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Traffic & Transport Study

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1. Introduction

This report has been prepared for Camden Council to provide a complete summary of traffic and transport reports undertaken to date for the Camden Town Centre. Further, to establish an understanding of existing capacity of road networks and transit operations in and around the Camden Town Centre and what improvements are available to ameliorate identified issues.

A significant volume of data collection and analysis has been undertaken to prepare this report. The data collection was tailored to provide Council with a clear understanding of current traffic, transport and parking conditions and to allow assessment of future conditions to inform policy.

The original objectives of the study as specified in the brief are provided below:

The study will be focus on transport infrastructure necessary to achieve greater accessibility for all road users whilst also seeking to retain the unique aspects that the Town Centre currently provides in terms of its heritage and 'country town' environment. These are but not limited to:

1. identify and resolve crash Blackspot sites;
2. manage the current and future level of traffic and transport;
3. identify and resolve pedestrian accident clustering;
4. facilitate improvements in the level of pedestrian access and priority, particularly in areas of pedestrian concentrations;
5. promote pedestrian access connectivity and enhance safe crossing points;
6. facilitate improvement in the level of personal mobility and safety for people with disabilities and senior through the provision of enhanced infrastructure and facilities;
7. facilitate safe bicycle access and parking;
8. identify parking patterns to maximise parking opportunities;
9. Investigate different parking restrictions:
    - Timed parking;
    - Pay Parking;
    - Residential permits parking; and
    - Multi-deck parking.
10. accommodate special event needs for all road users, including public transport (buses and taxi), vehicular access, pedestrians and parking facilities, etc.

The study area subject to the investigations in this report is shown in **Figure 1**.

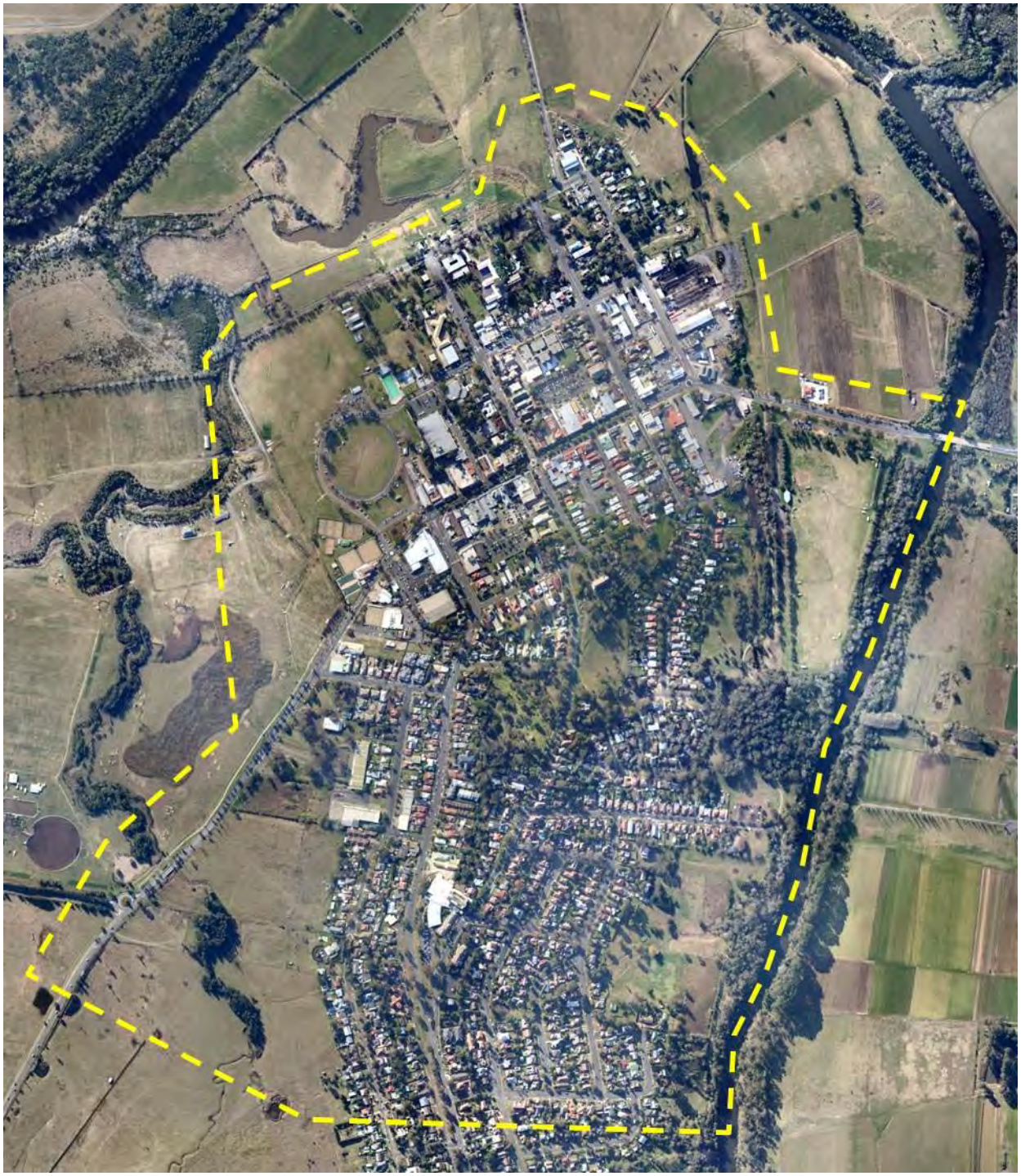


Figure 1: Study Area

2. Background Report Review

A number of background reports were provided by Camden Council for review as part of this study. A summary of the key elements of each report is provided below.

2.1 Camden Town Centre Strategy – June 2008

This strategy was prepared to establish a framework for guiding future development within the Camden Town Centre. In combination with developing partnerships to deliver particular outcomes, the strategy sought to deliver public realm improvements at a cost in the order of $12.5 million.

The strategy included short, medium and long term costed improvement projects.

Overall, the strategy noted the importance of maintaining the character of the Camden Town Centre and devised schemes to balance the accommodation of future development whilst maintaining the town centres character.

The study devised 9 key precincts in and around the Camden Town Centre and defined strategies for improvement for all facets of each area. The locations of each precinct from the study are provided below:

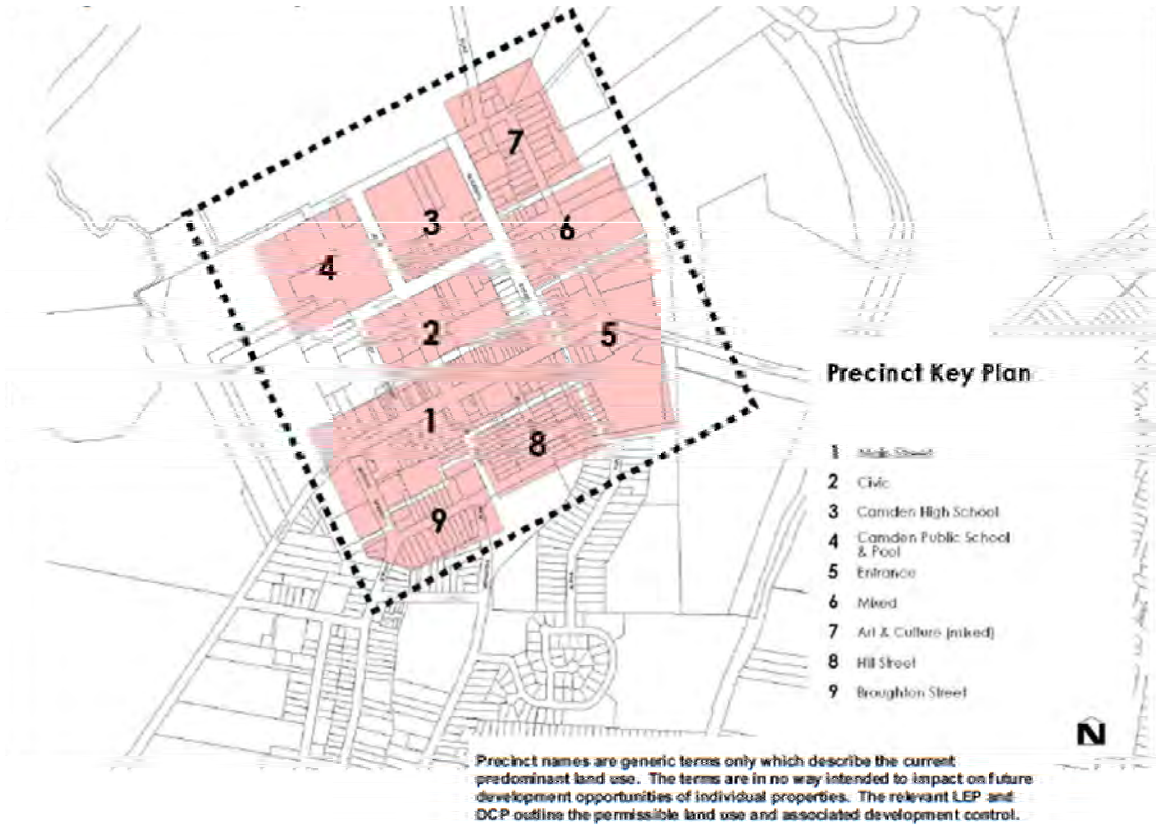


Figure 2: Camden Town Centre Adopted Precincts

Of key interest were the proposals for Main Street which included both Argyle Street and John Street. Three options with increasing changes for each included:

Option 1 Public domain upgrade included two additional street crossings. Including:

- Removal of informal crossings in median
- Two additional formal crossings

Option 2 Public domain upgrade with 1-3 intersections signalised. Including:

- One to three signalised intersections
- Retention of the median
- Two additional formal crossings

Option 3 Public domain upgrade, three signalised intersections with lane reductions. Including:

- Three signalised intersections
- Removal of central median
- Removal of informal crossings
- Reduction to two lanes in each direction (two travel and no parking or one travel and one parking)
- Reduced parking in Argyle Street
- Widened footpaths by 3.0m

The traffic impacts of the proposals were assessed by Transport and Urban Planning Pty Ltd which concluded the following:

An assessment of the three options proposed indicates that Option 1, whilst affording short term benefits at the detriment of existing and future traffic options, is unlikely to be a longer term viable option when traffic delay and pedestrian safety factors are considered and costed.

Option 3 offers improved pedestrian amenity on the footpaths at the expense of kerbside parking. Removal of the central median is not supported with retention of marked foot crossings (MFCs) in Argyle Street for reasons of safety. Widening of the footway and removal of the kerbside parking (39 spaces) is only supported if parking is readily available elsewhere.

Therefore Option 2 is favoured, particularly signals at John Street over the longer term with improved safety and service levels for pedestrians and minimal impacts on traffic operations / on street car parking.

A combination of Option 2 and 3 indicated in table 1 as a proposed alternate option, would also be supported, subject to a road safety audit of the proposal. Option 2 (or part thereof) is in the longer term likely to offer safer pedestrian controls and improved traffic management while not compromising existing parking provisions in Argyle Street

Thus a hybrid of Option 2 and 3 was recommended by the traffic assessment report.

The key findings of the traffic report is also summarised below:

2.2 Key Findings

The assessment of the three main street options highlighted the following:

- *Current mid-block crossings are potentially hazardous and will become more dangerous as traffic volumes increase;*
- *The retention of the central median is recommended for pedestrian safety reasons;*
- *Signalisation of the John and Argyle Street intersection was recommended.*
- *Signalisation of other intersections at Murray and Elizabeth may be warranted in the long term;*
- *At least 2 travel lanes in each direction are required on Argyle Street. One travel lane and 1 parking lane would not be feasible;*
- *If the footpaths were widened to include all of the existing parking lanes it could only be justified if the 39 car spaces that would be lost could be found elsewhere in the town centre.*
- *Removal of existing mid-block crossings are recommended in conjunction with signalisation and the provision of 2 additional relocated pedestrian crossings.*
- *Pedestrian crossing demand west of John Street may warrant a higher order of traffic controls – signals or mid-block pedestrian signals in the long term.*

A copy of the traffic report prepared by Transport and Urban Planning Pty Ltd was not provided as part of this study.

Of interest the study did not consider public parking either in what form it should take or what provision would be appropriate for the Town Centre. However, it is noted that parking demands have been assessed in a separate report which is summarised further below.

The recommended hybrid version of Option 2 and 3 as a comparison of all options from the traffic report is provided in **Table 1**.

Table 1: Transport & Urban Traffic Report Recommended Option

Element	Option 1 1 parking lane 2 travel lanes	Option 2 1 parking lane 2 travel lanes	Option 3 2 travel and no parking or 1 travel and 1 parking in each direction	**Proposed Alternate Option** 1 parking lane 2 travel lanes
Streetscape	Yes	Yes	Yes	Yes
Median	Yes	Yes	No	Yes
Bicycle racks	Yes	Yes	Yes	Yes
Existing Pedestrian Crossings	Yes	No	No	No
New Pedestrian Crossings	No	Yes (2)	No	Yes (2) relocated mid block
Traffic lights	No	Yes (1-3)	Yes (3)	Yes (1)
Pedestrian traffic	Not improved	Improved	Improved	Improved
Footpath widening	No	Yes(600mm)	Yes (1 lane/3.0m)	Yes (600mm)
Reduction in lanes	No	No	Yes	No
Reduction in parking	No	No	Yes	NO

The components of improvement of the preferred scheme are shown diagrammatically below:

Figure 3: Preferred Scheme

It is noted that the location of the signalised crossings to replace the existing crossings in Argyle Street were proposed to be located between Hill Street/Elizabeth Street in the east and Murray Street/Oxley Street in the west.

The preferred locations of improved pedestrian facilities in Argyle Street in this report differ from the above and further information is presented in Section 7.2.2.

Overall after a review of the 2008 strategy it is our view that retaining the central median is supported because of the safety benefits it provides. However, removal of the roundabout at John Street / Argyle Street and replacing with traffic signals is not considered warranted. This is discussed further in Section 7.2.3.

2.1.2 Commentary on Safety Aspects of Central Median

The central median improves pedestrian safety over the situations without the median by:

a) channelising traffic so that pedestrians do not have to deal with vehicles undertaking unpredictable manoeuvres such as travelling on the wrong side of the road or executing mid-block u-turns
b) it provides the opportunity for pedestrians to stage their crossing of Argyle Street so that they have to deal with only one direction of traffic at a time
c) it provides a visual cue to drivers that the road environment is narrow (than it otherwise would appear if the central median was not there), assisting to reduce traffic speeds

2.2 Camden Contributions Plan

Camden Council has adopted a Contributions Plan 2011 under the Environmental Planning and Assessment Act, Section 94, for the provision of public car parking facilities. The Contribution Plan sets out the need for the provision of public car parking facilities related to expected developments for both Camden and Narellan Town Centres.

Where the entire required car parking provision under the Council's Development Contract Plan may not be able to be provided due to the site constraints, Council will consider whether it is appropriate for the development to contribute toward providing the additional spaces that are required in a central public parking area. The contributions will be used to purchase land, construct car parking at ground level and to augment existing car parks by erecting deck structures.

The Contributions Plan for Camden Town Centre has adopted the provision of a decked car park. The possible sites for the decked car park are identified as in the following figure as Larkin Place and John/ Murray streets car parks.

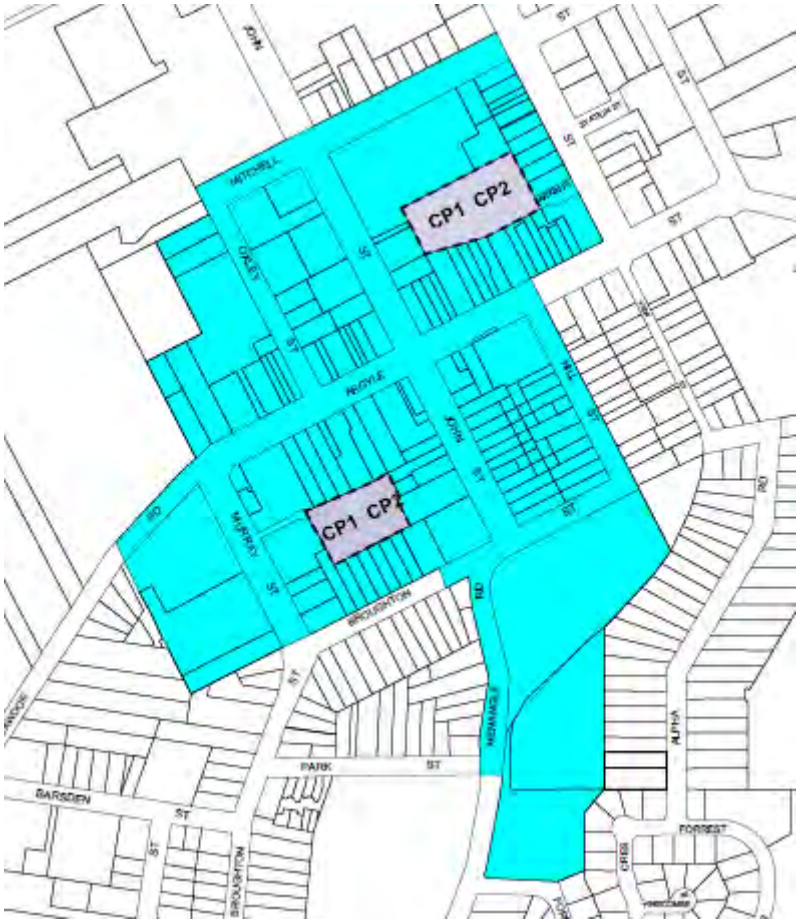


Figure 4: Decked Car Park locations from Contributions Plan

Council in 2006 resolved to adapt the John/Murray car park as the preferred site for the decked car park structure. The car park site is owned by Council and the Contribution Plan has been prepared on the basis of construction estimates for the deck car park structure.

The analysis for the required car parking spaces in the deck car park was based on a study by Haliburton (2002). That study identified the need for approx. 108 additional spaced based on an estimate of an additional 3,000m2 of retail and 1,500m2 of commercial floor space for new development in Camden Town Centre to 2021.

The estimated cost of the deck car park structure at John/Murray sites in the Contribution Plan is $3.64m. The Council's current section 94 contribution rate for car parking spaces for Camden Town Centre is $49,260 per space (June 2012).

Since the inception at the Contribution Plan and based on the funds collected towards car parking provision Council has only collected an equivalent amount to 14 spaces. With the relatively low rate of contributions for the deck car parking structure there must be serious doubt as to whether the full cost of the car parking facility in the plan will be collected via contributions.

The contribution rate at $49,260 per space may be considered a dis-incentive to development to warrant such a high dollar amount to the car parking facility. Council may wish to reconsider its position in respect to the section 94 Contribution rate for public car parking deck structure.

Some examples of other Council contribution rates both regional and Sydney metropolitan are presented below.

Table 2: Camden versus other Council Parking Space Contribution Rates

Council	Area	Rate per Space
Camden	All locations	$49,260
Campbelltown	Campbelltown	$17,452.80
	Ingleburn	$32,605.52
Ashfield	All locations	$30,000
Lane Cove	Lane Cove	$19,157-$20,986
Wollondilly Shire	All locations	Under VPA's
Gosford	All locations	$6,500-$15,600

From **Table 2** it can be seen that the parking contribution rate in Camden is well above other Councils.

As an alternative to Section 94 contribution rate for car parking based on the provision of monetary contribution in-lieu of car parking, it is suggested that a Section 94A contribution levy approach be determined as a more feasible arrangement. The Section 94A contribution levy of, say, 1% levy across all new development in Camden Town Centre may be utilised for all proposed civic improvements such as traffic facilities, town centre works including town square as well as parking facilities. From the Section 94A levy Council could determine a priority of civic improvements based on short, medium and long term with the decked parking structure long term facility.

2.3 Proposed Deck Car Park at Lot 26 DP 624557 and Lot 15 DP 235365 John Street & Murray Street, Camden

This report submitted to the Ordinary Council meeting held on 10 July 2006 was to allow Council to consider the merits of the application to construct a decked car park at the location of Council's existing car park off John Street

and Murray Street. As stated in Section 2.1, two locations are detailed in Council's contribution plan for additional public parking.

The car park in question currently includes some 139 public car spaces. The proposal would have created a two storey split level car park with provision for a total of 214 cars and 4 motorcycles.

Of interest, whilst the location is detailed in the contributions plan, the proposal was rejected by Council on a number of grounds including inconsistencies with the objective of the Town Centre zone and heritage grounds.

It is understood that no further consideration by Council to a deck car park for John & Murray Streets car park had occurred in accordance with the section 94 contribution plan.

2.4 Camden 2040

Camden Council has adopted the community's vision for the future of Camden Local Government Area being a document entitled Camden 2040 (adopted Dec 2010). Camden 2040 seeks to set out the vision and principles for the future development for Camden.

In the year 2040, Camden is set to be a dynamic, modern, urban place which is defined by its unique history and rural backdrop and has realised the many opportunities presented by urban development and population growth. Camden Council will experience considerable pressure from urban growth associated with the significant urban release areas identified in Sydney's South West Growth Centre Release Area.

Particularly relevant for this Camden Town Centre Traffic and Transport Study is the identified vision to protect Camden town as a unique country heritage town. The community of Camden does not want to lose the character of the town and the country town feel and lifestyle.
Camden's country town feel is greatly valued by both residents and visitors and is an important part of the place and the economy of the town. Also of importance to many in the community is Camden's main street.

An important strategy in Camden 2040 is developing a well-connected, well designed and free flowing road network supported by infrastructure for a growing community that provides effective movement of people and goods within the local area and broader region.

2.5 Camden Major Events

Council has provided event management plans for inclusion in the assessment / planning of this study. The event management plans cover the following events:

1. Australia Day Parade;
2. The Camden Show;
3. Light Up Camden; and
4. Anzac Day

A summary of the road network arrangements for each event is presented below.

2.5.1 Australia Day Parade

The traffic control arrangements are generally set around the closure of John Street between Argyle Street and Mitchell Street. Bus operations are moved to Elizabeth Street to accommodate the closure. During the middle of the day the road closures expand to Argyle Street just east of Murray Street to Elizabeth Street for the eastbound direction. In the westbound direction, closures commence from Hill Street (allowing entry into Hill Street) to just west of Murray Street.

The Larkin Place car park is closed to vehicles. However, existing remaining public car parks are available for access via the side street network.

Of interest during the peak period of the parade (11:15am – 11:45am), traffic travelling to Camden from the east (via Camden Valley Way) and who park in car parks on the southern side of Argyle Street have no alternative to get back to Camden Valley Way other than make their way to the Old Hume Highway and the Camden bypass.

2.5.2 The Camden Show

The arrangement includes the closure of John Street between Mitchell Street and Exeter Street to marshal persons involved in the parade. The parade then travels to / from the intersection of John Street / Mitchell Street and Argyle Street / Murray Street via the intersection of Argyle Street / John Street.

During the parade itself, Argyle Street is closed temporarily by police at the intersections of Argyle Street / John Street and Argyle Street / Murray Street which is then reopened once the parade has been completed.

2.5.3 Light Up Camden

Initially the closures include only John Street between Mitchell Street / Argyle Street and Argyle Street to the entry / exit driveway of the John Street public car park. During the main festivities arrangements which generally mirror the Australia Day arrangements are put in place between the hours of 2:00pm – 10:30pm.

As is the case for the Australia Day parade, traffic travelling to Camden from the east must use Old Hume Highway / Camden bypass to return.

2.5.4 Anzac Day

This is considered the largest event to manage from a traffic / access management perspective.

The arrangements include the closure of Argyle Street between Elizabeth Street and Barsden Street for both directions of traffic between the hours of 5:00am-7:00am and 10:00 – 11:00am. The closures also include John Street between the Larkin Place car park across Argyle Street to the John Street car park entry /exit. In addition, Elizabeth Street between Mitchell Street and Argyle Street is closed to traffic.

The resulting arrangements do not allow any vehicles travelling to Camden from the east to access any of the public car parking areas on the southern side of Argyle Street.

The main areas of occupation for each event are shown in **Figure 5**.

Figure 5: Major events use of roads

3. Existing Conditions

The data collected for this study has captured existing conditions for all nodes. Some of the information gathered included but not limited to:

1. Origin / Destination surveys
2. Intersection counts
3. Pedestrian counts
4. Parking demand counts
5. Parking restriction audit
6. Accident Analysis
7. Site observations
8. Background report reviews
9. Consultation meetings with Council officers.

The following presents the data collection approach of the study and an assessment of existing conditions by mode.

3.1 Intersection Counts

Intersection counts were undertaken during the morning and afternoon road network peak periods on both a Thursday and Saturday. These days were identified in the brief and captured and mix of road network and retail peaks combined. The locations of the intersection counts are provided below:

1. Argyle Street/Edward Street
2. Argyle Street/Elizabeth Street/View Street
3. Argyle Street (south side)/ Hill Street
4. Argyle Street/John Street
5. Argyle Street (north side)/Oxley Street
6. Argyle Street/Murray Street
7. Mitchell Street/Elizabeth Street
8. Mitchell Street/John Street
9. Broughton Street/John Street
10. Broughton Street/Murray Street
11. Broughton Street/Old Hume Highway/Menangle Road
12. Macquarie Grove/Exeter Street
13. Cawdor Road/Sheathers Lane
14. Camden Valley Way/Macarthur Road

The locations of the intersection counts are also shown in Figure 6.

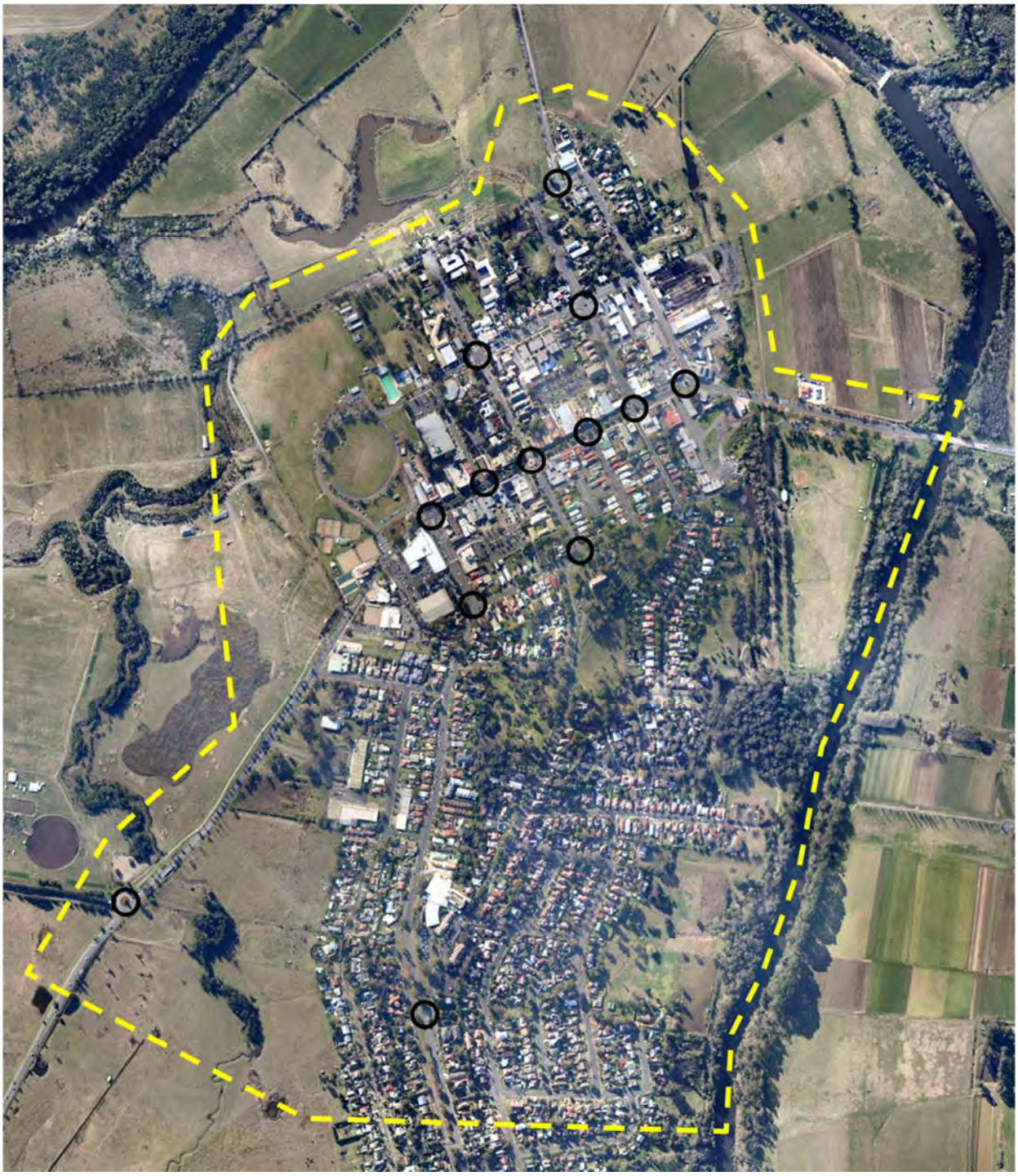


Figure 6: Intersection Count Locations

3.1.1 Existing Intersection Operating Conditions

The intersections within the study area have been analysed using the SIDRA Intersection analysis program. Sidra Intersection determines the average delay that vehicles encounter, the degree of saturation of the intersection, and the level of service. The degree of saturation is the ratio of the arrival rate of vehicles to the capacity of the approach. Sidra Intersection provides analysis of the operating conditions which can be compared to the performance criteria set out in **Table 3**.

Table 3: Level of Service Criteria

Level of Service	Average delay per vehicle (secs/veh)	Signals & Roundabouts	Give Way & Stop signs
A	less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & Spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays	At capacity, requires other control mode
F	> 70	Roundabouts require other control mode	Extreme delay, traffic signals or other major treatment required

Adapted from RTA 'Guide to Traffic Generating Developments' 2002

For roundabouts and priority intersections, the reported average delay is for the individual movement with the highest average delay per vehicle. At signalised intersections, the reported average delay is over all movements.

The results of this operational assessment are provided in **Table 4**.

Table 4: Thursday & Saturday AM/PM Existing Intersection Operating Conditions

		Existing Thursday AM		Existing Thursday PM		Existing Saturday AM		Existing Saturday PM	
Street 1	**Street 2**	**LOS**	**Delay (secs)**	**LOS**	**Delay (secs)**	**LOS**	**Delay (secs)**	**LOS**	**Delay (secs)**
Macquarie Grove Road	Exeter Street	A	10.5	A	10.3	B	18.2	A	9.2
John Street	Mitchell Street	B	15.4	B	14.6	A	11.2	A	10.7
Elizabeth Street	Mitchell Street	A	11.3	A	10.8	A	9.5	A	9.4
Argyle Street	Murray Street	B	20.4	B	14.7	B	15.3	A	13.1
Argyle Street	Oxley Street	B	18.2	B	15.3	A	13.9	A	12.3
Argyle Street	John Street	B	18.3	B	20.5	B	14.8	A	14.0
Argyle Street	Hill Street	B	14.7	B	18.4	A	12.8	A	12.0
Argyle Street	Elizabeth St	B	14.8	B	15.7	A	13.9	A	13.7
Argyle Street	Edward Street	B	15.3	B	16.7	B	14.7	A	13.1
Murray Street	Broughton Street	B	25.6	D	43.3	B	19.1	B	20.1
John Street	Broughton Street	A	12.0	B	14.4	A	10.5	A	10.0
Cawdor Road	Sheathers Lane	B	14.5	B	15.1	A	14.3	B	14.3
Old Hume Highway	Menangle Road	B	27.3	C	36.2	B	20.5	B	22.0

From **Table 4** the following observations have been made:

1. The vast majority of intersections within the study area operate well with minimal delays during all four peak periods assessed.
2. Intersection operating conditions during each AM peak period were similar at each location as which was the case for the PM peak periods compared
3. Only the intersection of Murray Street / Broughton Street during the Thursday afternoon peak period was found to operate poorly with right turning traffic out of Broughton Street delayed by through traffic in Menangle Road.
4. The intersection of Old Hume Highway / Menangle Road was nearing capacity during the Thursday afternoon peak. However, this was only for the right turn movement out of Menangle which included an only a small number of 10 vehicles.

For ease of reference, existing intersection operating conditions by day and peak period are shown in **Figure 7** to **Figure 10** below.

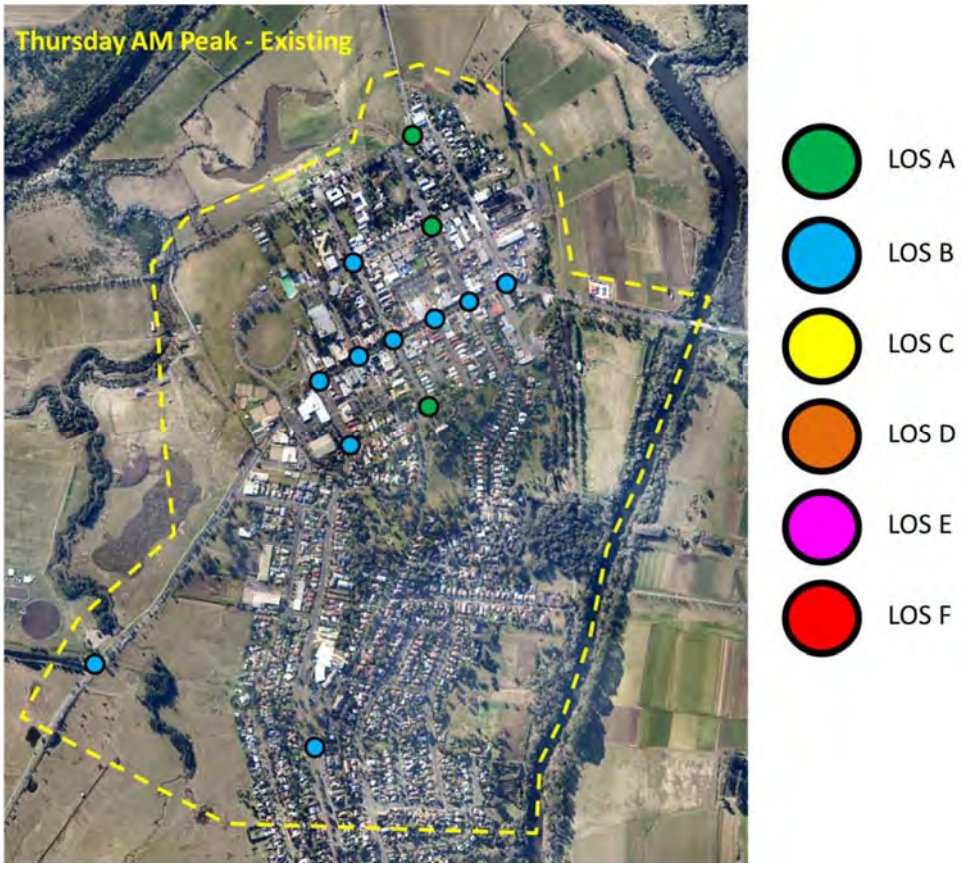


Figure 7: Thursday AM Peak Existing Intersection Operating Conditions

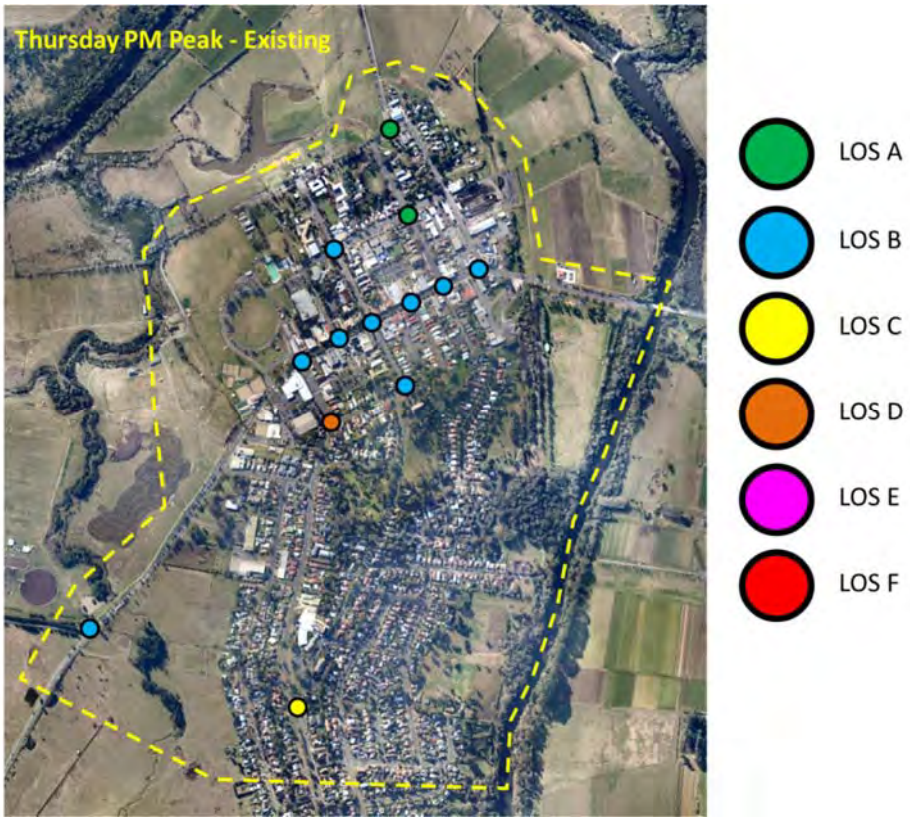


Figure 8: Thursday PM Peak Existing Intersection Operating Conditions

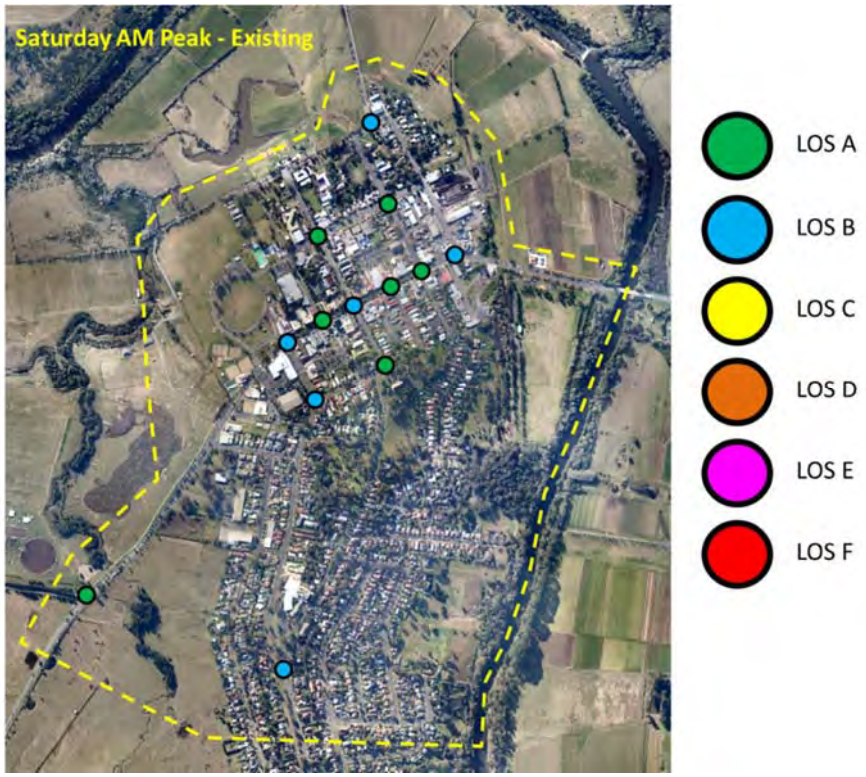


Figure 9: Saturday AM Peak Existing Intersection Operating Conditions

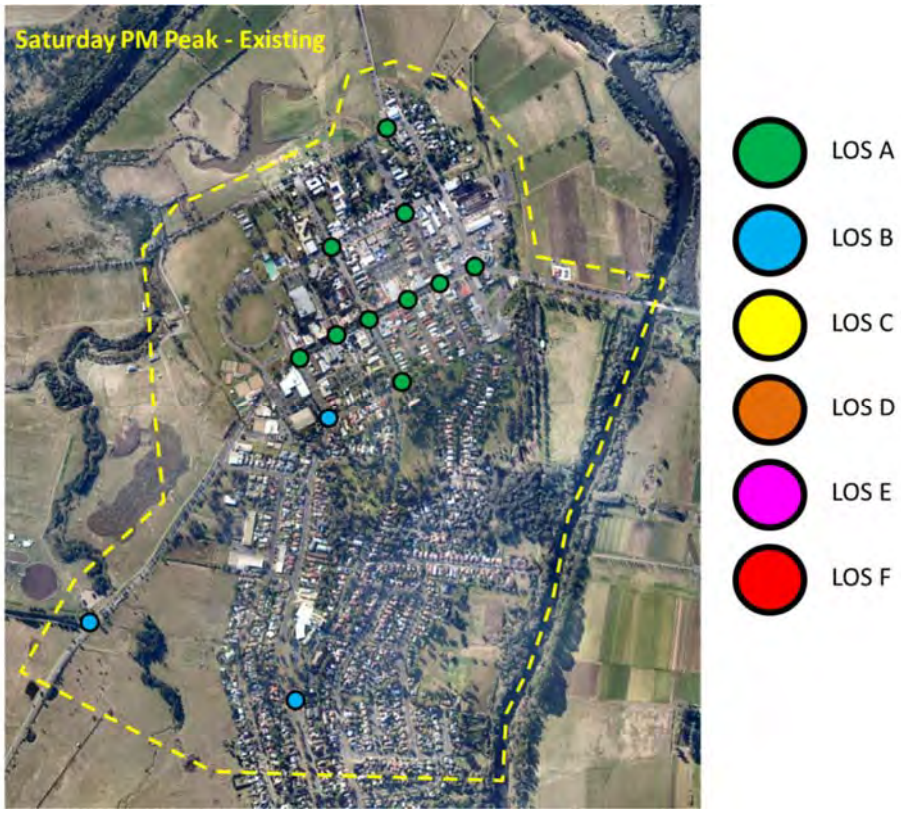


Figure 10: Saturday OM Peak Existing Intersection Operating Conditions

3.2 Mid Block Flows

Mid-block flows provide a further indication of existing traffic conditions. Mid-block demands versus available capacity is heavily dependent on side friction whether in the form of intersections or parking.

The following locations have been identified of interest:

1. Cawdor Road – between Sheathers Lane and Murray Street
2. Old Hume Highway – north of Menangle Road
3. Argyle Street – between Murray Street and Oxley Street
4. Argyle Street – between Oxley Street and John Street
5. Argyle Street – between John Street and Hill Street
6. Argyle Street – between Hills Street and Elizabeth Street
7. Argyle Street – between Elizabeth Street and Edward Street
8. Argyle Street – east of Edward Street

Existing mid-block AM and PM peak hour flows by direction are presented in Figure 11 to Figure 14:

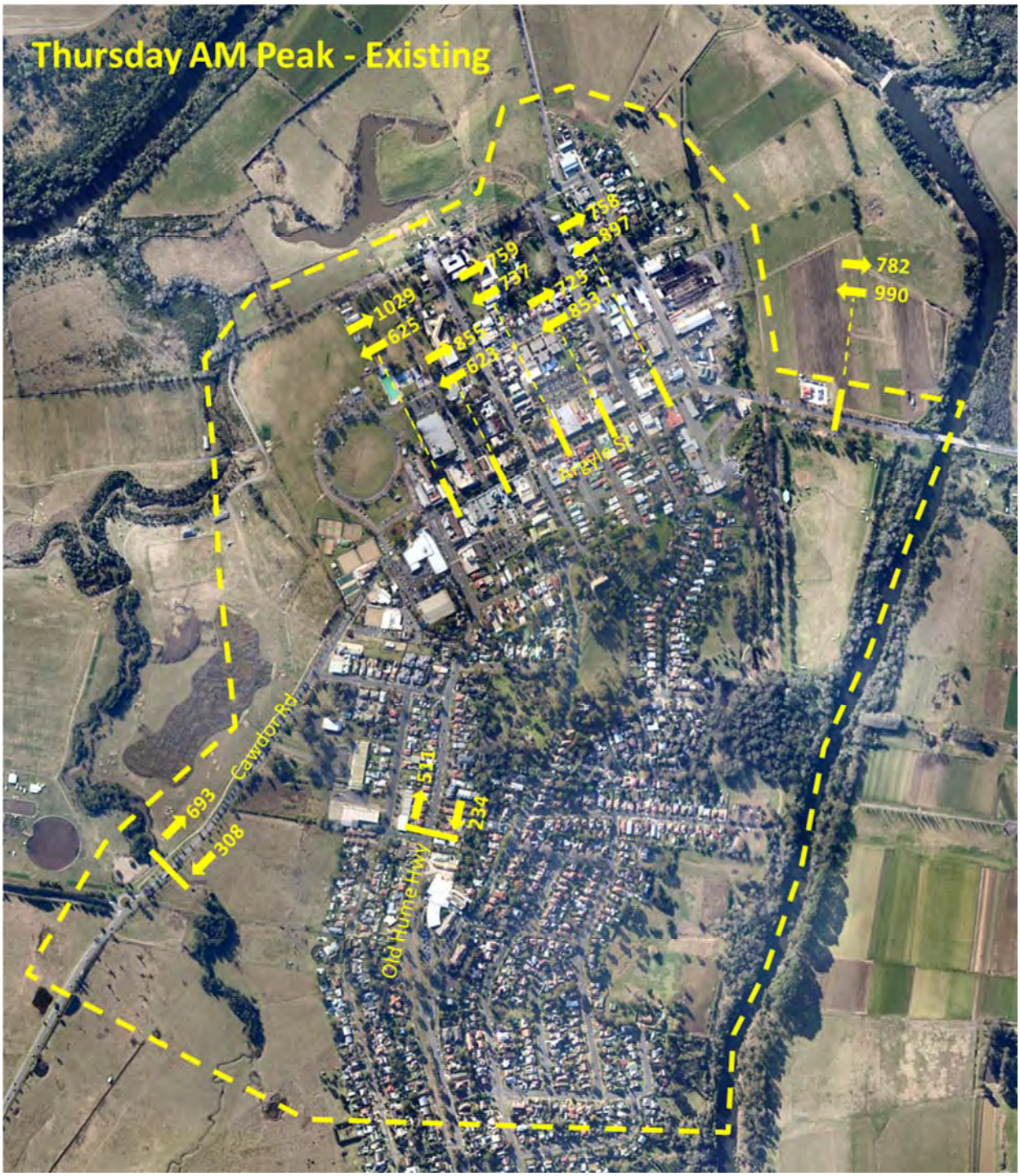


Figure 11: Thursday AM Peak Existing Mid-Block Flows

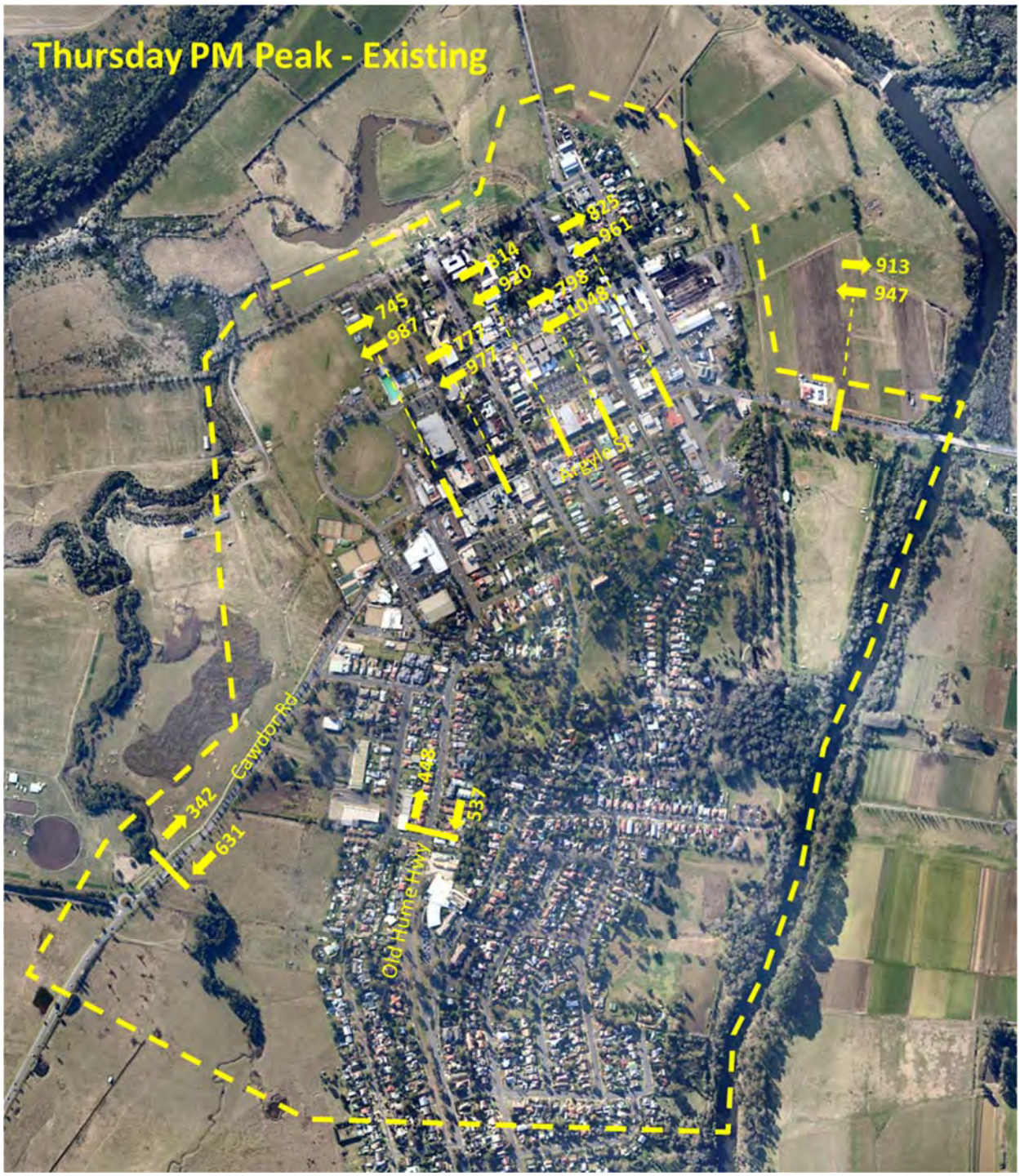


Figure 12: Thursday PM Peak Existing Mid-Block Flows

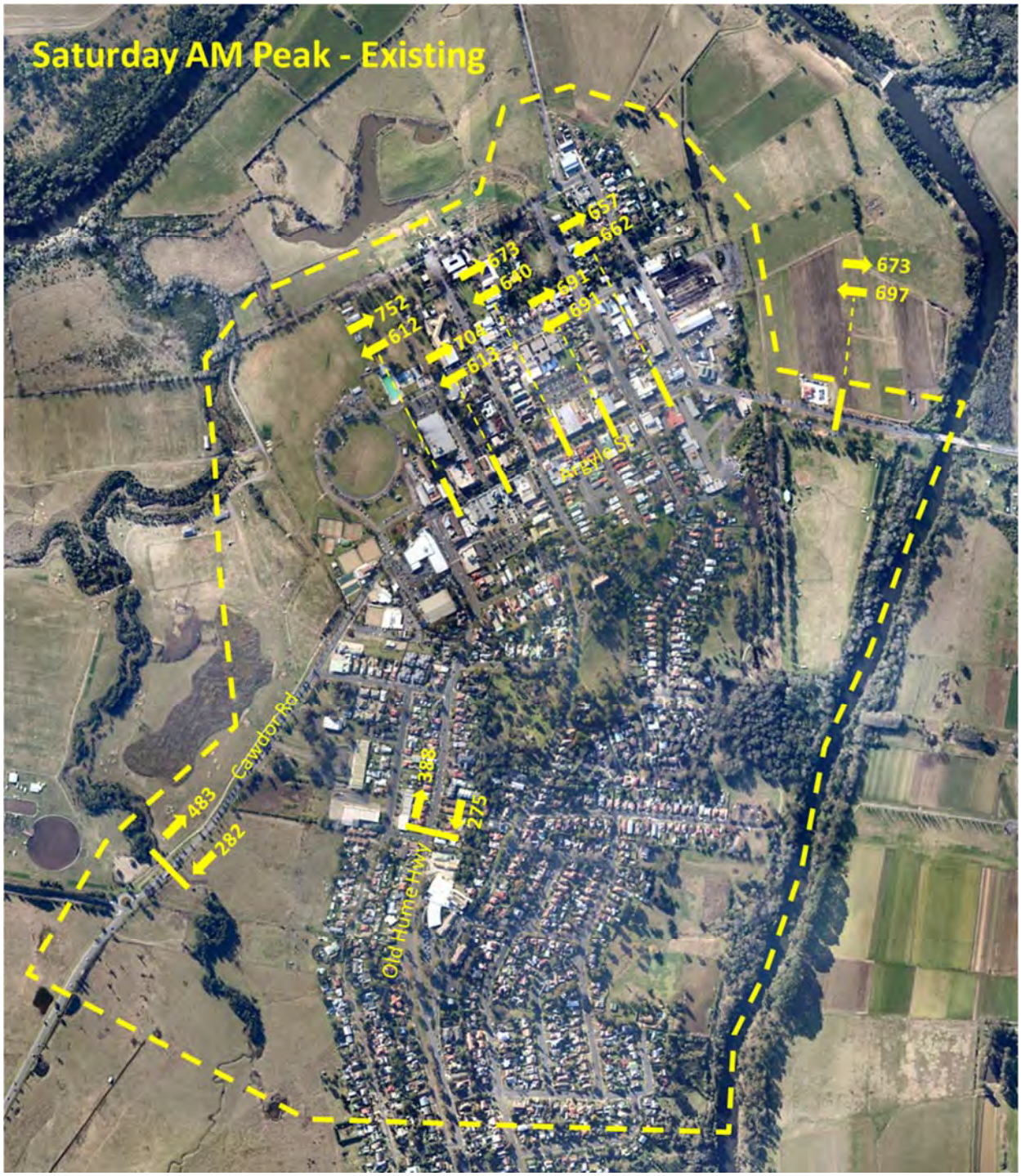


Figure 13: Saturday AM Peak Existing Mid-Block Flows

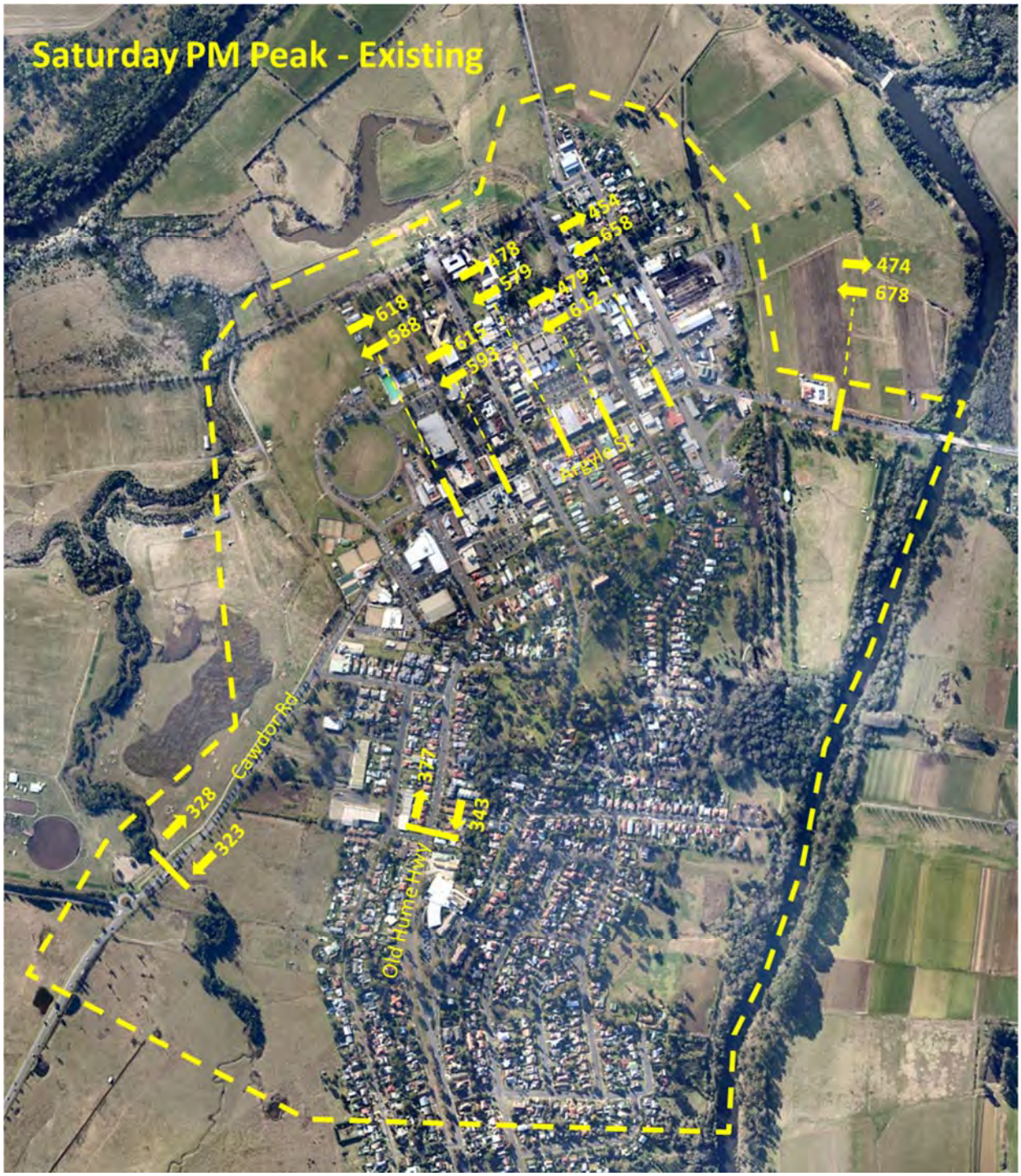


Figure 14: Saturday PM Peak Existing Mid-Block Flows

3.2.1 Commentary on Mid-Block Flows

During the AM peak on a weekday, the draw towards Camden Town Centre from the west is fairly evening split between Cawdor Road and Old Hume Highway (Murray Street). The mirror image occurs during the afternoon weekday peak period.

Flows along Argyle Street were generally consistent for its entire length. There was a reasonable draw of eastbound traffic in Argyle Street turning left into Oxley Street which explains the drop in eastbound flow east of the intersection.
Based on the recorded mid-block flows by direction in Argyle Street, reduction of the street to a single lane in each direction to allow footpath widening is not considered a viable option.

On a Saturday, similar distributions of traffic to / from the centre occur but a lower demand levels. Eastbound and westbound flows in Argyle Street are very similar. Traffic to / from the south and south west are fairly evenly split between Cawdor Road and Old Hume Highway.

As stated in the 2008 Town Centre Strategy report, the reduction of Argyle Street to a single lane in each direction was not considered feasible based on existing traffic demands. Further, rerouting of this traffic would provide more dis-benefits than benefits.

Having regard to the existing two – way mid block flows, it is the opinion of this assessment that reducing Argyle Street to a single lane of travel in each direction with a parallel parking lane is not feasible. This is discussed further in Section 6.2 of this report.

3.2 Public Parking Inventory

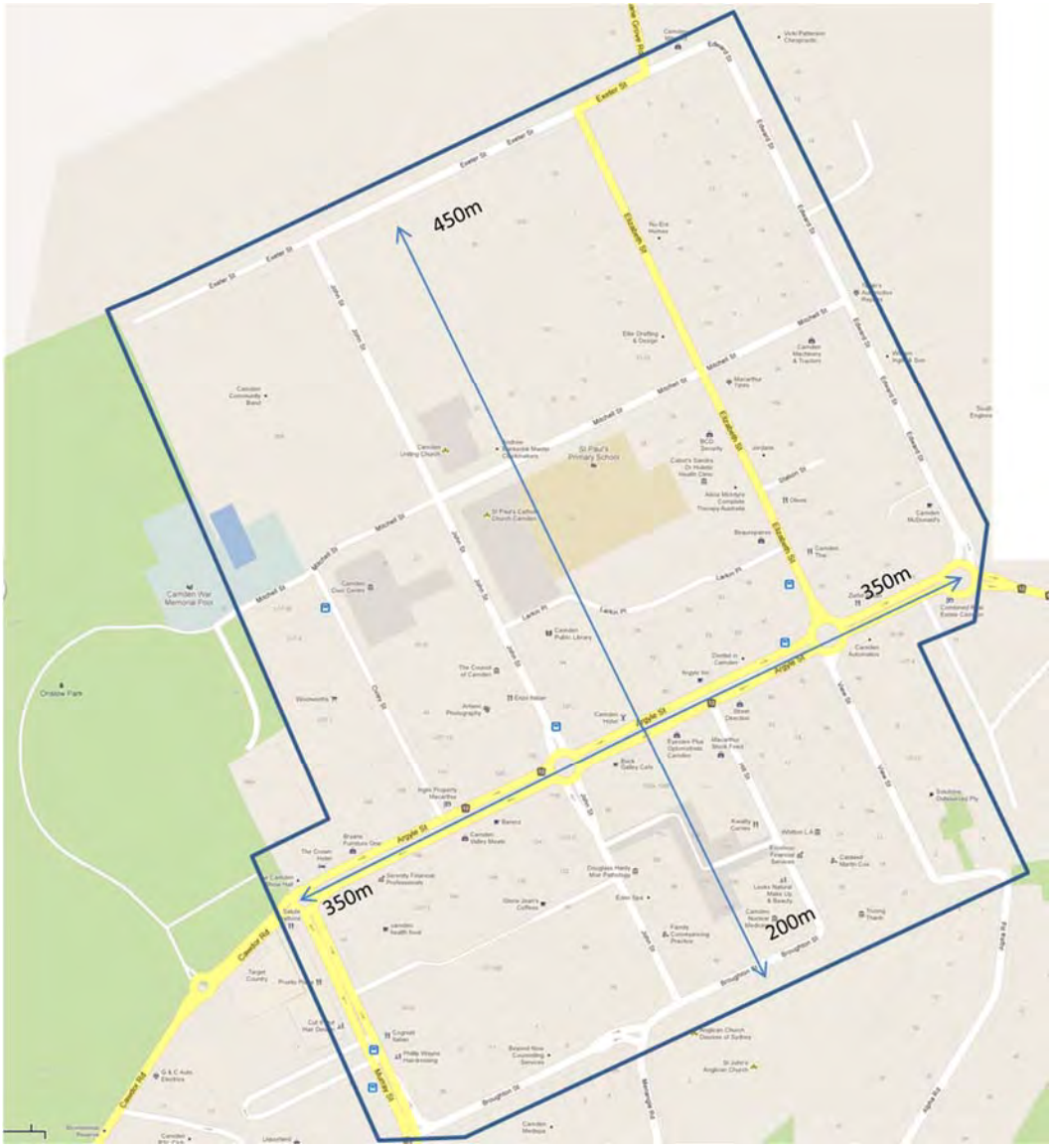


Figure 15: Public Parking Audit Study Area

The total estimated public parking provision within the area defined in **Figure 15** equates to the following:

Table 5 – Total Public Parking Spaces by Type

Total Unrestricted	879	
Total 15 Minutes	6	
Total 1 hour	259	
Total 2 hours	30	
Total 3 hours	394	
Total accessible	10	
Total	879	**1578**

Each public space was captured by the following elements:

1. Current imposed parking restriction
2. Whether on street or within a car park
3. Section and side of street

A plan showing all public parking spaces is provided in **Appendix A** of this report and is summarised in **Table 6**.

Table 6: Parking Spaces by Restriction by Location

Street	From	To	Side	Capacity	Restrictions	Times Monday to Friday	Times Sat	Times Sun
Exeter Street	Oval	John Street	Northern	10	Unrestricted	---	---	---
Exeter Street	Oval	John Street	Southern	20	Unrestricted	---	---	---
Exeter Street	John Street	Elizabeth Street	Northern	30	Unrestricted	---	---	---
Exeter Street	John Street	Elizabeth Street	Southern	30	Unrestricted	---	---	---
Exeter Street	Elizabeth Street	Edward Street	Northern	9	Unrestricted	---	---	---
Exeter Street	Elizabeth Street	Edward Street	Southern	15	Unrestricted	---	---	---
John Street	Exeter Street	Mitchell Street	Eastern	57	Unrestricted	---	---	---
John Street	Exeter Street	Mitchell Street	Western	50	Unrestricted	---	---	---
John Street	Mitchell Street	Argyle Street	Eastern	13	Bus Zone	8:00am - 9:30am, 2:30pm - 4:00pm	---	---
John Street	Mitchell Street	Argyle Street	Eastern	13	Unrestricted	9:30am - 2:30pm, 4:00pm - 6:00pm	---	---
John Street	Mitchell Street	Argyle Street	Eastern	1	15 Minutes	8:30am - 6:00pm	8:30am - 12:30pm	---
John Street	Mitchell Street	Argyle Street	Eastern	6	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
John Street	Mitchell Street	Argyle Street	Western	18	Unrestricted	---	---	---
John Street	Mitchell Street	Argyle Street	Western	8	2 hours	8:30am - 6:00pm	8:30am - 12:30pm	---
John Street	Mitchell Street	Argyle Street	Western	20	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Elizabeth Street	Exeter Street	Mitchell Street	Eastern	46	Unrestricted	---	---	---
Elizabeth Street	Exeter Street	Mitchell Street	Western	49	Unrestricted	---	---	---
Elizabeth Street	Mitchell Street	Argyle Street	Eastern	10	Unrestricted	---	---	---

Street	From	To	Side	Capacity	Restrictions	Times Monday to Friday	Times Sat	Times Sun
Elizabeth Street	Mitchell Street	Argyle Street	Eastern	17	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Elizabeth Street	Mitchell Street	Argyle Street	Western	19	Unrestricted	---	---	---
Edward Street	Exeter Street	Mitchell Street	Eastern	60	Unrestricted	---	---	---
Edward Street	Exeter Street	Mitchell Street	Western	60	Unrestricted	---	---	---
Edward Street	Mitchell Street	Argyle Street	Eastern	25	Unrestricted	---	---	---
Edward Street	Mitchell Street	Argyle Street	Western	14	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Mitchell Street	Oval	John Street	Northern	24	Bus Zone	8:00am - 9:30am, 2:30pm - 4:00pm	---	---
Mitchell Street	Oval	John Street	Northern	24	Unrestricted	9:30am - 2:30pm, 4:00pm - 6:00pm	---	---
Mitchell Street	Oval	John Street	Southern	6	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Mitchell Street	Oval	John Street	Southern	9	Unrestricted	---	---	---
Mitchell Street	John Street	Elizabeth Street	Northern	39	Unrestricted	---	---	---
Mitchell Street	John Street	Elizabeth Street	Southern	43	Unrestricted	---	---	---
Mitchell Street	Elizabeth Street	Edward Street	Northern	39	Unrestricted	---	---	---
Mitchell Street	Elizabeth Street	Edward Street	Southern	43	Unrestricted	---	---	---
Oxley Street	Mitchell Street	Argyle Street	Eastern	16	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Oxley Street Public Car Park North	Mitchell Street	Argyle Street	Eastern	46	3 hours	8:30am - 6:00pm	8:30am - 12:30pm	---
Oxley Street Council Car Park (Central)	Mitchell Street	Argyle Street	Eastern	26	Restricted	8:30am - 6:00pm	---	---

Street	From	To	Side	Capacity	Restrictions	Times Monday to Friday	Times Sat	Times Sun
Oxley Street Public Car Park South	Mitchell Street	Argyle Street	Eastern	Unknown	Unknown	Unknown	Unknown	Unknown
Oxley Street	Mitchell Street	Argyle Street	Western	18	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Larkin Place Public Car Park	John Street	Elizabeth Street	---	26	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Larkin Place Public Car Park	John Street	Elizabeth Street	---	2	Accessible			
Larkin Place Public Car Park	John Street	Elizabeth Street	---	151	3 hours	8:30am - 6:00pm	8:30am - 12:30pm	---
Cawdor Road	Oval	Murray Street	Northern	9	Unrestricted	---	---	---
Cawdor Road	Oval	Murray Street	Southern	4	Unrestricted	---	---	---
Argyle Street	Murray Street	John Street	Northern	12	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Argyle Street	Murray Street	John Street	Northern	5	15 Minutes	8:30am - 6:00pm	8:30am - 12:30pm	---
Argyle Street	Murray Street	John Street	Southern	21	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Argyle Street	John Street	Elizabeth Street	Northern	21	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Argyle Street	John Street	Elizabeth Street	Southern	19	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Argyle Street	Elizabeth Street	Edward Street	Northern	6	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Argyle Street	Elizabeth Street	Edward Street	Southern	3	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---

Street	From	To	Side	Capacity	Restrictions	Times Monday to Friday	Times Sat	Times Sun
Murray Street	John Street	Broughton Street	Eastern	6	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Murray Street	John Street	Broughton Street	Western	10	2 hours	All Day	All Day	All Day
Murray Street Public Car Park	Murray Street	John Street	---	29	Unrestricted	---	---	---
Murray Street Public Car Park	Murray Street	John Street	---	2	Accessible			
Murray Street Public Car Park	Murray Street	John Street	---	104	3 hours	8:30am - 6:00pm	8:30am - 12:30pm	---
John Street	Argyle Street	Broughton Street	Eastern	23	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
John Street	Argyle Street	Broughton Street	Western	6	Accessible	All Day	All Day	All Day
John Street	Argyle Street	Broughton Street	Western	23	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
John Street Public Car Park	John Street	Hill Street	---	93	3 hours	8:30am - 6:00pm	8:30am - 12:30pm	---
Hill Street	Argyle Street	Broughton Street	Eastern	13	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Hill Street	Argyle Street	Broughton Street	Eastern	10	2 hours	8:30am - 6:00pm	8:30am - 12:30pm	---
Hill Street	Argyle Street	Broughton Street	Western	10	1 hour	8:30am - 6:00pm	8:30am - 12:30pm	---
Hill Street	Argyle Street	Broughton Street	Western	10	2 hours	8:30am - 6:00pm	8:30am - 12:30pm	---
View Street	Argyle Street	Alpha Road	Eastern	22	Unrestricted	---	---	---
View Street	Argyle Street	Alpha Road	Western	0	No Parking	---	---	---

Street	From	To	Side	Capacity	Restrictions	Times Monday to Friday	Times Sat	Times Sun
Broughton Street	Murray Street	Menangle Road	Northern	15	Unrestricted	---	---	---
Broughton Street	Murray Street	Menangle Road	Southern	15	Unrestricted	---	---	---
Broughton Street	John Street	Hill Street	Northern	15	Unrestricted	---	---	---
Broughton Street	John Street	Hill Street	Southern	15	Unrestricted	---	---	---
			Total	**1578**				

3.2.1 Commentary on Public Parking Provision

A glaring omission of the existing restrictions in place in and around the Camden Town Centre is seven day restrictions are basically non-existent. Therefore after 12:30pm on a Saturday, whilst main retailers continue to trade in the town centre core, no time restrictions apply to any of the available public parking.

The Camden Town Centre benefits from four large public car parks which can be accessed in most instances without the need to travel the full length of Argyle Street from either direction. Allowing vehicles to come to and from a town centre and access public parking without the need to travel through the core is considered best practice.

The overall supply of accessible parking spaces within the centre as a whole equates to approximately 1% of the total parking available as recorded in **Table 5**. In previous versions of the Australian Standard for Off Street Car Parking Facilities – AS2890.1, a rate of 1-3% of total spaces set aside as accessible spaces was considered appropriate for retail uses.

Overall the existing accessible space provision in the centre is considered low and inadequate for the aging population which exists in and around the Camden area. It is recommended that Council adopt a 3% provision rate for accessible parking spaces. The provision of designated accessible spaces should be in the public car park adjacent to medical facilities.

Whilst accessible parking permits allow users to park double the designated time of the parking restriction, this does not give any consideration to the location and the accessible routes of travel to from that particular general parking space.

3.4 Public Parking Demand Analysis

Parking surveys were undertaken within the town centre on:

- Thursday 8:00am to 5:00pm with selected off-street car parks (P2 & P3) surveyed until 9:00pm
- Friday 6:00pm to 9:00pm at selected off-street car parks (P2 & P3)
- Saturday 8:00am to 5:00pm with selected off-street car parks (P2 & P3) surveyed until 9:00pm

A one hour beat survey method was used in which the number of vehicles present was recorded by street block and side of the street at hourly intervals. In addition to demand, parking regulations applying to each of these blocks was recorded along with their estimated capacity. The study area for the parking demand counts is shown below.

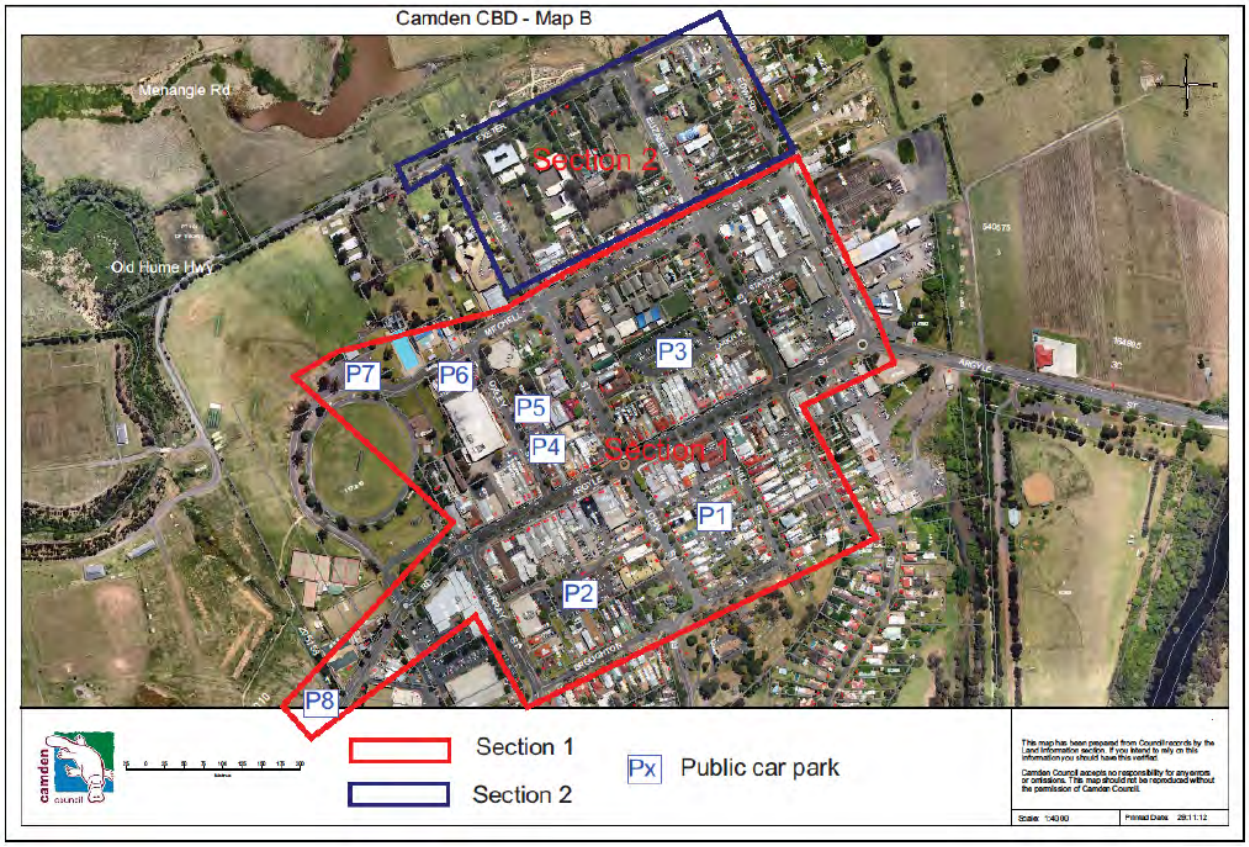


Figure 16: Public Parking Audit Study Area

3.4.1 Weekday Parking Supply

A detailed set of drawings was prepared indicating the prevailing parking regulations within the town centre. These are shown in Appendix A of this report and summarised above in **Table 6**.

In addition, an analysis of spaces by type was undertaken and is reported below. Of note is that some spaces have several different applicable regulations by time of day and day of week, and these are reflected in this analysis.

As part of the analysis spaces were classified into two broad groups:

- General – these are spaces that are generally available to all vehicles (including loading zones) and have a range of time limits applied
- Special – these are spaces designated for particular restricted user groups, such as disabled, set down pick up, police, council, etc;

The following table summarises the allocation of general car parking spaces within the town centre on weekdays.

Table 7: Parking space allocation by type and on street/off street, weekday, by hour

	General			Special			Total
Time	On-street	Off-street	Total	On-street	Off-street	Total	
8:00	1,058	813	1,871	20	41	61	1,932
9:00	1,058	813	1,871	20	41	61	1,932
10:00	1,094	823	1,917	20	41	61	1,978
11:00	1,094	823	1,917	20	41	61	1,978
12:00	1,094	823	1,917	20	41	61	1,978
13:00	1,094	823	1,917	20	41	61	1,978
14:00	1,094	823	1,917	20	41	61	1,978
15:00	1,058	813	1,871	20	41	61	1,932
16:00	1,094	823	1,917	20	41	61	1,978
17:00	1,094	823	1,917	20	41	61	1,978

This analysis demonstrates that general parking is by far the largest parking type surveyed, with special parking accounting for less than 5% of spaces. On-street spaces account for between 55% and 60% of general parking spaces; this reinforces the importance of the on-street parking resource for the town centre.

The next table summarises the time restrictions of general parking spaces.

Table 8: Parking space allocation by type and on street/off street, weekday, by hour

Time	P15	1P	2P	3P	No Restriction	Loading Zone	Total
8:00	5	253	110	445	1,050	8	1,871
9:00	5	253	110	445	1,050	8	1,871
10:00	5	253	110	455	1,086	8	1,917
11:00	5	261	110	455	1,086	0	1,917
12:00	5	261	110	455	1,086	0	1,917
13:00	5	261	110	455	1,086	0	1,917
14:00	5	261	110	455	1,086	0	1,917
15:00	5	261	110	445	1,050	0	1,871
16:00	5	261	110	455	1,086	0	1,917
17:00	5	261	110	455	1,086	0	1,917

Of the spaces in the town centre, those during the week with no restriction account for roughly half the supply. Spaces designated as 3P are about a quarter of spaces. There are few designated on-street loading zones and these convert to other parking types from 11:00am.

Table 9 provides a breakdown of special spaces among their designated users.

Table 9: Parking space allocation for special spaces, weekday, by hour and by time regulation

Time	Disable Parking	Motor Bikes Only	Pick up & Setdown only	Police vehicles Excepted	Service Vehicles only	Taxi Zone	No Parking -Auth. veh accepted	Total
8:00	22	4	1	2	1	5	26	61
9:00	22	4	1	2	1	5	26	61
10:00	22	4	1	2	1	5	26	61
11:00	22	4	1	2	1	5	26	61
12:00	22	4	1	2	1	5	26	61
13:00	22	4	1	2	1	5	26	61
14:00	22	4	1	2	1	5	26	61
15:00	22	4	1	2	1	5	26	61
16:00	22	4	1	2	1	5	26	61
17:00	22	4	1	2	1	5	26	61

The 26 'no parking authorised vehicles only' are spaces reserved for Council vehicles off Oxley Street. The supply of disabled parking spaces is between 1 and 2% of town centre spaces.

As part of the analysis, a notional walk distance between groups of car parking spaces and Argyle Street (between Murray Street and Elizabeth Street/View Street) was measured[1] to provide an indication of the convenience of spaces for town centre users. The following table identifies the number of general user parking spaces within these distances bands of Argyle Street.

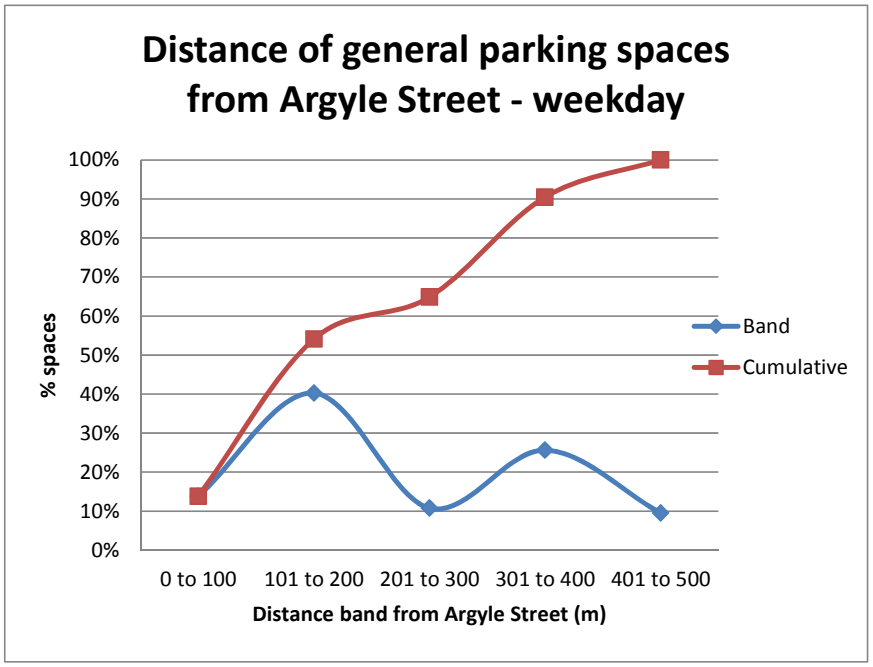
Table 10: Parking space walk distance bands by time restriction by hour, for general spaces – Thursday

Restriction	P15	1P			2P		3P	No Restriction					Loading Zone
Walk distance band (m)	0 to 100	101 to 200	201 to 300	301 to 400	0 to 100	101 to 200	101 to 200	0 to 100	101 to 200	201 to 300	301 to 400	401 plus	101 to 200
Time													
8:00	5	168	73	12	74	36	445	18	187	171	491	183	8
9:00	5	168	73	12	74	36	445	18	187	171	491	183	8
10:00	5	168	73	12	74	36	455	18	200	194	491	183	8
11:00	5	168	81	12	74	36	455	18	200	194	491	183	0
12:00	5	168	81	12	74	36	455	18	200	194	491	183	0
13:00	5	168	81	12	74	36	455	18	200	194	491	183	0
14:00	5	168	81	12	74	36	455	18	200	194	491	183	0
15:00	5	168	81	12	74	36	445	18	187	171	491	183	0
16:00	5	168	81	12	74	36	455	18	200	194	491	183	0
17:00	5	168	81	12	74	36	455	18	200	194	491	183	0

[1] *This was generally from the centroid of the parking zone to Argyle Street via the most direct walk path available, including via private arcade-style links. Argyle Street was chosen as it is a focus for the town centre; however, some people/vehicles do not necessarily want to use Argyle Street, and this is likely to account for some of the more distant parking activity, even when spaces closer to Argyle Street are available.*

Much of the general parking supply, both on- and off-street, is located in reasonably close proximity to Argyle Street. The following chart shows the proportional distribution of spaces by distance band, as well as a cumulative series. These are for a notional hour commencing 10:00am.

Chart 1: Proportional Distribution of Spaces by Distance Band



The above chart indicates that some two-thirds of the town centre's supply of general parking is located closer than the '301 to 400m' walk distance band and 90% is closer to Argyle Street than 400m.

3.4.2 Weekday Parking Demand

The beat surveys identified the number of vehicles actually parked in each set of parking spaces within the town centre. The following table provides a summary of vehicles present and the next table shows this as a percentage utilisation of spaces.

Table 11: Vehicles parked by type of space – Thursday

	General			Special			Total
Time	On-street	Off-street	Total	On-street	Off-street	Total	
8:00	429	146	575	12	27	39	614
9:00	523	419	942	10	36	46	988
10:00	577	529	1,106	9	34	43	1,149
11:00	567	575	1,142	8	30	38	1,180
12:00	588	632	1,220	9	32	41	1,261
13:00	634	747	1,381	12	40	52	1,433
14:00	625	737	1,362	11	37	48	1,410
15:00	637	691	1,328	11	36	47	1,375
16:00	498	547	1,045	8	23	31	1,076
17:00	393	344	737	4	9	13	750

The following table reports the utilisation of these spaces as a percentage of the total number of spaces by type.

Table 12: Utilisation of parking spaces by type of space, by hour – Thursday

	General			Special			Total
Time	On-street	Off-street	Total	On-street	Off-street	Total	
8:00	41%	18%	31%	60%	66%	64%	32%
9:00	49%	52%	50%	50%	88%	75%	51%
10:00	53%	64%	58%	45%	83%	70%	58%
11:00	52%	70%	60%	40%	73%	62%	60%
12:00	54%	77%	64%	45%	78%	67%	64%
13:00	58%	91%	72%	60%	98%	85%	72%
14:00	57%	90%	71%	55%	90%	79%	71%
15:00	60%	85%	71%	55%	88%	77%	71%
16:00	46%	66%	55%	40%	56%	51%	54%
17:00	36%	42%	38%	20%	22%	21%	38%

General parking spaces in off-street car parks experience higher overall utilisation than on-street spaces. This is likely due to the proximity of off-street car parks to town centre destinations when compared with on-street parking which is available over a greater range. Overall general parking spaces have a peak utilisation of just under three-quarters at around 1:00pm.

The following table disaggregates general parking demand by time restriction.

Table 13: Vehicles parked in general parking by time restriction, by hour – Thursday

Time	p15	1P	2P	3P	No Restriction	Loading Zone	Total
8:00	5	155	70	78	262	5	575
9:00	5	189	97	252	392	7	942
10:00	5	217	101	328	447	8	1,106
11:00	5	232	100	370	435	0	1,142
12:00	4	234	100	420	462	0	1,220
13:00	5	233	91	452	600	0	1,381
14:00	5	221	92	448	596	0	1,362
15:00	4	202	105	425	592	0	1,328
16:00	3	202	93	343	404	0	1,045
17:00	4	173	76	213	271	0	737

Numerically the 'no restriction' parking has the highest demand, peaking at around 600 vehicles at 1:00pm. The 3P parking is the next most important source of supply – it also peaks around 1:00pm, at just over 450 vehicles.

The relative utilisation of these spaces is summarised by hour in the following table.

Table 14: Utilisation of general parking spaces by time restriction by hour – Thursday

Time	p15	1P	2P	3P	No Restriction	Loading Zone	Total
8:00	100%	61%	64%	18%	25%	63%	31%
9:00	100%	75%	88%	57%	37%	88%	50%
10:00	100%	86%	92%	72%	41%	100%	58%
11:00	100%	89%	91%	81%	40%	n.a.	60%
12:00	80%	90%	91%	92%	43%	n.a.	64%
13:00	100%	89%	83%	99%	55%	n.a.	72%
14:00	100%	85%	84%	98%	55%	n.a.	71%
15:00	80%	77%	95%	96%	56%	n.a.	71%
16:00	60%	77%	85%	75%	37%	n.a.	55%
17:00	80%	66%	69%	47%	25%	n.a.	38%

The 15P parking is busy all day, but it is a very small proportion of supply. Peak utilisation of the other time restricted parking, i.e., 1P, 2P and 3P, are high at between 90 and 99% occurring around midday to 1:00pm. Parking with no restriction has peak utilisation of 56% around 3:00pm.

The use of special parking spaces is tabulated below.

Table 15: Vehicles parked in special parking spaces by restriction by hour – Thursday

Time	Disable Parking	Motor Bikes Only	Pick up & Setdown only	Police vehicles Excepted	Service Vehicles only	Taxi Zone	No Parking -Auth veh accepted	Total
8:00	6	4	0	1	0	2	26	39
9:00	17	0	0	0	1	2	26	46
10:00	14	0	0	0	0	3	26	43
11:00	11	0	0	0	0	3	24	38
12:00	14	1	0	0	0	3	23	41
13:00	20	1	0	0	1	4	26	52
14:00	19	0	0	0	0	3	26	48
15:00	15	0	0	2	1	3	26	47
16:00	8	0	0	2	0	3	18	31
17:00	2	0	0	1	0	2	8	13

The survey information suggests that most of these spaces turnover through the day, with considerable fluctuations in demand. The exception to this are the 'No Parking – authorised vehicles excepted' which are a yard of Council vehicles in the off-street car park on Oxley Street.

The utilisation of these spaces is shown in the next table.

Table 16: Utilisation of special parking spaces by restrictions by hour – Thursday

Time	Disable Parking	Motor Bikes Only	Pick up & Setdown only	Police vehicles Excepted	Service Vehicles only	Taxi Zone	No Parking – Auth. veh accepted	Total
8:00	27%	100%	0%	50%	0%	40%	100%	64%
9:00	77%	0%	0%	0%	100%	40%	100%	75%
10:00	64%	0%	0%	0%	0%	60%	100%	70%
11:00	50%	0%	0%	0%	0%	60%	92%	62%
12:00	64%	25%	0%	0%	0%	60%	88%	67%
13:00	91%	25%	0%	0%	100%	80%	100%	85%
14:00	86%	0%	0%	0%	0%	60%	100%	79%
15:00	68%	0%	0%	100%	100%	60%	100%	77%
16:00	36%	0%	0%	100%	0%	60%	69%	51%
17:00	9%	0%	0%	50%	0%	40%	31%	21%

The disabled parking spaces are well-used in the middle of the day, when they are utilised 85% or more for two hours.

Time distance bands (for the notional walk from the car parking spaces to Argyle Street) were attached to the data and these demands are summarised in Error! Reference source not found., below.

Table 17: Cars parked in general parking spaces by time restriction, by walk distance to Argyle Street, by hour – Thursday

Restriction	p15	1P			2P		3P	No Restriction					Loading Zone
Walk distance band (m)	0 to 100	0 to 100	101 to 200	201 to 300	0 to 100	101 to 200	101 to 200	0 to 100	101 to 200	201 to 300	301 to 400	401 plus	101 to 200
Time													
8:00	5	103	51	1	59	11	78	10	72	50	122	8	5
9:00	5	136	52	1	63	34	252	10	140	83	148	11	7
10:00	5	151	66	0	66	35	328	12	172	109	152	2	8
11:00	5	157	75	0	65	35	370	14	174	108	138	1	0
12:00	4	154	75	5	65	35	420	14	173	127	136	12	0
13:00	5	158	72	3	55	36	452	11	168	143	267	11	0
14:00	5	145	74	2	57	35	448	8	179	135	265	9	0
15:00	4	127	74	1	69	36	425	7	169	122	281	13	0

Restriction	p15	1P			2P		3P	No Restriction					Loading Zone
16:00	3	127	72	3	64	29	343	6	149	96	143	10	0
17:00	4	122	50	1	57	19	213	5	102	45	108	11	0

This demand information is used in the following table to provide an indication of utilisation.

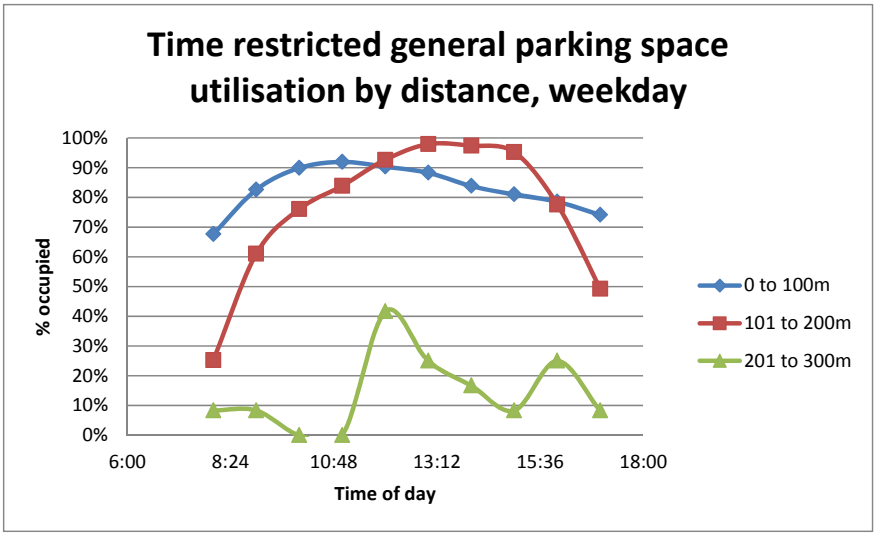
Table 18: Utilisation of general parking spaces by time restrictions, by walk distance to Argyle Street, by hour- Thursday

Restriction	p15	1P			2P		3P	No Restriction					Loading Zone
Walk distance band (m)	**0 to 100**	**0 to 100**	**101 to 200**	**201 to 300**	**0 to 100**	**101 to 200**	**101 to 200**	**0 to 100**	**101 to 200**	**201 to 300**	**301 to 400**	**401 plus**	**101 to 200**
Time													
8:00	100%	61%	70%	8%	80%	31%	18%	56%	39%	29%	25%	4%	63%
9:00	100%	81%	71%	8%	85%	94%	57%	56%	75%	49%	30%	6%	88%
10:00	100%	90%	90%	0%	89%	97%	72%	67%	86%	56%	31%	1%	100%
11:00	100%	93%	93%	0%	88%	97%	81%	78%	87%	56%	28%	1%	n.a.
12:00	80%	92%	93%	42%	88%	97%	92%	78%	87%	65%	28%	7%	n.a.
13:00	100%	94%	89%	25%	74%	100 %	99%	61%	84%	74%	54%	6%	n.a.
14:00	100%	86%	91%	17%	77%	97%	98%	44%	90%	70%	54%	5%	n.a.
15:00	80%	76%	91%	8%	93%	100 %	96%	39%	90%	71%	57%	7%	n.a.
16:00	60%	76%	89%	25%	86%	81%	75%	33%	75%	49%	29%	5%	n.a.
17:00	80%	73%	62%	8%	77%	53%	47%	28%	51%	23%	22%	6%	n.a.

The above analysis indicates that unrestricted spaces closer to Argyle Street (within 200m) are well used, holding around 85% utilisation from about 10:00am through to between 3:00 and 4:00pm. More than 200m from Argyle Street there is a good supply of un-used parking spaces.

The following chart presents the utilisation of all time restricted spaces by walk distance from Argyle Street.

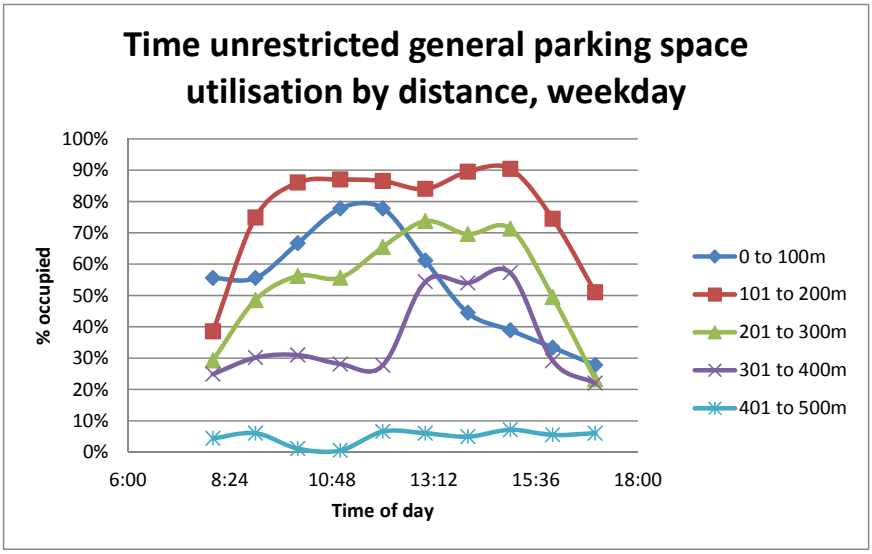
Chart 2: Parking Utilisation by Walk distance from Argyle Street – Time Restricted Spaces



The closer spaces tend to fill earlier than the more remote spaces, which is an expected finding. Of interest is that a large proportion of the time restricted spaces are occupied early in the day, prior to the commencement of a large proportion of retail and personal business customer activity (typically later, around 10:00am onward, and, at 8:00am, prior to the commencement of school. The more distant time restricted spaces are not heavily used, although there are few of them.

The next chart shows the same information for the unrestricted spaces.

Chart 3: Parking Utilisation by Walk distance from Argyle Street - Unrestricted Spaces



Again these tend to fill from the spaces that are closer to Argyle Street first, and then more distant spaces become utilised. Note that the number of unrestricted spaces up to 100m of Argyle Street is small. Our expectation was that a greater proportion of unrestricted spaces would be taken earlier in the day when compared with time restricted spaces. This was based on long-stay parkers (town centre workers) would arrive between 7:00am and 9:30am to prepare for the day, whilst their customers (generally short stay parkers) would arrive in substantial numbers from about 9:30am/10:00am. Whereas comparison of the above two charts indicates similar profiles of demand for spaces within 200m of Argyle Street, whether time restricted or not.

A partial explanation might be that there are private on-site parking spaces used by employees at a number of businesses and that these spaces were not included in the surveys undertaken for this study.

The following charts show the percentage utilisation of spaces for each of the main time restrictions.

Chart 4: Percentage Utilisation by 1 Hour Time Restrictions

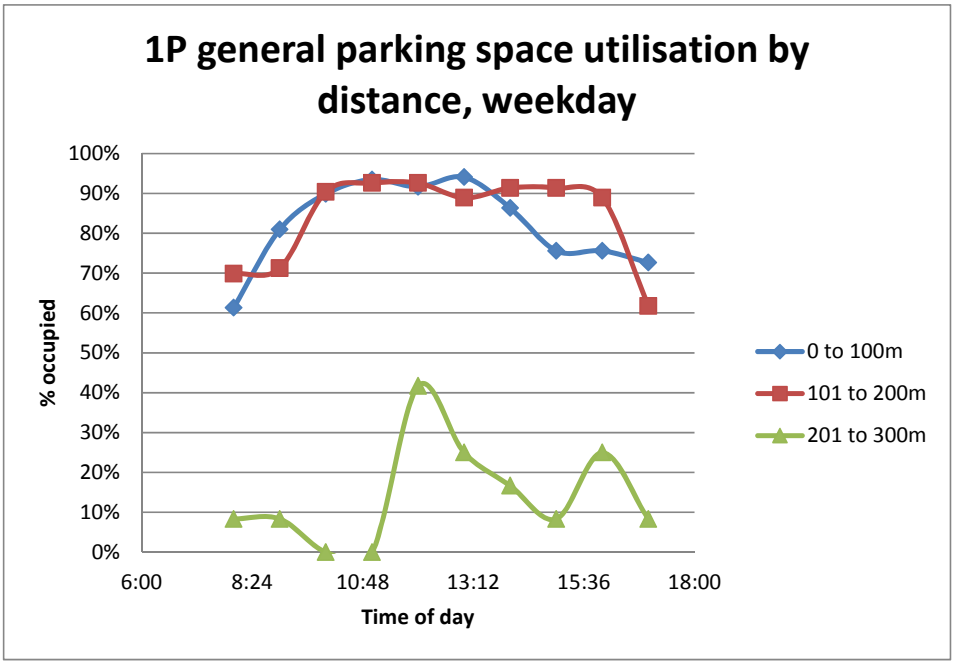


Chart 5: Percentage Utilisation by 2 Hour Time Restrictions

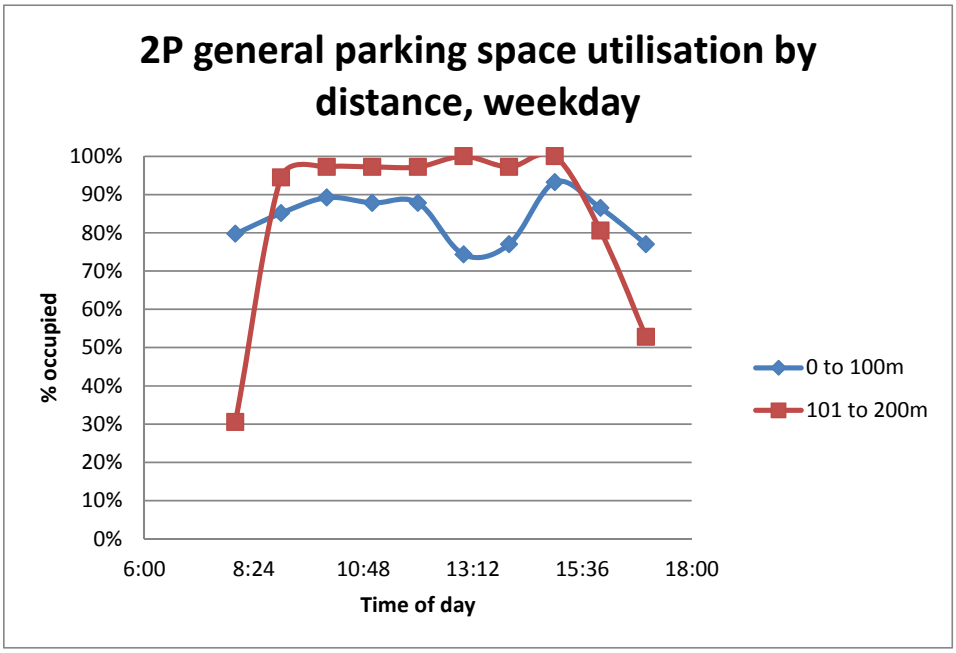
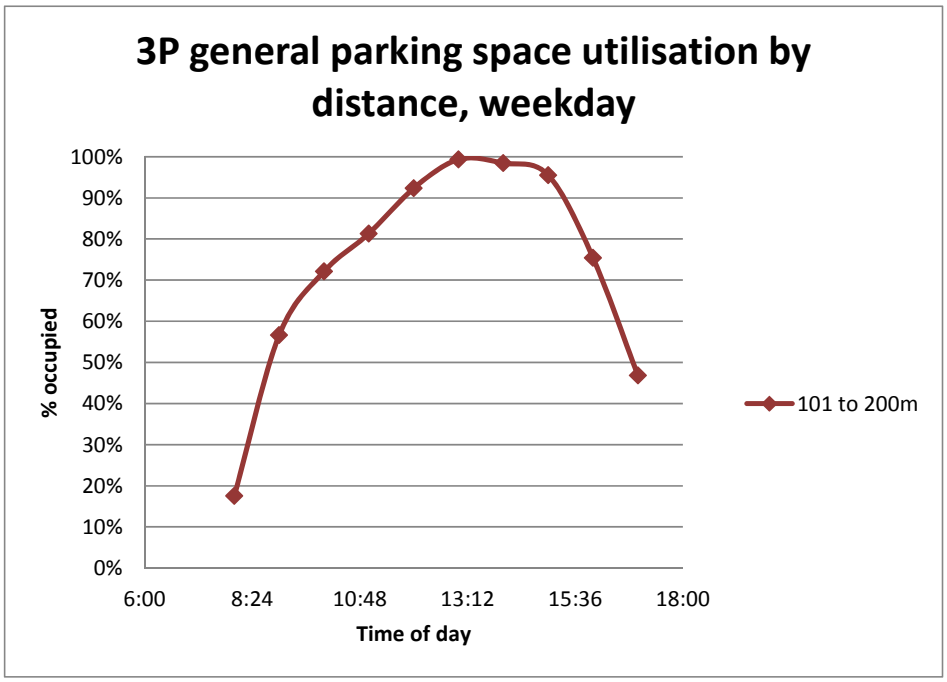


Chart 6: Percentage Utilisation by 3 Hour Time Restrictions



3.4.3 Weekday Evening Parking Demand

Surveys were taken in off-street car parks P2 and P3 on Thursday and Friday evenings from 6:00pm to 9:00pm. The following table reports the utilisation of these car parks on Thursday all day, including the evening, to provide context for the evening usage.

Table 19: Occupancy, capacity and utilisation of car parks P2 and P3 on Thursday (9.00am to 9.00pm), by hour

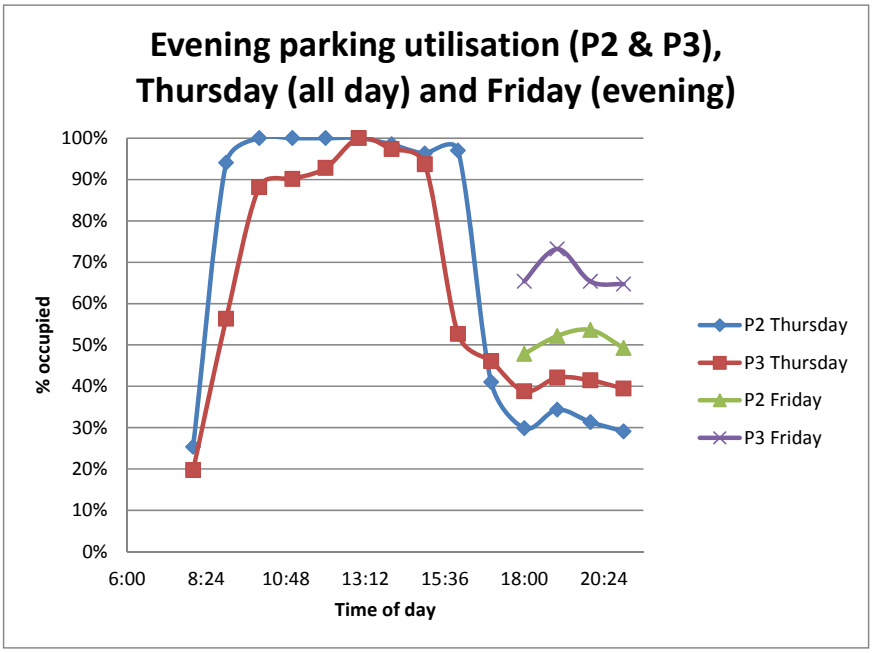
	Occupancy			Capacity			Utilisation		
Time	**P2**	**P3**	**Total**	**P2**	**P3**	**Total**	**P2**	**P3**	**Total**
8:00	34	28	62	134	142	276	25%	20%	22%
9:00	126	80	206	134	142	276	94%	56%	75%
10:00	134	134	268	134	152	286	100%	88%	94%
11:00	134	137	271	134	152	286	100%	90%	95%
12:00	134	141	275	134	152	286	100%	93%	96%
13:00	134	152	286	134	152	286	100%	100%	100%
14:00	132	148	280	134	152	286	99%	97%	98%
15:00	129	133	262	134	142	276	96%	94%	95%
16:00	130	80	210	134	152	286	97%	53%	73%
17:00	55	70	125	134	152	286	41%	46%	44%
18:00	40	59	99	134	152	286	30%	39%	35%
19:00	46	64	110	134	152	286	34%	42%	38%
20:00	42	63	105	134	152	286	31%	41%	37%
21:00	39	60	99	134	152	286	29%	39%	35%

The following table summarises the use of these car parks on the Friday evening.

	Occupancy			Capacity			Utilisation		
Time	**P2**	**P3**	**Total**	**P2**	**P3**	**Total**	**P2**	**P3**	**Total**
18:00	66	100	166	138	153	291	48%	65%	57%
19:00	72	112	184	138	153	291	52%	73%	63%
20:00	74	100	174	138	153	291	54%	65%	60%
21:00	68	99	167	138	153	291	49%	65%	57%

The following chart shows the utilisation of these spaces as a percentage of supply for all day Thursday (from 9:00am to 9:00pm) and for Friday evening.

Chart 7: 9.00am to 9.00pm Thursday – Percentage Utilisation by Supply



The utilisation on Thursday evening is relatively low for both car parks – below 50% and well below the daytime peaks of around 100%. On Friday evening the use of both car parks is higher, with P2 peaking around 50% utilised and P3 peaking around 75% utilised.

3.4.4 Saturday Parking Supply

This section presents a similar analysis of car park supply as in the above section for weekdays.
The following table summarises the allocation of general car parking spaces within the town centre on weekdays.

Table 21: Parking space allocation by type and on-street/off-street, Saturday, by hour

	General			Special			Total
Time	On-street	Off-street	Total	On-street	Off-street	Total	
8:00	1,066	823	1,889	20	41	61	1,950
9:00	1,066	823	1,889	20	41	61	1,950
10:00	1,066	823	1,889	20	41	61	1,950
11:00	1,066	823	1,889	20	41	61	1,950
12:00	1,066	823	1,889	20	41	61	1,950
13:00	1,066	823	1,889	20	41	61	1,950
14:00	1,066	823	1,889	20	41	61	1,950
15:00	1,066	823	1,889	20	41	61	1,950
16:00	1,066	823	1,889	20	41	61	1,950
17:00	1,066	823	1,889	20	41	61	1,950

Table 22: Parking space allocation for general spaces, Saturday, by hour and by time regulation

Time	p15	1P	2P	3P	No Restriction	Loading Zone	Total
8:00	5	261	110	445	1,068	n.a.	1,889
9:00	5	261	110	445	1,068	n.a.	1,889
10:00	5	261	110	445	1,068	n.a.	1,889
11:00	5	261	110	445	1,068	n.a.	1,889
12:00	5	261	110	445	1,068	n.a.	1,889
13:00			10	141	1,738	n.a.	1,889
14:00			10	141	1,738	n.a.	1,889
15:00			10	141	1,738	n.a.	1,889
16:00			10	141	1,738	n.a.	1,889
17:00			10	141	1,738	n.a.	1,889

Of note from the above analysis is that most of the time restrictions applicable to spaces in the town centre cease from 12:30pm on Saturday, hence the drop in the number of timed spaces and increase in number of unrestricted spaces that occurs around the middle of the day.

Table 23: Parking space allocation for special spaces, Saturday, by hour and by time regulation

Time	Disable Parking	Motor Bikes Only	Pick up & Setdown only	Police vehicles Excepted	Service Vehicles only	Taxi Zone	No Parking - Auth. veh accepted	Total
8:00	22	4	1	2	1	5	26	61
9:00	22	4	1	2	1	5	26	61
10:00	22	4	1	2	1	5	26	61
11:00	22	4	1	2	1	5	26	61
12:00	22	4	1	2	1	5	26	61
13:00	22	4	1	2	1	5	26	61
14:00	22	4	1	2	1	5	26	61
15:00	22	4	1	2	1	5	26	61
16:00	22	4	1	2	1	5	26	61
17:00	22	4	1	2	1	5	26	61

The same notional walk distances from car parking spaces to Argyle Street are used in the Saturday analysis. The following table identifies the number of spaces by their walk distance from Argyle Street.

3.4.5 Saturday Parking Demand

As with the Thursday surveys, on Saturday beat surveys identified the number of vehicles actually parked in each set of parking spaces within the town centre. The following table provides a summary of vehicles present and the next table shows this as a percentage utilisation of spaces.

Table 25: Vehicles parked by type of space, Saturday

	General			Special			Total
Time	On-street	Off-street	Total	On-street	Off-street	Total	
8:00	300	193	493	10	2	12	505
9:00	315	233	548	9	4	13	561
10:00	337	245	582	9	7	16	598
11:00	361	270	631	9	7	16	647
12:00	387	281	668	11	9	20	688
13:00	393	289	682	7	8	15	697
14:00	385	307	692	8	7	15	707
15:00	356	287	643	7	3	10	653
16:00	339	262	601	5	5	10	611
17:00	337	250	587	4	4	8	595

Table 26: Utilisation of parking spaces by type of space, by hour, Saturday

	General			Special			Total
Time	On-street	Off-street	Total	On-street	Off-street	Total	
8:00	28%	23%	26%	50%	5%	20%	26%
9:00	30%	28%	29%	45%	10%	21%	29%
10:00	32%	30%	31%	45%	17%	26%	31%
11:00	34%	33%	33%	45%	17%	26%	33%
12:00	36%	34%	35%	55%	22%	33%	35%
13:00	37%	35%	36%	35%	20%	25%	36%
14:00	36%	37%	37%	40%	17%	25%	36%
15:00	33%	35%	34%	35%	7%	16%	33%
16:00	32%	32%	32%	25%	12%	16%	31%
17:00	32%	30%	31%	20%	10%	13%	31%

The above table indicates that utilisation of spaces overall on Saturday is low when compared with Thursday. The number of vehicles parked by restriction type is summarised in **Table 27**.

Table 27: Vehicles parked in general parking by time restriction, by hour, Saturday

Time	p15	1P	2P	3P	No Restriction	Loading Zone	Total
8:00	5	160	63	139	126		493
9:00	5	172	65	171	135		548
10:00	5	188	63	179	147		582
11:00	5	195	71	208	152		631
12:00	5	200	79	215	169		668
13:00			9	63	610		682
14:00			9	62	621		692
15:00			9	58	576		643
16:00			9	47	545		601
17:00			9	43	535		587

The utilisation of these spaces is shown in the next table.

Table 28: Utilisation of general parking spaces by time restriction by hour, Saturday

Time	p15	1P	2P	3P	No Restriction	Loading Zone	Total
8:00	100%	61%	57%	31%	12%		26%
9:00	100%	66%	59%	38%	13%		29%
10:00	100%	72%	57%	40%	14%		31%
11:00	100%	75%	65%	47%	14%		33%
12:00	100%	77%	72%	48%	16%		35%
13:00			90%	45%	35%		36%
14:00			90%	44%	36%		37%
15:00			90%	41%	33%		34%
16:00			90%	33%	31%		32%
17:00			90%	30%	31%		31%

The relatively high utilisation of 2P spaces from 1:00pm through to the end of the survey period is partly due to the small number of these spaces (10 in the town centre after 12:30pm on a Saturday). Note that loading zone restrictions do not apply on Saturday.

The use of special parking spaces is shown in the next table.

Table 29: Vehicles parked in special parking spaces by restriction by hour, Saturday

Time	Disable Parking	Motor Bikes Only	Pick up & Setdown only	Police vehicles Excepted	Service Vehicles only	Taxi Zone	No Parking - authorised veh accepted	Total
8:00	5	4	0	1	0	0	2	12
9:00	7	4	0	0	0	0	2	13
10:00	8	4	0	0	0	0	4	16
11:00	7	4	0	0	0	0	5	16
12:00	11	4	0	0	0	1	4	20
13:00	7	1	0	0	0	1	6	15
14:00	9	0	0	1	0	1	4	15
15:00	6	0	0	0	0	1	3	10
16:00	5	0	0	0	0	1	4	10
17:00	3	0	0	0	0	1	4	8

This shows lower overall use when compared with Thursday's survey, apart from motorcycle parking spaces.

Table 30: Utilisation of special parking spaces by restriction by hour, Saturday

Time	Disable Parking	Motor Bikes Only	Pick up & Setdown only	Police vehicles Excepted	Service Vehicles only	Taxi Zone	No Parking - authorised veh accepted	Total
8:00	23%	100%	0%	50%	0%	0%	8%	20%
9:00	32%	100%	0%	0%	0%	0%	8%	21%
10:00	36%	100%	0%	0%	0%	0%	15%	26%
11:00	32%	100%	0%	0%	0%	0%	19%	26%
12:00	50%	100%	0%	0%	0%	20%	15%	33%
13:00	32%	25%	0%	0%	0%	20%	23%	25%
14:00	41%	0%	0%	50%	0%	20%	15%	25%
15:00	27%	0%	0%	0%	0%	20%	12%	16%
16:00	23%	0%	0%	0%	0%	20%	15%	16%
17:00	14%	0%	0%	0%	0%	20%	15%	13%

Use of general car parking spaces by walk distance from Argyle Street is shown in the following table.

Table 31: Cars parked in general parking spaces by time restriction, by walk distance to Argyle Street, by hour – Saturday

Restriction	p15	1P			2P		3P	No Restriction				
Walk distance band (m)	0 to 100	0 to 100	101 to 200	201 to 300	0 to 100	101 to 200	101 to 200	0 to 100	101 to 200	201 to 300	301 to 400	401 plus
Time												
8:00	5	112	48	0	45	18	139	7	48	21	45	5
9:00	5	122	50	0	49	16	171	9	52	26	41	7
10:00	5	129	59	0	44	19	179	9	56	27	49	6
11:00	5	132	62	1	46	25	208	9	69	22	47	5
12:00	5	137	58	5	52	27	215	11	67	42	40	9
13:00					9		63	196	320	47	38	9
14:00					9		62	190	329	55	38	9
15:00					9		58	176	297	50	43	10
16:00					9		47	170	287	44	37	7
17:00					9		43	174	283	38	33	7

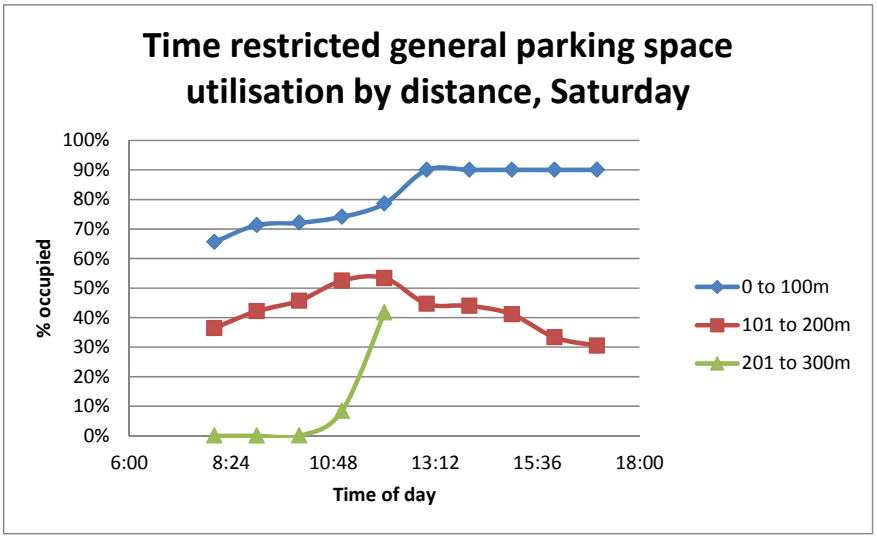
The switching off of most time restrictions in the middle of the day on Saturday is the reason for the sudden drop in time-restricted spaces and increase in unrestricted spaces. The percentage utilisation of the spaces is shown in **Table 32**.

Table 32: Utilisation of general parking spaces by time restriction, by walk distance to Argyle Street, by hour - Saturday

Restriction	p15	1P			2P		3P	No Restriction				
Walk distance band (m)	0 to 100	0 to 100	101 to 200	201 to 300	0 to 100	101 to 200	101 to 200	0 to 100	101 to 200	201 to 300	301 to 400	401 plus
Time												
8:00	100%	67%	59%	0%	61%	50%	31%	39%	23%	12%	9%	3%
9:00	100%	73%	62%	0%	66%	44%	38%	50%	25%	15%	8%	4%
10:00	100%	77%	73%	0%	59%	53%	40%	50%	27%	16%	10%	3%
11:00	100%	79%	77%	8%	62%	69%	47%	50%	34%	13%	10%	3%
12:00	100%	82%	72%	42%	70%	75%	48%	61%	33%	25%	8%	5%
13:00					90%		45%	77%	51%	26%	8%	5%
14:00					90%		44%	75%	53%	30%	8%	5%
15:00					90%		41%	69%	47%	27%	9%	5%
16:00					90%		33%	67%	46%	24%	8%	4%
17:00					90%		30%	68%	45%	21%	7%	4%

The above analysis suggests that there were no capacity issues on the Saturday of survey. The following chart shows utilisation of time restricted spaces in the town centre by distance from Argyle Street.

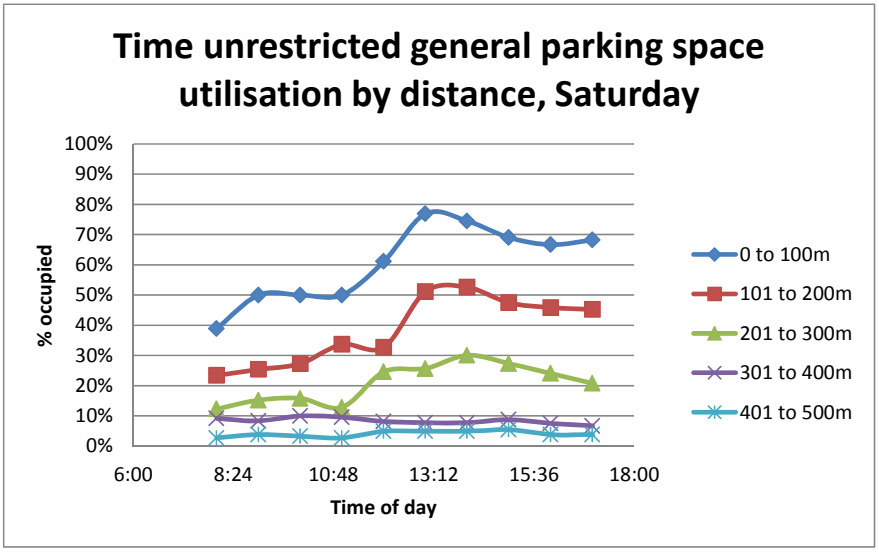
Chart 8: Utilisation by Distance – Saturday 9.00am to 9.00pm Thursday – Percentage Utilisation by Supply – Restricted Spaces



As previously noted, the high utilisation of spaces between 0 and 100m from Argyle Street after midday on Saturday is due to the small supply of these spaces after 12:30pm, when most become unrestricted.

The chart below shows the utilisation of time unrestricted spaces.

Chart 9: Utilisation by Distance – Saturday 9.00am to 9.00pm – Percentage Utilisation by Supply – Un-Restricted Spaces



3.4.6 Saturday Evening Parking Demand

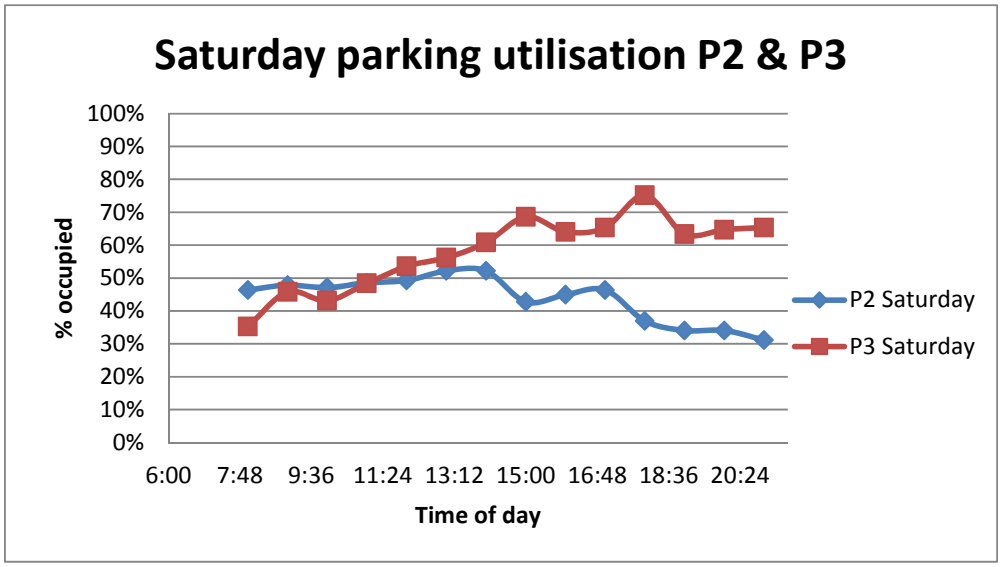
Car parks P2 and P3 were surveyed all day Saturday from 9:00am to 9:00pm. The following table presents the results of the survey.

Table 33: Utilisation of car parks P2 and P3, by hour, Saturday (9.00am to 9.00pm)

	Occupancy			Capacity			Utilisation		
Time	P2	P3	Total	P2	P3	Total	P2	P3	Total
8:00	64	54	118	138	153	291	46%	35%	41%
9:00	66	70	136	138	153	291	48%	46%	47%
10:00	65	66	131	138	153	291	47%	43%	45%
11:00	67	74	141	138	153	291	49%	48%	48%
12:00	68	82	150	138	153	291	49%	54%	52%
13:00	72	86	158	138	153	291	52%	56%	54%
14:00	72	93	165	138	153	291	52%	61%	57%
15:00	59	105	164	138	153	291	43%	69%	56%
16:00	62	98	160	138	153	291	45%	64%	55%
17:00	64	100	164	138	153	291	46%	65%	56%
18:00	51	115	166	138	153	291	37%	75%	57%
19:00	47	97	144	138	153	291	34%	63%	49%
20:00	47	99	146	138	153	291	34%	65%	50%
21:00	43	100	143	138	153	291	31%	65%	49%

The following chart shows the utilisation series for both car parks.

Chart 10: P2 & P3 Public Car Parks – Utilisation – Saturday 9.00am to 9.00pm



3.5 Origin/ Destination Assessment

In accordance with the brief, an origin / destination count strategy was developed to gauge routes of choice through the town centre from all available road access points. The locations of the origin / destination data collectors are shown below.

Figure 17: Origin/Destination Count Locations

The number of vehicles recorded from each O/D station to each remaining O/D station is presented below.

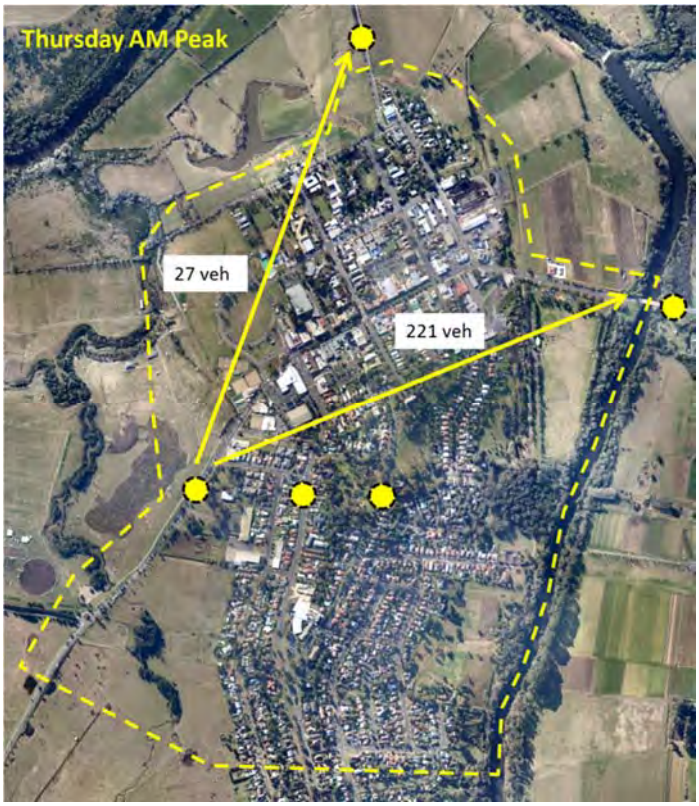


Figure 18: Cawdor Road Station Origin to Macquarie Grove Road & Camden Valley Way

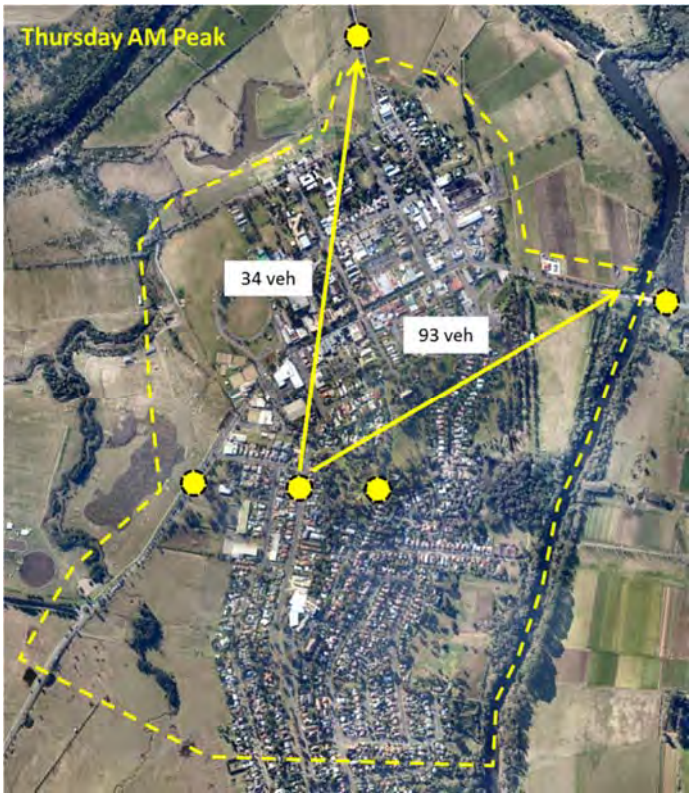


Figure 19: Old Hume Highway Station Origin to Macquarie Grove Road & Camden Valley Way

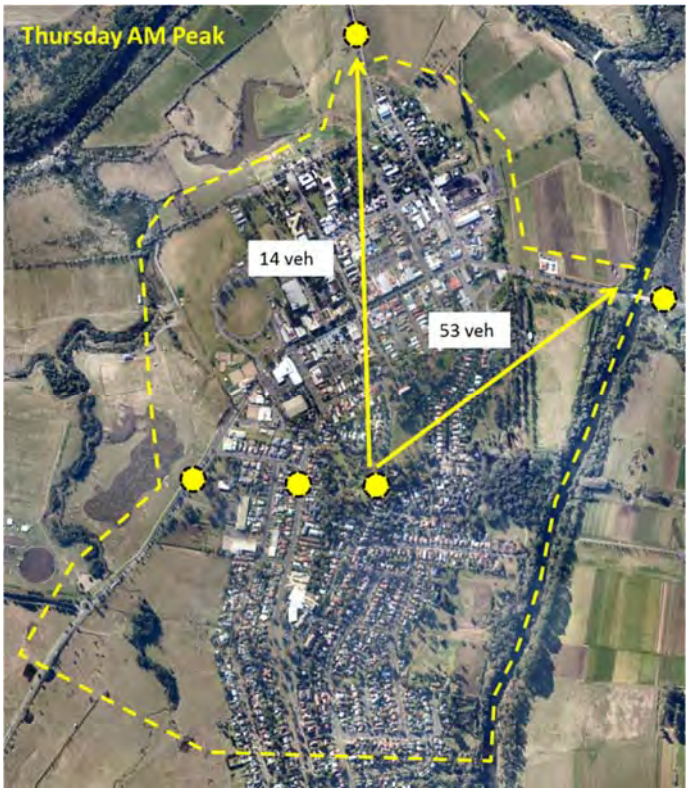


Figure 20: Menangle Road Station Origin to Macquarie Grove Road & Camden Valley Way

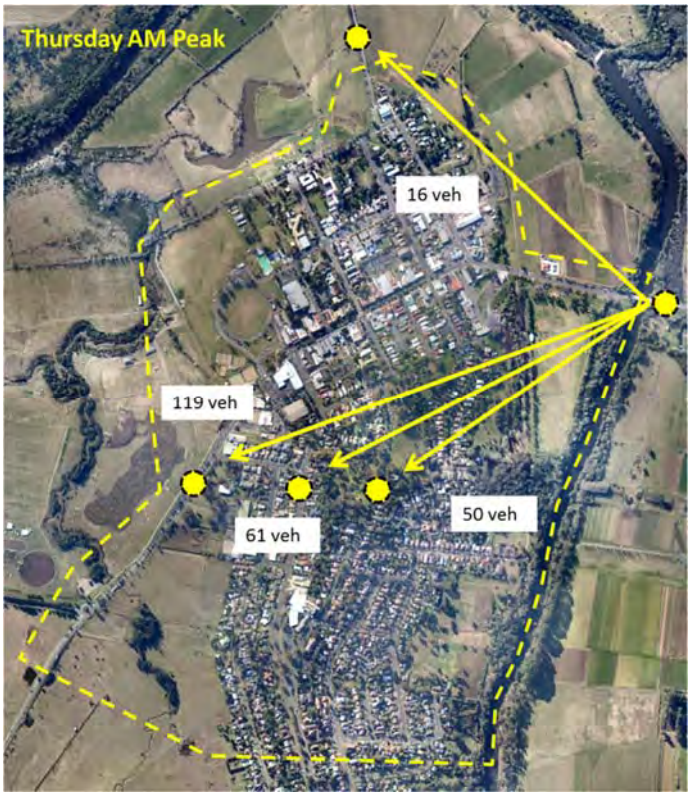


Figure 21: Camden Valley Way Origin to All Stations

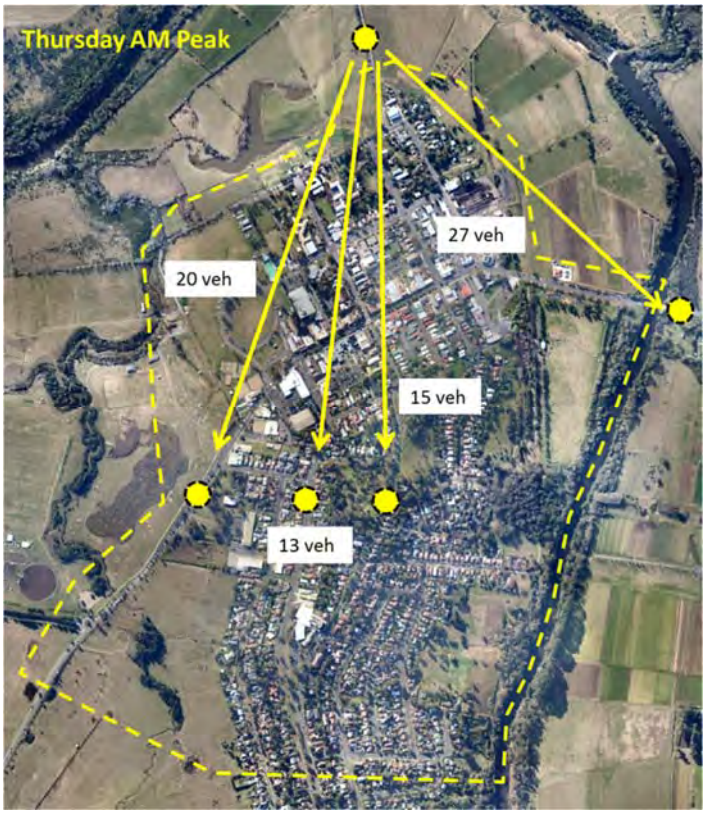


Figure 22: Macquarie Grove Road Origin to All Stations

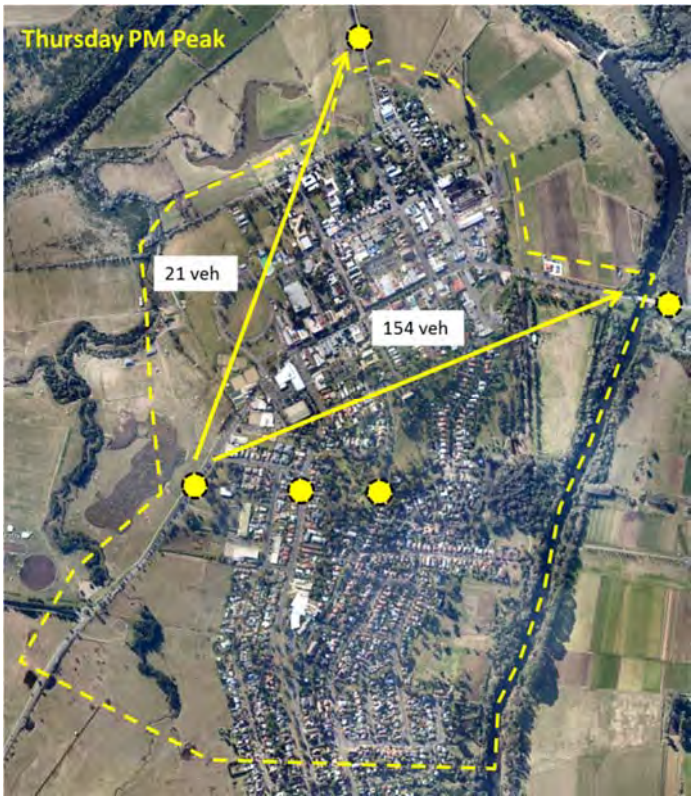


Figure 23: Cawdor Road Station Origin to Macquarie Grove Road & Camden Valley Way

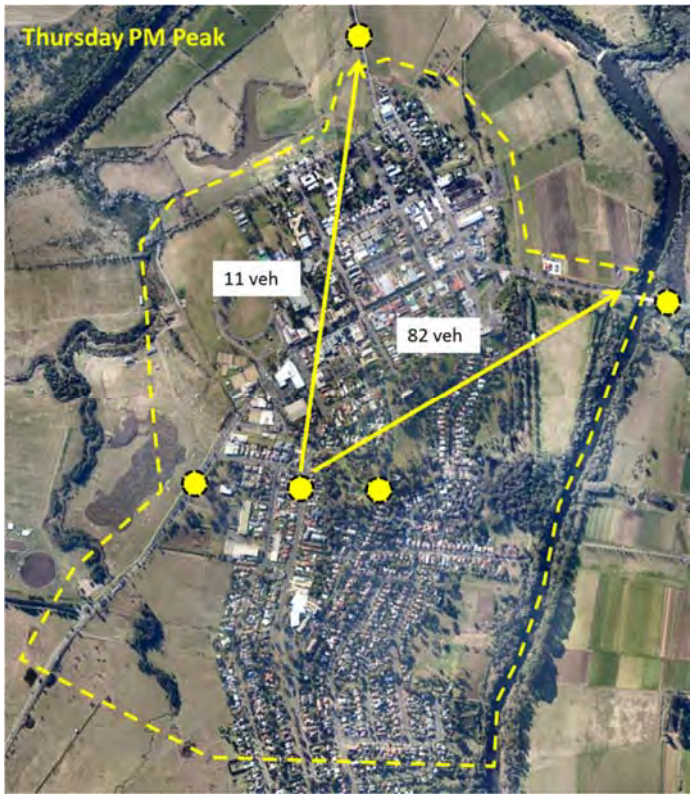


Figure 24: Menangle Road Station Origin to Macquarie Grove Road & Camden Valley Way

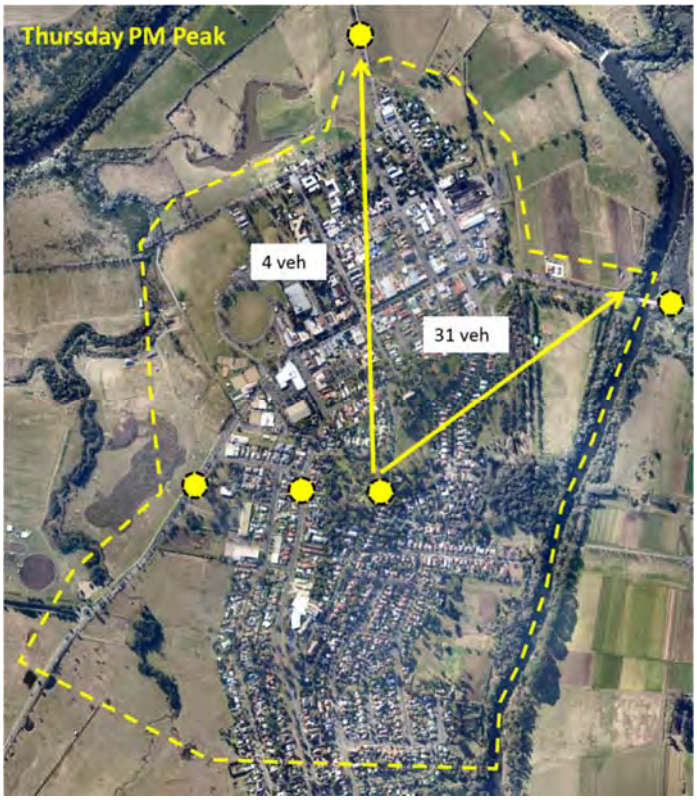


Figure 25: Menangle Road Station Origin to Macquarie Grove Road & Camden Valley Way

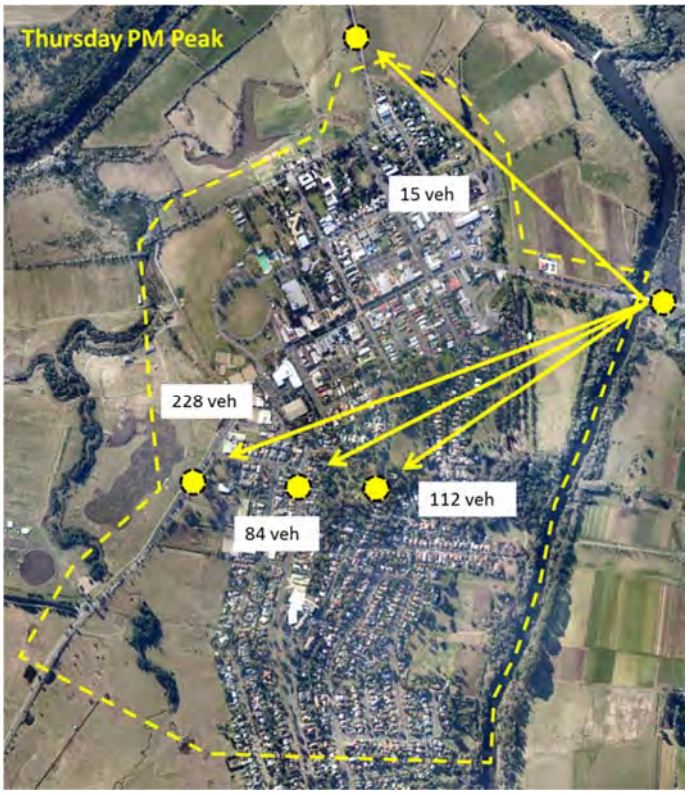


Figure 26: Camden Valley Way Origin to All Stations

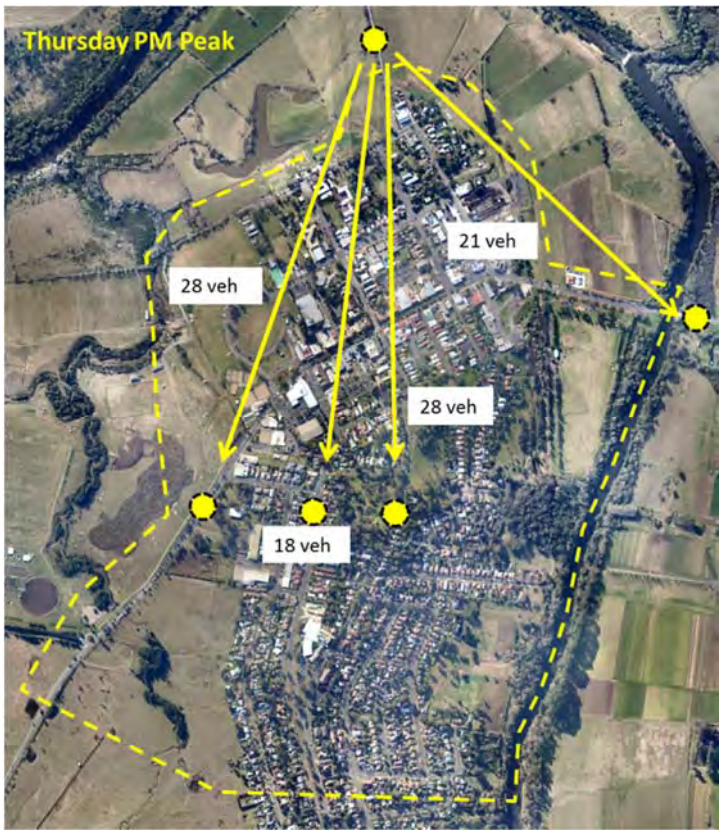


Figure 27: Macquarie Grove Road Origin to All Stations

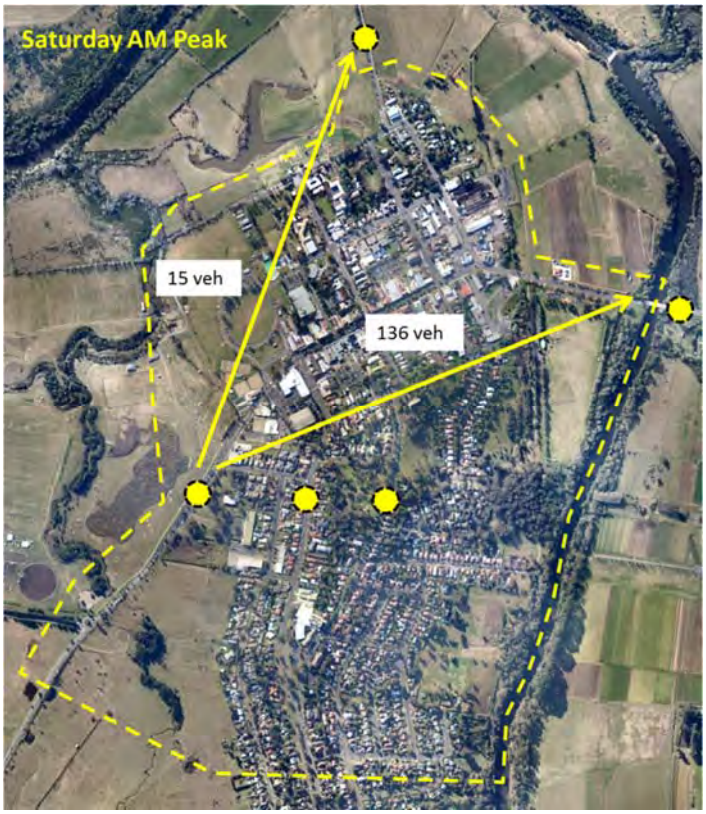


Figure 28: Cawdor Road Station Origin to Macquarie Grove Road & Camden Valley Way

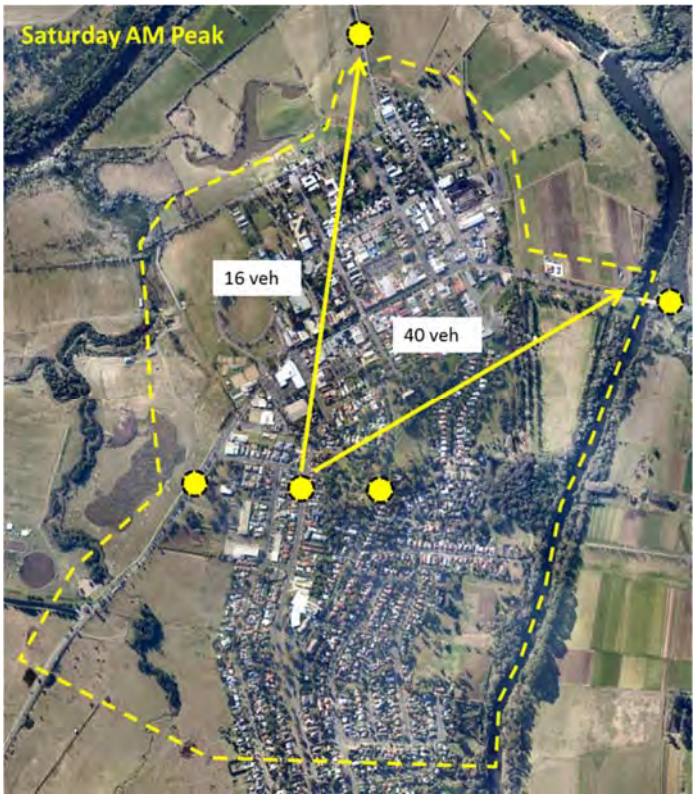


Figure 29: Old Hume Highway Station Origin to Macquarie Grove Road & Camden Valley Way

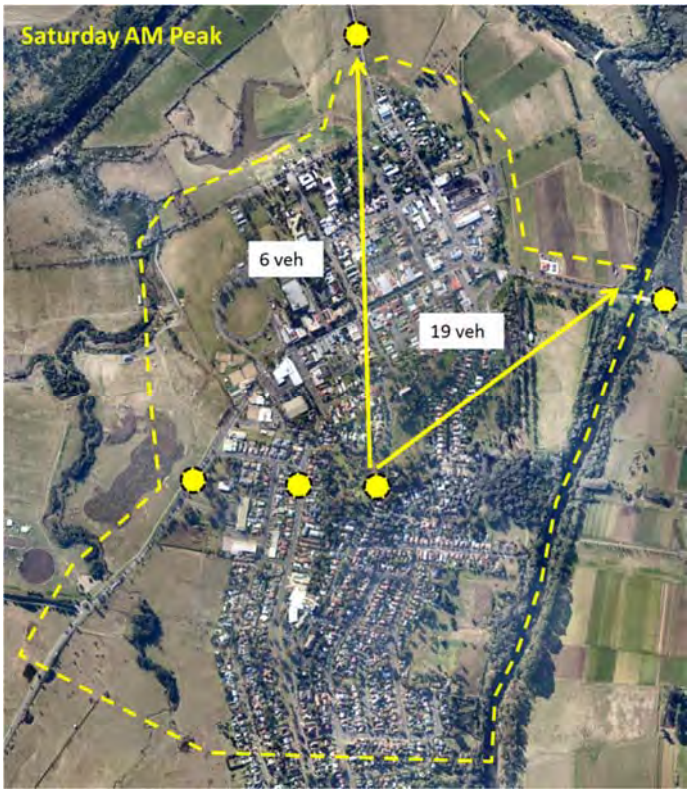


Figure 30: Menangle Road Station Origin to Macquarie Grove Road & Camden Valley Way

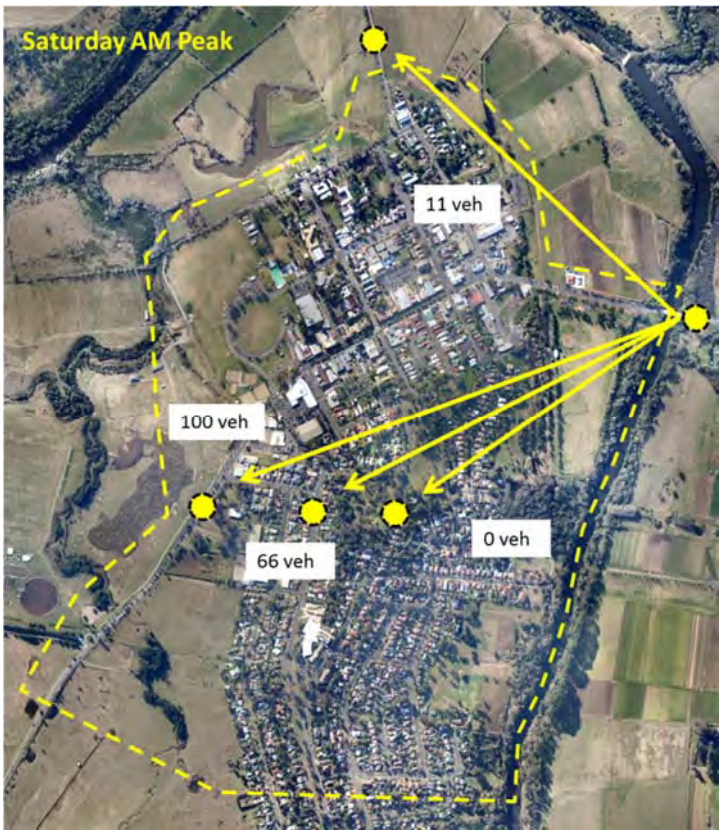


Figure 31: Camden Valley Way Origin to All Stations

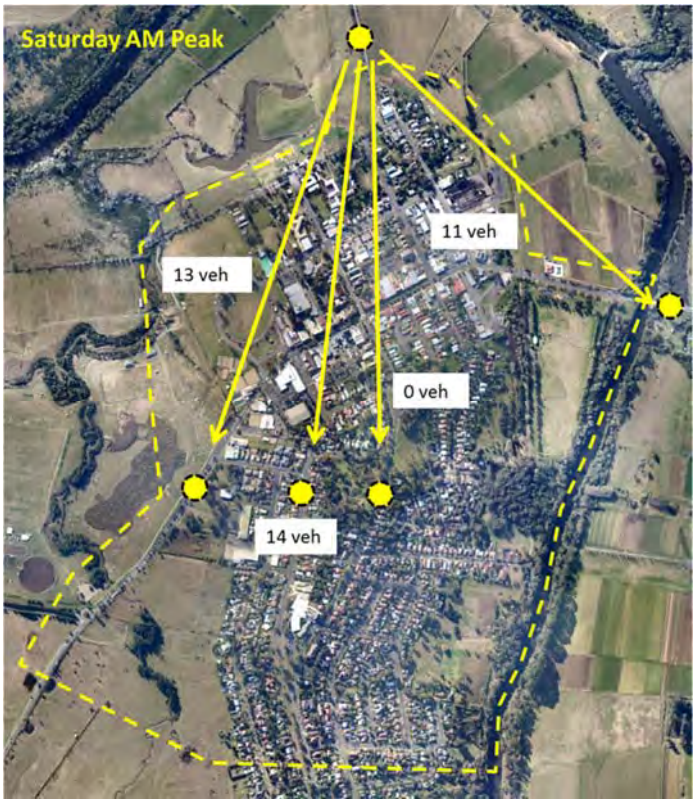


Figure 32: Macquarie Grove Road Origin to All Stations

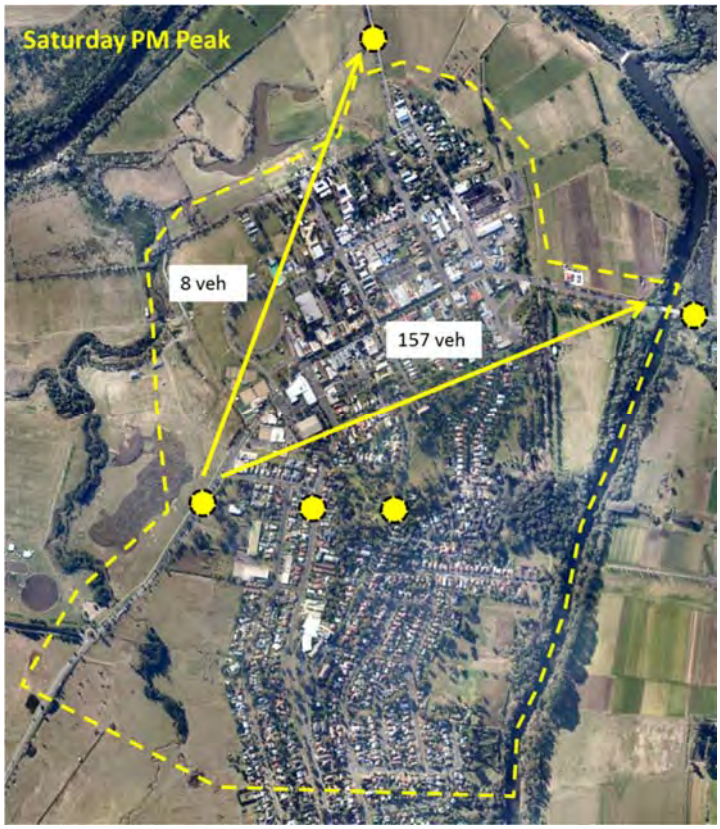


Figure 33: Cawdor Road Station Origin to Macquarie Grove Road & Camden Valley Way

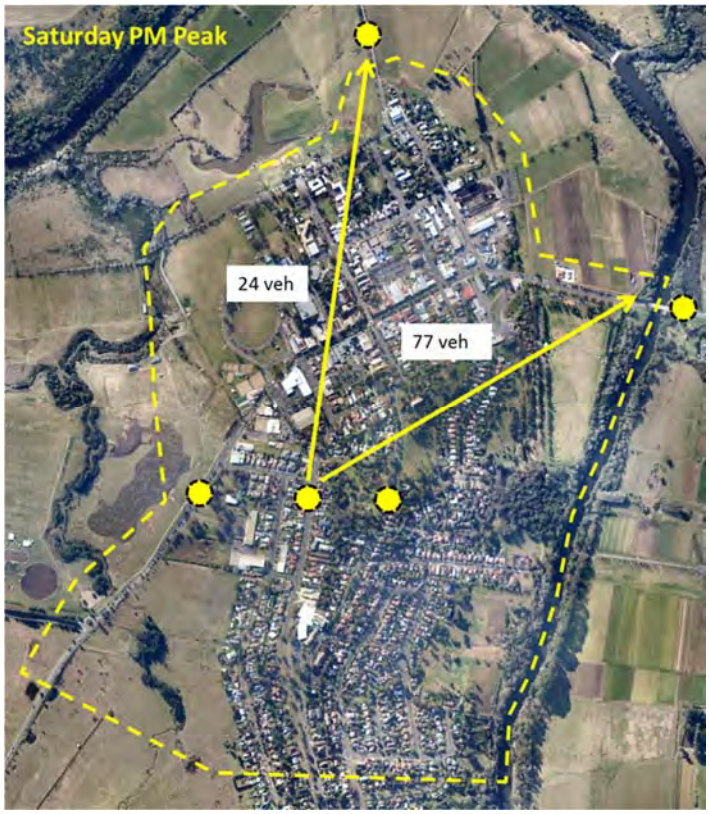


Figure 34: Old Hume Highway Station Origin to Macquarie Grove Road & Camden Valley Way

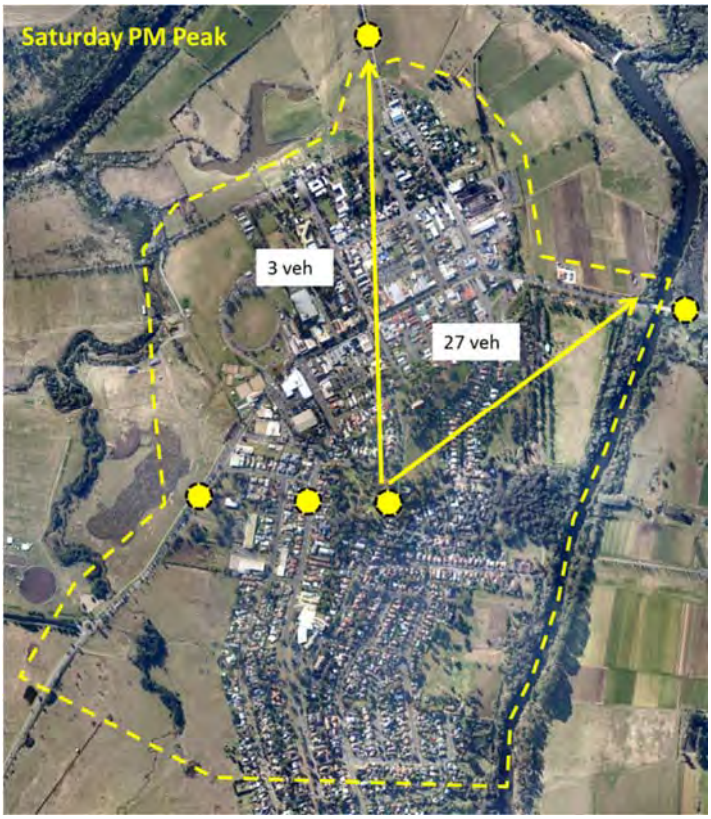


Figure 35: Menangle Road Station Origin to Macquarie Grove Road & Camden Valley Way

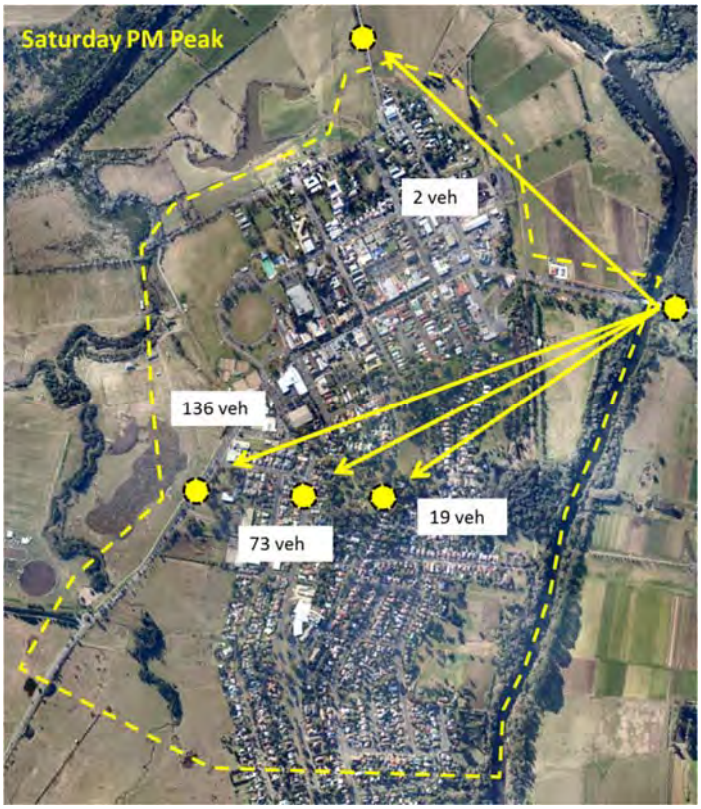


Figure 36: Camden Valley Way Origin to All Stations

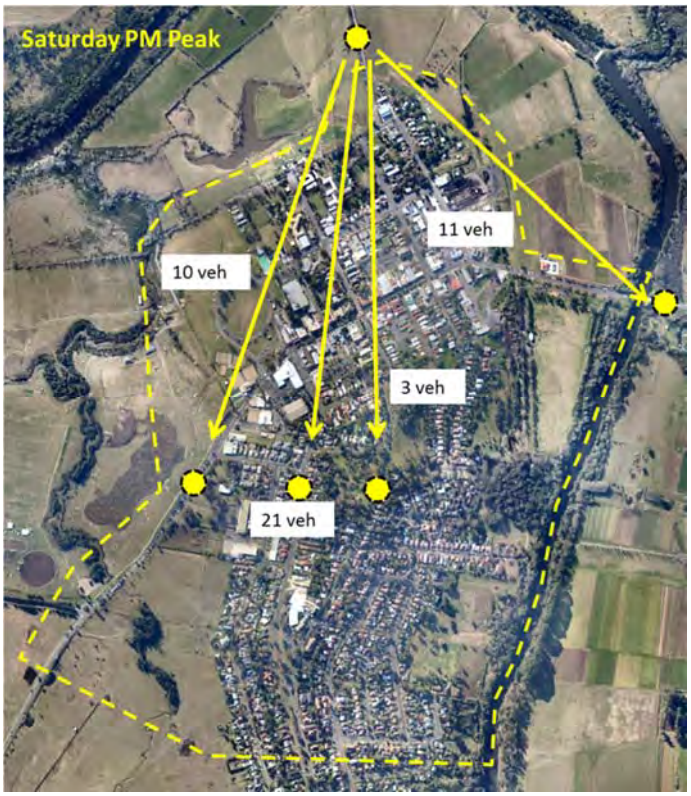


Figure 37: Macquarie Grove Road Origin to All Stations

Whilst the proportions of through traffic vary by time of day and day of week, it is clear that a large portion of traffic observed at the survey cordon is destined for Camden town centre. No station had more than 50% of its traffic travelling through the town centre during any of the four survey periods. This reinforces the role that Camden has of a local service centre, offering retail, education and employment for the district.

3.6 Pedestrian Counts

In addition to the minimum requirements of the brief, pedestrian counts at the two existing pedestrian crossings in Argyle Street were undertaken between the hours of 2:30pm -6:30pm on Thursday 11 April 2013.

The locations of the existing crossings are shown below.

Figure 38: Pedestrian Count Locations

The hourly flows at each location are presented below:

Table 34: Thursday PM Pedestrian Flows by Type

Approach	Pedestrian Crossing located on Argyle St											
Direction	(Site1) between John St and Oxley St						(Site2) between John St and Hill St					
Time Period	Children	Adults	Prams	Wheelchairs	Cyclists	Total	Children	Adults	Prams	Wheelchairs	Cyclists	Total
14:30 to 15:30	27	252	8	0	1	**288**	29	87	5	0	1	**122**
14:45 to 15:45	49	275	13	0	1	**338**	35	96	3	0	1	**135**
15:00 to 16:00	60	289	16	0	1	**366**	38	102	3	0	1	**144**
15:15 to 16:15	74	289	13	0	1	**377**	41	106	4	0	0	**151**
15:30 to 16:30	69	269	12	0	0	**350**	34	116	3	0	0	**153**
15:45 to 16:45	54	243	7	0	0	**304**	32	102	3	0	0	**137**
16:00 to 17:00	48	200	4	0	0	**252**	30	88	2	0	0	**120**
16:15 to 17:15	37	180	3	1	0	**221**	17	76	1	0	0	**94**
16:30 to 17:30	26	166	2	1	0	**195**	21	54	0	0	0	**75**
16:45 to 17:45	21	148	0	2	0	**171**	17	51	0	0	1	**69**
17:00 to 18:00	20	134	0	2	0	**156**	13	43	0	0	1	**57**
17:15 to 18:15	14	103	0	1	0	**118**	9	37	0	0	1	**47**
17:30 to 18:30	11	74	0	1	0	**86**	3	36	0	0	1	**40**
Totals	**133**	**761**	**22**	**2**	**1**	**919**	**87**	**293**	**8**	**0**	**2**	**390**

From **Table 34** it can be seen that there is a constant stream of pedestrians using each crossing hourly. It should be noted that the above counts did not capture those pedestrians who cross Argyle Street using the gaps in the existing median like faux pedestrian refuges.

3.6.1 Pedestrian Facility Warrant Assessment

Having regard to the pedestrian flows shown in **Table 34** and the traffic flows in Argyle Street presented in Section 3.2, the following presents the warrants for signalisations of pedestrian crossings:

A signalised mid-block pedestrian crossing requires the following warrants to be met:

Warrant 1

a) For each of four one-hour periods of an average day:
   i. The pedestrian flow crossing the road exceeds 250 persons per hour; and
   ii. The vehicular flow exceeds 600 vehicles per hour in both directions or, where there is a central pedestrian refuge, 1000 vehicles per hour in both directions.

OR

Warrant 2

b) For each of eight one-hour periods of an average day:
   i. The pedestrian flow exceeds 175 persons per hour; and
   ii. The vehicular flow exceeds 600 vehicles per hour in both directions or, where this is a central pedestrian refuge, 1000 vehicles per hour in both directions; and
   iii. There is no other pedestrian crossing within a reasonable distance

A signalised mid-block pedestrian crossing may also be considered in certain special situations if one of the following warrants is met:

a) The flow warrant for a marked foot crossing is realised but its provision could cause a hazard to pedestrians because of the width of the carriageway, insufficient sight distance to the crossing or the speed or number of vehicles.

OR

b) There is a large seasonal variation in the traffic flow (such as at a holiday resort) and it can be shown to meet the general criterion during the busy season, even if during the rest of the year the general criterion is not met.

OR

c) The location has been the site of two or more pedestrian casualties over a three year period that could have been prevented by traffic signals.

The recorded volumes of vehicles and pedestrians per hour for a Thursday afternoon are presented below.

Table 35: Argyle Street marked foot crossing between Oxley Street and John Street – Pedestrian Signal Warrant Assessment

Hour	EB	WB	Total	Total Pedestrians	Warrant No.1 Met?	Warrant No.2 Met?
6:30	464	286	750			
7:30	753	458	1,211			
8:30	816	624	1,440			
14:30	800	754	1,554	288	Yes*	Yes
15:30	795	906	1,701	350	Yes	Yes
16:30	794	988	1,782	195	No	Yes**
17:30	690	862	1,552	86	No	Yes**

**Assuming median is not considered a central pedestrian refuge where pedestrians can wait*
*** No other pedestrian crossing facility within reasonable walking distance*

Table 36: Argyle Street marked foot crossing between Hill Street and John Street – Pedestrian Signal Warrant Assessment

Hour	EB	WB	Total	Total Pedestrians	Warrant No.1 Met?	Warrant No.2 Met?
6:30	265	413	678			
7:30	503	645	1,148			
8:30	738	716	1,454			
14:30	741	691	1,432	122	No*	No*
15:30	819	706	1,525	153	No*	No*
16:30	920	739	1,659	75	No*	No*
17:30	769	651	1,420	40	No*	No*

From **Table 35** it is noted that warrants for signalisation of the existing pedestrian crossing in Argyle Street between Oxley Street and John Street are being meet with current pedestrian and vehicle volumes.

However, pedestrian flows on the existing pedestrian crossing between John Street and Hill Street are below that which is required whilst traffic volumes exceed the minimum requirements of either warrant.

Further analysis of the two existing pedestrian crossings is discussed in Section 8 of this report.

3.7 Public Transport Operations

Camden is served by Busways as part of Metropolitan bus service contract region 15. The bus network provides connections to Camden Town Centre, as well as to local travel generators and onto surrounding centres such as Narellan and Campbelltown/Macarthur.

The closest access to the CityRail network is at Campbelltown and Macarthur. Trains from here run into the City via East Hills and Airport Line, as well as via Liverpool and Bankstown. There are also services to Schofields via the Cumberland Line, providing direct connections to Parramatta.

Trains on the Southern Highlands Line also serve Campbelltown and Macarthur. Most of these services terminate/commence at Campbelltown, although there are a limited number of services through to Central. The forthcoming modified timetable is expected to make some changes to these arrangements, although it is not clear what will change at this stage.

3.7.1 Bus Networks

Camden Country Networks

The following routes form the country bus service network that hubs off Camden town centre:

- Rt 31 – Camden – Coates Park Rd, Cobbitty
- Rt 32 – Camden – Cobbitty, Theresa Park, Orangeville, Werombi and Warragamba
- Rt 38 – Camden – Spring Creek
- Rt 39 – Camden – Rockbarton and Mowbray Park
- Rt 40 – Camden – The Oaks, Oakdale, and Belimbla Park
- Rt 47 – Camden – Menangle via Remembrance Drive
- Rt 49 – Camden – Razorback via Cawdor

These offer connections between smaller rural villages spread out around Camden town centre and the town centre. They are characterised by limited service levels, generally with several trips a day, although some offer almost an hourly service (e.g., rt 32), that run out and then back. Some of these are tied to school services, with trips only running on public school days (e.g., rts 38 and 39). Several of the routes offer Saturday trips, but most are weekday only.

The alignment of some of the services is fairly circuitous; as well some have route diversions. These characteristics indicate that the level of patronage is low and that bus resources are being optimised to afford the opportunity for bus-based mobility, whilst keeping operating costs low. Given the population in some of the route catchments is low, the patronage potential would be very low. Nonetheless, these services provide an essential level of mobility for residents of the outlying areas.

Contact Region 15 Metropolitan Bus Network

Camden falls within metropolitan bus service contract region 15, run by Busways, as shown in the figure below.

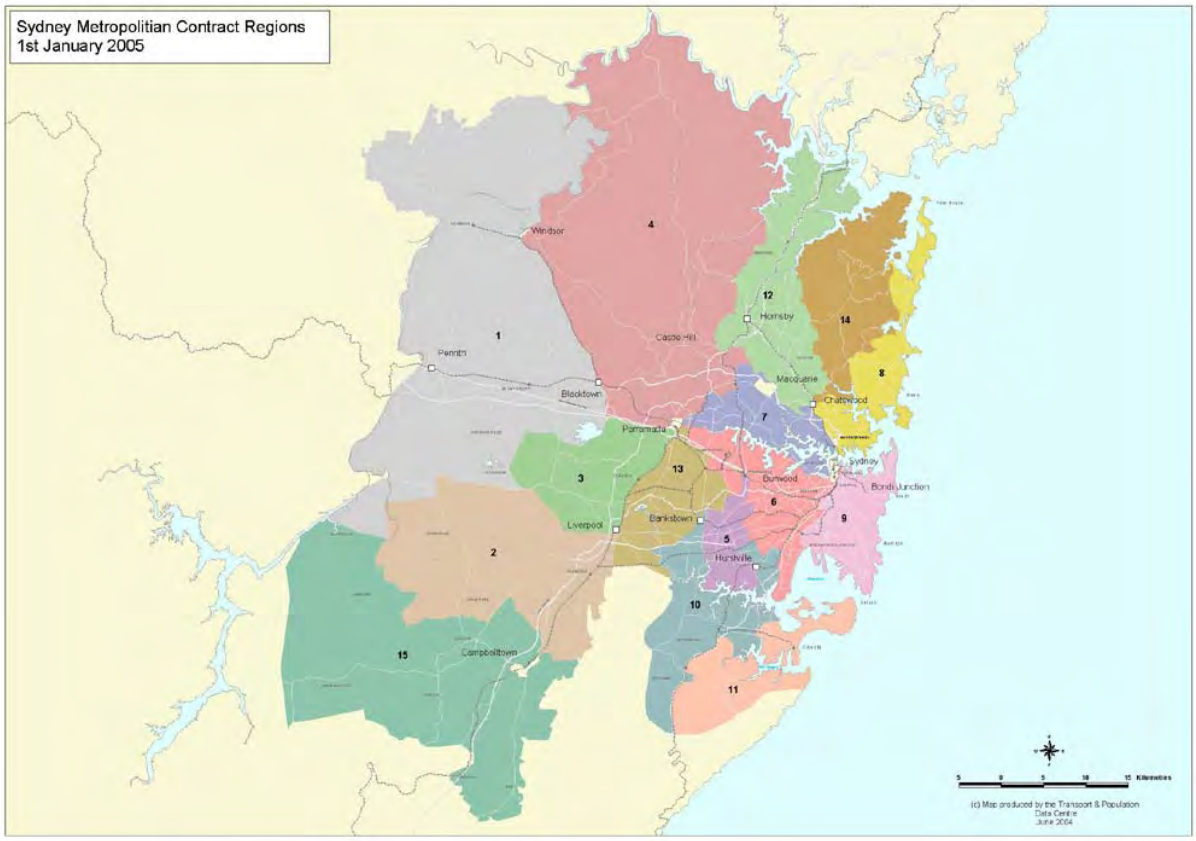


Figure 39: Metropolitan bus service contract regions

The following metropolitan routes connect Camden:

- Rt 890 – Campbelltown – Harrington Park or Camden
- Rt 893 – Camden – Spring Farm and Narellan
- Rt 894 – Campbelltown – Bridgewater Estate via Narellan
- Rt 894X – Campbelltown – Bridgewater Estate via Camden Bypass
- Rt 895 – Campbelltown – Camden and Camden South
- Rt 899 – Camden – Catherine Field
- Rt 900 – Picton - Narellan[2]

The following figure shows routing within the town centre for metropolitan bus services that commence and terminate within the town centre. The terminus is on John Street, north of Argyle Street.

[2] Some trips terminate at Camden; this service is operated by Picton Buslines

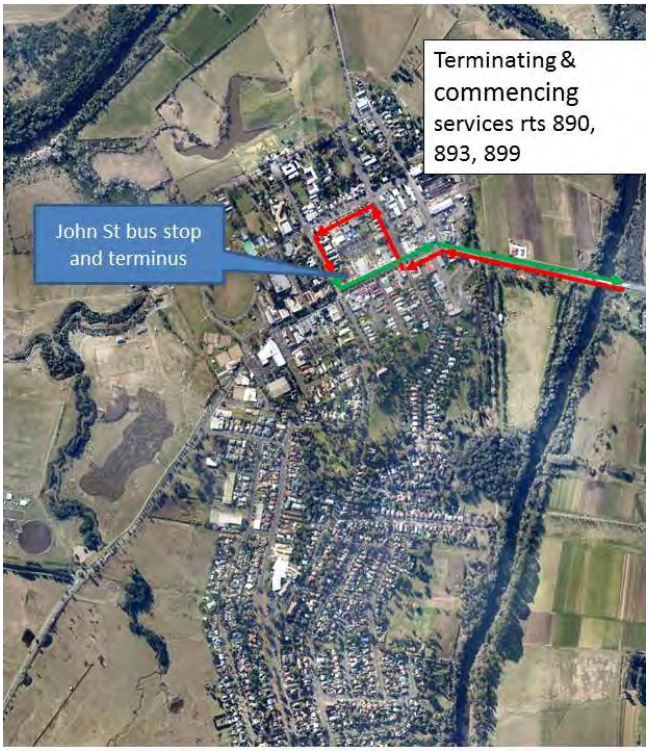


Figure 40: Metropolitan bus routes terminating & commencing in the town centre

Figure 41 shows circulation pattern of metropolitan bus services that through route the town centre.

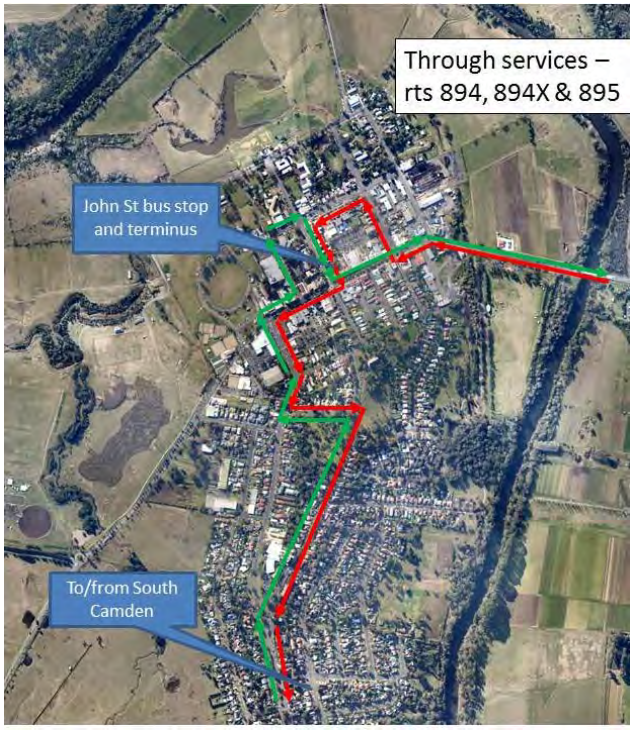


Figure 41: Metropolitan bus routes running through the town centre

This indicates the importance of the bus stop on John Street north of Argyle Street, as well as quite clearly showing the additional coverage of Camden afforded by these through routes.

Approximate service frequencies are:

- Rt 890 – ten trips each way per weekday
- Rt 893 – three trips each way per weekday
- Rt 894 – ten trips to Campbelltown Station per weekday and twelve going to South Camden
- Rt 894X –two trips each way per weekday
- Rt 895 – 102 trips per weekday
- Rt 899 – offers two trips each way per weekday
- Rt 900 - offers four services each way per weekday

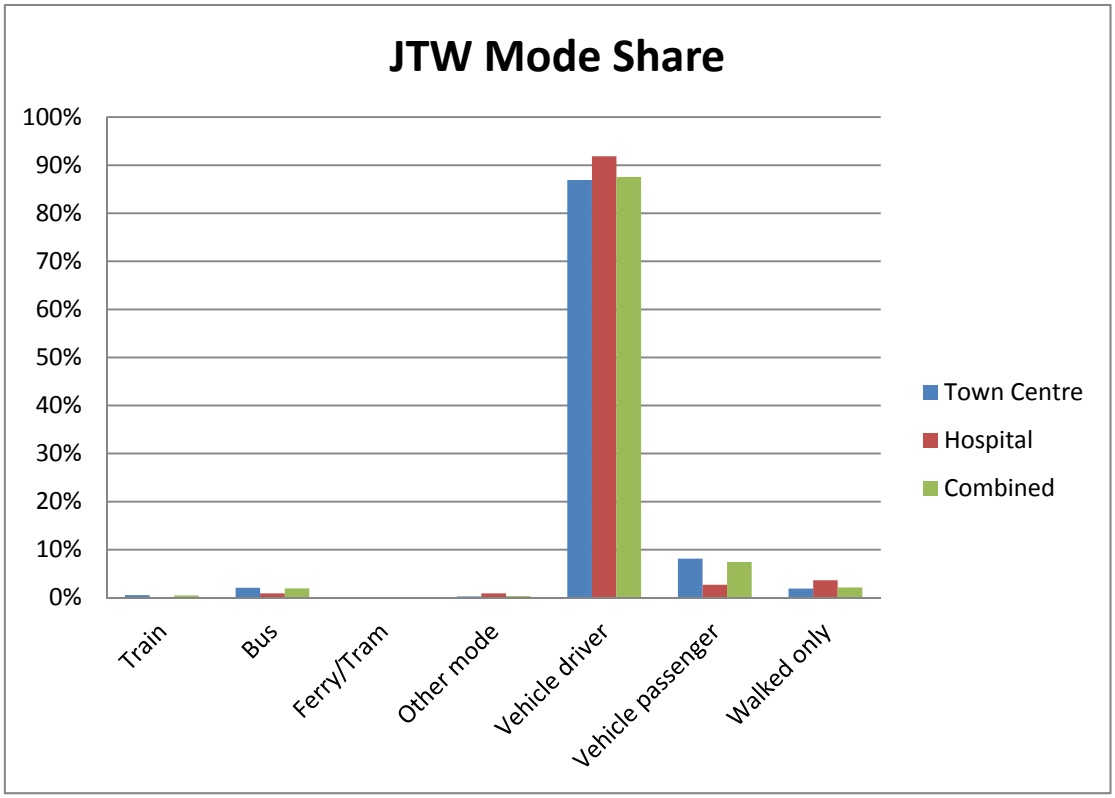
School Services

In addition to the regular passenger services, a network of school bus services supports Camden town centre, calling at bus stops outside the public school in Mitchell Street near Oxley Street and in John Street near St Paul's Primary School.

3.8 Journey to Work Patterns

The census provides information about how workers travel to work. The most common method of characterising this is to identify an area's mode share (the proportion of commute travel by different travel modes). The following chart indicates mode share of those who work in Camden town centre as well as the zone immediately to the south around Camden hospital.

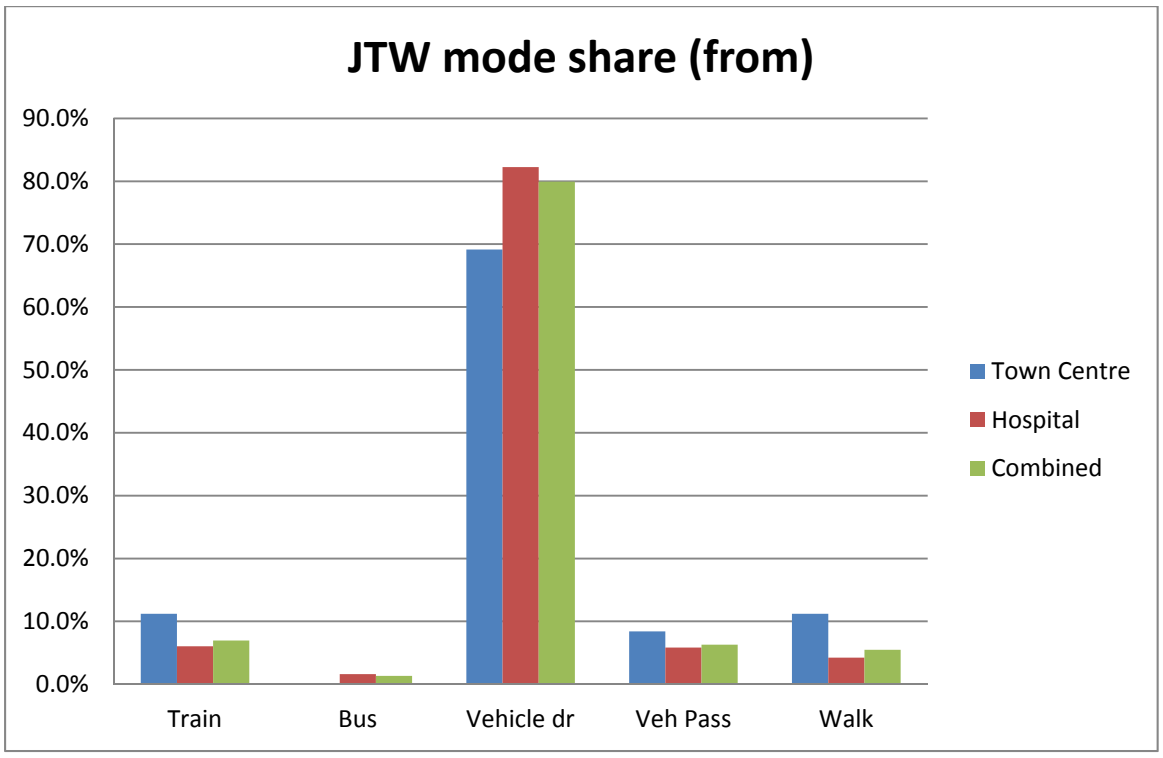
Figure 42: Existing JTW by Mode



The above indicates that overwhelmingly commuters use vehicles to get to work in the town centre and the area around Camden Hospital.

For those who live in Camden town centre and the zone around the hospital, the mode shares are shown below.

Figure 43: JTW Mode Share (from)



These shares indicate greater use of train and walk, especially for residents of the town centre. The method of coding the census data used in the above analysis uses a priority mode system to reflect the modes that the census form provides the respondent to complete (some 235 mode combinations). At the top of the hierarchy of priority modes is rail, which means that a commuter is counted as a rail user, even if they took a car or bus or possibly and car and bus to the train station.

For commuter travel to work out of Camden town centre and the hospital zone almost all train users drive to the station. For commuters who work in the town centre, the coding of modes to the hierarchy does not overly skew the picture of modal usage, as car is so dominant. Nonetheless, of the few train users, most nominated car and or bus in conjunction with train; unfortunately it is not known from the census whether they took the bus to the local station and then got a lift to Camden, perhaps with a colleague.

3.9 Accident Assessment

As part of the provision of background information, Camden Council provided the most recent accident statistics for the study area since 2005 up to June 2012 (7.5 years). For this period, a total of 272 accidents had occurred.

The RMS Crashlink Data manual provides three classifications of Degree of Severity of Accidents. Namely "Fatal, Injury and Non-Casualty (tow away). A summary of the number of accidents by type is shown below.

Table 37: No. accidents by severity classification

		Grand Total
Total Accidents		150
Total Degree 1		2
Total Degree 2		57
Total Degree 3		92

A summary of the number of accidents by degree by street within the study area is shown below.

Table 38: No. accidents by severity by location

	Total Degree 1	Total Degree 2	Total Degree 3	Total Accidents	Accident Per Year	No Ped Accidents
Alpha	0	0	2	2	0.27	0
Argyle	1	22	18	41	5.47	10
Barsden	0	0	1	1	0.13	0
Broughton	0	5	9	14	1.87	1
Cawdor	1	3	10	14	1.87	0
Edward	0	0	1	1	0.13	0
Elizabeth	0	6	7	13	1.73	9
Exeter	0	0	0	0	0.00	0
Hill	0	1	0	0	0.00	1
John	0	1	5	6	0.80	3
Little	0	1	1	2	0.27	1
Macarthur	0	7	22	29	3.87	1
Menangle	0	4	9	13	1.73	1
Murray	0	3	7	10	1.33	1
Oxley	0	1	0	1	0.13	1
Park	0	0	0	0	0.00	0
Pindari	0	2	1	3	0.40	1
View	0	0	0	0	0.00	0
Total	**2**	**56**	**93**	**150**		**30**

From **Table 38** it is noted that a total of 150 accidents were recorded and of these 30 accidents involved pedestrians. Of the two accidents which included fatalities, the two recorded occurred at the following locations:

- 2011 – Argyle Street - Pedestrian fatality at pedestrian crossing in Argyle Street between John Street and Hill Street
- 2009 – Cawdor Road 60m south of Sheathers Lane – Single vehicle off carriageway crash on right bend in to object

In the town centre core, Argyle Street included a total of 41 accidents. Of these, a total of 10 accidents occurred which involved pedestrians. Of these 10 accidents, 8 accidents occurred on the existing pedestrians crossings. Four accidents occurred on the existing pedestrian crossing in Argyle Street between John Street and Hill Street. Also, four accidents occurred on the existing pedestrian crossing between John Street and Oxley Street. The remaining two accidents occurred at the intersection of Argyle Street with Oxley Street and Argyle Street / Murray Street respectively.

ALL pedestrian accidents in Argyle Street were classified as either Degree 1 – Fatal (1) or Degree 2 – Injury (9).

Of interest, four accidents which occurred out of the 41 recorded involved single vehicles crashing out of control in Argyle Street.

Elizabeth Street also included a high proportion of pedestrian accidents. That is, 70% of all accidents which occurred in Mitchell Street involved pedestrians. Further, every one of these accidents occurred at the intersection of Elizabeth Street and Mitchell Street.

Copies of all accident statistics are provided in **Appendix B** of this report and are analysed further in Section 8.

3.10 Traffic Modelling

A traffic model was prepared for this study to assist in the traffic analysis for Camden Town Centre. The model selected was an application called Commuter produced by Azalient (refer to www.azalient.com). This is a nanosimulation model and provides agent based analysis of the movements and interactions between the road network and vehicles and pedestrians.

To analyse traffic in town centres it is important to endeavour to reflect the many things that influence traffic system performance. These include:

- Interactions between through vehicles with vehicles parking at kerbside.
- Queuing on approach to intersections.
- The impact of pedestrians on traffic movements where pedestrians have right of way.
- The effect of different vehicle types, with different kinematic performance, as well as the effect of different driver behaviours.
- The effect of buses stopping along routes through the town centre.
- A model was established for the peak hour within each of the survey periods:
- Thursday morning, with peak between 8:15am and 9:15am

- Thursday evening, with peak between 4:30pm and 5:30pm
- Saturday morning, with peak between 9:00am and 10:00am
- Saturday afternoon, with peak between 5:15pm and 6:15pm.

The key features of the models are:

- Network extent from Sheathers Lane in the west through to Macarthur Road in the east and Macquarie Grove in the north to Old Hume Highway and Menangle Road in the south (refer to **Figure 44** below).

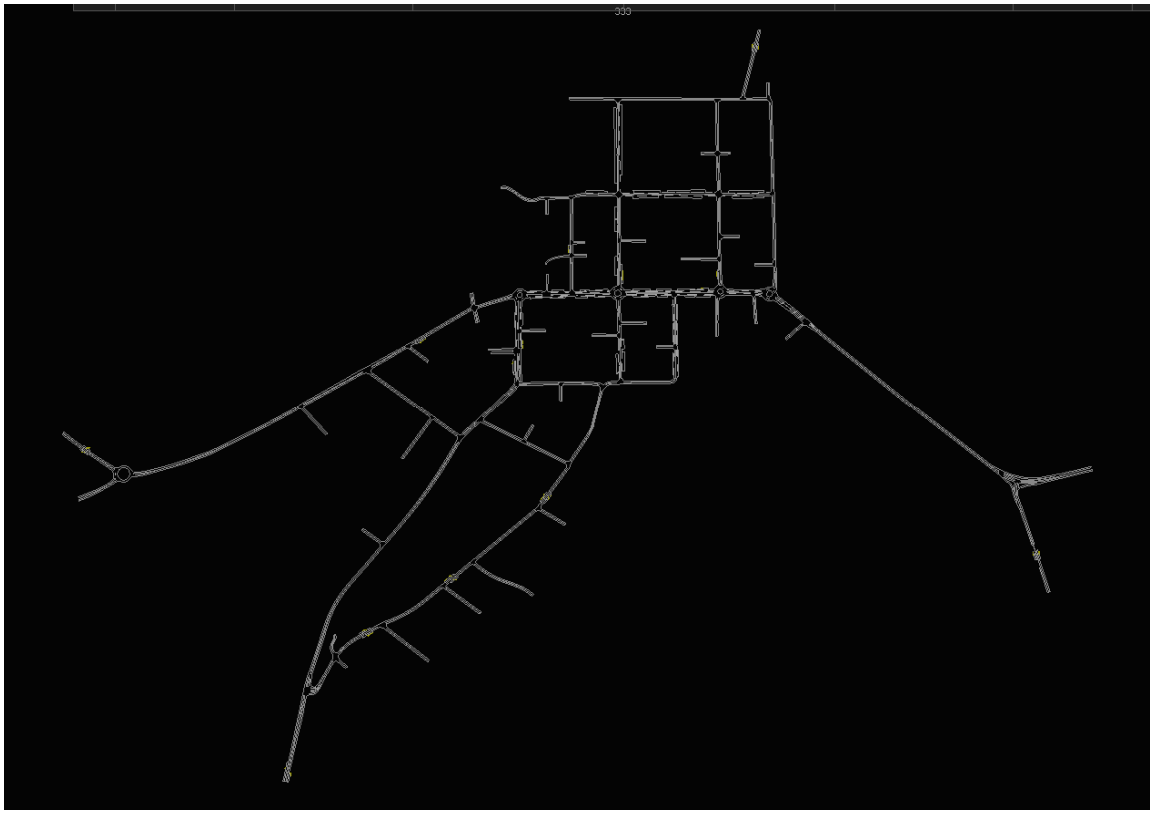


Figure 44: Network Modelling Extents

- The network reflects traffic conditions, such as lane widths, intersection mode of control and priority arrangements, key access points, sign posted speed limits, with School zone active during Thursday morning model.
- On-street parking is included where this has an impact on traffic flow and where it is important for traffic distribution control.
- A relatively fine grained zonal system to provide reasonable control over movements.
- Inclusion of scheduled route buses within the modelling system.
- Marked foot crossings included where activity on these has an impact on traffic flow.
- Demands were built from traffic information collected during the surveys, plus land use information and census information. These are segmented into light vehicles, heavy vehicles, buses and pedestrians based on counts. Further disaggregation of agent types for light vehicles and heavy vehicles was based on information in the RTA microsimulation modelling standards.

- A graphical interface.

The modelling process involved the establishment of base models, with demand calibration to fit traffic counts within a margin. Future year demands were forecast by applying growth factors to different traffic segments, based on their characteristics. The growth factors were based on land use projections and are discussed elsewhere in this report. The future demands were then assigned to the model, and the model's performance was reviewed. Adjustments to the model parameters were made where required to ensure traffic operations were appropriate. Further details of the traffic modelling are in **Appendix C** - Traffic Modelling Working Paper.

4. Future Development Potential

4.1 Introduction

This section summarises the land use of the study area, including the environs of the broader Camden area. This provides information regarding employment, population, dwellings and vehicle ownership. It also provides information about projected future land use, which is an important input to traffic analysis.

4.2 Last Five Years of Development

In respect to development in Camden Town Centre the following figure shows the location of the development approvals issue by Council in the last 5 years.

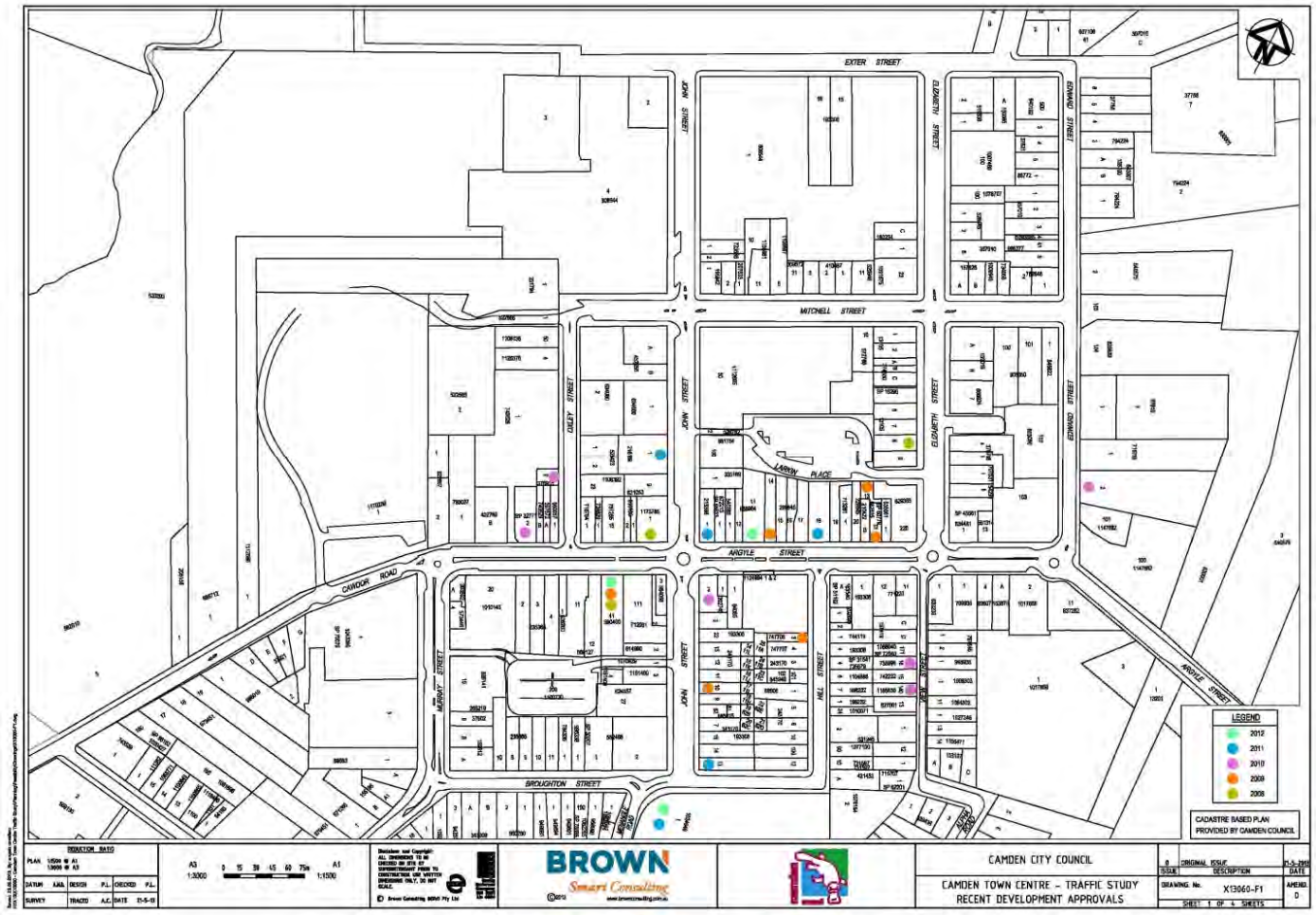


Figure 45: Development Approval Locations in the last 5 years

There is no distinct factor to the approvals, with no real pattern appearing to major re-developments.

As part of identifying future development potential the identification of properties that has an area of greater than 1,000m2 have been plotted on the following plan. Properties that have been strata subdivided have been excluded due to separate ownership making the property unlikely to be redeveloped.

The larger development sites are those currently developed by major supermarkets, the hotels and the school sites as well as the Council owned properties. These are shown in **Figure 46**.

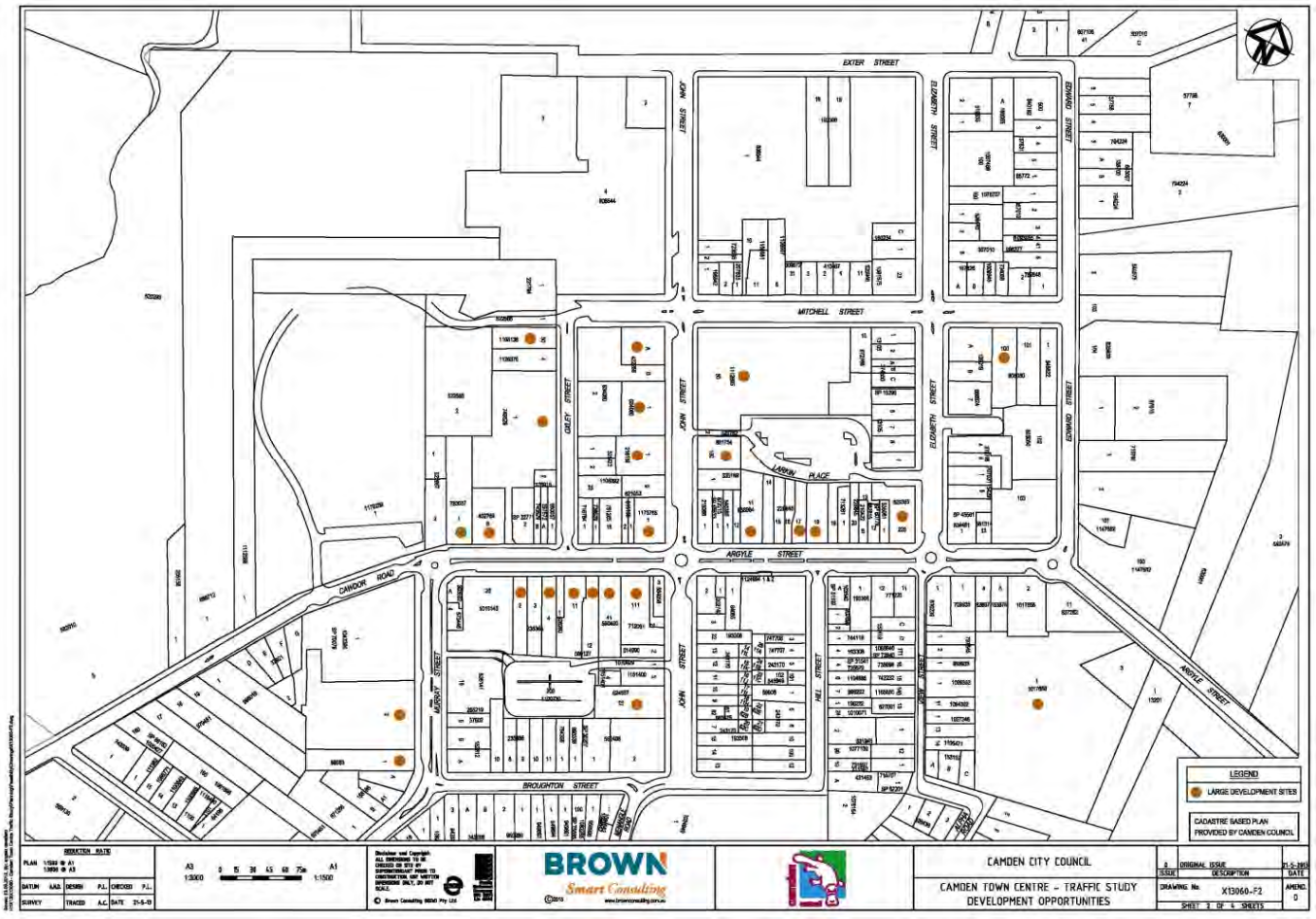


Figure 46: Development Site Opportunities

4.3 Strategic Overview

Camden town sits within the local government of Camden, which is in Sydney's southwest sub-region, which has been redefined in the latest draft metropolitan strategy to add Bankstown and Fairfield to the previously included local government areas of Camden, Campbelltown, Liverpool and Wollondilly. The most recent metropolitan strategy projects the following population and employment targets for this redefined southwest sub region[3].

[3] South west sub region: Bankstown, Camden, Campbelltown, Fairfield, Liverpool and Wollondilly.

Table 39: Land use projections from latest Metropolitan Strategy

Parameter	Current	Target to 2021 (2011 to 2021)	Target to 2031 (2011 to 2031)
Population	829,000	1,048,000 (218,000)	1,298,000 (469,000)
Housing	286,000	346,000 (60,000)	427,000 (141,000)
Employment	298,000	362,000 (64,000)	432,000 (134,000)

Source: pg 95 Draft Metropolitan Strategy for Sydney

These are not comparable with the previous sub regional strategies, which were developed under the umbrella of the 2005 Metropolitan Strategy, making it difficult to discern a meaningful population growth trajectory for Camden, at least under state strategic plans. The Draft Metropolitan Strategy does confirm the previously announced large population growth in the South West Growth Centre of 64,000 dwellings over the next 20 years (pg 96), which includes the northern portion of Camden LGA.

The following table compares the latest small area population forecasts produced by the Bureau of Transport Statistics for each of the local government areas in the Southwest Sub region.

Table 1: Small area population projections for LGAs in Southwest Sub region, persons

LGA	2006	2011	2016	2021	2026	2031	2036	2041	2046
Bankstown	176,857	190,723	199,510	210,443	220,288	231,036	242,550	254,868	268,212
Camden	50,940	63,158	99,299	129,111	178,910	229,323	261,886	288,791	302,158
Campbelltown	147,440	157,887	172,647	191,286	209,770	228,161	245,699	262,816	279,535
Fairfield	187,263	196,962	204,184	212,749	223,515	235,194	247,659	260,937	275,276
Liverpool	170,915	194,099	215,168	249,250	281,029	309,951	355,040	398,425	443,861
Wollondilly	41,221	45,992	49,766	54,839	59,665	64,766	70,125	75,729	81,697
Total	**774,636**	**848,821**	**940,575**	**1,047,678**	**1,173,177**	**1,298,430**	**1,422,959**	**1,541,566**	**1,650,738**

Source: BTS Small area population projections, August 2012

The above table indicates very strong growth for Camden, with its population surpassing that of Bankstown and Campbelltown by 2031 and exceeding Fairfield's population by 2036. Within ten years Camden's population is projected to be larger than Campbelltown's current (2011) population. The next table indicates the projected population increase from 2006 through to 2046.

Table 2: Small area population projections for LGAs in Southwest Sub region, change in persons from 2006 to 2046

LGA	2006 to	2011	2016	2021	2026	2031	2036	2041	2046
Bankstown		13,866	22,653	33,586	43,431	54,179	65,693	78,011	91,355
Camden		12,218	48,359	78,171	127,970	178,383	210,946	237,851	251,218
Campbelltown		10,447	25,207	43,846	62,330	80,721	98,259	115,376	132,095
Fairfield		9,699	16,921	25,486	36,252	47,931	60,396	73,674	88,013
Liverpool		23,184	44,253	78,335	110,114	139,036	184,125	227,510	272,946
Wollondilly		4,771	8,545	13,618	18,444	23,545	28,904	34,508	40,476
Total		**74,185**	**165,939**	**273,042**	**398,541**	**523,794**	**648,323**	**766,930**	**876,102**

Source: Based on data in BTS Small area population projections, August 2012

In terms of numeric increase in population the above table indicates the large scale population growth projected for Camden and Liverpool over the horizon of the projections. In Camden's case the increase in population over the next twenty years (to 2031) is expected to see an *increase* that is greater than the current population of Campbelltown. Note that Wollondilly shows more subdued growth, with its population projected to double form 2006 to 2046.

The next table shows the growth factors for population for each of the LGAs based off 2006.

Table 3: Small area population projections for LGAs in Southwest Sub region, growth factors from 2006 to 2046

2006 to	2011	2016	2021	2026	2031	2036	2041	2046
Bankstown	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.5
Camden	1.2	1.9	2.5	3.5	4.5	5.1	5.7	5.9
Campbelltown	1.1	1.2	1.3	1.4	1.5	1.7	1.8	1.9
Fairfield	1.1	1.1	1.1	1.2	1.3	1.3	1.4	1.5
Liverpool	1.1	1.3	1.5	1.6	1.8	2.1	2.3	2.6
Wollondilly	1.1	1.2	1.3	1.4	1.6	1.7	1.8	2.0
Total	**1.1**	**1.2**	**1.4**	**1.5**	**1.7**	**1.8**	**2.0**	**2.1**

Source: Based on data in BTS Small area population projections, August 2012

Camden is clearly expected to see the largest rate of growth, with a growth factor of 5.9 over the long term which is more than twice as fast as the next fastest growing LGA of Liverpool with a growth factor of 2.6.

Alternative population forecasts are available through a link on Camden Council's website to profile.id and forecast.id. These project a population for Camden of 213,376 by 2036, about 50,000 persons lower than the BTS projections.

Camden has seen rapid growth in the Narellan Spring Farm and Elderslie Area over the past ten to fifteen years, with rapid development commencing further north, around Oran Park Town Centre, as part of the South West Growth Centre, as well as later stages of Harrington Park.

Expectations further south, around Camden town centre, are more subdued, with modest population and employment growth.

To illustrate the differential distribution of growth, BTS's population projections for Camden LGA were disaggregated into the following eight precincts that were defined to assist in understanding how land use changes might affect Camden Town Centre:

- Camden Town Centre which is the focus of the study
- South Camden the urban area to the south of the town centre
- South west rural Camden, west of the town centre and south of the river, abutting Wollondilly Shire

- Elderslie and Spring Farm areas to the east of the town centre, over the river, which are experiencing rapid urban development
- Narellan, Mount Annan, Harrington Park, Smeaton Grange and Currans Hill, an area which includes a mix of established urban areas around Narellan as well as growth areas, such as Currans Hill and the later stages of Harrington Park
- Southern portion of South West Growth Centre from north of Harrington Park and Oran Park through to south and west of Catherine Field
- North east portion of South West Growth Centre covering a triangle from Leppington to Bringelly to Catherine Fields
- Western rural part of Camden LGA

The next table summarises the projected population level by future five-year period by precinct.

Table 4: Small area population projections for precincts around Camden town, from 2006 to 2046

	2006	2011	2016	2021	2026	2031	2036	2041	2046
West of Nepean									
Town Centre	412	441	978	991	996	1,052	1,100	1,155	1,194
South Camden	7,289	7,440	7,648	7,888	8,119	8,387	8,613	8,848	9,025
South west rural	2,416	2,765	2,994	3,144	3,431	3,748	4,020	4,632	4,935
Elderslie & Spring Farm	2,944	7,359	17,310	21,736	23,254	23,873	24,611	25,027	25,290
Narellan	31,718	38,227	45,430	48,552	49,253	50,063	51,086	54,667	56,335
Sth SWGC	355	926	16,925	32,491	48,935	57,650	64,917	68,839	71,783
NE SWGC	4,941	5,071	6,718	12,999	43,587	83,190	106,151	124,191	132,134
Western rural	864	928	1,295	1,310	1,334	1,362	1,387	1,433	1,462
Total	***50,940***	***63,158***	***99,299***	***129,111***	***178,910***	***229,323***	***261,886***	***288,791***	***302,158***

Source: Based on data in BTS Small area population projections, August 2012

The following table summarises the numerical projected growth from 2006 for each of these precincts, as well as indicating the share of Camden LGA's total growth from 2006.

Table 5: Small area population projections for precincts around Camden town, numerical increase from 2006 to 2046

	2006 to	2011	2016	2021	2026	2031	2036	2041	2046
West of Nepean									
Town Centre		29	566	579	584	640	688	742	781
South Camden		151	359	599	831	1,098	1,325	1,559	1,737
South west rural		349	579	729	1,015	1,332	1,605	2,216	2,519
Elderslie & Spring Farm		4,415	14,366	18,792	20,310	20,928	21,667	22,083	22,346
Narellan		6,508	13,711	16,834	17,535	18,344	19,367	22,949	24,617
Sth SWGC		571	16,570	32,136	48,580	57,295	64,562	68,484	71,428
NE SWGC		130	1,777	8,057	38,646	78,249	101,210	119,250	127,193
Western rural		64	431	445	469	497	523	569	597
Total growth		**12,218**	**48,359**	**78,171**	**127,970**	**178,383**	**210,946**	**237,851**	**251,218**
West of Nepean		4%	3%	2%	2%	2%	2%	2%	2%
Elderslie & Spring Farm		36%	30%	24%	16%	12%	10%	9%	9%
Narellan		53%	28%	22%	14%	10%	9%	10%	10%
Sth SWGC		5%	34%	41%	38%	32%	31%	29%	28%
NE SWGC		1%	4%	10%	30%	44%	48%	50%	51%
Western rural		1%	1%	1%	0%	0%	0%	0%	0%

Source: Based on data in BTS Small area population projections, August 2012

This analysis indicates that:

- Camden Town Centre, South Camden and south west rural area of the LGA are expecting modest population growth in comparison with the rest of the LGA. By 2036 growth in the town centre plus south Camden would have contributed less than 2% of the LGA's growth.
- Elderslie and Spring Farm and Narellan are expected to contribute most of the near term growth to 2016 and possibly 2021. After that their growth is more subdued.
- After 2021 the two precincts identified as part of the SWGC (South SWGC and NE SWGC) are expected to contribute the vast majority of growth, with the north eastern portion of the growth centre, some 17 km from Camden Town Centre, containing some 120,000 additional residents by 2041.

Scattered around this are several areas where urban development is expected:

Northern part of Wollondilly Shire – this connects to the north and east via either Burragorang Road, the Old Oaks Road and Sheathers Lane into Camden Town Centre or via Burragorang Road, the Coal Road and Camden Bypass.

The projected population increase for the land supported by this alignment is:

Table 6: Small area population projections for part of Wollondilly Shire adjoining study area, from 2006 to 2046

Zone	2006	2011	2016	2021	2026	2031	2036	2041	2046
1437	5,410	5,578	5,628	5,704	6,020	6,362	6,695	7,052	7,414

Source: Based on data in BTS Small area population projections, August 2012

This level of additional population is modest, representing an increase of about three-quarters of a percent per annum.

1.1.1 Employment

This section provides a set of analyses similar to the above but this time for projected employment contained in the latest set of BTS's small area projections. Employment projections for the southwest sub region LGAs are tabulated below.

Table 7: Small area employment projections for LGAs in Southwest Sub region, 2006 to 2046 (jobs)

Row Labels	2006	2011	2016	2021	2026	2031	2036	2041	2046
Bankstown	71,007	76,482	79,310	81,163	83,449	85,895	88,886	91,993	95,537
Camden	17,318	19,811	24,273	30,598	39,236	48,962	56,115	62,185	64,592
Campbelltown	45,926	53,422	59,529	65,438	71,019	76,784	82,945	89,587	93,131
Fairfield	56,203	63,158	69,418	74,930	80,868	87,031	92,711	98,920	102,723
Liverpool	59,156	71,309	81,499	90,983	98,943	109,330	120,304	130,932	136,137
Wollondilly	10,920	13,495	14,980	15,910	16,884	17,845	18,864	19,958	20,751
Total	**260,531**	**297,678**	**329,010**	**359,021**	**390,398**	**425,848**	**459,825**	**493,574**	**512,871**

Source: Based on data in BTS Small area population projections, August 2012

The above table indicates a substantial increase in jobs in the sub-region of approximately a quarter of a million additional jobs by 2046. However, as indicated in further analysis, even this large increase in employment is insufficient to provide employment for the increased sub-regional resident workforce. Consequently, large-scale outward commuting is likely to remain a feature of the sub-region for another generation or two.

The following table shows the large numerical increase in jobs for the sub-region.

Table 8: Small area employment projections for LGAs in Southwest Sub region, numerical change from 2006

Row Labels	2006	2011	2016	2021	2026	2031	2036	2041	2046
Bankstown		5,475	8,303	10,156	12,442	14,888	17,879	20,986	24,530
Camden		2,492	6,955	13,279	21,917	31,644	38,797	44,867	47,273
Campbelltown		7,496	13,603	19,512	25,093	30,858	37,019	43,661	47,205
Fairfield		6,955	13,215	18,727	24,664	30,828	36,508	42,716	46,520
Liverpool		12,153	22,343	31,827	39,787	50,174	61,148	71,776	76,981
Wollondilly		2,575	4,060	4,990	5,964	6,925	7,944	9,037	9,831
Total		**37,147**	**68,479**	**98,490**	**129,867**	**165,317**	**199,294**	**233,044**	**252,341**

Source: Based on data in BTS Small area population projections, August 2012

Table 9 below summarises the growth factors from 2006 that describe the extent of growth.

Table 9: Small area employment projections for LGAs in Southwest Sub region, growth factors from 2006 to 2046

LGA	2006	2011	2016	2021	2026	2031	2036	2041	2046
Bankstown		1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.3
Camden		1.1	1.4	1.8	2.3	2.8	3.2	3.6	3.7
Campbelltown		1.2	1.3	1.4	1.5	1.7	1.8	2.0	2.0
Fairfield		1.1	1.2	1.3	1.4	1.5	1.6	1.8	1.8
Liverpool		1.2	1.4	1.5	1.7	1.8	2.0	2.2	2.3
Wollondilly		1.2	1.4	1.5	1.5	1.6	1.7	1.8	1.9
Total		1.1	1.3	1.4	1.5	1.6	1.8	1.9	2.0

Source: Based on data in BTS Small area population projections, August 2012

The next table shows the ratio of projected population to jobs by LGA. While not a perfect measure of net jobs surplus or deficit in an area, due to differing factors such as age profiles, unemployment rates and workforce participation rates, declines in this ratio suggest that there would be a relative decrease in available employment, and hence an increase in the size of an area's existing jobs deficit. The consequence of this would be increasing levels of out-commuting.

Table 10: Small area employment projections for LGAs in Southwest Sub region, ratio of jobs to population ratio, from 2006 to 2046

LGA	2006	2011	2016	2021	2026	2031	2036	2041	2046
Bankstown	0.40	0.40	0.40	0.39	0.38	0.37	0.37	0.36	0.36
Camden	0.34	0.31	0.24	0.24	0.22	0.21	0.21	0.22	0.21
Campbelltown	0.31	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.33
Fairfield	0.30	0.32	0.34	0.35	0.36	0.37	0.37	0.38	0.37
Liverpool	0.35	0.37	0.38	0.37	0.35	0.35	0.34	0.33	0.31
Wollondilly	0.26	0.29	0.30	0.29	0.28	0.28	0.27	0.26	0.25
Total	**0.34**	**0.35**	**0.35**	**0.34**	**0.33**	**0.33**	**0.32**	**0.32**	**0.31**

Source: Based on data in BTS Small area population projections, August 2012

The jobs ratio in Bankstown in 2006 was roughly sufficient to provide employment self-containment for the area (of course people out-commute and some in-commute). All the other area's ratios in 2006 are well below that of Bankstown, indicating a higher level of out-commute as a proportion of the resident workforce.

From the above table it is clear that the Bankstown, Camden, Liverpool and Wollondilly will all see their ratio decline; whilst others are expected to experience an increase in the ratio, although none would have a ratio approaching 0.40 by 2046.

Employment projections for precincts around Camden town are shown in the following table.

Table 11: Small area employment projections for precincts around Camden town, from 2006 to 2046

Precinct	2006	2011	2016	2021	2026	2031	2036	2041	2046
West of Nepean									
Town Centre	2,827	3,279	3,669	3,991	4,326	4,651	4,990	5,356	5,571
South Camden	1,242	1,535	1,768	1,996	2,221	2,446	2,681	2,935	3,057
South west rural	559	686	793	905	1,012	1,119	1,231	1,350	1,407
East of Nepean									
Elderslie & Spring Farm	512	593	652	723	788	850	913	977	1,018
Narellan	10,264	11,589	12,628	13,590	14,544	15,569	16,665	17,847	18,547
Sth SWGC	285	332	659	2,583	5,407	7,655	9,166	10,659	11,063
NE SWGC	1,276	1,402	3,688	6,353	10,441	16,138	19,899	22,452	23,295
Western rural	354	394	416	456	496	533	571	609	634
Total	**17,318**	**19,811**	**24,273**	**30,598**	**39,236**	**48,962**	**56,115**	**62,185**	**64,592**

Source: Based on data in BTS Small area population projections, August 2012

The projected increase in jobs is focused to the east of the Nepean, with the overwhelming bulk of new jobs (about 70% of new jobs by 2046) to be located within the South West Growth Centre. The area west of the Nepean would have a share of new jobs of about 11%, with about 2,000 extra jobs in the Camden town zone, by 2046.

Table 12: Small area population projections for precincts around Camden town, numerical growth from 2006 to 2046

Precinct	2006	2011	2016	2021	2026	2031	2036	2041	2046
West of Nepean									
Town Centre		452	842	1,164	1,499	1,824	2,163	2,529	2,744
South Camden		293	526	753	979	1,203	1,439	1,693	1,815
South west rural		127	234	346	453	560	672	791	848
Elderslie & Spring Farm		82	140	212	276	338	401	466	506
Narellan		1,325	2,364	3,325	4,280	5,305	6,400	7,583	8,282
Sth SWGC		47	374	2,298	5,122	7,370	8,881	10,374	10,778
NE SWGC		126	2,413	5,077	9,166	14,863	18,623	21,176	22,020
Western rural		40	62	103	143	180	217	255	280
Total growth		**2,492**	**6,955**	**13,279**	**21,917**	**31,644**	**38,797**	**44,867**	**47,273**
Share of growth									
West of Nepean		35%	23%	17%	13%	11%	11%	11%	11%
Elderslie & Spring Farm		3%	2%	2%	1%	1%	1%	1%	1%
Narellan		53%	34%	25%	20%	17%	16%	17%	18%
Sth SWGC		2%	5%	17%	23%	23%	23%	23%	23%
NE SWGC		5%	35%	38%	42%	47%	48%	47%	47%
Western rural		2%	1%	1%	1%	1%	1%	1%	1%

Source: Based on data in BTS Small area population projections, August 2012

5. Identified Key Areas for Improvement

5.1 Road Network

From the investigations presented in Section 3 of this report, it has been determined that in general intersections throughout the Camden Town Centre operate at a satisfactory level of service during both weekday and weekend peak periods.

Further, there is spare capacity in the road network to accommodate the demands of future development in the area. This is discussed further in Section 6 of this report.

The nature of Argyle Street through the Camden Town Centre provides a relatively safe environment with separated opposing traffic via a landscaped median in a distinctive mainstreet environs.

It is the view of this study that observed traffic congestion along the Argyle Street corridor is more related to the poor operation of the existing marked pedestrian crossings than traffic loadings along the corridor.

5.2 Discussion of future traffic conditions

The critical time period for the town centre is Thursday PM peak, followed by Thursday AM peak, and the Saturday peaks are not as critical, in terms of traffic performance.

The section of Argyle Street between Murray Street and John Street is the critical section of the town centre in terms of traffic operations. Traffic density, queuing and transient delays in this area are most marked in this area in the existing year and future year models. Eastbound operations appear more constrained than westbound operations, primarily due to the interaction of operation of the marked foot crossing of Argyle Street west of John Street with the roundabout at the intersection of Argyle Street and John Street.

In effect, eastbound vehicles are delayed at the marked foot crossing, to the point where the approach queue at the roundabout dissipates, so that few or no vehicles are at the roundabout approach to take advantage of gaps at the roundabout to proceed through the intersection. This interaction tends to reduce overall sub-system capacity. In future years, with the increase in pedestrians using the crossing, more traffic on Argyle Street and more side-street traffic, this situation. Of note is that this behaviour is sensitive to our projections of volumes of pedestrian crossing at the marked foot crossing – a substantial increase over our projection would see traffic operations of this sub-system under more pressure.

Future Model – Thursday AM

In the future Thursday AM model, transient eastbound queues extend back to and past Oxley Street. This results in small (less than 5 vehicles) southbound queues in Oxley Street, waiting to turn left onto Argyle Street. The rest of the network functions well with only transient queues at the various intersections. The section of Argyle Street east of John Street functions well – primarily due to lower volumes of pedestrians crossing the marked foot crossing than the crossing to the west, but also because the marked foot crossing is approximately 20 metres further form the roundabout, permitting more vehicles to store between the two facilities, thereby reducing the interaction between the two facilities.

- Future Model – Thursday PM

In the future Thursday PM model, the transient eastbound queues along Argyle Street from John Street, are longer, frequently extending past Oxley Street, and, as a result, causing longer queues of southbound traffic waiting to turn left form Oxley Street to Argyle Street. The length of this southbound queue varies, but at one point extends up to 20 vehicles in length in the model, with a queue length of 5 to 10 vehicles more usual. The rest of the network functions well during this time period.

- Future Model – Saturday AM

In the Saturday AM Future Year model the network operates well with few queues. Again, the critical part of the network is the section of Argyle Street between Murray and John Street, but this generally operates satisfactorily over the model's analysis hour.

- Future Model – Saturday PM

In the Saturday PM Future Year model the network operates well with few queues, in a similar fashion to the Saturday AM Future Year model.

Discussion of future traffic conditions with signals at Argyle Street and Oxley Street and removal of marked foot crossing west of John Street

- Future Model – Thursday AM with Signals at Oxley Street

With the closure of the marked foot crossing west of John Street and the introduction of signals at the intersection of Argyle Street and Oxley Street the southbound queues in Oxley Street almost completely disappear. Eastbound queuing on Argyle Street remains but is more veenly balanced between the new stop line at Argyle and Oxley Streets signals and the western approach to the roundabout at John Street and Argyle Street. This is partly due to the increased distance between the John Street roundabout and the proposed signals at Oxley Street compared with the marked footcrossing. This increased distance permits the storage of another 8 to 12 eastbound vehicles on Argyle Street between Oxley Street and John Street. If these signals are implemented in the real world, with direct SCATS control, it is likely that the situation on Argyle Street would have even shorter queues and lower delays, as signal would timings adapt to traffic conditions.

- Future Model – Thursday PM with Signals at Oxley Street

With the introduction of signals at Argyle and Oxley Streets, the southbound queuing in Oxley Street is substantially reduced, with six or seven vehicles as the maximum. This is even though right turn vehicles are now also using Oxley Street. This is a result of changing the mode of control to signals and the additional short left turn lane provided in Oxley Street at its approach to Argyle Street. There is still eastbound queuing on Argyle Street, but in a similar manner to the Thursday AM Model, the queuing between intersections is better balanced than in the Thursday PM model without signals. Of note is that friction from on-street parking in Argyle Street is included in the model. Overall, whilst the signals at Argyle and Oxley Streets tend to introduce more stops and some minor additional delay

to Argyle Street traffic[4], they provide better overall town centre capacity and improved egress of town centre traffic to the west, as well as providing a high quality pedestrian crossing facility of both Argyle Street and Oxley Street.

- Future Model – Saturday AM with Signals at Oxley Street

This model runs well with limited queuing and good traffic flow along Argyle Street. The rest of the network operates satisfactorily.

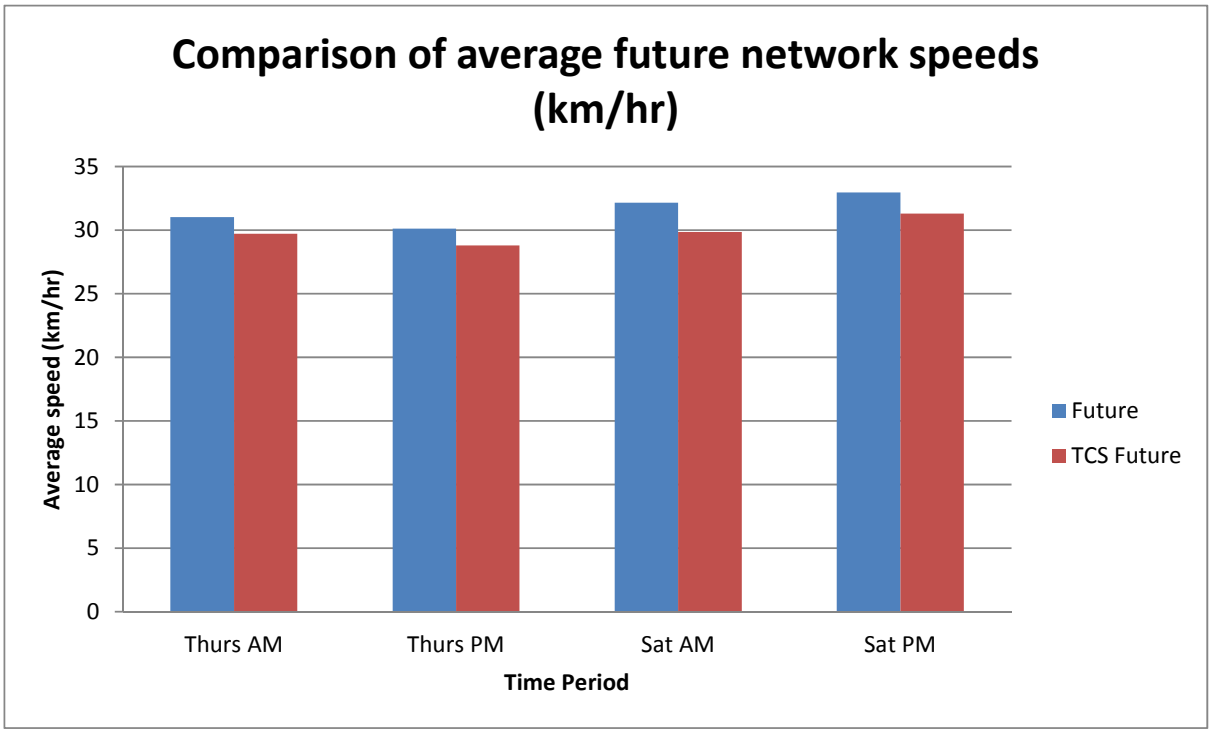
- Future Model – Saturday PM with Signals at Oxley Street

As with the Saturday AM model with signals at Oxley Street, this model operates satisfactorily.

Comparison of future network performance

As an indication of overall network performance the following chart compares future average network speeds with and without the implementation of traffic signals (TCS) at the intersection of Argyle Street and Oxley Street.

Figure 47: Comparison of average future network speeds



The chart indicates small reductions in average network speeds with the implementation of traffic signals. This is to be expected, as signals tend to introduce stops along the main road where previously vehicles had priority. The purpose of the chart is to indicate that, despite the introduction of these signals, there is only a small impact on

[4] As noted elsewhere the signals have been tested using an arrangement of cycle times and phase settings to provide a robust assessment of performance which provides a high proportion of green time to pedestrians. This has been done on the basis that if the signals work satisfactorily under these conditions then they are most likely to work well in the real world. Consequently, it provides a more negative view of the impact on vehicular traffic.

overall network performance. In terms of considering alternatives, as indicated elsewhere, the current marked foot crossing of Argyle Street is unlikely to remain for the medium to long term. From an economic appraisal perspective the future case in the above chart (i.e., the existing road network with future traffic growth) would not be the base case against which to compare the effects of signals at Argyle Street and Oxley Street.

5.3 Pedestrian Network/ Access

As stated above, an observed and real issue for the Argyle Street corridor is the existing marked footcrossings to the north and south of John Street.

Under current Roads and Maritime Services guidelines, new marked footcrossings on four lane roads are not permitted. Granted the existing crossings have been in place for many years. However, they are noted to be one of the major influences on traffic conditions along Argyle Street.

Further, it is noted that over some years now the RMS has been actively removing existing marked footcrossings on four lane roads. For example in Canterbury Road at Summer Hill. Thus it is expected that the existing crossings would be removed / replaced at some time in the future.

A key concern of marked footcrossings on four lane roads is the limited sight distance for approaching traffic to crossing pedestrians. The problems with view corridors to crossing pedestrians are further amplified by the fact that Argyle Street includes a landscaped median.

When a pedestrian crosses from a kerbline, a vehicle in the median lane has limited viewing distance to the crossing pedestrians if a vehicle in the kerbside lane is adjacent. Once a pedestrian crossing across the path of the two waiting vehicles, it was observed the median lane vehicle would not move forward unless the kerbside waiting vehicle moved forward. The current arrangement is very inefficient and impacts markedly on traffic flows during peak pedestrian periods.

Linkages between public car parks are generally confined to through privately owned properties. Further, access ways to / from Argyle Street and the car parks are poorly delineated and on the southern side of Argyle Street require pedestrians to walk through back of house areas of properties fronting Argyle Street.

The access from the Larkin Place car park is of a higher standard with active frontages internally.

Argyle Street itself includes an active and vibrant retail strip shopping experience with seating areas catering for outdoor dining. However, the conditions of the footpaths were noted to be generally of a poor standard with many areas of maintenance taken place historically which have resulted in a patchwork of materials, condition and look.

In other locations, the crossfall grade of the footpaths was too steep for outside dining. Overall the town centre would benefit from an urban design study which determined the look of pedestrian infrastructure in keeping with the character of the centre. This study could include identification of suitable and non-suitable locations of coherent treatments including outdoor dining. This could also reference to the findings of Council's drainage study currently being undertaken as advised by Council officers.

Throughout peripheral areas of the town centre pedestrian facilities are limited. The wide roads of John Street, Elizabeth Street and Edward Street are not user friendly and require pedestrians to cross long lengths in the path of traffic.

There are generally poor pedestrian connections between the public car parking areas in Oxley Street and Larkin Place.

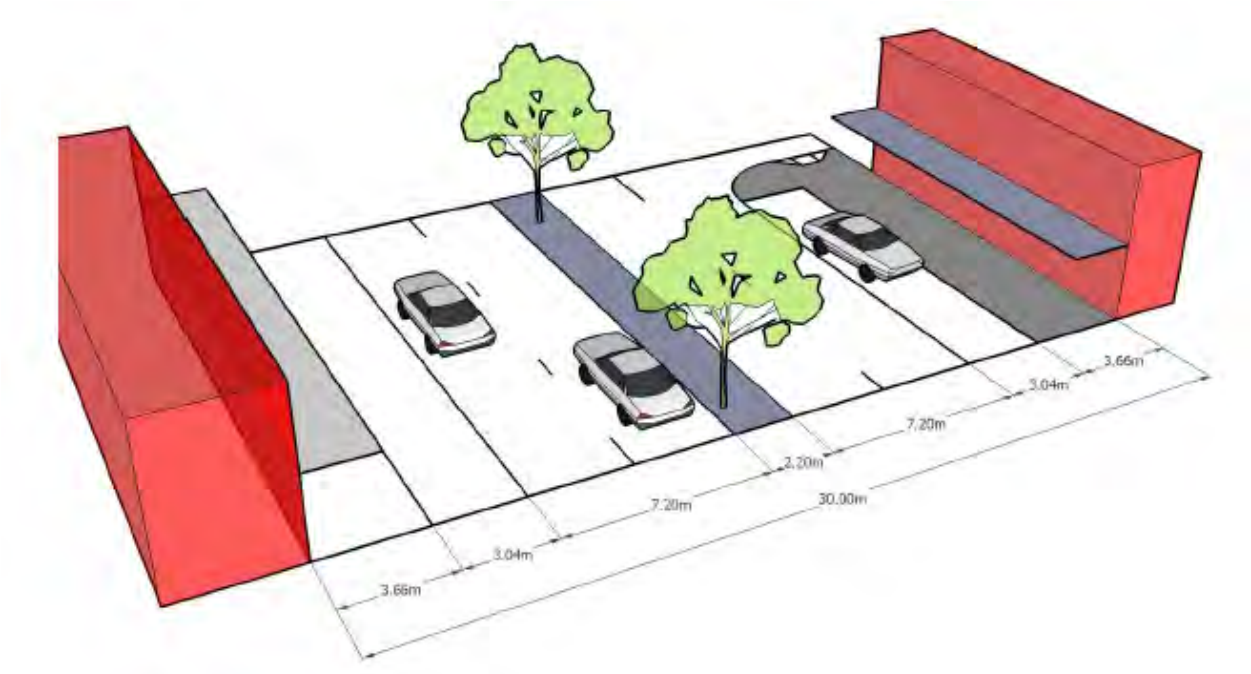
Topography plays a role of a barrier towards the southern ends of John Street, Hill Street, and View Street towards the Hospital.

As is the case of Argyle Street, the existing crossing in Murray is located on a four lane section of road. However, the viability of reducing this section of Murray Street to a single lane approach in each direction is discussed further in Section 6.2.

5.3.1 Argyle Street Footpath Widening Opportunities

Of particular interest are the suggestions for Argyle Street in the 2008 Town Centre Strategy report. The report noted the following existing general arrangements of Argyle Street:

Figure 48: Existing Parking and Lane Widths in Argyle Street



The existing configuration includes a wide parallel parking lane of 3.04m (the Australian Standard would suggest 2.5m would be sufficient) and a total width of 7.2m for two travel lanes (3.6m per lane). The potential changes to the existing configuration to achieve improvement to the pedestrian environment in Argyle Street are discussed further in Section Error! Reference source not found. of this report. This assessment has regard to the

xisting and future capacity needs of Argyle Street which in turn require a minimum of two travel lanes in each direction.

5.3 Car Parking

The following is noted in summary from the analysis conducted in Section 3.4 of this report:

- General parking spaces in off-street car parks experience higher overall utilisation than on-street spaces.
- Overall general parking spaces have a peak utilisation of just fewer than three-quarters at around 1:00pm.
- Numerically the 'no restriction' parking has the highest demand, peaking at around 600 vehicles at 1:00pm.
- The 3P parking is the next most important source of supply – it also peaks around 1:00pm, at just over 450 vehicles.
- Of note form the above analysis is that most of the time restrictions applicable to spaces in the town centre cease from 12:30pm on Saturday.

In general, there appears to be minimal need for an increase in overall parking provision within the Camden Town Centre as capacity can be increased with both increased enforcement of existing restrictions and conversion of parking restrictions to 'Seven Day' restrictions.

However, information on existing parking areas, their capacity and directions to their locations is considered a key element of an efficiently function town centre. That is, both locals and visitors have a clear understanding of where to travel to via their vehicle and what pathways are provided to / from the town centre core.

5.4 Wayfinding Signage

Whilst the Camden Town Centre would include a large proportion of 'locals' who know where parking areas are located and how best to travel to / from there, given the attractiveness of the centre to visitors there is overall a minimal volume of wayfinding signage for visitors. This includes advice on parking areas, routes of travel, key pedestrian pathways and public transport locations.

The Town Centre would benefit greatly from a wayfinding strategy for all modes and this is discussed further in the recommendations of this report.

6. Future Traffic Conditions Assessment

6.1 Town Centre Projections

6.1.1 Introduction

The prime driver of town centre traffic growth is town centre activity and employment. This note provides background information on the Bureau of Transport Statistics projections and then provides an analysis of local and aggregate factors that are likely to act to reduce employment in the town centre.

6.1.2 Background Projections

Bureau of Transport Statistics latest small area employment projections (August 2012) indicate, as shown in Table 52, the growth in employment for Camden Town Centre.

Table 52: Employment projections for the town centre

Precinct	2006	2011	2016	2021	2026	2031	2036	2041	2046
Town Centre	2,827	3,279	3,669	3,991	4,326	4,651	4,990	5,356	5,571

Note – These projections use travel zone 1371 (2006 travel zones – TZ06), which approximates TZ11 3101

Recent information about town centre employment from 2011 Census journey to work information indicates there were 2563 jobs. This information is not consistent with Table 1 of projections due to Census undercount. The comparable figure for 2006 Census was 2365 jobs. Using the same factor from 2006 Census to correct for undercount applied to the 2011 Census estimate was 2563*(2827/2365) = 3,064 jobs. This suggests that recent town centre jobs numbers have fallen short of expectations – i.e., a growth factor of 8% compared with the projection of 15%.

The following table shows implied growth factors for the latest BTS small area employment projections and for a modified series which maintains employment projections for the out-years, but rebases to the modified 2011 estimate of 3064.

Table 13 – Employment projection growth factors – BTS and re-based to lower 2011 employment

Precinct	2006	2011	2016	2021	2026	2031	2036	2041	2046
BTS projections									
Town Centre	2,827	3,279	3,669	3,991	4,326	4,651	4,990	5,356	5,571
Growth factors			1.12	1.22	1.32	1.42	1.52	1.63	1.70
Re-based to latest employment estimate									
Town Centre		3,064							
Growth factors			1.20	1.30	1.41	1.52	1.63	1.75	1.82

The growth factor for the period from 2011 to 2041 is between 1.63 and 1.75. Numerically this is an increase of between 2,086 and 2,301 jobs in the town centre. The implication is that for retail jobs at approximately 1 per 30sqm, this translates into a requirement for around some 60,000 to 70,000 sqm of floorspace, and if they were commercial jobs at 1 per 25 sqm, this would require some 50,000 to 60,000 sqm of floorspace.

1.1.2 Likely employment outcomes

Development and employment growth in the town centre faces a number of hurdles that are likely to reduce this level of growth below the projections. Please note that this is not a criticism of BTS's employment projections – it is simply focusing on the local factors that will challenge growth as well as touching on some issues at the aggregate level. These factors include:

1. Physical constraints – primarily flooding issues
2. Land ownership and planning constraints:
    a. limited number of large sites or aggregated sites within single ownership
    b. heritage constraints on development that are likely to reduce yields and increase costs of development
3. Competition from surrounding centres, especially Narellan, but also Oran Park Town Centre for trade and for investment
4. Limited projected population growth in the immediate catchment of the town centre, of about 33% over the 30-year period

Table 14 - Population projections for the immediate town centre catchment

Travel zone in catchment	2011	2016	2021	2026	2031	2036	2041
Ellis Lane (1366)	1,809	1,914	2,024	2,226	2,449	2,638	2,834
Camden TC (1371)	441	978	991	996	1,052	1,100	1,155
Elderslie (1375)	2,804	2,964	3,168	3,201	3,216	3,231	3,247
southern Camden (1376)	2,931	3,048	3,209	3,430	3,677	3,887	4,104
Bickley Vale (1381)	956	1,081	1,120	1,205	1,299	1,382	1,798
South Camden (1376)	4,509	4,599	4,679	4,689	4,710	4,726	4,744
Combined	***13,450***	***14,584***	***15,191***	***15,747***	***16,403***	***16,965***	***17,882***
Catchment growth factors from 2011		1.08	1.13	1.17	1.22	1.26	1.33

5. Scheduled move of Council Chambers from the town centre has the potential to reduce town centre activity, until a comparable occupier of the space can be found. This potential reduction in activity will be somewhat of a demand side shock to existing activity.
6. Recent growth of jobs has not matched projections.
7. Similarly, there have been only sporadic development consents granted in recent years, suggesting that competition for investment with surrounding centres may have already commenced in earnest.

8. It is unlikely that the number of jobs in the future in Sydney per head of population will be as high as projected due to a reduction in the workforce participation rate for the working age population, as the recent levels of the participation rate have been historically high, driven by the recent resource investment boom. It is considered unlikely, based on historical cycles that such a large boom will be seen again within the next two generations (i.e., prior to 2070).

Thus for the purpose of assessing future traffic conditions, a development growth factor of 1.3 was applied to determine future traffic flows for the testing of specific options for improvement.

Future intersection analysis can be found in **Appendix E** of this report.

6.2 Strategic Option Assessment

As part of the preparation of this report, a number of potential options were considered for improvement in and around the Camden Town Centre. During the initial phases of the assessment, some options were not progressed to final assessment based on a strategic analysis of their feasibility, benefits and impacts. A summary of all options considered and the pros and cons of each is provided in **Appendix D**.

6.3 Future Year Traffic Analysis

As discussed in Section **Error! Reference source not found.**, land use projections for the study area and its environs were used to forecast future traffic demands. These demands were then analysed using the traffic model to identify future traffic flows, and overall network performance. This information formed the basis of estimates of future year traffic flows for analysis in the detailed intersection analysis application, SIDRA, as discussed above in the section on existing intersection performance. This tiered approach to traffic analysis provides a robust assessment of future year traffic conditions.

Further details about the analysis are in **Appendix C** - Traffic Modelling Working Paper.

7. Options for Improvement Assessment

This component of the study includes an assessment for improvements to existing conditions from both an overall holistic perspective for Camden Town Centre core and site specific improvements to ameliorate identified issues such as accident trends.

7.1 Town Centre Core Improvement Strategy

After consideration of the existing conditions for all modes, the key areas of improvement have been identified as follows:

1. Replacement / upgrade of existing marked footcrossings in Argyle Street north and south of John Street.
2. Future use of parking areas in Oxley Street which currently service Council offices.
3. Better access from existing parking areas in Oxley Street north of Argyle Street
4. Grid pattern of pedestrian pathways linking existing main public car parks
5. Future use of Council offices site and creation of civic precinct in John Street

The 'grid within a grid' recommended overall outcome for the town centre is shown in **Figure 49** below

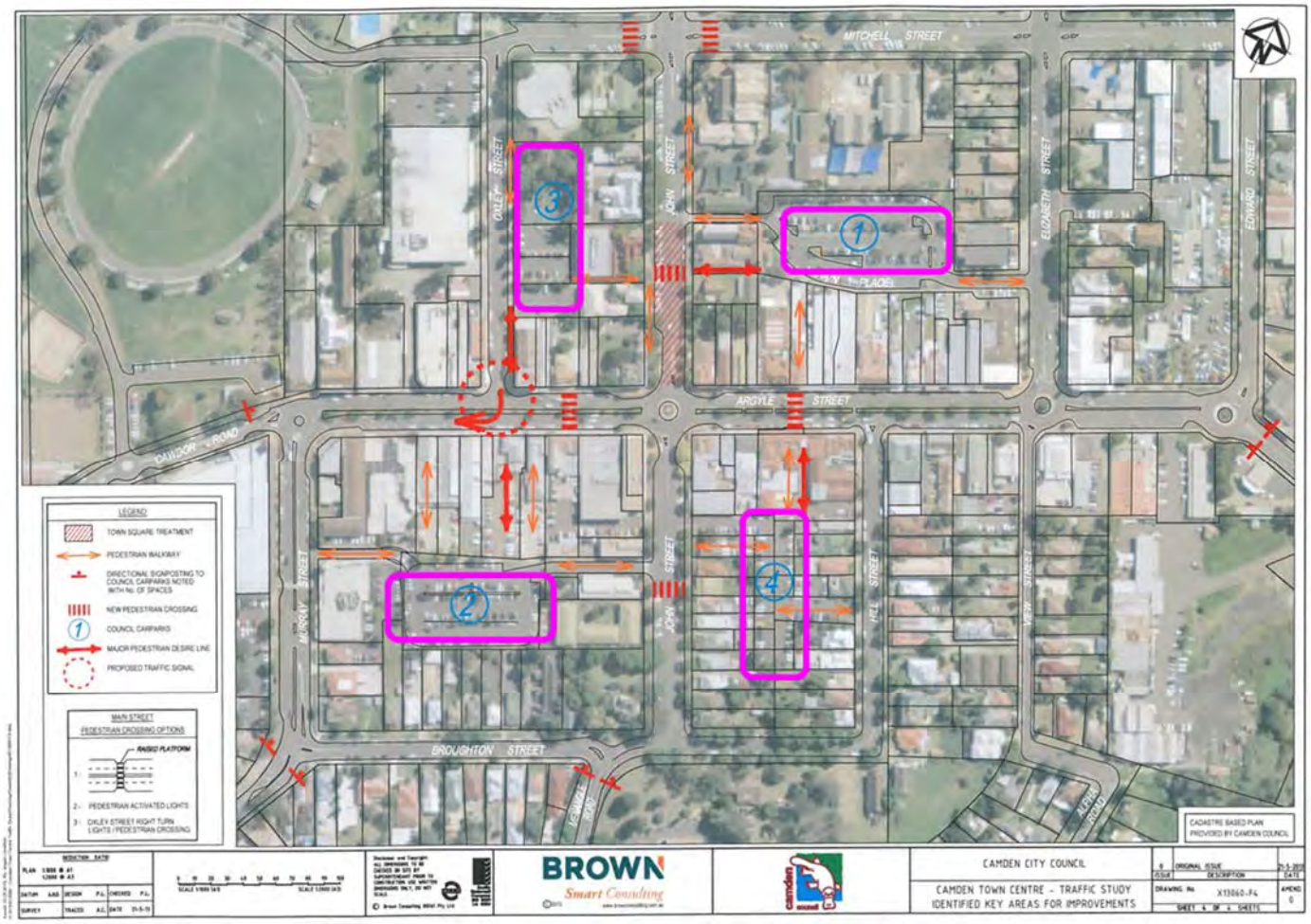


Figure 49: Recommended overall town centre core improvements

The following provides an assessment of the possible changes which may be considered in the short, medium and long term. The SIDRA assessments of future operating conditions at intersections where improvements are proposed are provided in **Appendix E** of this report.

7.2 Options Testing

7.2.1 Signalisation of Argyle Street/ Oxley Street & Removal of Marked Footcrossing

As shown in Table 36, the warrants for signalisation of the existing marked footcrossing are being currently met. Therefore signalisation of this non-compliant crossing would appear a reasonable improvement to consider.

Of further interest is the main pedestrian link to / from Argyle Street and the main car park between Murray Street and John Street is located in close proximity to the Argyle Street /Oxley Street intersection.

Oxley Street includes the major Woolworths supermarket and future potential additional public parking areas with the relocation of the Council offices to Oran Park. Thus, allow vehicles to exit Oxley Street and travel south along Argyle Street would alleviate pressure on the Argyle Street / John Street roundabout.

Therefore signalisation of the intersection of Argyle Street / Oxley Street and include pedestrian phasing's across both Argyle Street and Oxley Street would allow removal of the existing marked footcrossing and provision of a higher grade safer facility. Right turn movements into Oxley Street are not supported as this traffic travelling from the east to Oxley Street have the option to either travel via Mitchell Street (out of the town centre core) or U-turn at Murray Street.

The suggested improvements are shown below:

Figure 50: Siganlisation of Oxley Street/ Removal of Marked Footcrossing

The proposal would result in the loss of a small number of on street spaces. However, the improvements to pedestrian safety and connectivity to public carparks would be markedly improved.

A further significant benefit of the proposal is traffic travelling from the west via Cawdor Road and south west via Murray Street could travel to the Oxley Street car parks within the need of passing through the Argyle Street / John Street intersection.

SIDRA assessment of future conditions with the signals in place found the intersection would operate at a satisfactory level of service during peak periods on both a weekday and weekend day.

7.2.2 Signalisation of Marked Footcrossing in Argyle Street between John Street and Hill Street

As stated in Section 3.6.1 of this report, the warrants based on traffic flows / pedestrian flows were just below those required for traffic signals at the existing marked footcrossing.

However, application of the 'special warrant' *"The location has been the site of two or more pedestrian casualties over a three year period that could have been prevented by traffic signals",* signalisation of the intersection is justified.

It is recommended that if signalisation is considered, the existing openings in the central median which allow pedestrians to cross in various locations should be closed so crossing is concentrated to the signalised pedestrian crossing.

To maintain traffic efficiency along Argyle Street, it is recommended that these signals are 'actuated' pedestrian signals. The potential arrangements are shown below:

Figure 51: Signalisation of Marked Footcrossing – Argyle Street between John Street & Hill Street

7.2.3 Signalisation of Argyle Street/ John Street Roundabout

In the event that support from the Roads and Maritime Services for the signalisation of the marked footcrossing as shown in **Figure 51**, the an alternative would be to replace the roundabout at Argyle Street / John Street with traffic signals.

It is noted that the existing roundabout does not meet current design standards to allow two vehicles (a semi-trailer / car) at the same time and signalisation of the intersection would resolve this issue. However, signalisation should only be considered if it included the closure of the existing marked footcrossing east of John Street.

Having regard to the overall desired 'grid within a grid' strategy, closure of the crossing would require pedestrians to walk longer distances to cross Argyle Street east of John Street which is less desirable compared with the option in Figure 48.

The arrangements for signalisation of Argyle Street / John Street intersection are shown below.

Figure 52: Traffic Signals at Argyle Street/ John Street Intersection

The arrangement would also require the provision of right turn bays eastbound and westbound in place of a proportion of the existing landscaped central median.

In the future, the intersection would operate at a poor level of service during the Thursday PM peak. However, it would operate satisfactorily at all other peak times assessed.

Whilst the above option is feasible, maintaining the roundabout and signalisation of the existing pedestrian crossing in Argyle Street east of John Street is considered a holistically better outcome.

7.3 Further Potential Improvement Options

7.3.1 Additional Multi Storey Car Park – Oxley Street

Whilst not currently considered in the existing contribution plan, the relocation of the Council offices to Oran Park and creation of a civic precinct (discussed further below in Section 7.3.2) would allow provision of a multi storey car park on the existing public car park on Oxley Street.

The proposal to signalise the Argyle Street / Oxley Street intersection as described above would reinforce this public car park option. A multi storey car park in this location would not impact upon any major heritage items.

Council could consider allowing redevelopment of the site to a private developer on the basis that a minimal number of public car spaces were provided as part of the private development. In addition, monies collected from the contributions plan to date to assist in paying for further public spaces in this location.

A further benefit of providing a multi-deck car park in this location is that it has the potential of allowing for a significant redevelopment of the Council building to say provide a regional community asset. This may include a multipurpose centre, a theatre or the like.

7.3.2 Creation of a Civic Precinct

The area north of Argyle Street along John Street is well utilised during major events. Further, the relocation of the Council offices to Oran Park would provide the opportunity to create a civic / marketplace precinct in and around this location.

With the proposals listed above in place, John Street between Argyle Street and the entrance to the existing public car park could be closed for events and weekend markets with minimal disruption to traffic. The signalisation of Oxley Street would allow traffic travelling to / from the west and south west to use Oxley Street public car parking. Traffic from the east and north could still gain access to the Larkin Place car park.

To reinforce the precinct, alternative paving could be considered in John Street which includes delineation of the existing bus stop areas in a holistic approach to improving the area and reinforcing the character of the Camden Town Centre.

A missing link to achieving the above and the ‘grid within a grid’ system is a safe crossing facility across John Street linking the two public car parks. It is recommended that either a marked footcossing with kerb extensions (if

warrants are met in the future) or an elongated pedestrian refuge be considered. It should be located directly opposite the pedestrian pathway to the Larkin Place car park.

The overall potential scheme is shown below.

Figure 53: John Street Gateway Precinct Scheme

Other areas which were considered for a 'town square' environment included John Street south of Argyle Street and Oxley Street north of Argyle Street.

John Street south of Argyle Street has topographical issues with steep grades away from Argyle Street. Further, the crossfall of footpaths were adverse. In the event this section of John Street was closed there would still be opportunities to travel to the existing off street car parks either side of John Street. However, traffic wishing to travel back to the east would have a long distance to travel via the Camden bypass or via Murray Street to travel eastbound along Argyle Street.

Whilst Oxley Street provides an off street car parking facility, the street in its current form (which includes a relatively new supermarket development) does not include active frontages.

7.3.3 Elizabeth Street/Mitchell Street

As stated in Section 3.9, the intersection of Elizabeth Street / Mitchell Street has had a large number of accidents which have involved pedestrians. The existing arrangements are shown below.

Figure 54: Elizabeth Street/Mitchell Street Existing Intersection Arrangements

Figure 55: Mitchell Street – looking north to Elizabeth Street

The existing intersection includes pedestrian refuges on all legs of the intersection. However, the wide nature of both Elizabeth Street and Mitchell Street combined with vehicles parked at 60 degree angles exposes crossing pedestrians to poor sight distance and long walking distances in the path of oncoming traffic.

Closer examination of the times of accidents revealed accidents has occurred at all times of the day and therefore there is no clear common time period for which pedestrian accidents are occurring. Thus, it is not an issue of say poor lighting or say intoxicated persons being hit by oncoming vehicles. Further, the ages of the pedestrians involved ranged from 17 years old to 70 years old with an average of 45 years old.

Overall improvements to the delineation of the intersection and narrowing where possible would assist in reducing the number of pedestrian accidents.

These improvements could include:

- Painting all existing pedestrian refuge islands in Glassbead paint to improve reflectivity
- Incorporate splayed approach chevron linemarking for each refuge
- Installing standard pedestrian refuge island signage and hoop as per the RTA Technical Direction 2011 / 01A (shown below)

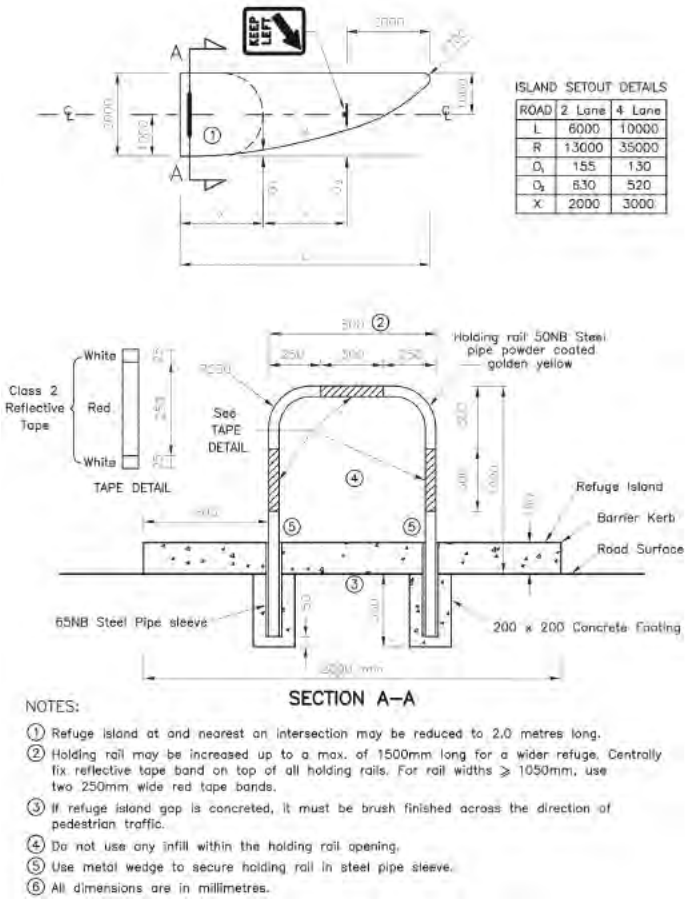


Figure 56: RTA Direction 2011/01A

An alternative arrangement to the above would be the provision of a roundabout at the intersection, closure of the centre islands to prevent pedestrians from using them and creation of a midblock pedestrian facility between John Street and Elizabeth Street.

However, such an arrangement would not follow the desire lines of existing pedestrian flows along Elizabeth Street and Edward Street. The frontage of Mitchell Street between Elizabeth Street and Edward Street consists of a very long impermeable block as is the case for most blocks in the town centre.

7.3.4 Seven Day Parking Restrictions

As stated in Section, 3.3, all current restrictions except for a few spaces in Murray Street end at 12:30pm on a Saturday. However, much of the premises in Argyle Street operate with seven (7) day trading.

Centres like the Camden Town Centre which include thriving street retail must include convenient street parking with good turnover to maintain their attractiveness. The further benefit of extending restrictions to seven (7) day restrictions is that additional parking capacity (through increased turnover and opportunities) can be created.

It is recommended that the area encompassed by seven (7) restrictions be slowly expanded over time beyond the initial precinct which includes Argyle Street.

The suggested precinct to include seven (7) day restrictions is shown below.

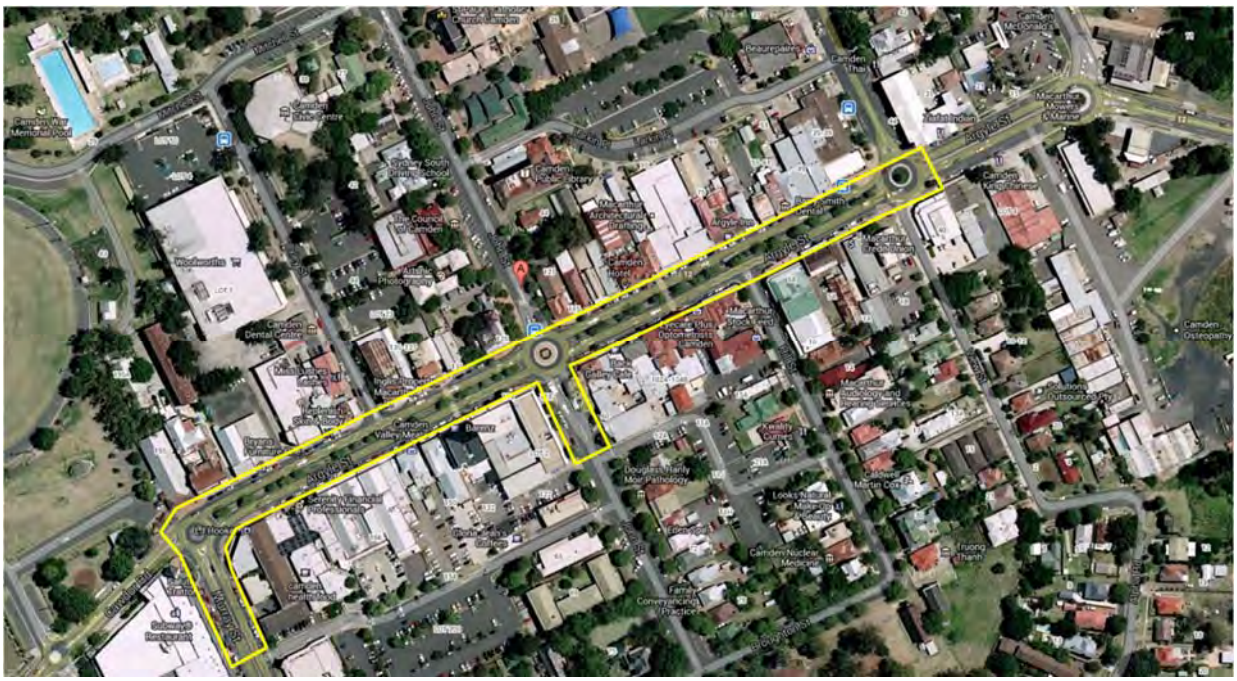


Figure 56: Recommended Precinct for Seven (7) Day parking restrictions

7.3.5 Murray Street/ Broughton Street

As stated in Section 3.1 of this report, the intersection of Menangle Road and Broughton Street currently operates at a LOS D in the afternoon peak. This LOS is generated by the difficulty vehicles have exiting Broughton Street. The provision of a single lane roundabout at the location would both slow vehicle speeds through the intersection and provide additional opportunities for vehicles exiting Broughton Street to join the traffic in Murray Street.

A single lane roundabout has been assessed for future operating conditions (30% increase in development scenario) and was found to operate with a good level of service in all weekday and weekend day peaks. This analysis is provided in **Appendix E** of this report.

Figure 57: Recommended Single Lane Roundabout at Murray Street/ Broughton Street

7.3.6 Wayfinding Signage

The existing signposting of Council's existing parking areas and in particular directional signage to these car parks is generally non-existent. Council should consider the installation of direction signage to each car park from each direction in Argyle Street to direct traffic to car parks and so to avoid where possible the intersection of Argyle Street / John Street.

This signage should also include the number of spaces available in each car park (as a total number) as this type of signage generally attracts more visitors in knowing that they are travelling towards a large capacity carpark. The locations of the signage are shown below:

Figure 58: Suggested Public Car Park Wayfinding Signage Locations

8. Short, Medium, Long Term Recommendations

8.1 Road Network

Section 7 of this report provides a number of improvements recommended for the road network.

Whilst the existing dual lane roundabout at the intersection of Argyle Street / John Street does not comply with current standards, it is not recommended that this intersection by converted to traffic signals.

In the short term, Council should explore the feasibility of signalising the intersection of Argyle Street / Oxley Street to allow vehicles to exiting Oxley Street and travel west / south. Right turn movements into Oxley Street from Argyle Street should not be permitted.

The signalisation of Argyle Street / Oxley Street would allow the closure of John Street between Argyle Street / Larkin Place car park access road for weekend markets and other events. Consideration should be given to providing a gateway scheme to this section of John Street with alterative pavement materials and improved bus layover facilities.

In the medium term provision of a single lane roundabout at the intersection of Menangle Road / Broughton Street would improve intersection operating conditions in the weekday PM peak.

8.1.1 Narrowing of Argyle Street to one lane

As noted elsewhere in this report, Argyle Street between Edward Street and Murray Street is a divided road with two travel lanes in each direction and kerbside parking. At face value, there are opportunities to consider the re-configuration of the cross section to re-allocate road space away from vehicles, possibly to other road users, such as pedestrians and bicycles, and maybe toward outdoor dining.
The current capacity of Argyle Street is:

- Lane next to on-street parking – approximately 600 vehicles per hour
- Lane next to median – approximately 900 vehicles per hour
- Combined one-way capacity – approximately 1,500 vehicles per hour

To achieve service flows of traffic comparable with these capacities requires efficient intersections. Current traffic flows are between 700 and 1,100 vehicles per hour one-way depending on the section of Argyle Street, with future demand of between 850 and 1,400 vehicles per hour.

The implications of a potential scheme, such as removing a lane in each direction from Argyle Street to permit the widening of the footpath, needs to consider the capacity of Argyle Street after the change and the traffic loading on alternative routes. Removal of one travel lane would reduce Argyle Street's capacity from 1,500 vehicles per hour to around 600 vehicles per hour. This is largely the result of side friction between moving traffic and kerbside activity such as parking.

If the travel lane on Argyle Street were wide, say 3.6m, then some of the friction from kerbside activity might be reduced and a slightly higher service flow achieved of say 650 vehicles per hour one-way. However, to achieve these service flows efficient intersections will be required, which would include, among other things, two-lane approaches on the new one-lane section of Argyle Street.

The following table provides a comparison of the future four-lane situation and a reconfigured arrangement for westbound traffic, across a screenline between Elizabeth Street and John Street, in terms of traffic capacity and predicted service flows. An advantage of using a screenline is that it abstracts away from the difficulties of how this deviation of traffic would connect at Argyle Street and how intersections could be configured to manage these large deviation flows.

Table 55: Existing & Reduced cross section

Scenario		Argyle Street	Mitchell Street	Combined Screenline
Existing cross section	*Configuration*	Two-lanes each way	One-lane each way	
	Traffic capacity	1,500 vph	600 vph*	2,100 vph
	Service flows future	1,280 vph	100 vph	1,380 vph
Reduced cross-section	*Configuration*	One-lane each way	One-lane each way	
	Traffic capacity	650 vph	600 vph*	1,350 vph
	Service flows future	650 vph	730 vph	1,380 vph

** The traffic capacity is based on traffic flow, whereas Mitchell Street has residential lots and sensitive land use along it (school), environmental capacity considerations would apply.*

The above table indicates that, on traffic capacity grounds, some 630 vehicles per hour from Argyle Street would need to use an alternative route, such as Mitchell Street, for the remaining flows on Argyle Street to stay below traffic capacity. This would combine with the 100 vehicles per hour on Mitchell Street to give a one-way volume of 730 vehicles per hour westbound on Mitchell Street. This would exceed the traffic capacity of Mitchell Street.

However, Mitchell Street provides a collector type of traffic function and has sensitive land uses along it, including residential and a school. As such, environmental capacity must be considered. For a collector road a maximum two-way flow of 500 vehicles per hour is the environmental capacity. Mitchell Street, as per the above table, would have around 730 vehicles per hour westbound. In addition it would have around 550 vehicles per hour eastbound – a total of about 1,300 vehicles per hour, more than two and a half times the environmental capacity.

In order for the traffic flow on Mitchell Street to remain within environmental capacity for a collector road, no more than 200 to 250 vehicles per hour (combined directions) could transfer from Argyle Street in the future.

Why is Argyle Street two lanes in each direction?

When examining Camden Town centre's road network, the question arises as to why, if the approach roads to the town centre are all one-lane each way, does Argyle Street need to be two-lanes each way?

The response is that there is convergence of traffic from several roads onto Argyle Street; the roads feeding in from rural areas (and indeed Camden Valley Way) do not experience the interruptions to traffic flow associated with a town centre and so have higher effective capacities per lane than Argyle Street, and that there is circulating traffic within town centres some of which, in Camden's case, uses Argyle Street. In addition, the intersections in town centres tend to be the regulator of road network capacity; the two-lanes on Argyle Street provide higher capacity approaches and departures to intersections along the route.

Several roads converge on the town centre – for example, Murray Street and Cawdor Street are effectively a single lane in each direction, but then converge onto the western end of Argyle Street in the afternoon. In the morning peak:

- Cawdor Street eastbound – 621 vph of which 564 vph proceed to Argyle Street
- Murray Street northbound – 471 vph or which 395 vph proceed to Argyle Street
- Argyle Street has 70 vph u-turning from westbound to eastbound
- Combined flow on Argyle Street of 1,029 vph which exceeds capacity of a single lane

The effective capacity of some of the roads feeding the town centre is in excess of traffic capacity that can be achieved within a town centre. For example, Camden Valley Way, whilst only a single lane each way, has features that enhance its capacity. These include:

- Almost no kerbside activity such as parking, a shoulder is provided
- Limited property access points
- Open environment with few, if any, pedestrians around and good sight distances
- Flaring to two-lanes on eastern approach and departure to the intersection with Edward Street
- Seagull treatment at Macarthur Road with priority to the through movements on Camden Valley Way

8.2 Pedestrian Network

Of more importance to improve pedestrian connectivity in the Town Centre is the adoption of a 'grid within a grid' system linking the main street and the main public car parks.

To facilitate this in the short term the following should be considered:

1. Signalisation of the intersection of Argyle Street / Oxley Street and the removal of the existing pedestrian crossing west of John Street
2. Signalisation of the existing marked footcrossing in Argyle Street between John Street and Hill Street
3. Marked footcrossing (or pedestrian refuge if marked footcrossing warrants are not meet) in John Street opposite existing pathway to Larkin Place car park

In the medium to long term, having public accessways to car parks over private property should be avoided. Council may consider in future planning policies to promote transfer of the existing accessways linking car parks to Argyle Street to public ownership with incentives for developers to do so. That may come in the form of reduction in parking contributions, higher yields or a number of other alternatives.

8.2.1 Narrowing Lanes in Argyle Street

As stated in Section 5.2.1, there is an opportunity to widen the footpaths of Argyle Street through the narrowing of the existing travel and parking lanes.

The Australian Standard for On Street Parking Facilities suggests a width of 2.5m could be considered for a parking lane. However, in the environment in Argyle Street, a wider lane of 3.0m as is currently in place provides some additional separation between a parallel parked vehicle and the adjacent two lanes of travel.

Overall the parallel parking lanes could be provided at a width of 2.75m which is still considered generous and would allow an additional 250mm of footpath widening on either side of Argyle Street.

As shown in **Figure 48**: Existing Parking and Lane Widths in Argyle Street

8 Argyle Street includes 7.2m of road to provide two travel lanes in each direction, or 3.6m wide lanes.

There would be the opportunity to consider narrowing the lanes to a width of 3.25m per lane which would provide an additional 500mm of footpath width. A lanewidth of 3.25m would still be considered acceptable to accommodate large articulated vehicles.

However, any changes to the lane widths need to consider design investigations at each intersection in Argyle Street to confirm what impacts they may have on turning manoeuvres.

8.3 Bicycle Networks

As stated above, there is an opportunity to widen the footpaths in Argyle Street through the narrowing of the parking and travel lanes. However, in turn this would limit the opportunity to allow bicycles to travel along Argyle Street in wide lanes. There is no opportunity to allow off street cycleways along Argyle Street.

It is noted that a cycleway is currently installed along Camden Valley Way in the east to the Town Centre. However, ends at Edward Street.

Consideration could be given to identifying an on road cycle road around the town centre using Edward Street / Mitchell Street / Oxley Street. Exit vehicle Oxley Street could be facilitated at the recommended signals for the intersection.

There is generally a lack of existing bicycle parking facilities in the town centre. These should be located in high pedestrian flow areas to maximise passive surveillance of parked bikes. In the short term, consideration should be given to increasing the number of bicycle racks with the possible provision of higher order parking facilities

such as lockers. The bicycle provision rate should a minimum of 1 space/ 50 car spaces and should be located in areas of high surveillance i.e. John/ Argyle Street.

In the medium to long term, Camden Council should consider updating the Camden Bicycle Plan which was undertaken a significant number of years ago.

8.4 Public Parking

After a detailed review of the availability of parking in the town centre and its use, it is the view of this report that at this stage additional multi deck car parking is not required to accommodate current demands.

Of a more pressing nature is the enforcement of existing restrictions which Council advised only forms some 5% of the duties of the two existing Council rangers who patrol the entire LGA. The volume of parking available in the Camden and Narellan Town Centres justifies a further range who's main role is to police existing restrictions to in turn maximise turnover and parking availability.

Also in the short term consideration should be given to converting existing parking restrictions in Argyle Street between Murray Street and Elizabeth Street to seven (7) day restrictions maintaining the current one hour limits. A short section of Murray Street between Argyle Street and the entrance to the Murray Street car park should also be converted to seven (7) day restrictions.

In the medium to long term it is suggested that Council investigate through survey length of stay of vehicles parking in the four main public car parks. Whilst this information was not gathered as part of this report, observations during many site inspections revealed that a large proportion of vehicles were using the car parks as all day parking.

Also in the medium to long term, consideration should also be given to including the existing Oxley Street public carpark in the contributions plan to provide a multi deck car park in the future. This location is considered the most feasible in terms of limiting impact on surrounding areas. Again, signalisation of the intersection of Argyle Street / Oxley Street would be required to maximise the success of a larger car park.

8.4.1 Future Additional Parking Provision

Does Camden need a multi-story car park?

Analysis of the surveys for this study indicate that current off-street car parking and much of the on-street car parking close to Argyle Street is heavily used during the middle of the surveyed weekday. Further away from Argyle Street there are substantial amounts of unused on-street car parking.

The data and on-site observations suggest that there is a fair proportion of long-stay parking occurring in short-stay spaces. Town centre workers (the predominant group of long-stay parkers in a town centre such as Camden) would be expected to park in unrestricted spaces, at some distance from the core of Argyle Street. This situation was expected to be evidenced by many of these unrestricted spaces filling early in the day (prior to 9am) and remaining occupied for a large proportion of the day. This would appear like a doughnut –filling at the periphery early; the centre filling later in the morning, as shoppers and other town centre visitors arrive.

On a Saturday, the off-street car parking areas, which on a weekday were substantially full by 9:00am and 10:00am, do not reach more than 60% utilisation all day, except for the Larkin Street car park, which exceeds 60% only after 2:00pm, when the main retail activity has wound down. As there is less commercial activity on a Saturday, with various government offices and most banks closed, the Saturday parking demands probably provide a better indicator of retail parking demand.

The following discussion outlines a series of activities to improve the utilisation of the existing parking assets which currently support Camden. Below this is a set of next steps.

Achieve better utilisation of existing parking assets, by conversion of all long-stay parking spaces close to Argyle Street (between Broughton Street and Mitchell Street, exclusive) to short-stay. This includes the public off-street car parks. It would also require increased enforcement of time restrictions – additional activity by rangers would be appropriate. Further, this would need to be supported by ensuring that there is no doubt that Council has the ability to enforce infringement notices.

This approach would push a proportion of long-stay parking demand away from the town centre core, where it could be readily accommodated in on-street parking. To support this, consideration should be given to way finding signage, ensuring that signs and lines for these parking places are in good order and that pedestrian pathways are maintained in good condition.

The amount of parking capacity that would be freed-up as a result of the above actions cannot be directly quantified now without knowing the current duration of stay of parkers. Whilst the indirect evidence discussed above indicates there is a non-trivial problem of over-stay parking, it does not quantify it. Surveys of duration of stay in a good sample of on-street and off-street parking areas on a weekday would provide direct evidence and a good estimate of the size of the problem.

Once long-stay parkers are using existing peripheral on-street parking spaces, the prime retail parking spaces will be available for town centre visitors.

As activity in the town centre grows, it is expected that demand for car parking would also increase. As new developments are approved, there is a requirement for those developments to meet their parking demands through provision of on-site parking or a contribution toward common-user off-street parking, to be arranged by Council. If all the parking demand that would be generated by future development were accommodated on-site, then, theoretically, no additional public car parking would be required.

However, as our review of land holdings and lot sizes indicated, many of the sites which might be considered for redevelopment are physically constrained and would reasonably be expected not to be able to accommodate all their parking on-site. The few recent development approvals, which were also reviewed, indicated most occurred on small sites, with little on-site parking and few contributions have been collected toward a common parking facility.

In the future some site consolidation might be achieved, possibly through some form of incentive introduced in the planning regulations, and this might lead to the ability to accommodate much of the additional parking demand on-site; this would result in only a small requirement for additional Council-provided off-street parking and this would be many years in the future.

However, with the site constraints outlined above, there will be a requirement for additional off-street car parking at some future point. The timing of this will depend on:

- The proportion of existing parking that is freed-up by the more active enforcement
- Development uptake rate
- Proportion of additional car parking demand generated by the development uptake accommodated on the relevant sites

Given current conditions and a reasonable shift of existing long-stay parkers to more peripheral locations, through enhanced enforcement, additional off-street car parking capacity is not likely to be required in the short to medium term.

8.4.2 Next Steps

- Council to have surveys of parking taken to establish the duration of stay profiles for a good sample of existing on-street and off-street car parking facilities
- Investigate improvements to enforcement including budget implications, changes required to ensure that infringement notices can be enforced
- Convert long-stay/unrestricted spaces that are close to Argyle Street to short-stay
- Identify improvements to pedestrian facilities, signage and lines required to 'formalise' existing on-street car parking in peripheral areas
- Implement enhanced enforcement with a period of grace/awareness to endeavour to maintain public support
- Twelve months after implementation retake car park surveys to identify use of the various parking areas and the duration of stay; identify available parking capacity (unused) close to Argyle Street
- Monitor growth in the town centre and number of car parking spaces provided by new developments on-site and how many are required off-site – update this progressively as developments are approved and then constructed
- Retake parking surveys, say, every five-years, unless something should occur that suggests they should be re-taken more frequently
- Based on the parking surveys and the monitoring, especially after Camden Council's offices have relocated out of town, a better appreciation of the likely timing of new parking capacity would be available.

8.5 Town Square

As stated in Sections 7.3.2 and 8.1, a gateway scheme should be considered for John Street between Argyle Street and the entrance to the Larkin Place car park. This section of John Street could be closed on weekends for markets and / or other events with minimal impact on traffic conditions in the town centre. However, as also stated above consideration should be given to undertaking these works in parallel with the signalisation of the intersection of Argyle Street / Oxley Street.

The relocation of Council offices to Oran Park also provides the opportunity to create a civic precinct which links John Street to the Oxley Street public car park.

8.6 Public Transport Operations

8.6.1 Future Bus Services

South West Sector Bus Servicing Plan – Technical Paper (prepared by Maunsell|Aecom for Ministry of Transport, February 2013) provides an indication of future bus servicing arrangements in the south west of Sydney. The scope of the investigation does not directly include Camden town centre, as it is located outside the growth centre's area (refer to Figure 2.1 in AECOM's report). The technical paper does, however, give some consideration to how bus services between Camden town centre and the growth centre might emerge.

The bus network plans put forward by AECOM's technical paper cover:

- Long-term
- Short-term
- Staging strategy.

The long-term network indicates a peak hour route – P1 – between Leppington and Camden. This would use Camden Valley Way from Camden to Narellan, then The Northern Road up to Oran Park Town Centre.

The short-term network shows rt 890 between Camden and Campbelltown/Macarthur via Narellan and Mount Annan. This looks like a combination of the existing rts 894 and 892.

The two major difficulties facing Camden in terms of gaining improved bus services for a range of travel opportunities, including better access to rail, are:

- Its location, which is off to the west and south of the South West Growth Centre. The implication is that services that anchor on Campbelltown/Macarthur and link areas to the west to this sub-regional centre, travel along the Narellan Road alignment. At Narellan they face a choice – turn south west to Camden or turn north/ north west to various centres and their catchments, including Harrington Park, Oran Park, and precincts, such as Catherine Field.
- Its size, which is small in comparison with the rapidly expanding areas in the South West Growth Centres.

It is not practical for a route to serve Campbelltown/Macarthur, Narellan and both Camden and the South West Growth Centre, they must diverge at Narellan.

An alternative approach to improving bus connectivity that would link Camden via Narellan and Oran Park Town Centre to Leppington, as indicated by P1 in AECOM's report, is too long for attractive end-to-end travel from Camden to Leppington. It will certainly provide a useful connection to Oran Park Town Centre from Camden, but it is unlikely that many Camden boarders would stay on as far as Leppington.

As such it is unlikely that bus will be able to attract a substantial increase in patronage from the Camden travel market. Whilst existing bus links may only serve a limited existing market, it is recommended that:

- Any proposed changes to town centre traffic facilities bear in mind the potential impact on buses and work to improve the conditions that can make bus use more attractive. These include improved pedestrian connectivity, accessibility and general conditions; a high standard of urban design around bus stops (e.g., John Street bus stop reflects this high quality); positioning of bus stops close to major potential generators.
- Council liaise with the bus operator and TfNSW through local traffic committee as well as engaging with service planning processes to ensure that current bus resources are retained and improved, where possible. For example, the through routing of bus services to the South Camden area is advantageous as they serve a larger catchment, including the hospital; provide a useful local link; and they do this without requiring layover within the town centre – this arrangement should be encouraged.
- Opportunities for linking country routes onto metropolitan routes, to provide longer direct connections for patrons should be explored. This would entail hooking the country route onto the metropolitan route, so the metropolitan bus would continue through Camden town centre and run the country route. Due to differences in frequency, this might see the first metropolitan trip run a country route, then the next trip run a different country trip. Whilst there are institutional barriers to this, as well as practical issues of hooking very low frequency country services onto low frequency metropolitan services, and having a complex service pattern, the potential benefits to passengers, and possibly to operational costs, may warrant further investigation. It also has the potential to reduce the number of town centre terminators.

8.7 Potential Bus Terminus Locations

The bus stop, located on the east side of John Street north of Argyle Street, is the main focus for buses serving Camden Town centre. It is the terminus for all the Country services, and some of the Metropolitan services.

It is fairly centrally located, providing reasonably broad accessibility to attractors within the town centre. It is supported by bus stops on Oxley Street (for buses coming into town from the south and the west), on Elizabeth Street for buses approaching from the east, and a bus stop on Argyle Street (west of Elizabeth Street) for buses heading east.

Moving this bus stop to Oxley Street or to an off-street facility behind the Council Offices would reduce the coverage of the town centre for most routes, and would be undesirable. The main considerations are discussed below:

- Being an off-street facility it would lack the high degree of passive surveillance that the current stop on John Street enjoys.
- Whilst the Country services and the 890 use the John Street bus stop as their terminus (i.e., they terminate and commence trips at the stop), the other Metropolitan services, rts 894 and 895, call at John Street on their way through (they run between Camden South and Campbelltown). It would be desirable in the future to encourage TfNSW's bus planning group and the contract region's operator, to look for opportunities to convert some of the John Street terminators so that they run through the town centre. This provides benefits for patrons as well as reducing the need for a terminus within the town centre.
- An off-street terminus is generally not as efficient in terms of operating costs as a facility such as the John Street bus stop where there is little or no extraneous movement of the bus.
- The John Street stop is closely located to existing amenities, such as the adjacent public toilets, which the drivers can use.

Given the relative advantages of the current arrangement for bus patrons and bus operations, it is unlikely that the operator would be keen to use it. Unless something dramatic changes in the future, it is likely that John Street would remain as the main bus stop/focal point in Camden.

8.8 Road Geometry

This report has assessed a number of opportunities to modify the road geometry of both individual streets and intersections. This information can be found in Sections 7.2, 7.3, 8.1 and 8.2.1.

8.9 Speed Limits

The data collection requirements of the brief to develop this report did not include any traffic speed surveys and thus it is beyond the scope of this report to comment on areas where speeding is an issue.

The Town Centre includes as with the surrounding residential streets a 50km/hr speed limit. From Camden Valley Way, a 60km/hr speed zone ends immediately south of the Hot Spot fuel station. The same is the case in Cawdor Road with a 60km/hr approach speed limit and a 50km/hr limit imposed just west of Barsden Street.

The streets around the town centre to the north include 40km/hr speed zones for the existing schools. This includes John Street and Mitchell Street.

The nature of the town centre and the low observed travel speeds may provide the opportunity to consider a 40km/hr High Pedestrian Activity speed zone along Argyle Street subject to RMS review and approval.

It is recommended that investigations into a 40km/hr High Pedestrian Activity Area be considered for Argyle Street in consultation with the RMS.

8.10 Street Lighting

The provision of adequate street lighting is under the care and control of the relevant power supply authority. In general, street lighting was noted to be in place in most areas of the Camden Town Centre.

The provision of adequate street lighting is also related to the 'look' of the town centre infrastructure and as recommended in this report below consideration should be given to developing a design manual for the Town Centre for the provision of all future infrastructure including street furniture and lighting.

8.11 Streetscape

From a traffic management and safety point of view, the existing median island in Argyle Street should remain as it provides a number of measurable benefits. Suggested changes to the streetscape including provision for a 'Civic Precinct' are addressed in Section 8.5 of this report.

Further, potential opportunities to provide greater footpath widths in Argyle Street are addressed in Section 8.2.1.of this report.

8.12 Cost Estimates of Potential Options

Formal engineering cost estimates of proposals detailed in this report are beyond the scope of the study. However, preliminary cost estimates of list of potential improvement options as detailed in Section Error! Reference source not found. are presented below:

Option	Comment	Estimated Cost
Argyle Street / Oxley Street		
Traffic Signals	Signalisation of intersection	$350,000
Asphalt Works	Resheeting of intersection	$62,500
Central Median	Remove Median / Ped Xing	$15,000
Argyle St Crossing Signalisation		
Existing Crossing	Removal	$10,000
Traffic Signals	Pedestrian Actuated Signals	$175,000
Central Median	Close existing breaks in median	$15,000
Argyle Street / John Street		
Existing Roundabout	Removal	$35,000
Central Median	Create right turn bays	$40,000
Traffic Signals	Signalisation of intersection	$350,000
Asphalt Works	Resheeting intersection	$75,000
Central Median	Close existing breaks in median	$15,000

Option	Comment	Estimated Cost
Elizabeth St / Mitchell St		
Pedestrian Refuges improvements	Signage / Linemarking	$25,000
Civic Precinct		
John Street	Alternative paving works	$200,000
Pedestrians	Pedestrian crossing + islands	$20,000
Buses	Bus shelters	$20,000 - $45,000
Parking Restrictions **Seven (7) day parking restrictions** **Murray St/Broughton St**	Replacement signage	$400 per sign installed
Intersection improvements	Roundabout	$60,000
Asphalt Works	Resheeting	$30,000

9. Responses to Brief Objectives

For ease of reference, the following provides the locations in this report which respond to each objective of the original brief. In some instances, additional information has also been provided on each matter.

Objective 1: Identify and resolve crash Blackspot sites
Comment: Accident analysis can be found in Section 3.9 of this report.

Objective 2: Manage the current and future level of traffic and transport
Comment: Existing conditions road network assessment can be found in Section 3.1 and 3.2 of this report. Future year assessment can be found in Section 4 and **Appendix E**.

Objective 3: Identify and resolve pedestrian accident clustering
Comment: Accident analysis can be found in Section 3.9 of this report. Recommendations for improvements to pedestrian accident cluster locations can be found in Section 8.2.

Objective 4: Facilitate improvements in the level of pedestrian access and priority, particularly in areas of pedestrian concentrations;
Comment: Recommended short, medium and long term improvements for pedestrians can be found in Section 8.2.

Objective 5: Promote pedestrian access connectivity and enhance safe crossing points.
Comment: Recommended short, medium and long term improvements for pedestrians can be found in Section 8.2.

Objective 6: Facilitate improvement in the level of personal mobility and safety for people with disabilities and senior through the provision of enhanced infrastructure and facilities
Comment: Identification of existing parking for persons for disabilities is provided in Section 3.3. Recommended short, medium and long term improvements for pedestrians can be found in Section 8.2.

Objective 7: Facilitate safe bicycle access and parking;
Comment: Recommended improvements to bicycle parking and planning are provided in Section 8.3.

Objective 8: Identify parking patterns to maximise parking opportunities
Comment: Assessment of parking utilisation is provided in Section 3.4. Recommendations for improvements to parking are provided in Section 8.4.

Objective 9:

- Investigate different parking restrictions:
- Timed parking;
- Pay Parking;
- Residential permits parking; and
- Multi-deck parking.

Comment: Assessment of parking utilisation is provided in Section 3.4. Recommendations for improvements to parking both in terms of provision and changes to restrictions are provided in Section 8.4.

On the matter of introducing paid parking in the Camden Town Centre, in the short to medium term it is the view of this report that it is not required. Focus by Council should be on introducing seven day restrictions along Argyle Street and enforcing existing restrictions on both on and off street car parking locations.

On the matter of residential parking permits, it was noted that the majority of residencies in the Town Centre have their own off street parking provision. Further, parking availability in the residential areas to the north and south of Argyle Street is substantial. Resident parking schemes are not considered warranted for the study area.

Objective 10: Accommodate special event needs for all road users, including public transport (buses and taxi), vehicular access, pedestrians and parking facilities, etc.
Comment: A review of existing special event operations is provided in Section 2.5. Recommendations for an introduction of a Civic Precinct and changes to allow the closure of John Street north of Argyle Street to enhance existing events and facilitate new events are provided in Section 8.5.

10. Appendices

Appendix A – Public Parking by Location and Restriction
Appendix B – Accident Statistics Review
Appendix C – Traffic Modelling Summary Paper
Appendix D – Option Assessment Matrix
Appendix E – SIDRA Assessment of Future Conditions

BROWN

Appendices

Appendix A Public Parking by Location and Restriction


EXTER STREET
UNRESTRICTED 10 SPACES
UNRESTRICTED 30 SPACES
UNRESTRICTED 3 SPACES
UNRESTRICTED 6 SPACES
UNRESTRICTED 20 SPACES
UNRESTRICTED 30 SPACES
UNRESTRICTED 15 SPACES
JOHN STREET
ELIZABETH STREET
EDWARD STREET
UNRESTRICTED 50 SPACES
UNRESTRICTED 57 SPACES
UNRESTRICTED 49 SPACES
UNRESTRICTED 46 SPACES
UNRESTRICTED 60 SPACES
UNRESTRICTED 60 SPACES
BUS ZONE 8:00 - 9:30 SCHOOL DAYS OR 24 UNRESTRICTED SPACES
UNRESTRICTED 39 SPACES
UNRESTRICTED 39 SPACES
NO PARKING
NO PARKING
MITCHELL STREET
1 HOUR PARKING 6 SPACES
UNRESTRICTED 9 SPACES
UNRESTRICTED 43 SPACES
UNRESTRICTED 43 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 10 SPACES
OXLEY STREET
UNRESTRICTED 18 SPACES
3 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 46 SPACES
2 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 8 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 16 SPACES
BUS ZONE 8:30 - 9:30 / 2:30 - 4:00 SCHOOL DAYS OR UNRESTRICTED 13 SPACES
UNRESTRICTED 19 SPACES
UNRESTRICTED 10 SPACES
3 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 153 SPACES
15 MIN PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 1 SPACE
LARKIN PLACE
COUNCIL CARPARK 26 SPACES
TBA
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 20 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 6 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 26 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 17 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 14 SPACES
UNRESTRICTED 25 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 8 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 12 SPACES
15 MIN PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 5 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 21 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 6 SPACES
ARGYLE STREET
UNRESTRICTED 8 SPACES
CAWDOR ROAD
UNRESTRICTED 5 SPACES
2 HOUR PARKING 7 DAYS 10 SPACES
MURRAY STREET
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 6 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 21 SPACES
ACCESSIBLE PARKING 6 SPACES
3 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 104 SPACES
UNRESTRICTED 31 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 23 SPACES
UNRESTRICTED 15 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 4 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 9 SPACES
2 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 10 SPACES
3 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 95 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 19 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 10 SPACES
UNRESTRICTED 15 SPACES
HILL STREET
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 10 SPACES
2 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 13 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 10 SPACES
NO PARKING AT ALL TIMES
VIEW STREET
UNRESTRICTED 22 SPACES
1 HOUR PARKING 8:30 - 6:00 M-F 8:30 - 12:30 SAT 3 SPACES
BROUGHTON STREET
UNRESTRICTED 15 SPACES
UNRESTRICTED 15 SPACES
MENANGLE ROAD
ALPHA ROAD
ARGYLE STREET
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL

REDUCTION RATIO
PLAN 1:1500 @ A1
1:3000 @ A3

DATUM	A.H.D.	DESIGN	P.L.	CHECKED	P.L.
SURVEY		TRACED	A.C.	DATE	21-5-13

A3 1:3000 — 0 15 30 45 60 75m — A1 1:1500

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CAMDEN CITY COUNCIL

CAMDEN TOWN CENTRE - TRAFFIC STUDY
PARKING RESTRICTIONS

ISSUE	DESCRIPTION	DATE
0	ORIGINAL ISSUE	21-5-2013

DRAWING. No. X13060-F3 — AMEND. 0
SHEET 3 OF 4 SHEETS

Saved: 23.05.2013, By: angelo cavallaro
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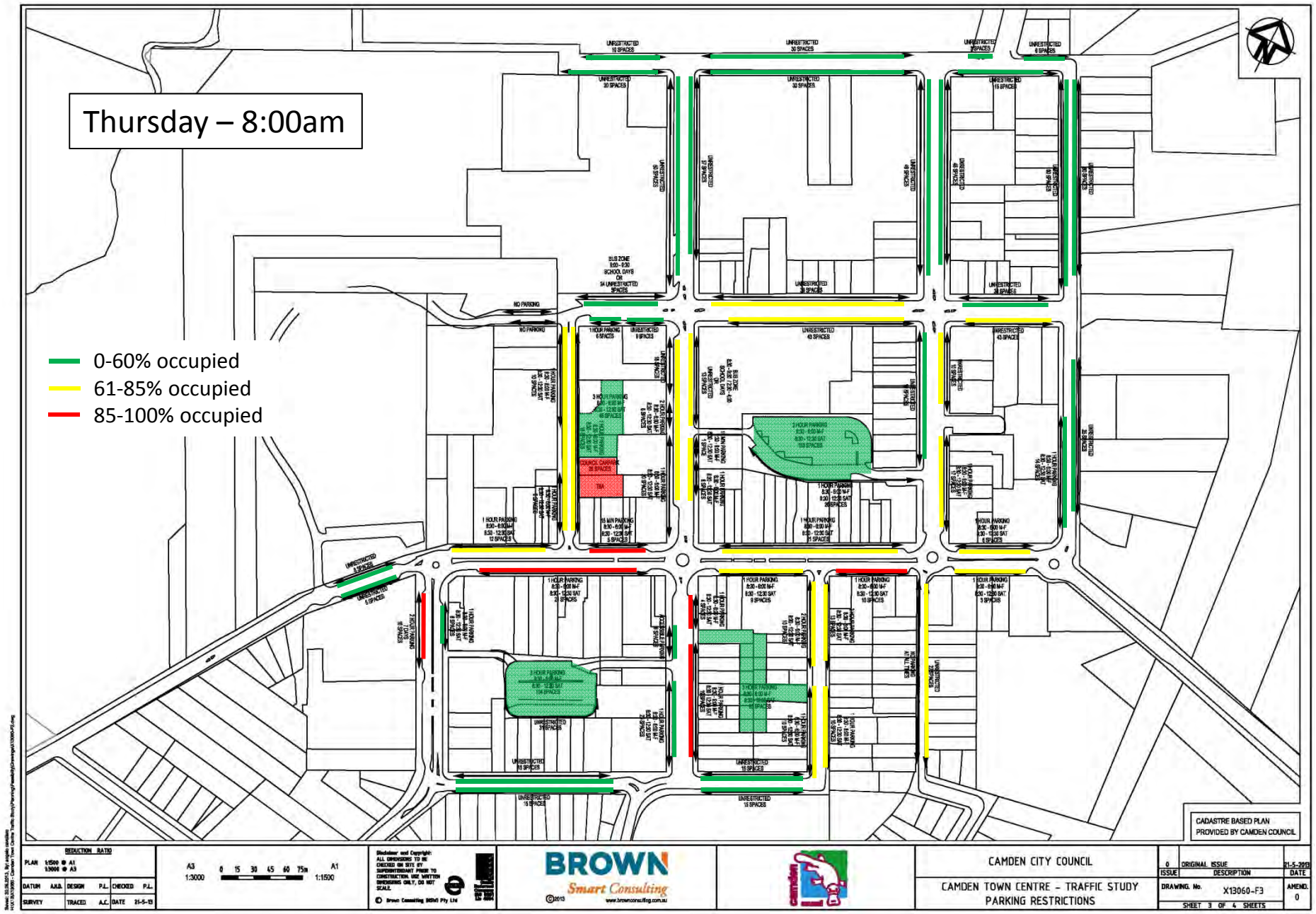
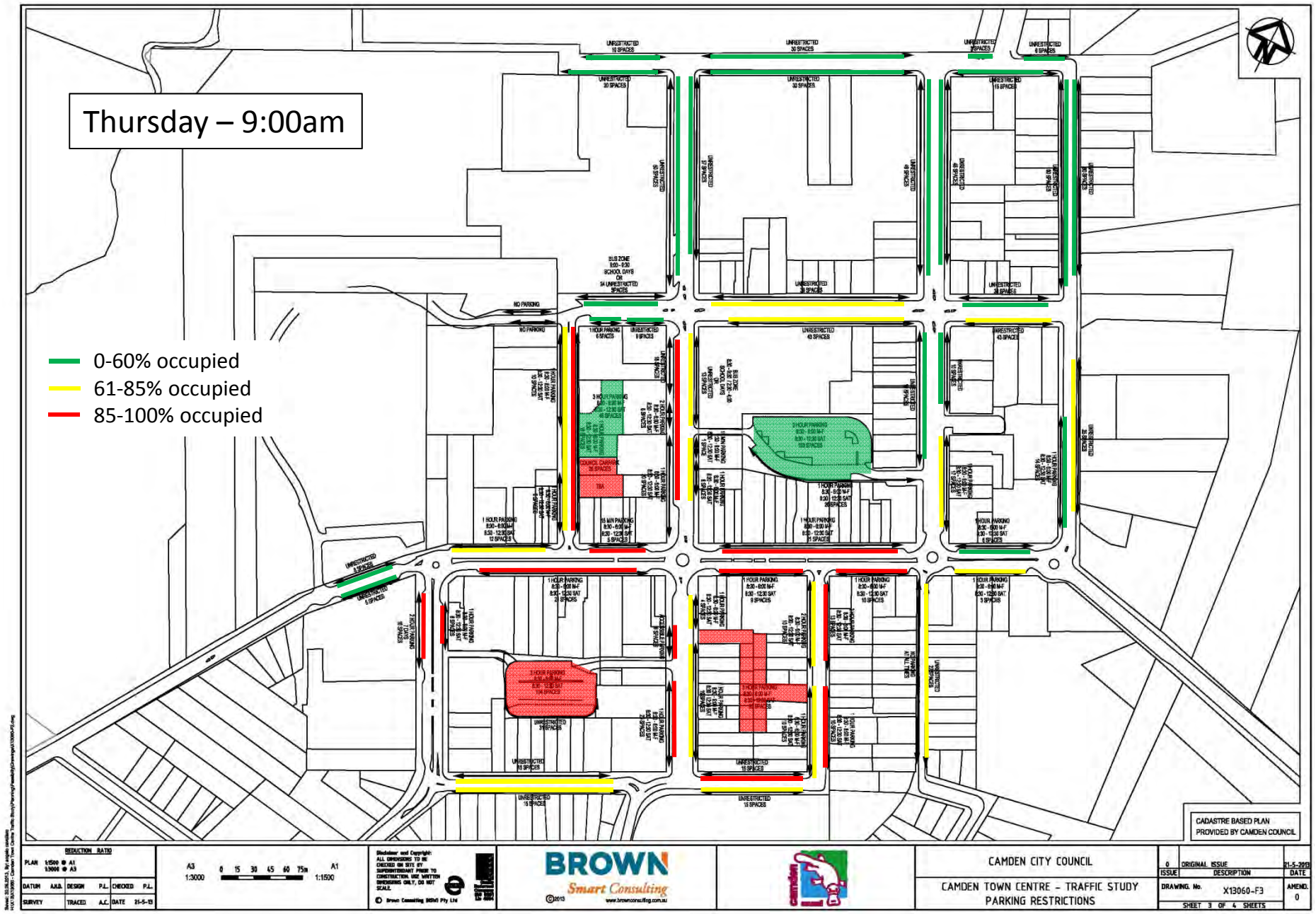

Thursday – 8:00am
0-60% occupied
61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
BROWN
Smart Consulting
CAMDEN CITY COUNCIL
CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
21-5-2013
DRAWING. No. X13060-F3
SHEET 3 OF 4 SHEETS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PROVIDED BY CAMDEN COUNCIL
BROWN
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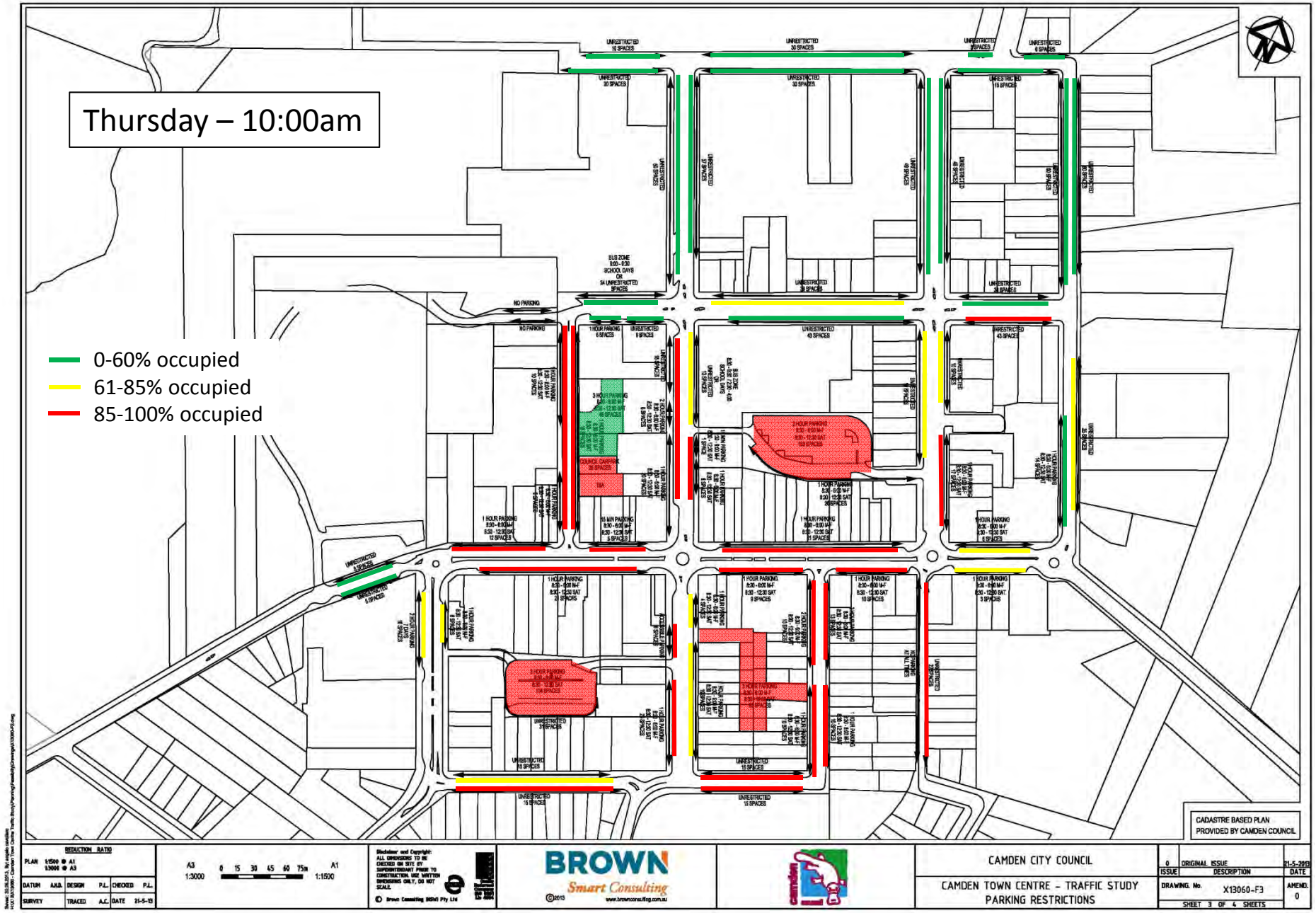
CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
21-5-2013
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS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PROVIDED BY CAMDEN COUNCIL
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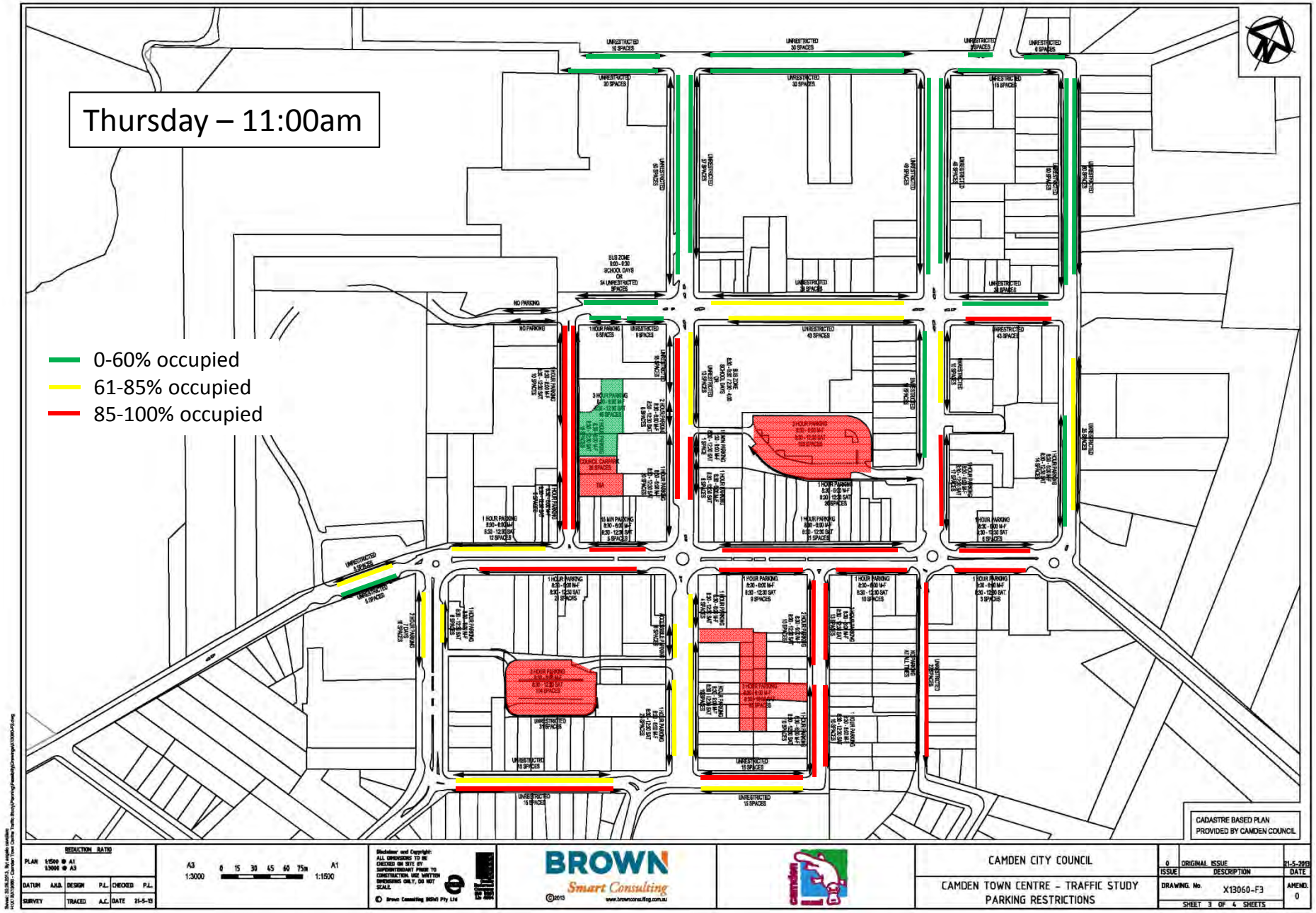
CAMDEN CITY COUNCIL
CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
21-5-2013
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS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PROVIDED BY CAMDEN COUNCIL
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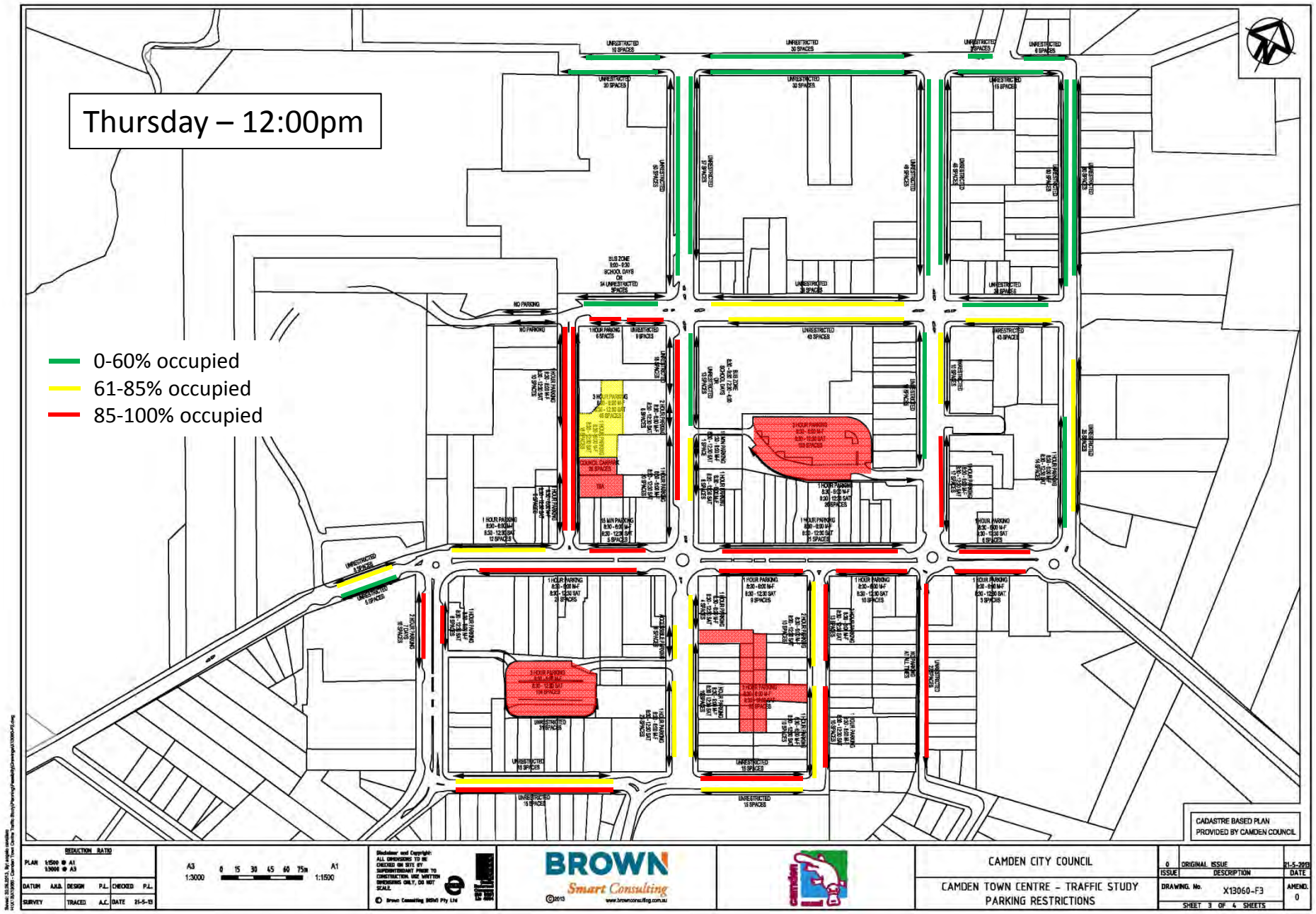
CAMDEN CITY COUNCIL
CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
21-5-2013
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS


Thursday – 12:00pm
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61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
21-5-2013
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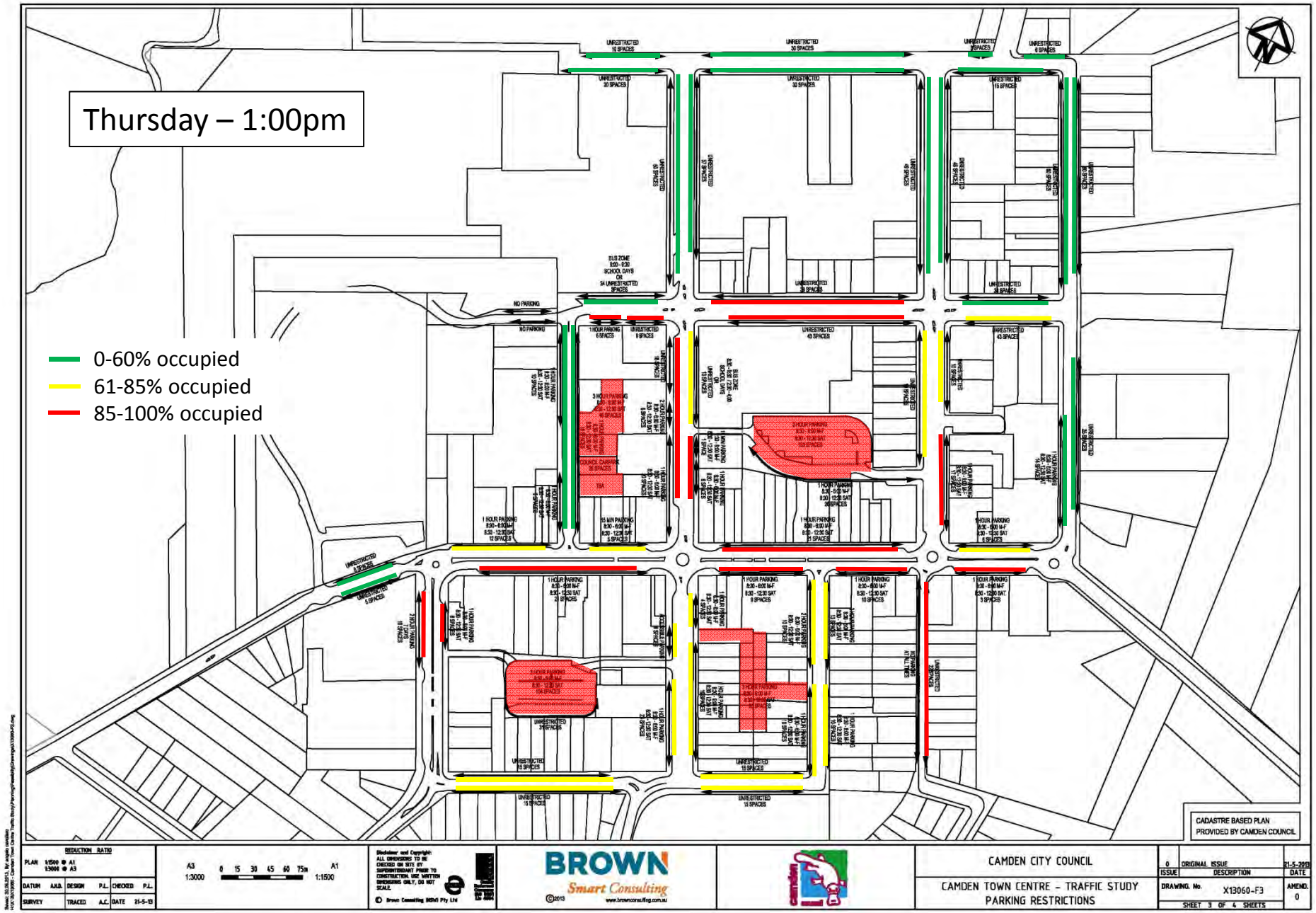
SHEET 3 OF 4 SHEETS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61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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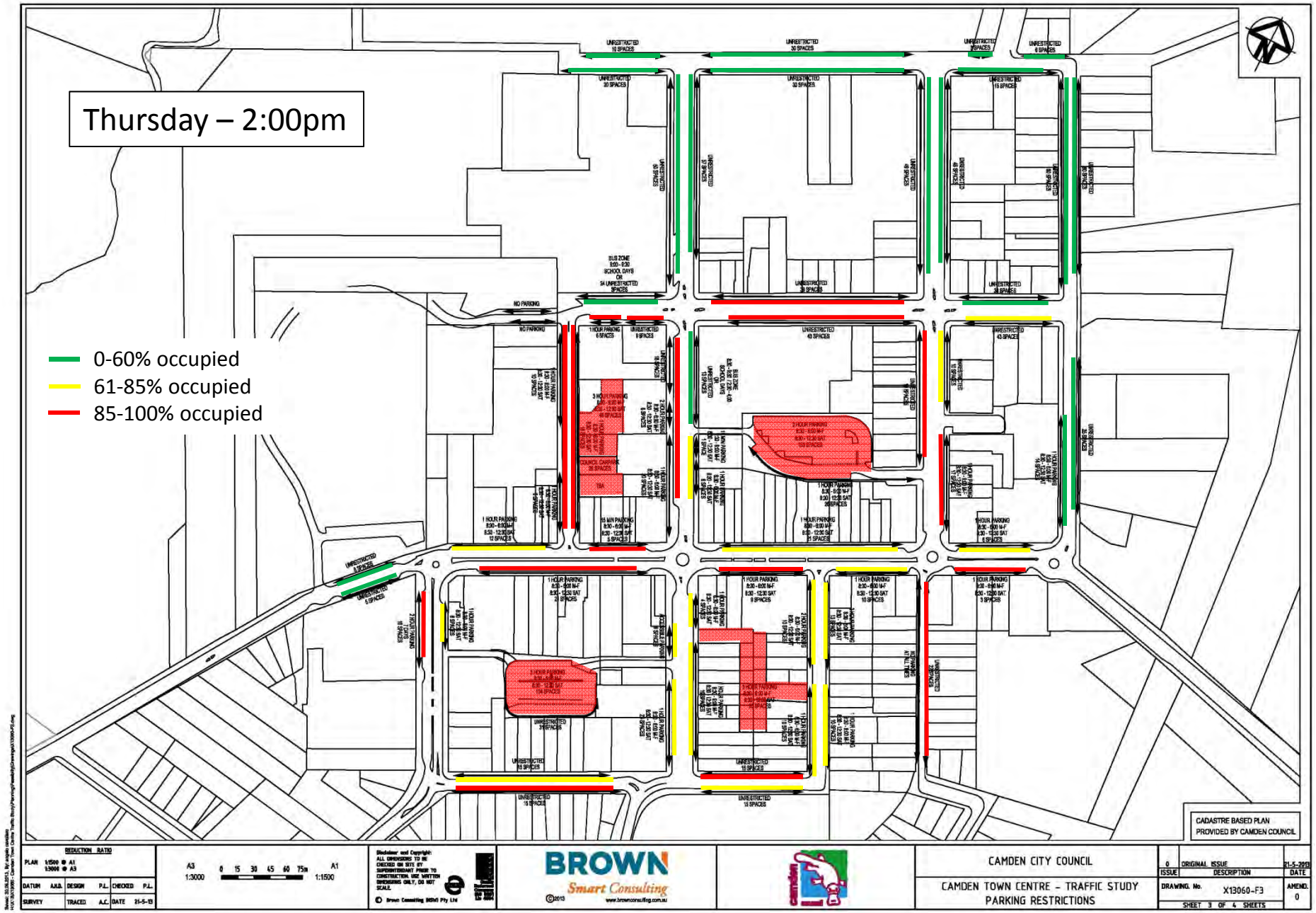
CAMDEN CITY COUNCIL
CAMDEN TOWN CENTRE - TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
21-5-2013
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS


Thursday – 2:00pm
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61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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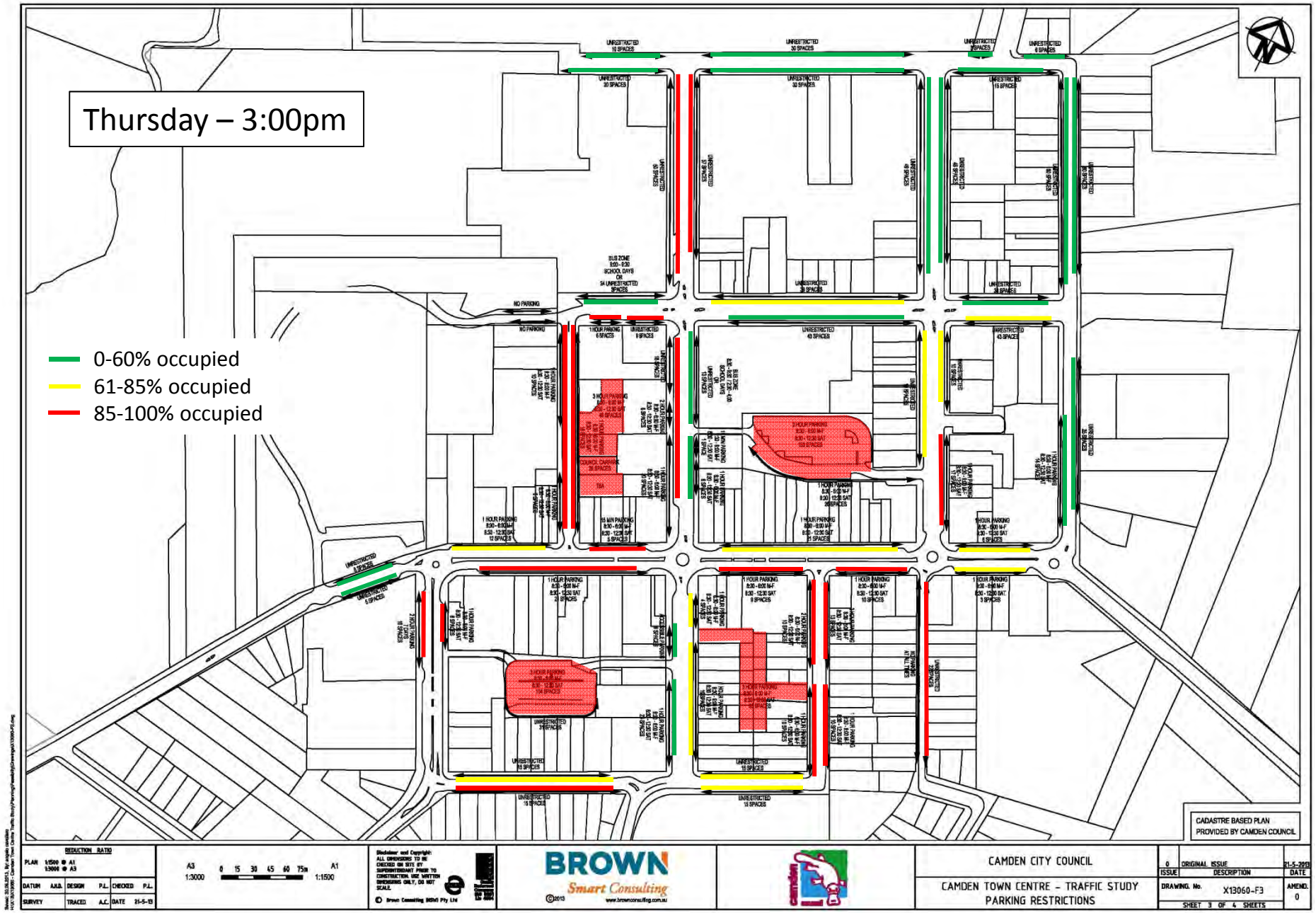
CAMDEN CITY COUNCIL
CAMDEN TOWN CENTRE - TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS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61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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CAMDEN CITY COUNCIL
CAMDEN TOWN CENTRE - TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS


Thursday – 4:00pm
0-60% occupied
61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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CAMDEN CITY COUNCIL
CAMDEN TOWN CENTRE - TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
21-5-2013
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS


Thursday – 5:00pm
0-60% occupied
61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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CAMDEN CITY COUNCIL
CAMDEN TOWN CENTRE - TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
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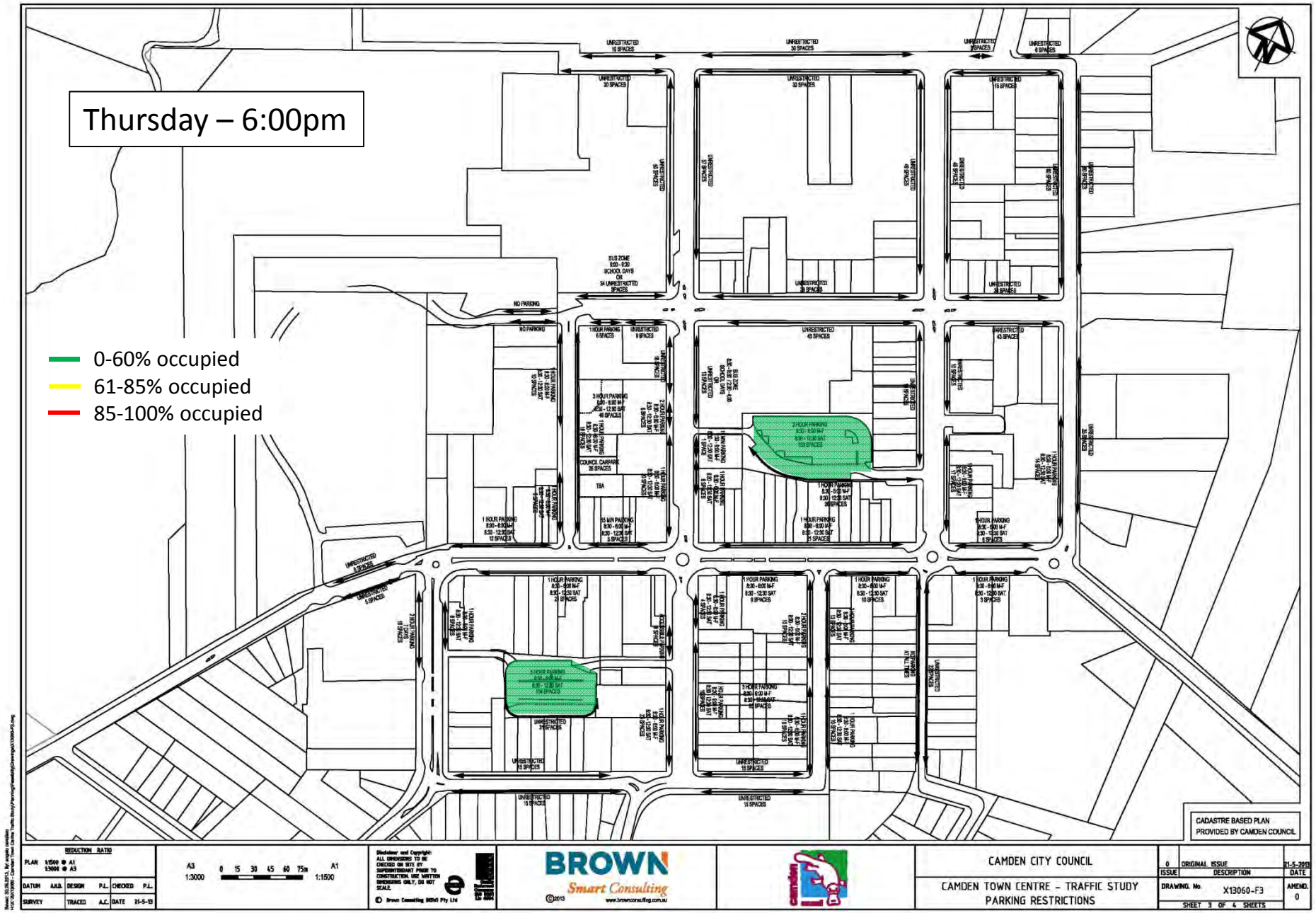
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61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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CAMDEN TOWN CENTRE - TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
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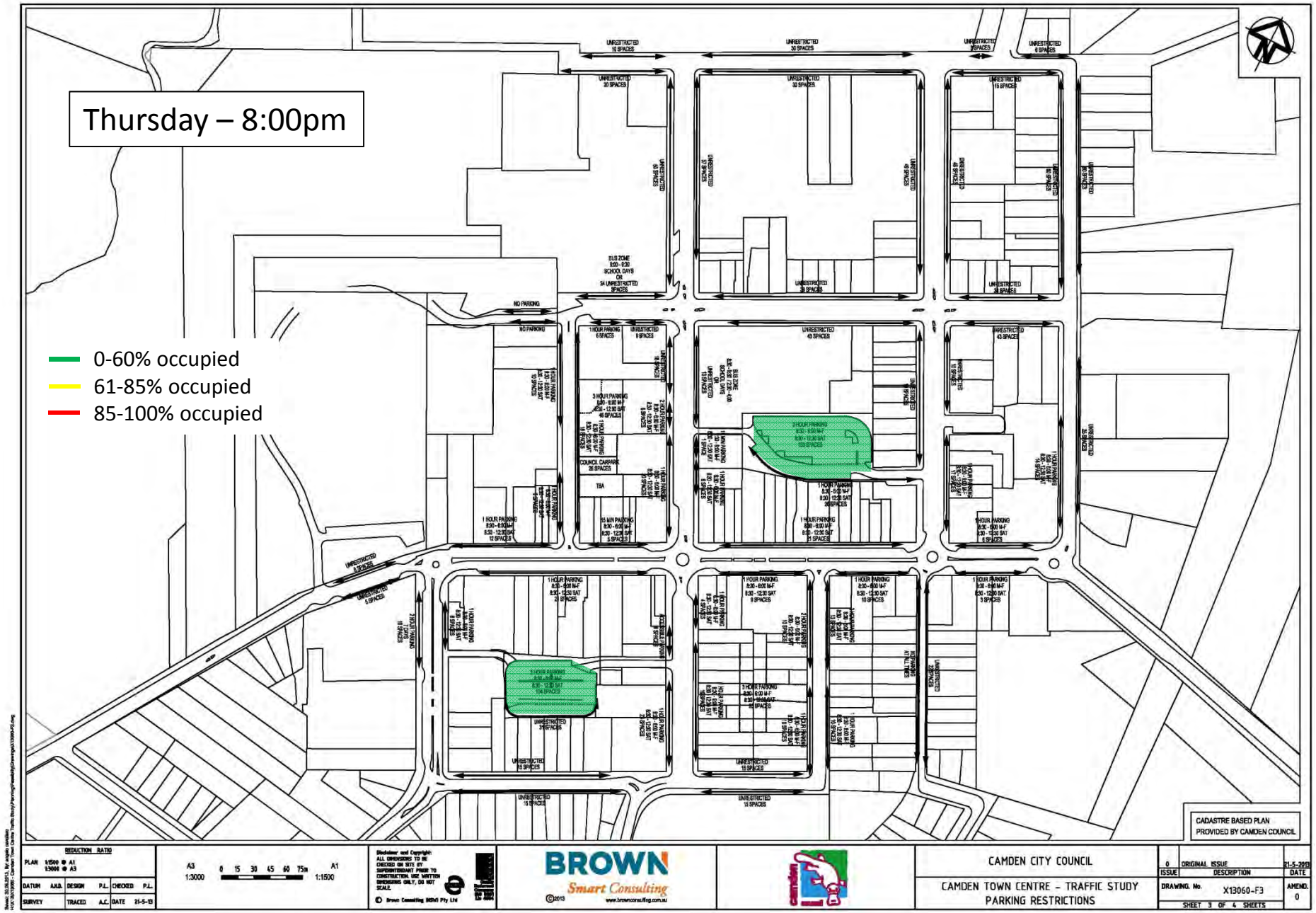
CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS

0 ORIGINAL ISSUE 21-5-2013
ISSUE DESCRIPTION DATE

DRAWING No. X13060-F3

SHEET 3 OF 4 SHEETS

AMEND. 0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85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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CAMDEN TOWN CENTRE - TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
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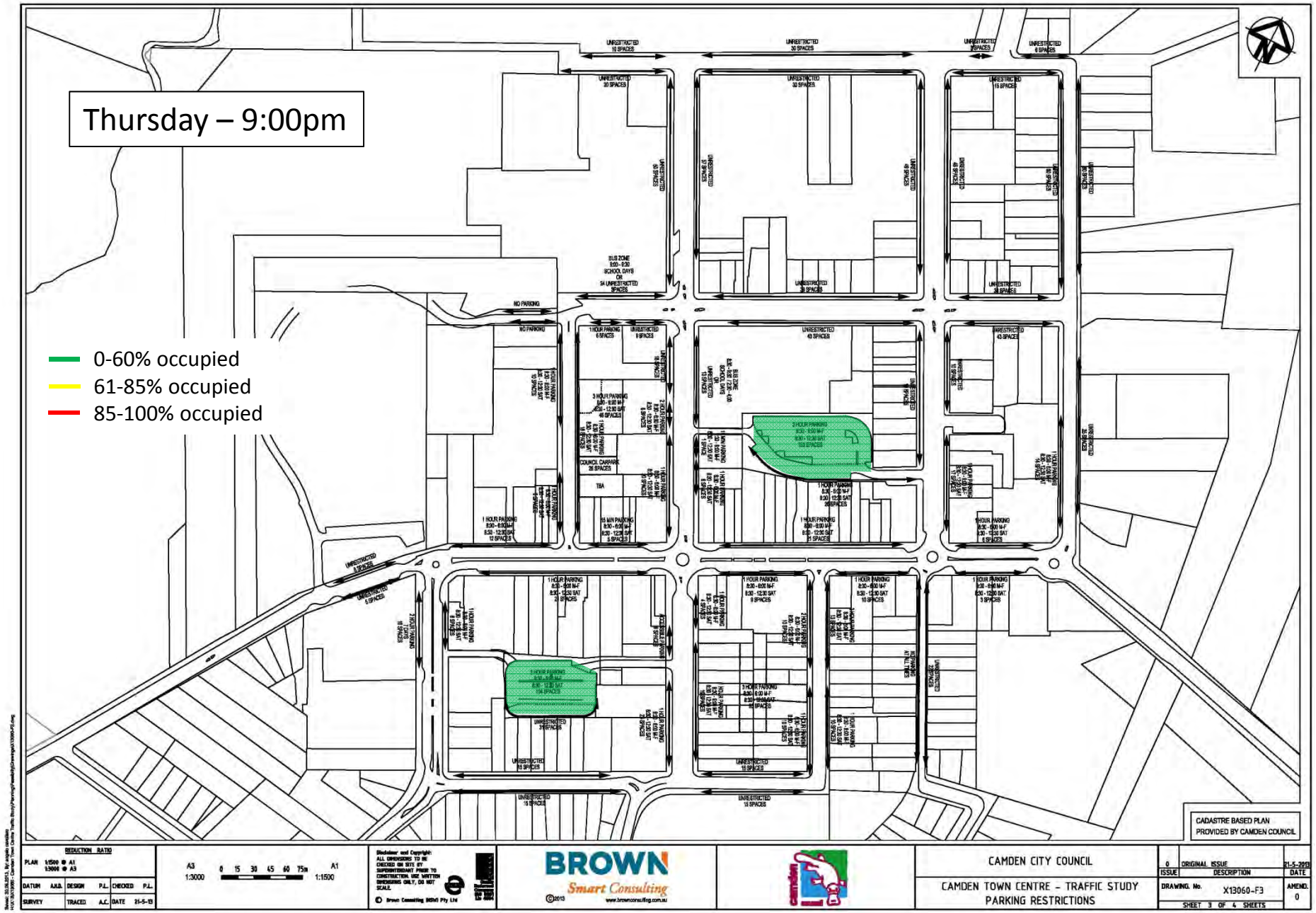

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CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS

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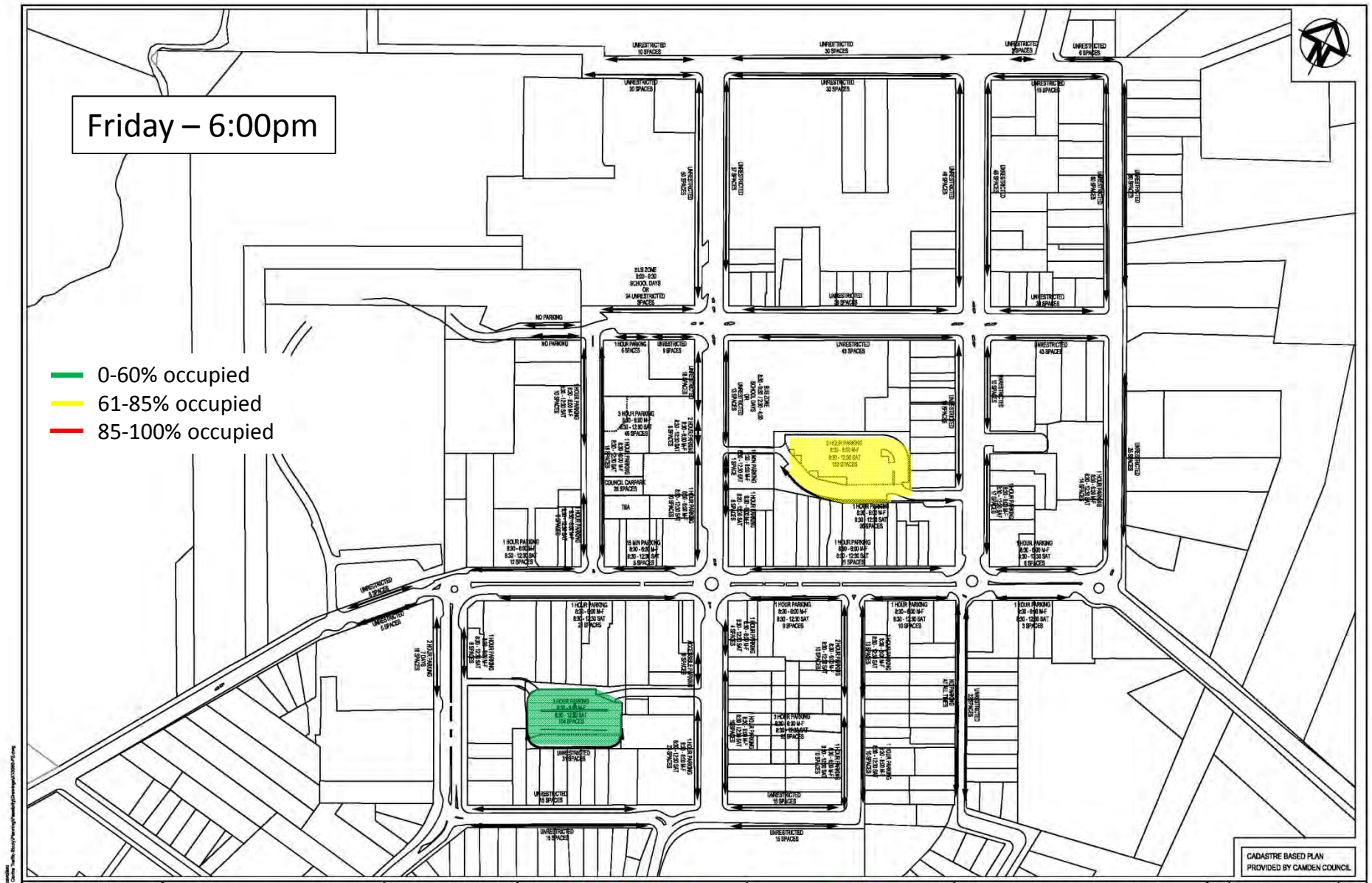

REDUCTION RATIO
PLAN 1:500 ● A1 1:1000 ● A3
DATUM AHD DESIGN P.L. CHECKED P.L.
SURVEY TRACED A.C. DATE 21-5-13

A3 1:3000 0 15 30 45 60 75m A1 1:1500

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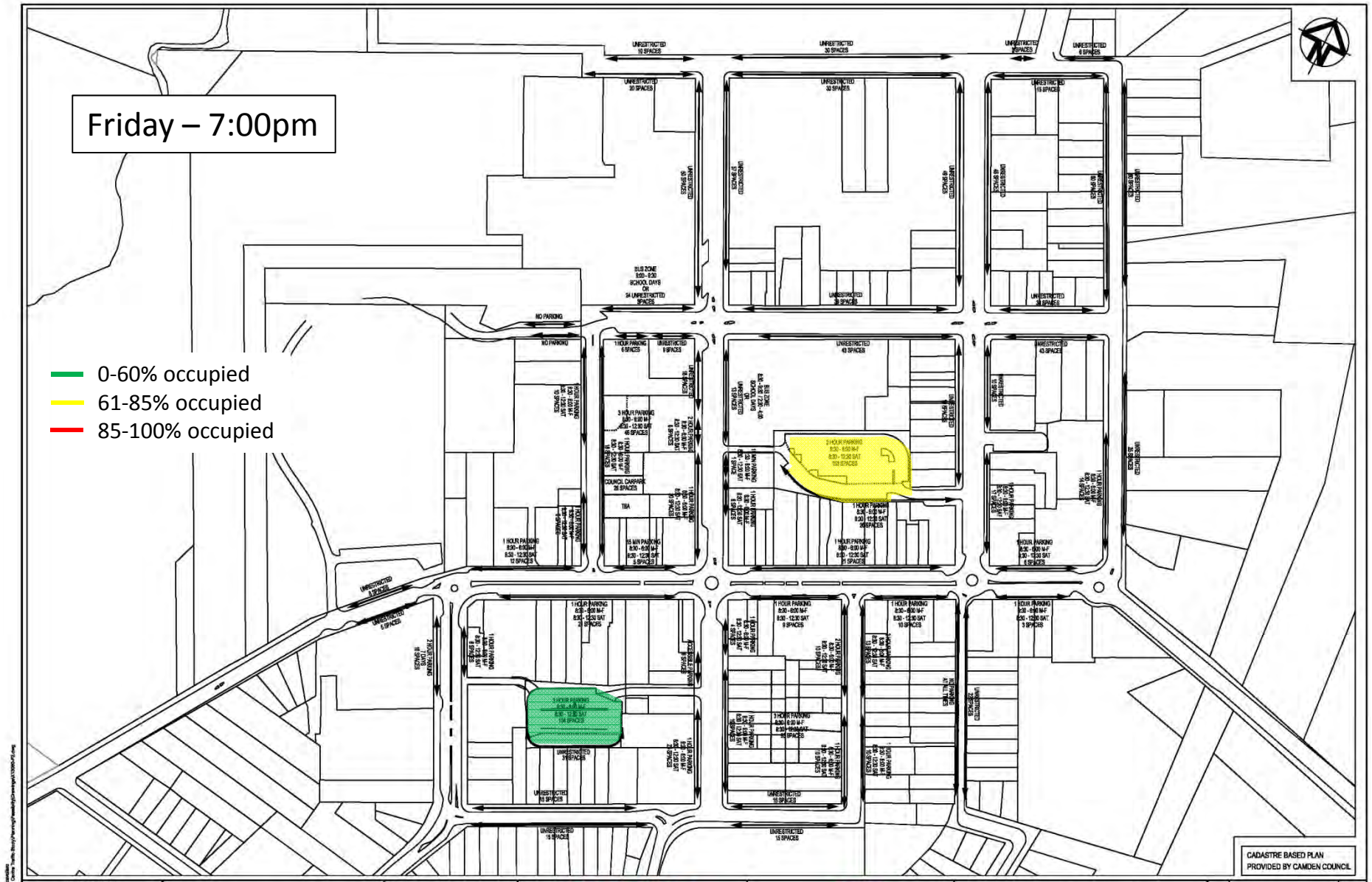
CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS

ISSUE	DESCRIPTION	DATE
0	ORIGINAL ISSUE	21-5-2013

DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS
AMEND. 0


Friday – 7:00pm
0-60% occupied
61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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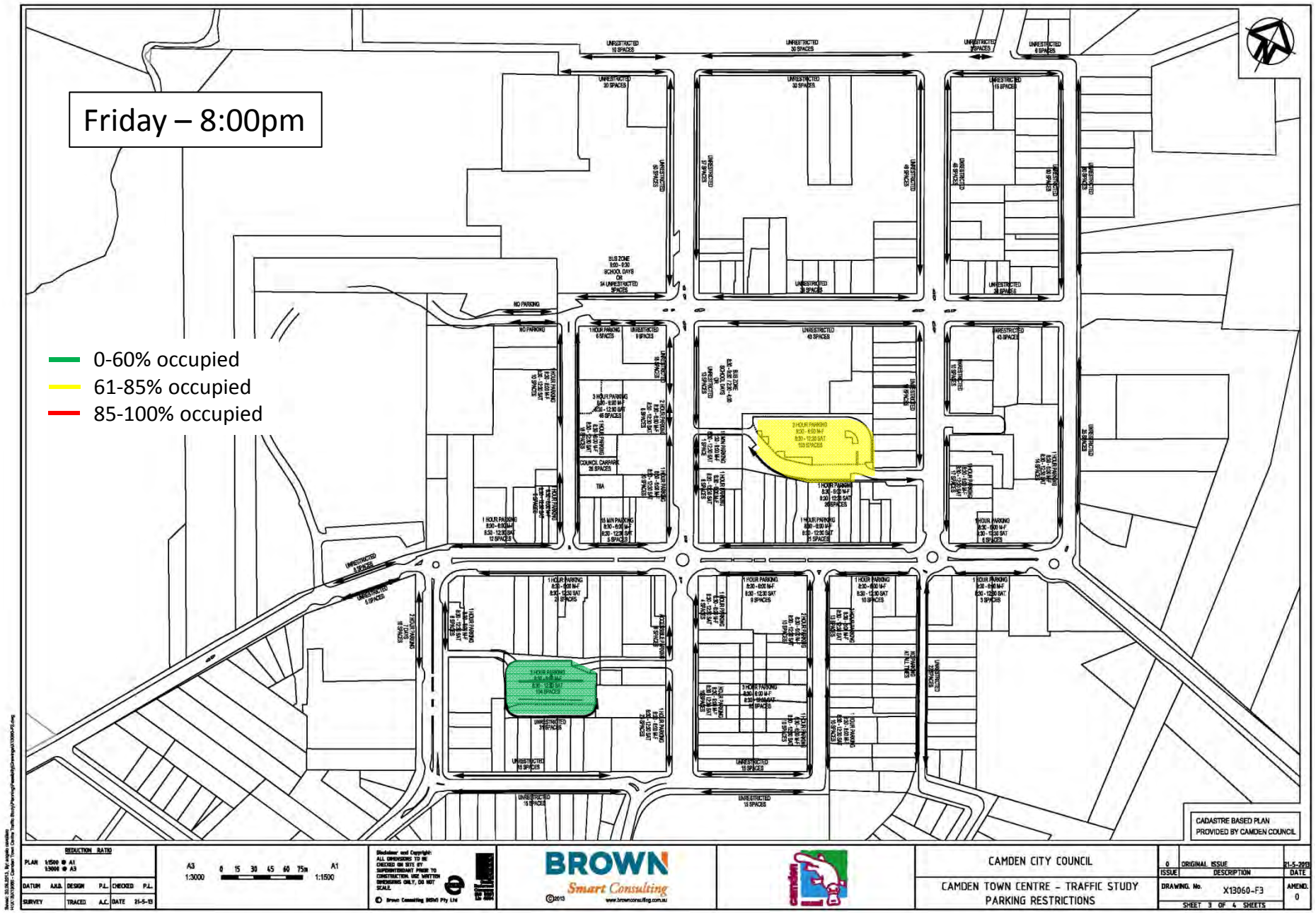
CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS


Friday – 8:00pm
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61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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CAMDEN TOWN CENTRE - TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
DRAWING No. X13060-F3
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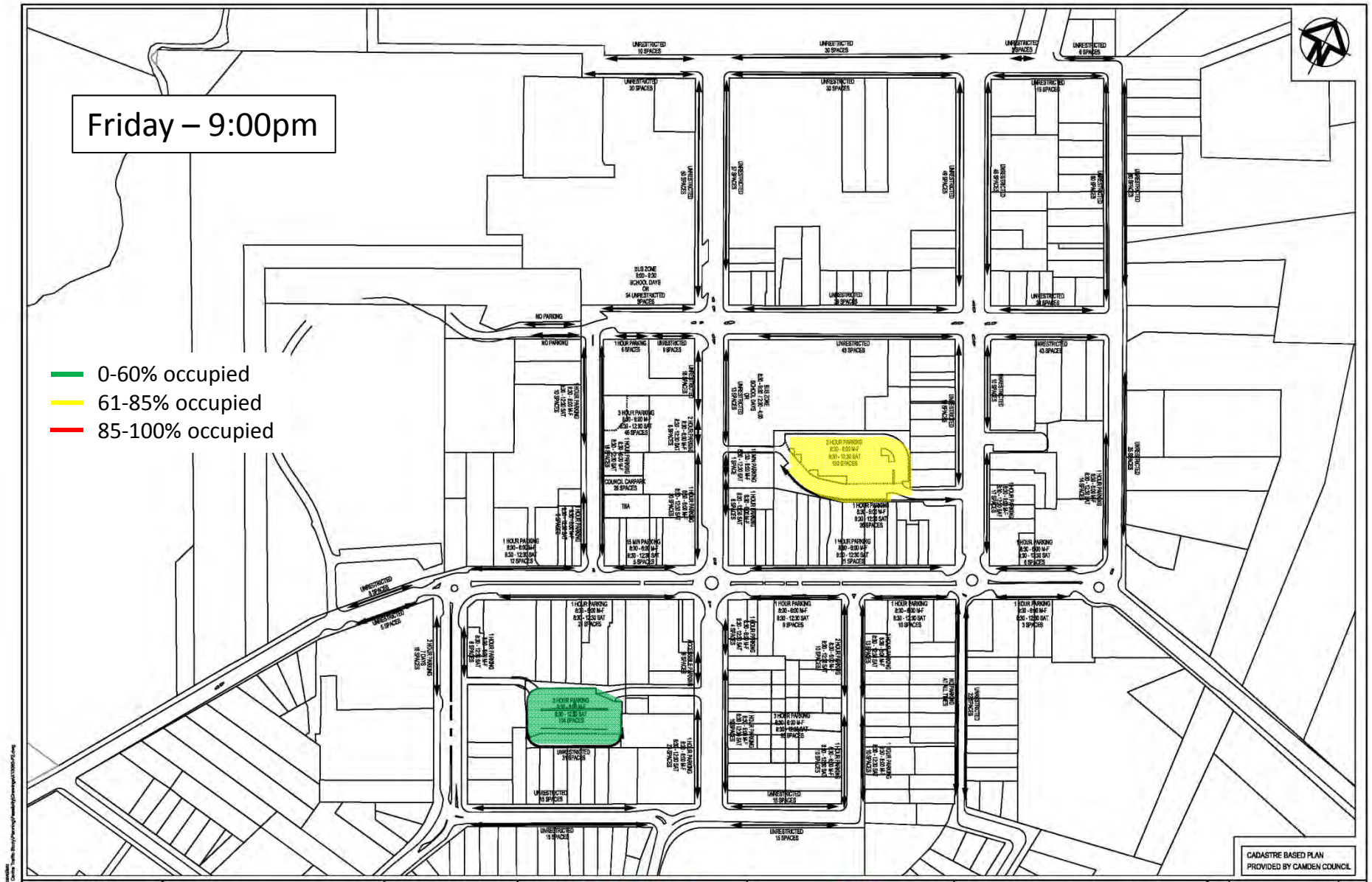

REDUCTION RATIO
PLAN 1:500 ● A1 1:1000 ● A3
DATUM AHD DESIGN P.L. CHECKED P.L.
SURVEY TRACED A.C. DATE 21-5-13

A3 1:3000 0 15 30 45 60 75m A1 1:1500

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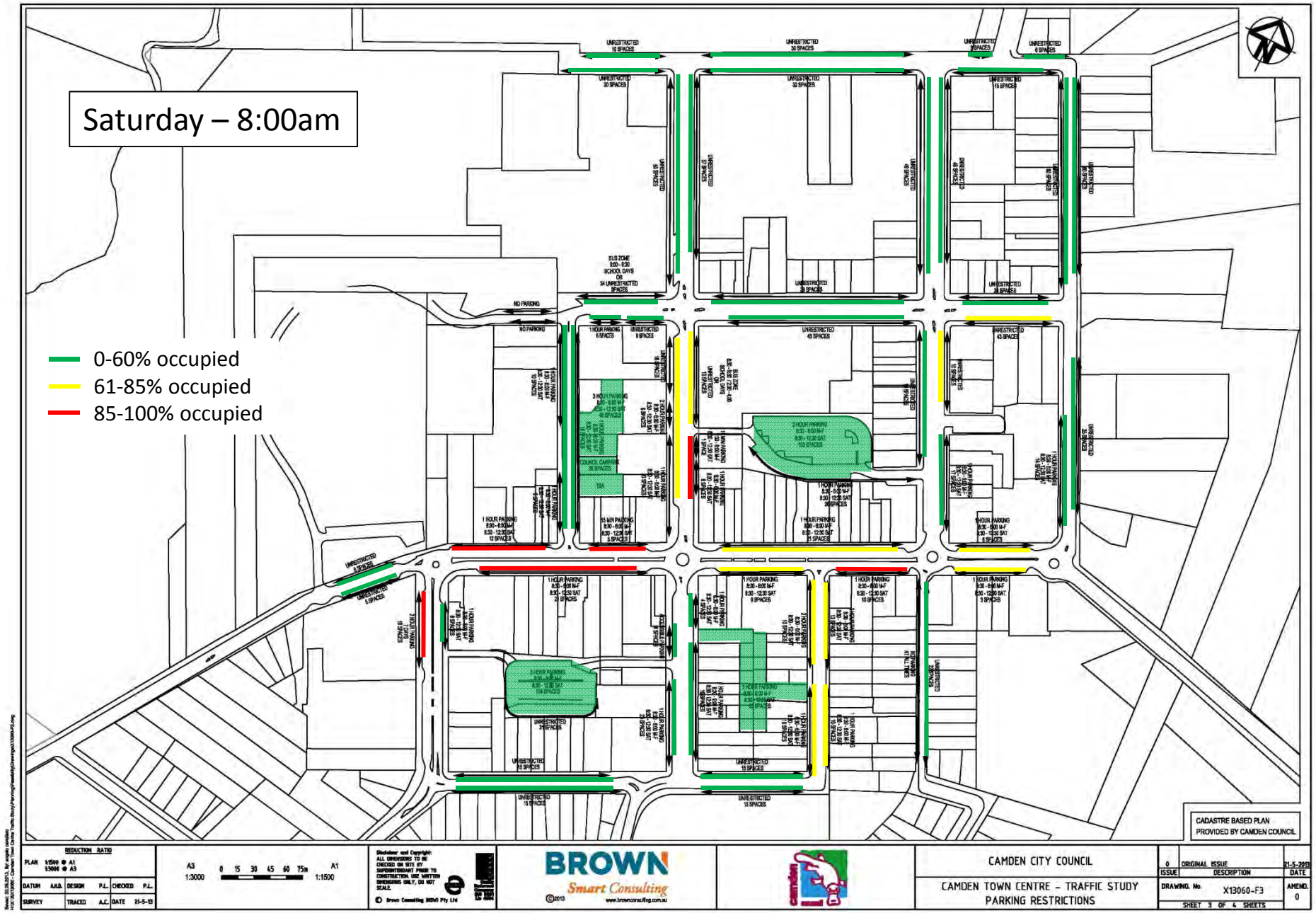
Saturday – 8:00am
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61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
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REDUCTION RATIO
PLAN 1:500 ● A1 1:1000 ● A3
DATUM AHD DESIGN P.L. CHECKED P.L.
SURVEY TRACED A.C. DATE 21-5-13

A3 1:3000 0 15 30 45 60 75m A1 1:1500

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ISSUE	DESCRIPTION	DATE
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AMEND. 0

CAMDEN CITY COUNCIL

CAMDEN TOWN CENTRE – TRAFFIC STUDY
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ISSUE 0 ORIGINAL ISSUE 21-5-2013

DRAWING No. X13060-F3

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CAMDEN TOWN CENTRE – TRAFFIC STUDY
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0 ORIGINAL ISSUE 21-5-2013
ISSUE DESCRIPTION DATE

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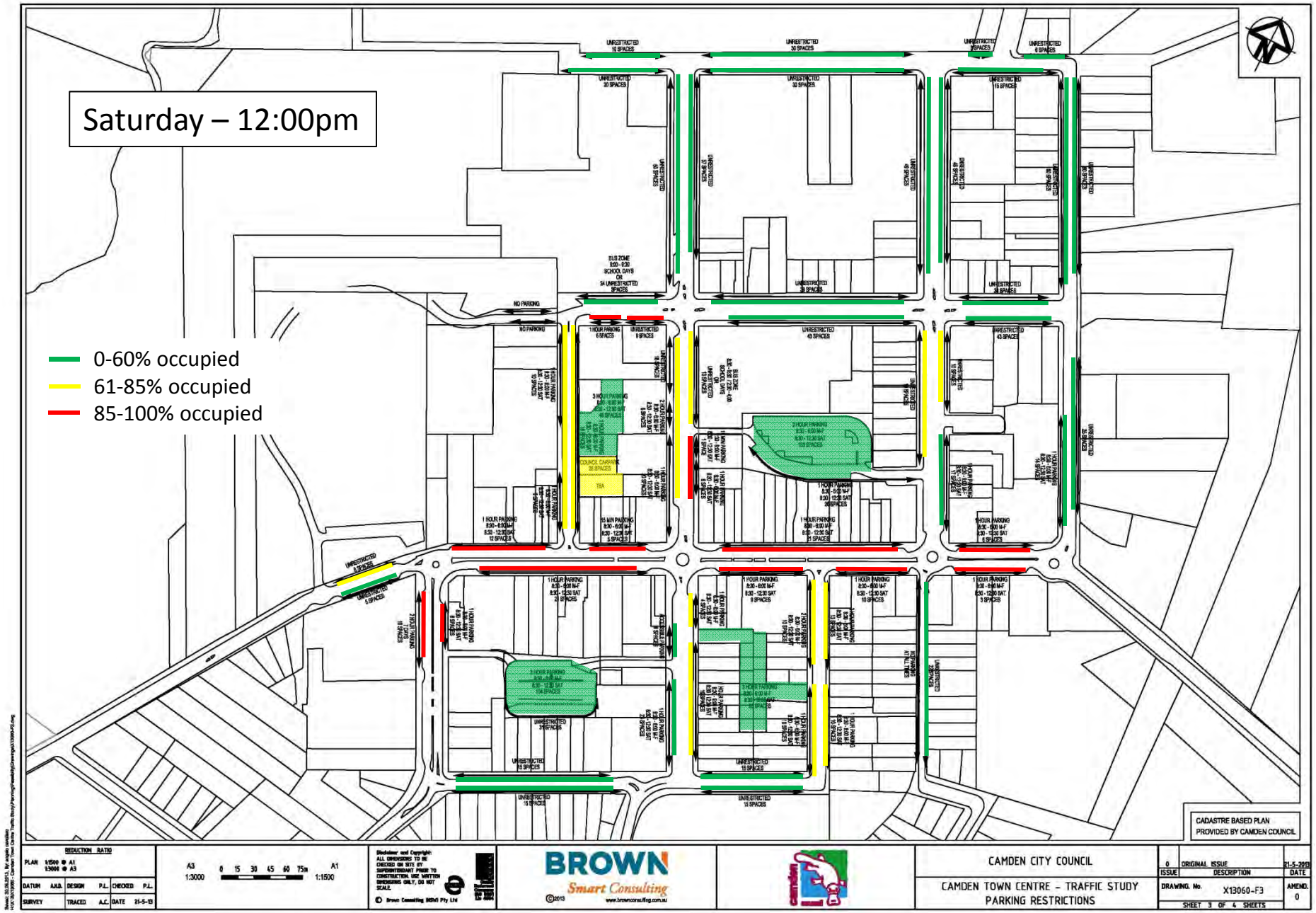
SHEET 3 OF 4 SHEETS

AMEND. 0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CADASTRE BASED PLAN
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CAMDEN TOWN CENTRE - TRAFFIC STUDY
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ORIGINAL ISSUE
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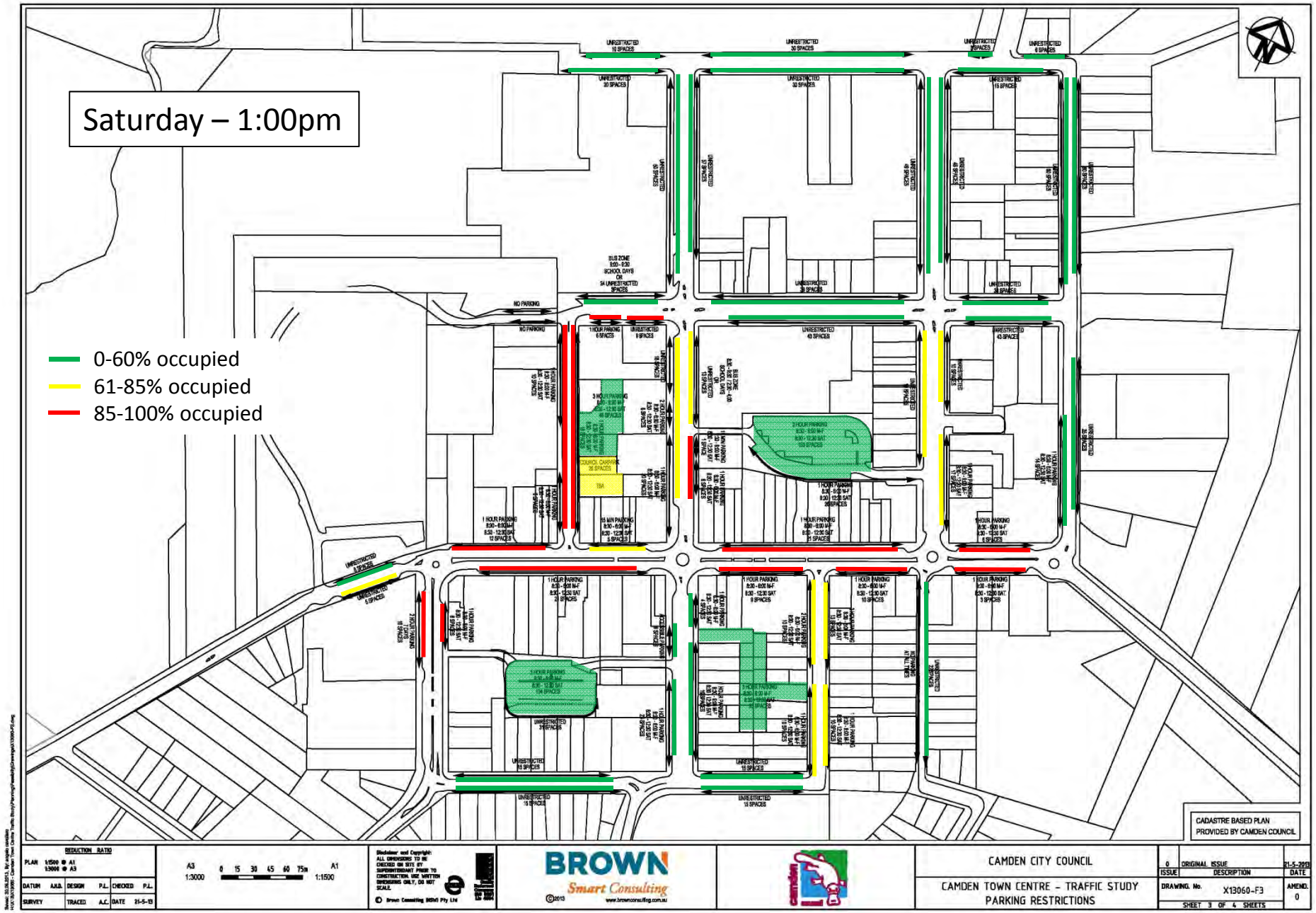
SHEET 3 OF 4 SHEETS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CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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CAMDEN TOWN CENTRE - TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
21-5-2013
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS


Saturday – 2:00pm
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61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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CAMDEN CITY COUNCIL
CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS
ORIGINAL ISSUE
21-5-2013
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS


Saturday – 3:00pm
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61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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CAMDEN TOWN CENTRE - TRAFFIC STUDY
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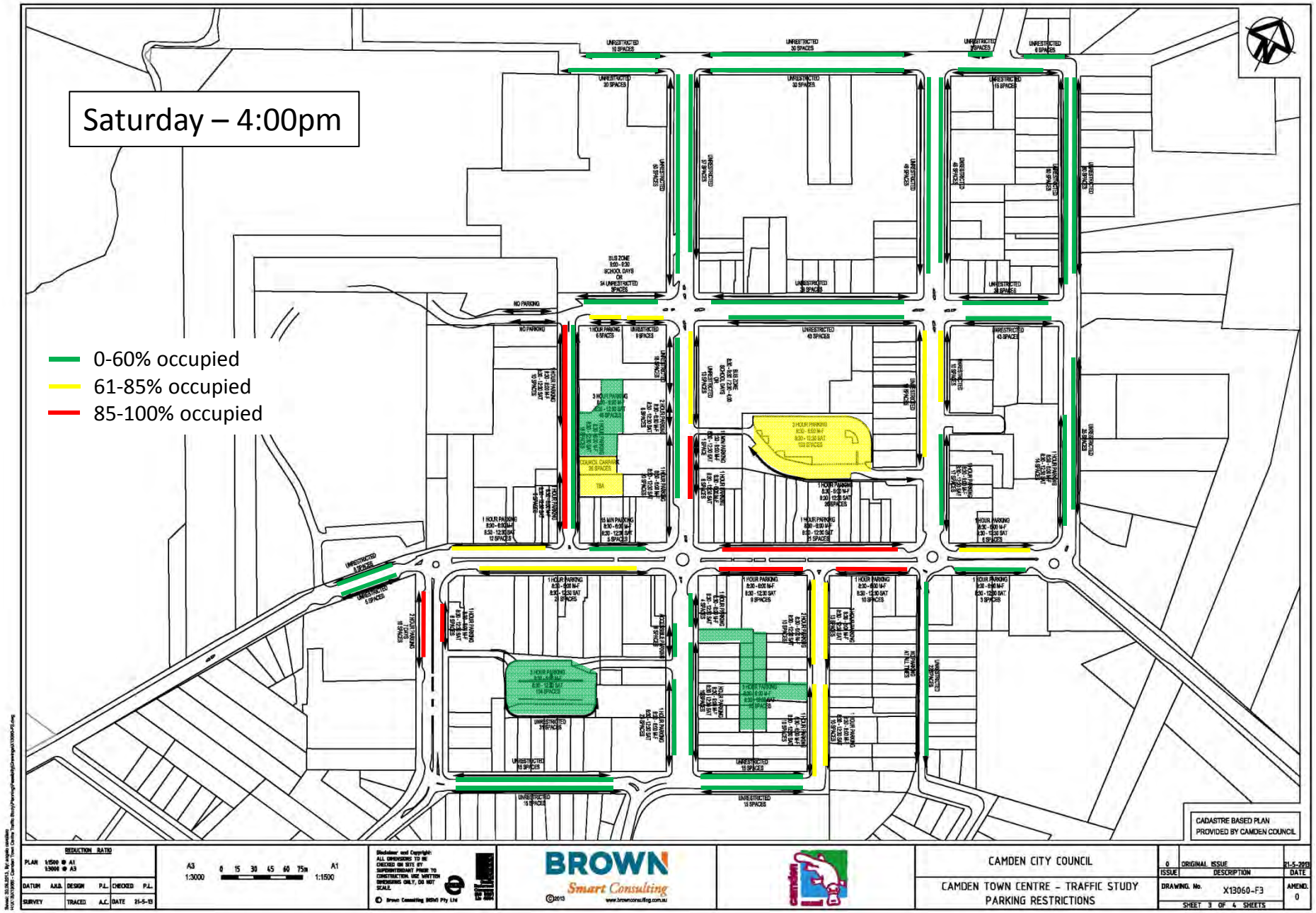
ORIGINAL ISSUE
21-5-2013
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS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CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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PARKING RESTRICTIONS
ORIGINAL ISSUE
21-5-2013
DRAWING No. X13060-F3
SHEET 3 OF 4 SHEETS


Saturday – 5:00pm
0-60% occupied
61-85% occupied
85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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CAMDEN TOWN CENTRE - TRAFFIC STUDY
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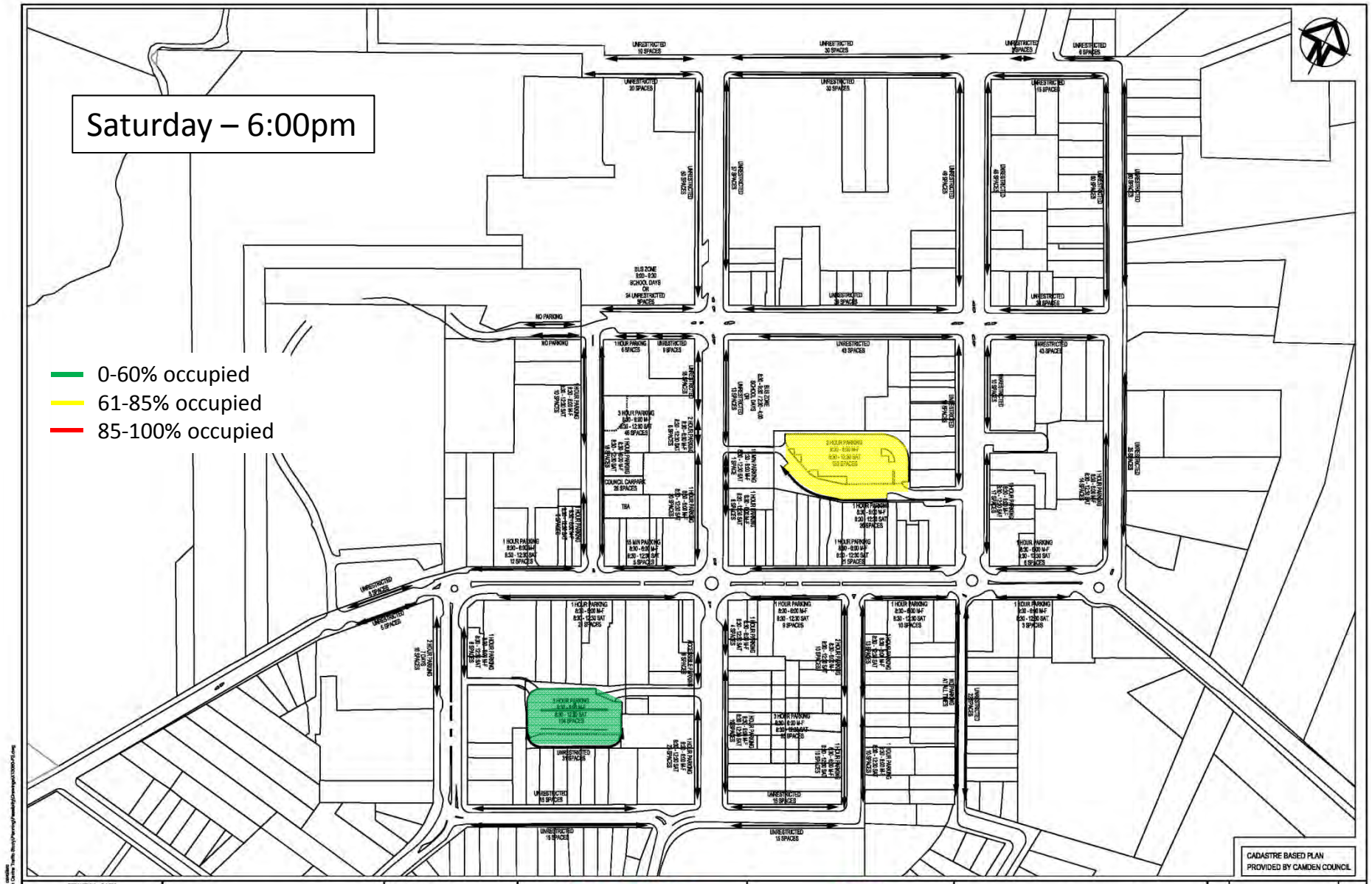
SHEET 3 OF 4 SHEETS



REDUCTION RATIO
PLAN 1:500 ● A1 1:1000 ● A3
DATUM AHD DESIGN P.L. CHECKED P.L.
SURVEY TRACED A.C. DATE 21-5-13

A3 1:3000 0 15 30 45 60 75m A1 1:1500

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CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS

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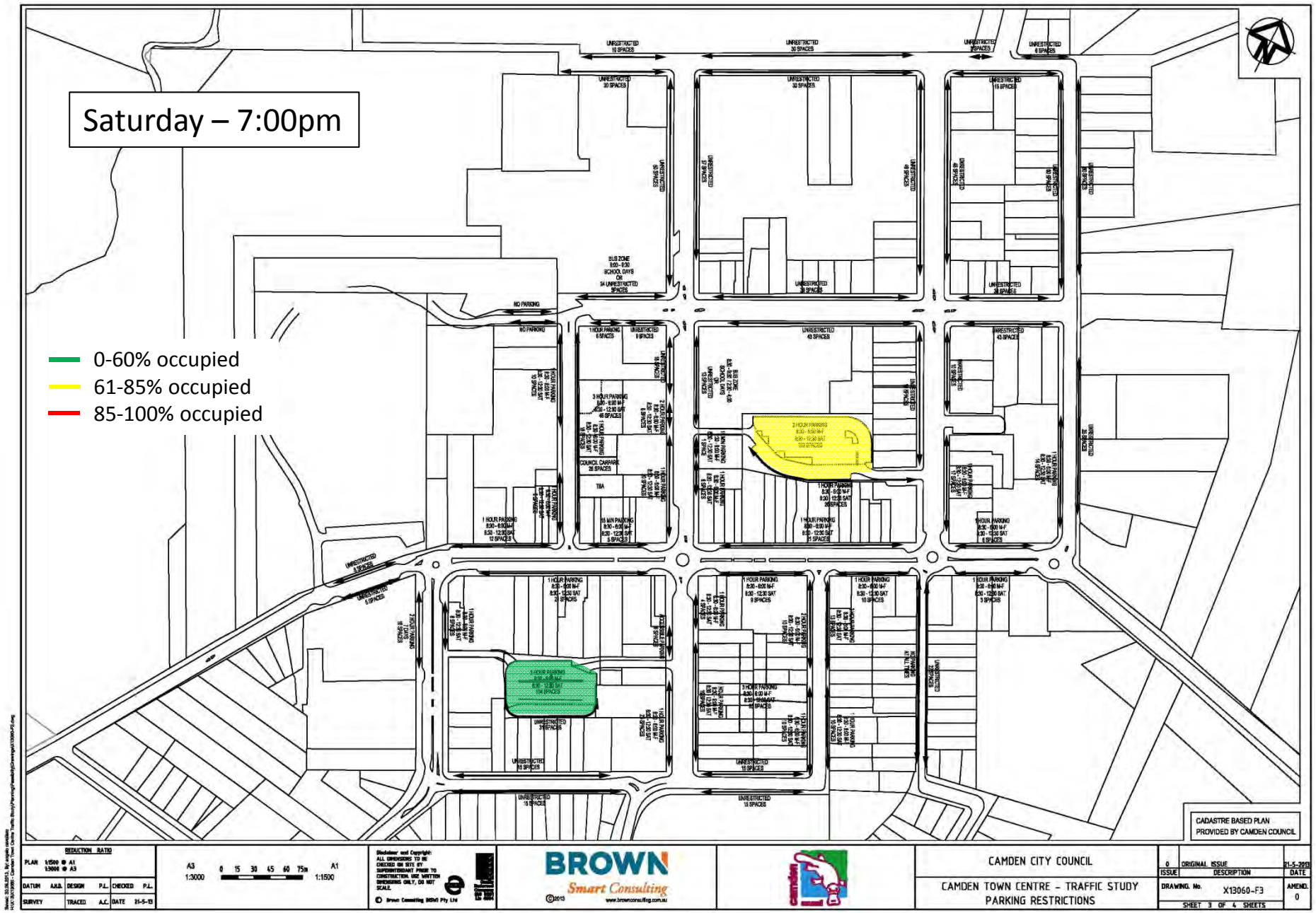
SHEET 3 OF 4 SHEETS
AMEND. 0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85-100% occupied
CADASTRE BASED PLAN
PROVIDED BY CAMDEN COUNCIL
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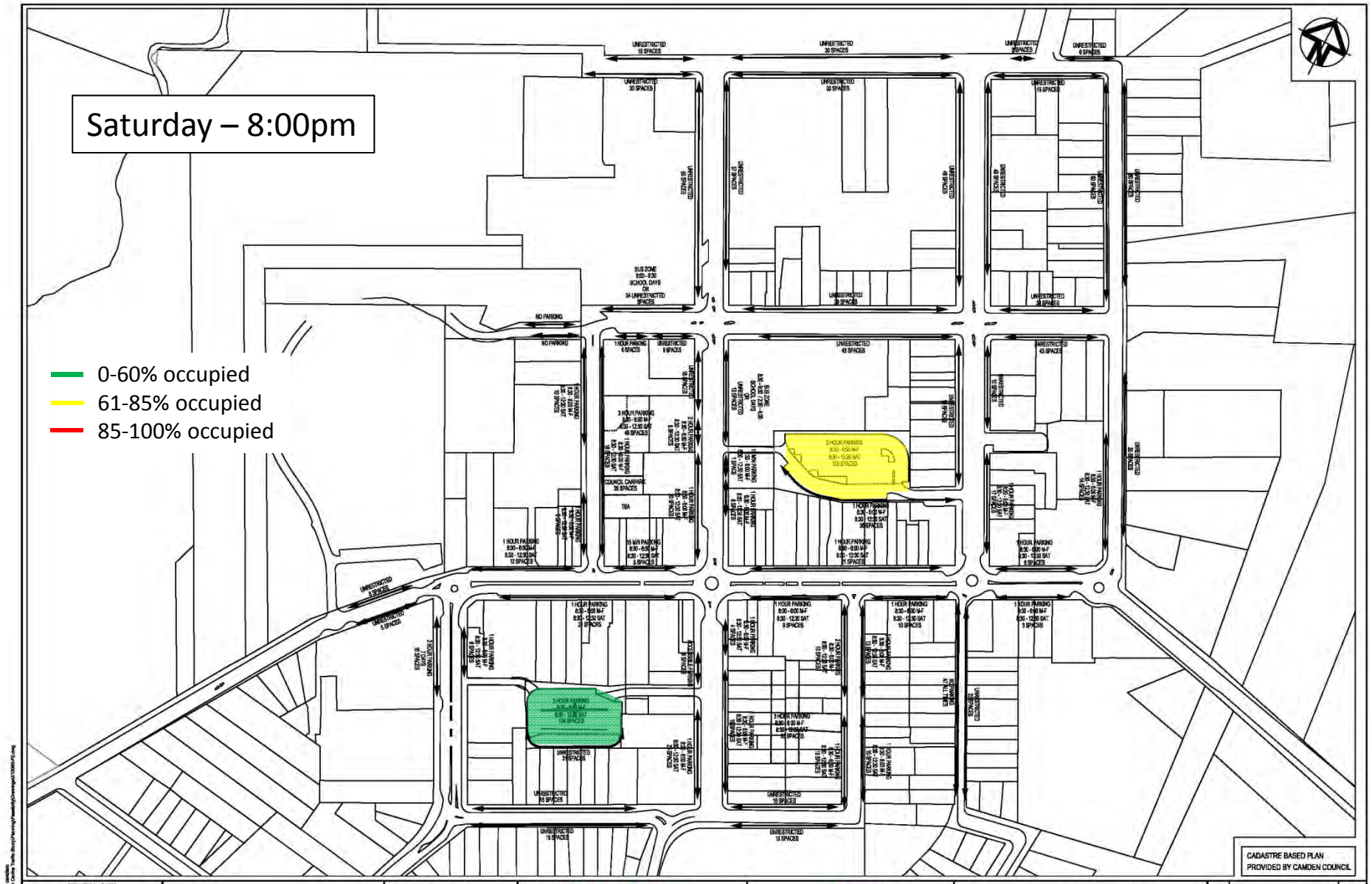
SHEET 3 OF 4 SHEETS



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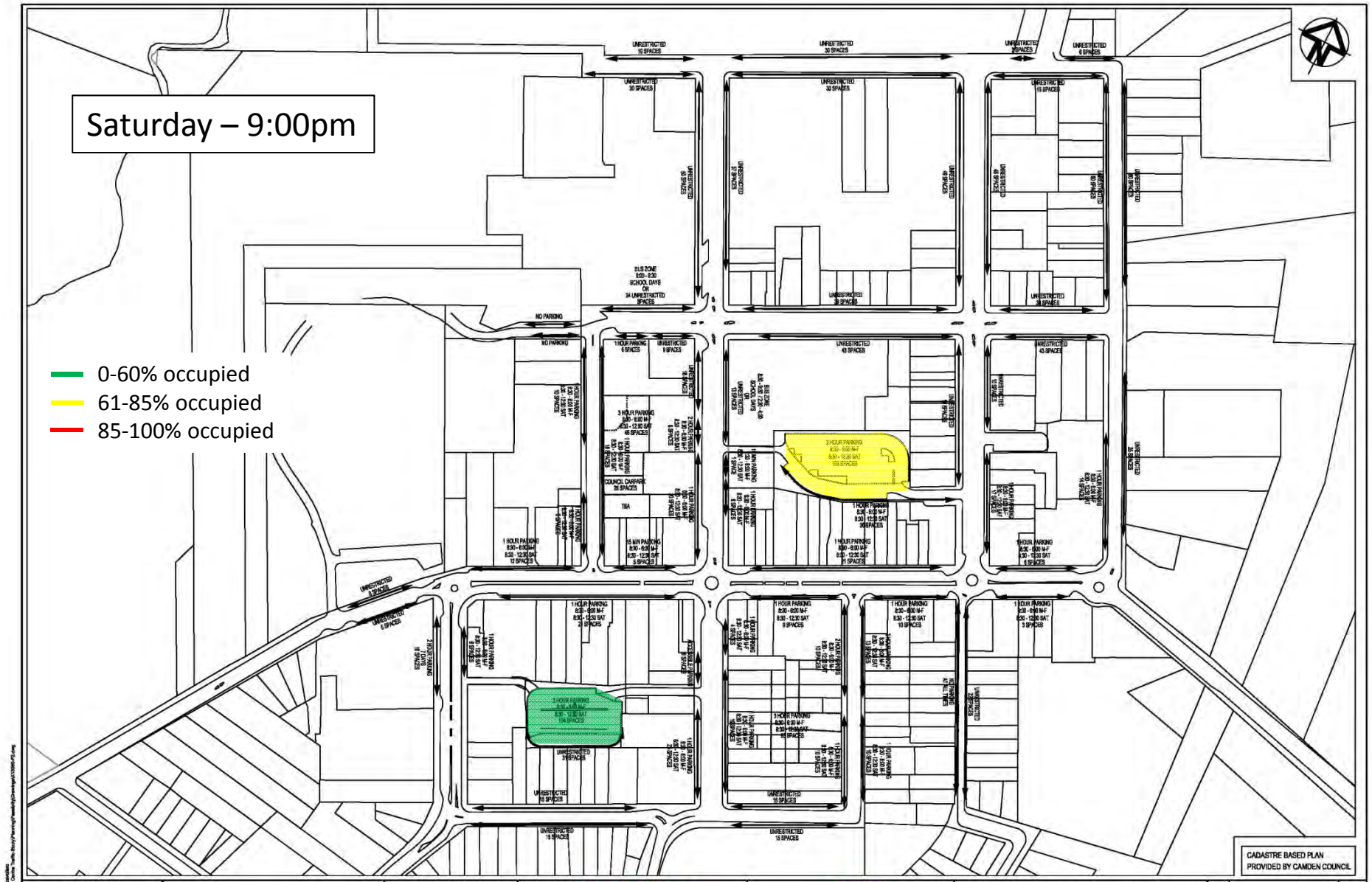

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CAMDEN CITY COUNCIL

CAMDEN TOWN CENTRE – TRAFFIC STUDY
PARKING RESTRICTIONS

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Appendix B Accident Statistics Review

Appendix B: Accident Statistics Review

		Jan-June	Grand Total
Total Accidents	**148**	**6**	**154**
Total Degree 1	**2**	**0**	**2**
Total Degree 2	**56**	**3**	**59**
Total Degree 3	**91**	**3**	**94**

	Total Degree 1	Total Degree 2	Total Degree 3	Total Accidents	Accident Per Year	No Ped Accidents
Alpha	0	0	2	2	0.27	0
Argyle	1	22	18	41	5.47	10
Barsden	0	0	1	1	0.13	0
Broughton	0	5	9	14	1.87	1
Cawdor	1	3	10	14	1.87	0
Edward	0	0	1	1	0.13	0
Elizabeth	0	6	7	13	1.73	9
Exeter	0	0	0	0	0.00	0
Hill	0	1	0	0	0.00	1
John	0	1	5	6	0.80	3
Little	0	1	1	2	0.27	1
Macarthur	0	7	22	29	3.87	1
Menangle	0	4	9	13	1.73	1
Murray	0	3	7	10	1.33	1
Oxley	0	1	0	1	0.13	1
Park	0	0	0	0	0.00	0
Pindari	0	2	1	3	0.40	1
View	0	0	0	0	0.00	0
Total	2	56	93	150		30

Appendix C Traffic Modelling Summary Paper

Traffic Modelling Working Paper

1.0 Introduction

A traffic model was prepared for this study to assist in the analysis of traffic in Camden Town Centre. The model selected was an application called Commuter produced by Azalient (refer to www.azalient.com). This is a nanosimulation model and provides agent based analysis of the movements and interactions between the road network and vehicles and pedestrians.

This working paper describes the process used to establish the base models and how they were subsequently modified to provide an indication of future traffic conditions.

2.0 Software selection

To analyse traffic in town centres it is important to endeavour to reflect the many things that influence traffic system performance. These include:

- Interactions between through vehicles with vehicles parking at kerbside.
- Queuing on approach to intersections.
- The impact of pedestrians on traffic movements where pedestrians have right of way.
- The effect of different vehicle types, with different kinematic performance, as well as the effect of different driver behaviours.
- The effect of buses stopping along routes through the town centre.
- Circulating traffic and the relatively high number of u-turns.

Commuter provides these functions, as well as more sophisticated facilities to manage traffic signals and large public transport networks. This application has been in use for a number of years in NSW and has been applied on a number of projects by various agencies, including:

- SCATS and the Environment – Spit Road Corridor for RTA/RMS, where it was used to test the impact of SCATS control and different signal controls on the environmental performance of the Spit Road Corridor from Sydney Road through to the Warringah Freeway.
- Wynyard Precinct model – for TfNSW, where was used to test the operational performance of vehicles, buses, pedestrians in a congested part of the CBD's road network.

The version of Commuter used on this project is 5.2 (64 bit implementation).

3.0 Base model development

3.1 Process

The base models are established to reflect existing traffic and road conditions. These are then modified to reflect expected future traffic demands and provide an insight into how traffic might operate in the future, including the assigned volumes.

The process followed was:

- Collate and analyse survey information and prepare for incorporation in the models
- Select model hour within the survey periods
- Build the model networks, using the base information and information from site visits
- Develop the demand specification for the models, to produce a pattern matrix
- Calibrate the demands through a process of demand adjustments and network modifications
- Review base models against calibration and validation criteria

The following sources of base information were drawn upon:

- Town centre cadastral boundaries
- Aerial photographs of the town centre
- Traffic counts
- Traffic surveys
- Census information
- Bus timetables, network maps and bus stop locations

3.2 Collate and Analyse survey information

The field data was received from the survey firm and reviewed prior to its preparation for inclusion in the traffic models. This review process entailed the production of detailed stickfigures of the town centre in excel to represent the key traffic facilities such as roads, intersections and car park access points.

The turning movement counts were read into the spreadsheets, which permitted ready identification of mis-closures in the counts. These are where the departure flows from an intersection do not correspond with the arrival flows at downstream intersections. This can be caused by intervening land use and intersections, it can also be due to timing differences in the surveys.

The turning movement counts were also compared within the stickfigures (and for equivalent hours) with turning movement counts taken in 2010. This comparison showed that some counts were down and some were up, which is expected when looking at single day counts several years apart. The earlier counts did not include u-turn movements at the large roundabouts, which may also explain some of the apparent differences between the years.

Based on this review, no adjustments were made to the raw counts, and minor misclosures remaining in the data used to calibrated the demand matrices. The implication of this is that some of the differences between modelled flows and observed counts form the fieldwork will be due to minor inconsistencies in the data, rather than a problem with the models.

The origin destination was reviewed to identify travel time distributions and average travel times in each survey period between selected road sections that corresponded with survey stations.

3.3 Selection of model hour within the survey periods

The attached note (ATTCHMENT A) describes the process used to select hours within survey periods for traffic modelling. A model was established for the peak hour within each of the survey periods:

- Thursday morning, with peak between 8:15am and 9:15am
- Thursday evening, with peak between 4:30pm and 5:30pm
- Saturday morning, with peak between 9:00am and 10:00am
- Saturday afternoon, with peak between 5:15pm and 6:15pm.

To achieve realistic network loads at the commencement of the analysis hour a fifteen-minute warm-up period was run in the lead up to the analysis hour.

3.4 Model network development

The model network was developed using a cadastral layer and aerial photographs. This provided dimensional control and assisted in the initial selection of road network elements to position within the model. Subsequent site visits and network testing refined the network further.

The key features of the model networks are:

- Network extent from Sheathers Lane in the west through to Macarthur Road in the east and Macquarie Grove in the north to Old Hume Highway and Menangle Road in the south (refer to Figure 1 below).
- The network reflects traffic conditions, such as lane widths, intersection mode of control and priority arrangements, key access points, sign posted speed limits, with School zone active during Thursday morning model.
- On-street parking is included where this has an impact on traffic flow and where it is important for traffic distribution control.
- A relatively fine grained zonal system was developed to reflect the dispersed pattern of traffic loading to the network and to provide control over movements.
- Inclusion of scheduled route buses within the modelling system.
- Marked foot crossings included where activity on these has an impact on traffic flow.

The following series of figures show the traffic model's network in progressively more detail.

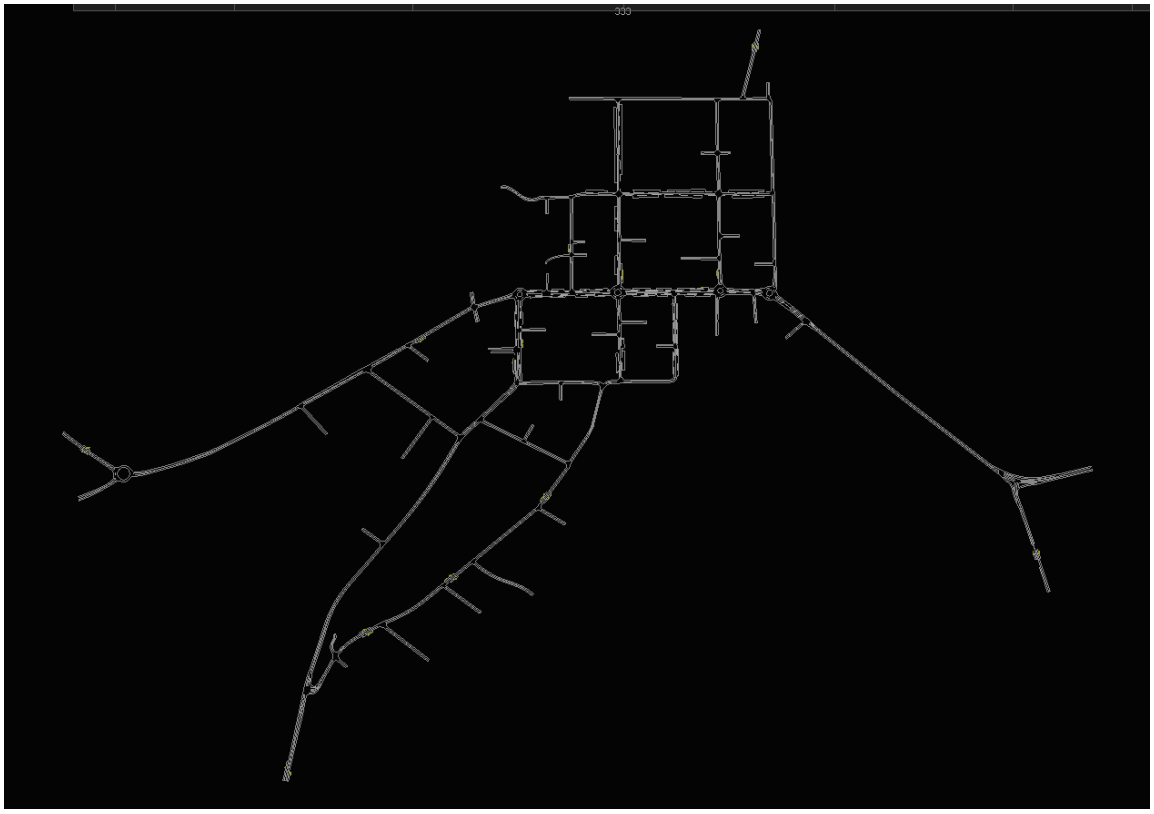


Figure 1 – Model extents

Figure 2 – Model network of town centre

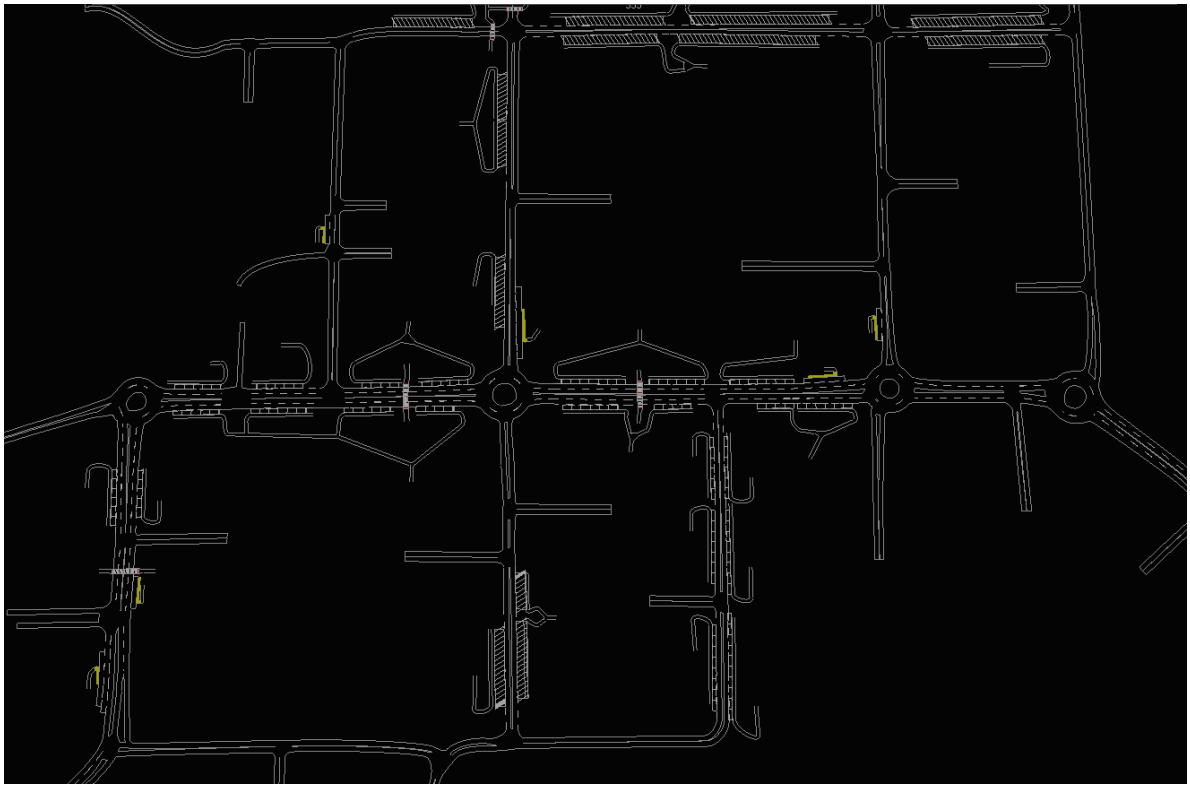


Figure 3 – Model network of central town centre, showing on-street car parking and pedestrian crossings

3.5 Network spatial information

A cadastral layer provided by the client in DWG format was imported into the modelling application and this was supplemented with aerial photographs, to provide spatial control.

3.6 Road elements

Links were coded into the model using default links with:

- Signposted speed limits as evidenced on the ground – the only time of day change to speed limits was the school speed zone, which is marked along John Street north of Argyle Street, Mitchell Street from west of Elizabeth Street to west of Oxley Street and the north end of Oxley Street
- Default lane widths of 3.0m which were subsequently adjusted where required

Default cost factors of 1.0 were subsequently adjusted to provide differentiation of routes such that:

- Argyle Street had an adjusted cost factor of 1.0
- North of Argyle Street had an adjusted cost factor of 1.3
- South of Argyle Street had an adjusted cost factor of 1.5

During the network calibration process of the Thursday PM peak model the relativities of cost factors along different routes was tested and the above scheme was modified to:

- Argyle Street cost factor of 1.0
- North of Argyle Street cost factor of 1.7
- South of Argyle Street cost factor of:
    - View Street cost factor of 1.3
    - John Street south cost factor of 1.3
    - Broughton Street from View Street to John Street cost factor 1.5
    - Broughton Street from John Street to Menangle Road cost factor 1.3
    - Broughton Street west of Menangle Road cost factor 1.7
    - Murray Street cost factor 1.0.

This scheme was applied in the other three time period networks without modification as it produced reasonable routing of demands.

3.7 Intersection coding

Intersections were generally coded to reflect conditions on the ground in terms of mode of control, approach number of lanes and configuration, and priority arrangements.

The exception to this was the four arm mini-roundabout on Cawdor Road south west of Murray Street, which was coded as a four way priority intersection, with the main road (Cawdor Road) having priority. This approach was used to avoid issues with mini-roundabout operations and is considered satisfactory in terms of traffic operations.

Priority coded in the model was checked at all intersections to ensure that traffic with right of way was not yielding to other vehicles. Commuter provides four levels of priority:

- Stop
- Give way
- Yield
- Free flow

The approach used was to select the particular priority based on a driver's expectation – i.e., a stop sign on the ground was generally coded so that vehicles facing the stop sign were assigned to priority level 'Stop'. Some adjustments to this were made during the network calibration process with changes between 'Give way' and 'Yield' selected depending on the traffic operations within the model. Due to the relatively low traffic volumes away from Argyle Street, the actual priority adopted in those areas was not critical over all operations, as long as the relative hierarchy of priority was maintained between movements.

Camden town centre does not currently have traffic signals for intersection control or for pedestrian crossings.

3.8 On-street parking coding

On-street parking was included in the model primarily because:

- It is a source of friction within the town centre, influencing network costs and assignment of traffic.
- On-street parking areas are a key, fine-grained element of the traffic demand specification for most town centres, and Camden is no different.

To reflect these attributes of on-street parking, not all on-street parking in the town centre has been included. It is evident from the models' network the locations of modelled on-street parking.

The parking was coded by creating:

- the parking lane, either parallel or angle parking, as appropriate;
- a parking zone over the parking lane;
- walkways beside the parking zones; and
- an area which generates/attracts people to walk to/from parked vehicles.

The walkways are simply to connect areas to parking zones – they do not endeavour to reflect footpath conditions or the direction of demand of town centre pedestrians – far more field work would be required to achieve this and for the purposes of this model, such refinement is not required.

We have not populated parking zones with parked vehicles at the commencement of the analysis period, so some of the parking zones look sparse at the commencement of some of the analysis period.

Due to the stochastic the nature of the model's demand generation process it is not possible to perfectly match parking area ins and outs so that the accumulation of traffic will fit within the number of spaces within the parking zone. Consequently, some parking zone choice rules were introduced to direct vehicles to an alternative one or two on-street parking zones, should their initially allocated destination one be full.

No other model facilities, such as incidents, were used to reflect friction in the road network.

3.9 Off-street parking coding

The major off-street car parking areas within the model extent are included in the model as transition zones, attached to person generating areas. These are coded as short side roads off the town centre roads, such as Elizabeth Street, with a priority intersection. The short access road into the car park terminates at a traffic zone (a transition zone) which is the place where the vehicles appears to vanish from the model, and their drivers walk to or from the person generating areas.

3.10 Bus stops and routes

The trails facility within Commuter was used to code in the major route bus services operated within the town centre. This used information about networks and routes from operator publications (from Busways' website), as well as information about bus stops available on www.131500.info.

The bus stops were coded along the trails in the appropriate location. At the edge of the model, additional bus stops were coded to permit buses to be loaded onto and off the road network at these places. The dwell time at these stops was set to a minimum value of 1 second.

Subsequently, the operative bus stops were associated in the definition of particular routes and their trails through the network.

Buses were released onto the model's road network in accordance with the timetables and then they proceed along the trails as fixed-route demands. The dwell time of buses at each stop was coded separately and reflects expectations given the potential boardings and alightings of the bus stop's surrounds and the function of the stop, based on the modeller's experience. For example, the main town centre bus stop, at John Street, has a longer dwell time than other bus stops. The model's operation is not particularly sensitive to the adopted dwell times as most stops, where the buses dwell, are located out of the travel lanes, and there are relatively few bus trips.

3.11 Pedestrian crossing facilities

The following marked foot crossing facilities (zebra crossings) were coded into the model:

- Argyle Street between John Street and Hill Street
- Argyle Street between John Street and Oxley Street
- Murray Street between Argyle Street and Broughton Street
- Mitchell Street's western approach to John Street
- John Street's northern approach to Mitchell Street

When a pedestrian steps onto a marked foot crossing in the model, the software stops vehicles from passing over the crossing. To prevent unrealistic delays at the first three crossings (listed above) in the model, they were coded as staged crossings, so that if a pedestrian steps on to the crossing on the southern carriageway, vehicles are not prevent from passing over the crossing on the northern carriageway (unless of course, there are also separate pedestrians on this crossing). These operate so that there is a 'separate' crossing of each carriageway.

The crossings are connected via footways to person generating areas located approximately where pedestrians would 'appear' from prior to using the crossing. These are included to provide realistic loading of the pedestrian crossing facilities and do not reflect the broader movements of pedestrians within the town centre.

3.12 Approach to traffic assignment

Traffic assignment in the model is governed by the approach to assignment specified in the model. For this project the following approach was used:

- Cost spreading 5%
- Standard model behaviour for drivers.

Pedestrian assignment is not a concern as pedestrians in the model had not route choice available to them.

3.13 Demand specification

3.13.1 Sources of demand

The following sources of demand are represented in the model:

- Light vehicle demand, based on person movements between person-generating areas and transition zones
- Heavy vehicle demand, based on vehicle movements between zones
- Bus demand, as discussed above, it is modelled as fixed route demands
- Pedestrian movements at marked foot crossings, with people moving between person-generating areas.

3.13.2 Demand distribution

Light and heavy vehicles spatial dimension of demand is specified with matrices:

- Light vehicles – demand is specified between person-generating areas through transition or on-street parking zones, where people are loaded into vehicles; the vehicles then enter the road network, travel to their destination transition or on-street parking zone, where they leave their vehicle and walk to the person-generating areas.
- Heavy vehicles – demand is specified between an origin traffic zone (a transition zone for light vehicles) to a destination traffic zone via the road network.
- Buses are specified so that each individual trip follows the bus route, with commencement reflecting the timetabled location of the bus at the edge of the model, or at the commencement bus stop.
- Person demand for pedestrian crossings is specified as movements between the person-generating areas connected at either end of the crossing and is also contained in a matrix.

These demand elements were developed in a staged process which is described in the following paragraphs.

An all-vehicle (light vehicles and heavy vehicles) pattern matrix was developed to represent movements between person-generating areas that were connected to transition zones for each model time period. This drew upon the origin destination survey information, land use information and traffic generation estimates. This provided an estimate of trip ends by direction at each zone, an estimate of traffic volumes across the model cordon, as well as an estimate of through traffic volumes. A balancing process was applied so that the estimated trip ends within the modelled area approximately reflected the non-through traffic volumes across the cordon. Then the cordon flows into the model were distributed proportionally among the internal trip ends. A similar process was applied to 'match' the out bound traffic across the cordon to origin trip ends within the modelled area.

This all-vehicle pattern matrix was assigned on the model network, and adjusted so that screenline flows within the model generally matched counts (within a tolerance). This adjustment process then adjusted the cordon flows so they generally matched the counts, again within a tolerance. The next step was a review of turning movements within the network, and where these were wayward, our approach was to follow key routes – Cawdor Road, Old Hume Highway, and Argyle Street – to gain an appreciation of the pattern of differences between assigned flows and observed counts from survey. In some cases an improvement could be achieved through a minor network adjustment, in other places the demand was adjusted. AT this stage some trialling of different cost factor schemes were tried till a reasonable balance of routes was achieved. Further adjustments to demand were made to improve the 'fit' of the model.

Once the all-vehicle matrix was producing satisfactory assignment of traffic within the model, a heavy vehicle sub-matrix was developed, based on counts and origin-destination surveys, as well as identifying traffic zones with a high propensity to generate truck movements. This matrix was developed manually.

The heavy vehicle matrix was subsequently deducted from the all-vehicle matrix, resulting in separate light vehicle and heavy vehicle matrices.

The assignment of both matrices was tested within the model to ensure that the vehicle movements retained a reasonable fit to the counts.

At this stage the bus demands were coded to timetable, as previously described, and the bus trips were generated in the model.

Pedestrian demands at foot crossings were developed in the following manner:

- Argyle Street between John Street and Hill Street – based on counts taken on a Thursday afternoon. For the Thursday afternoon model, the counts were used directly, assuming an approximately 50/50 directional split of movements. The Thursday morning volumes were assumed to be the same as the Thursday afternoon counts. Volumes used in the Saturday model were scaled off the Thursday counts using the relationship between pedestrian movements at the intersection of Argyle Street and John Street in both periods (collected during the intersection count surveys).
- Argyle Street between John Street and Oxley Street – as for the above crossing.

- Murray Street between Argyle Street and Broughton Street – this was based on the use of the Argyle Street crossings, although with a scaled down volume.
- Mitchell Street's western approach to John Street – these were counted directly by surveys, as art of the intersection counts.
- John Street's northern approach to Mitchell Street – as for the above crossing.

The following table identifies the role of each of the matrices in the models.

Table 1 – Demand matrix descriptions

Matrix	Description
Matrix 1	Analysis hour movement of people between areas via transition zones and the road network in light vehicles.
Matrix 2	Warm-up period equivalent of Matrix 1.
Matrix 3	Person movements across pedestrian crossings of Argyle Street.
Matrix 4	Warm-up period equivalent of Matrix 3.
Matrix 5	Person movements across pedestrian crossing of Murray Street.
Matrix 6	Warm-up period equivalent of Matrix 5.
Matrix 7	Analysis hour movement of heavy vehicles between zones ad the road network.
Matrix 8	Warm-up period equivalent of Matrix 7.

3.13.3 Demand temporal profiles

These provide an indication of the relative proportion of an hour's flow occurring in each of the four 15-minute periods in the analysis hour. Profiles were developed from counts for each of the cordon zones for each of the analysis hours. The other zones all had flat profiles through the hour.

These profiles are tabulated below.

Table 2 - Traffic profiles – Thursday AM

	Quarter hour commencing…			
Zone	**8:30**	**8:45**	**9:00**	**9:15**
Cawdor Road (Z1)	34%	30%	20%	16%
SHheather's Lane (Z2)	24%	30%	23%	22%
Macquarie Grove Road (Z4)	27%	31%	24%	18%
Camden Valley Way (Z5)	23%	31%	25%	21%
Macarthur Street (Z6)	26%	33%	24%	17%
Hill Street (Z7)	38%	19%	19%	24%
Old Hume Highway (Z8)	23%	28%	25%	23%
Other	25%	25%	25%	25%

Table 3 - Traffic profiles - Thursday PM

	Quarter hour commencing…

Zone	16:30	16:45	17:00	17:15
Cawdor Road (Z1)	22%	26%	27%	25%
SHheather's Lane (Z2)	23%	28%	25%	25%
Macquarie Grove Road (Z4)	23%	26%	25%	25%
Camden Valley Way (Z5)	23%	27%	24%	26%
Macarthur Street (Z6)	27%	25%	22%	25%
Hill Street (Z7)	23%	8%	35%	33%
Old Hume Highway (Z8)	25%	28%	23%	24%
Other	25%	25%	25%	25%

Table 4 - Traffic profiles - Saturday AM

	Quarter hour commencing…			
Zone	**9:00**	**9:15**	**9:30**	**9:45**
Cawdor Road (Z1)	34%	28%	15%	23%
SHheather's Lane (Z2)	31%	33%	16%	20%
Macquarie Grove Road (Z4)	39%	31%	14%	16%
Camden Valley Way (Z5)	33%	32%	17%	18%
Macarthur Street (Z6)	38%	33%	14%	15%
Hill Street (Z7)	29%	36%	22%	13%
Old Hume Highway (Z8)	37%	34%	13%	16%
Other	25%	25%	25%	25%

Table 5 - Traffic profiles - Saturday PM

	Quarter hour commencing…			
Zone	**17:00**	**17:15**	**17:30**	**17:45**
Cawdor Road (Z1)	27%	24%	24%	24%
SHheather's Lane (Z2)	22%	25%	27%	26%
Macquarie Grove Road (Z4)	25%	25%	24%	27%
Camden Valley Way (Z5)	23%	25%	23%	28%
Macarthur Street (Z6)	24%	26%	25%	25%
Hill Street (Z7)	29%	29%	19%	23%
Old Hume Highway (Z8)	22%	25%	24%	29%
Other	25%	25%	25%	25%

3.13.4 Vehicle Types

Vehicle types within the light vehicle fleet were based on three different sizes of light vehicles (4.1m, 4.4m and 4.8m). These sizes were drawn and their proportion of the light vehicle fleet (33%, 4% and 25% respectively) was sourced from RTA-commissioned analysis of vehicle registrations in NSW.

Heavy vehicle types were drawn from previous fleet information published by the RTA. The following heavy vehicle types and their proportions of the heavy vehicle fleet were coded into the models:

- Light goods vehicle (LGV) (14%)
- Light rigid heavy vehicle (23%)

- Medium rigid heavy vehicle (22%)
- Heavy rigid heavy vehicles (21%)
- Light semi-trailer (10%)
- Heavy semi-trailer (10%).

Buses were coded using Commuter's Standard Bus 202.

People within the model were coded using Commuters default standard person type, without adjustment to their physical attributes (such as size, weight, walk speed, etc;). This included a 0.10 size variation parameter, which in effect sets the standard distribution of the dimensions to be within 10% of the mean.

No adjustment to driver behaviour attributes was made.

3.13.5 Calibration of the network and demands

This process involves adjustments to demand and the network. The following approach was generally applied:

- Improved demand matrices (see description above) were assigned to the road network, with all elements of the demand specification in place, including route buses, heavy vehicles, profiles, pedestrians and selected vehicle types and fleet compositions.
- The network's traffic operations are observed to ensure that vehicles are using appropriate lane discipline at intersections, that they are obeying priority arrangements, and that they are not causing undue delay as a result of aberrant behaviour.
- The assigned traffic flows are compared with observed counts, and where counts are out of tolerance, an assessment is made, with reference to comparisons along corridors and at adjoining intersections, as to whether it is a routing problem or a demand problem. Adjustments are made accordingly.

The main network adjustments undertaken were:

- Lane choice rules were applied to get most vehicles in the appropriate lanes at intersections. In particular, along Argyle Street lane choice rules were coded into the network to force most vehicles into the appropriate approach lane based on their departure leg from the intersection. The two left-in-left-out intersections with Argyle Street (Oxley Street and Hill Street) both had vehicles turning left into the side road from the median lane, waiting for a gap in the traffic in the adjacent lane prior to turning. This was causing unrealistic queuing on Argyle Street. Lane choice rules were introduced to force most left turning vehicles across to the correct lane (i.e., not the median lane). Of note is that during the stability testing of the model, in some time periods for some seed values, an episode or two of this behaviour was observed for a short period – it is considered that one or two episodes of this behaviour in an hour is a fair reflection of on-the-ground behaviour.
- Route choice rules were applied where vehicles were using unnecessarily circuitous routes, when more direct routes were obviously available.

- Parking choice rules were applied to selected on-street parking zones so that vehicles arriving to park at the zone move to an alternative zone, should their initial choice of zone be full and unable to accommodate them.
- Adjustment to the position of intersection streams to try to maintain the expected vehicle path of travel as they move through the intersection.
- Adjustments to the end handle of links at intersections to better reflect approach angle and position of stop or yield line (even if notional).
- Lane attributes were adjusted in selected locations to better represent driver behaviour:
    - Along Argyle Street – the avoidance attribute was selected to ensure drivers were looking ahead for pedestrians at the crossings and for vehicles drawing in or pulling out from the kerbside to park.

4.0 Model calibration and validation summary reporting

4.1 General

Model calibration compares modelled and observed volumes to establish the level of fit of the model to real-world traffic movements. The comparison is for traffic volumes at:

- Link Flows
- Turning movements
- Screenlines

Model validation uses travel time information collected by the origin destination survey to check if times of vehicles through the model provide a reasonable fit to real-world conditions. This required a review of the matched travel times to ensure that long duration 'trips' were excluded from the group of observations that were used to calculate average travel times.

Model stability was tested using five seeds with which to initialise the modelling application's random number generator. The following seed values were used:

- 12345
- 349508
- 836912
- 1198894
- 1694994

These were selected following advice that the seed values should be at least 100,000 apart by selecting the increment from the first to the second, the second to the third, etc, using the random number generator in excel to select a number between 105,000 and 513,000. The same seed values were used in each of the time period models. While each of the models were run with different seed values, the network was observed to check if there were stuck vehicles or behaviours leading to network operation instability or lock-ups. Through this process all models ran smoothly and the volumes in each model showed a good fit to the observed counts. This indicates that the models are stable and that there were no readily identifiable aspects of the model operation leading to unrealistic behaviours that cause model instability.

This section reports a summary of the calibration and validation comparisons for each of the four models in turn.

4.2 Thursday morning model

4.2.1 Demand calibration

Table 6 – Summary statistics for comparison of modelled and observed mid-block flows (freq), Thursday AM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	30	29	29	29	30
5<GEH<=10	0	1	1	1	0
10<=GEH	0	0	0	0	0
Total	**30**	**30**	**30**	**30**	**30**

Table 7 – Summary statistics for comparison of modelled and observed mid-block flows (%), Thursday AM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	100%	97%	97%	97%	100%
5<GEH<=10	0%	3%	3%	3%	0%
10<=GEH	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Table 8 – Summary statistics for comparison of modelled and observed turning movement flows (freq) , Thursday AM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	103	100	103	97	103
5<GEH<=10	11	14	11	17	11
10<=GEH	0	0	0	0	0
Total	**114**	**114**	**114**	**114**	**114**

Table 9 – Summary statistics for comparison of modelled and observed turning movement flows (%), Thursday AM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	90%	88%	90%	85%	90%
5<GEH<=10	10%	12%	10%	15%	10%
10<=GEH	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%

Table 10 – Summary statistics for comparison of modelled and observed screenline flows (freq) , Thursday AM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	12	12	12	12	12
5<GEH<=10	0	0	0	0	0
10<=GEH	0	0	0	0	0
Total	**12**	**12**	**12**	**12**	**12**

Table 11 – Summary statistics for comparison of modelled and observed screenline flows (%), Thursday AM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	100%	100%	100%	100%	100%
5<GEH<=10	0%	0%	0%	0%	0%
10<=GEH	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

4.2.2 Model validation

Table 12 – Comparison of modelled and observed screenline flows (%), Thursday AM Peak, seed value 12345

Travel time movement	Observed Avg (s)	Modelled count	Modelled Avg (s)	Difference (s)	%	GEH
Cawdor Road to Camden Valley Way	169	135	164	-5	-3.1	0.4
Camden Valley Way to Cawdor Road	173	176	152	-21	-11.9	1.6
Camden Valley Way to Macquarie Grove Road	112	16	105	-7	-6.6	0.7
Macquarie Grove Road to Camden Valley Way	105	27	100	-5	-4.8	0.5
Camden Valley Way to Murray Street	177	41	179	2	1.0	0.1
Murray Street to Camden Valley Way	212	72	180	-32	-15.1	2.3
Camden Valley Way to Menangle Road	155	34	149	-6	-4.0	0.5
Menangle Road to Camden Valley Way	179	88	147	-32	-17.7	2.5
Murray Street to Macquarie Grove Road	177	11	205	28	16.1	2.1
Macquarie Grove Road to Murray Street	196	3	185	-11	-5.7	0.8
Menangle Street to Macquarie Grove Road	208	12	180	-28	-13.3	2.0
Macquarie Grove Road to Menangle Street	149	6	170	21	14.4	1.7

4.2.3 Model stability

All models using five seed values ran to completion without lock-ups.

4.3 Thursday afternoon model

4.3.1 Demand calibration

Table 13 – Summary statistics for comparison of modelled and observed mid-block flows (freq), Thursday PM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	30	30	30	30	30
5<GEH<=10	0	0	0	0	0
10<=GEH	0	0	0	0	0
Total	**30**	**30**	**30**	**30**	**30**

Table 14 – Summary statistics for comparison of modelled and observed mid-block flows (%), Thursday PM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	100%	100%	100%	100%	100%
5<GEH<=10	0%	0%	0%	0%	0%
10<=GEH	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Table 15 – Summary statistics for comparison of modelled and observed turning movement flows (freq) , Thursday PM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	111	110	111	110	109
5<GEH<=10	6	7	6	7	8
10<=GEH	0	0	0	0	0
Total	**117**	**117**	**117**	**117**	**117**

Table 16 – Summary statistics for comparison of modelled and observed turning movement flows (%), Thursday PM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	95%	94%	95%	94%	93%
5<GEH<=10	5%	6%	5%	6%	7%
10<=GEH	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%

Table 17 – Summary statistics for comparison of modelled and observed screenline flows (freq) , Thursday PM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	12	12	12	12	12
5<GEH<=10	0	0	0	0	0
10<=GEH	0	0	0	0	0
Total	**12**	**12**	**12**	**12**	**12**

Table 18 – Summary statistics for comparison of modelled and observed screenline flows (%), Thursday PM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	100%	100%	100%	100%	100%
5<GEH<=10	0%	0%	0%	0%	0%
10<=GEH	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

4.3.2 Model validation

Table 19 – Comparison of modelled and observed screenline flows (%), Thursday PM Peak, seed value 12345

Travel time movement	Observed Avg (s)	Modelled count	Modelled Avg (s)	Difference (s)	%	GEH
Cawdor Road to Camden Valley Way	140	186	163	23	16.3	1.9
Camden Valley Way to Cawdor Road	168	260	160	-8	-5.0	0.7
Camden Valley Way to Macquarie Grove Road	98	15	109	11	11.0	1.1
Macquarie Grove Road to Camden Valley Way	125	28	102	-23	-18.4	2.2
Camden Valley Way to Murray Street	200	70	183	-17	-8.6	1.2
Murray Street to Camden Valley Way	185	99	181	-4	-2.2	0.3
Camden Valley Way to Menangle Road	147	49	153	6	4.3	0.5
Menangle Road to Camden Valley Way	155	51	148	-7	-4.6	0.6
Murray Street to Macquarie Grove Road	163	20	184	21	12.9	1.6
Macquarie Grove Road to Murray Street	214	16	180	-34	-16.0	2.4
Menangle Street to Macquarie Grove Road	182	3	169	-13	-7.0	1.0
Macquarie Grove Road to Menangle Street	156	10	152	-4	-2.8	0.4

4.3.3 Model stability

All models using five seed values ran to completion without lock-ups.

4.4 Saturday morning model

4.4.1 Demand calibration

Table 20 – Summary statistics for comparison of modelled and observed mid-block flows (freq), Saturday AM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	30	30	30	30	30
5<GEH<=10	0	0	0	0	0
10<=GEH	0	0	0	0	0
Total	**30**	**30**	**30**	**30**	**30**

Table 21 – Summary statistics for comparison of modelled and observed mid-block flows (%), Saturday AM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	100%	100%	100%	100%	100%
5<GEH<=10	0%	0%	0%	0%	0%
10<=GEH	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Table 22 – Summary statistics for comparison of modelled and observed turning movement flows (freq), Saturday AM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	108	112	113	111	111
5<GEH<=10	9	5	4	6	6
10<=GEH	0	0	0	0	0
Total	**117**	**117**	**117**	**117**	**117**

Table 23 – Summary statistics for comparison of modelled and observed turning movement flows (%), Saturday AM Peak

Seed	**12345**	**349508**	**836912**	**1198894**	**1694994**
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	92%	96%	97%	95%	95%
5<GEH<=10	8%	4%	3%	5%	5%
10<=GEH	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Table 24 – Summary statistics for comparison of modelled and observed screenline flows (freq), Saturday AM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	12	12	12	12	12
5<GEH<=10	0	0	0	0	0
10<=GEH	0	0	0	0	0
Total	**12**	**12**	**12**	**12**	**12**

Table 25 – Summary statistics for comparison of modelled and observed screenline flows (%), Saturday AM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	100%	100%	100%	100%	100%
5<GEH<=10	0%	0%	0%	0%	0%
10<=GEH	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

4.4.2 Model validation

Table 26 – Comparison of modelled and observed screenline flows (%), Saturday AM Peak, seed value 12345

Travel time movement	Observed Avg (s)	Modelled count	Modelled Avg (s)	Difference (s)	%	GEH
Cawdor Road to Camden Valley Way	136	456	159	23	17.1	1.9
Camden Valley Way to Cawdor Road	141	450	152	11	7.7	0.9
Camden Valley Way to Macquarie Grove Road	97	52	103	6	6.3	0.6
Macquarie Grove Road to Camden Valley Way	101	50	97	-4	-3.9	0.4
Camden Valley Way to Murray Street	152	62	178	26	17.3	2.0
Murray Street to Camden Valley Way	183	148	175	-8	-4.3	0.6
Camden Valley Way to Menangle Road	NS	0	NA	NA	NA	NA
Menangle Road to Camden Valley Way	144	22	145	1	1	0.1
Murray Street to Macquarie Grove Road	131	68	179	48	37	3.9
Macquarie Grove Road to Murray Street	154	28	162	8	5	0.6
Menangle Street to Macquarie Grove Road	127	0	NA	NA	NA	NA

4.4.3 Model stability

All models using five seed values ran to completion without lock-ups.

4.5 Saturday afternoon model

4.5.1 Demand calibration

Table 27 – Summary statistics for comparison of modelled and observed mid-block flows (freq), Saturday PM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	30	30	30	30	30
5<GEH<=10	0	0	0	0	0
10<=GEH	0	0	0	0	0
Total	**30**	**30**	**30**	**30**	**30**

Table 28 – Summary statistics for comparison of modelled and observed mid-block flows (%), Saturday PM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	100%	100%	100%	100%	100%
5<GEH<=10	0%	0%	0%	0%	0%
10<=GEH	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Table 29 – Summary statistics for comparison of modelled and observed turning movement flows (freq), Saturday PM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	108	109	104	108	109
5<GEH<=10	5	4	9	5	4
10<=GEH	0	0	0	0	0
Total	**113**	**113**	**113**	**113**	**113**

Table 30 – Summary statistics for comparison of modelled and observed turning movement flows (%), Saturday PM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	96%	96%	92%	96%	96%
5<GEH<=10	4%	4%	8%	4%	4%
10<=GEH	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Table 31 – Summary statistics for comparison of modelled and observed screenline flows (freq), Saturday PM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**Freq**	**Freq**	**Freq**	**Freq**	**Freq**
GEH<=5	12	12	12	12	12
5<GEH<=10	0	0	0	0	0
10<=GEH	0	0	0	0	0
Total	**12**	**12**	**12**	**12**	**12**

Table 32 – Summary statistics for comparison of modelled and observed screenline flows (%), Saturday PM Peak

Seed	12345	349508	836912	1198894	1694994
GEH Band	**%**	**%**	**%**	**%**	**%**
GEH<=5	100%	100%	100%	100%	100%
5<GEH<=10	0%	0%	0%	0%	0%
10<=GEH	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

4.5.2 Model validation

Table 33 – Comparison of modelled and observed screenline flows (%), Saturday PM Peak, seed value 12345

Travel time movement	Observed Avg (s)	Modelled count	Modelled Avg (s)	Difference (s)	%	GEH
Cawdor Road to Camden Valley Way	126	166	150	24	18.8	2.0
Camden Valley Way to Cawdor Road	127	236	146	19	15.2	1.7
Camden Valley Way to Macquarie Grove Road	189	8	102	-87	-46.0	7.2
Macquarie Grove Road to Camden Valley Way	100	12	100	0	-0.1	0.0
Camden Valley Way to Murray Street	150	29	173	23	15.6	1.8
Murray Street to Camden Valley Way	145	20	172	27	18.7	2.1
Camden Valley Way to Menangle Road	148	20	142	-6	-4.3	0.5
Menangle Road to Camden Valley Way	136	6	147	11	7.7	0.9
Murray Street to Macquarie Grove Road	144	16	173	29	19.9	2.3
Macquarie Grove Road to Murray Street	144	6	161	17	11.7	1.4
Menangle Street to Macquarie Grove Road	114	0	114	-114	-100.0	15.1

4.5.3 Model stability

All models using five seed values ran to completion without lock-ups.

4.6 Apparent Issues

At the access to the area south of Woolworths (directly off Oxley Street) there is a one-way access coded into the model to connect to transition zone 18 (connected to and person-generating area #49). The software flags this as an unconnected link. This has been investigated and the arrangement appears to be operating as intended – so the unconnected link message has been ignored.

The inbound bus stop coded on Macquarie Grove (coded as a dummy stop to permit buses to load onto the road network at the cordon) flags an issue in models that load no buses at this location. We have explored the issue and the area is operating as expected.

5.0 Future conditions models

The purpose of this study is to project future traffic conditions within the town centre. To meet this requirement the following process was followed:

- Review land use projections for the town centre
- Review the surrounding strategic situation in terms of future land use and transport network developments
- Consider the applicability of the land use projections for the town centre, in terms of physical constraints, recent market activity, expected future development
- Based on the strategic assessment of the above factors, develop growth factors to apply to base year traffic demands
- Produce future year traffic and pedestrian demand matrices, and consider likely changes to bus route networks and frequencies
- Develop future year road networks incorporating known works – in this case the starting point for future year networks was the existing road network
- Assign these in the model and examine network operations and make minor adjustments to the allocation of demand
- Review assigned volumes

Zones in the model were categorised as either:

- Internal town centre zones
- Internal non town centre zones
- External zones

Based on a review of factors identified above, future year peak demands were produced by using the following growth factors:

- Internal town centre zones to internal town centre zones: 1.3
- External zones to external zones: 1.2
- Internal town centre zones to external zones: 1.3
- External zones to internal town centre zones: 1.3
- Internal non town centre zones to/from all types of zones: 1.1

The resulting demands were assigned to the base year road networks in each of the time periods. The models were run and the traffic operations were examined. The models generally ran satisfactorily, although some changes were made. These were:

- As noted previously, a small number of vehicles turning left from Argyle Street to Oxley Street and from Argyle Street to View Street endeavour to do so from the median lane. As such they must await a gap in the kerbside lane's traffic to safely turn. With additional traffic on the network this problem was exacerbated. Consequently, additional lane choice rules were introduced to deal with the issue at Argyle Street and Oxley Street; these included lane choice rules applied within the circulating lanes of the Argyle Street and Murray Street roundabout. This appeared to improve the situation, although several times in the analysis hour, the problem emerges and has a negative effect on eastbound traffic flow along Argyle Street.
- No changes were introduced to deal with this problem at Argyle Street and View Street as it does not have the same impact and occasional aberrant behaviour is probably worth retaining in the model from a realism perspective.

These future year models show good traffic operations within the town centre. The Thursday models have noticeably higher traffic density, with transient eastbound queues. The higher pedestrian volumes using the pedestrian crossing of Argyle Street between Oxley Street and John Street, interacting with the roundabout at John Street appear to have a detrimental impact on traffic.

5.1 Discussion of future traffic conditions

The critical time period for the town centre is Thursday PM peak, followed by Thursday AM peak, and the Saturday peaks are not as critical, in terms of traffic performance.

The section of Argyle Street between Murray Street and John Street is the critical section of the town centre in terms of traffic operations. Traffic density, queuing and transient delays in this area are most marked in this area in the existing year and future year models. Eastbound operations appear more constrained than westbound operations, primarily due to the interaction of operation of the marked foot crossing of Argyle Street west of John Street with the roundabout at the intersection of Argyle Street and John Street.

In effect, eastbound vehicles are delayed at the marked foot crossing, to the point where the approach queue at the roundabout dissipates, so that few or no vehicles are at the roundabout approach to take advantage of gaps at the roundabout to proceed through the intersection. This interaction tends to reduce overall sub-system capacity. In future years, with the increase in pedestrians using the crossing, more traffic on Argyle Street and more side-street traffic, this situation. Of note is that this behaviour is sensitive to our projections of volumes of pedestrian crossing at the marked foot crossing – a substantial increase over our projection would see traffic operations of this sub-system under more pressure.

Future Model – Thursday AM

In the future Thursday AM model, transient eastbound queues extend back to and past Oxley Street. This results in small (less than 5 vehicles) southbound queues in Oxley Street, waiting to turn left onto Argyle Street. The rest of the network functions well with only transient queues at the various intersections. The section of Argyle Street east of John Street functions well – primarily due to lower volumes of pedestrians crossing the marked foot crossing than the crossing to the west, but also because the marked foot crossing is approximately 20 metres further form the roundabout, permitting more vehicles to store between the two facilities, thereby reducing the interaction between the two facilities.

Future Model – Thursday PM

In the future Thursday PM model, the transient eastbound queues along Argyle Street from John Street, are longer, frequently extending past Oxley Street, and, as a result, causing longer queues of southbound traffic waiting to turn left form Oxley Street to Argyle Street. The length of this southbound queue varies, but at one point extends up to 20 vehicles in length in the model, with a queue length of 5 to 10 vehicles more usual. The rest of the network functions well during this time period.

Future Model – Saturday AM

In the Saturday AM Future Year model the network operates well with few queues. Again, the critical part of the network is the section of Argyle Street between Murray and John Street, but this generally operates satisfactorily over the model's analysis hour.

Future Model – Saturday PM

In the Saturday PM Future Year model the network operates well with few queues, in a similar fashion to the Saturday AM Future Year model.

The following tables compare travel times between the base models and the future models

Table 34 – Comparison of Observed, Base Modelled and Future Modelled Travel Times, Thursday AM

Travel time movement	Observed avg (s)	Modelled count	Base Modelled Avg (s)	Future Modelled Avg (s)	Modelled Diff (s) Base - Future	Diff (%)
Cawdor Road to Camden Valley Way	169	135	164	185	21.7	13.3%
Camden Valley Way to Cawdor Road	173	176	152	163	10.9	7.2%
Camden Valley Way to Macquarie Grove Road	112	16	105	109	4.1	3.9%
Macquarie Grove Road to Camden Valley Way	105	27	100	101	1.4	1.4%
Camden Valley Way to Murray Street	177	41	179	185	5.7	3.2%
Murray Street to Camden Valley Way	212	72	180	199	19.0	10.5%
Camden Valley Way to Menangle Road	155	34	149	155	5.8	3.9%
Menangle Road to Camden Valley Way	179	88	147	151	3.8	2.6%
Murray Street to Macquarie Grove Road	177	11	205	222	16.3	8.0%
Macquarie Grove Road to Murray Street	196	3	185	197	12.3	6.6%
Menangle Street to Macquarie Grove Road	208	12	180	190	9.3	5.2%
Macquarie Grove Road to Menangle Street	149	6	170	158	-12.4	-7.3%

Table 35 – Comparison of Observed, Base Modelled and Future Modelled Travel Times, Thursday PM

Travel time movement	Observed avg (s)	Modelled count	Base Modelled Avg (s)	Future Modelled Avg (s)	Modelled Diff (s) Base - Future	Diff (%)
Cawdor Road to Camden Valley Way	140	186	163	195	32.4	19.9%
Camden Valley Way to Cawdor Road	168	260	160	177	17.6	11.0%
Camden Valley Way to Macquarie Grove Road	98	15	109	105	-4.3	-4.0%
Macquarie Grove Road to Camden Valley Way	125	28	102	103	0.9	0.9%
Camden Valley Way to Murray Street	200	70	183	201	18.3	10.0%
Murray Street to Camden Valley Way	185	99	181	218	36.8	20.3%
Camden Valley Way to Menangle Road	147	49	153	167	14.0	9.2%
Menangle Road to Camden Valley Way	155	51	148	165	17.7	11.9%
Murray Street to Macquarie Grove Road	163	20	184	208	23.9	13.0%
Macquarie Grove Road to Murray Street	214	16	180	198	17.9	10.0%
Menangle Street to Macquarie Grove Road	182	3	169	188	18.3	10.8%
Macquarie Grove Road to Menangle Street	156	10	152	158	6.2	4.1%

Table 36 – Comparison of Observed, Base Modelled and Future Modelled Travel Times, Saturday AM

Travel time movement	Observed Avg (s)	Modelled count	Modelled Avg (s) Base	Modelled Avg (s) Future	Modelled Diff (s)	Diff (%)
Cawdor Road to Camden Valley Way	136	456	159	168	8.4	5.3%
Camden Valley Way to Cawdor Road	141	450	152	156	4.5	2.9%
Camden Valley Way to Macquarie Grove Road	97	52	103	103	-0.1	-0.1%
Macquarie Grove Road to Camden Valley Way	101	50	97	101	3.9	4.1%
Camden Valley Way to Murray Street	152	62	178	178	-0.1	0.0%
Murray Street to Camden Valley Way	183	148	175	184	9.1	5.2%
Camden Valley Way to Menangle Road	NS	0	NA	154	NA	NA
Menangle Road to Camden Valley Way	144	22	145	190	45.2	31.1%
Murray Street to Macquarie Grove Road	131	68	179	180	0.4	0.2%
Macquarie Grove Road to Murray Street	154	28	162	127	-34.7	-21.4%
Menangle Street to Macquarie Grove Road	127	0	NA	144	NA	NA
Macquarie Grove Road to Menangle Street	NS	6	148	NA	NA	NA

Table 37 – Comparison of Observed, Base Modelled and Future Modelled Travel Times, Saturday PM

Travel time movement	Observed avg (s)	Modelled count	Base Modelled Avg (s)	Future Modelled Avg (s)	Modelled Diff (s)	Diff (%)
Cawdor Road to Camden Valley Way	126	166	150	156	6.1	4.1%
Camden Valley Way to Cawdor Road	127	236	146	152	5.4	3.7%
Camden Valley Way to Macquarie Grove Road	189	8	102	106	3.7	3.6%
Macquarie Grove Road to Camden Valley Way	100	12	100	105	5.0	5.0%
Camden Valley Way to Murray Street	150	29	173	172	-1.0	-0.6%
Murray Street to Camden Valley Way	145	20	172	173	1.4	0.8%
Camden Valley Way to Menangle Road	148	20	142	144	2.2	1.5%
Menangle Road to Camden Valley Way	136	6	147	151	4.9	3.3%
Murray Street to Macquarie Grove Road	144	16	173	174	1.8	1.0%
Macquarie Grove Road to Murray Street	144	6	161	170	9.0	5.6%
Menangle Street to Macquarie Grove Road	114	0	114	114	0.0	0.0%
Macquarie Grove Road to Menangle Street	147	0	147	138	-9.3	-6.3%

The above comparison of travel times from existing conditions to future year conditions show generally small changes in terms of seconds of travel time as well as proportions of base travel times in all time periods except for Thursday PM when several of the routes show increases of the order of half a minute and about 20% of the base value. These are still relatively modest increases in travel time.

6.0 Future Option Model – signals at Argyle Street and Oxley Street

Based on a review of the structure of the town centre and key traffic generators, an option was developed which sought to support the pedestrian crossing movements, whist also facilitating traffic access and departure from the town centre. This entailed:

- Introduction of signal controls at the intersection of Argyle Street and Oxley Street
- Opening access at this intersection to permit right turns out of Oxley Street – which is currently left-in-left-out – but not permit the right turn in from Argyle Street
- Remove the marked foot crossing of Argyle Street between John Street and Oxley Street
- Include pedestrian crossing facilities at in the proposed signals.

To model this, the following modifications were made to the models:

- Removal of foot crossing of Argyle Street between John Street and Oxley Street
- Removal of limited on-street parking on Argyle Street
- Permitting right turn out of Oxley Street to Argyle Street
- Introduction of foot crossing on eastern approach to signals
- Coding of a second land on the approach of Oxley Street to Argyle Street
- A blocking reduction treatment was introduced on John Street south to reduce the likelihood of vehicles turning into the car park on the east side and west side of John Street inter-locking and blocking access

- No changes were made to the assignment parameters or cost factors within the model. It is possible that, due to the signals at Oxley Street, drivers would perceive Oxley Street to be higher in the hierarchy of streets and a proportion of them may switch from current routes to Oxley Street.

Signal Arrangements

Four phases were used:

- A – Argyle Street runs
- B – all traffic stops and crossing of Argyle Street operates
- C – Oxley Street left and right turn operates and Argyle Street left turn to Oxley Street operates
- D – Argyle Street operates but left turn from Argyle Street to Oxley Street is red

In effect Phase D operates as a late start phase for Phase A, permitting pedestrians to cross Oxley Street. Phase B is in effect also a late start for Phase C, letting pedestrians cross Argyle Street – note, in the model if there are pedestrians still on the crossing at the completion of Phase B, vehicles in Phase C give way to the pedestrians.

The plans used in each of the modelled time periods were:

- Thursday AM CT 102 sec, phase order: A,B,C,D green splits: 56,19,13,12%
- Thursday PM CT 102 sec, phase order: A,B,C,D green splits: 50,23,18,9%
- Saturday AM CT 96 sec, phase order: A,B,C,D green splits: 47,21,17,15%
- Saturday PM CT 90 sec, phase order: A,B,C,D green splits: 53,20,17,10%

Each phase ran in each cycle.

This signal arrangement was used for testing purposes and would require optimisation. On the ground, with SCATS's adaptive logic controlling the signals, it is expected that traffic operations would be more efficient than indicated by the modelling. In particular, the adaptive nature of SCATS means that some phases may not be called in every cycle (depending on demand), and the ability to tailor phase splits (again in response to demand) over time, means that delays would be expected to be lower than indicated by the modelling.

In general the Oxley Street approach cleared every cycle, which largely reflects the volume of pedestrians wishing to cross Argyle Street, requiring phase B/C to be run each cycle.

Due to the length of phase B a second pedestrian crossing of Argyle Street on the western approach to Oxley Street would be accommodated (although not shown in the modelling[1]). Similarly, phase D may not be needed if the pedestrians crossing Oxley Street can do so within Phase B; although retaining it would reduce delays to pedestrians.

Any future optimisation of the signal arrangements ought to endeavour to reduce cycle times so that delays to pedestrians are minimised.

[1] For testing purposes we have used one crossing (on the eastern approach) and placed all pedestrian demand on it to see how pedestrians interact and how they manage to cross the road.

Future Model – Thursday AM with Signals at Oxley Street

With the closure of the marked foot crossing west of John Street and the introduction of signals at the intersection of Argyle Street and Oxley Street the southbound queues in Oxley Street almost completely disappear. Eastbound queuing on Argyle Street remains but is more veenly balanced between the new stop line at Argyle and Oxley Streets signals and the western approach to the roundabout at John Street and Argyle Street. This is partly due to the increased distance between the John Street roundabout and the proposed signals at Oxley Street compared with the marked footcrossing. This increased distance permits the storage of another 8 to 12 eastbound vehicles on Argyle Street between Oxley Street and John Street. If these signals are implemented in the real world, with direct SCATS control, it is likely that the situation on Argyle Street would have even shorter queues and lower delays, as signal would timings adapt to traffic conditions.

Future Model – Thursday PM with Signals at Oxley Street

With the introduction of signals at Argyle and Oxley Streets, the southbound queuing in Oxley Street is substantially reduced, with six or seven vehicles as the maximum. This is even though right turn vehicles are now also using Oxley Street. This is a result of changing the mode of control to signals and the additional short left turn lane provided in Oxley Street at its approach to Argyle Street. There is still eastbound queuing on Argyle Street, but in a similar manner to the Thursday AM Model, the queuing between intersections is better balanced than in the Thursday PM model without signals. Of note is that friction from on-street parking in Argyle Street is included in the model. Overall, whilst the signals at Argyle and Oxley Streets tend to introduce more stops and some minor additional delay to Argyle Street traffic[2], they provide better overall town centre capacity and improved egress of town centre traffic to the west, as well as providing a high quality pedestrian crossing facility of both Argyle Street and Oxley Street.

Future Model – Saturday AM with Signals at Oxley Street

This model runs well with limited queuing and good traffic flow along Argyle Street. The rest of the network operates satisfactorily.

Future Model – Saturday PM with Signals at Oxley Street

As with the Saturday AM model with signals at Oxley Street, this model operates satisfactorily.

The following tables compare travel times through the model with the observed, base model, future model and future model with signals. These are for a single seed value (12345).

[2] As noted elsewhere the signals have been tested using an arrangement of cycle times and phase settings to provide a robust assessment of performance which provides a high proportion of green time to pedestrians. This has been done on the basis that if the signals work satisfactorily under these conditions then they are most likely to work well in the real world. Consequently, it provides a more negative view of the impact on vehicular traffic.

Table 38 – Comparison of travel times for observed, base model, future model and future model with signals, Thursday AM (seconds)

Travel time movement	Observed avg (s)	Base Modelled Avg (s)	Future Modelled Avg (s)	Future Modelled with Signals Avg (s)
Cawdor Road to Camden Valley Way	169	164	185	194
Camden Valley Way to Cawdor Road	173	152	163	171
Camden Valley Way to Macquarie Grove Road	112	105	109	110
Macquarie Grove Road to Camden Valley Way	105	100	101	103
Camden Valley Way to Murray Street	177	179	185	189
Murray Street to Camden Valley Way	212	180	199	210
Camden Valley Way to Menangle Road	155	149	155	156
Menangle Road to Camden Valley Way	179	147	151	157
Murray Street to Macquarie Grove Road	177	205	222	232
Macquarie Grove Road to Murray Street	196	185	197	195
Menangle Street to Macquarie Grove Road	208	180	190	188
Macquarie Grove Road to Menangle Street	149	170	158	188

Table 39 – Comparison of travel times for observed, base model, future model and future model with signals, Thursday PM (seconds)

Travel time movement	Observed avg (s)	Base Modelled Avg (s)	Future Modelled Avg (s)	Future Modelled with Signals Avg (s)
Cawdor Road to Camden Valley Way	140	163	195	204
Camden Valley Way to Cawdor Road	168	160	177	195
Camden Valley Way to Macquarie Grove Road	98	109	105	107
Macquarie Grove Road to Camden Valley Way	125	102	103	105
Camden Valley Way to Murray Street	200	183	201	215
Murray Street to Camden Valley Way	185	181	218	217
Camden Valley Way to Menangle Road	147	153	167	164
Menangle Road to Camden Valley Way	155	148	165	166
Murray Street to Macquarie Grove Road	163	184	208	225
Macquarie Grove Road to Murray Street	214	180	198	194
Menangle Street to Macquarie Grove Road	182	169	188	184
Macquarie Grove Road to Menangle Street	156	152	158	151

Table 40 – Comparison of travel times for observed, base model, future model and future model with signals, Saturday AM (seconds)

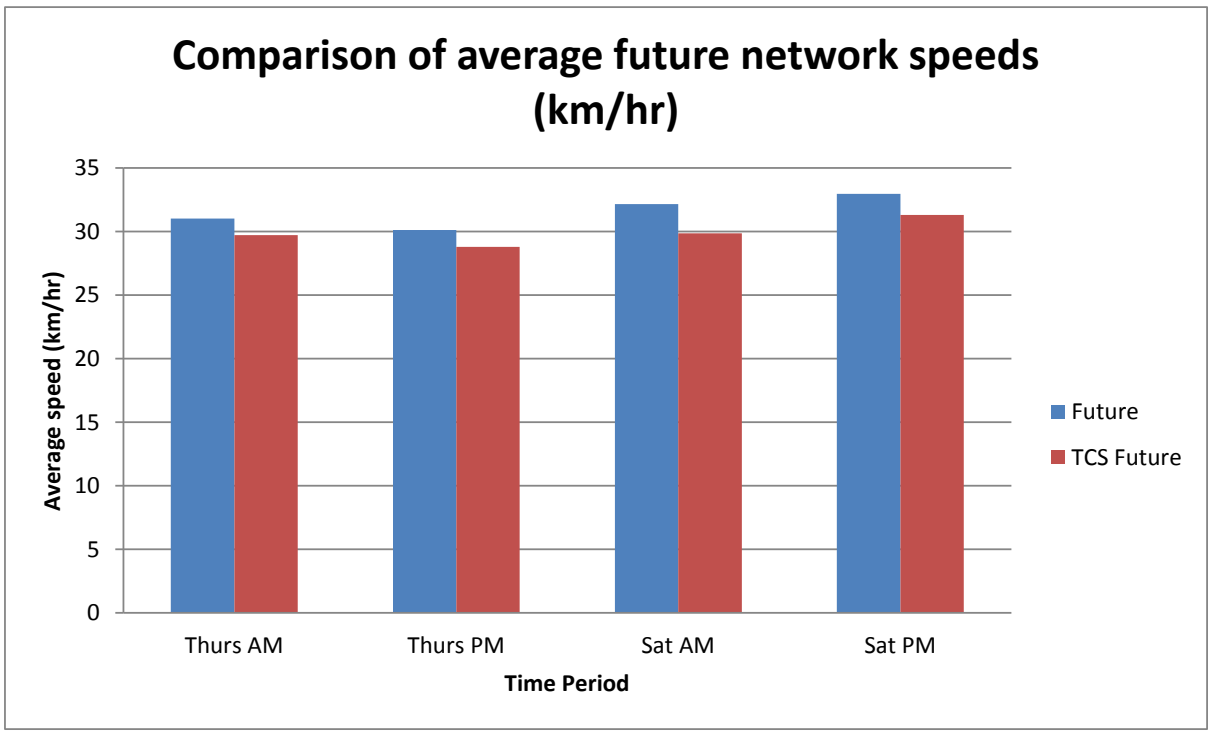
Travel time movement	Observed avg (s)	Base Modelled Avg (s)	Future Modelled Avg (s)	Future Modelled with Signals Avg (s)
Cawdor Road to Camden Valley Way	136	159	168	182
Camden Valley Way to Cawdor Road	141	152	156	167
Camden Valley Way to Macquarie Grove Road	97	103	103	103
Macquarie Grove Road to Camden Valley Way	101	97	101	101
Camden Valley Way to Murray Street	152	178	178	193
Murray Street to Camden Valley Way	183	175	184	201
Camden Valley Way to Menangle Road	NS	NA	154	152
Menangle Road to Camden Valley Way	144	145	190	209
Murray Street to Macquarie Grove Road	131	179	180	185
Macquarie Grove Road to Murray Street	154	162	127	155
Menangle Street to Macquarie Grove Road	127	NA	144	145
Macquarie Grove Road to Menangle Street	NS	148	NA	NA

Table 41 – Comparison of travel times for observed, base model, future model and future model with signals, Saturday PM (seconds)

Travel time movement	Observed avg (s)	Base Modelled Avg (s)	Future Modelled Avg (s)	Future Modelled with Signals Avg (s)
Cawdor Road to Camden Valley Way	126	150	156	173
Camden Valley Way to Cawdor Road	127	146	152	164
Camden Valley Way to Macquarie Grove Road	189	102	106	107
Macquarie Grove Road to Camden Valley Way	100	100	105	98
Camden Valley Way to Murray Street	150	173	172	189
Murray Street to Camden Valley Way	145	172	173	193
Camden Valley Way to Menangle Road	148	142	144	145
Menangle Road to Camden Valley Way	136	147	151	144
Murray Street to Macquarie Grove Road	144	173	174	190
Macquarie Grove Road to Murray Street	144	161	170	176
Menangle Street to Macquarie Grove Road	114	114	114	136
Macquarie Grove Road to Menangle Street	147	147	138	145

In general the above four tables indicate that the signals would introduce small additional delays into the traffic network. With signal optimisation using SCATS on the ground, it is likely that these increases in travel times would be lower than indicated above. Given the advantages of the proposed signals at Argyle Street and Oxley Street, these minor delays would be more than offset by the high quality pedestrian crossing, the better egress to the west for town centre traffic and the greater stability of eastbound traffic along Argyle Street between Murray Street and John Street.

As an indication of overall network performance the following chart compares future average network speeds with and without the implementation of traffic signals (TCS) at the intersection of Argyle Street and Oxley Street.



The chart indicates small reductions in average network speeds with the implementation of traffic signals. This is to be expected, as signals tend to introduce stops along the main road where previously vehicles had priority. The purpose of the chart is to indicate that, despite the introduction of these signals, there is only a small impact on overall network performance. In terms of considering alternatives, as indicated elsewhere, the current marked foot crossing of Argyle Street is unlikely to remain for the medium to long term. From an economic appraisal perspective the future case in the above chart (i.e., the existing road network with future traffic growth) would not be the base case against which to compare the effects of signals at Argyle Street and Oxley Street.

Appendix D Option Assessment Matrix

Strategic assessment of options

Camden Town Centre

This appendix considers potential options for re-configuration of Camden's road network. These are considered in terms of their objectives, advantages and disadvantages using a strategic approach which focusses on the concepts involved.

The main features of the town centre are:

- Grid pattern network, with a fairly large grid size. The central block bounded by Argyle Street, Elizabeth Street, Mitchell Street and John Street is approximately 240 m east west and 230 m north south.
- The roads are relatively large – Argyle Street is two-lanes in each direction, reflecting its long past function as the main Sydney-Melbourne Road, which largely ceased in the 1970s with the opening of the Camden Bypass, and was further reduced with the subsequent opening of the Hume Freeway.
- Argyle Street and to the north, the land is gently graded, whereas south of Argyle Street approximately east of Oxley Street rises to the south.

The traffic surveys indicated that:

- Mid-block volumes on Argyle Street (existing and future) would be accommodated within the current configuration and that they were generally too high during peak periods to permit Argyle Street to be reduced to a single travel lane in each direction.
- That the Argyle Street roundabouts had relatively high u-turn volumes for u-turns for travel along Argyle Street. The size and location of the u-turns varied by peak period, but were evident in all four traffic survey periods. Side roads (John Street, Murray Street, Elizabeth Street and Edward Street) generally had much lower u-turn volumes. Clearly the roundabouts are providing a traffic circulation function which, given limited movements permitted at Argyle Street and Oxley Street and at Argyle Street and Hill Street (both are left in left out), is not surprising.
- The origin destination surveys indicated that through traffic is not the dominant traffic segment into the town centre, although it is a non-trivial proportion of traffic.
- The two marked foot crossings of Argyle Street are heavily used. The western one (between Oxley Street and John Street) has about two-and-a-half times the usage of the eastern one (between John Street and Hill Street) during the surveyed period. Both these crossings are much more heavily used than crossings at the roundabout controlled intersection of Argyle Street (during the Thursday afternoon, only one pedestrian was counted crossing Argyle Street at the John Street roundabout).

There are a range of modifications to the town centre road network that could be considered.

Options include the creation of an inner bypass.

Objectives of this could be to:

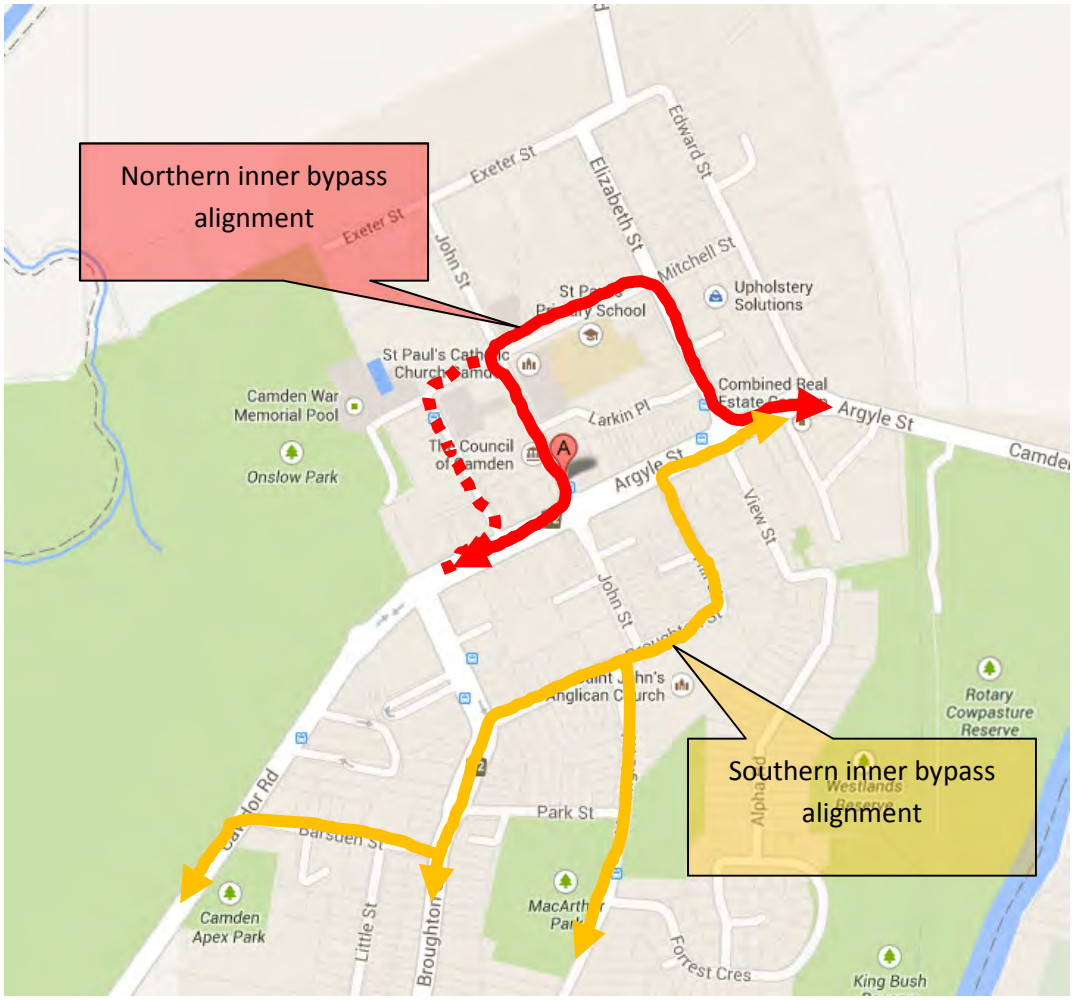
A. Provide traffic relief for Argyle Street in the event that traffic volumes grew beyond the current capacity.
B. Divert traffic from Argyle Street so that Argyle Street's cross-section could be reconfigured to remove a travel lane in each direction. The freed up road space might be used to widen the footways and possibly to allow for more extensive urban streetscape treatments.

Traffic relief for Argyle Street is unlikely to be required in the medium to long term (Objective A).

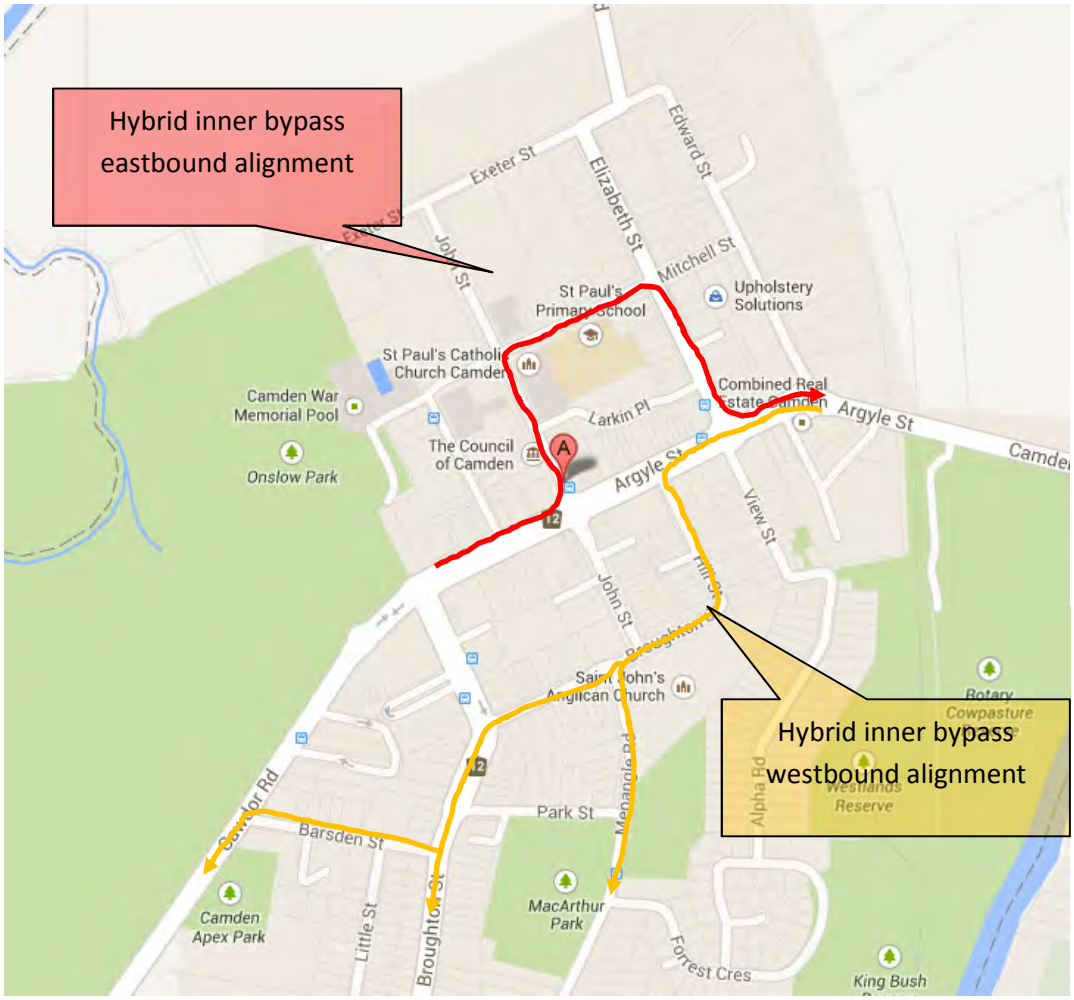
Diversion of traffic from Argyle Street could take the following forms:

- A northern bypass using Mitchell Street – notionally this could use Elizabeth Street and John Street (or possibly Oxley Street) as the connecting roads.
- A southern bypass using Hill Street and possibly Broughton Street to the Old Hume Highway; Hill Street and Menangle Road; and, possibly Broughton Street and Barsden Street to Cawdor Road. Using John Street as the diversion road, as opposed to Hill Street, is unlikely to be as effective as it is further west, providing no relief to Argyle Street between John Street and Elizabeth Street.
- A hybrid, which puts eastbound traffic on the Mitchell Street alignment and westbound traffic on the Hill Street/Broughton Street/Barsden Street alignment

The following sketch illustrates the concept of the northern bypass and the southern bypass. The lines are notional sketches, and would be largely confined to existing road reservations with two-way traffic movement along each alignment.



The hybrid alignment is shown in the following sketch.



Using roads further from Argyle Street than the above, such as Exeter Street, which is approximately half a kilometre north of Argyle Street, is considered impractical. Similarly, the use of View Street alignment is too circuitous and unattractive to be used as a bypass (in addition the alignment and adjoining residential land use would not support a bypass function).

Northern Inner bypass

Encouraging/pushing a substantial segment of Argyle Street's traffic onto this alignment:

- From a physical perspective in terms of road widths and roadspace available at key intersections is likely to be accommodated, subject to more detailed investigation;
- Would result in traffic volumes on Mitchell Street exceeding environment capacity thresholds;
- Would result in placing additional traffic past sensitive land uses, such as the two schools on Mitchell Street (currently the sections of Mitchell Street, John Street and Oxley Street that might form part of this alignment are all school speed zones (subject to 40 km/hr restrictions during school arrival and departure times)
- If further development were to take place to the north of Mitchell Street, this traffic diverted to Mitchell Street would increase severance effects and discourage integration of

activity with the core of the town centre – it would increase severance between Camden Public School and the core of the town centre, including access to the library; and between St Paul's Primary School and Camden Pool and Onslow Park
- Would require a substantial increase in delays along Argyle Street in order for drivers to use Mitchell Street.

Southern inner bypass

Encouraging substantial additional traffic volumes to use Hill Street:

- is in conflict with the current use of Hill Street as an access road to local retail and commercial services;
- Hill Street and Broughton Street east of John Street is relatively narrow and subject to grades;
- On-street parking in Hill Street would need to be reviewed, adjusted, and some would be lost;
- The additional traffic on Hill Street would make access to/from the existing off-street car park less attractive, as delays would increase;
- As traffic volumes increase on this alignment, travel times and delays would increase relatively quickly due to the lower standard of road and relatively simple intersection arrangements, such as at John Street and Broughton Street – the increase in delays at this intersection for vehicles trying to turn right from John Street to Broughton Street may be sufficient to encourage that traffic segment to use Argyle Street as an alternative;
- To support traffic to and from Cawdor Road
- To achieve sufficient traffic relief for Argyle Street would:
    - Most likely result in environmental capacity thresholds being exceeded along part or all of the alignment;
    - Would require a substantial increase in costs (additional travel times and delays) to be imposed on drivers using Argyle Street.

Hybrid inner bypass

The hybrid option would tend to reduce the impacts of the additional traffic through diffusion across two alignments. However, environmental thresholds would still be exceeded, and the severance effects, etc; would now impact almost the entire town centre core's edge.

All three of the above would require significant increases in costs (higher travel times and delays) to be incurred by vehicles using Argyle Street in order for drivers to consider diverting. This is a major issue and would face a number of hurdles. Over time, as traffic volumes increase on Argyle Street, some traffic will divert to use alternatives. However the amount that diverts is expected to be modest – primarily because alternative routes would, in their current form, experience a relatively rapid increase in costs as the volumes they try to process increase. An additional 150 to 200 vehicles per hour each way along the current Mitchell Street alignment, would see substantial increases in queues and delays (as well as likely breaching environmental capacity thresholds). This broad order of traffic diversion would not be sufficient to remove a travel lane in each direction on Argyle Street.

Consequently, the diversion of substantial traffic volumes from Argyle Street (i.e., sufficient to leave a single travel lane in each direction on Argyle Street) to alternative routes is unlikely to be achieved without actively increasing delays on Argyle Street. This could take a number of forms, including narrowings, partial closures, etc; The introduction of a 40km/hr high pedestrian activity scheme along Argyle Street could reduce the use of Argyle Street marginally, as it would reduce traffic speeds and increase travel times by a small amount (due to the roundabouts and parking activity on Argyle Street it is unlilely that this reduction in sign posted speed limit would substantially alter the overall travel time along Argyle Street – although it would be expected to reduce peak speeds)[1].

From a practical perspective, the associated increase in road user costs associated with this sort treatment would most likely result in a road user cost benefit analysis of the scheme indicating a negative net present value and a benefit cost ratio of something less than unity. Obtaining funds for the works may, therefore, prove difficult. As the diversion route (Mitchell Street) would increase the distance of travel by 400m, and would increase delays at intersections and car park access points along the way (and on Argyle Street), it is most unlikely that the higher road user costs could be offset by the value of the improved amenity along the core of Argyle Street[2].

Opportunities for improvement

An approach that encourages vehicles to use alternative routes and minimises circulating traffic would provide benefits for Camden. Argyle Street would remain the key traffic route through town, with better sign-posting of car parking facilities and greater turnover of car parking spaces, drivers would turn from Argyle Street earlier and access the car parks, rather than trawling along the length of the main street, u-turning and coming back along the other side. There is also an opportunity to reduce travel along Argyle Street as a result of improving egress from Oxley Street to Argyle Street, better serving the Oxley Street precinct

[1] It is understood that Council has commissioned an investigation of a High Pedestrian Activity Study, which would provide further advice about the degree of speed reduction that could be achieved by such a scheme.
[2] If Argyle Street were heavily congested and if the alternative route was not as circuitous, then it may be more likely that increases in road user costs would be modest and that the relatively smaller disbenefit to road users could be offset by arguments about improved main street amenity.

Appendix E SIDRA Assessment of Future Conditions

Appendix E: SIDRA Assessment of Future Conditions

The following presents the assessment of future conditions based on a 30% increase growth scenario as described in Section 4 of this report.

Intersection Operating Conditions

The existing intersection operating conditions are presented again below.

Table 1 - Thursday & Saturday AM / PM Existing Intersection Operating Conditions

Street 1	Street 2	Existing Thursday AM		Existing Thursday PM		Existing Saturday AM		Existing Saturday PM	
		LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)
Macquarie Grove Road	Exeter Street	A	10.5	A	10.3	B	18.2	A	9.2
John Street	Mitchell Street	B	15.4	B	14.6	A	11.2	A	10.7
Elizabeth Street	Mitchell Street	A	11.3	A	10.8	A	9.5	A	9.4
Argyle Street	Murray Street	B	20.4	B	14.7	B	15.3	A	13.1
Argyle Street	Oxley Street	B	18.2	B	15.3	A	13.9	A	12.3
Argyle Street	John Street	B	18.3	B	20.5	B	14.8	A	14.0
Argyle Street	Hill Street	B	14.7	B	18.4	A	12.8	A	12.0
Argyle Street	Elizabeth St	B	14.8	B	15.7	A	13.9	A	13.7
Argyle Street	Edward Street	B	15.3	B	16.7	B	14.7	A	13.1
Murray Street	Broughton Street	B	25.6	D	43.3	B	19.1	B	20.1
John Street	Broughton Street	A	12.0	B	14.4	A	10.5	A	10.0
Cawdor Road	Sheathers Lane	B	14.5	B	15.1	A	14.3	B	14.3
Old Hume Highway	Menangle Road	B	27.3	C	36.2	B	20.5	B	22.0

As can be seen from Table 1, all intersections currently operate satisfactorily in all peaks assessed except for the intersection of Murray Street / Broughton Street which operated near capacity in the Thursday PM peak. However, this is directly attributed to the small number of right turn movements (some 10 vehicles) being delayed exiting Broughton Street.

The additional traffic generated by a 30% yield and taking into account future traffic conditions has been assessed. The following presents the future intersection operating conditions in both tabulated and diagrammatic form.

Table 2 - Thursday & Saturday AM / PM - Future Intersection Operating Conditions

Street 1	Street 2	Future Thursday AM		Future Thursday PM		Future Saturday AM		Future Saturday PM	
		LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)
Macquarie Grove Road	Exeter Street	A	11.1	A	10.7	A	10.8	A	9.4
John Street	Mitchell Street	B	18.7	B	22.2	A	11.5	A	11.4
Elizabeth Street	Mitchell Street	A	11.9	A	11.4	A	9.8	A	9.6
Argyle Street	Murray Street	F	>120	B	18.9	B	18.6	B	14.7
Argyle Street	Oxley Street	C	29.1	B	22.7	B	17.3	B	14.4
Argyle Street	John Street	B	27.2	F	>120	B	16.4	B	14.9
Argyle Street	Hill Street	B	18.2	B	28.7	B	14.1	A	13.0
Argyle Street	Elizabeth St	B	16.3	B	18.0	B	14.2	A	14.0
Argyle Street	Edward Street	B	17.3	B	19.8	B	15.4	A	13.5
Murray Street	Broughton Street	C	38.5	F	110.0	B	23.8	B	26.4
John Street	Broughton Street	A	13.6	B	20.6	A	11.2	A	10.5
Cawdor Road	Sheathers Lane	B	15.8	B	15.7	B	14.6	B	14.6
Old Hume Highway	Menangle Road	D	44.4	C	29.6	B	27.0	C	30.2

*Modified intersection

Figure 56 - Thursday AM Peak Future Intersection Operating Conditions

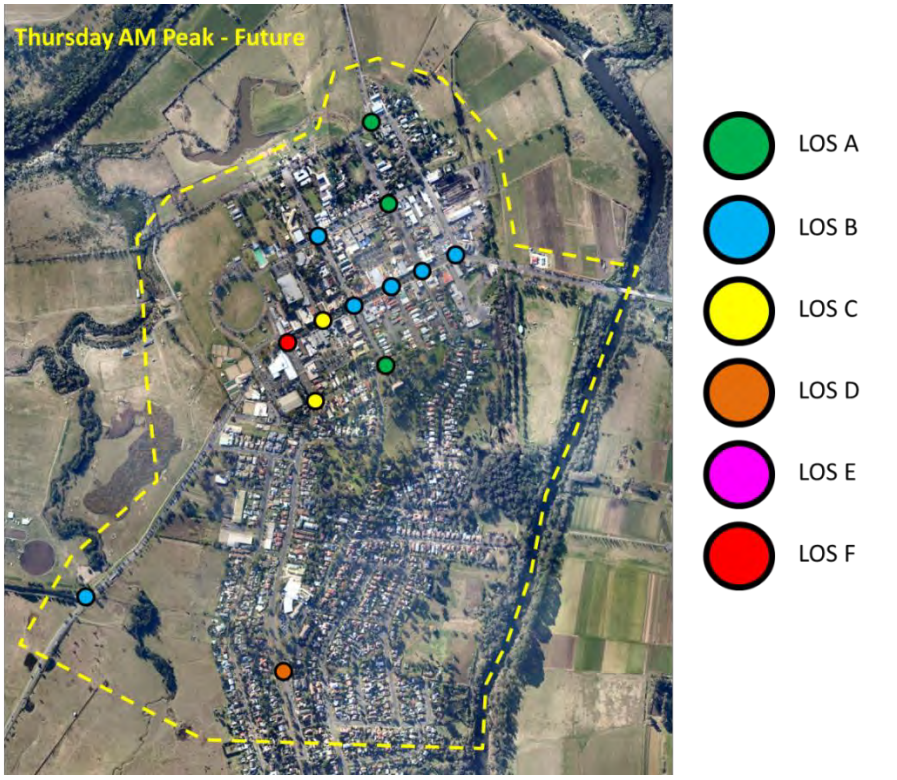


Figure 57 - Thursday PM Peak Future Intersection Operating Conditions

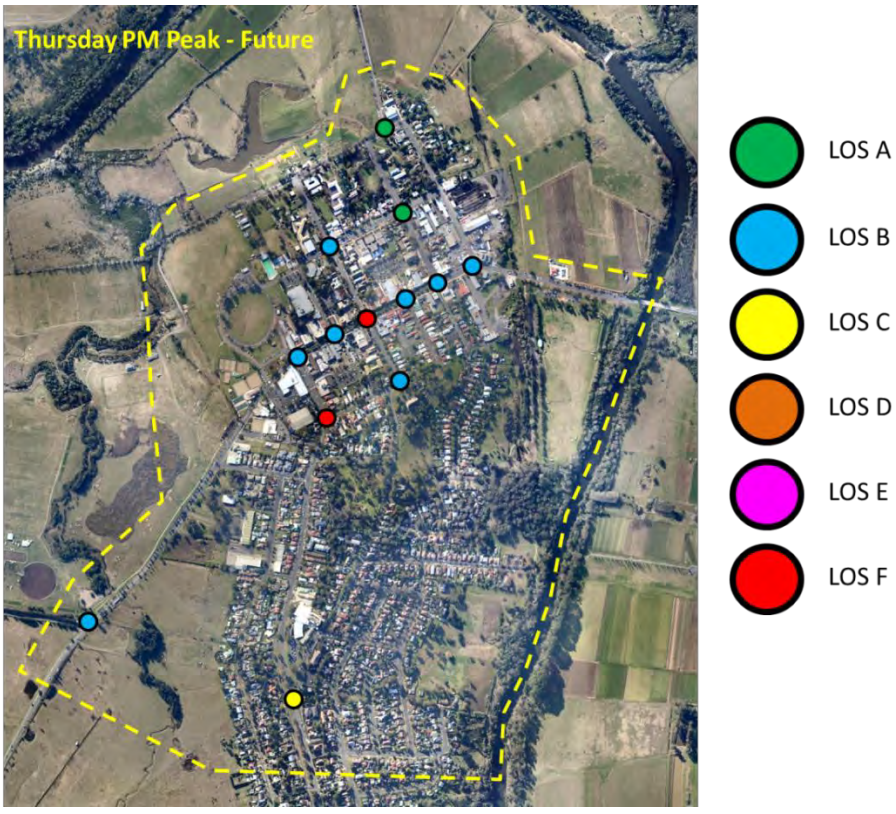


Figure 58– Saturday AM Peak Future Intersection Operating Conditions

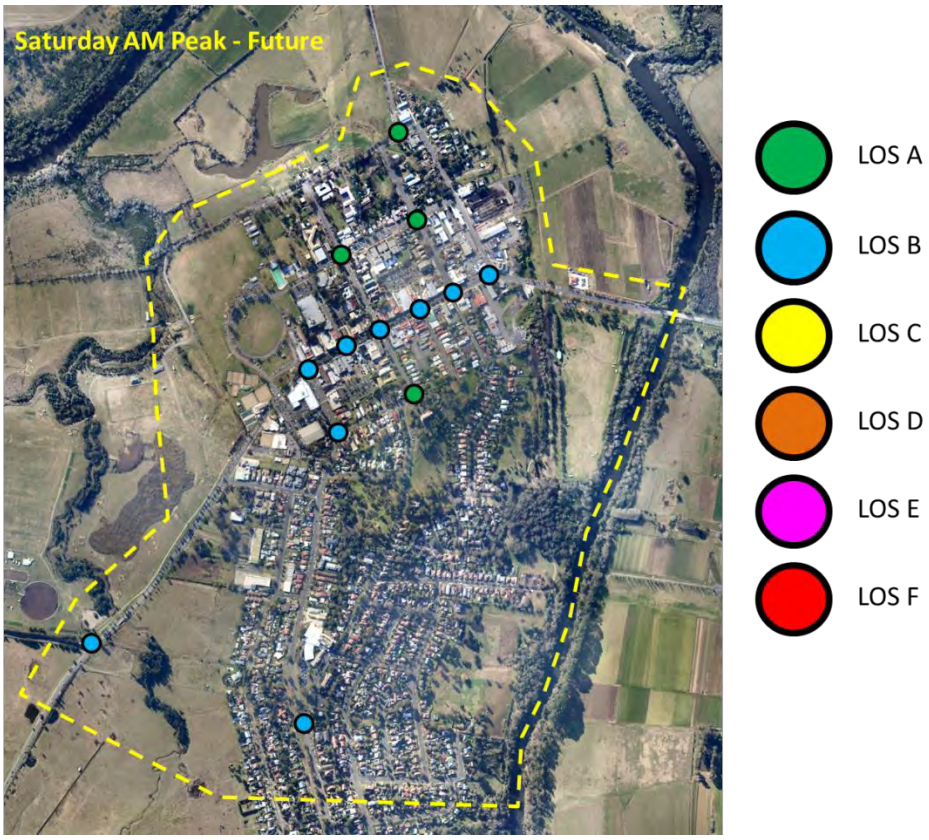
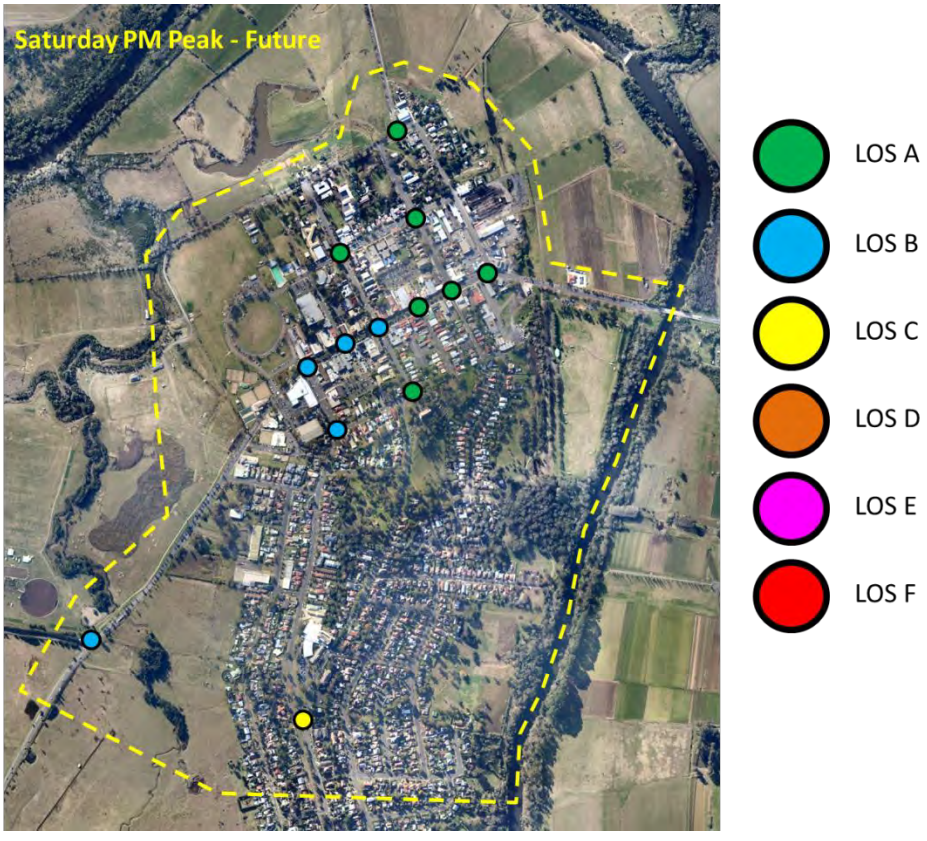


Figure 59 – Saturday PM Peak Future Intersection Operating Conditions



Having regard to the future conditions presented above, the following locations were identified for additional assessment:

- Argyle St / Murray Street – Thursday AM Future LOS F
- Argyle St / John Street – Thursday PM Future LOS F
- Murray Street / Broughton Street – Thursday PM Future LOS F

Argyle Street / Murray Street

The existing layout and resultant LOS for each movement at the intersection during the Thursday PM peak period in the future is shown below.

Figure 60 – Argyle Street / Murray Street Modelled Configuration

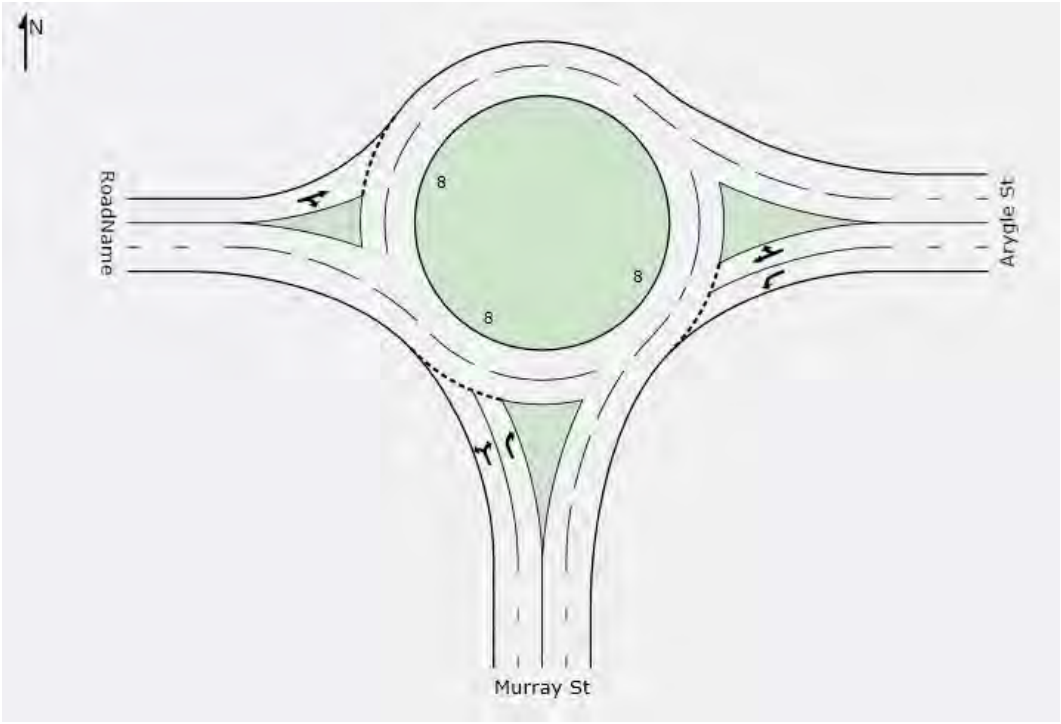
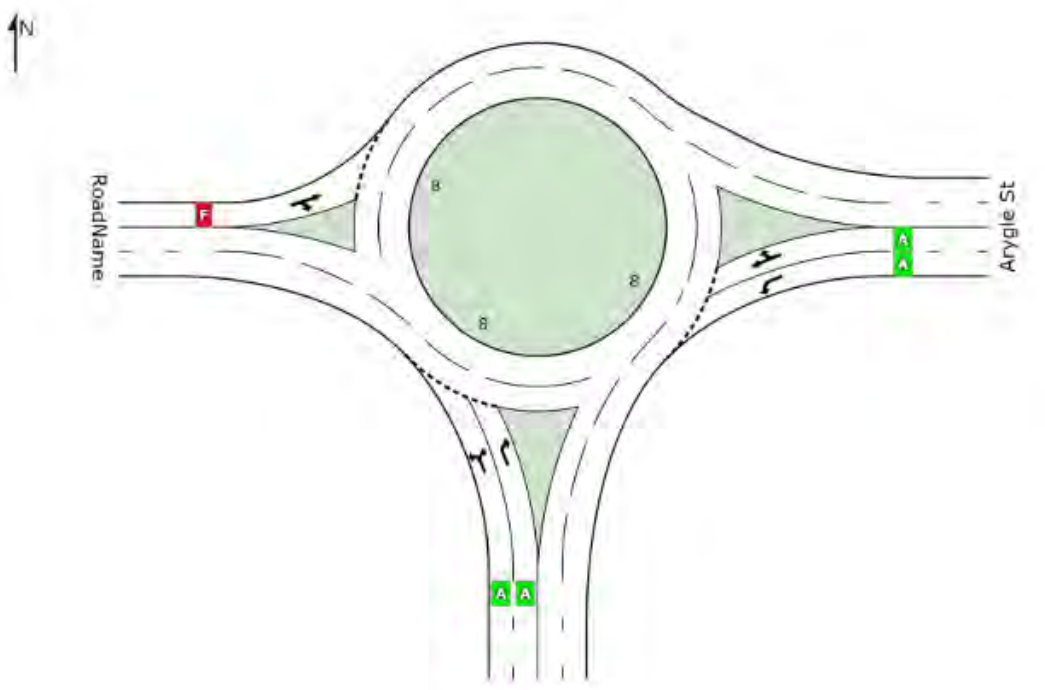


Figure 10 – Argyle Street / Murray Street Thursday AM Future LOS by Movement



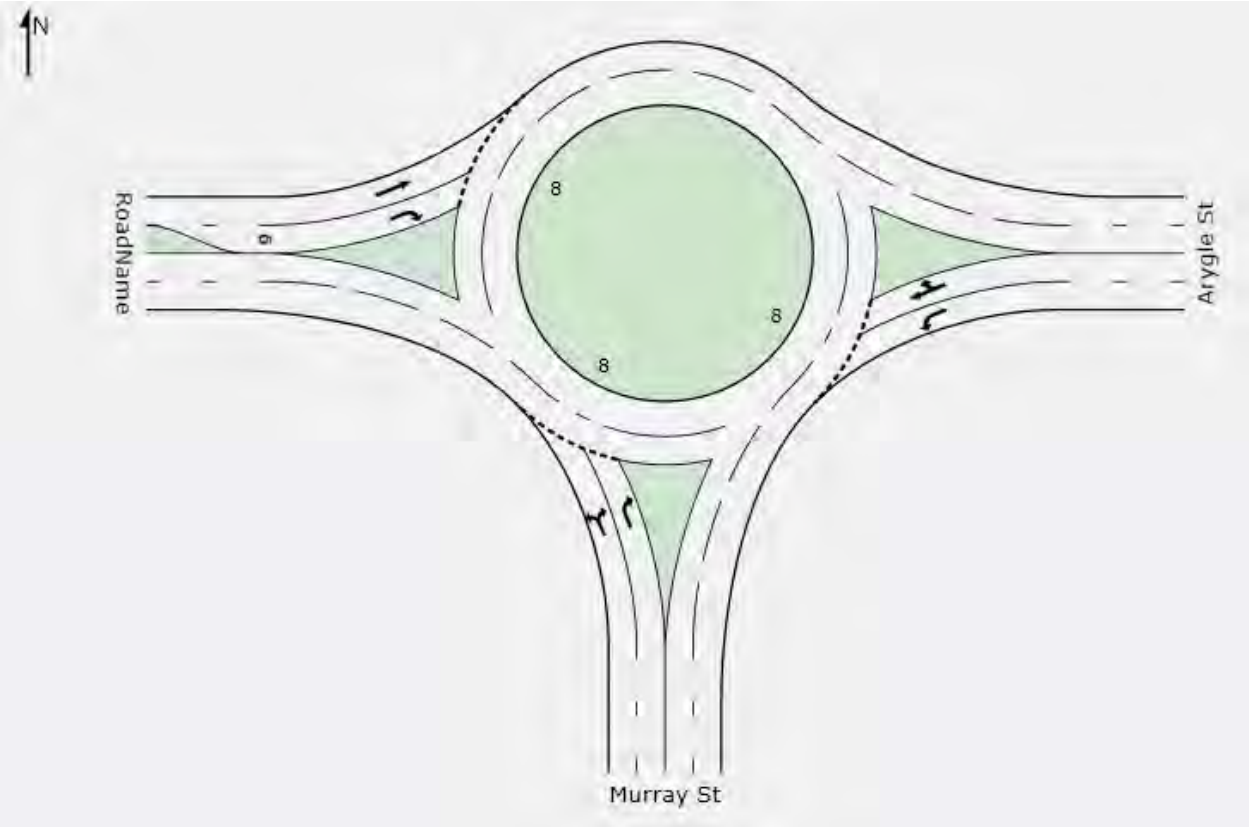
From Figure 61 it can be seen that the LOS of F is attributed to the eastbound through / right turn lane whereas all other movements operate very well.

The existing arrangements are shown below:

Figure 62 – Argyle Street / Murray Street Existing Arrangements

The existing arrangement allows an eastbound through movement to pass through the roundabout immediately following a right turn movement into Murray Street commencing their turn. SIDRA is highly sensitive to these situations and a minor change can change the LOS estimates. To account for the actual existing arrangements, the following modified layout was adopted:

Figure 63 – Argyle Street / Murray Street Modified Modelling Arrangement

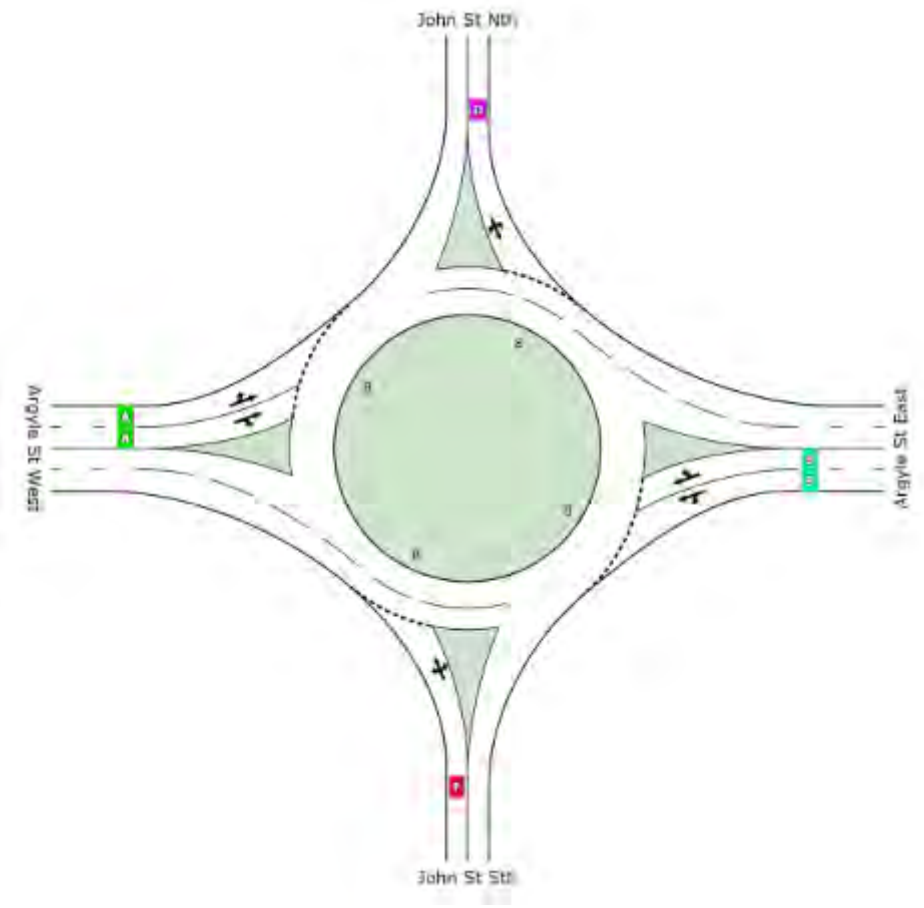


The above arrangement shown in Figure 63 results in a LOS 'B' with delay of the worst movement being 18.7m seconds. Thus no upgrades are considered necessary to accommodate future traffic flows in the Thursday PM peak or at any other peak period assessed.

Argyle Street / John Street

The modelling of the existing roundabout for the future Thursday PM peak indicated the intersection would operate at a LOS "F". The following shows the LOS by movement during this peak.

Figure 64 – Argyle Street / John Street Thursday PM Peak Future LOS by Movement



From **Figure** 64 it is noted that the exit flows from John Street south are resulting in the intersection being classified as LOS "F". This would occur if the 30% development yield increases were achieved well into the future.

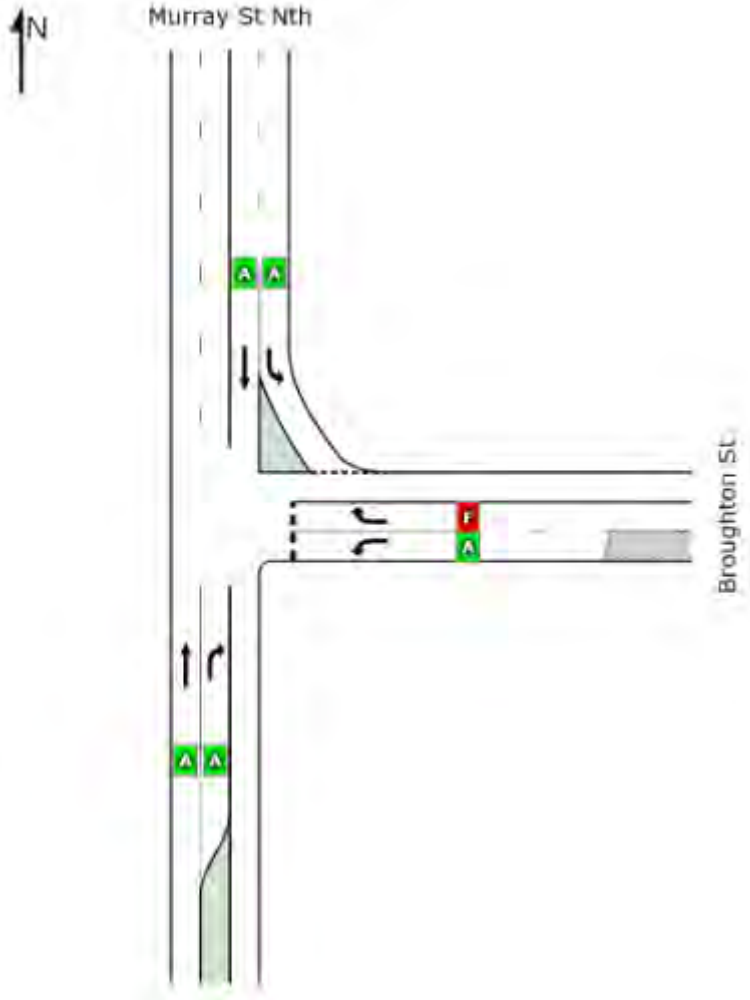
As stated in Section 7.2.3 there are many benefits to retain the existing roundabout. Therefore as issues only occur during one peak period well into the future and are generated by side street traffic, it is suggested that signalisation of the roundabout could occur at times when it is required. The traffic signals would operate on as needs basis and would be triggered by queuing in John Street south.

It is also suggested that the LOS at the intersection be assessed into the future to gauge whether the potential flows and delays for John Street south traffic do eventuate or whether travel patterns change over time.

Murray Street / Broughton Street

Modelling indicates that the intersection would operate at a LOS "F" in the future Thursday PM peak. The LOS by movement is presented below.

Figure 65 – Murray Street / Broughton Street Thursday PM Peak Future LOS by Movement



As stated in Section 7.3.5 a single lane roundabout at the location would assist right turn movements from exiting Broughton Street. The provision of a single lane roundabout at the location would result in an intersection operating conditions of LOS "B" with delay of the worst movement of 16.6 seconds.