   Modelled Vehicles

The model uses default vehicle types. These vehicle types are intended to represent a typical urban network in ACT or NSW.

3.4   Posted Speed Limits

All speed within the study area have been coded according to the road speed limits as listed below:

- 80 km/h
  - Parkes Way Ramps
- 70 km/h
  - Commonwealth Avenue
- 60 km/h
  - London Circuit (parts)
  - Northbourne Avenue
  - Edinburgh Avenue
  - Vernon Circle
- 40 km/h
  - Marcus Clarke Street
  - London Circuit (parts)
- All others 50km/h

3.5   Traffic Signals

There are 14 signalised sites in the model area, which are:

- Barry Drive/Marcus Clarke Street
- Marcus Clarke Street/Rudd Street/Rimmer Street
- Marcus Clarke Street/Alinga Street
- Marcus Clarke Street/Allsop Street
- Northbourne Avenue/London Circuit
- Marcus Clarke Street/University Avenue
- London Circuit/Gordon Street
- Vernon Circle/Constitution Avenue
- London Circuit/Edinburgh Avenue
- Marcus Clarke Street/Edinburgh Avenue
- Edinburgh Avenue/Phillip Law Street
- Parkes Way/Edinburgh Avenue (North)
- Parkes Way/Edinburgh Avenue (South)
- Commonwealth Avenue pedestrian crossing

3.5.1   SCATS Data

TCCS provided traffic signal data to inform the configuration of the traffic signals within the model. The following data were supplied for each intersection:

- Phase sequence
- Right turn operation
- Cycle length
- Phase timings
- Intergreen details
- Site linkage
- Pedestrian timing
- Detector location
- Intersection layout (schematic)
- Available phases

3.5.2 Cycle Time and Phase Splits

All intersections have been coded as fixed time. The phase and cycle times were based on the times supplied by TCCS.

All the signal phase operations and phase times in the model have been manually configured based on the SCATS data. This data indicates which signal phases ran during the peak periods and the average duration for which each phase ran. This information was then used as the basis for creating the signal plans in the base model. The average phase times supplied by TCCS are presented in the following sections. The actual modelled phase times differ if the average is less than the sum of minimum green time and inter-green time (typically 12 seconds).

3.5.3 Signal Configurations

3.5.3.1 Barry Drive/Marcus Clarke Street
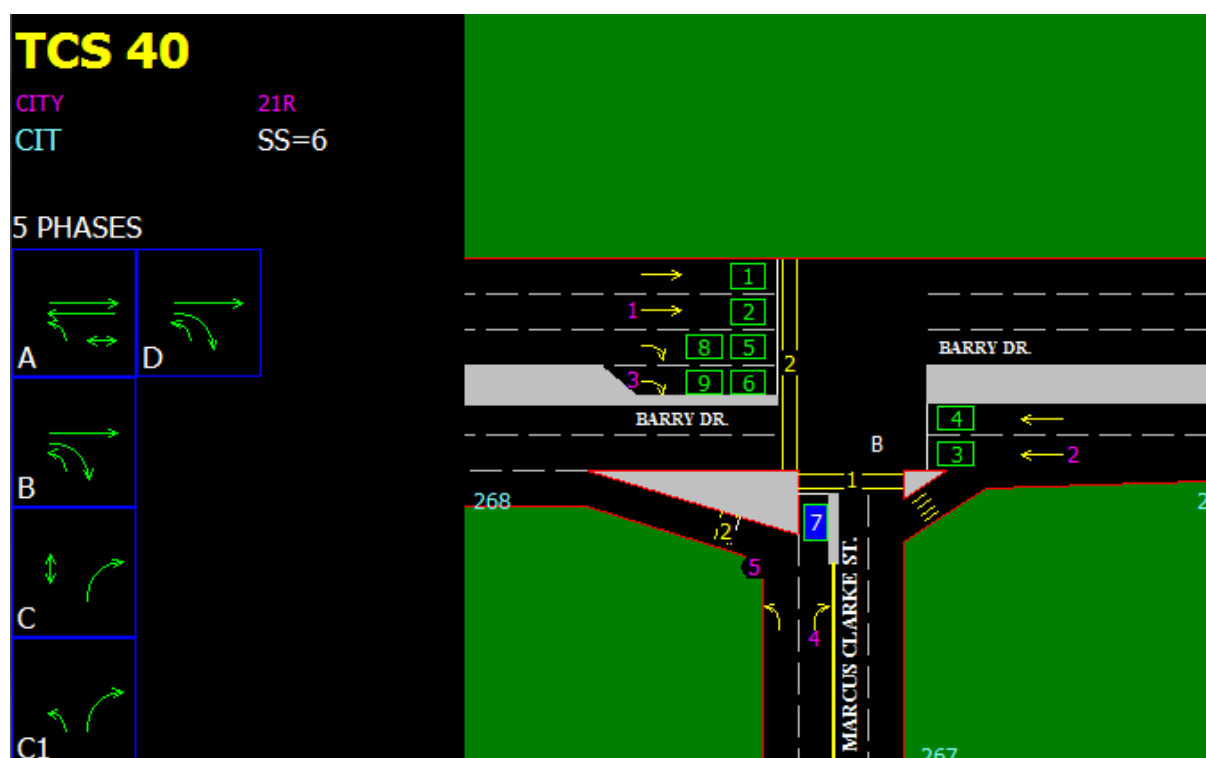
Site details

- T-junction
- Phase sequence: A-B-C at all times.

Right turn operation

- Right turns on Barry Dr are fully controlled (i.e. no filters).

Phase time and cycle length details

- Maximum cycle time is 130 sec
- Average phase time (sec) and cycle length (sec) details on 07 February 2019:

PEAK	TIME PERIOD	AVG CL	A	B	C
AM	0800-0900	130	31	67	32
PM	1700-1800	130	67	24	39
Late Start			0	0	0
Minimum Green time (sec)			8	8	8
Yellow Time (sec)			4	4	4
Red Time (sec)			2	2	2
Intergreen time (Yellow + Red)			6	6	6

Linking

- Site is permanently linked to Barry Dr/ Northbourne Ave (Set 2) intersection.

Signals Coordination & Offsets

- In AM peak, the eastbound coordination is favourable
  - B phase at this site terminates 20 sec BEFORE the end of E phase at Set 2 (see SCATS graphics below).
- In PM peak, the westbound coordination is favourable
  - A phase at this site terminates 20 sec AFTER the end of D phase at Set 2 (see SCATS graphics below).

Pedestrian timings & Activations

PED WALK	VEHICLE PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	AM NO. OF PED ACTIVATIONS	PM NO. OF PED ACTIVATIONS
P1	A	14	28	28
P2	C	22	27	27

3.5.3.2 Marcus Clarke Street/Rudd Street/Rimmer Street
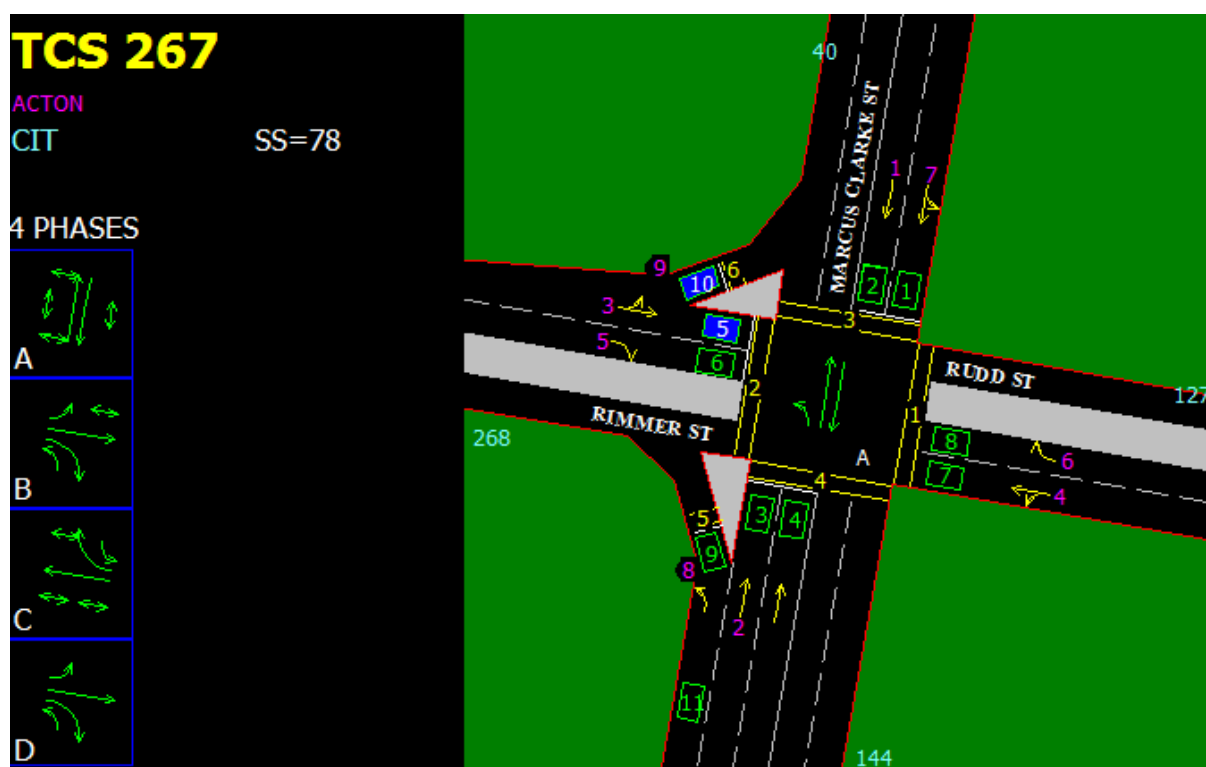
Site details

- Phase sequence: A-B-C-D at all times.

Right turn operation

- Right turns on Edinburgh Ave are fully controlled (i.e. no filters).

Phase time and cycle length details

- Maximum cycle time is 120 sec.
- Phase times (sec) and cycle length (sec) details on 07 February 2019:

PEAK	TIME PERIOD	AVG CL	A	B	C	D*
AM	0800-0900	120	81	20	23	15
PM	1700-1800	120	70	22	31	14
Minimum Green time			8	8	8	8
Yellow Time			4	4	4	4
Red Time			2	2	2	2
Intergreen time (Yellow + Red)			6	6	6	6

*: D phase and B phase are combined in the micro-simulation model to match quoted cycle length

Linking

- In morning peak, site is linked to Edinburgh Ave/ Parkes Way ramps (Set079)
- Rest of the day, site is linked to Edinburgh Ave/ Marcus Clarke St (Set031).

Signals Coordination

- In morning peak, the north-east coordination (i.e. towards London Circ) is favourable.
- Rest of the day, the south-west coordination (i.e. towards Parkes Way) is favourable.

Pedestrian timings

PED WALK	ALLOWED PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	AM PEAK NO. OF PED ACTIVATIONS	PM PEAK NO. OF PED ACTIVATIONS
P1	A	14	28	24
P2	A	14	28	28
P3	B	15	24	27
P4	C	14	28	28
P5	A, C	14	33	36
P6	A, C	14	33	36

3.5.3.3 Marcus Clarke Street/Alinga Street

Site details

- Phase sequence: A-B-C-D at all times.

Right turn operation

- Right turns on Marcus Clarke St are fully controlled (i.e. no filters).

Phase time and cycle length details

- Maximum cycle time is 120 sec.
- Phase times (sec) and cycle length (sec) details on 07 February 2019:

PEAK	TIME PERIOD	AVG CL	A	B	C	D
AM	0800-0900	120	71	23	15	21
PM	1700-1800	120	63	16	23	25
Minimum Green time			8	8	8	8
Yellow Time			4	4	4	4
Red Time			2	2	2	2
Intergreen time (Yellow + Red)			6	6	6	6

Linking

- Site is linked to Marcus Clarke St/ Alinga St (Set 112) in peak hours.

Signals Coordination

- At all times, site favours both directions.

Pedestrian timings

PED WALK	ALLOWED PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	NO. OF PED ACTIVATIONS IN AM PEAK	NO. OF PED ACTIVATIONS IN PM PEAK
P1	A	22	28	28
P2	C	18	28	27
P3	D	18	27	28

3.5.3.4   Marcus Clarke Street/Allsop Street

Site details

- Phase sequence: A-B-C-D at all times.
- C is Bus Exit only phase.

Right turn operation

- Right turns on Marcus Clarke St are allowed to filter.

Phase time and cycle length details

- Maximum cycle time is 120 sec.
- Phase times (sec) and cycle length (sec) details on 07 February 2019:

PEAK	TIME PERIOD	AVG CL	A	B*	C	D
AM	0800-0900	120	71	23	15	21
PM	1700-1800	120	62	34	17	18
Minimum Green time			8	7	8	6
Late Start			0	3	0	0
Yellow Time			4	4	4	4
Red Time			3	3	3	2
Intergreen time (Yellow + Red)			7	7	7	6

* B was demanded 12 times in PM peak, out of 30 cycles

Linking

- None (Master site)

Signals Coordination

- None (Master site)

Pedestrian timings

PED WALK	ALLOWED PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	NO. OF PED ACTIVATIONS IN AM PEAK	NO. OF PED ACTIVATIONS IN PM PEAK
P1	A	16	17	21
P2	B	16	23	21
P3	B	16	28	26

3.5.3.5   Northbourne Avenue/London Circuit
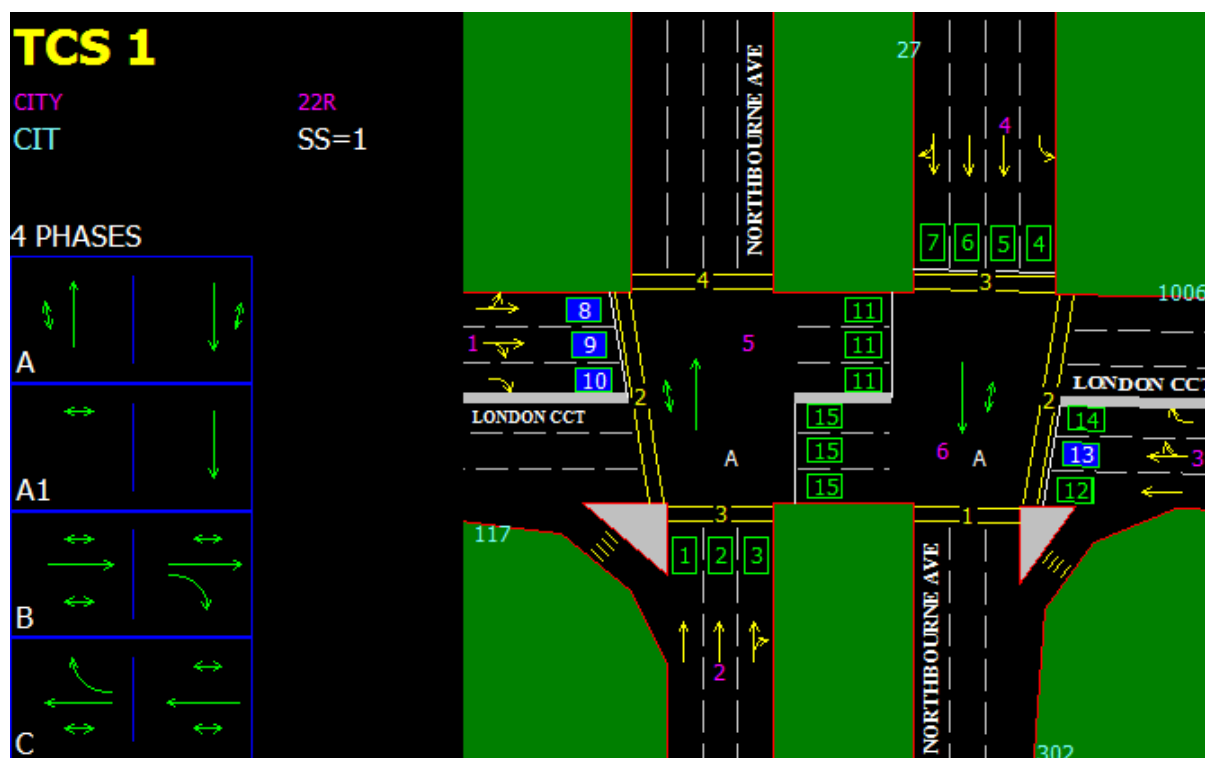
Site details

- Phase sequence: A-B-C at all times.

Right turn operation

- Right turns on Northbourne Ave are fully controlled (i.e. no filters).

Phase time and cycle length details

- Maximum cycle time is 130 sec
- Average phase time (sec) and cycle length (sec) details on 07 February 2019:

PEAK	TIME PERIOD	AVG CL	A	B	C
AM	0800-0900	130	77	29	24
PM	1700-1800	130	67	35	28
Minimum Green time (sec)			8	10	10
Early Cut-off green (sec)			5	4	4
Yellow Time (sec)			4	4	4
Red Time (sec)			2	2	2
Intergreen time (Yellow + Red)			6	6	6

Linking

- Linked to Northbourne Ave/ Alinga St (Set 027)

Pedestrian timings

PED WALK	VEHICLE PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	AM PEAK NO. OF PED ACTIVATIONS	PM PEAK NO. OF PED ACTIVATIONS
P1	A	18	27 (auto)	28 (auto)
P2	A	28	27 (auto)	28 (auto)
P3	B, C	18	28 (auto)	28 (auto)
P4	B	20	28 (auto)	28 (auto)

3.5.3.6 Marcus Clarke Street/University Avenue

Site details

- Phase sequence: A-B-C at all times.
- Site has Late Start for all phases.

Right turn operation

- Right turns along Marcus Clarke St are allowed to filter, and give-way to pedestrian movements across University Ave.

Phase time and cycle length details

- Maximum cycle time is 130 sec
- Average phase time (sec) and cycle length (sec) details on 07 February 2019:

PEAK	TIME PERIOD	AVG CL	A	B	C
AM	0800-0900	130	75	21	34
PM	1700-1800	130	70	30	30
Late Start			6	3	3
Minimum Green time (sec)			8	8	8
Yellow Time (sec)			4	4	4
Red Time (sec)			2	2	2
Intergreen time (Yellow + Red)			6	6	6

Linking

- None (Master Site)

Pedestrian timings

PED WALK	VEHICLE PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	NO. OF PED ACTIVATIONS IN AM PEAK	NO. OF PED ACTIVATIONS IN PM PEAK
P1	B	16	22	20
P2	C	16	24	23
P3	A	16	28	26

3.5.3.7 London Circuit/Gordon Street
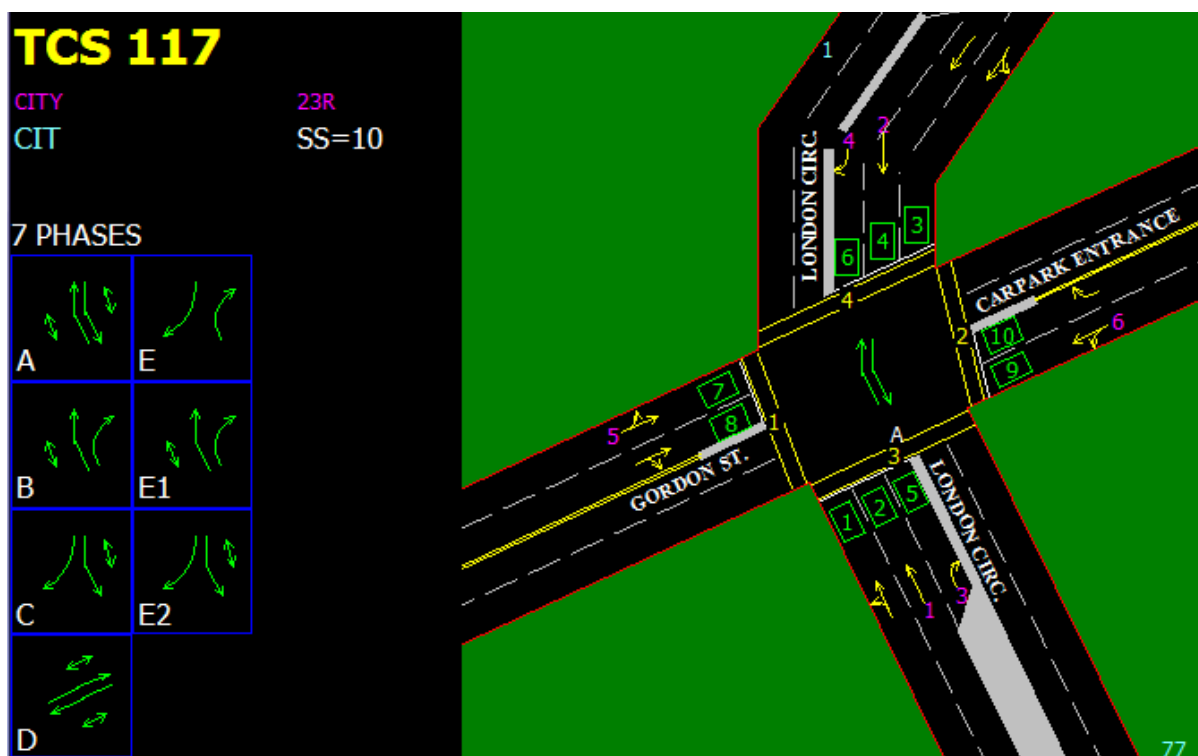
Site details

- Phase sequence: A-[B]-D-E at all times. B phase runs only in AM peak

Right turn operation

- Right turns on London Circ are fully controlled (i.e. no filters).
- Right turns on side streets are not controlled (i.e. filters allowed).

Phase time and cycle length details

- Maximum cycle time is 120 sec
- Average phase time (sec) and cycle length (sec) details on 07 February 2019:

PEAK	TIME PERIOD	AVG CL	A	B	D	E*
AM	0800-0900	120	59	17	23	21
PM	1700-1800	90	53	-	24	13
Minimum Green time (sec)			8	6	8	6
Yellow Time (sec)			4	4	4	4
Red Time (sec)			2	2	2	2
Intergreen time (Yellow + Red)			6	6	6	6

* E phase was demanded 18 times in PM peak, out of 40 cycles

Linking

- None (Master site)

SIDRA Coordination

- At all times, coordination on north and south approaches are 'favourable'

Pedestrian timings

PED WALK	VEHICLE PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	AM PEAK NO. OF PED ACTIVATIONS	PM PEAK NO. OF PED ACTIVATIONS
P1	A	16	19	27
P2	A	16	12	9
P3	D	18	14	11
P4	D	18	26	13

3.5.3.8 Vernon Circle/Constitution Avenue

Site details

- T-junction
- Phase sequence: A-B-C at all times.

Right turn operation

- Not applicable.

Phase time and cycle length details

- Maximum cycle time – 130 sec
- Average phase time (sec) and cycle length (sec) details on 07 February 2019:

PEAK	TIME PERIOD	AVG CL	A	B	C*
AM	0800-0900	130	107	16	20
PM	1700-1800	130	104	19	21
Minimum Green time (sec)			8	8	6
Yellow Time (sec)			4	4	4
Red Time (sec)			2	2	2
Intergreen time (Yellow + Red)			6	6	6

* C phase activated twice in AM and none in PM peak hours.

Linking

- Site is linked to London Circ/ Northbourne Ave intersection (Set 001)

SIDRA Coordination

- Site favours southbound direction at all times.

Pedestrian timings

PED WALK	VEHICLE PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	AM PEAK NO. OF PED ACTIVATIONS	PM PEAK NO. OF PED ACTIVATIONS
P1	A	16	28 (Auto)	28 (Auto)
P2	C	14	2	0
P3	B	14	4	4

3.5.3.9   London Circuit/Edinburgh Avenue
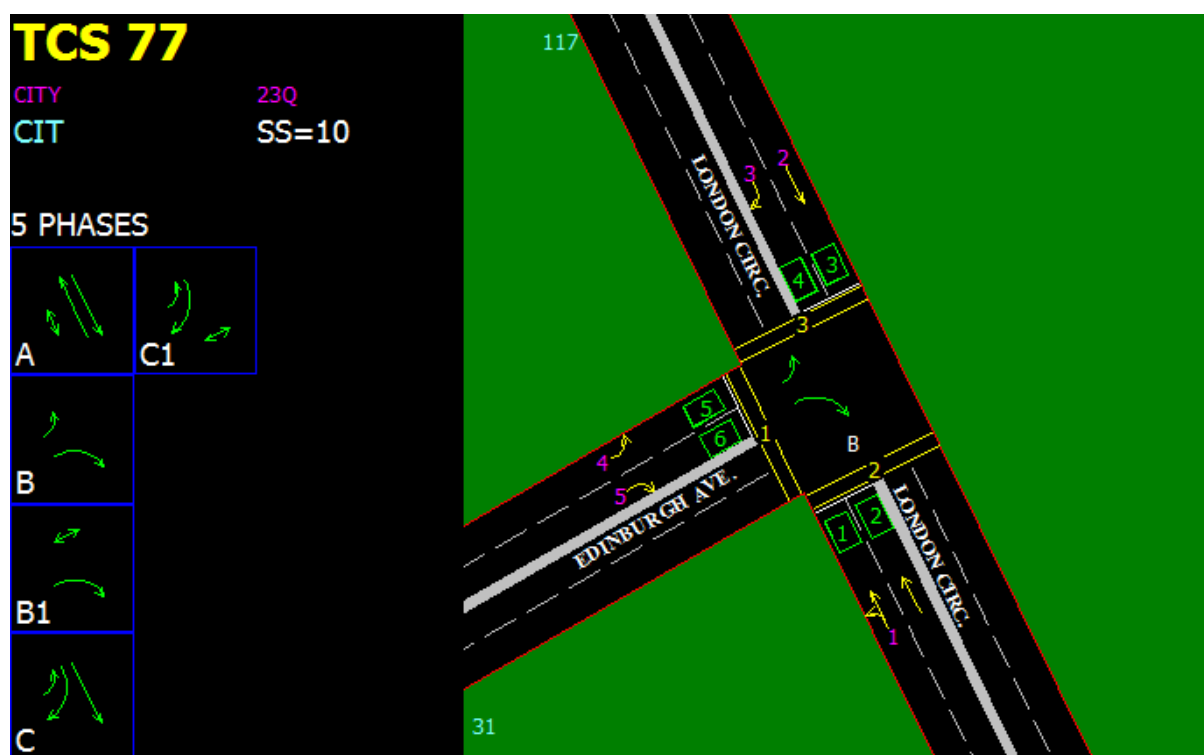
Site details

- Phase sequence: A-B-C at all times.

Right turn operation

- Right turns on London Cct are fully controlled (i.e. no filters).

Phase time and cycle length details

- Maximum cycle time is 120 sec
- Average phase time (sec) and cycle length (sec) details on 07 February 2019:

PEAK	TIME PERIOD	AVG CL	A	B	C
AM	0800-0900	120	56	43	21
PM	1700-1800	90	44	20	26
Minimum Green time (sec)			8	8	6
Yellow Time (sec)			4	4	4
Red Time (sec)			2	2	2
Intergreen time (Yellow + Red)			6	6	6

Linking

- None (Master Site)

Pedestrian timings

PED WALK	VEHICLE PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	NO. OF PED ACTIVATIONS IN AM PEAK	NO. OF PED ACTIVATIONS IN PM PEAK
P1	A	20	17	20
P2	C	20	15	15
P3	B	20	15	10

3.5.3.10 Marcus Clarke Street/Edinburgh Avenue

Site details

- Phase sequence: A-[B]-D-E-F at all times. B phase runs in AM peak only.

Right turn operation

- Right turns on Edinburgh Ave are fully controlled (i.e. no filters)

Phase time and cycle length details

- Maximum cycle time – 120 sec
- Average phase time (sec) and cycle length (sec) details on 07 February 2019:

PEAK	TIME PERIOD	AVG CL	A	B*	D	E	F
AM	0800-0900	120	38	19	26	25	16
PM	1700-1800	120	34	-	43	27	16
Minimum Green time (sec)			8	8	8	8	8
Yellow Time (sec)			4	4	4	4	4
Red Time (sec)			2	2	2	2	2
Intergreen time (Yellow + Red)			6	6	6	6	6

* B phase demanded 14 times in AM peak, out of 36 cycles

Linking

- None (Master site)

Pedestrian timings

PED WALK	VEHICLE PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	AM PEAK NO. OF ACTIVATIONS	PM PEAK NO. OF ACTIVATIONS
P1	A	16	14	15
P2	A	14	19	21
P3	D	18	30	31
P4	E	22	23	25

3.5.3.11 Edinburgh Avenue/Phillip Law Street

Site details

- T-junction
- Phase sequence: A-[B]-C-D at all times. B phase runs in only in AM peak.

Right turn operation

- Right turns on Edinburgh Ave are fully controlled (i.e. no filters).

Phase time and cycle length details

- Maximum cycle time is 120 sec.
- Phase times (sec) and cycle length (sec) details on 07 February 2019:

| PEAK	TIME PERIOD	AVG CL	A	B	C	D
AM	0800-0900	120	63	20	15	22
PM	1700-1800	120	84	-	14	22
Minimum Green time			8	8	8	8
Yellow Time			4	4	4	4
Red Time			2	2	2	2
Intergreen time (Yellow + Red)			6	6	6	6

Linking

- In morning peak, site is linked to Edinburgh Ave/ Parkes Way ramps (Set079)
- Rest of the day, site is linked to Edinburgh Ave/ Marcus Clarke St (Set031).

Signals Coordination

- In morning peak, the north-east coordination (i.e. towards London Circ) is favourable.
- Rest of the day, the south-west coordination (i.e. towards Parkes Way) is favourable.

Pedestrian timings

PED WALK	ALLOWED PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	AM PEAK NO. OF PED ACTIVATIONS	PM PEAK NO. OF PED ACTIVATIONS
P1	A	17	11	8
P2	D	17	24	26

3.5.3.12 Parkes Way/Edinburgh Avenue
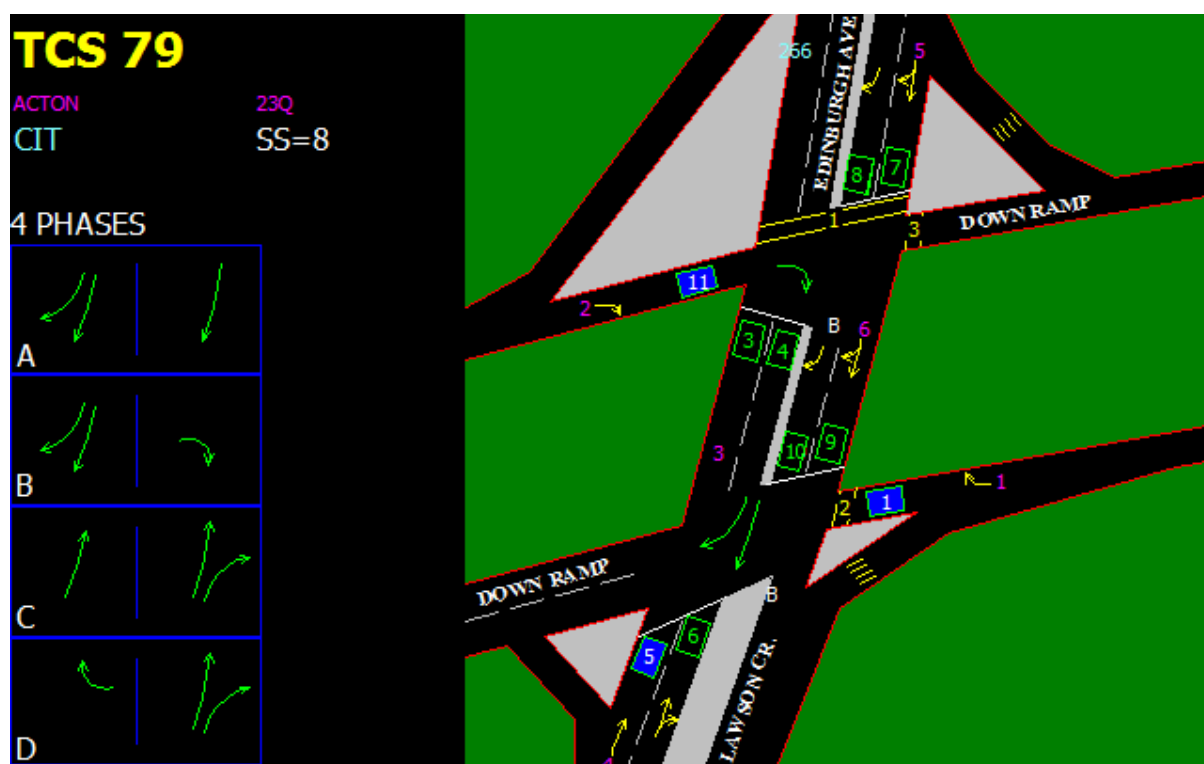
Site details

- Phase sequence: A-B-C-D at all times.

Right turn operation

- Right turns on Edinburgh Ave are fully controlled (i.e. no filters).

Phase time and cycle length details

- Maximum cycle time is 120 sec.
- Phase times (sec) and cycle length (sec) details on 07 February 2019:

PEAK	TIME PERIOD	AVG CL	A	B*	C	D
AM	0800-0900	120	22	25	17	56
PM	1700-1800	120	51	20	21	32
Minimum Green time			10	10	10	10
Early cut-off green			0	3.7	0	3.4
Yellow Time			4	4	4	4
Red Time			2	2	2	2
Intergreen time (Yellow + Red)			6	6	6	6

* B was demanded 12 times in PM peak, out of 30 cycles

Linking

- In morning peak, site is linked to Edinburgh Ave/ Parkes Way ramps (Set079)
- Rest of the day, site is linked to Edinburgh Ave/ Marcus Clarke St (Set031).

Signals Coordination

- In morning peak, the north-east coordination (i.e. towards London Circ) is favourable.
- Rest of the day, the south-west coordination (i.e. towards Parkes Way) is favourable.

Pedestrian timings

PED WALK	ALLOWED PHASE(S)	WALK+ CLEARANCE TIME (IN SEC)	NO. OF PED ACTIVATIONS IN AM PEAK	NO. OF PED ACTIVATIONS IN PM PEAK
P1	B	16	0	1
P2	A, B, C	14	10	6
P3	A	14	10	5

4 Demand Development

The traffic demand on the network is driven by the trip matrices, which form an input into the Aimsun model. This section describes the development of the base year trip matrices for calibration of the network assignment model.

4.1 Source Data

The data used to develop existing base case demand matrices are from two key sources:

- Demand matrices from the CSTM
- Traffic counts:
    - Manual intersection turning movement counts
    - Signalised intersection inductive loop counts

4.2 Zone Structure

The zone structure in the model is based on the zones in the CSTM, with additional zones added where necessary to improve the distribution of traffic amongst minor roads and access points. The model has 13 internal zones and 23 external zones. Details of the zones are shown in Table 1 and Figure 4.

Table 1: Aimsun Zone Details

ZONE ID	TYPE	DESCRIPTION/LOCATION
1	External	Northbourne Avenue
2	External	London Circuit (North)
3	External	Constitution Avenue
4	External	London Circuit (South)
5	External	London Circuit – Parkes Way EB Exit Ramps
6	External	London Circuit – Parkes Way WB Exit Ramps
7	External	Commonwealth Avenue
8	External	London Circuit – Parkes Way EB Entry Ramps
9	External	London Circuit – Parkes Way WB Entry Ramps
10	Internal	Marcus Clarke Street (South)
11	Internal	Phillip Law Street
12	External	Edinburgh Avenue – Parkes Way East Ramps
13	External	Lawson Crescent
14	External	Edinburgh Avenue – Parkes Way West Ramps
15	External	Hales Street
16	External	Gordon Street (West)
17	External	Ellery Crescent
18	External	University Avenue
19	External	Allsop Street
20	External	Rimmer Street

21	Internal	Carpark (Lena Karmel Lodge)
22	External	Barry Drive (West)
23	External	Barry Drive (East)
24	Internal	Carpark (St George Building)
25	External	Rudd Street
26	External	Alinga Street
27	External	West Row
28	Internal	Knowles Place Carpark
29	Internal	Magistrates Court Access
30	Internal	Police Station Carpark
31	Internal	Gordon Street Carpark
32	Internal	City Sections 61/90/91/92
33	Internal	City Section 5
34	Internal	Hobart Place
35	Internal	City Section 63
36	Internal	City Hill (unused)
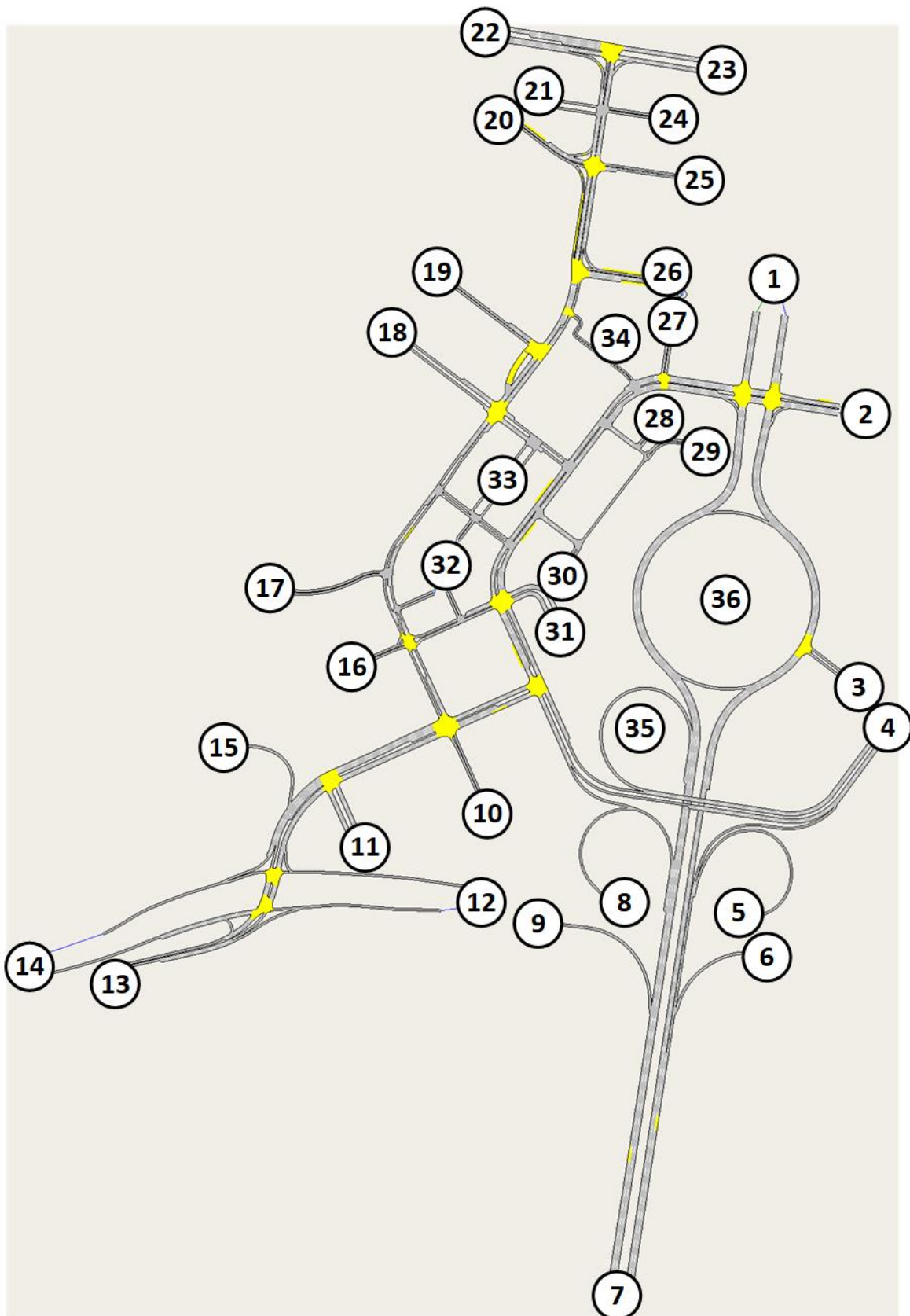
Figure 4: Zone Map

4.3 Pattern Matrix

Initial trip matrices were extracted from the CSTM. These matrices represent the number of vehicles travelling into, out of and through the model sub-area cordon shown in Figure 4 as modelled in the CSTM. The base model matrices represent the morning and evening peak periods for a typical weekday in 2016.

4.4 Traffic Volumes

The counts were carried out during February 2019, providing AM and PM peak traffic demand on the roads and through intersections in the area.

4.5 Demand Profiles

It is important in microsimulation modelling that the traffic demand that is being produced by the model matches real-world traffic demand as closely as possible. The intersection turning movement counts were available in 15-minute time segments in both the AM and PM peak periods. Demand profiles for the microsimulation models were developed using this information to model the effect of the changes in immediate traffic demand throughout the assignment period. The profiles for the AM and PM peak periods are shown in Table 2.

Table 2: AM and PM Peak Traffic Demand Profile

AM PEAK		PM PEAK	
PERIOD	PROPORTION	PERIOD	PROPORTION
08:00 – 08:15	24.1%	17:00 – 17:15	25.8%
08:15 – 08:30	25.0%	17:15 – 17:30	26.9%
08:30 – 08:45	25.4%	17:30 – 17:45	25.3%
08:45 – 09:00	25.5%	17:45 – 18:00	22.0%
Total	100.0%	Total	100.0%

4.6 Vehicle Classifications

The vehicular composition is based on the traffic volumes surveyed in February 2019. The following vehicle types are present:

- Light vehicles (LV)
- Heavy vehicles (HV)

A separate origin-destination (OD) matrix was developed for each vehicle class during OD matrix estimation in Aimsun. In other, less refined models, a global factor or average would be used to assign MCVs and HCVs to the modelled road network. The inclusion of separate matrices adds an important level of detail which increases confidence in the baseline and any future year model outputs.

4.7 Traffic Demand Development

The traffic demand for the road network was estimated as a zone to zone trip matrix for each of the peak periods. The development of these matrices is described in the following subsections.

For each of the peak periods, a sub-area pattern matrix was generated using the static traversal tool in Aimsun as a basis for generating each final 2019 traffic demand matrix. The pattern matrices were then modified using Aimsun's static adjustment tool to match the observed traffic counts. The process was as follows:

- Identified, for each count location, the origin-destination pairs whose traffic would pass through the count location

- Expressed an estimate of the count as the sum of the volumes in the identified origin-destination pairs
- Compared the estimated volumes with the counted volumes and average the GEH statistic of the differences
- Adjusted the values of the prior matrices to minimise the average of the GEH statistic of the differences.

This methodology is carried out by Aimsun during the OD matrix adjustment process. It undertakes the process iteratively, progressively refining the outcome. The output is a matrix that, when assigned to the network, much more closely matches the observed counts than the input matrix.

4.8   Traffic Assignment

The traffic assignment is a dynamic, microscopic simulation with Stochastic Route Choice (SRC). The SRC method begins by calculating the initial shortest path for each OD pair using the defined initial costs. In the case of this model, a prior path assignment must be generated for each microsimulation scenario. This has been done because the OD matrix adjustment was conducted using the static assignment method. It should be noted that the. After the 30 minute warmup period, the travel times calculated at the end of the warmup period. The route choice cycle is 15 minutes and 100% of vehicles are allowed to adjust their routes.

5 Model Calibration

5.1 Overview

Roads and Maritime *Traffic Modelling Guideline, Version 1, February 2013* (Roads and Maritime guideline) was used as a main guideline for base year model development and calibration process.

The Roads and Maritime guidelines specify statistical criteria that can be used to assess whether a microsimulation model is adequately representing existing:

• Traffic volumes
• Signal timings

The traffic surveys conducted during February 2019 form the basis of the traffic volume calibration.

The signal set up and input data have been discussed in detail in Section 3.5.

5.2 Calibration Criteria

5.2.1 Traffic Volumes

The traffic volumes are calibrated on a network wide basis using the GEH statistic as per calibration criteria given in Roads and Maritime guideline. The GEH statistic is calculated for each surveyed intersection turning movement to compare the model and observed traffic volumes.

To achieve calibration, Roads and Maritime guideline stipulates that, for the entire network, the following calibration targets should be achieved:

• 85 per cent of count sites with a GEH statistic less than five
• Sites with GEH statistic greater than 10 are undesirable and require explanation if they exist
• Coefficient of determination (R^2) should be greater than 0.9

In addition, the slope of the relationship between counted and modelled sites should be within 0.05 of unity.

5.3 Performance Against Criteria

5.3.1 Traffic Volume Comparison

The modelled traffic volumes, taken as the average of five different seed runs, have been compared to the observed volumes at the locations described in Section 2.1 during the estimation process. The GEH statistic has been calculated for each intersection turning movement count.

Figure 5 and Figure 6 show plots of observed versus modelled traffic volumes for the AM and PM peak periods respectively.
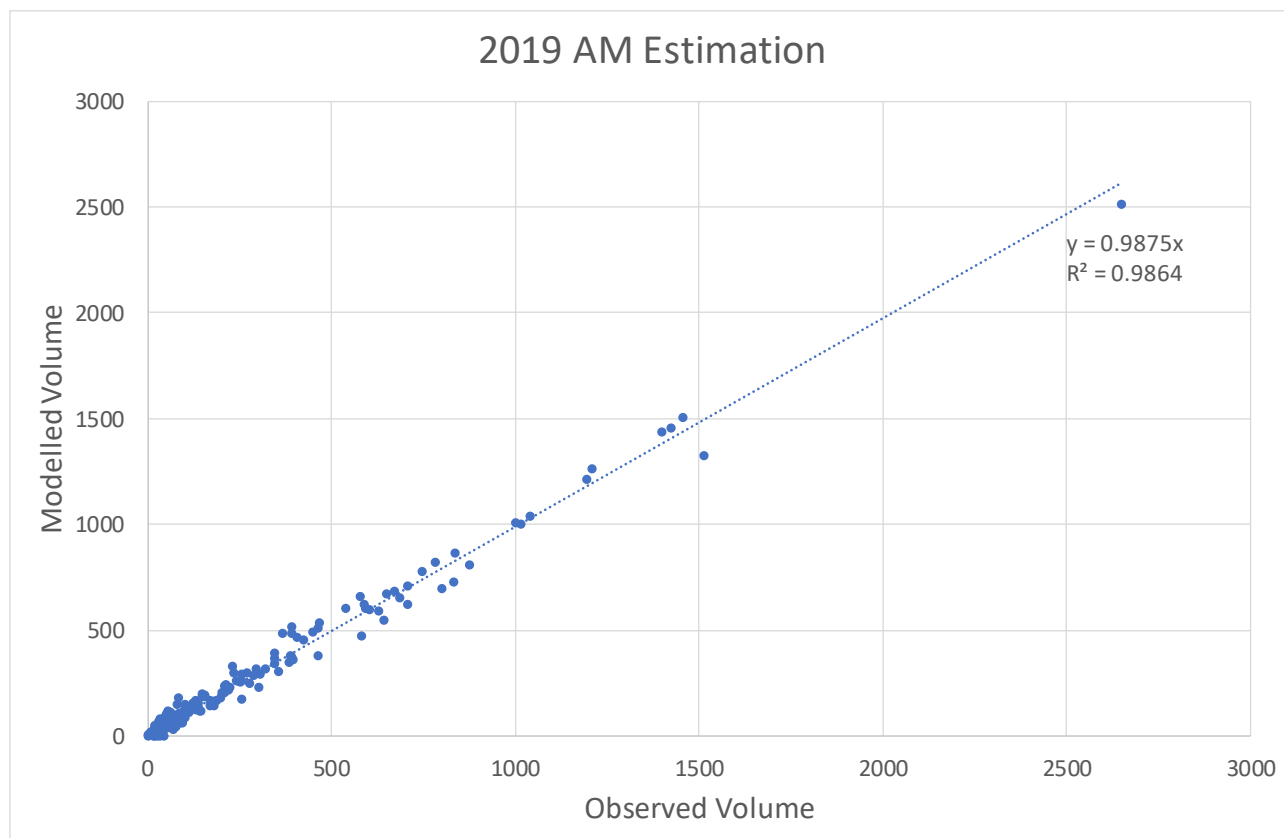
Figure 5: AM Peak Validation Comparison
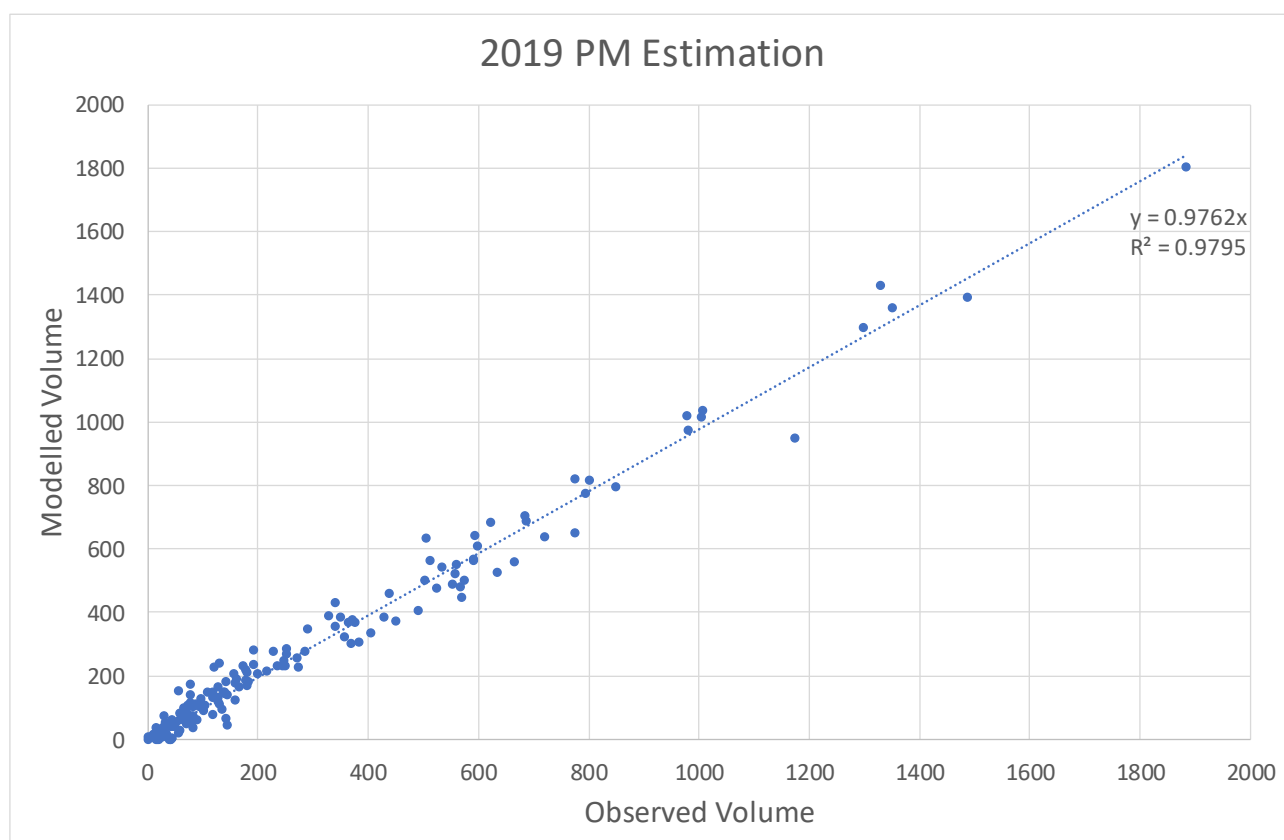
Figure 6: PM Peak Validation Comparison

The estimation shows good correlation in both peak periods, with coefficients of correlation of 0.99 in the AM peak and 0.98 in the PM peak. There are no movements in either peak period with GEH values above 10.

Table 3 shows the summary data for the GEH statistic calculation for the AM and PM peak models. The results shown reflect the average volumes from five different seed runs.

Table 3: Traffic volume calibration summary (overall)

MODEL PERIOD	NUMBER OF CALIBRATION COUNT SITES	GEH <5	GEH <10	AVERAGE GEH	R²	SLOPE
AM Peak	166	148 (89%)	166 (100%)	2.3	0.99	0.99
PM Peak	166	144 (87%)	166 (100%)	2.6	0.98	0.98

The results indicate that 89% of locations have a GEH statistic of less than 5 in the AM peak and 87% of locations have a GEH of less than 5 in the PM peak. All locations in both peaks have a GEH statistic less than 10. Therefore, the AM and PM peak models are considered calibrated to the observed traffic volumes. Based on this result, it is very likely that the future year models would provide a good representation of traffic operations where similar levels of model coding and accuracy are applied.

6   Summary and Conclusion

This report summarises the development and calibration process for the base case models of the road network surrounding Section 100.

6.1   Summary

A microsimulation model using stochastic route choice assignment functionality of Aimsun 8.3 has been developed for the area around Section 100, as agreed with TCCS.

Observed traffic counts from February 2019 and outputs from the recently calibrated CSTM were used to generate AM and PM base OD matrices for the 2019 model year.

Calibration of the model was conducted to match existing road network and intersection behaviour, using recent aerial imagery and signal control plans provided by TCCS.

Validation of the model was conducted against the observed traffic count data. The outcomes of the traffic count validation, with model volumes taken as the average of five different seed runs, are shown in **Error! Reference source not found.**. 89% of movements in the AM peak and 87% of movements in the PM peak have a GEH statistic less than 5 and no movements in the AM and PM peak base models give a GEH statistic of greater than 10.

: Traffic volume calibration summary (overall)

MODEL PERIOD	NUMBER OF CALIBRATION COUNT SITES	GEH <5	GEH <10	AVERAGE GEH	R²	SLOPE
AM Peak	166	148 (89%)	166 (100%)	2.3	0.99	0.99
PM Peak	166	144 (87%)	166 (100%)	2.6	0.98	0.98

Therefore, the AM and PM peak models developed for this assessment are considered to be calibrated to the existing conditions and they are appropriate for use in this study.

6.2   Conclusion

The baseline Aimsun traffic model has been adequately calibrated and validated to the prescribed modelling guidelines. As such, the traffic model can be progressed and used for the purposes detailed in Section 1.2 of this report.

Appendix A   Traffic Surveys

local people
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SMEC is recognised for providing technical excellence and consultancy expertise in urban, infrastructure and management advisory. From concept to completion, our core service offering covers the life-cycle of a project and maximises value to our clients and communities. We align global expertise with local knowledge and state-of-the-art processes and systems to deliver innovative solutions to a range of industry sectors.

Appendix C   Detailed Intersection Analysis Results

1: Barry Drive - Marcus Clarke Street

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Marcus Clarke South	Left	128	6.6	A	1.4	27.9	648	7.9	A	8.4
	Right	132	49.3	D	12.1	36.4	331	33.5	C	20.1
Barry Drive East	Left	168	12.1	B	3.4	86.3	152	17.5	B	4.3
	Through	318	31.3	C	8.2	11.3	1035	8.0	A	6.3
Barry Drive West	Through	1011	7.7	A	5.7	75.4	541	8.8	A	3.7
	Right	895	25.5	C	18.8	75.4	276	53.8	D	13.3
	Total	**2652**	**18.8**	**B**	**18.8**		**2983**	**15.7**	**B**	**20.1**

2: Marcus Clarke Street - Rimmer Street - Rudd Street

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Marcus Clarke South	Left	28	54.8	D	4.1	108.8	36	67.8	E	6.3
	Through	306	13.1	B	3.5	111.3	672	19.5	B	11.3
Rudd Street East	Left	50	47.4	D	4.4	99.5	105	44.6	D	8.6
	Through	25	37.4	D	1.7	99.5	19	37.4	D	1.3
	Right	0	-1.0		0.0	99.5	129	43.8	D	10.4
Marcus Clarke North	Left	259	12.1	B	5.0	53.5	103	7.1	A	1.2
	Through	766	16.6	B	10.0	53.5	368	15.9	B	4.9
Rimmer Street West	Left	33	34.0	C	2.1	11.2	80	38.1	D	5.5
	Through	31	36.6	D	2.0	15.0	65	38.6	D	4.7
	Right	45	55.0	D	3.6	15.0	38	58.7	E	3.6
	Total	**1543**	**19.1**	**B**	**10.0**		**1615**	**25.4**	**C**	**11.3**

3: Marcus Clarke Street - Alinga Street

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Marcus Clarke South	Through	158	5.5	A	0.0	33.0	521	5.1	A	1.9
	Right	267	41.5	D	21.7	33.0	197	41.0	D	16.4
Hobart Place East	Left	36	20.2	C	1.4	99.3	59	27.1	C	2.9
	Right	150	81.8	F	11.3	99.3	166	49.0	D	7.5
	Right (Bus)	28	99.8	F	5.6	99.3	37	59.5	E	4.2
Marcus Clarke North	Left	120	17.8	B	1.3	89.4	101	0.6	A	0.0
	Through	738	6.8	A	8.1	14.6	411	7.8	A	5.5
	Total	**1497**	**23.3**	**C**	**21.7**		**1492**	**17.4**	**B**	**16.4**

4: Marcus Clarke Street - Hobart Place

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Marcus Clarke South	Through	425	6.4	A	1.5	46.4	681	2.9	A	0.9
	Right	2	28.2	D	0.1	46.4	0	-1.0		0.0
Hobart Place East	Left	0	-1.0		0.0	63.9	0	-1.0		0.0
	Right	2	0.9	A	0.0	63.9	37	16.7	C	1.1
Marcus Clarke North	Left	8	1.1	A	0.0	35.9	2	1.1	A	0.0
	Through	763	0.6	A	0.0	35.9	468	1.2	A	0.5
	Total	**1200**	**2.7**	**A**	**1.5**		**1188**	**2.6**	**A**	**1.1**

5: Marcus Clarke Street - Allsop Street

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Marcus Clarke	Left	177	23.5	C	7.0	46.2	43	15.2	B	1.1
South	Through	400	13.7	B	4.8	46.2	499	17.4	B	7.4
Marcus Clarke	Through	612	5.0	A	2.5	44.7	430	9.1	A	3.3
North	Right	146	14.6	B	3.5	44.7	36	12.0	B	0.7
Allsop Street	Left	19	58.2	E	2.1	122.5	142	43.1	D	11.3
West	Right	0	-1.0		0.0	122.5	110	43.7	D	8.8
City West	Through	8	12.9	B	1.2	50.1	40	32.9	C	8.1
	Total	**1362**	**11.8**	**B**	**7.0**		**1300**	**19.9**	**B**	**11.3**

6: London Circuit - West Row

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
London Circuit	Through	287	0.3	A	0.0	72.7	298	0.4	A	0.0
East	Right	145	6.6	A	1.5	72.7	139	9.4	A	2.0
West Row North	Left	113	11.6	B	2.2	95.2	239	15.0	B	6.3
	Right	72	14.1	B	1.7	95.2	25	20.7	C	0.9
London Circuit	Left	21	0.5	A	0.0	25.2	99	0.6	A	0.0
West	Through	464	0.1	A	0.0	25.2	566	0.1	A	0.0
	Total	**1102**	**3.1**	**A**	**2.2**		**1366**	**4.1**	**A**	**6.3**

7: London Circuit - Northbourne Avenue

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Northbourne	Left	279	12.7	B	5.6	90.8	99	13.7	B	2.2
Avenue	Through	1060	4.1	A	2.3	3.9	829	6.2	A	2.8
South	Right	172	7.0	A	2.1	3.9	91	5.2	A	0.9
London	Left	101	17.9	B	3.4	64.5	104	21.4	C	4.2
Circuit	Through	194	34.0	C	4.0	4.6	494	16.3	B	4.7
East	Right	81	0.2	A	0.0	16.7	207	0.4	A	0.0
Northbourne	Left	117	18.3	B	3.5	91.3	172	22.3	C	6.3
Avenue	Through	1172	17.6	B	11.3	91.3	1014	22.2	C	12.6
North	Right	45	22.0	C	1.7	91.3	40	25.1	C	1.6
London	Left	52	86.0	F	8.4	86.3	46	54.3	D	4.8
Circuit	Through	520	67.3	E	21.7	86.3	754	48.5	D	22.3
West	Right	237	2.2	A	0.4	19.3	342	0.3	A	0.0
	Total	**4030**	**20.2**	**C**	**21.7**		**4192**	**20.0**	**C**	**22.3**

7: London Circuit - Northbourne Avenue West

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Northbourne	Left	279	12.7	B	5.6	90.8	99	13.7	B	2.2
Avenue	Through	1060	4.1	A	2.3	3.9	829	6.2	A	2.8
South	Right	172	7.0	A	2.1	3.9	91	5.2	A	0.9
London Cct	Through	158	24.2	C	3.6	16.7	331	9.6	A	10.2
East	Right	81	0.2	A	0.0	16.7	207	0.4	A	0.0
London Cct	Left	52	86.0	F	8.4	86.3	46	54.3	D	4.8
West	Through	520	67.3	E	21.7	86.3	754	48.5	D	22.3
	Total	**2322**	**22.5**	**C**	**21.7**		**2357**	**20.9**	**C**	**22.3**

7: London Circuit - Northbourne Avenue East

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
London Cct East	Left	101	17.9	B	3.4	64.5	104	21.4	C	4.2
	Through	194	34.0	C	4.0	4.6	494	16.3	B	4.7
Northbourne Avenue North	Left	117	18.3	B	3.5	91.3	172	22.3	C	6.3
	Through	1172	17.6	B	11.3	91.3	1014	22.2	C	12.6
	Right	45	22.0	C	1.7	91.3	40	25.1	C	1.6
London Cct West	Through	456	20.8	C	8.7	19.3	497	9.6	A	4.3
	Right	237	2.2	A	0.4	19.3	342	0.3	A	0.0
	Total	**2322**	**18.2**	**B**	**11.3**		**2663**	**16.0**	**B**	**12.6**

8: London Circuit - Hobart Place

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
London Circuit South	Left	0	-1.0		0.0	50.6	0	-1.0		0.0
	Through	474	0.1	A	0.0	50.6	645	0.2	A	0.0
London Circuit North	Through	336	0.2	A	0.0	25.3	313	0.1	A	0.0
	Right	23	3.6	A	7.0	25.3	11	5.8	A	0.1
Hobart Place West	Left	10	1.0	A	0.0	34.8	20	1.3	A	0.0
	Right	0	-1.0		0.0	34.8	2	0.7	A	0.0
	Total	**843**	**0.3**	**A**	**7.0**		**991**	**0.2**	**A**	**0.1**

9: Marcus Clarke Street - University Avenue

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Marcus Clarke South	Left	209	16.3	B	5.4	104.5	124	22.3	C	4.7
	Through	324	16.6	B	4.6	104.5	310	16.3	B	4.3
	Right	0	-1.0		0.0	104.5	23	28.0	C	1.1
University Ave East	Left	7	58.5	E	0.8	40.9	27	71.1	E	3.7
	Through	156	46.2	D	6.5	40.9	159	49.0	D	7.3
	Right	208	44.2	D	16.5	40.9	185	53.9	D	18.3
Marcus Clarke North	Left	95	2.6	A	0.3	69.3	151	39.8	D	10.8
	Through	477	3.7	A	1.3	69.3	375	9.9	A	2.6
	Right	37	8.4	A	0.5	69.3	15	20.7	C	0.5
University Ave West	Left	53	59.1	E	6.0	131.9	47	42.2	D	3.7
	Through	0	-1.0		0.0	131.9	69	41.8	D	2.8
	Right	0	-1.0		0.0	131.9	175	46.8	D	15.2
	Total	**1566**	**19.8**	**B**	**16.5**		**1660**	**30.9**	**C**	**18.3**

10: London Circuit - Knowles Place North

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
London Cct South	Through	474	0.2	A	0.0	57.1	642	0.4	A	0.0
	Right	118	1.6	A	0.1	57.1	95	1.4	A	0.2
London Cct North	Left	120	0.9	A	0.0	46.4	116	1.0	A	0.0
	Through	215	0.2	A	0.0	46.4	202	0.2	A	0.0
	Total	**927**	**0.5**	**A**	**0.1**		**1055**	**0.5**	**A**	**0.2**

11: London Circuit - University Avenue

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
London Cct South	Left	287	1.6	A	0.0	56.0	302	1.3	A	0.0
	Through	497	0.4	A	0.1	56.0	534	0.3	A	0.0
London Cct North	Through	138	0.1	A	0.0	57.6	131	0.4	A	0.0
	Right	76	9.4	A	1.2	57.6	71	10.3	B	1.2
University Ave West	Left	95	11.9	B	1.9	36.9	201	18.0	C	6.2
	Right	4	23.8	C	0.2	36.9	41	27.2	D	1.7
	Total	**1097**	**2.4**	**A**	**1.9**		**1280**	**4.8**	**A**	**6.2**

12: Marcus Clarke Street - Farrell Place

Approach	Movement	2019 AM Count	Delay	LoS	Queue	Length	2019 PM Count	Delay	LoS	Queue
Marcus Clarke	Through	528	0.6	A	0.0	118.5	389	0.5	A	0.0
South	Right	1	0.5	A	0.0	118.5	1	0.5	A	0.0
Farrell Place	Left	25	9.6	A	0.4	45.7	3	13.1	B	0.0
East	Right	3	8.4	A	0.0	45.7	64	17.2	C	1.9
Marcus Clarke	Left	46	1.7	A	0.0	103.5	114	2.3	A	0.0
North	Through	433	1.4	A	0.3	103.5	461	1.7	A	0.3
	Total	**1036**	**1.2**	**A**	**0.4**		**1032**	**2.3**	**A**	**1.9**

13: London Circuit - Knowles Place South

Approach	Movement	2019 AM Count	Delay	LoS	Queue	Length	2019 PM Count	Delay	LoS	Queue
London	Through	636	0.3	A	0.0	46.0	671	0.2	A	0.0
Knowles	Left	35	2.1	A	0.1	47.8	57	1.1	A	0.0
Pl S East	Right	148	3.2	A	0.6	47.8	163	3.5	A	0.7
London	Through	143	0.1	A	0.0	57.1	172	0.2	A	0.0
	Total	**962**	**0.8**	**A**	**0.6**		**1063**	**0.8**	**A**	**0.7**

14: London Circuit - Farrell Place

Approach	Movement	2019 AM Count	Delay	LoS	Queue	Length	2019 PM Count	Delay	LoS	Queue
London	Left	49	2.2	A	0.0	67.8	40	1.5	A	0.0
Cct South	Through	629	0.6	A	0.0	67.8	643	0.5	A	0.0
London	Through	161	0.7	A	0.1	39.3	226	0.3	A	0.0
Cct North	Right	16	4.1	A	0.1	39.3	3	6.6	A	0.0
Farrell	Left	7	13.6	B	0.2	39.9	28	16.9	C	0.8
Pl West	Right	43	13.1	B	0.9	39.9	115	16.3	C	3.2
	Total	**905**	**1.5**	**A**	**0.9**		**1055**	**2.7**	**A**	**3.2**

15: Marcus Clarke Street - Ellery Crescent

Approach	Movement	2019 AM Count	Delay	LoS	Queue	Length	2019 PM Count	Delay	LoS	Queue
Marcus Clarke	Left	131	0.9	A	0.0	43.9	71	0.8	A	0.0
South	Through	303	0.1	A	0.0	43.9	292	0.2	A	0.0
Marcus Clarke	Through	281	3.8	A	1.6	113.6	398	2.6	A	1.4
North	Right	172	8.4	A	2.2	113.6	65	6.6	A	0.7
Ellery Crescent	Left	225	15.3	C	6.0	116.4	99	15.4	C	2.6
West	Right	0	-1.0		0.0	116.4	202	15.6	C	5.2
	Total	**1112**	**5.5**	**A**	**6.0**		**1127**	**5.5**	**A**	**5.2**

16: London Circuit - Gordon Street

Approach	Movement	2019 AM				Length	2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
London	Left	76	29.2	C	3.9	92.7	25	6.9	A	0.3
Circuit	Through	599	14.0	B	7.3	92.7	526	13.1	B	6.1
South	Right	279	35.8	D	17.8	92.7	17	41.5	D	1.3
Gordon	Left	5	45.1	D	0.4	59.6	125	32.8	C	7.6
Street	Through	0	-1.0		0.0	59.6	0	-1.0		0.0
East	Right	79	52.6	D	7.7	59.6	157	34.8	C	9.8
London	Left	132	28.3	C	6.8	56.5	13	20.7	C	0.5
Circuit	Through	72	19.4	B	1.3	56.5	327	15.1	B	4.2
North	Right	0	-1.0		0.0	56.5	0	-1.0		0.0
Gordon	Left	0	-1.0		0.0	37.3	0	-1.0		0.0
Street	Through	2	52.3	D	0.1	37.3	0	-1.0		0.0
West	Right	23	49.3	D	2.1	37.3	31	43.4	D	2.5
	Total	**1267**	**24.8**	**C**	**17.8**		**1221**	**19.6**	**B**	**9.8**

17: Vernon Circle - Constitution Avenue

Approach	Movement	2019 AM				Length	2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Constitution Ave	Left	60	60.6	E	6.5	59.4	101	58.0	E	11.0
Vernon Circle	Left	168	7.0	A	1.4	161.8	118	5.7	A	6.3
North	Through	1333	4.2	A	2.5	161.8	1352	5.1	A	3.2
	Total	**1561**	**6.7**	**A**	**6.5**		**1571**	**8.5**	**A**	**11.0**

18: Marcus Clarke Street - Gordon Street

Approach	Movement	2019 AM				Length	2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Marcus Clarke	Left	179	1.6	A	0.0	94.4	34	1.1	A	0.0
South	Through	458	1.0	A	0.0	94.4	354	0.7	A	0.0
Gordon Street	Left	12	3.4	A	0.0	60.6	25	15.9	C	0.7
Marcus Clarke North	Left	2	0.4	A	0.0	28.7	4	0.9	A	0.0
	Through	153	0.7	A	0.1	28.7	591	0.7	A	0.5
	Right	128	11.1	B	3.3	28.7	21	4.6	A	0.2
Gordon Street	Left	15	1.9	A	0.0	7.0	26	2.8	A	0.1
West	Right	87	4.4	A	0.6	4.6	113	8.7	A	1.5
	Total	**1034**	**2.6**	**A**	**3.3**		**1168**	**1.9**	**A**	**1.5**

19: London Circuit - Edinburgh Avenue

Approach	Movement	2019 AM				Length	2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
London	Left	330	28.1	C	15.1	96.1	405	22.6	C	16.6
Circuit	Through	492	29.1	C	11.8	96.1	355	20.3	C	5.7
South	Right	0	0.0	A	0.0	#N/A	0	0.0	A	0.0
Edinburgh	Left	0	0.0	A	0.0	#N/A	0	0.0	A	0.0
Avenue	Through	0	0.0	A	0.0	#N/A	0	0.0	A	0.0
East	Right	0	0.0	A	0.0	#N/A	0	0.0	A	0.0
London	Left	0	0.0	A	0.0	#N/A	0	0.0	A	0.0
Circuit	Through	28	0.5	A	0.0	96.4	111	2.6	A	0.2
North	Right	72	33.7	C	4.3	96.4	371	49.2	D	32.9
Edinburgh	Left	468	30.0	C	30.4	103.4	212	51.4	D	20.2
Avenue	Through	0	0.0	A	0.0	#N/A	0	0.0	A	0.0
West	Right	274	32.0	C	15.8	103.4	66	34.5	C	3.8
	Total	**1664**	**29.4**	**C**	**30.4**		**1520**	**31.6**	**C**	**32.9**

20: Marcus Clarke Street - Edinburgh Avenue

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Marcus Clarke South	Left	82	46.2	D	7.0	91.5	87	52.9	D	8.5
	Through	9	44.1	D	0.7	91.5	47	48.2	D	4.2
	Right	65	47.5	D	5.7	91.5	52	41.7	D	4.0
Edinburgh Avenue East	Left	33	34.2	C	1.9	103.5	81	44.2	D	6.6
	Through	213	71.3	E	6.4	103.5	578	39.8	D	21.1
	Right	149	297.0	F	241.8	103.5	111	71.4	E	14.7
Marcus Clarke North	Left	60	49.3	D	5.5	93.7	23	35.0	C	1.4
	Through	25	45.6	D	2.1	93.7	24	47.4	D	2.1
	Right	172	42.6	D	6.7	93.7	683	42.8	D	26.4
Edinburgh Avenue West	Left	478	7.9	A	3.9	140.3	231	13.9	B	12.0
	Through	619	22.1	C	11.3	140.3	203	27.2	C	4.8
	Right	206	47.3	D	16.2	140.3	41	86.6	F	6.5
	Total	**2111**	**50.4**	**D**	**241.8**		**2161**	**40.3**	**D**	**26.4**

22: Edinburgh Avenue - Phillip Law Street

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Phillip Law South	Left	84	39.2	D	6.1	93.9	201	39.9	D	14.7
	Right	39	51.0	D	3.7	93.9	76	101.1	F	14.5
Edinburgh Avenue East	Left	88	18.0	B	2.3	139.3	51	5.6	A	0.2
	Through	378	30.4	C	9.7	139.3	1294	4.2	A	2.9
Edinburgh Avenue West	Through	1271	14.7	B	9.9	47.2	398	6.0	A	1.2
	Right	110	17.3	B	7.4	47.2	60	33.4	C	3.7
	Total	**1970**	**19.8**	**B**	**9.9**		**2080**	**12.4**	**B**	**14.7**

23: Parkes Way - Edinburgh Avenue (North)

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Edinburgh Ave South	Through	613	4.1	A	3.9	17.4	243	3.0	A	1.1
	Right	59	0.3	A	0.0	17.4	148	0.7	A	0.0
Edinburgh Ave North	Left	167	15.4	B	3.8	91.5	548	18.4	B	14.8
	Through	291	61.3	E	16.3	22.2	959	18.2	B	14.5
Parkes Way Off-ramp West	Left	888	0.4	A	0.0	170.8	340	0.1	A	0.0
	Through	102	49.1	D	8.8	49.8	4	41.4	D	0.3
	Right	41	43.5	D	3.2	49.8	21	45.8	D	1.7
	Total	**2161**	**13.9**	**B**	**16.3**		**2263**	**13.1**	**B**	**14.8**

24: Parkes Way - Edinburgh Avenue (South)

Approach	Movement	2019 AM					2019 PM			
		Count	Delay	LoS	Queue	Length	Count	Delay	LoS	Queue
Lawson Crescent South	Left	43	1.6	A	0.0	143.4	152	1.7	A	0.0
	Through	59	55.0	D	3.0	29.3	166	46.3	D	6.9
Parkes Way Off-ramp East	Left	336	26.9	C	14.4	183.9	84	4.4	A	0.6
	Right	612	18.2	B	18.2	27.3	226	36.2	D	14.6
Edinburgh Ave North	Through	175	1.7	A	0.3	19.6	26	3.0	A	0.1
	Right	157	0.7	A	0.0	19.6	954	0.4	A	0.0
	Total	**1382**	**17.3**	**B**	**18.2**		**1608**	**10.5**	**B**	**14.6**

1: Barry Drive - Marcus Clarke Street

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Marcus Clarke South	Left	27.9	342	7.5	A	4.3	626.2	7.9	A	8.2	504	6.0	A	5.0	763.4	7.5	A	9.5
	Right	36.4	199.6	36.7	D	13.0	406.2	33.5	C	24.4	231.6	35.7	D	14.9	459.6	38.1	D	32.0
Barry Drive East	Left	20.4	326.8	3.8	A	2.0	200	1.3	A	0.4	293.2	17.1	B	8.2	205.6	1.5	A	0.5
	Through	11.3	595.6	18.9	B	8.9	1136	7.6	A	6.5	552.8	19.9	B	8.7	1062	7.8	A	6.4
Barry Drive West	Through	75.4	775.2	7.5	A	4.4	840.8	11.2	B	7.0	810.8	22.5	C	4.0	737.2	20.4	C	5.6
	Right	75.4	802.2	28.8	C	20.2	466.6	74.9	E	38.4	787.4	101.6	F	42.8	498.6	126.1	F	62.2
	Total		**3041**	**16.9**	**B**	**20.2**	**3676**	**19.5**	**B**	**38.4**	**3180**	**39.5**	**D**	**42.8**	**3726**	**29.5**	**C**	**62.2**

2: Marcus Clarke Street - Rimmer Street - Rudd Street

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Marcus Clarke South	Left	108.8	28	52.7	D	4.0	36	65.0	E	6.2	27.2	49.7	D	3.8	36	69.0	E	6.3
	Through	111.3	497.8	14.5	B	6.0	810.6	19.7	B	13.4	725.8	15.2	B	8.8	988.6	39.0	D	33.5
Rudd Street East	Left	99.5	53.8	53.4	D	5.4	85.4	43.7	D	6.8	74	90.0	F	13.2	131.2	168.1	F	40.9
	Through	99.5	22.4	51.7	D	2.2	64.6	44.4	D	5.3	23	85.3	F	3.7	53.2	153.4	F	15.4
	Right	99.5	53.2	49.1	D	4.8	147	44.9	D	12.1	50.6	66.8	E	6.1	180.8	172.8	F	56.9
Marcus Clarke North	Left	53.5	328.8	12.2	B	6.2	138.4	10.6	B	2.3	224.4	21.4	C	7.9	232	11.1	B	4.1
	Through	53.5	781	15.6	B	9.6	570.6	18.2	B	8.3	856.2	46.8	D	33.7	510	22.2	C	9.7
Rimmer Street West	Left	11.2	46	45.5	D	3.9	53	42.7	D	4.2	35.8	54.1	D	3.6	21.4	43.8	D	1.8
	Through	15.0	93.4	45.2	D	7.8	97.6	44.8	D	7.9	96.4	52.5	D	7.7	135.6	42.3	D	10.4
	Right	15.0	50	53.6	D	4.0	39	54.5	D	3.9	50	86.9	F	5.0	45	56.0	E	4.5
	Total		**1954**	**20.7**	**C**	**9.6**	**2042**	**25.5**	**C**	**13.4**	**2163**	**37.2**	**D**	**33.7**	**2334**	**53.8**	**D**	**56.9**

3: Marcus Clarke Street - Alinga Street

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Marcus Clarke South	Through	33.0	327	1.0	A	0.0	624.6	5.9	A	2.5	410.2	0.7	A	0.1	800	6.0	A	3.1
	Right	33.0	177.2	43.1	D	19.0	218.6	47.3	D	19.0	181.8	41.6	D	15.8	223.2	43.8	D	21.1
Alinga Street East	Left	99.3	70.2	32.1	C	4.1	101	36.9	D	6.7	136.8	112.6	F	30.5	87.2	46.2	D	7.4
	Right	99.3	170.2	55.9	E	8.6	196.4	51.1	D	9.2	317.2	94.6	F	27.8	206	53.2	D	10.1
	Right (Bus)	99.3	28	65.8	E	3.8	36.8	51.7	D	3.8	27.2	76.0	E	5.4	36.8	56.7	E	4.2
Marcus Clarke North	Left	29.3	169.6	1.4	A	0.3	83	3.0	A	0.3	243.8	1.6	A	0.4	140	2.5	A	0.4
	Through	14.6	713.4	7.0	A	8.2	613.4	8.5	A	8.2	727.4	9.7	A	10.6	538.8	13.2	B	10.9
	Total		**1656**	**16.2**	**B**	**19.0**	**1874**	**18.8**	**B**	**19.0**	**2044**	**30.7**	**C**	**30.5**	**2032**	**19.3**	**B**	**21.1**

4: Marcus Clarke Street - Hobart Place

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Marcus Clarke	Through	46.4	507.6	1.3	A	0.3	835	5.4	A	2.3	592	0.9	A	0.2	1013	5.3	A	2.5

South	Right	46.4	18.4	21.9	C	2.2	5.2	19.9	C	0.2	12.8	18.4	C	0.4	3.2	13.4	B	1.0
Hobart Place	Left	63.9	144.2	15.7	C	4.0	54	17.3	C	1.7	144.2	149.7	F	42.5	56	41.3	E	4.3
East	Right	63.9	1.6	21.3	C	0.1	8.8	28.0	D	0.5	3	122.3	F	0.7	12.2	48.5	E	1.1
Marcus Clarke	Left	35.9	29.6	1.8	A	0.0	4.8	2.6	A	0.0	35.6	13.5	B	0.8	2.4	8.2	A	0.0
North	Through	35.9	752.2	1.2	A	0.7	709.6	4.9	A	5.2	826.2	7.5	A	9.8	623.8	11.0	B	11.2
	Total		**1454**	**3.0**	**A**	**4.0**	**1617**	**5.8**	**A**	**5.2**	**1614**	**18.2**	**C**	**42.5**	**1711**	**8.9**	**A**	**11.2**

5: Marcus Clarke Street - Allsop Street

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Marcus Clarke	Left	46.2	287	16.1	B	7.5	91.8	10.4	B	1.5	265.6	14.7	B	6.2	89.6	23.1	C	3.6
South	Through	46.2	481.8	16.9	B	7.2	711.6	16.4	B	9.8	561	18.3	B	9.1	883.4	19.4	B	14.7
Marcus Clarke	Through	44.7	752	7.2	A	4.4	681	13.9	B	7.8	864.2	19.2	B	13.1	603.6	28.3	C	14.5
North	Right	44.7	144.2	20.1	C	4.9	86	30.9	C	4.6	111	27.7	C	5.3	80.2	42.9	D	6.1
Allsop Street	Left	122.5	36.6	50.8	D	3.5	88.8	50.4	D	8.2	37.4	51.7	D	3.6	94	80.4	F	14.0
West	Right	122.5	20.8	49.5	D	1.9	266.2	51.3	D	25.1	34	57.5	E	3.6	216.8	108.6	F	44.2
City West	Through	50.1	8.2	4.7	A	1.0	40	28.7	C	7.7	7.8	3.0	A	1.0	39	31.7	C	7.7
	Total		**1731**	**13.9**	**B**	**7.5**	**1965**	**22.4**	**C**	**25.1**	**1881**	**20.1**	**C**	**13.1**	**2007**	**35.9**	**D**	**44.2**

6: London Circuit - West Row

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
London Circuit	Through	72.7	724.2	0.5	A	0.1	706.2	4.3	A	1.7	1104	11.9	B	10.9	1087	37.1	E	27.0
East	Right	72.7	101.4	7.5	A	1.2	193	12.2	B	4.3	91.6	19.7	C	1.9	281.6	31.7	D	13.8
West Row North	Left	95.2	207	11.3	B	3.8	310.8	50.1	F	27.8	103.4	159.2	F	33.8	260.2	39.9	E	19.7
	Right	95.2	68.4	19.5	C	2.3	9	70.3	F	1.2	216.6	180.7	F	80.5	7.4	100.2	F	1.5
London Circuit	Left	25.2	73.2	0.7	A	0.0	233.6	2.3	A	1.6	80.8	0.8	A	0.0	239.8	1.0	A	0.6
West	Through	25.2	586.4	0.1	A	0.0	679.4	3.0	A	1.1	702.6	0.1	A	0.0	550	2.4	A	0.8
	Total		**1761**	**2.8**	**A**	**3.8**	**2132**	**11.3**	**B**	**27.8**	**2299**	**30.7**	**D**	**80.5**	**2426**	**25.5**	**D**	**27.0**

7: London Circuit - Northbourne Avenue

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Northbourne	Left	19.4	641.6	0.7	A	0.0	571.2	0.8	A	0.1	969.2	1.8	A	1.1	1055	4.5	A	4.1
Avenue	Through	3.9	1222	8.2	A	5.4	1073	7.3	A	4.3	1204	8.1	A	5.1	1144	7.1	A	3.9
South	Right	3.9	281	12.8	B	6.1	369.4	10.5	B	5.7	285.4	11.0	B	5.4	346.4	8.7	A	4.3
London	Left	25.2	152	4.9	A	1.0	217.6	2.6	A	0.6	150.4	6.4	A	1.4	195.8	5.2	A	1.3
Circuit	Through	4.6	196.8	31.9	C	3.7	398	23.3	C	5.3	151	36.7	D	3.4	346.2	28.9	C	5.9
East	Right	16.7	68.2	0.9	A	0.0	149.6	4.0	A	0.5	60.2	0.3	A	0.0	136.8	7.1	A	0.9
Northbourne	Left	91.3	102.8	61.2	E	11.3	91	62.7	E	10.1	82.2	96.4	F	14.5	63.4	79.6	E	9.0
Avenue	Through	91.3	1271	57.7	E	43.6	1401	59.3	E	48.9	1034	91.7	F	57.7	1251	81.8	F	61.1
North	Right	91.3	57	68.8	E	7.0	73	103.4	F	14.2	157.4	357.4	F	108.0	118.2	352.3	F	87.6
London	Left	86.3	27	51.9	D	2.6	40.8	96.7	F	7.6	72.2	43.3	D	5.9	42.2	98.4	F	7.8

Circuit West	Movement	Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Circuit	Through	86.3	744.8	47.0	D	22.0	935	88.4	F	51.9	719.4	49.6	D	22.2	742.2	96.8	F	46.4
West	Right	19.3	446.8	0.5	A	0.1	599.6	2.9	A	1.5	495.8	0.9	A	0.3	603.8	6.5	A	3.6
	Total		**5210**	**27.1**	**C**	**43.6**	**5919**	**35.0**	**D**	**51.9**	**5381**	**40.8**	**D**	**108.0**	**6044**	**42.5**	**D**	**87.6**

7: London Circuit - Northbourne Avenue West

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Northbourne	Left	19.4	641.6	0.7	A	0.0	571.2	0.8	A	0.1	969.2	1.8	A	1.1	1055	4.5	A	4.1
Avenue	Through	3.9	1222	8.2	A	5.4	1073	7.3	A	4.3	1204	8.1	A	5.1	1144	7.1	A	3.9
South	Right	3.9	281	12.8	B	6.1	369.4	10.5	B	5.7	285.4	11.0	B	5.4	346.4	8.7	A	4.3
London Cct	Through	16.7	186.4	20.8	C	4.1	323	18.1	B	6.0	248	49.2	D	11.6	326.2	38.7	D	11.9
East	Right	16.7	68.2	0.9	A	0.0	149.6	4.0	A	0.5	60.2	0.3	A	0.0	136.8	7.1	A	0.9
London Cct	Left	86.3	27	51.9	D	2.6	40.8	96.7	F	7.6	72.2	43.3	D	5.9	42.2	98.4	F	7.8
West	Through	86.3	744.8	47.0	D	22.0	935	88.4	F	51.9	719.4	49.6	D	22.2	742.2	96.8	F	46.4
	Total		**3171**	**17.2**	**B**	**22.0**	**3462**	**30.4**	**C**	**51.9**	**3558**	**18.4**	**B**	**22.2**	**3792**	**27.8**	**C**	**46.4**

7: London Circuit - Northbourne Avenue East

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
London Cct	Left	25.2	152	4.9	A	1.0	217.6	2.6	A	0.6	150.4	6.4	A	1.4	195.8	5.2	A	1.3
East	Through	4.6	196.8	31.9	C	3.7	398	23.3	C	5.3	151	36.7	D	3.4	346.2	28.9	C	5.9
Northbourne	Left	91.3	102.8	61.2	E	11.3	91	62.7	E	10.1	82.2	96.4	F	14.5	63.4	79.6	E	9.0
Avenue	Through	91.3	1271	57.7	E	43.6	1401	59.3	E	48.9	1034	91.7	F	57.7	1251	81.8	F	61.1
North	Right	91.3	57	68.8	E	7.0	73	103.4	F	14.2	157.4	357.4	F	108.0	118.2	352.3	F	87.6
London Cct	Through	19.3	575.8	12.2	B	6.4	700	12.1	B	7.7	507.8	13.0	B	5.9	475.6	11.5	B	5.0
West	Right	19.3	446.8	0.5	A	0.1	599.6	2.9	A	1.5	495.8	0.9	A	0.3	603.8	6.5	A	3.6
	Total		**2802**	**34.9**	**C**	**43.6**	**3480**	**33.4**	**C**	**48.9**	**2579**	**66.9**	**E**	**108.0**	**3054**	**55.5**	**E**	**87.6**

8: London Circuit - Hobart Place

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
London Circuit	Left	50.6	20.2	0.9	A	0.0	2	0.8	A	0.0	24.6	0.9	A	0.0	3.6	2.2	A	0.5
South	Through	50.6	567.4	0.2	A	0.0	855	0.5	A	0.1	672.2	0.2	A	0.0	735.6	0.4	A	0.0
London Circuit	Through	23.6	764.2	0.5	A	0.2	710	2.9	A	1.6	1289	5.7	A	5.9	1083	15.5	C	14.1
North	Right	23.6	27.2	6.0	A	0.3	7.2	12.7	B	1.4	25.6	7.6	A	1.3	5	8.1	A	1.1
Hobart Place	Left	34.8	92	8.1	A	1.2	58	3.7	A	0.3	111	17.3	C	3.6	55.8	19.3	C	2.0
West	Right	34.8	55.2	15.6	C	1.5	10.2	17.5	C	0.3	35.4	50.5	F	3.5	15.4	83.8	F	2.4
	Total		**1526**	**1.5**	**A**	**1.5**	**1642**	**1.8**	**A**	**1.6**	**2158**	**5.3**	**A**	**5.9**	**1898**	**10.3**	**B**	**14.1**

9: Marcus Clarke Street - University Avenue

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue

Approach	Movement	Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Marcus Clarke South	Left	104.5	480.8	32.4	C	24.0	247.4	26.5	C	10.4	426.2	23.5	C	14.8	208.8	39.5	D	13.8
	Through	104.5	446.4	27.4	C	10.1	521	22.1	C	9.5	511.4	20.9	C	8.7	591.2	39.4	D	20.0
	Right	104.5	39	39.9	D	2.8	7.6	36.9	D	0.5	57.4	36.4	D	3.6	15.2	84.7	F	2.3
University Ave East	Left	40.9	123.2	54.1	D	13.9	20.2	74.8	E	2.9	98	64.0	E	13.2	197.4	30.3	C	11.5
	Through	40.9	160.6	46.8	D	6.8	197.2	65.1	E	11.9	125	51.5	D	5.8	177.4	30.9	C	5.1
	Right	40.9	261	47.3	D	23.5	208.4	64.3	E	25.1	247	52.8	D	28.0	324.4	30.7	C	20.4
Marcus Clarke North	Left	69.3	208.4	10.6	B	3.9	163	41.8	D	16.0	307.2	66.8	E	58.8	195	77.2	E	28.6
	Through	69.3	507.8	7.4	A	3.0	773.4	29.3	C	18.0	542.4	31.2	C	11.8	622.8	63.9	E	33.7
	Right	69.3	54.4	25.1	C	2.4	17	31.2	C	0.9	34.2	48.2	D	3.0	13.8	76.8	E	1.9
University Ave West	Left	131.9	69.2	56.6	E	7.5	75	63.0	E	8.8	74	235.0	F	35.4	53.8	308.8	F	31.8
	Through	131.9	39.8	56.6	E	2.1	133	58.4	E	7.2	44.4	323.3	F	14.0	125	341.5	F	42.5
	Right	131.9	139.4	60.3	E	16.4	229.2	60.9	E	25.9	92.8	276.7	F	57.1	148	295.8	F	78.2
	Total		2530	30.8	C	24.0	2592	39.5	D	25.9	2560	56.7	E	58.8	2673	79.8	E	78.2

10: London Circuit - Knowles Place North

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
London Cct South	Through	57.1	587.2	0.5	A	0.0	856.6	0.6	A	0.1	696.2	0.5	A	0.1	739.4	1.1	A	0.3
	Right	57.1	103.4	10.5	B	1.7	160.2	7.7	A	1.8	103	15.6	C	4.3	149.4	23.9	C	8.4
London Cct North	Left	43.3	145.8	1.3	A	0.1	259.6	1.7	A	0.1	179.4	5.9	A	1.4	192.6	11.0	B	3.2
	Through	43.3	672.2	4.4	A	2.4	465	20.8	C	8.0	1138	14.5	B	13.1	895	38.6	E	28.1
	Total		1509	3.0	A	2.4	1741	6.8	A	8.0	2117	9.2	A	13.1	1976	20.7	C	28.1

11: London Circuit - University Avenue

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
London Cct South	Left	56.0	188.8	7.8	A	2.6	109.2	10.0	A	3.9	143.8	9.9	A	2.7	223.2	7.8	A	4.1
	Through	56.0	489.2	0.9	A	0.3	734.4	1.4	A	0.6	664.8	0.8	A	0.3	662.4	1.8	A	0.8
London Cct North	Through	57.6	287.8	12.9	B	2.0	165.4	34.2	D	1.8	798.6	14.0	B	7.3	395.2	33.2	D	8.4
	Right	57.6	381.8	39.0	E	40.4	313	77.4	F	122.8	337.6	59.7	F	48.8	491.2	69.8	F	85.6
University Ave West	Left	36.9	200.6	7.5	A	2.3	283.2	10.3	B	4.6	135.4	25.9	D	6.0	226	21.5	C	8.6
	Right	36.9	55	17.6	C	1.6	21.4	24.9	C	0.9	246.6	36.2	E	16.0	104	38.8	E	7.4
	Total		1603	14.3	B	40.4	1627	21.8	C	122.8	2327	19.6	C	48.8	2102	28.2	D	85.6

12: Marcus Clarke Street - Farrell Place

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Marcus Clarke South	Through	118.5	936.4	7.8	A	9.4	610.6	1.9	A	1.1	915	10.4	B	14.0	611.8	5.8	A	4.7
	Right	118.5	166.4	18.0	C	5.0	128.8	20.5	C	4.6	189.8	22.9	C	7.3	147.8	21.5	C	5.4
Farrell Place East	Left	45.7	50	53.6	F	5.1	12.2	42.1	E	0.8	55.6	60.3	F	6.6	65	70.2	F	7.1
	Right	45.7	29.8	119.2	F	6.9	160	50.6	F	15.3	77.2	90.0	F	14.1	187	86.5	F	29.6
Marcus Clarke North	Left	103.5	104.8	3.0	A	0.2	281	4.6	A	0.5	252.6	8.0	A	1.9	189.4	5.3	A	0.4
	Through	103.5	666.8	2.0	A	1.1	740.6	4.1	A	1.7	471.6	5.7	A	2.6	777.4	4.0	A	1.9

Approach	Movement	Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
	Total		1954	9.3	A	9.4	1933	8.7	A	15.3	1962	14.7	B	14.1	1978	16.0	C	29.6

13: London Circuit - Knowles Place South

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
London	Through	46.0	556.4	0.3	A	0.0	618	0.5	A	0.1	809.2	0.4	A	0.0	887	0.4	A	0.0
Cct South	Right																	
Knowles	Left	47.8	76.2	2.1	A	0.2	89.2	1.6	A	0.1	200.2	29.7	D	10.6	347	28.4	D	18.0
Pl S East	Right	47.8	121.2	4.8	A	0.8	221.8	4.5	A	1.5	0	0.0	A	0.0	0	0.0	A	0.0
London	Through	57.1	342	0.2	A	0.0	184.8	1.0	A	0.2	830.4	6.8	A	4.0	415.2	15.2	C	6.3
	Total		1096	0.9	A	0.8	1114	1.5	A	1.5	1840	6.5	A	10.6	1649	10.0	B	18.0

14: London Circuit - Farrell Place

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
London	Left	67.8	5.4	1.8	A	0.0	29.4	2.1	A	0.0	30.8	11.9	B	0.8	21.2	15.0	B	0.5
Cct South	Through	67.8	473	0.4	A	0.0	304	0.5	A	0.0	557.8	1.3	A	0.5	618.8	1.3	A	0.5
London	Through	39.3	352	0.8	A	0.1	95.8	3.9	A	0.1	891.2	9.3	A	6.2	527.4	19.7	C	4.9
Cct North	Right	39.3	66.2	6.1	A	0.9	172.2	10.2	B	2.9	134	14.1	B	4.9	237	44.6	E	14.0
Farrell	Left	39.9	83.4	7.5	A	0.9	313.8	3.9	A	1.3	251.8	14.9	B	6.0	268	13.1	B	5.7
Pl West	Right	39.9	147.8	9.9	A	2.3	118	5.3	A	0.9	173.6	19.8	C	5.8	83	19.3	C	2.8
	Total		1128	2.6	A	2.3	1033	4.0	A	2.9	2039	9.1	A	6.2	1755	15.5	C	14.0

15: Marcus Clarke Street - Ellery Crescent

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Marcus Clarke	Left	43.9	82.6	1.2	A	0.0	68.8	0.9	A	0.0	105.2	2.1	A	0.2	30.8	0.7	A	0.0
South	Through	43.9	1007	1.3	A	1.3	564.8	0.3	A	0.0	1013	2.5	A	3.4	646	0.6	A	0.3
Marcus Clarke	Through	113.6	595.8	5.4	A	4.7	675	4.1	A	3.3	448.6	8.7	A	6.1	740.4	9.8	A	9.9
North	Right	113.6	120.2	23.9	C	5.4	76.6	10.4	B	1.3	76	25.2	D	3.4	98	13.9	B	2.1
Ellery Crescent	Left	116.4	95.6	22.4	C	3.9	176.2	9.0	A	2.5	98	36.4	E	7.7	114.8	17.3	C	3.4
West	Right	116.4	40	26.1	D	1.9	126.2	10.3	B	2.0	17.8	53.7	F	2.0	195	19.6	C	6.4
	Total		1941	5.5	A	5.4	1688	4.0	A	3.3	1758	7.4	A	7.7	1825	8.1	A	9.9

16: London Circuit - Gordon Street

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
London	Left	92.7	79	11.2	B	1.5	82.2	28.5	C	4.3	60.4	27.6	C	2.9	107.4	57.5	E	11.5
Circuit	Through	92.7	338.6	9.4	A	2.8	58.6	39.1	D	2.1	318.4	34.4	C	8.9	129	40.1	D	4.8
South	Right	92.7	197	27.6	C	10.7	10.6	51.0	D	1.0	257.2	144.9	F	88.1	35.2	69.5	E	4.5
Gordon	Left	59.6	55.8	47.8	D	5.1	161.6	47.1	D	14.2	250.2	45.1	D	25.0	577.6	50.7	D	54.1
Street	Through	59.6	2.6	53.6	D	0.3	16	48.9	D	1.4	5.6	99.9	F	1.4	229.2	63.0	E	27.2
East	Right	59.6	30.4	81.3	F	4.7	162.8	48.0	D	14.3	113.4	90.6	F	20.8	324.2	60.3	E	36.0

London	Left	56.5	165.8	23.1	C	7.2	31.8	34.2	C	2.0	713.2	23.7	C	33.7	296.4	46.6	D	28.0
Circuit	Through	56.5	319	21.2	C	6.0	160	33.5	C	4.9	325.6	22.0	C	6.1	264.2	38.1	D	8.8
North	Right	56.5	15.6	58.1	E	1.7	22.8	70.5	E	3.0	29.6	60.0	E	3.3	52	150.2	F	21.0
Gordon	Left	37.3	109.4	72.6	E	15.7	112	38.5	D	15.9	162.2	40.1	D	14.4	187	41.6	D	27.4
Street	Through	37.3	54	69.9	E	3.7	4.2	30.8	C	0.0	86.6	40.7	D	3.1	42.6	44.3	D	1.3
West	Right	37.3	152.4	88.4	F	25.4	36.8	33.4	C	2.2	41.2	100.8	F	7.8	34.2	36.2	D	2.2
	Total		1520	33.9	C	25.4	859.4	40.8	D	15.9	2364	47.4	D	88.1	2279	52.5	D	54.1

17: Vernon Circle - Constitution Avenue

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Constitution Ave	Left	59.4	67.8	59.9	E	7.5	58.2	64.4	E	7.1	167.2	236.0	F	75.5	141.2	62.9	E	16.7
Vernon Circle	Left	161.8	139.8	6.7	A	1.1	155.4	16.0	B	6.9	250	8.9	A	5.6	191.8	29.0	C	8.5
North	Through	161.8	1769	4.1	A	3.1	2081	13.2	B	13.6	1680	5.2	A	4.1	2022	44.2	D	25.5
	Total		1977	6.2	A	7.5	2295	14.7	B	13.6	2097	24.0	C	75.5	2355	44.1	D	25.5

18: Marcus Clarke Street - Gordon Street

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Marcus Clarke	Left	94.4	110	2.7	A	0.1	80.4	1.7	A	0.0	127	3.4	A	0.3	43.2	1.4	A	0.0
South	Through	94.4	1068	2.2	A	0.8	594.6	1.0	A	0.0	1104	4.3	A	5.2	644.8	1.0	A	0.0
Gordon Street	Left	60.6	73.2	11.1	B	1.4	80.6	14.9	B	2.1	98.2	11.2	B	1.8	361.8	65.2	F	41.6
Marcus Clarke	Left	28.7	278.4	4.1	A	1.8	115.4	2.7	A	0.4	247.8	4.9	A	1.9	226.2	3.7	A	1.2
North	Through	28.7	388.6	5.2	A	3.3	715.4	2.7	A	2.8	267.6	4.6	A	2.0	679.6	5.3	A	5.7
	Right	28.7	63	21.1	C	2.8	28.6	7.3	A	0.4	39.8	18.3	C	3.9	62.8	6.1	A	0.6
Gordon Street	Left	7.0	81	14.7	B	1.8	90.8	4.6	A	0.6	80.6	17.0	C	2.0	66.4	5.0	A	0.4
West	Right	4.6	88	19.4	C	2.4	128.6	16.2	C	2.8	67.2	19.5	C	2.1	110.2	34.9	D	2.2
	Total		2151	5.1	A	3.3	1834	3.7	A	2.8	2032	6.0	A	5.2	2195	15.2	C	41.6

19: London Circuit - Edinburgh Avenue

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
London	Left	96.1	140.2	45.4	D	14.1	202.6	47.7	D	19.0	168.8	44.9	D	18.3	165	80.5	F	40.3
Circuit	Through	96.1	100.8	36.7	D	3.2	68	43.0	D	2.2	122.8	47.3	D	5.3	142.4	54.1	D	5.6
South	Right	96.1	3.8	30.7	C	0.2	2.6	39.0	D	0.2	6.4	69.9	E	0.9	29	62.4	E	3.3
Edinburgh	Left	65.4	29.2	49.4	D	1.3	21.2	43.2	D	0.8	47.2	76.4	E	2.5	133.6	45.5	D	5.6
Avenue	Through	65.4	76.4	57.2	E	4.0	408.4	43.7	D	16.6	121	85.4	F	11.3	254.6	41.8	D	9.8
East	Right	65.4	73.8	48.8	D	6.6	15	37.0	D	1.0	52.6	93.5	F	14.6	32.6	44.6	D	2.7
London	Left	94.3	9.4	17.9	B	0.3	7	27.6	C	0.4	94	29.4	C	4.8	398.6	22.2	C	14.0
Circuit	Through	94.3	316.4	21.2	C	5.7	231	11.4	B	2.0	260.8	32.0	C	6.2	186.6	21.3	C	3.1
North	Right	94.3	197.4	81.0	F	31.3	119.8	78.4	E	19.5	263.2	84.9	F	52.1	291	56.7	E	32.2
Edinburgh	Left	103.4	438	59.0	E	57.1	68.2	9.4	A	1.1	478.2	77.3	E	79.3	96.8	25.4	C	5.1
Avenue	Through	103.4	180.4	46.8	D	7.5	247.8	11.5	B	2.5	252.2	60.0	E	14.8	236.4	30.8	C	7.2

Approach	Movement	Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
West	Right	103.4	358.6	43.1	D	14.2	81.4	24.6	C	1.9	362.2	52.4	D	16.9	75.6	42.5	D	3.2
	Total		**1924**	**47.9**	**D**	**57.1**	**1473**	**33.8**	**C**	**19.5**	**2229**	**61.6**	**E**	**79.3**	**2042**	**40.8**	**D**	**40.3**

20: Marcus Clarke Street - Edinburgh Avenue

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Marcus Clarke South	Left	91.5	98.4	112.6	F	20.7	104.8	89.9	F	17.5	94.8	74.1	E	13.4	102.8	217.3	F	42.6
	Through	91.5	113.6	112.5	F	23.6	64.2	86.0	F	10.2	143.4	80.4	F	22.3	62.2	219.6	F	25.3
	Right	91.5	148.4	117.6	F	33.2	64.8	84.4	F	10.2	97	79.0	E	14.7	47.6	217.3	F	19.7
Edinburgh Avenue East	Left	103.5	69	35.5	D	4.4	76.6	51.8	D	7.2	86.6	41.5	D	6.4	62.2	68.8	E	7.8
	Through	103.5	224	39.7	D	8.0	411	41.9	D	15.3	273.8	43.9	D	10.7	520.2	59.2	E	28.1
	Right	103.5	118.4	28.8	C	6.0	242	62.9	E	27.9	193.8	53.9	D	19.7	125	78.4	E	18.1
Marcus Clarke North	Left	93.7	25.2	74.0	E	3.5	32.6	31.6	C	1.9	67.6	70.4	E	8.9	143.2	38.2	D	10.0
	Through	93.7	99.2	83.3	F	15.4	41.6	38.5	D	2.8	54	76.1	E	8.0	67.4	35.3	D	4.3
	Right	93.7	422.2	77.5	E	30.3	857	34.8	C	26.2	306	69.5	E	19.9	944	31.2	C	25.7
Edinburgh Avenue West	Left	140.3	945.4	27.9	C	33.9	371	18.6	B	10.5	896.6	36.8	D	49.0	501.2	28.9	C	20.1
	Through	140.3	815.2	38.9	D	26.2	299.4	89.6	F	24.9	938.4	74.3	E	60.4	229.4	184.6	F	41.6
	Right	140.3	77.6	27.8	C	3.0	118	120.3	F	28.1	76	56.2	E	6.9	89.4	405.3	F	99.3
	Total		**3157**	**50.4**	**D**	**33.9**	**2683**	**51.1**	**D**	**28.1**	**3228**	**58.7**	**E**	**60.4**	**2895**	**76.6**	**E**	**99.3**

21: Commonwealth Avenue - London Circuit

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Commonwealth Avenue South	Left	62.6	101.6	18.0	B	2.8	45.8	24.8	C	2.6	131.4	19.9	B	3.9	111	29.4	C	5.4
	Through	62.6	2125	14.9	B	16.1	1880	23.1	C	22.7	2366	15.4	B	18.4	1845	27.1	C	27.7
	Right	62.6	612.4	46.8	D	48.7	264	91.7	F	43.9	507.2	46.1	D	40.2	201.8	72.7	E	27.6
London Circuit East	Left	90.4	361.2	33.1	C	21.0	702	56.0	E	57.1	397.4	31.6	C	20.9	705.2	53.2	D	57.9
	Through	90.4	112.4	115.6	F	12.3	222.2	71.1	E	12.2	141.4	108.8	F	13.9	175.6	71.4	E	9.9
	Right	90.4	23.4	109.0	F	4.7	22	73.6	E	2.4	23.8	74.5	E	3.3	64.6	68.9	E	7.2
Commonwealth Avenue North	Left	155.2	9.2	90.5	F	1.5	0.8	130.4	F	0.2	52.8	45.8	D	4.1	10.4	80.3	F	1.4
	Through	155.2	1647	94.8	F	90.6	1959	94.0	F	101.0	1364	48.3	D	39.8	1884	88.2	F	81.2
	Right	155.2	29.8	110.0	F	8.3	8.8	103.8	F	1.7	35.8	95.3	F	8.7	49.6	376.2	F	92.9
London Circuit West	Left	69.9	15.6	71.8	E	2.1	16.4	49.3	D	1.5	39	80.2	F	6.0	124.4	51.9	D	11.6
	Through	69.9	492.6	64.5	E	28.6	201.2	45.6	D	8.1	448	66.0	E	25.7	103.4	58.7	E	3.7
	Right	69.9	182.8	63.4	E	21.4	118.4	87.8	F	23.7	193.2	70.2	E	24.6	155.4	237.7	F	94.1
	Total		**5713**	**51.5**	**D**	**90.6**	**5440**	**60.8**	**E**	**101.0**	**5700**	**36.9**	**D**	**40.2**	**5430**	**65.8**	**E**	**94.1**

22: Edinburgh Avenue - Phillip Law Street

Approach	Movement		2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Phillip Law South	Left	93.9	150.6	41.1	D	10.9	205.6	76.0	E	24.8	129.6	44.1	D	9.2	176.4	45.0	D	14.0
	Right	93.9	134	116.5	F	33.6	134	235.3	F	97.9	130.8	127.1	F	42.7	130.2	161.9	F	46.9
Edinburgh	Left	139.3	53.4	38.8	D	3.5	142.2	8.1	A	0.7	53.8	20.3	C	1.4	134	9.4	A	0.9

		139.3	691.2	37.5	D	21.5	1233	5.8	A	3.6	624.6	30.2	C	15.5	1432	7.3	A	4.9
Avenue East	Through	139.3	691.2	37.5	D	21.5	1233	5.8	A	3.6	624.6	30.2	C	15.5	1432	7.3	A	4.9
Edinburgh	Through	47.2	1706	15.7	B	13.3	652.6	9.1	A	3.0	1819	20.1	C	16.9	679.4	9.4	A	3.2
Avenue West	Right	47.2	128.8	19.5	B	6.8	191.8	44.6	D	17.7	132	23.0	C	5.8	154.2	35.2	D	12.2
	Total		2864	27.6	C	33.6	2559	27.4	C	97.9	2890	28.3	C	42.7	2706	19.4	B	46.9

23: Parkes Way - Edinburgh Avenue (North)

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Edinburgh Ave South	Through	17.4	604.2	3.5	A	3.2	466.4	8.4	A	6.7	636.2	3.4	A	3.1	384.2	5.3	A	3.4
	Right	17.4	158.6	0.6	A	0.0	190.4	0.5	A	0.9	154	0.5	A	0.0	197.8	0.5	A	0.0
Edinburgh Ave North	Left	26.2	404.2	3.5	A	1.1	316.8	1.6	A	0.0	384.8	2.7	A	0.7	310.8	1.8	A	0.1
	Through	22.2	434.6	45.7	D	17.5	1124	17.2	B	16.3	371	38.8	D	13.0	1314	14.8	B	16.2
Parkes Way Off-ramp West	Left	79.4	1289	0.4	A	0.0	469.4	0.1	A	0.0	1401	1.6	A	1.0	533.6	0.1	A	0.0
	Through	49.8	71.8	53.1	D	6.9	1.6	37.1	D	0.1	55.6	53.7	D	5.4	2	62.4	E	0.2
	Right	49.8	66.6	52.8	D	6.5	15.2	48.2	D	1.3	61.2	56.1	E	6.3	13.8	50.8	D	1.3
	Total		3029	10.3	B	17.5	2584	9.5	A	16.3	3063	8.6	A	13.0	2756	8.4	A	16.2

24: Parkes Way - Edinburgh Avenue (South)

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Lawson Crescent South	Left	16.3	62.2	2.3	A	0.1	351.6	7.9	A	3.8	67.8	2.0	A	0.1	348.2	11.2	B	5.5
	Through	29.3	167.2	70.1	E	10.5	260.8	49.5	D	11.6	168.4	65.5	E	10.1	260.8	54.2	D	12.7
Parkes Way Off-ramp East	Left	91.3	389	0.7	A	0.0	87	0.8	A	0.0	388.4	0.6	A	0.0	75.4	0.6	A	0.0
	Right	27.3	595.4	17.0	B	16.7	395.4	36.2	D	24.5	623.2	16.2	B	16.4	321.4	35.1	D	19.6
Edinburgh Ave North	Through	19.6	88	7.9	A	1.3	23.8	2.1	A	0.1	90	5.9	A	0.9	18.6	5.2	A	0.2
	Right	19.6	412.4	0.6	A	0.0	1115	0.5	A	0.0	342.4	0.4	A	0.0	1309	0.5	A	0.0
	Total		1714	13.5	B	16.7	2234	13.7	B	24.5	1680	13.2	B	16.4	2333	12.9	B	19.6

27: Edinburgh Avenue Extension - Knowles Place Extension

Approach	Movement	2031 AM DM					2031 PM DM				2031 AM S100				2031 PM S100			
		Length	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Knowles Pl Ext't	Left	43.4	38	0.8	A	0.0	73.8	4.1	A	0.4	100.4	11.4	B	2.1	235.6	1.7	A	0.4
	Right	43.4	64.6	2.7	A	0.2	167.6	7.0	A	1.8								
Edinburgh Ave Ext'n East	Left	46.6	134.8	1.3	A	0.0	88.4	1.3	A	0.0	127.2	3.2	A	0.5	61.6	1.4	A	0.0
	Through	46.6	139.6	0.5	A	0.0	377.4	0.6	A	0.0	127.4	7.8	A	0.9	185.6	0.9	A	0.0
	Right										290	6.4	A	3.0	87.6	5.1	A	0.6
Knowles	Left										291.2	9.3	A	4.5	489.2	17.4	C	15.7
Edinburgh Ave Ext'n West	Left										91.6	4.4	A	0.6	44.6	8.4	A	0.6
	Through	65.6	116.8	0.2	A	0.0	237	0.3	A	0.0	196.6	6.6	A	1.1	582.8	9.8	A	5.0
	Right	65.6	76.8	0.3	A	0.0	20.4	0.6	A	0.0	65.6	4.7	A	0.5	22.8	9.5	A	0.3
	Total		570.6	0.9	A	0.2	964.6	1.9	A	1.8	1290	7.1	A	4.5	1710	9.3	A	15.7

28: Vernon Circle - Edinburgh Avenue Extension

Approach	Movement	Length	2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
			Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Vernon Cir South	Left	46.1	274.6	12.1	B	53.5	466.6	8.2	A	19.0	547	14.5	B	67.0	334.8	32.3	C	25.7
	Through	46.1	2017	2.6	A	1.9	1618	2.6	A	1.0	2237	5.2	A	3.3	1825	26.1	C	19.9
Edinburgh	Left	46.7	182.2	45.6	D	7.7	400.6	33.7	C	12.5	493.4	64.4	E	29.5	1060	28.2	C	27.2
	Total		2474	6.8	A	53.5	2485	8.7	A	19.0	3277	15.7	B	67.0	3220	27.5	C	27.2

29: Knowles Place - Knowles Place Extension

Approach	Movement	Length	2031 AM DM				2031 PM DM				2031 AM S100				2031 PM S100			
			Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue	Count	Delay	LoS	Queue
Knowles Pl South	Left	19.9	26.6	0.1	A	0.0	37.2	0.2	A	0.0								
	Left										16	35.6	D	1.1	2	72.1	E	0.5
	Right										369	59.9	E	41.0	127	66.1	E	16.2
S100 East	Left										201	31.9	C	12.0	311.6	21.1	C	12.3
	Through										111.4	35.5	D	7.4	304.8	21.0	C	11.8
Knowles Place North	Left	127.3	40.2	0.3	A	0.0	77.4	0.4	A	0.0	119.6	19.4	B	4.3	97.4	14.4	B	2.4
	Through	127.3	40.2	0.3	A	0.0	77.4	0.4	A	0.0								
	Through										81.4	18.8	B	2.8	158.8	23.1	C	6.8
	Right	127.3	171	0.5	A	0.0	276	0.6	A	0.0	69	22.4	C	2.6	42	30.0	C	2.3
Knowles Pl West	Left																	
	Through										208.6	54.9	D	21.2	41.6	68.7	E	6.9
	Right										7.2	50.3	D	0.7	26.6	103.4	F	8.8
	Total		278	0.4	A	0.0	468	0.5	A	0.0	1183	42.5	D	41.0	1112	30.1	C	16.2

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