Penrith Homemaker Centre Expansion

Traffic Impact Assessment

October 2017 Final Report

Prepared for

Harvey Norman

Prepare by

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Contents

Page

Appendix A Mulgoa Road / Castlereagh Road Corridor Upgrade Traffic & Transport Assessment Study: Penrith Homemaker Centre Preliminary Traffic Modelling

Appendix B SIDRA Movement Summary Reports

Appendix C Parking Surveys

1 Introduction

1.1 The Proposal

Harvey Norman proposes a minor extension of floorspace and parking within the Penrith Homemaker Centre, Pattys Place Jamisontown (the Centre). The Proposal would provide an additional 2,560m^2 gross floor area (GFA) of bulky goods retail space within the existing Domayne building, and increase total parking provision across the Centre from the existing 1,633 parking spaces to a total of 1,701 parking spaces.

It is additionally proposed that Harvey Norman purchase a section of Wolseley Street between Mulgoa Road and the internal Centre roundabout (the Wolseley Roundabout), a local road owned by Penrith City Council (Council), either as part of a 'land swap' or other commercial arrangement. The Proposal would provide for a minor relocation of the Wolseley Roundabout generally to the north-west of its existing location, and then a realignment of the private access road (the Southern Aisle) extending from the Wolseley Roundabout through to Bunnings. This will provide significant efficiencies to the existing Centre access network and enhance the provision of parking in proximity to key 'Precincts' within the Centre.

1.2 Scope of Traffic Assessment

1.2.1 Background

ARC Traffic + Transport (ARC) was commissioned by Harvey Norman in 2016 to examine the access, traffic and parking characteristics of the Proposal, and specifically the existing operation of the Centre and local road network, and the operation of the Centre and local road network further to the Proposal.

In discussions with Council and the Roads & Maritime Service (RMS) during the preparation of the assessment, it was determined that RMS plans for the Mulgoa Road Corridor Upgrade (the MR Upgrade) would significantly alter the design of the Mulgoa Road & Wolseley Street intersection, which provides primary access to the Centre. Specifically, the MR Upgrade proposes the removal of the existing 'mouse hole' which provides unopposed access for right turn trips from Mulgoa Road north into Wolseley Street, to be replaced by (two) at-grade right turn lanes; and more broadly the widening of Mulgoa Road to three through lanes per direction.

In May 2017, the RMS exhibited the Mulgoa Road / Castlereagh Road Corridor Upgrade Preferred Option Report (the Upgrade Report), Appendix B of which comprises the January 2017 Mulgoa Road / Castlereagh Road Corridor Upgrade Traffic & Transport Assessment Study (Upgrade TTAS) prepared by Arcadis on behalf of the RMS.

The Upgrade TTAS reported that the MR Upgrade would not have a detrimental impact on the key Centre access intersection of Mulgoa Road & Wolseley Street, which would operate at a level of service B in the Thursday PM Peak Hour through 2036 further to the MR Upgrade, even further to sensitivity testing which increased the Centre trip generation from surveyed flows. Notwithstanding, further to detailed consultation it was agreed by the RMS and Council that additional modelling – including modelling of Saturday PM Peak Hour conditions – would be undertaken to ensure the validity of the initial Upgrade TTAS modelling results. As such, the RMS commissioned Arcadis to revise the Upgrade TTAS, with a particular focus on the Mulgoa Road & Wolseley Street and Mulgoa Road & Blaikie Road intersections in both the Thursday PM Peak Hour and Saturday PM Peak Hour.

1.2.2 Revised Upgrade TTAS Modelling – Technical Note 1

The Penrith Homemaker Centre Preliminary Traffic Modelling report was completed by Arcadis in July 2017 and presented as Technical Note 1 (TN1) to the Upgrade TTAS. It has been agreed with the RMS and Council that the revised modelling (provided in TN1) is the most appropriate reference (in regard to the future operation of the road network providing for the Centre), and as such this assessment specifically references TN1 in regard to future traffic operations. TN1 is provided as **Appendix A** of this assessment.

1.3 Scope of General Assessment

In addition to the future traffic implications of the Proposal, ARC has prepared a detailed assessment of the access and parking characteristics of the existing Centre and the Proposal, with a specific focus on internal access (for general and service vehicles) and parking provision and allocation across the Centre. In preparing this assessment, ARC has also: -

- Reviewed existing and future trip generation rates for the Centre;
- Reviewed proposed changes to the internal Centre road network, specifically focusing on the minor relocation of the Wolseley Roundabout and the realignment of the Southern Aisle; and the implications of such in regard to general and service vehicle paths through the Centre;
- Reviewed existing and future parking requirements, provision and design; and
- Referenced key planning documents and standards, including: -
    - RTA Guide to Traffic Generating Developments (GTGD)
    - RMS Technical Direction 2013 04a – Guide to Traffic Generating Developments; Updated traffic surveys (GTGD Update)
    - Penrith Development Control Plan 2014 (DCP 2014)
    - AS 2890.1:2004 Parking Facilities Part 1: Off-Street Parking (AS 2890.1)
    - AS 2890.2:2002 Parking Facilities Part 2: Off-Street Commercial Vehicle Facilities (AS 2890.2)
    - AS 2890.6:2009 Parking Facilities Part 6: Off Street Parking for People with Disabilities (AS 2890.6)

From the outset, ARC would acknowledge the assistance of RMS and Council officers in determining the broader scope of this assessment and the additional modelling completed in TN1.

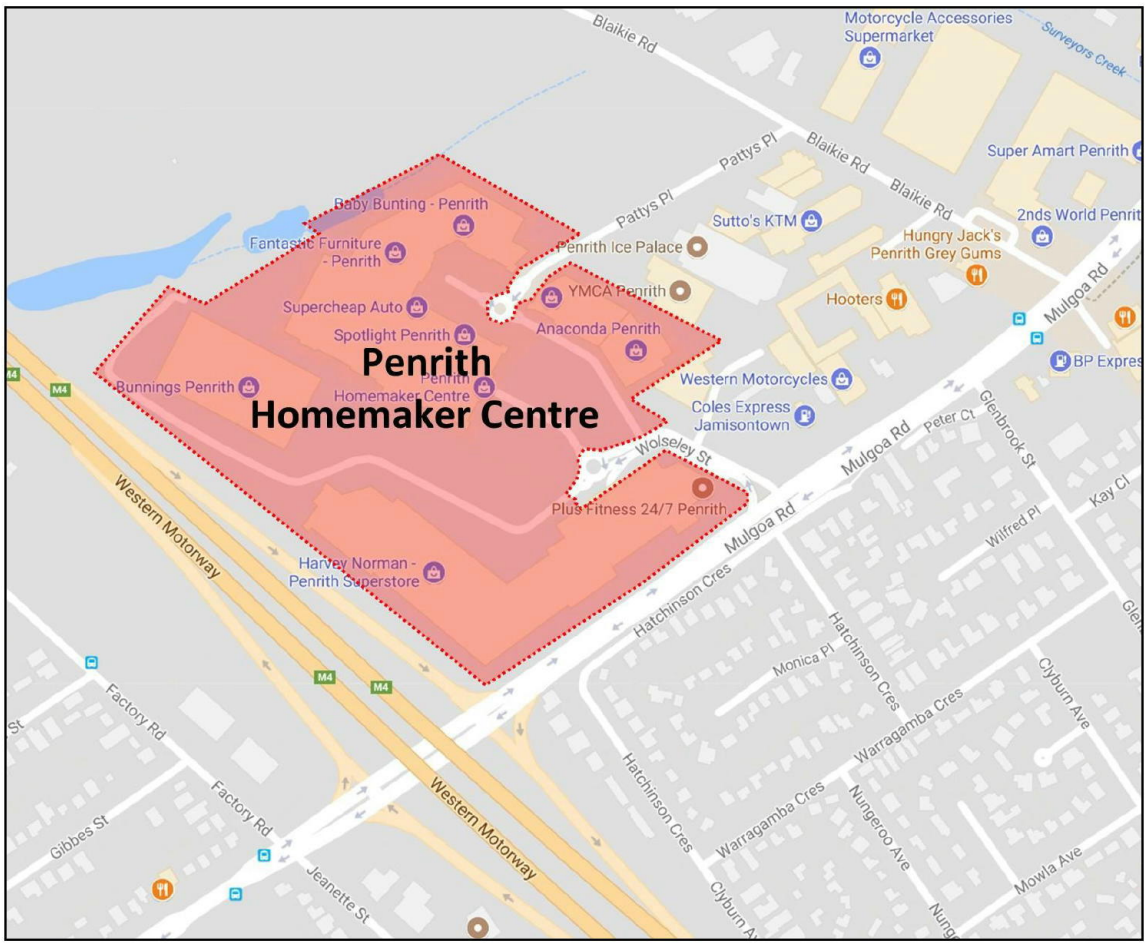
2 The Existing Centre

2.1 Location

The Centre is located at Lot 2, Pattys Place, Jamisontown, noting that the Centre's address is better identified as the corner of Mulgoa Road & Wolseley Street based on the primary Centre access point.

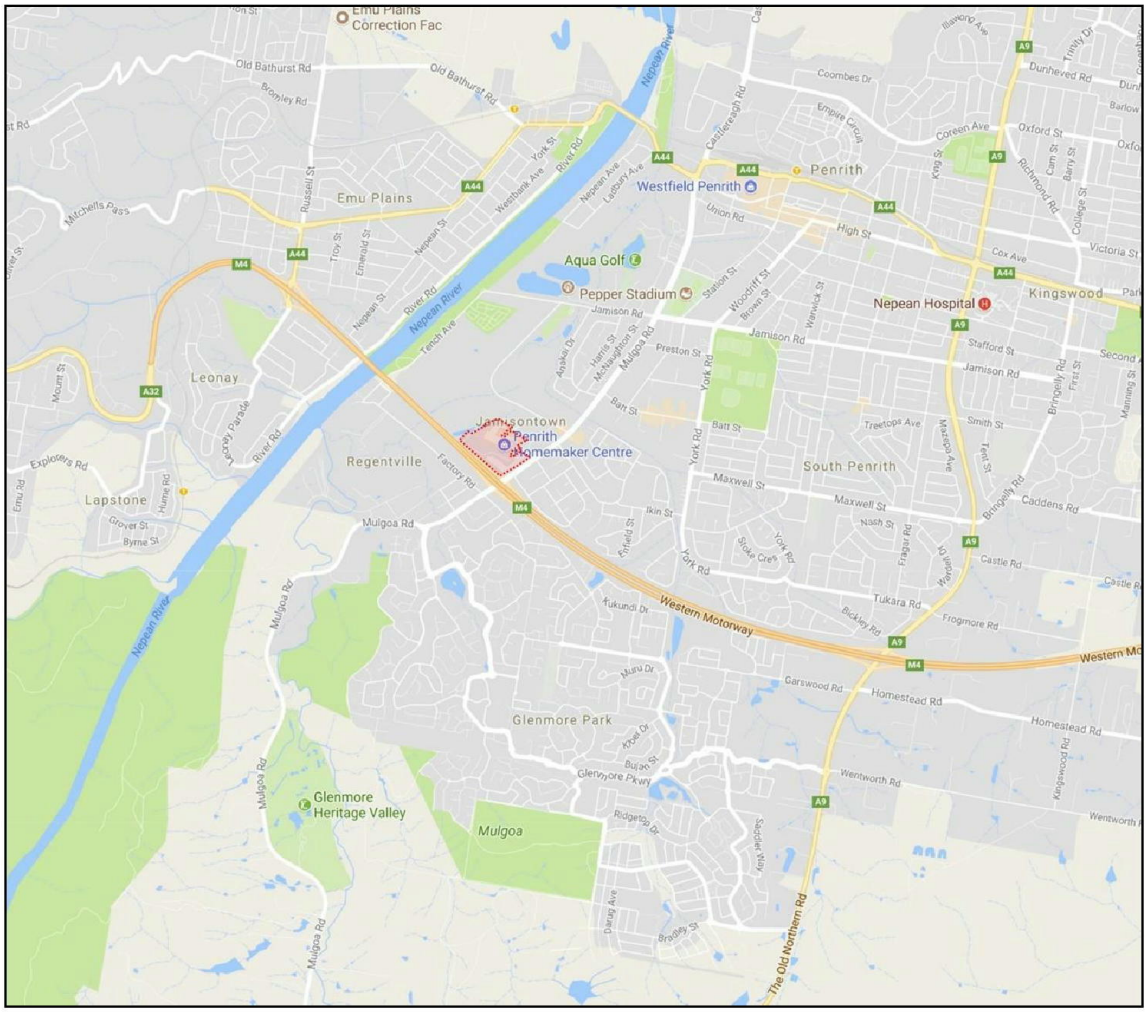
The Centre in its local context is shown in **Figure 2.1.1**, and in its sub-regional context in **Figure 2.1.2**. For ease of reference through this assessment, ARC has referred to Mulgoa Road and Pattys Place as running north-south.

Figure 2.1.1 Centre Location Local Context



Source: Google Maps

Figure 2.1.2 Centre Location Sub-Regional Context



Source: Google Maps

2.2 Centre Components

2.2.1 Centre Area

The Centre has floorspace of some 66,577m^2 GFA, and provides what are generally referred to as 'bulky goods' retail outlets, augmented in recent years by a Bunnings hardware store.

2.2.2 Centre Parking

The Centre currently provides at total of some 1,633 parking spaces. This equates to the provision of approximately 1 space per 41m^2 GFA, which is in excess of the parking requirements of DCP 2014 for bulky goods floorspace. A more detailed review of existing Centre parking is provided in **Section 2.9**.

2.3 Vehicle Access

2.3.1 External Road Network

Centre access is available via the intersection of Mulgoa Road & Wolseley Street; and via Pattys Place (in turn primarily to/from the intersection of Mulgoa Road & Blaikie Road). From Mulgoa Road, access is available to the north to Penrith and the Great Western Highway; and to the south to the M4, Glenmore Park and Mulgoa. Pattys Place provides secondary access via Blaikie Road to Mulgoa Road, almost exclusively for trips to and from the north.

More broadly, the Centre is provided with excellent and immediate access to the sub-regional and regional road network.

2.3.2 Internal Road Network

Wolseley Street – a (Council owned) local road – runs from Mulgoa Road to the Wolseley Roundabout; the Council owned land includes the Wolseley Roundabout itself and the immediate approach to the Wolseley Roundabout from Southern Aisle. Pattys Place is also a Council owned local road which extends south from Blaikie Road to a point immediately north of the internal (private) Centre roundabout (termed the Pattys Roundabout for ease of reference).

Additional key internal (private) Centre road infrastructure includes: -

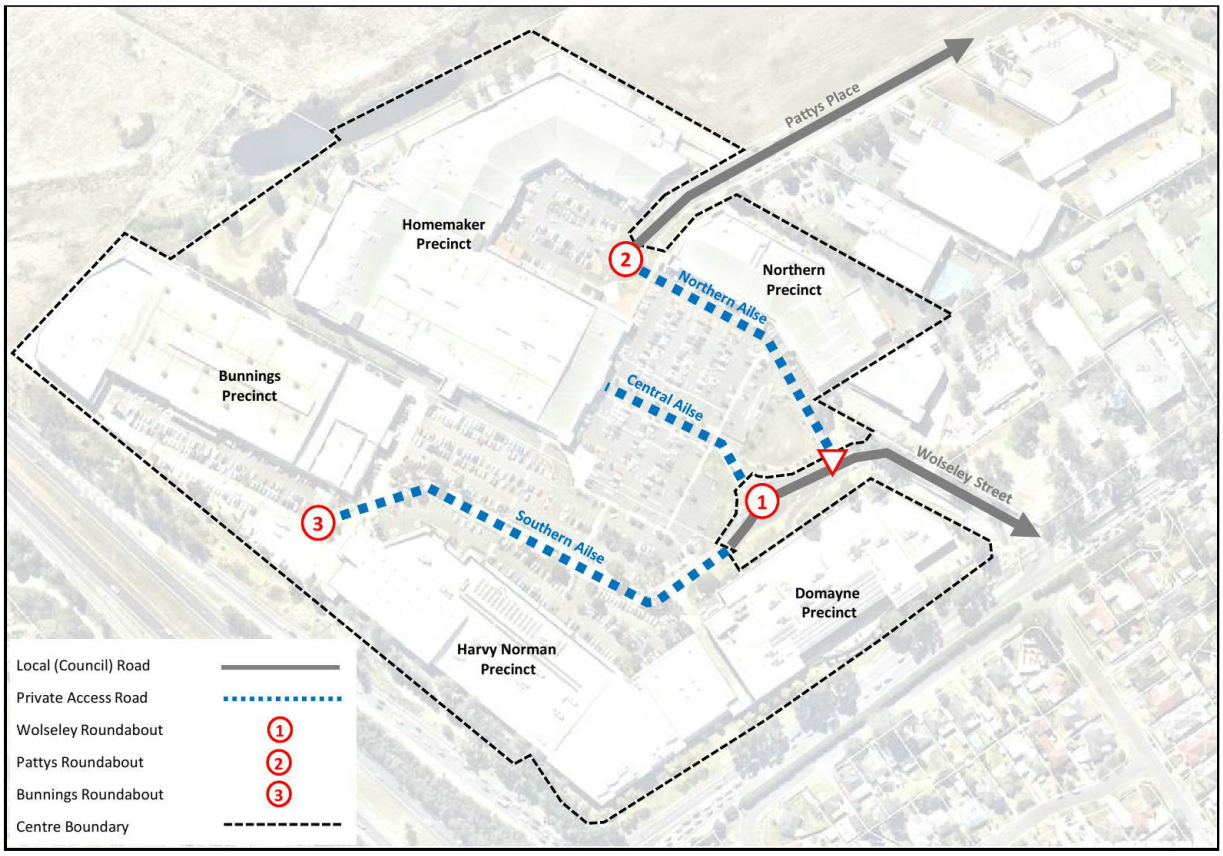
- As previously described, the two-way Southern Aisle running generally south and south-west from the Wolseley Roundabout through to a small roundabout (termed the Bunnings Roundabout) adjacent to Bunnings.

- A two-way access aisle running generally east-west from the Wolseley Roundabout which provides access to the central Centre car parks and – somewhat circuitously via parking aisles – to the Pattys Roundabout. ARC has termed this aisle 'Central Aisle'.

- A two-way access aisle running generally east-west between Wolseley Street (adjacent to Nick Scali Furniture) and the Pattys Roundabout; ARC has termed this 'Northern Aisle'. It is noted that given the central median in Wolseley Street at its intersection with Wolseley Street, no right turn movements are available to/from Wolseley Street from/to Northern Aisle.

The boundaries of the Council owned roads, and the key internal (private) roads, are shown in **Figure 2.3.2** below. The general Precincts within the Centre are also shown.

Figure 2.3.2 Existing Centre Primary Access Roads



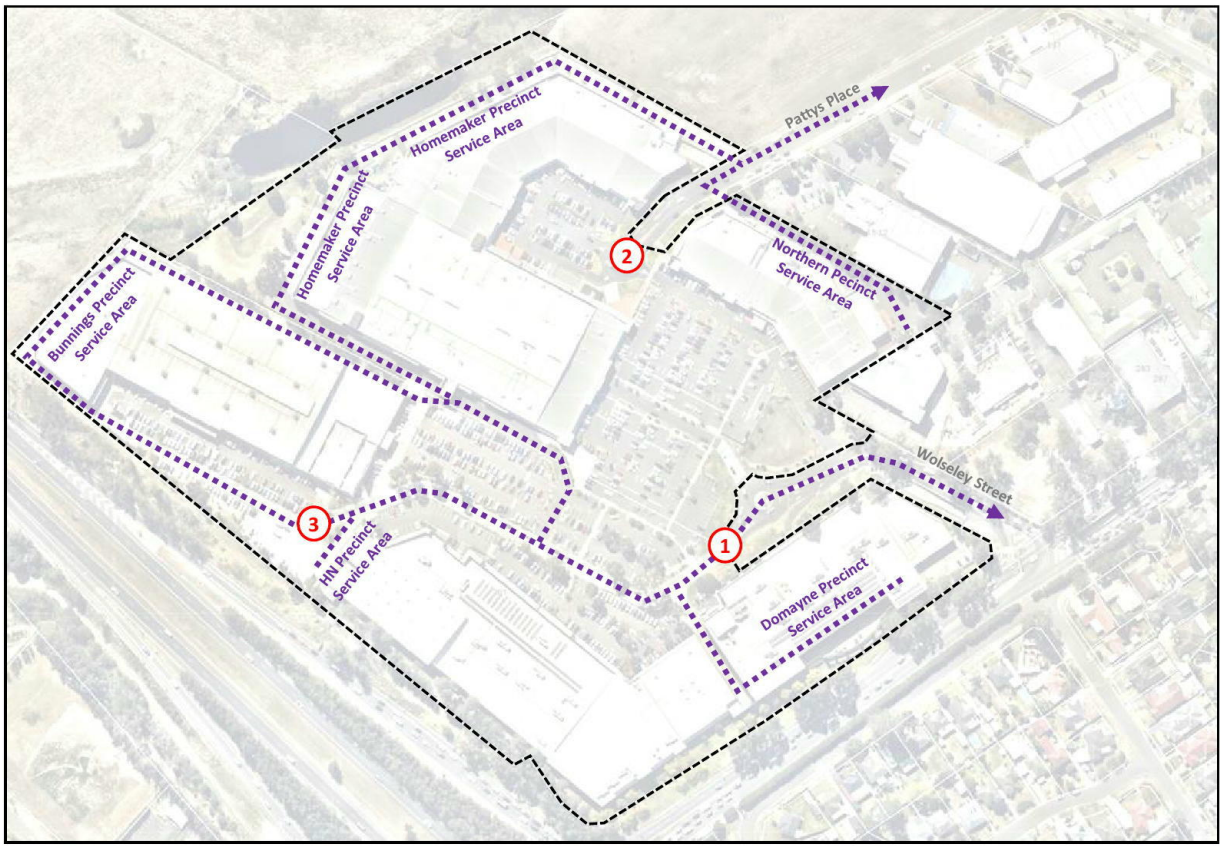
Source: Nearmap

2.3.3 Service Vehicle Access

Service areas are provided within each of the Centre Precincts, which are accessed via Southern Aisle (to the Domayne, Harvey Norman, Bunnings and Homemaker Precincts service areas) and via a dedicated service road off Pattys Place (to the Homemaker Precinct service area). All service areas are appropriately separated from internal general access areas, and it is important to note from the outset that the Proposal would retain all Centre service areas in their current locations.

Existing service areas and service vehicle paths are shown in **Figure 2.3.3**.

Figure 2.3.3 Existing Centre Service Vehicle Access



Source: Nearmap

2.3.4 Existing Centre Access Issues

Based on our on-site observations, general vehicle circulation through the Centre is good, with significant access infrastructure available, and moreover significant parking available readily accessible to all Centre Precincts. Notwithstanding, ARC notes the following: -

- Some service vehicle paths through the Centre are poor, or more precisely the paths currently taken by some service vehicles are poor. One of the primary issues with existing service vehicle circulation is (service vehicle) access from the Wolseley Roundabout through to the Pattys Roundabout, which requires the use of Central Aisle and then the minor parking aisles to Northern Aisle. Neither Central Aisle or these minor parking aisles are designed for the movement of (anything other than small rigid) service vehicles, which results in excessive manoeuvring by some service vehicles at the intersections of Central Aisle (and Northern Aisle) and the minor parking aisles.

- Southern Aisle south of the Wolseley Roundabout turns sharply to the south-west towards the Bunnings Precinct, which can result in larger service vehicles at times encroaching on the opposing lane to turn through this corner.

- During off-peak periods, primarily during the weekday mornings, some service vehicles utilise (largely empty) car parking areas between the Wolseley Roundabout and the Bunnings and Homemaker Precincts service areas for access rather than Southern Aisle.

- The Wolseley Roundabout approach from Mulgoa Road provides 2 approach lanes, each of which allows for a right turn to Central Aisle; however, the departure lanes in Central Aisle providing for these movement are poorly marked (i.e. there is no formal demarcation of the dual departure lanes).

- With regard to general movements between Pattys Place and Mulgoa Road, there is minor non-Centre through movement utilising the internal Centre road network (and particularly Northern Aisle).

With reference to **Section 3**, it is our opinion that the Proposal will significantly improve the internal Centre access, responding specifically to each of the issues outlined above.

2.4 Trip Generation

As previously discussed, it has been agreed with the RMS and Council that the revised modelling provided in TN1 is to be the primary reference for this assessment of future traffic conditions; as such, sections below reference the TN1 assessment data.

2.4.1 Traffic Surveys

Arcadis commissioned extended Thursday and Saturday peak period traffic surveys in April 2017 at the following intersections: -

- Mulgoa Road & Wolseley Street
- Mulgoa Road & Glenbrook Street
- Mulgoa Road & Blaikie Road
- Wolseley Roundabout
- Blaikie Road & Pattys Place

It is noted that the surveys do not provide a specific count in Pattys Place immediately north of the Centre (i.e. at a location to measure Centre specific trip generation). The 2017 survey data is reported in Appendix A of TN1, with the selected Thursday PM Peak Hour and Saturday PM Peak Hour identified as the hour with the highest combined vehicle flows (all movements) at the intersection of Mulgoa Road & Wolseley Street (see further below).

2.4.2 Trip Generation

With reference to the 2017 surveys provided in TN1, it is estimated that the Centre had the following trip generation during the Thursday PM Peak Hour (3:00pm to 4:00pm) and Saturday PM Peak Hour (2:00pm to 3:00pm): -

- Thursday PM Peak Hour 1.83 trips per 100m^2 GFA
- Saturday PM Peak Hour 2.81 trips per 100m^2 GFA

2.5 Assessment Base Trip Generation

The 2017 surveys were undertaken during a period where retail trip generation is generally marginally lower than an average (for assessment) trip generation period. It is therefore important to consider factoring the surveyed trip generation of the Centre to an appropriate average for the purpose of assessment. Sections below provide a discussion in regard to the key characteristics of bulky goods trip generation.

2.5.1 GTGD Update Trip Rates

The GTGD Update provides the following summary trip rates for bulky goods development: -

- Thursday PM Peak Hour 2.4 trips per 100m^2 GFA
- Saturday PM Peak Hour 3.9 trips per 100m^2 GFA

It is important to note that these summary rates are primarily based on surveys of smaller (generally individual) bulky goods sites/stores, rather than a larger development such as the Centre. A detailed review of the *Trip Generation and Parking Generation Surveys Bulky Goods / Hardware Stores* (*TGPG Bulky Goods*) prepared by Hyder in 2009 for the RMS (upon which the GTGD Update summary rates are based) indicates that the only surveyed larger bulky goods site similar to the Centre – Harvey Norman at Auburn (25,00m^2 GFA) - has a significantly lower trip generation rate than the summary rates, which are specifically 'inflated' by the inclusion of smaller (primarily electronics or faster trade) retailers.

The peak hour trip rates reported in the *TGPG Bulky Goods* for Harvey Norman Auburn are reported as: -

- Weekday PM Network Peak Hour 1.21 trips per 100m^2 GFA
- Saturday PM Network Peak Hour 2.20 trips per 100m^2 GFA

Reference to these surveys strongly suggests that the trip generation of the Centre would be significantly less than the GTGD Update summary rates.

2.5.2 GTGD Season Trip Variation

The GTGD provides a summary of retail trip variations by month across the year based on surveys of retail outlet surveys over a 4 year period. It is our opinion that these variations would equally apply to bulky goods retail, and are shown in **Table 2.5.2** below.

Table 2.5.2 GTGD Retail Seasonal Variation

Month	Variation (compared with average)	Month	Variation % (compared with average)
January	0.89	July	1.03
February	0.87	August	1.01
March	0.97	September	0.96
April	0.96	October	0.98
May	1.01	November	1.08
June	0.97	December	1.28

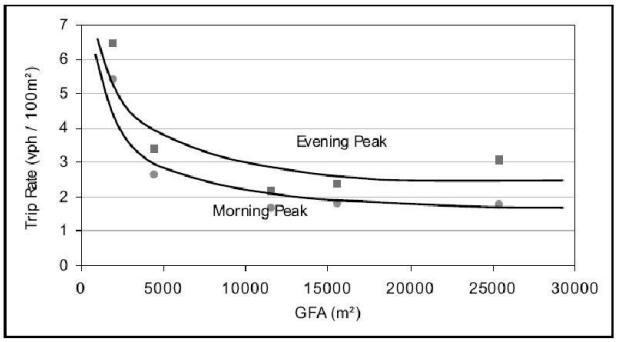
Source: GTGD

With reference to **Table 2.5.2**, the April 2017 survey period represents a period where (the GTGD indicates) retail trip generation is slightly lower than average (yearly) trip generation. It is noted that all month's report average generation well below the December peak; however, such super-peak conditions are not an appropriate standard for design. With reference to **Table 2.5.2**, the April 2017 trip generation of the Centre would therefore be only marginally lower (by 4%) than average annual generation.

2.5.3 Centre Size

The 2004 *Does size matter? – bulky goods retail trip generation and car parking demands* (Hulbert et al) paper presented to the Australian Institute of Traffic Planning & Management provides evidence that trip rates for bulky goods development decrease as the size of the development increases, as shown in **Figure 2.5.3** below (noting that this data relates to weekday trips).

Figure 2.5.3 Relationship between Bulky Goods Store Size & Trip Generation Rates



Source: *Does size matter? – bulky goods retail trip generation and car parking demands*

A similar trend is of course displayed in regard to general retail (shopping centre) developments, as evidenced in the GTGD Update shopping centre trips rates as reproduced below: -

Table 2.5.3 GTGD Update Retail Shopping Centre Trip Rates

Range in Total Floor Area (GLFA – m^2)	Peak Hour Generation Rate (vehicles per $100m^2$ GLFA)			
	Thursday (V(P)/A)	Friday (V(P)/A)	Saturday PVT (A)	Sunday
0 – 10,000	12.3	12.5	16.3	
10,000 – 20,000	7.6 (6.2)	6.2 (6.7)	7.5 (7.5)	(6.6)
20,000 – 30,000	5.9 (6.0)	5.6 (5.9)	7.5 (7.0)	(6.3)
30,000 – 40,000	4.6	3.7	6.1	
40,000 – 70,000	(4.4)	(4.4)	(5.5)	(4.6)
70,000+	(3.1)	(4.0)	(3.6)	(3.2)

Source: GTGD Update, noting that figures in brackets refer to 2011 surveys

Again, reference to this data strongly suggests that the trip generation of the Centre would be significantly less than the GTGD Update summary rates.

2.5.4 Bunnings Trip Generation

Finally, it is also the case that the trip generation of the Centre includes the higher generating Bunnings in the south-west corner of the Centre.

With reference to the GTGD Update, hardware stores such as Bunnings generate trips at a significantly higher rate than bulky goods, particularly in the Saturday peak (where the trip rate for the similarly sized Bunnings Minchinbury was 6.3 trips per $100m^2$, or some 60% higher than the bulky goods summary rates). This means that in the peak hours, the average generation of the Centre is inflated by the higher generating Bunnings.

2.5.4 Assessment Trip Rates

The trip generation factors described in sections above strongly support the contention that the application of the GTGD Update trip rates to the Centre would, quite simply, significantly overstate the trip generation of the Centre. As such, and with reference to all available information, the following maximum trip rates have been identified by ARC for the base assessment: -

- Thursday PM Peak Hour 2.10 trips per $100m^2$ GFA
- Saturday PM Peak Hour 3.20 trips per $100m^2$ GFA

The application of these rates to the Centre provides the following trip generation totals for the assessment of 'base' conditions: -

- Thursday PM Peak Hour 1,398 trips
- Saturday PM Peak Hour 2,130 trips

It is noted that these trip totals do not include the additional trips which would be generated by the Proposal (see **Section 3**).

2.6 Trip Distribution

2.6.1 Directional Distribution

The 2017 surveys provide the following directional trip distribution profile for the Centre during the peak periods: -

- Thursday PM Peak Hour
  - Approximately 82% of trips generated to/from Mulgoa Road, of which approximately 39% were to/from the north, and 61% were to/from the south.
  - Approximately 18% of trips generated to/from Pattys Place.

- Saturday PM Peak Hour
  - Approximately 82% of trips generated to/from Mulgoa Road, of which approximately 42% were to/from the north, and 58% to/from the south.
  - Approximately 18% of trips generated to/from Pattys Place.

In context, if it is (reasonably) assumed that the majority of trips to/from Pattys Place are from/to areas north of the Centre, then the broader distribution split would be: -

- Thursday PM Peak Hour
  - Approximately 50% of trips to/from the north
  - Approximately 50% of trips to/from the south

- Saturday PM Peak Hour
  - Approximately 52% of trips to/from the north
  - Approximately 48% of trips to/from the south

2.6.2 Arrival & Departure Distribution

The 2017 surveys indicate that in both the Thursday PM Peak Hour and Saturday PM Peak Hour, approximately 50% of trips are arrival trips and 50% of trips are departure trips.

2.7 Assessment Base Trip Assignment

With reference to sections above, the assessment base trips have been assigned to the key interface and internal intersections with reference to the TN1 survey data, noting that additional trips have been proportionally assigned with reference to the 2017 surveyed trip distribution. The resulting assessment base flows are shown in the figures below.

Figure 2.7.1 Thursday PM Peak Hour Assessment Base Flows

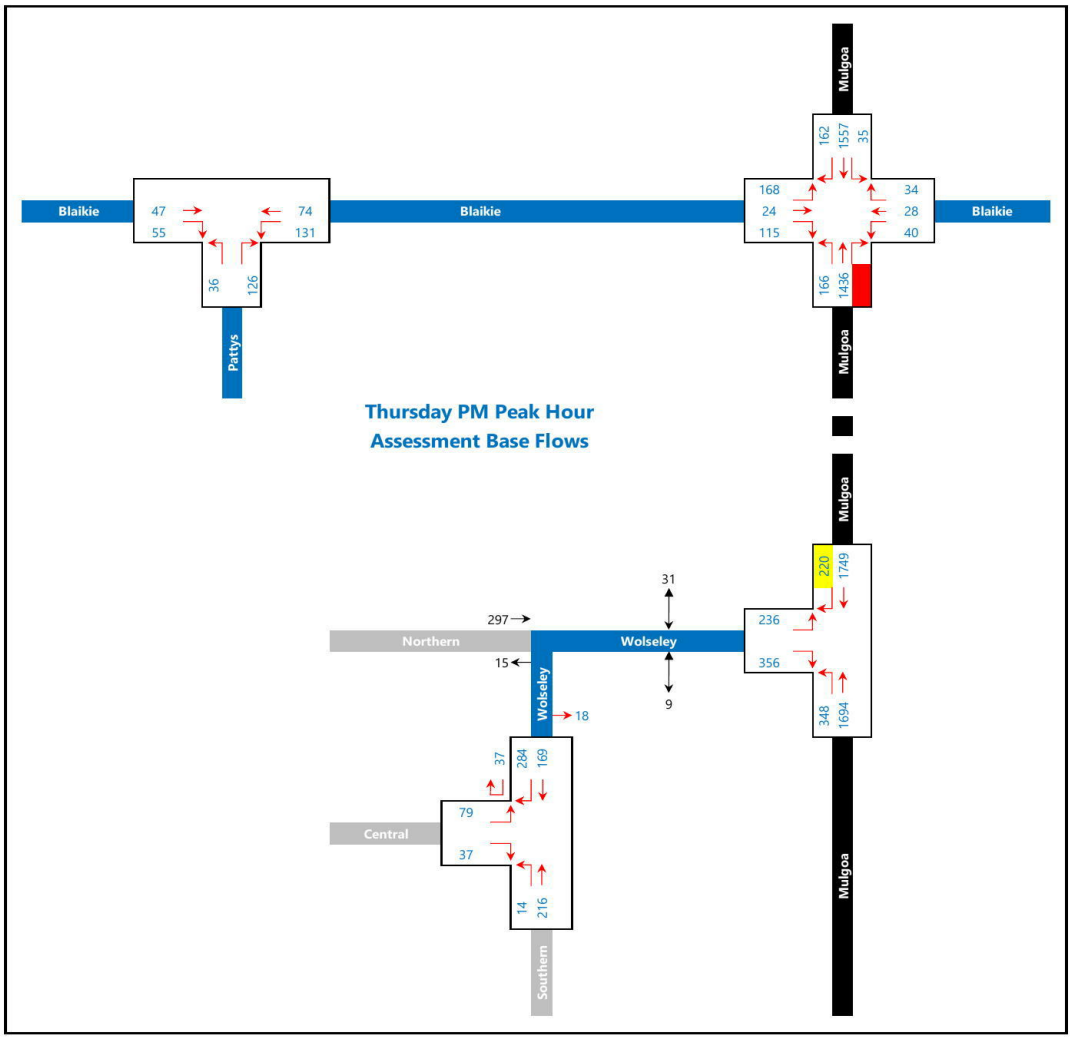
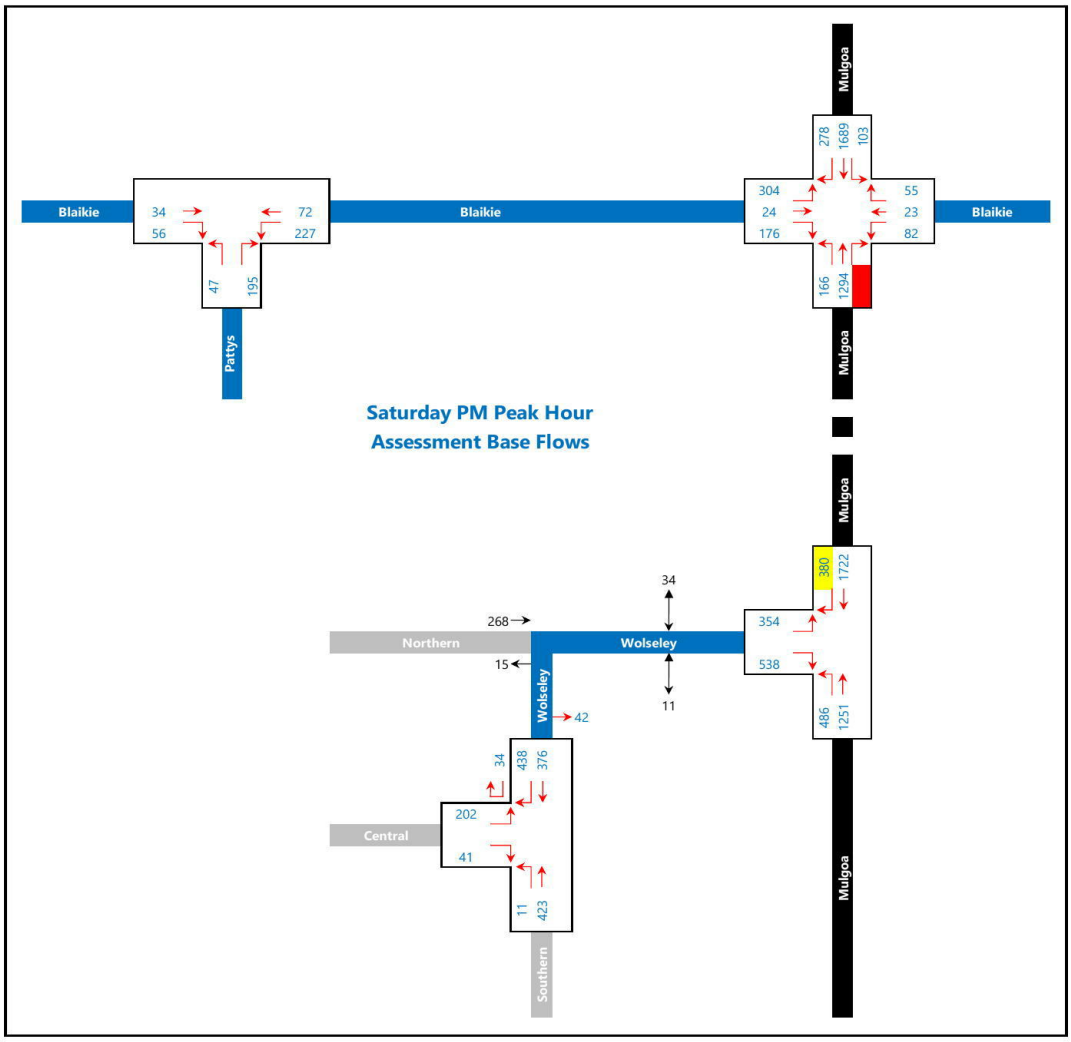


Figure 2.7.2 Saturday PM Peak Hour Assessment Base Flows



2.8 Assessment Base Intersection Operations

2.8.1 SIDRA

In order to determine the current level of service at the key local intersections, ARC has modelled intersection performance using the SIDRA model. SIDRA is an RMS approved intersection performance model that determines key performance measures for 'isolated' intersections, be they priority, roundabout or signal controlled.

The SIDRA analysis includes: -

- Surveyed peak hour traffic flows, speed profiles and sight distances
- Existing intersection geometry and priority control
- Existing lane availability and utilisation based on the time period and/or local conditions

The key performance measures resulting from the analysis are outlined below.

- **Level of Service**

Level of Service (LoS) is a basic performance parameter assigned to an intersection based on average delay; we note that we have assessed the intersections using the RTA parameters which use only delay in the calculation of LoS. For signalised and roundabout intersections, LoS is based on the average delay to all vehicles, while at priority controlled intersections LoS is based on the minor approach delays.

The RMS Level of Service criteria are provided below: -

Level of Service	Control delay per vehicle in seconds (d) (*including geometric delay*)
	All intersection types
A	d ≤ 14.5
B	14.5 < d ≤ 28.5
C	28.5 < d ≤ **42.5**
D	**42.5** < d ≤ 56.5
E	56.5 < d ≤ 70.5
F	70.5 < d

- **Degree of Saturation**

Degree of Saturation (DoS) is defined as the ratio of demand (arrival) flow to capacity. Degrees of Saturation above 1.0 represent over-saturated conditions (demand flows exceed capacity) and degrees of saturation below 1.0 represent under-saturated conditions (demand flows are below capacity)

- **Delay**

Delay represents the difference between interrupted and uninterrupted travel times through an intersection, and is measured in seconds per vehicle in this assessment. Delays include queued vehicles accelerating and decelerating from/to the intersection stop, as well as general delays to all vehicles travelling through the intersection. With reference to the LoS criteria above, the average intersection delay for signals and roundabouts represents an average of delays to all vehicles on all approaches, while for priority intersections the average delay for the worst approach is used.

- **Queue Lengths**

Queue length (QL) is the number of vehicles waiting at the stop line, and in this assessment is based on the 95th percentile back of queue length. It is measured as the number of queued vehicles per traffic lane at the start of the green period (signals) or queued vehicles in each 'gap acceptance cycle' for roundabouts and priority intersections (i.e. the longest period in which no vehicles from the minor movement can enter the opposing primary flow).

2.8.2 Assessment Base Intersection Operations

The operations of the key intersections based on the assessment base flows as reported in **Section 2.7** are summarised in the tables below. SIDRA summary reports are provided in **Appendix B**.

Table 2.8.2 Assessment Base Intersection Operations

Assessment Base Flows Intersection Operations	Level of Service		Average Delay (s)		Degree of Saturation		Wolseley Queue Length (m)	
	Thursday	Saturday	Thursday	Saturday	Thursday	Saturday	Thursday	Saturday
Mulgoa & Wolseley	B	B	16.3	17.4	0.676	0.738	94.9	105.1
Mulgoa & Blaikie	B	B	19.6	25.2	0.729	0.897		
Wolseley Roundabout	A	A	4.4	4.6	0.212	0.324	9.1	15.6

With reference to **Table 2.8.2**, it is apparent that all intersections currently operate at appropriate levels of service during both the Thursday PM Peak Hour and Saturday PM Peak Hour, though there is little spare capacity at the Mulgoa Road & Blaikie Road intersection. Importantly – and as agreed with Council and the RMS based on their officer's observations - queue lengths in Wolseley Street, both on the approach to Mulgoa Road and on the approach to the Wolseley Roundabout, are well contained within the available lane distance between Mulgoa Road and the Wolseley Roundabout so as to not impact the operation of the adjacent intersections.

2.9 Parking

2.9.1 Parking Supply

As discussed, the Centre currently provides a total of some 1,633 parking spaces. The existing parking supply equates to the provision of approximately 1 space per 41m^2, which exceeds the DCP 2014 parking requirements for bulky goods of 1 space per 50m^2 GFA. **Table 2.9.1** provides a general breakdown of available parking within the Centre, noting of course that many of the car parks provide good access for multiple Centre Precincts.

Table 2.9.1 Existing Centre Parking

Existing Centre Parking	General Spaces	Accessible	Parents with Prams	Motorcycle	Trailer/Loading	Staff	Total Spaces
Domayne Precinct	64	3	0	0	2	0	69
Harvey Norman Precinct	126	6	0	0	0	19	151
Bunnings Precinct	171	6	0	0	17	0	194
Central/Homemaker Car Parks	587	12	4	0	9	18	630
Northern Precinct	32	4	0	0	0	25	61
Underground Car Park	505	8	10	4	1	0	528
Total Parking	**1485**	**39**	**14**	**4**	**29**	**62**	**1633**

2.9.2 Parking Demand

Parking surveys of the primary car parks within the Centre were undertaken by Matrix Traffic & Transport Data (Matrix) in June 2016 and are provided in **Appendix C**.

The surveys, and moreover our observations, indicate that parking is (generally) freely available in close proximity to most of the Centre Precincts. The large basement car park in the north-western corner of the Centre is generally underutilised other than during peak periods (of the year). This appears to be a function of the spare capacity (again through most of the year) available at grade.

With regard to the Domayne Precinct, 58 spaces are provided in the undercroft car park, with additional spaces in the immediate vicinity of the Domayne Precinct including those in the central car parks and in the adjacent Harvey Norman Precinct car parks. With reference to our observations and to the parking surveys, it is apparent that visitors to the Domayne Precinct will use each of these car parks, but there is a 'preference' for spaces within the undercroft car park (which provides sheltered access to both the lower and upper floor tenancies) and in the central car parks.

With specific regard to capacity within the car parks readily accessible to the Domayne Precinct: -

- On the surveyed Thursday, the peak demand for the undercroft car park was for 35 of the 58 available spaces (11:00am), while across the adjacent car parks (including the undercroft car park) primarily providing for the Domayne Precinct there was a peak demand for 173 of the 370 available spaces (11:00am).

- On the surveyed Saturday, the peak demand for the undercroft car park was for 42 of the 58 available spaces (1:00pm), while across the adjacent car parks (including the undercroft car park) primarily providing for the Domayne Precinct there was a peak demand for 256 of the 370 available spaces (2:00pm).

Even further to factoring demand in the same manner as the factoring of traffic flows to an assessment base peak period (as per the traffic calculations in **Section 2.5**) it is clear that a significant amount of parking is available in close proximity to the Domayne Precinct, while acknowledging the (relatively) limited parking provided immediately within the Domayne Precinct.

2.9.3 Staff Parking

Notwithstanding the above, ARC has observed a (relatively) significant level of staff parking in the primary (at grade) parking areas, and particularly in the central and Harvey Norman Precinct car parks which provide good access for Domayne Precinct visitors. Based on our discussions with Harvey Norman, parking management strategies are currently being developed and implemented which would require staff to utilise the large basement car park, which as discussed is significantly underutilised. The implementation of these strategies will further increase the number of (more immediately) available at grade spaces for visitors to all Centre Precincts.

2.10 Public & Active Transport

2.10.1 Public Transport

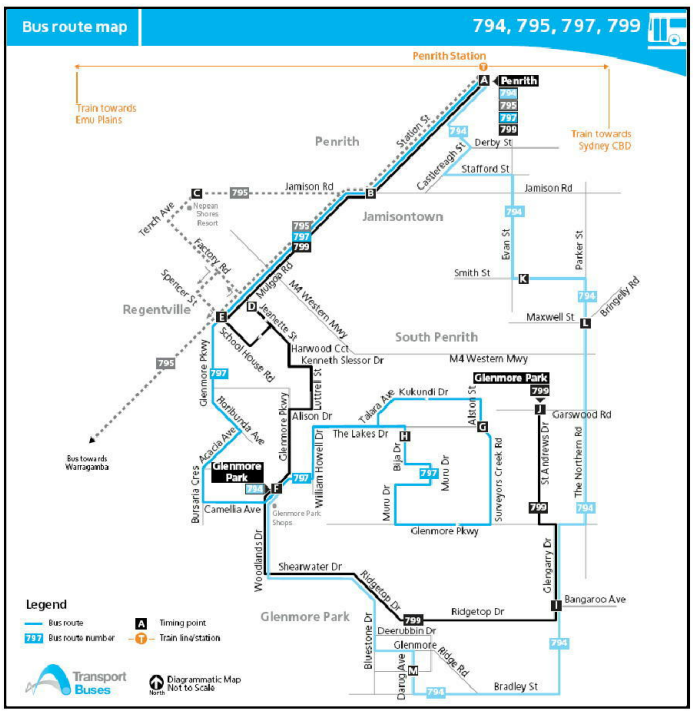
While the potential for public transport trip generation for visitors is relatively moderate given the type of goods available at the Centre, there are excellent opportunities for staff (and of course some visitors) to utilise bus services for access to the Centre, services which will be significantly augmented further to the MR Upgrade.

Busways currently operate the following services in Mulgoa Road directly past the Centre, with bus stops in Mulgoa Road south of Blaikie Road: -

- Route 791 Penrith to St Marys via Orchard Hills
- Route 795 Penrith the Warragamba via Jamisontown
- Route 797 Penrith to Glenmore Park via Mulgoa Road
- Route 799 Penrith to Glenmore Park via Regentville

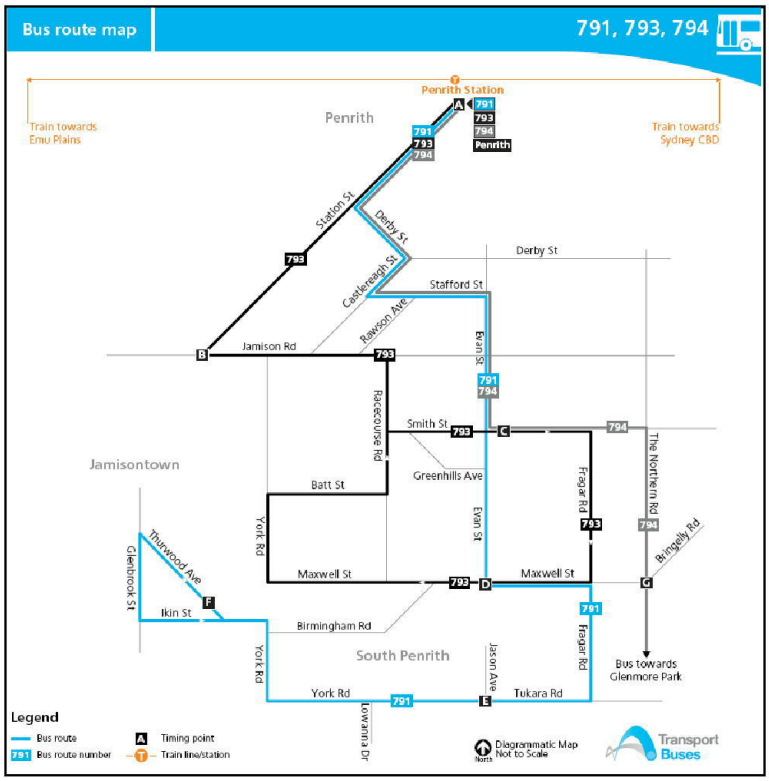
Each of these routes connects to the Penrith Town Centre and transport interchange at Penrith Station, providing excellent local and sub-regional accessibility. These routes are shown in the figures below, noting that the MR Upgrade provides for new bus stops immediately north of Wolseley Street; bus priority at the new signalised intersection of Mulgoa Road & Wolseley Street; and a new signalised pedestrian crossing linking the bus stops.

Figure 2.10.1.1 Local Bus Services 795, 797 and 799



Source: Transport Buses

Figure 2.10.1.2 Local Bus Services 795, 797 and 799



Source: Transport Buses

2.10.2 Active Transport

As with public transport, active transport (pedestrian and cycle) opportunities would generally be reserved for Centre staff, though the on-site pedestrian environment is of course important to both staff and visitors.

Off-site, pedestrian paths are provided along the western side Mulgoa Road, with a signalised crossing of Wolseley Street, and a pedestrian crossing of the Mulgoa Road left turn slip lane to Wolseley Street. A signalised crossing of Mulgoa Road on the northern approach to the Wolseley Street intersection is also provided. These paths then link to an on-site pedestrian path along the southern side of Wolseley Street, which in turn links to on-site paths through the Domayne Precinct and then to connections throughout the Centre, including numerous north-south and east-west marked footpaths and pedestrian crossings of key internal access roads.

An off-road shared path extends from the north along the eastern side of Mulga Road, terminating just north of Wolseley Street (then connecting to a short footpath to the signalised crossing of the Mulgoa Road northern approach). It is noted that the MR Upgrade proposes cross sections which will provide shared paths for the length of Mulgoa Road, which would meet the recommendations of Council's Penrith Accessible Trails Hierarchy Study (PATHS), which aims to provide shared or dedicated cycle paths on all key roads throughout Penrith.

Pedestrian paths are also provided into the Centre along the eastern side of Pattys Place, though pedestrian demand in Pattys Place would be relatively minor.

3 The Proposal

3.1 Proposal Components

The Proposal provides for the addition of some 2,560m^2 of GFA at the Centre, to be provided as an extension of the existing Domayne building. The Proposal would also provide an additional 68 parking spaces across the Centre, with a resulting total parking supply of some 1,701 parking spaces.

In addition, the Proposal provides for: -

- The relocation of the Wolseley Roundabout (and by association its immediate approaches) to a point generally north-west of its existing location. This relocation would provide for additional and relocated parking to the east of the Wolseley Roundabout (i.e. within the Domayne Precinct) to be accessed via a new eastern approach (termed the Eastern Aisle) to the Wolseley Roundabout.

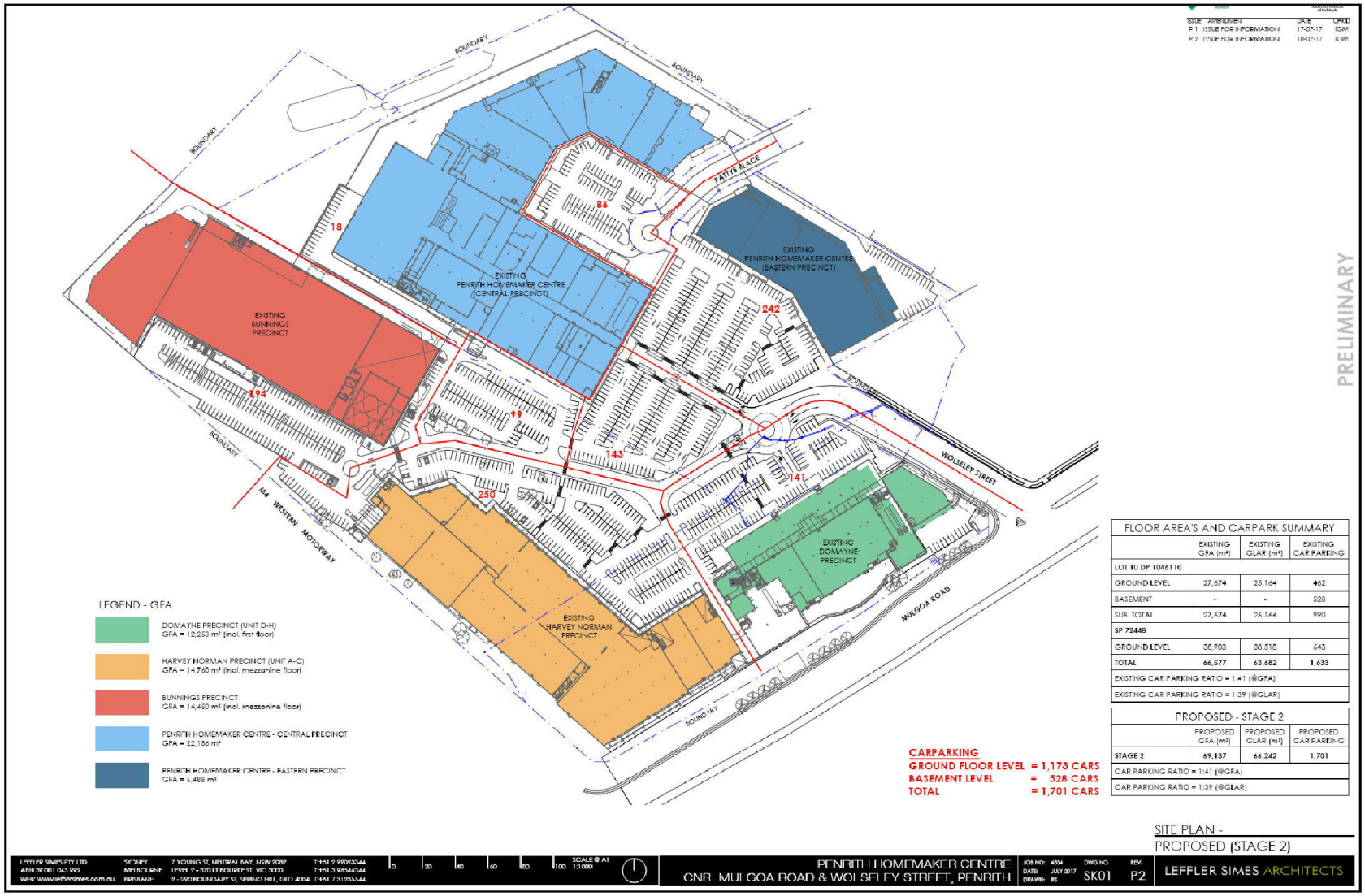
- Further to the above, the realignment of Southern Aisle south and south-west of the Wolseley Roundabout through to the Bunnings Roundabout.

- Broader revisions to existing car parks further to the new alignment of Southern Aisle.

- Additional on-site upgrades and management proposals designed to provide enhanced access to all parking and service areas.

An overview of the Proposal is provided in **Figure 3.1** below.

Figure 3.1 The Proposal



Source: Leffler Simes

3.2 Vehicle Access

3.2.1 External Road Network Access

Access to the external road network would be essentially unchanged by the Proposal, with all such access retained via the intersection of Mulgoa Road & Wolseley Street, and via Pattys Place. With reference to **Section 3.3** below, the Proposal would result in the generation of only very minor additional trips to both intersections.

3.2.2 Internal Road Network Access

As discussed, the Proposal will provide for the relocation of the Wolseley Roundabout and for the realignment of Southern Aisle. Further to the relocation of the Wolseley Roundabout, the realignment of Wolseley Street north of the Wolseley Roundabout would be very minor (limited to the immediate approach to the Wolseley Roundabout) while the realignment of Southern Aisle south and south-west of the Wolseley Roundabout will be more significant, providing a more direct path through to the Harvey Norman and Bunnings Precincts car parks and service areas.

Further details of the proposed changes to the internal road network are detailed in sections below.

3.2.2.1 Removal of Wolseley Street Access Points

The Proposal provides for the removal of the existing Domayne Precinct undercroft car park access point from Wolseley Street immediately north of the Wolseley Roundabout. Subject to final MR Upgrade planning, the existing access point immediately west of Mulgoa Road (providing access to the small car park in the north-eastern corner of the Centre) may also be closed, but this remains to be determined, noting that the removal of these 11 parking spaces would have no impact on overall Centre parking provision meeting, and indeed exceeding, DCP 2014 requirements.

The Proposal also provides for the removal of the Wolseley Street & Northern Aisle intersection, which will result in a redistribution of departure trips currently using Northern Aisle (primarily to Wolseley Street) to Central Aisle and the Wolseley Roundabout; this redistribution is discussed further in **Section 3.4**.

Importantly, the Proposal would not affect the existing access points to Nick Scali or the service station north of Wolseley Street.

3.2.2.2 Wolseley Roundabout

As discussed, the Proposal provides for the relocation of the Wolseley Roundabout generally to the north-west of the existing roundabout location; and for Eastern Aisle, servicing an expanded car park within the Domayne Precinct.

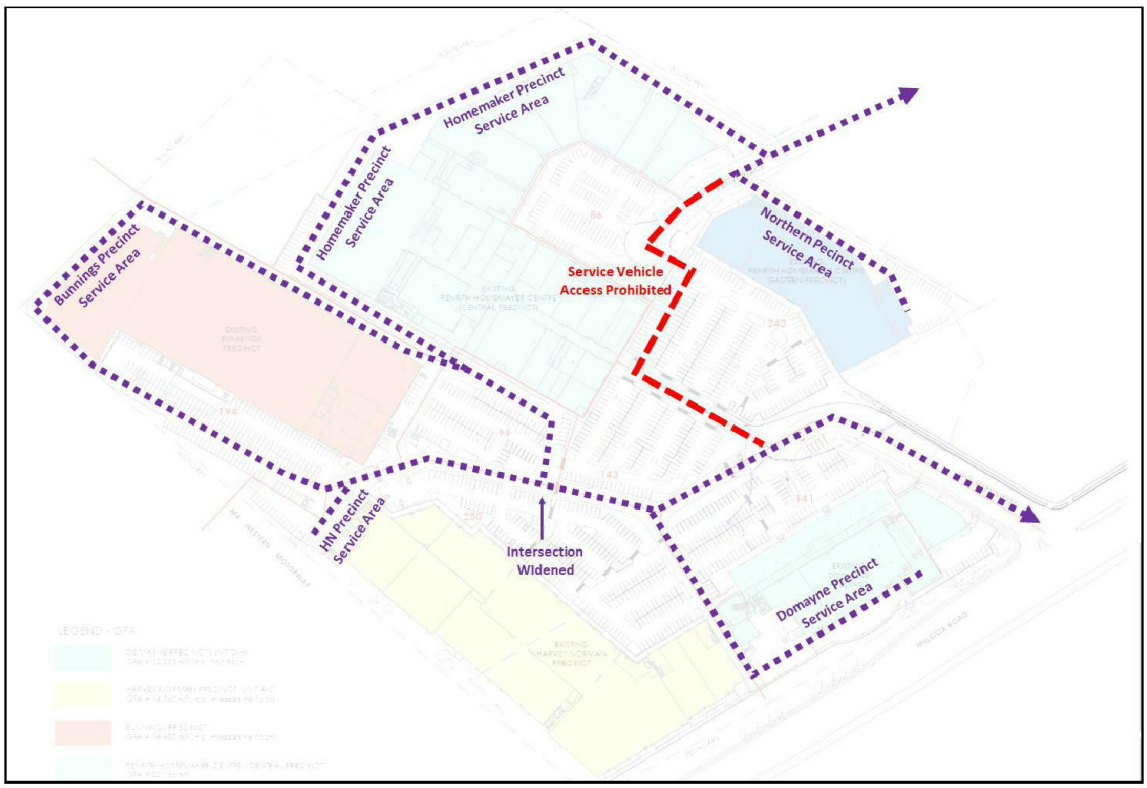
Further to the relocation of the Wolseley Roundabout, revisions to the designation of approach lanes are also proposed so as to better accommodated redistributed (Centre) flows at the Wolseley Roundabout resulting from the closure of the Northern Aisle connection to Wolseley Street, and from the broader redistribution of parking across the Centre further to the Southern Aisle realignment (see also **Section 4.4**).

3.2.3 Service Vehicle Access

Access to all service areas across the Centre will also be significantly improved by the Proposal, noting again that the Proposal would retain all existing service areas as described in **Section 2.2.3**. As well as the general realignment of Southern Aisle providing a more direct and trafficable path through to all service areas, the intersection north of Southern Aisle providing access to and from the Homemaker Precinct service area, and from the Bunnings Precinct service area, will be widened so as to better accommodate the turning paths of heavy vehicles. Access to the Bunnings Precinct service area, and to and from the Harvey Norman Precinct service area, will be generally unaffected by the Proposal (notwithstanding the provision of the more direct alignment of the Southern Aisle).

In response to the existing observed conditions (detailed in **Section 2.3.4**), it is further proposed that service vehicle access to the Central Aisle be restricted. This is unlikely to have any significant impacts on general service vehicle trips, with service vehicles currently accessing the Homemaker Precinct service area to/from Mulgoa Road essentially the only vehicles affected, and being instead required to access the Homemaker Precinct service area via the realigned Southern Aisle access path, or via the Pattys Place dedicated service vehicle driveway.

Figure 3.2.3 Service Vehicle Access



Service vehicle turn paths through the Centre and to/from service areas are provided in the broader submission which this accompanies.

3.3 Trip Generation

There is no information to suggest that the proposed additional bulky goods retail GFA would not generate trips in line with the assessment trip rates as detailed in **Section 2.5.4**. As such, the additional 2,560m^2 GFA is expected to generate an additional 54 vph in the Thursday PM Peak Hour, and an additional 84 vph in the Saturday PM Peak Hour. In both instances, the additional generation represents an increase of less than 4% in total Centre trips.

3.4 Trip Distribution

3.4.1 External Trip Distribution

There is no information to suggest that the distribution of trips to/from the Centre would be significant altered from the distribution detailed in **Section 2.6**.

3.4.2 Internal Trip Distribution

As discussed, the Proposal will result in a redistribution of internal trips within the Centre, as detailed in sections below.

3.4.2.1 Closure of Wolseley Street & Northern Aisle Intersection

The closure of the Wolseley Street & Northern Aisle intersection will result in trips currently turning left from Wolseley Street to Northern Aisle and – more significantly – trips currently turning left from Northern Aisle to Wolseley Street, instead being generated to Central Aisle and the Wolseley Roundabout.

3.4.2.2 Closure of Wolseley Street Access Point to Domayne Car Park

The closure of the existing Domayne Precinct undercroft car park access point to Wolseley Street north of the Wolseley Roundabout will result in these trips (and additional trips further to the additional parking provided off Eastern Aisle) being generated to the proposed Eastern Aisle approach to the Wolseley Roundabout. It is noted that trips from the Domayne Precinct undercroft car park currently depart to Southern Aisle south of the Wolseley Roundabout, and as such there would be a reduction in this departure trip movement.

3.4.2.3 Provision of New and Relocation of Existing Car Parks

The provision of additional parking off Eastern Aisle will result in a proportional increase to trips to/from Eastern Aisle, with a commensurate reduction in trips to/from Central Aisle and Southern Aisle. At the same time, further to the realignment of Southern Aisle a higher proportion of (Centre) parking will be provided south of Southern Aisle; this would again reduce trips to/from Central Aisle, but increase trips to/from Southern Aisle.

With reference to the broader car park revisions and the traffic surveys of existing distribution, it is estimated that further to the Proposal, trips generated to/from the Mulgoa Road intersection will in turn have the following distribution at the Wolseley Roundabout: -

- Thursday PM Peak Hour
  - Approximately 55% of Centre trips will be to/from Central Aisle
  - Approximately 35% of trips will be to/from Southern Aisle
  - Approximately 10% of trips will be to/from Eastern Aisle

- Saturday PM Peak Hour
  - Approximately 50% of Centre trips will be to/from Central Aisle
  - Approximately 40% of trips will be to/from Southern Aisle
  - Approximately 10% of trips will be to/from Eastern Aisle

It is noted that the higher assignment of trips to Southern Aisle on a Saturday is consistent with the surveyed flows, which reflects the higher generation of Bunnings on a Saturday.

3.4.2.4 Nick Scali and Service Station Access

As stated, access to Nick Scali and the service station would be retained via Wolseley Street at the current access point locations. The only difference would be that trips arriving at these sites from Pattys Place would use the Central Aisle to the Wolseley Roundabout and then Wolseley Street as opposed to using Northern Aisle to Wolseley Street.

3.5 Trip Assignment

With reference to sections above, the figures below provide an assignment of total Centre trips further to the Proposal, being the assessment base flows determined in **Section 2.7** plus the additional Proposal flows determined in **Section 3.3**, but accounting for the redistribution of trips at the Wolseley Roundabout as determined in **Section 3.4.2**.

Figure 3.5.1 Thursday PM Peak Hour Total Future Flows

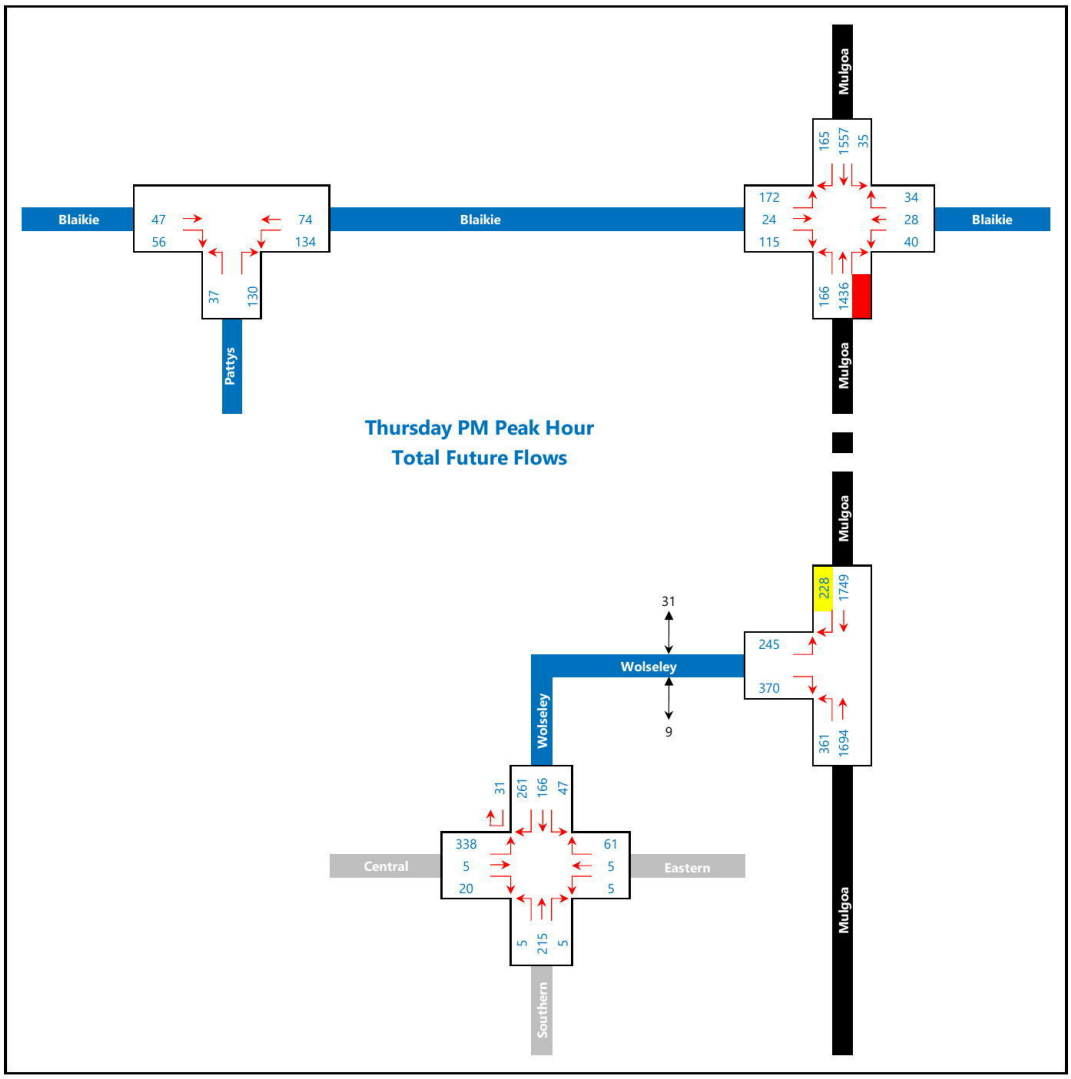
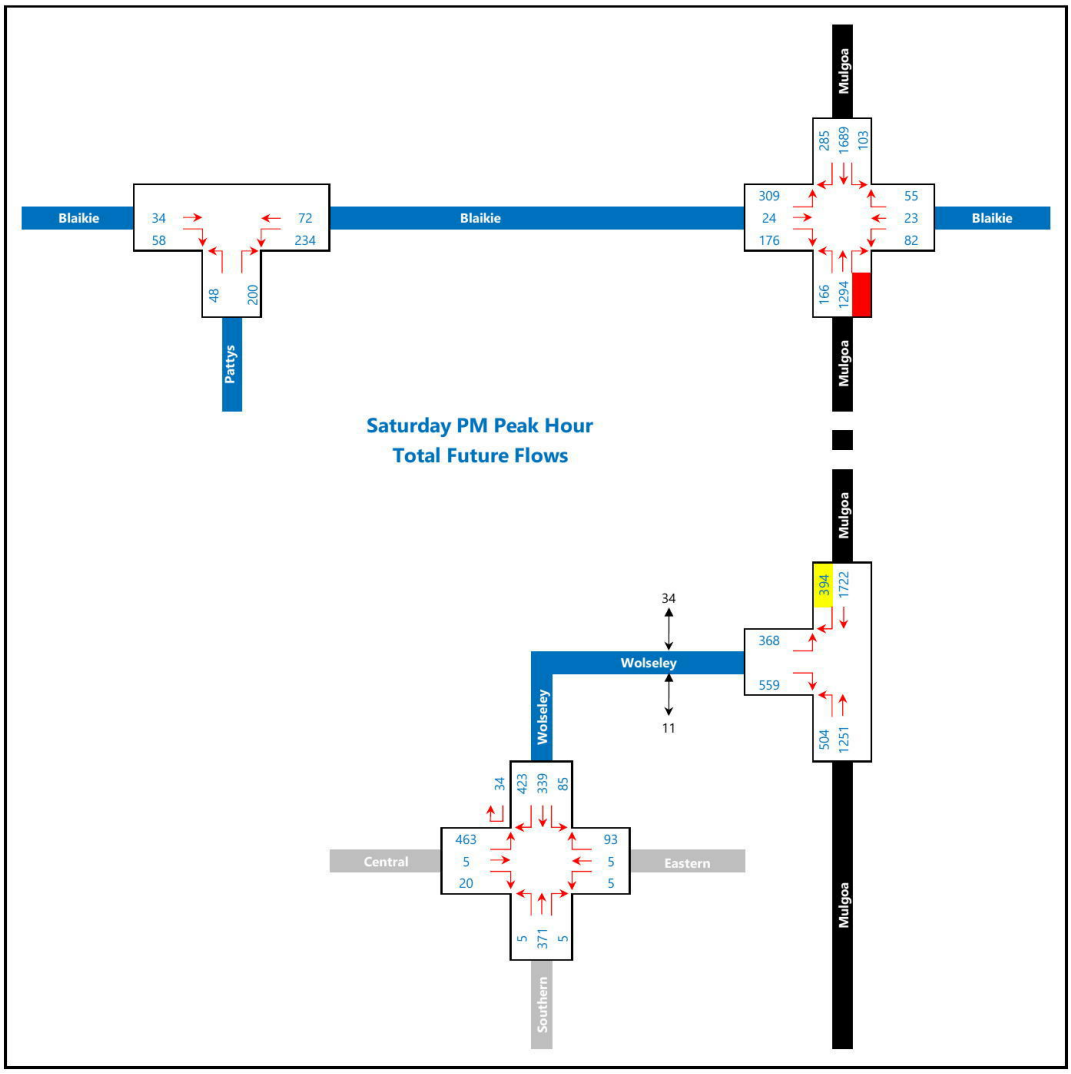


Figure 3.5.2 Saturday PM Peak Hour Total Future Flows



3.6 Future Traffic Conditions

As agreed with Council and the RMS, ARC has referenced TN1 in regard to the assessment of future traffic; a detailed review of the TN1 future traffic assessment is provided in **Section 4**.

3.7 Parking

3.7.1 Parking Requirement

With reference to DCP 2014, the proposed additional 2,560m^2 GFA of bulky goods retail floorspace would in and of itself require the provision of an additional 51 parking spaces. Moreover, further to the Proposal the Centre would require a total of 1,383 parking spaces to provide compliance with DCP 2014.

3.7.2 Parking Provision

The Proposal will provide a total of 1,701 parking spaces, an increase of some 68 spaces over the existing Centre parking provision, and thereby providing full compliance with DCP 2014. This total of 1,701 parking spaces equates to the provision of approximately 1 space per 41m^2, a near identical amount of parking (per GFA) as currently provided at the Centre.

3.7.3 Parking Allocation

The Proposal will provide more appropriate levels of parking in proximity to each of the Centre Precincts than currently provided, particularly in the instance of the Domayne Precinct where the (existing) alignment of Wolseley Street (and Southern Aisle) has previously restricted the provision of immediately adjacent parking; a total of some 141 parking spaces will be provided immediately adjacent to the Domayne Precinct east of the Wolseley Roundabout.

Importantly, the provision of this additional parking within the Domayne Precinct is not at the expense of (continuing to provide) parking in proximity to other Centre Precincts, while the central car parks – both north and south of Central Aisle – will continue to provide additional capacity accessible to all Centre Precincts.

The distribution of parking across the Centre further to the Proposal is outlined in **Table 3.7.3** below, noting that the designation of dedicated parking (for example accessible parking) remains to the finalised in regard to specific locations (see further **Section 3.7.4** below).

Table 3.7.3 Future Centre Parking

Future Centre Parking	General Spaces	Existing/Estimated Accessible	Existing/Estimated Parents with Prams	Existing/Estimated Motorcycle	Existing Trailer/Loading	Existing Staff	**Total Spaces**
Domayne Precinct	146	3	2	2			152
Harvey Norman Precinct	221	5	3	3		19	250
Bunnings Precinct	171	6			17		194
Central/Homemaker Car Parks	461	10	5	5		18	499
Northern Precinct	51	2	1			25	78
Underground Car Park	505	8	10	4	1		528
Total Parking	**1555**	**34**	**20**	**13**	**18**	**62**	**1701**

3.7.4 Parking Design

All parking aisles and spaces will necessarily be designed to provide full compliance with Australian Standards, and specifically AS 2890.1, AS 2890.3 and AS 2890.6. In addition – and with reference to the existing provision of 'dedicated' spaces and DCP 2014 - it is proposed that: -

- A total of not less than 30 accessible spaces be provided so as to provide compliance with the Australian Access to Premises Standards; where new accessible spaces are to be provided, they will be designed to the new AS 2890.6 requirements, noting that some existing accessible spaces which would be unaffected by the Proposal are designed to the earlier AS2890.1 design requirements.

- A total of not less than 15 'Parents with Prams' spaces be provided.

- The retention of the car & trailer spaces within the Bunnings Precinct.

- A total of not less than 20 bike spaces will be provided, noting reference to the SW State Government's Planning guidelines for walking and cycling while also considering a realistic demand for bike access to the Centre.

As stated, the specific location of these dedicated spaces within the Centre will be finalised further to approval, but where appropriate – and specifically in regard to accessible spaces and parents with prams spaces – they would be provided immediately adjacent to key footpaths adjacent to the key buildings within each Centre Precinct.

3.8 Public & Active Transport

3.8.1 Public Transport

As described in **Section 2.10.1**, the Centre is provided with good public transport options, specifically based on bus services along Mulgoa Road connecting to Penrith Station. Further to the MR Upgrade, new bus stops would be provided immediately north of Wolseley Street, and bus priority measures along the Mulgoa Road corridor will provide more efficient bus services. This has the potential to increase the use of public transport by both staff and visitors.

3.8.2 Active Transport

As described in **Section 2.10.2**, pedestrian and cycle infrastructure is provided in Mulgoa Road, and will be enhanced further to the MR Upgrade with new shared paths and – in the future – additional connectivity with the regional bike network.

The Proposal will result in minor changes to the on-site pedestrian network. Connectivity to Mulgoa Road along the southern side of Wolseley Street is unchanged, and then links are provided to a new pedestrian path extending along the front of the new Domayne building. In turn, marked pedestrian crossings will continue to be provided across all primary access aisles to provide safe crossing points so that safe pedestrian access is available to all Centre Precincts from both the external pedestrian network and the internal car parks.

Pedestrian access to Pattys Place would be unchanged further to the Proposal.

4 Future Traffic Conditions

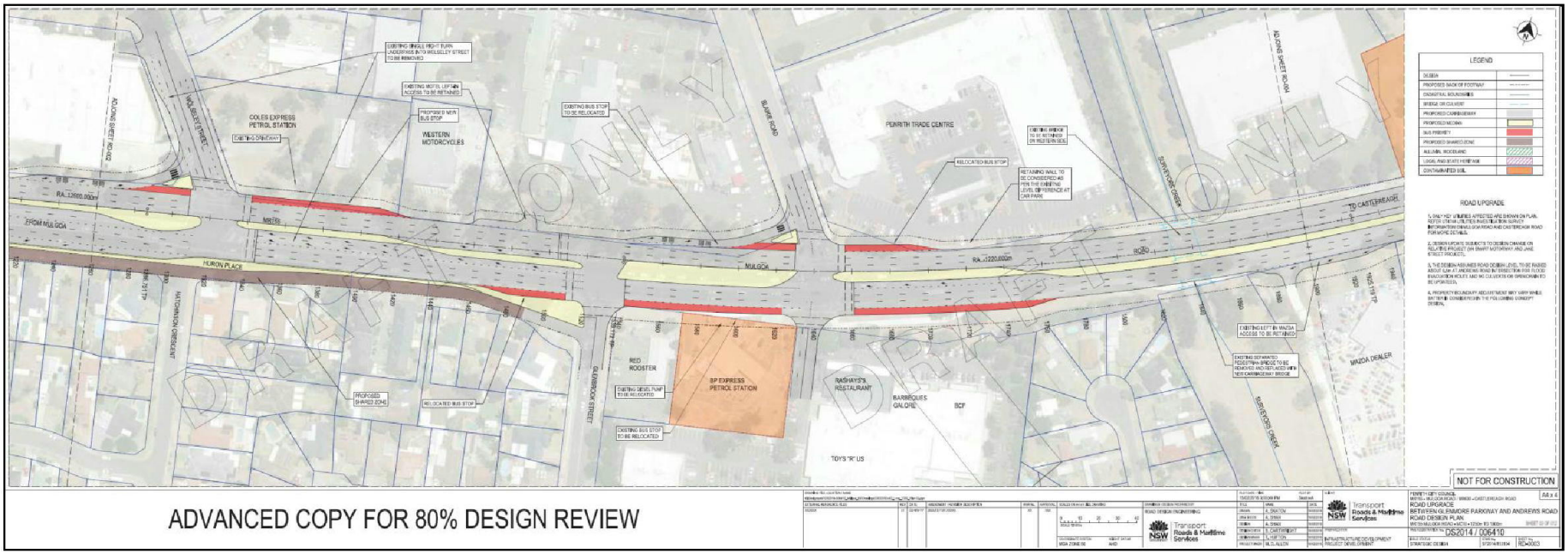
4.1 Mulgoa Road Upgrade

The RMS is currently finalised proposals for the MR Upgrade. With specific reference to the Centre, the MR Upgrade will provide for an additional Mulgoa Road through lane in each direction; the removal of the mouse hole at the Mulgoa Road & Wolseley Street intersection, to be replaced with dual right turn lanes; and additional bus priority and pedestrian infrastructure. At the intersection of Mulgoa Road & Blaikie Road, an additional Mulgoa Road through lane in each direction will also be provided.

As previously discussed, there is no information to suggest that the MR Upgrade would have any significant impact on the design of Wolseley Street west of Mulgoa Road; the proposed minor relocation of the Wolseley Roundabout would require a realignment of only the immediate approach from Mulgoa Road, such that the approach to Mulgoa Road would remain in its existing location and – notwithstanding the provision of 2 at grade entry lanes from Mulgoa Road rather than the existing at grade lane and mouse whole ramp – with the same general geometry.

The preliminary design of Mulgoa Road including the Wolseley Street, Glenbrook Street and Blaikie Road intersections is provided in **Figure 4.1** below.

Figure 4.1.1 Preliminary Design, Mulgoa Road Wolseley Street to Blaikie Road



Source: Upgrade Report

4.2 TN1 Traffic Assignment

As agreed with the RMS and Council, an assessment of future conditions further to the MR Upgrade was completed by Arcadis on behalf of the RMS so as to include specific consideration of the Centre, including sensitivity testing which accounts for the additional trip generation of the Proposal; consideration of the Saturday PM Peak Hour; and a detailed review of queue lengths in Wolseley Street.

4.2.1 Centre Traffic Flows Forecasts

Appendix A of TN1 provides detailed traffic flow diagrams for the key intersections for a future year 2036 further to the implementation of the MR Upgrade.

With reference to these flow diagrams, it is clear that the TN1 trip assignment of Centre traffic is in excess of the estimated trip generation of the Centre even further to the Proposal (per **Section 3.3** above). In this regard, the maximum trip generation of the Centre further to the Proposal has been estimated by ARC at some 1,452 vph and 2,214 vph in the Thursday PM Peak Hour and Saturday PM Peak Hour respectively. The TN1 assignment of trips (to a future year 2036) is some 1,519 vph and 2,408 vph in the Thursday PM Peak Hour and Saturday PM Peak Hour respectively, i.e. higher trip totals have been assigned to the forecast year in the TN1 assessment than are estimated to be generated by the Centre even further to the Proposal.

As such, it can be concluded that the Centre trip generation assigned in the TN1 assessment appropriately accounts for the future trip generation of the Centre further to the Proposal.

4.2.2 Background Traffic Flow Forecasts

With regard to background traffic flow increases in Mulgoa Road, the TN1 assessment builds on the macro and micro modelling of future conditions detailed in the Upgrade TTAS, assigning relatively significant additional flows to through movements along Mulgoa Road through to a forecast year 2036.

4.2.3 Trip Distribution

The direction distribution of future trips (2036) forecast in the TN1 assessment is not significantly different to that surveyed in 2017, though it is noted that where the distribution has (slightly) changed it results in additional trips being generated to some of the critical movements (with regard to Centre accessibility) - particularly the right turn from Mulgoa Road to Wolseley Street, and the right turn from Wolseley Street to Mulgoa Road - than would have been generated if an identical distribution (to that surveyed) were applied.

Of course, such minor distribution changes are expected given that the TN1 modelling accounts for broader growth forecasts (and resulting distribution changes) across the entire Mulgoa Road corridor.

4.3 TN1 Mulgoa Road Intersections Assessment

Further to the trip assignment detailed in sections above, and accounting for the MR Upgrade as proposed, sections below provide a summary of the TN1 conclusions in regard to future road network operations at the key Mulgoa Road intersections providing Centre access.

4.3.1 Mulgoa Road & Wolseley Street Intersection

The TN1 analysis of the Mulgoa Road & Wolseley Street intersection includes the MR Upgrade proposed infrastructure, the TN1 forecast of Centre trip generation (as described in sections above), and forecast increases along the Mulgoa Road corridor to 2036. The future operation of the intersection as reported in TN1 is detailed in the tables below.

Table 4.3.1.1 TN1 2036 Intersection Level of Service, Mulgoa Road & Wolseley Street

Future Traffic Conditions	Overall Intersection Delay (sec)	Level of Service
Thursday	18	B
Saturday	23	B

Source: TN1

Table 4.3.1.1 TN1 2036 Intersection Queue Lengths, Mulgoa Road & Wolseley Street

Approach	Thursday (metres)	Saturday (metres)	Distance to upstream intersection
Mulgoa Road (N) Right turn	29 ✓	54 ✓	80 m of right turn bay storage length
Mulgoa Road (S)	109 ✓	140 ✓	300 m to M4 interchange
Wolseley Street (W)	63 ✓	87 ✓	160 m to Wolseley Street roundabout

Source: TN1

TN1 provides the following summary of the future operation of the Mulgoa Road & Wolseley Street intersection: -

The traffic modelling undertaken in 2036 for Mulgoa Road / Wolseley Street intersection indicated that proposed upgrades would provide level of service B (18 seconds delay) for Thursday traffic condition. Model predicted level of service B (23 seconds delay) for Saturday traffic condition.

Replacing the grade separated access (mousehole) with dual right-turn lanes from Mulgoa Road (southbound) into Wolseley Street would increase delay for the right-turn movement from the current zero to about 42 seconds in 2036, traffic modelling indicates that the overall intersection would still operate satisfactorily at level of service B for both weekday and weekend traffic conditions.

And in regard to queue lengths, TN1 provides the following: -

- *The longest queues on the Mulgoa Road (northern approach) is predicted for right turn movement for Saturday peak traffic condition. However, queues would contain within the storage length proposed in the reference design*
- *The longest queues on the Mulgoa Road (southern approach) is predicted for through traffic movement for Thursday and Saturday peak traffic condition. The queues would contain within intersection approach length.*
- *The queues on Wolseley Street (western approach) would not extend to the carpark roundabout.*

Overall therefore, TN1 confirms that the intersection of Mulgoa Road & Wolseley Street would operate at an appropriate level of service even further to the Proposal through 2036, and there would be no queuing constraints such as would impact on the Wolseley Roundabout.

4.3.2 Mulgoa Road & Blaikie Road Intersection

The TN1 analysis of the Mulgoa Road & Blaikie Road intersection also includes the MR Upgrade proposed infrastructure, the TN1 forecast of Centre trip generation, and forecast increases along the Mulgoa Road corridor to 2036. The future operation of the intersection as reported in TN1 is detailed in the tables below.

Table 4.3.2.1 TN1 2036 Intersection Level of Service, Mulgoa Road & Blaikie Road

Future Traffic Conditions	Overall Intersection Delay (sec)	Level of Service
Thursday	20	B
Saturday	30	C

Source: TN1

Table 4.3.2.2 TN1 2036 Intersection Queue Lengths, Mulgoa Road & Blaikie Road

Approach	Thursday (metres)	Saturday (metres)	Distance to upstream intersection
Mulgoa Road (N)	140 ✓	167 ✓	410 m to Batt Street intersection
Blaikie Road (E)	18	31	-
Mulgoa Road (S)	53 ✓	37 ✓	95 m to Glenbrook Street intersection
Blaikie Road (W)	48 ✓	161 ✓	280 m to Pattys Place intersection

Source: TN1

TN1 provides the following summary of the future operation of the Mulgoa Road & Blaikie Road intersection: -

The traffic modelling undertaken in 2036 for Mulgoa Road / Blaikie Road intersection indicated that proposed upgrades would provide level of service B (20 seconds delay) for Thursday traffic condition. Model predicted level of service C (30 seconds delay) for Saturday traffic condition.

And in regard to queue lengths, TN1 provides the following: -

- *The longest queues on the Mulgoa Road (northern approach) is predicted for through traffic movement for Saturday peak traffic condition. However, queues would contain within intersection approach length.*
- *The longest queues on the Mulgoa Road (southern approach) is predicted for through traffic movement for Thursday peak traffic condition. The queues would contain within intersection approach length.*
- *The queues on Blaikie Road (western approach) would not extend to the Pattys Place intersection.*

Overall therefore, TN1 confirms that the intersection of Mulgoa Road & Blaikie Road would operate at an appropriate level of service even further to the Proposal through 2036.

4.4 Wolseley Street Roundabout Assessment

TN1 does not provide details of the assigned distribution of trips to the Wolseley Roundabout, or as to how trips have been assigned to the new eastern approach (to the proposed parking accessed via the Eastern Aisle). While not impacting on the operations of the key Mulgoa Road & Wolseley Street intersection as described above (given that the trips to and from the Mulgoa Road & Wolseley Street intersection would be the same regardless of the distribution at the Wolseley Roundabout), sections below provide a more detailed review of the forecast operation of the Wolseley Roundabout.

4.4.1 TN1 Assessment

The future operation of the Wolseley Roundabout as reported in TN1 is detailed in the tables below.

Table 4.4.1.1 TN1 2036 Intersection Level of Service, Wolseley Roundabout

Future Traffic Conditions	Worst Movement Delay (sec)	Level of Service
Thursday	13*	A
Saturday	47*	D

Source: TN1

Table 4.4.1.2 TN1 2036 Intersection Queue Lengths, Wolseley Roundabout

Approach	Thursday (metres)	Saturday (metres)	Distance to upstream intersection
Wolseley Street (N)	14 ✓	43 ✓	160 m to Mulgoa Road/ Wolseley Street intersection
Carpark (E)	10	14	-
Carpark (S)	13	90	-
Carpark (W)	14	33	-

Source: TN1

TN1 provides the following summary of the future operation of the Mulgoa Road & Wolseley Street intersection: -

The traffic modelling undertaken in 2036 for Wolseley Street / Homemaker Centre Carpark roundabout indicated that proposed upgrades would provide level of service A (13 seconds delay) for Thursday traffic condition. Model predicted level of service D (47 seconds delay) for Saturday traffic condition.

Sensitivity modelling undertaken by ARC using the SIDRA model indicates slightly better operations at the intersection when assigning the TN1 forecast flows and TN1 reported intersection design (level of service 'C' for the worst approach), but moreover an overall intersection level of service 'A', noting that TN1 specifically reports the level of service for the worst approach, whereas it is standard RMS (and SIDRA) practice to report the overall intersection level of service for roundabouts.

Notwithstanding, the SIDRA modelling does indicate moderate queue lengths on some approaches under peak conditions. As such, ARC has tested a number of different operational scenarios based on a redistribution of trips at the Wolseley Roundabout, and based on different approach lane configurations as detailed in sections below.

4.4.2 Directional Distribution

TN1 provides the following general distribution of trips to the Wolseley Roundabout approaches further to the introduction of the additional Eastern Aisle approach: -

- Thursday PM Peak Hour
  - 53% to/from Central Aisle
  - 32% to/from Southern Aisle
  - 15% to/from Eastern Aisle

- Saturday PM Peak Hour
  - 48% to/from Central Aisle
  - 39% to/from Southern Aisle
  - 13% to/from Eastern Aisle

As discussed in **Section 3.4.2**, consideration of the trip generation of the different Centre Precincts and the parking which would be provided either in immediately proximity to those Precincts or with the central car parks suggests a similar distribution of trips, with the only significant difference being a slightly lower distribution to Eastern Aisle.

4.4.3 Arrival & Departure Distribution

The TN1 forecast flows indicate that – like existing flows – arrivals and departures to the interface intersections at Mulgoa Road and Blaikie Road are generally balanced in both the Thursday PM Peak Hour and Saturday PM Peak Hour. However, the arrival and departure distribution to each of the Wolseley Roundabout approaches provided in TN1 indicates relatively significant differences in arrival and departure distribution for each approach. For example: -

- In the Thursday PM Peak Hour: -
  - In Central Aisle, 41% of the total arrival flow and 65% of the total departure flow
  - In Southern Aisle, 38% of the total arrival flow and 26% of the total departure flow
  - In Eastern Aisle, 21% of the total arrival flow and 9% of the total departure flow

- In the Saturday PM Peak Hour: -
  - In Central Aisle, 44% of the total arrival flow and 54% of the total departure flow
  - In Southern Aisle, 42% of the total arrival flow and 35% of the total departure flow
  - In Eastern Aisle, 15% of the total arrival flow and 11% of the total departure flow

As previously stated, the assumptions made in preparing this arrival and departure distribution profile are not detailed in TN1, but it is our opinion that the arrival and departure profile of each of the Wolseley Roundabout approaches would be more balanced (between arrivals and departures) in line with the surveyed arrival and departure distribution of the existing Central Aisle (and Northern Aisle) and Southern Aisle approaches.

4.4.4 Wolseley Roundabout Approach Lane Configuration

At present, the Wolseley Street approach to the Wolseley Roundabout provides a shared through & right turn lane and a dedicated right turn lane; in our opinion, this design in part reflects the existing approach conditions from Mulgoa Road, where there is a relatively short distance between the egress from the mouse hole and the Wolseley Roundabout, therefore making the weave (from the mouse hole) to a single (inner) right turn lane difficult; as such, the right turn is also provided from the kerbside lane.

Further to the MR Upgrade, there would be significant length for vehicles to move to the appropriate approach to the Wolseley Roundabout. This would allow a reassignment of approach lanes to provide a left & through lane (to Eastern Aisle and Southern Aisle respectively) and a through & right lane (to Southern Aisle and Central Aisle respectively).

The primary queue length reported in the ARC sensitivity testing of the TN1 flow forecasts is the departure queue from Central Aisle. An additional (short) dedicated left turn lane, along with a shared left & through & right turn lane, can be accommodated on this approach given the two northbound departure lanes in Wolseley Street (through to Mulgoa Road) and would provide significant benefits in regard to queueing (and more generally in regard to level of service).

Finally, with reference to Figure 3-4 of TN1, the TN1 modelled roundabout provides only a shared left & through & right approach lane from Southern Aisle, whereas the proposed roundabout provides a (short) left & through approach lane and a through & right approach lane, noting that this is more consistent with the existing Southern Aisle approach lane infrastructure.

4.4.5 Wolseley Roundabout Operations

SIDRA analysis of this proposed approach lane infrastructure under a range of trip distribution scenarios indicates good operations (level of service 'A') with significantly reduced queue lengths, particularly in Central Aisle and Southern Aisle. Very significantly, the provision of only the single right turn lane from Wolseley Street to Central Aisle does not generate a significant queue length towards Mulgoa Road during either of the peak periods (maximum 48m), which is not surprising given that this movement is not opposed by any other significant turning movements.

The results of this SIDRA testing are provided in **Appendix B**.

4.5 Pattys Roundabout

Finally, ARC has assessed the performance of the Pattys Roundabout using the SIDRA model based on the forecast flows provided in the TN1 distributed in accordance with 2016 surveys completed by Matrix, and have determined that the intersection will continue to operate at high level of service at all times, with minimal queue lengths and significant spare capacity.

4.6 Network Operations Summary

With reference to sections above, it is the conclusion of ARC – and moreover the conclusion of TN1 - that the key intersections providing access to and within the Centre will continue to operate at appropriate levels of service further to the MR Upgrade; further to the proposed relocation of the Wolseley Roundabout and realignment of Southern Aisle; and further to the introduction of the minor additional trip generation associated with the Proposal.

5 Conclusions

Further to a detailed and independent assessment of the Proposal – and with specific reference to additional local network modelling undertaken by the RMS – ARC has concluded that the Proposal is supportable with regard to access, traffic and parking issues. Specifically: -

- The internal Centre road network will be significantly improved further to the relocation of the Wolseley Roundabout and realignment of Southern Aisle, with a better distribution of trips to car parks adjacent to all Centre Precincts, and improved service vehicle paths throughout the Centre to existing service areas. These improved service vehicle access paths will also allow for the removal of service vehicles from Central Aisle (and the central car parks).

- The additional trip generation of the Proposal is very moderate, and the TN1 modelling indicates that the key interface intersections to the Centre at Mulgoa Road & Wolseley Street, and Mulgoa Road & Blaikie Road, will continue to operate at good levels of service through 2036 even further to that additional trip generation.

- The Wolseley Street approach queue lengths to Mulgoa Road would not extend to the Wolseley Roundabout further to the Mulgoa Road & Wolseley Street intersection upgrade.

- The Wolseley Roundabout will operate at good levels of service further to a minor reassignment of approach lanes to reflect the broader reassignment of parking across the Centre, and approach queue lengths to the Wolseley Roundabout from Mulgoa Road would not extend to Mulgoa Road.

- Parking will be provided at rates in excess of the requirements of DCP 2014, and further to the Proposal would be better distributed across the Centre to provide convenient parking adjacent to all Centre Precincts. All new parking spaces and parking aisles will be designed with reference to the appropriate Australian Standards, and include an allocation of accessible, parents with prams and trailer parking.

- Good public transport services are available to visitors and staff, services which will be augmented further to the MR Upgrade, including new bus stops immediately adjacent to the Centre in Mulgoa Road and bus priority measures at key Mulgoa Road intersections.

- Pedestrian and cycle infrastructure along Mulgoa Road will also be enhanced further to the MR Upgrade, while internal pedestrian infrastructure will provide safe and immediate pedestrian access from Mulgoa Road and Pattys Place, and from the Centre car parks, to all Centre Precincts.

Penrith Homemaker Centre Expansion

Traffic Impact Assessment

October 2017

Appendix A Mulgoa Road / Castlereagh Road Corridor Upgrade Traffic & Transport Assessment Study: Penrith Homemaker Centre Preliminary Traffic Modelling

ARCADIS Design & Consultancy for natural and built assets

PENRITH HOMEMAKER CENTRE

Preliminary Traffic Modelling

Incorporating Hyder

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ROADS AND MARITIME SERVICES (ROADS AND MARITIME)

PENRITH HOMEMAKER CENTRE

Preliminary Traffic Modelling

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Report No	AA008188	

This report has been prepared for Roads and Maritime in accordance with the terms and conditions of appointment for Mulgoa Road/Castlereagh Road Corridor Between Glenmore Parkway and Andrews Road dated 01/05/2015. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared by	Approved by
A	20/06/2017	Draft Final Report for Clients review	RC, MW	MW

CONTENTS

1 Report Purpose

This preliminary modelling report documents future traffic impacts on Mulgoa Road / Wolseley Street and Mulgoa Road / Blaikie Road intersections which provide access to the Homemaker Centre, Penrith. In the course of preparing this report, relevant documents associated with the Homemaker Centre site have been reviewed, and potential impacts on the road network have been assessed. The traffic assessment has been carried out in consultation with Roads and Maritime project team.

A new traffic survey was undertaken by Arcadis Australia Pty Ltd (Arcadis) during March and April 2017 for Thursday and Saturday peak period for four intersections including Mulgoa Road / Blaikie Road, Mulgoa Road / Wolseley Street, Blaikie Road / Pattys Place and Wolseley Street / Homemaker Centre Carpark access.

For the purpose of traffic modelling, the assessment has been undertaken for 2036 traffic conditions for both Thursday and Saturday peak traffic conditions. The reference design traffic models developed for proposed six lanes upgrades on the Mulgoa Road / Castlereagh Road corridor has been used as a basis for this assessment. The future year traffic modelling has included proposed roundabout realignment at Wolseley Street / Homemaker Centre Carpark.

1.1 Modelling Study Area

Figure 1-1 shows modelling study area for Penrith Homemaker Centre site. The road network includes four key intersections including Mulgoa Road / Blaikie Road, Mulgoa Road / Wolseley Street, Blaikie Road / Pattys Place and Wolseley Street / Homemaker Centre Carpark access.

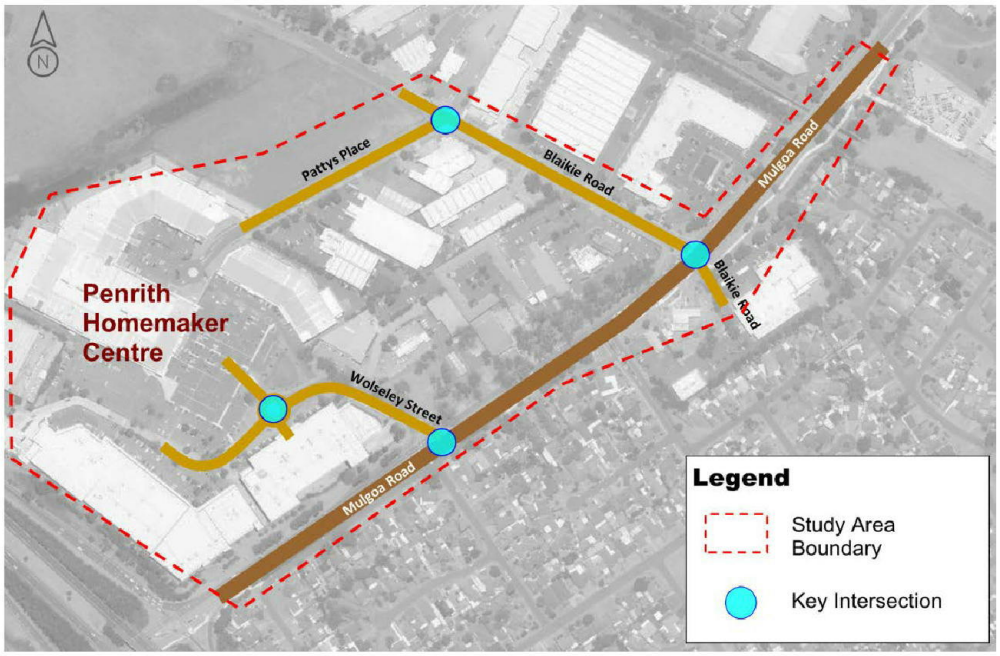


Figure 1-1 Modelling Study Area

1.2 Reference Traffic Data and Model Used

Future Years Models and Updates

The traffic assessment has been undertaken using purposely built micro-simulation traffic model. The micro-simulation model has used VISSIM software (version 9). The reference design traffic models developed for proposed six lanes upgrades on the Mulgoa Road / Castlereagh Road corridor has been used as a basis for this assessment. The future year 2036 traffic modelling has assumed the following upgrades:

- **Mulgoa Road / Blaikie Road Intersection**:
  - Provide one dedicated right turn lane, three through lanes and one dedicated left turn lane on Mulgoa Road northern approach
  - Provide share through and right turn lane, and dedicated left turn lane on Blaikie Road eastern approach
  - Provide three through lanes and one left turn slip lane on Mulgoa Road southern approach
  - Provide bus priority lane on both Mulgoa Road northbound and southbound direction.
- **Mulgoa Road / Wolseley Street Intersection**:
  - Provide three through lanes and two right turn lanes on Mulgoa Road northern approach
  - Provide three through lanes and one left turn slip lane on Mulgoa Road southern approach
  - Provide one left turn lane and two right turn lanes on Wolseley Street
  - Provide bus priority lane on Mulgoa Road northbound direction.

Figure 1-2 below shows the VISSIM micro-simulation (cut version of subarea) models used for Penrith Homemaker Centre traffic assessment.

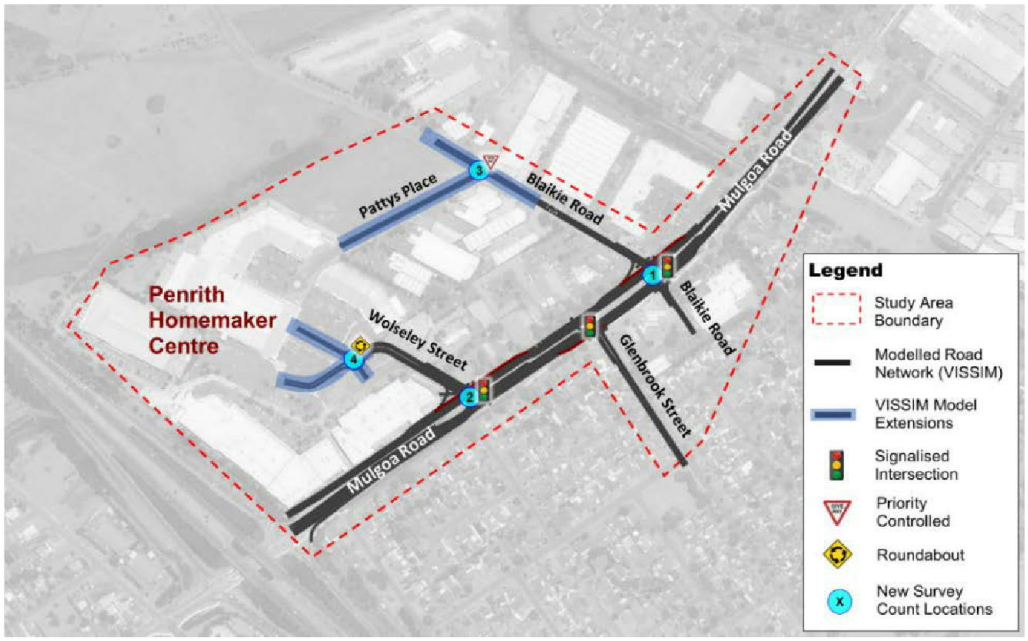
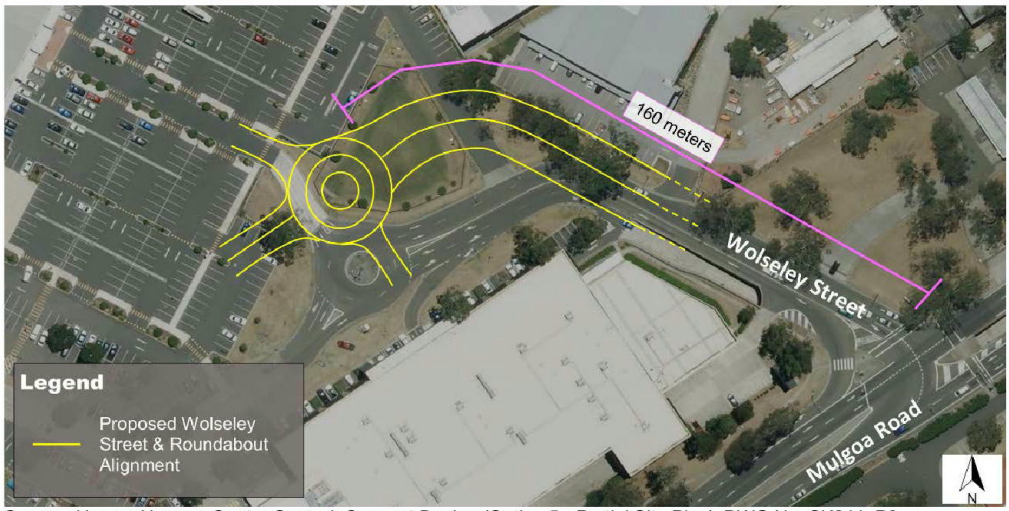


Figure 1-2 VISSIM Model Network for Penrith Homemaker Centre

The future year VISSIM model includes proposed upgrades at Wolseley Street/ Car park roundabout alignment (refer to Figure 1-3).



Source: *Harvey Norman Centre Carpark Concept Design (Option 5 - Partial Site Plan)*, DWG No: SK241_P3 (Leffler Simes Architects, May 2016)

Figure 1-3 Proposed Wolseley Street and Roundabout Alignment

Traffic Surveys and Data

- A new traffic survey was undertaken by Arcadis in March/April 2017 for Thursday and Saturday peak periods at the following intersections:
  1. Mulgoa Road / Blaikie Road (signal)
  2. Mulgoa Road / Wolseley Street (signal)
  3. Blaikie Road / Pattys Place (priority)
  4. Wolseley Street / Carpark (roundabout)
- The 2017 traffic data undertaken by Arcadis was compared with June 2016 traffic data undertaken by Anton Reisch Consulting for Thursday and Saturday peak periods at Mulgoa Road / Wolseley Street intersection. *Appendix A* includes existing traffic volumes in 2017 for Thursday and Saturday.

Future Traffic Growth

For the purposes of this assessment, following traffic growth assumptions are used for both Thursday and Saturday traffic models including:

- Annual growth rate of 2.0 per cent on Mulgoa Road for through traffic. This growth rate is consistent with growth rate reported in Mulgoa Road / Castlereagh Road Corridor Upgrade report (Table 5-3, in Arcadis Report January 2017) for the section between Jamison Road and M4 Western Motorway.
- Annual growth rate of 1.1 per cent for traffic movements in and out of Homemaker Centre via Blaikie Road and Wolseley Street.

Reports and Guidelines

- *Mulgoa Road / Castlereagh Road Corridor Upgrade between Glenmore Parkway and Andrews Road*, Traffic and Transport Assessment Study (Arcadis, January 2017)
- *Traffic Modelling Guidelines* (Roads and Maritime Services, V 1.0, February 2013)
- *Harvey Norman Centre Carpark Concept Design (Option 5 - Partial Site Plan)*, DWG No: SK241_P3 (Leffler Simes Architects, May 2016)
- Anton Reisch Consulting provided traffic survey data

2 Traffic Data Comparison

This section documents the comparison of traffic volumes at Mulgoa Road / Wolseley Street intersection. The traffic volume comparison at Mulgoa Road / Wolseley Street intersection is based on the following two sets of data including:

- Traffic survey undertaken by Anton Reisch Consulting (ARC) in June 2016
- Traffic survey undertaken by Arcadis in April 2017.

Figure 2-1 below shows the location of the Mulgoa Road / Wolseley Street intersection.

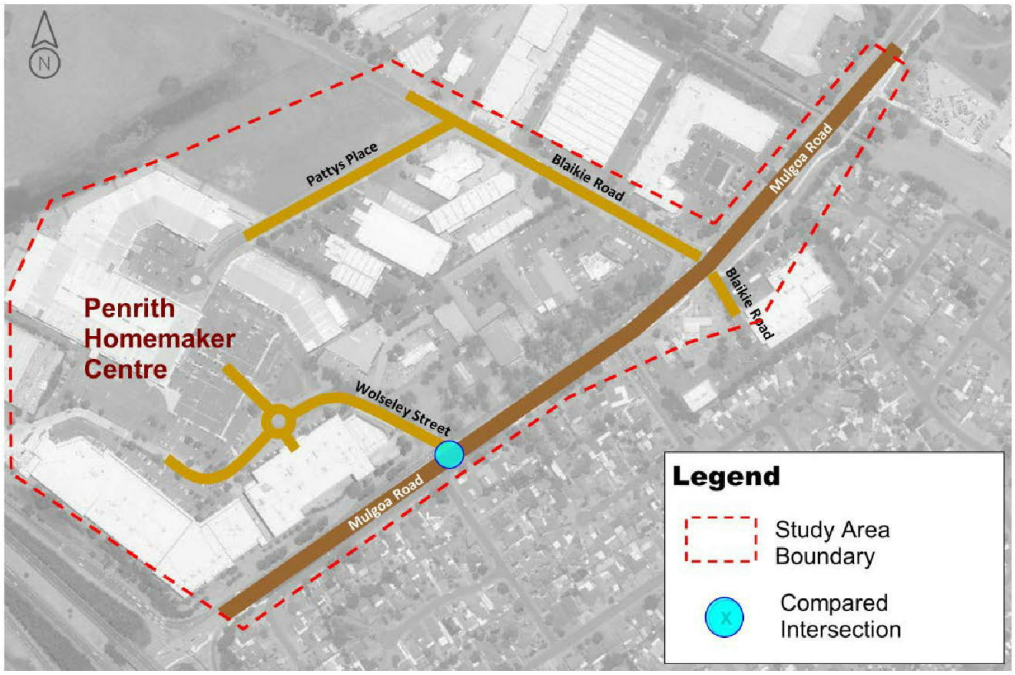


Figure 2-1 Mulgoa Road / Wolseley Street Intersection

2.1 Peak Period

Table 2-1 below shows the survey time periods undertaken on Thursday and Saturday afternoon and evening peak.

Table 2-1 Survey Period

Year	ARC 2016		Arcadis 2017	
	Time Period	No. of Hours	Time Period	No. of Hours
Thursday	4 PM – 6 PM	2	3 PM – 9 PM	6
Saturday	10 AM – 4 PM	6	1 PM – 5 PM	4

Note: ARC = Anton Reisch Consulting.

2.2 Existing Traffic Volumes

Table 2-2 shows the comparison of peak hourly intersection turning volumes at the Mulgoa Road / Wolseley Street intersection undertaken in 2016 and 2017.

Table 2-2 Comparison of Peak Hourly Intersection Volume at Mulgoa Road/Wolseley Street Intersection

Intersection volume	2016 Traffic Survey by ARC	2017 Traffic Survey by Arcadis	Difference	% Diff.
Thursday	4335	4446	111	2.6%
Saturday	4570	4574	4	0.1%

Note: ARC = Anton Reisch Consulting.

The traffic volumes at Mulgoa Road / Wolseley Street intersection has found to be similar when two sets of data are compared. The 2017 total intersection volumes at Mulgoa Road / Wolseley Street intersection are about 2.6 per cent higher on Thursday and about 0.1 per cent higher on Saturday than 2016 traffic volumes.

The 2016 data by ARC on Thursday indicates highest peak hour between 5 PM and 6 PM.

The 2017 data by Arcadis on Thursday indicates highest peak hour between 3 PM and 4 PM.

For Saturday traffic conditions, ARC 2016 data shows between 1.30 PM and 2.30 PM as the highest peak hour while Arcadis 2017 data shows between 2 PM and 3 PM as the highest peak hour.

Figure 2-2 and Figure 2-3 below shows the comparison of 2016 and 2017 turning volumes and percentage distribution at Mulgoa Road / Wolseley Street intersection for Thursday and Saturday traffic conditions respectively.

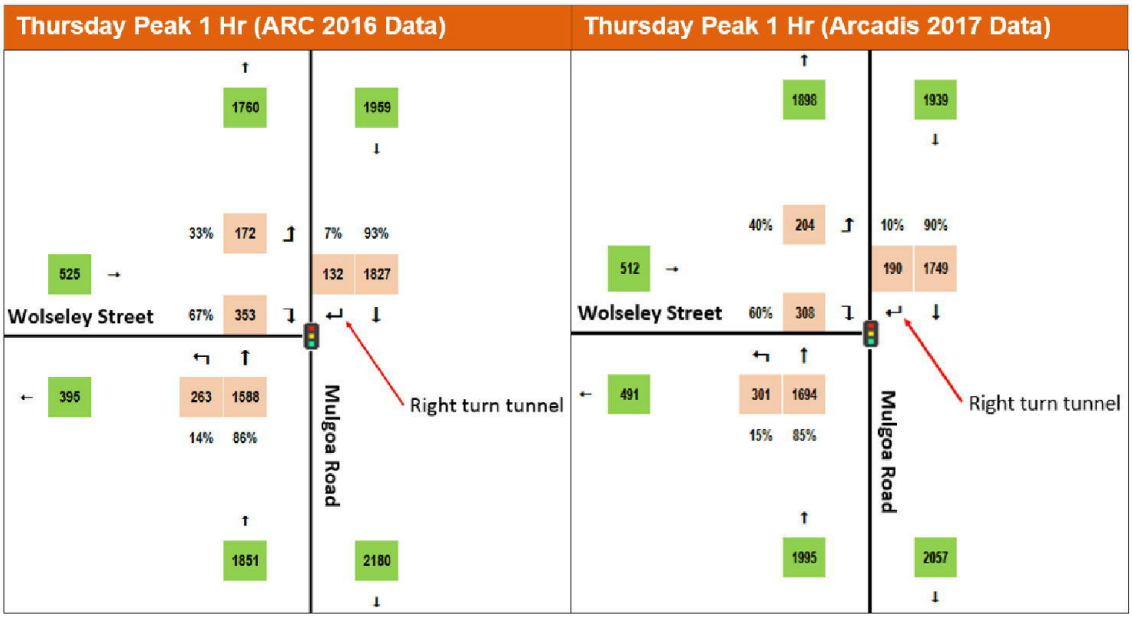


Figure 2-2 Traffic Volume Comparison at Mulgoa Road / Wolseley Street Intersection for Thursday

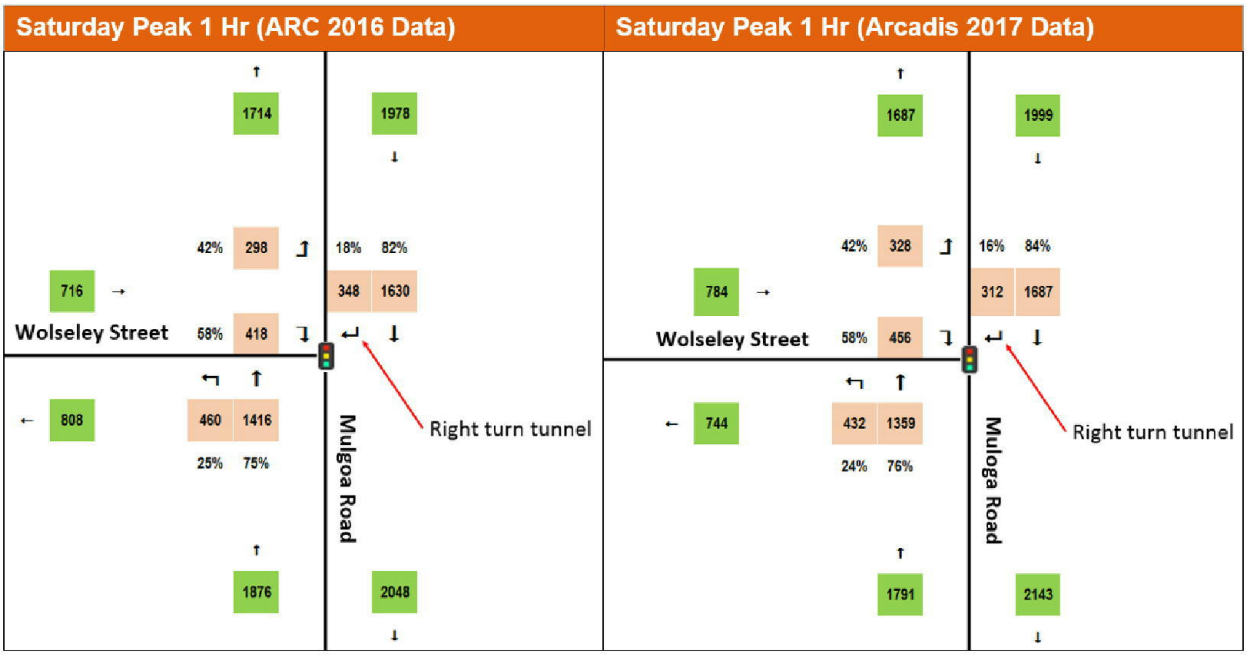


Figure 2-3 Traffic Volume Comparison at Mulgoa Road / Wolseley Street Intersection for Saturday

The turning volume distribution to and from Homemaker Centre is generally similar for both 2016 and 2017 data with minor differences:

- For Thursday traffic conditions:
  - The north-south through movement on Mulgoa Road is similar for both surveys. About 1,800 and 1,750 southbound vehicles are counted in 2016 and 2017 respectively. About 1,600 northbound vehicles in 2016 and about 1,700 northbound vehicles in 2017 are counted on Mulgoa Road
  - About 60 more inbound vehicles into Homemaker Centre are counted using the "mouse hole" in 2017 compared to 2016. About 40 more inbound vehicles are counted from the south in 2017 compared to 2016
  - The outbound vehicles from Homemaker Centre are found to be in the order of 500 vehicles for both surveys.
- For Saturday traffic conditions:
  - The north-south through movement on Mulgoa Road is similar for both surveys. About 1,650 and 1,700 southbound vehicles are counted in 2016 and 2017 respectively. About 1,400 northbound vehicles are counted on Mulgoa Road in both 2016 and 2017
  - About 40 less inbound vehicles into Homemaker Centre are counted using the "mouse hole" in 2017 compared to 2016. About 30 less inbound vehicles are counted from the south in 2017 compared to 2016
  - The outbound vehicles from Homemaker Centre are found to be 720 vehicles in 2016 and about 780 vehicles in 2017, contributing to about 60 more vehicles in 2017.

2.3 Homemaker Centre Traffic Generation

Currently Homemaker Centre provides access to Mulgoa Road via Wolseley Street and Pattys Place. Wolseley Street provides access to Homemaker Centre via mousehole tunnel underneath Mulgoa Road. Pattys Place provides access to Homemaker Centre via Blaikie Road.

Table 2-3 and Table 2-4 show trip generation to/from Homemaker Centre in 2016 and 2017 for Thursday and Saturday peak hour respectively.

Table 2-3 Thursday Peak Hourly Trips Generated to / from Homemaker Centre

	ARC 2016		Arcadis 2017	
Peak 1 Hour Trip Generation - Thursday	**Inbound**	**Outbound**	**Inbound**	**Outbound**
Wolseley Street	395	525	491 ▲	512 ▼
Pattys Place	281	110	166 ▼	145 ▲
Total 2-way peak hour trips	1311		1314 ▲	

Note: ARC = Anton Reisch Consulting.

Table 2-4 Saturday Peak Hourly Trips Generated to / from Homemaker Centre

	ARC 2016		Arcadis 2017	
Peak 1 Hour Trip Generation - Saturday	**Inbound**	**Outbound**	**Inbound**	**Outbound**
Wolseley Street	808	716	744 ▼	784 ▲
Pattys Place	218	193	270 ▲	224 ▲
Total 2-way peak hour trips	1935		2022 ▲	

Note: ARC = Anton Reisch Consulting.

The trip generation comparison for Homemaker Centre suggests that:

- About 100 more inbound trips are observed to use Wolseley Street in 2017 compared to 2016 for Thursday traffic conditions. Thursday outbound trips using Wolseley Street were observed to be about 500 for both surveys.
- About 1,300 total 2-way trips were observed for both surveys for Thursday traffic conditions
- About 60 less inbound trips are observed to use Wolseley Street in 2017 compared to 2016 for Saturday traffic conditions. Observed Saturday outbound trips were about 720 in 2016 and about 780 in 2017, contributing to about 60 more vehicles in 2017
- About 1,900 total 2-way trips were observed in 2016 and about 2,000 total 2-way trips in 2017. This contributes to an increase of about 100 more trips in 2017 compared to 2016
- Saturday peak hourly traffic in and out of Homemaker Centre is generally higher than Thursday peak hourly traffic, about 48 per cent higher in 2016 and 54 per cent higher in 2017.

2.4 Summary on Traffic Data Comparison

In 2016 and 2017, traffic volumes at Mulgoa Road / Wolseley Street intersection are found to be similar. The 2017 total intersection volumes at Mulgoa Road / Wolseley Street intersection are about 3 per cent higher on Thursday and about 0.1 per cent higher on Saturday than 2016 traffic volumes.

The inbound and outbound traffic distribution to and from Homemaker Centre was found to be similar between 2016 and 2017 data.

The 2017 counts undertaken by Arcadis are recent and marginally higher than 2016 counts undertaken by Anton Reisch Consulting.

In agreement with Roads and Maritime project team, the 2017 traffic survey data undertaken by Arcadis has been used in future year traffic modelling and assessment.

3 Traffic Assessment

This section documents future traffic modelling results undertaken for Thursday and Saturday traffic conditions in 2036. The level of service is reported for four intersections as follow:

- Mulgoa Road / Wolseley Street (upgraded as per six lanes reference design of Mulgoa Road corridor upgrade)
- Mulgoa Road / Blaikie Road (upgraded as per six lanes reference design of Mulgoa Road corridor upgrade)
- Wolseley Street / Carpark (upgraded roundabout realignment)
- Blaikie Road / Pattys Place (at its current form, no upgrade is required)

The forecast traffic volumes in 2036 for modelled intersections are included in *Appendix A*.

3.1 Level of Service Criteria

Level of service is reported in accordance with the Roads and Maritime guideline (*Traffic Modelling Guidelines, V 1.0, February 2013*). It recommends that intersections with roundabouts or sign controlled intersections, the level of service (LoS) value is determined by the critical movement with the highest delay whereas for signalised intersections (TCS), LoS criteria are related to the average intersection delay measured in seconds per vehicle. The performance of an intersection is measured by the intersection average delay per vehicle which in turns leads to a "level of service" measure for the intersection.

Table 3-1 below shows the standard LoS criteria used for intersection assessment.

Table 3-1 Level of Service Criteria

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	<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 Roundabouts require other control mode	At capacity, requires other control mode
F	>70	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing

Source: Roads and Maritime Guide to Traffic Modelling, February 2013

The following sections report future traffic performance and level of service of four intersections assessed for post upgrade conditions in 2036 (Figure 3-1 below shows location of four intersections).

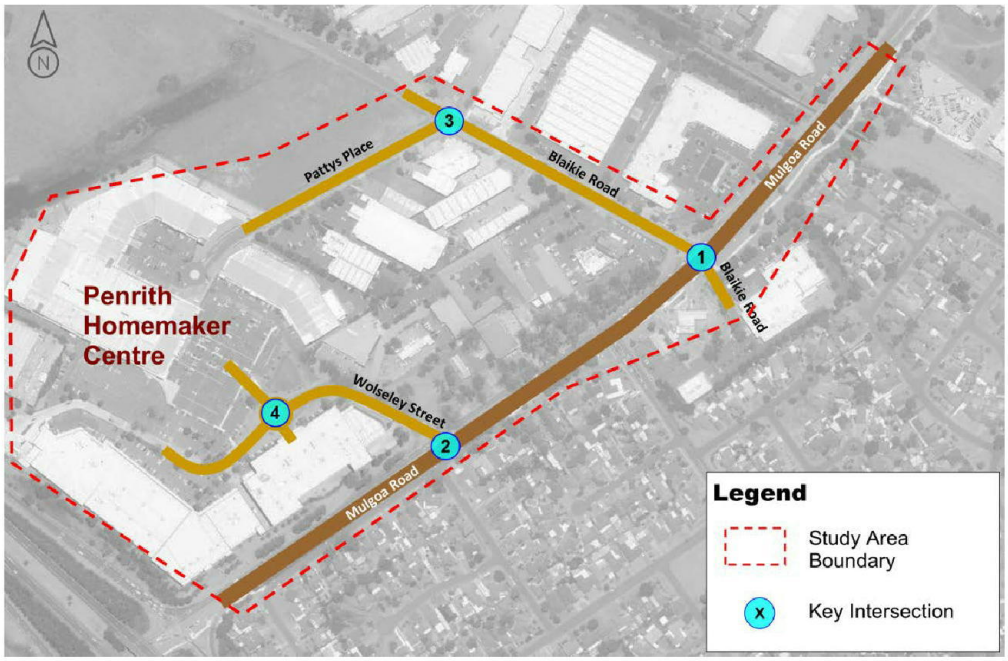


Figure 3-1 Location of Four Intersections Assessed

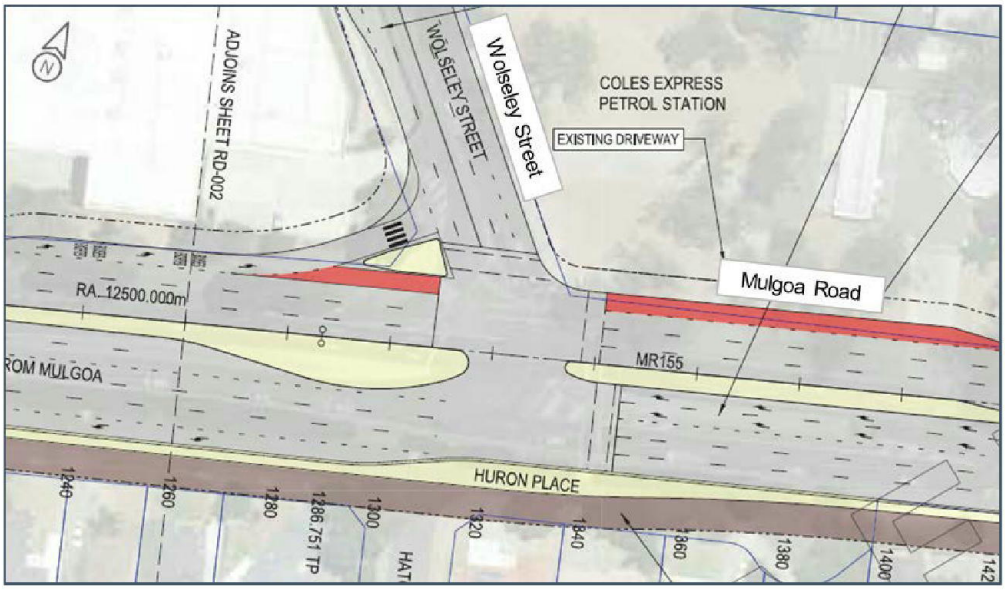
3.2 Traffic Impact at Mulgoa Road / Wolseley Street Intersection

Proposed Upgrades

The proposed upgrades at Mulgoa Road / Wolseley Street signalised intersection (Figure 3-2) include:

- Provide three through lanes and two right turn lanes on Mulgoa Road northern approach
- Provide three through lanes and one left turn slip lane on Mulgoa Road southern approach
- Provide one left turn lane and two right turn lanes on Wolseley Street
- Provide bus priority lane on Mulgoa Road northbound direction.

The reference design proposes to replace the grade separated access (mousehole) that provides for right-turn movements from Mulgoa Road (southbound) into Wolseley Street, with dual right-turn lanes.



Source: *Mulgoa Road / Castlereagh Road Corridor Upgrade between Glenmore Parkway and Andrews Road*, Traffic and Transport Assessment Study (Rev E dated January 2017)

Figure 3-2 Mulgoa Road / Wolseley Street Intersection Upgrade

Level of Service

Table 3-2 shows future traffic performance in 2036 at Mulgoa Road / Wolseley Street intersection for Thursday and Saturday traffic conditions. The delay and level of service is reported for the entire intersection for post upgrade conditions in 2036.

Table 3-2 Traffic Performance in 2036 – Mulgoa Road / Wolseley Street Intersection

Future Traffic Conditions	Overall Intersection Delay (sec)	Level of Service
Thursday	18	B
Saturday	23	B

Thursday Model: F:\AA008188\Variation 13 - Homemaker Centre\Modelling\VISSIM\Thursday model\20170623 Penrith Homemaker Centre_2036_Thursday_PM
Saturday Model: F:\AA008188\Variation 13 - Homemaker Centre\Modelling\VISSIM\Saturday model\20170623 Penrith Homemaker Centre_2036_Saturday_PM

Queue Lengths

Table 3-3 below shows predicted queue length for post upgrade conditions in 2036 for Thursday and Saturday. The traffic modelling indicated that:

- The longest queues on the Mulgoa Road (northern approach) is predicted for right turn movement for Saturday peak traffic condition. However, queues would contain within the storage length proposed in the reference design
- The longest queues on the Mulgoa Road (southern approach) is predicted for through traffic movement for Thursday and Saturday peak traffic condition. The queues would contain within intersection approach length
- The queues on Wolseley Street (western approach) would not extend to the carpark roundabout.

Table 3-3 95th-percentile of Maximum Queues Predicted at Mulgoa Road/Wolseley Street Intersection in 2036

Approach	Thursday (metres)	Saturday (metres)	Distance to upstream intersection
Mulgoa Road (N) Right turn	29 ✓	54 ✓	80 m of right turn bay storage length
Mulgoa Road (S)	109 ✓	140 ✓	300 m to M4 interchange
Wolseley Street (W)	63 ✓	87 ✓	160 m to Wolseley Street roundabout

Traffic Implications

The traffic modelling undertaken in 2036 for Mulgoa Road / Wolseley Street intersection indicated that proposed upgrades would provide level of service B (18 seconds delay) for Thursday traffic condition. Model predicted level of service B (23 seconds delay) for Saturday traffic condition.

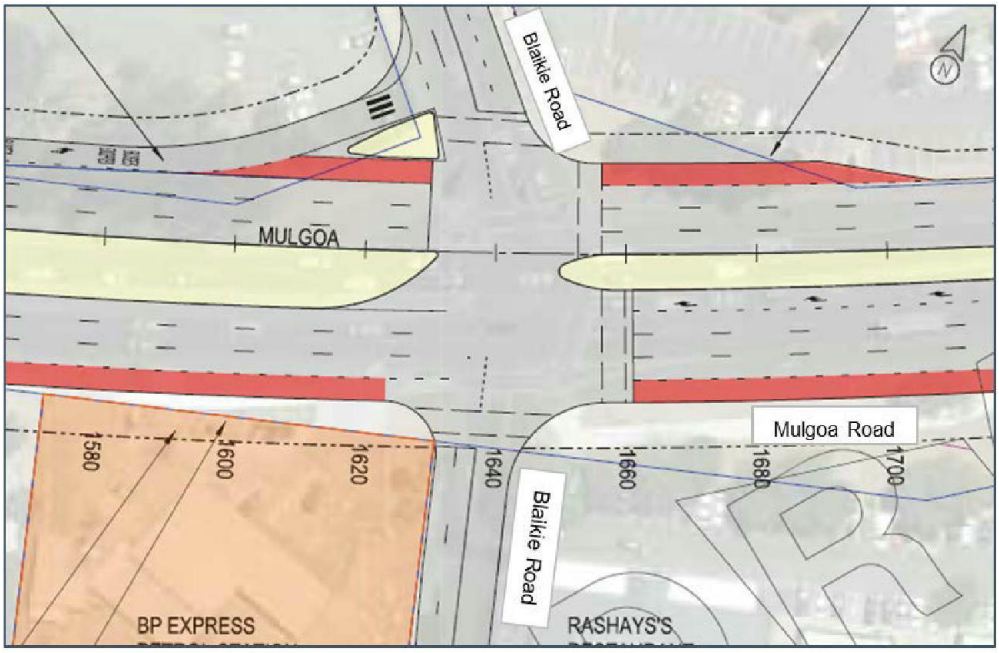
Replacing the grade separated access (mousehole) with dual right-turn lanes from Mulgoa Road (southbound) into Wolseley Street would increase delay for the right-turn movement from the current zero to about 42 seconds in 2036, traffic modelling indicates that the overall intersection would still operate satisfactorily at level of service B for both weekday and weekend traffic conditions.

3.3 Traffic Impact at Mulgoa Road / Blaikie Road Intersection

Proposed Upgrades

The proposed upgrades at Mulgoa Road / Blaikie Road signalised intersection (Figure 3-3) include:

- Provide one dedicated right turn lane, three through lanes and one dedicated left turn lane on Mulgoa Road northern approach
- Provide shared through and right turn lane, and dedicated left turn lane on Blaikie Road eastern approach
- Provide three through lanes and one left turn slip lane on Mulgoa Road southern approach
- Provide bus priority lane on both Mulgoa Road northbound and southbound direction.



Source: *Mulgoa Road / Castlereagh Road Corridor Upgrade between Glenmore Parkway and Andrews Road*, Traffic and Transport Assessment Study (RevE dated January 2017)

Figure 3-3 Mulgoa Road / Blaikie Road Intersection Upgrade

Level of Service

Table 3-4 shows future traffic performance in 2036 at Mulgoa Road / Blaikie Road intersection for Thursday and Saturday traffic conditions. The delay and level of service is reported for the entire intersection for post upgrade conditions in 2036.

Table 3-4 Traffic Performance in 2036 – Mulgoa Road / Blaikie Road Intersection

Future Traffic Conditions	Overall Intersection Delay (sec)	Level of Service
Thursday	20	B
Saturday	30	C

Thursday Model: F:\AA008188\Variation 13 - Homemaker Centre\Modelling\VISSIM\Thursday model\20170623 Penrith Homemaker Centre_2036_Thursday_PM
Saturday Model: F:\AA008188\Variation 13 - Homemaker Centre\Modelling\VISSIM\Saturday model\20170623 Penrith Homemaker Centre_2036_Saturday_PM

Queue Lengths

Table 3-5 below shows predicted queue length for post upgrade conditions in 2036 for Thursday and Saturday. The traffic modelling indicated that:

- The longest queues on the Mulgoa Road (northern approach) is predicted for through traffic movement for Saturday peak traffic condition. However, queues would contain within intersection approach length
- The longest queues on the Mulgoa Road (southern approach) is predicted for through traffic movement for Thursday peak traffic condition. The queues would contain within intersection approach length
- The queues on Blaikie Road (western approach) would not extend to the Pattys Place intersection.

Table 3-5 95th-percentile of Maximum Queues Predicted at Mulgoa Road/Blaikie Road Intersection in 2036

Approach	Thursday (metres)	Saturday (metres)	Distance to upstream intersection
Mulgoa Road (N)	140 ✓	167 ✓	410 m to Batt Street intersection
Blaikie Road (E)	18	31	-
Mulgoa Road (S)	53 ✓	37 ✓	95 m to Glenbrook Street intersection
Blaikie Road (W)	48 ✓	161 ✓	280 m to Pattys Place intersection

Traffic Implications

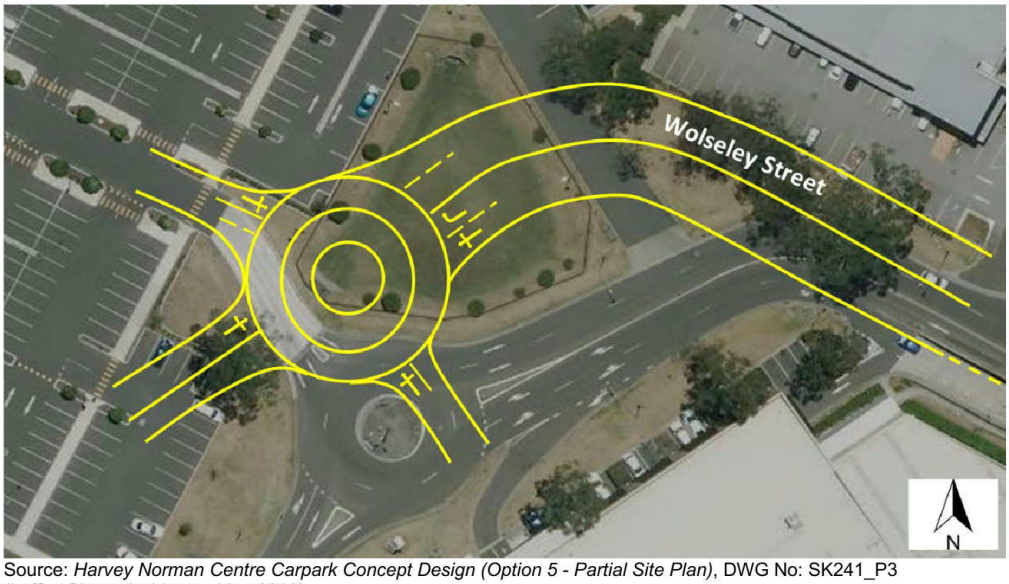
The traffic modelling undertaken in 2036 for Mulgoa Road / Blaikie Road intersection indicated that proposed upgrades would provide level of service B (20 seconds delay) for Thursday traffic condition. Model predicted level of service C (30 seconds delay) for Saturday traffic condition.

3.4 Traffic Impact at Wolseley Street / Homemaker Centre Carpark Roundabout

Proposed Upgrades

The proposed upgrades at Wolseley Street / Homemaker Centre Carpark roundabout (Figure 3-4) include:

- Realign roundabout towards to north
- Provide two circulating lanes in roundabout
- Provide two lane entry - one dedicated right turn lane and one shared left, through and right turn lane on Wolseley Street northern approach
- Provide one lane entry on eastern approach (Domayne carpark)
- Provide one lane entry on southern approach (Harvey Norman/Bunnings carpark)
- Provide one lane entry on western approach (Homemaker Centre carpark).



Source: *Harvey Norman Centre Carpark Concept Design (Option 5 - Partial Site Plan)*, DWG No: SK241_P3 (Leffler Simes Architects, May 2016)

Figure 3-4 Wolseley Street / Carpark Intersection Upgrade

Level of Service

Table 3-6 shows future traffic performance in 2036 at Wolseley Street / Homemaker Centre Carpark roundabout for Thursday and Saturday traffic conditions. The delay and level of service for roundabout is reported for the worst movement for post upgrade conditions in 2036.

Table 3-6 Traffic Performance in 2036 – Wolseley Street / Homemaker Centre Carpark roundabout

Future Traffic Conditions	Worst Movement Delay (sec)	Level of Service
Thursday	13*	A
Saturday	47*	D

Thursday Model: F:\AA008188\Variation 13 - Homemaker Centre\Modelling\VISSIM\Thursday model\20170623 Penrith Homemaker Centre_2036_Thursday_PM
Saturday Model: F:\AA008188\Variation 13 - Homemaker Centre\Modelling\VISSIM\Saturday model\20170623 Penrith Homemaker Centre_2036_Saturday_PM
*Note: Priority/roundabout intersection delay represents worst movement delay.

Queue Lengths

Table 3-7 below shows predicted queue length for post upgrade conditions in 2036 for Thursday and Saturday. The traffic modelling indicated that:

- The queues on the Wolseley Street (northern approach) would not extend to the Mulgoa Road / Wolseley Street intersection
- The queues on the roundabout southern approach would not extend beyond 90 meters
- The queues on the roundabout eastern and western approaches would not extend beyond 35 meters.

Table 3-7 95th-percentile of Maximum Queues Predicted at Wolseley Street Roundabout in 2036

Approach	Thursday (metres)	Saturday (metres)	Distance to upstream intersection
Wolseley Street (N)	14 ✓	43 ✓	160 m to Mulgoa Road/ Wolseley Street intersection
Carpark (E)	10	14	-
Carpark (S)	13	90	-
Carpark (W)	14	33	-

Traffic Implications

The traffic modelling undertaken in 2036 for Wolseley Street / Homemaker Centre Carpark roundabout indicated that proposed upgrades would provide level of service A (13 seconds delay) for Thursday traffic condition. Model predicted level of service D (47 seconds delay) for Saturday traffic condition.

3.5 Traffic Impact at Blaikie Road / Pattys Place

The Blaikie Road / Patty Place local intersection was assessed as priority controlled configuration. No upgrade is required at this intersection. Figure 3-6 shows the existing intersection configuration used in the modelling.

Figure 3-5 Blaikie Road / Pattys Place Intersection

Level of Service

Table 3-8 shows future traffic performance in 2036 at Blaikie Road / Pattys Place intersection for Thursday and Saturday traffic conditions. The delay and level of service is reported for the worst movement in 2036.

Table 3-8 Traffic Performance in 2036 – Blaikie Road / Pattys Place Intersection

Future Traffic Conditions	Worst Movement Delay (sec)	Level of Service
Thursday	5*	A
Saturday	8*	A

Thursday Model: F:\AA008188\Variation 13 - Homemaker Centre\Modelling\VISSIM\Thursday model\20170623 Penrith Homemaker Centre_2036_Thursday_PM
Saturday Model: F:\AA008188\Variation 13 - Homemaker Centre\Modelling\VISSIM\Saturday model\20170623 Penrith Homemaker Centre_2036_Saturday_PM
*Note: Priority/roundabout intersection delay represents worst movement delay.

Queue Lengths

The traffic modelling did not indicate queuing issues at Blaikie Road / Pattys Place intersection.

Traffic Implications

The traffic modelling undertaken in 2036 for Blaikie Road / Pattys Place intersection indicated that under current form this intersection would provide level of service A for both Thursday and Saturday traffic conditions.

4 Conclusions

Overview

This traffic modelling report documents future traffic impacts on Mulgoa Road / Wolseley Street and Mulgoa Road / Blaikie Road intersections which provide access to the Homemaker Centre, Penrith.

The traffic assessment has been carried out in consultation with Roads and Maritime project team.

A new traffic survey was undertaken by Arcadis Australia Pty Ltd (Arcadis) during March and April 2017 for Thursday and Saturday peak period for four intersections including Mulgoa Road / Blaikie Road, Mulgoa Road / Wolseley Street, Blaikie Road / Pattys Place and Wolseley Street / Homemaker Centre Carpark access. The 2017 traffic data undertaken by Arcadis was compared with June 2016 traffic data undertaken by Anton Reisch Consulting for Thursday and Saturday peak periods at Mulgoa Road / Wolseley Street intersection.

The traffic assessment has been undertaken using purposely built micro-simulation traffic model. The micro-simulation model has used VISSIM software (version 9). The reference design traffic models developed for proposed six lanes upgrades on the Mulgoa Road / Castlereagh Road corridor has been used as a basis for this assessment. The future year traffic modelling has also included proposed roundabout realignment at Wolseley Street / Homemaker Centre Carpark.

For the purpose of traffic modelling, the assessment has been undertaken for 2036 traffic conditions for both Thursday and Saturday peak traffic conditions.

Traffic Impact Assessment

Currently Homemaker Centre provides access to Mulgoa Road via Wolseley Street and Pattys Place. Wolseley Street provides access to Homemaker Centre via a tunnel (mousehole) underneath Mulgoa Road. Pattys Place provides access to Homemaker Centre via Blaikie Road.

In 2016 and 2017, traffic volumes at Mulgoa Road / Wolseley Street intersection are found to be similar. The 2017 total intersection volumes at Mulgoa Road / Wolseley Street intersection are about 3 per cent higher on Thursday and about 0.1 per cent higher on Saturday than 2016 traffic volumes.

The inbound and outbound traffic distribution to and from Homemaker Centre was found to be similar between 2016 and 2017 data.

The 2017 counts undertaken by Arcadis are recent and marginally higher than 2016 counts undertaken by Anton Reisch Consulting.

In agreement with Roads and Maritime project team, the 2017 traffic survey data undertaken by Arcadis has been used in future year traffic modelling and assessment.

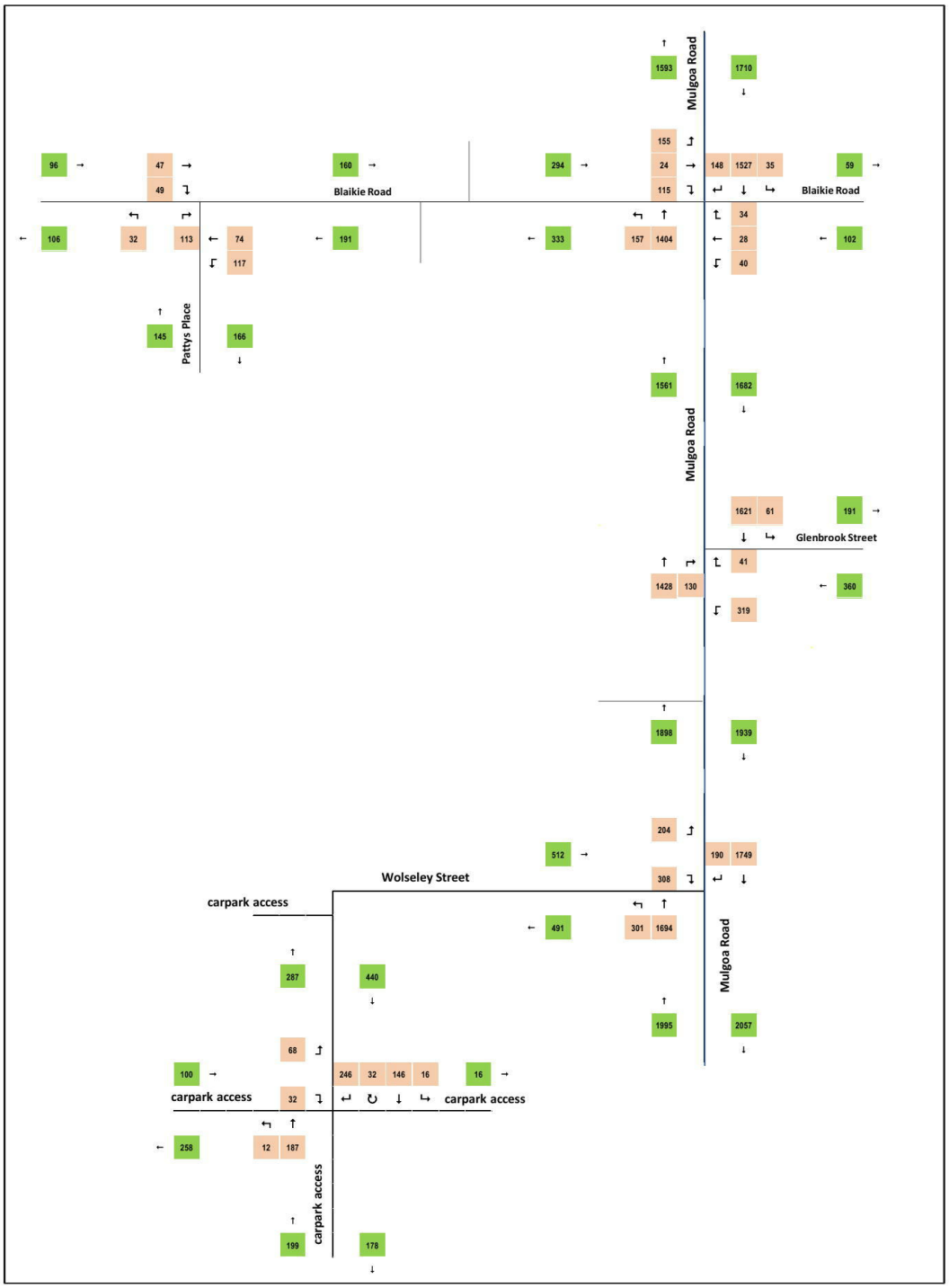
Arcadis' traffic modelling assessment in 2036 for post upgrade conditions has found that:

- Proposed upgrades at Mulgoa Road / Wolseley Street intersection would provide level of service B for both weekday (Thursday) and Saturday traffic conditions. The predicted queue length data suggested that queues on the Wolseley Street would not extend to the Homemaker Centre carpark roundabout. The roundabout realignment at Wolseley Street / Homemaker Centre Carpark would work from traffic grounds.
- Proposed upgrades at Mulgoa Road / Blaikie Road intersection would provide level of service B for weekday (Thursday) and level of service C for Saturday traffic conditions.
- The reference design proposes to replace the grade separated access (mousehole) that provides for right-turn movements from Mulgoa Road (southbound) into Wolseley Street, with dual right-turn lanes. While this would increase delay for the right-turn movement from the current zero to about 42 seconds in 2036. Traffic modelling indicates that overall Mulgoa Road / Wolseley Street intersection would still operate satisfactorily with level of service B for both weekday and weekend traffic conditions.

APPENDIX A EXISTING AND FUTURE TURN VOLUME DIAGRAMS

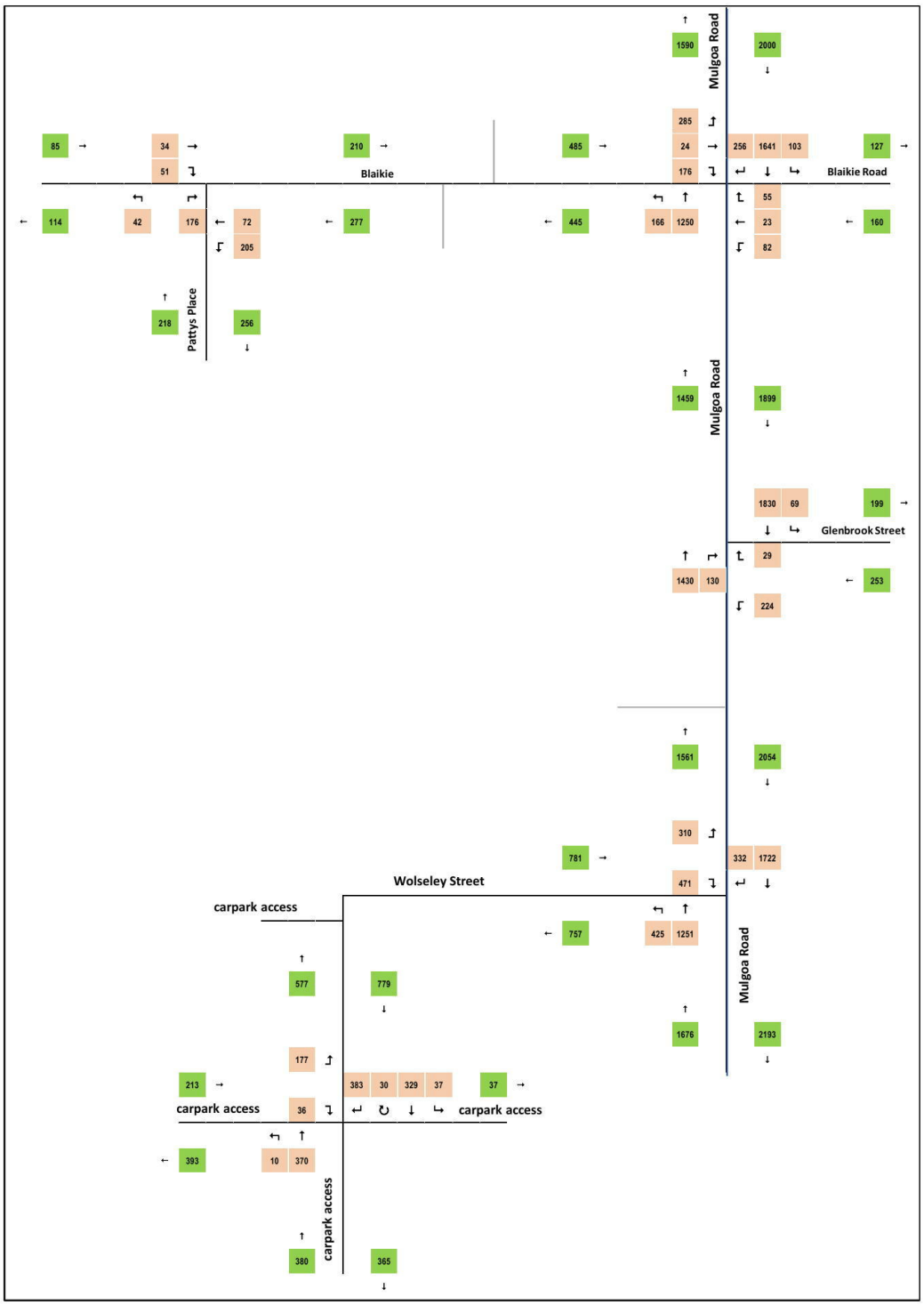
2017 EXISTING TURN VOLUMES

2017 Thursday Peak 1 Hour Traffic Conditions



Note: 2017 Thursday peak 1 hour represents 3 PM to 4 PM.

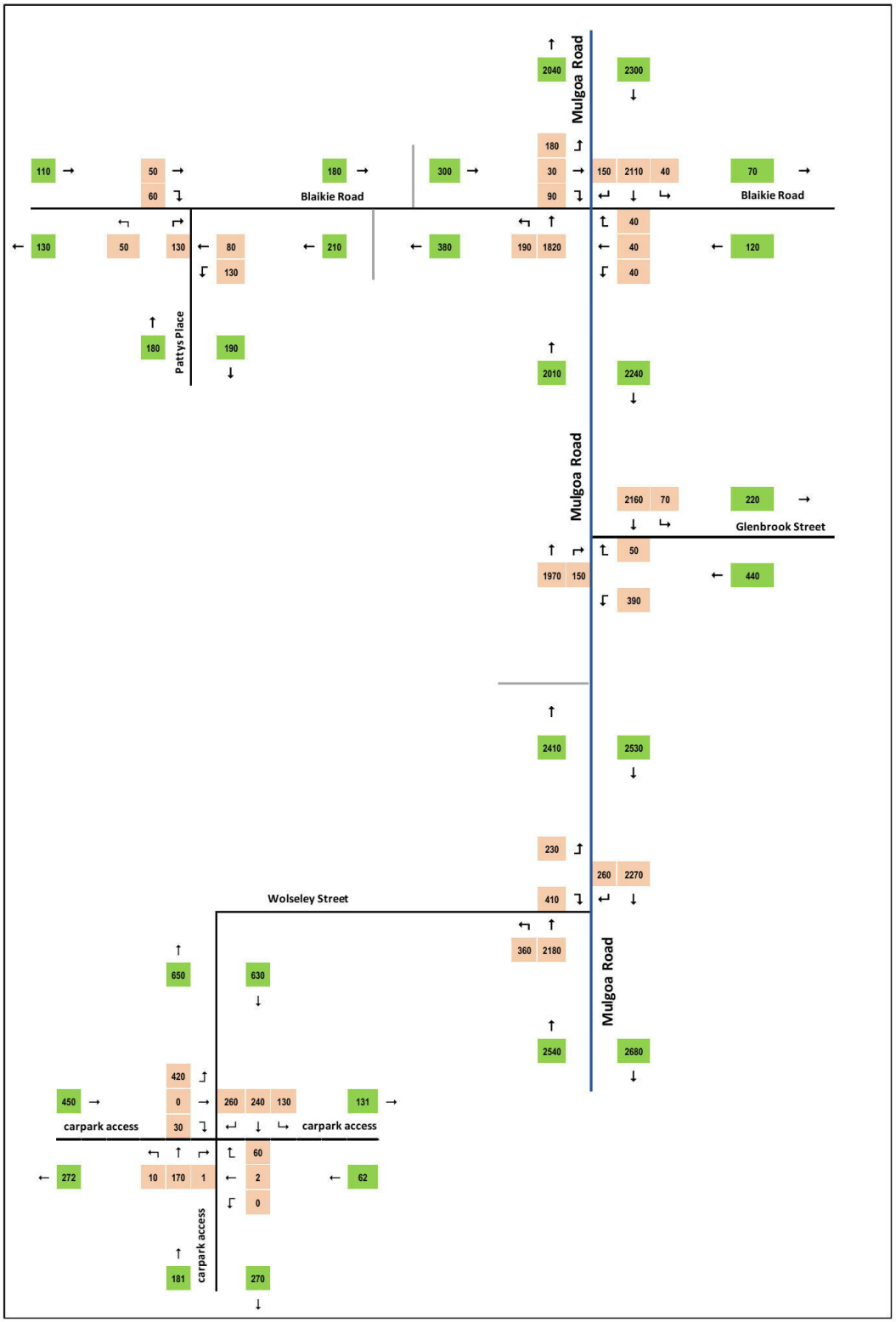
2017 Saturday Peak 1 Hour Traffic Conditions



Note: 2017 Saturday peak 1 hour represents 2 PM to 3 PM.

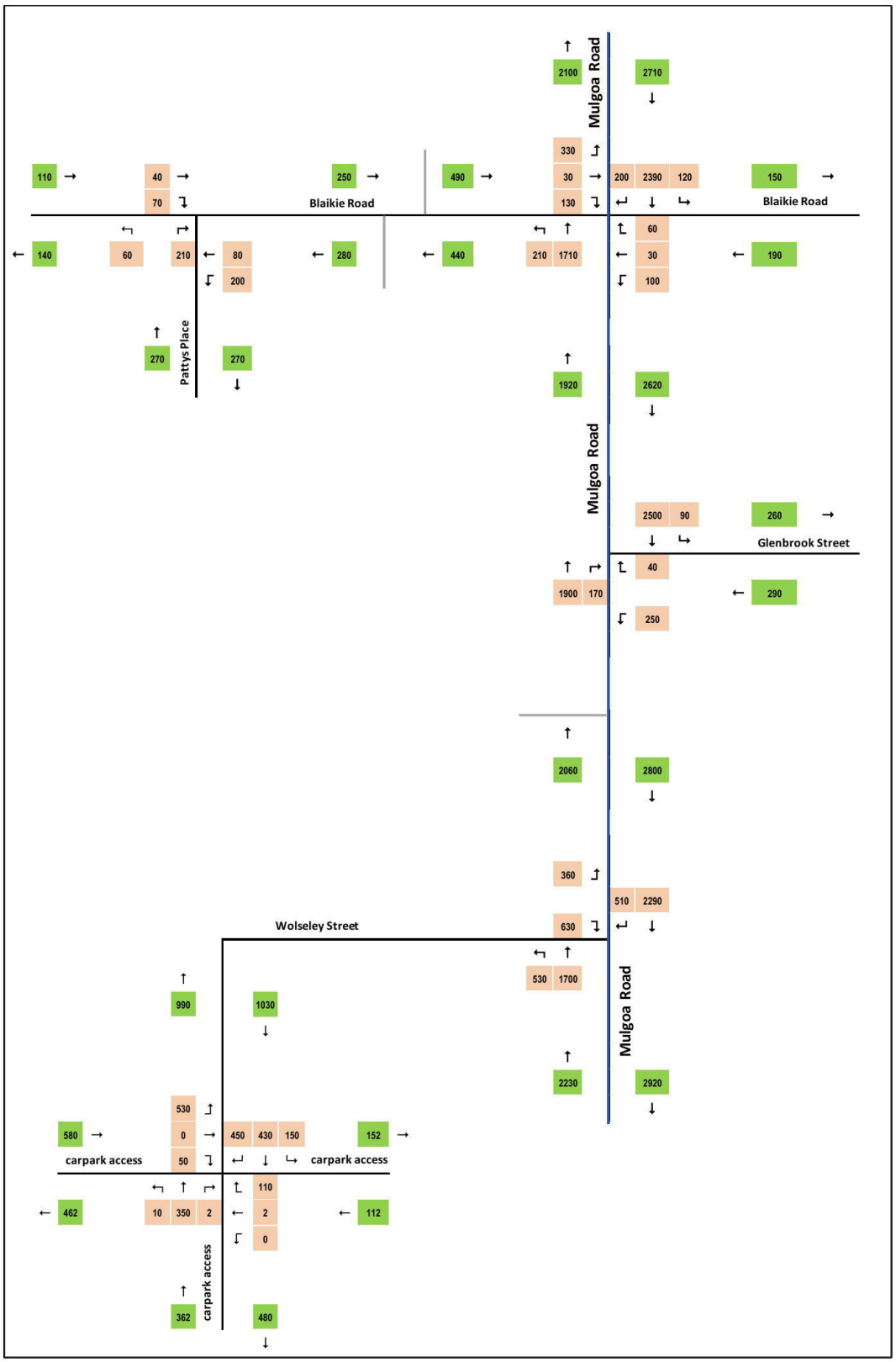
2036 FORECAST TURN VOLUMES

2036 Thursday Peak 1 Hour Traffic Conditions



Note: 2036 Thursday peak 1 hour represents 3 PM to 4 PM (rounded to nearest 10 for volumes more than 10)

2036 Saturday Peak 1 Hour Traffic Conditions



Note: 2036 Saturday peak 1 hour represents 2 PM to 3 PM (rounded to nearest 10 for volumes more than 10)

Penrith Homemaker Centre Expansion

Traffic Impact Assessment

October 2017

Appendix B SIDRA Movement Summary Reports

Anton Reisch Consulting Pty Ltd
19 Canoon Road Turramurra NSW 2074
Ph 02 9449 5161 Mob 0427 995160
antonreisch@optusnet.com.au
ACN: 150 259 493

MOVEMENT SUMMARY

Site: 1 [MR & WS Thursday PM 2017 TN1 Assessment Base Flows]

Mulgoa Road & Wolseley Street Existing
Signals - Fixed Time Isolated Cycle Time = 140 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Mulgoa Road											
1	L2	366	1.0	0.199	5.6	LOS A	0.0	0.0	0.00	0.53	54.9
2	T1	1783	5.0	0.676	9.3	LOS A	32.7	238.8	0.53	0.50	52.1
Approach		2149	4.3	0.676	8.7	LOS A	32.7	238.8	0.44	0.50	52.5
North: Mulgoa Road											
8	T1	1841	6.0	0.660	9.5	LOS A	31.0	228.0	0.55	0.51	51.9
Approach		1841	6.0	0.660	9.5	LOS A	31.0	228.0	0.55	0.51	51.9
West: Wolseley Street											
10	L2	248	1.0	0.657	62.5	LOS E	13.4	94.9	0.99	0.83	26.0
12	R2	375	1.0	0.657	62.5	LOS E	13.4	94.9	0.99	0.83	26.0
Approach		623	1.0	0.657	62.5	LOS E	13.4	94.9	0.99	0.83	26.0
All Vehicles		4614	4.5	0.676	16.3	LOS B	32.7	238.8	0.56	0.55	46.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P3	North Full Crossing	53	62.4	LOS F	0.2	0.2	0.94	0.94
P4	West Full Crossing	53	7.9	LOS A	0.1	0.1	0.34	0.34
All Pedestrians		105	35.1	LOS D			0.64	0.64

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 1 [MR & WS Saturday PM 2017 TN1 Assessment Base Flows]

Mulgoa Road & Wolseley Street Existing
Signals - Fixed Time Isolated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Mulgoa Road											
1	L2	512	1.0	0.277	5.7	LOS A	0.0	0.0	0.00	0.53	54.9
2	T1	1317	3.0	0.530	9.9	LOS A	16.9	121.4	0.58	0.52	51.6
Approach		1828	2.4	0.530	8.7	LOS A	16.9	121.4	0.42	0.52	52.5
North: Mulgoa Road											
8	T1	1813	3.0	0.729	12.4	LOS A	29.1	208.6	0.72	0.67	49.9
Approach		1813	3.0	0.729	12.4	LOS A	29.1	208.6	0.72	0.67	49.9
West: Wolseley Street											
10	L2	373	1.0	0.738	44.2	LOS D	14.9	105.1	0.99	0.88	29.9
12	R2	566	1.0	0.738	44.2	LOS D	14.9	105.1	0.99	0.88	29.9
Approach		939	1.0	0.738	44.2	LOS D	14.9	105.1	0.99	0.88	29.9
All Vehicles		4580	2.4	0.738	17.4	LOS B	29.1	208.6	0.65	0.65	44.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P3	North Full Crossing	53	43.3	LOS E	0.1	0.1	0.93	0.93
P4	West Full Crossing	53	10.6	LOS B	0.1	0.1	0.46	0.46
All Pedestrians		105	27.0	LOS C			0.70	0.70

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 2 [MR & BR Thursday PM 2017 TN1 Assessment Base Flows]

Mulgoa Road & Blaikie Road Existing 2017
Signals - Fixed Time Isolated Cycle Time = 140 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Mulgoa Road											
1	L2	175	3.0	0.176	15.9	LOS B	4.5	32.1	0.50	0.69	47.1
2	T1	1512	5.0	0.729	19.2	LOS B	39.5	288.1	0.72	0.66	45.6
Approach		1686	4.8	0.729	18.9	LOS B	39.5	288.1	0.70	0.66	45.7
East: Blaikie Road											
4	L2	42	1.0	0.152	58.0	LOS E	2.5	17.8	0.91	0.71	24.1
5	T1	29	1.0	0.275	57.8	LOS E	4.0	28.4	0.93	0.73	24.3
6	R2	36	1.0	0.275	59.5	LOS E	4.0	28.4	0.93	0.73	24.1
Approach		107	1.0	0.275	58.5	LOS E	4.0	28.4	0.92	0.72	24.1
North: Mulgoa Road											
7	L2	37	1.0	0.022	5.9	LOS A	0.1	0.9	0.10	0.57	38.9
8	T1	1639	3.0	0.567	7.1	LOS A	22.9	164.5	0.45	0.42	53.7
9	R2	171	3.0	0.563	53.9	LOS D	10.9	78.3	0.98	0.97	31.3
Approach		1846	3.0	0.567	11.4	LOS A	22.9	164.5	0.49	0.47	50.0
West: Blaikie Road											
10	L2	177	3.0	0.317	45.3	LOS D	9.2	66.1	0.81	0.78	33.8
11	T1	25	1.0	0.718	69.9	LOS E	10.1	72.4	1.00	0.86	22.6
12	R2	121	3.0	0.718	71.3	LOS F	10.1	72.4	1.00	0.86	27.4
Approach		323	2.8	0.718	57.0	LOS E	10.1	72.4	0.90	0.82	30.0
All Vehicles		3963	3.7	0.729	19.6	LOS B	39.5	288.1	0.62	0.59	44.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	53	5.7	LOS A	0.1	0.1	0.29	0.29
P3	North Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	13.8	LOS B	0.1	0.1	0.44	0.44
All Pedestrians		158	27.9	LOS C			0.56	0.56

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 2 [MR & BR Saturday PM 2017 TN1 Assessment Base Flows]

Mulgoa Road & Blaikie Road Existing 2017
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Mulgoa Road											
1	L2	175	2.0	0.147	8.7	LOS A	1.6	11.0	0.38	0.65	51.9
2	T1	1362	3.0	0.875	35.4	LOS C	38.5	276.7	0.93	0.96	37.9
Approach		1537	2.9	0.875	32.3	LOS C	38.5	276.7	0.87	0.93	39.1
East: Blaikie Road											
4	L2	86	1.0	0.246	39.6	LOS C	3.6	25.7	0.89	0.73	27.4
5	T1	24	1.0	0.275	38.2	LOS C	3.5	24.8	0.90	0.73	27.8
6	R2	58	1.0	0.275	39.9	LOS C	3.5	24.8	0.90	0.73	27.6
Approach		168	1.0	0.275	39.5	LOS C	3.6	25.7	0.89	0.73	27.5
North: Mulgoa Road											
7	L2	108	1.0	0.068	6.1	LOS A	0.4	2.9	0.15	0.59	38.8
8	T1	1778	3.0	0.795	10.3	LOS A	30.5	219.3	0.64	0.60	51.3
9	R2	293	2.0	0.694	45.6	LOS D	12.5	89.3	0.97	1.00	33.7
Approach		2179	2.8	0.795	14.8	LOS B	30.5	219.3	0.66	0.65	47.3
West: Blaikie Road											
10	L2	320	2.0	0.406	26.7	LOS B	10.7	76.5	0.74	0.79	40.9
11	T1	25	1.0	0.897	64.1	LOS E	12.5	88.6	1.00	1.03	23.4
12	R2	185	2.0	0.897	65.4	LOS E	12.5	88.6	1.00	1.03	28.6
Approach		531	2.0	0.897	42.0	LOS C	12.5	88.6	0.84	0.88	34.5
All Vehicles		4415	2.6	0.897	25.1	LOS B	38.5	276.7	0.76	0.78	41.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	53	7.2	LOS A	0.1	0.1	0.38	0.38
P3	North Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P4	West Full Crossing	53	19.3	LOS B	0.1	0.1	0.62	0.62
All Pedestrians		158	23.6	LOS C			0.65	0.65

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 3 [WS Roundabout Thursday PM 2017 TN1 Assessment Base Flows]

Wolseley Street Roundabout
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Wolseley Street											
1	L2	15	1.0	0.118	4.4	LOS A	0.5	3.7	0.42	0.47	38.2
2	T1	227	1.0	0.118	3.6	LOS A	0.5	3.7	0.42	0.48	38.9
3u	U	5	1.0	0.118	8.2	LOS A	0.5	3.7	0.42	0.48	39.4
Approach		247	1.0	0.118	3.7	LOS A	0.5	3.7	0.42	0.48	38.8
North: Wolseley Street											
8	T1	178	1.0	0.139	2.4	LOS A	0.8	5.4	0.19	0.31	39.4
9	R2	299	1.0	0.213	5.7	LOS A	1.3	9.1	0.19	0.55	38.2
9u	U	39	1.0	0.213	7.0	LOS A	1.3	9.1	0.19	0.55	38.6
Approach		516	1.0	0.213	4.7	LOS A	1.3	9.1	0.19	0.46	38.6
West: Central Parking Aisle											
10	L2	83	1.0	0.135	3.7	LOS A	0.6	3.9	0.39	0.57	38.0
12	R2	39	1.0	0.135	6.7	LOS A	0.6	3.9	0.39	0.57	38.7
12u	U	5	1.0	0.135	8.0	LOS A	0.6	3.9	0.39	0.57	39.2
Approach		127	1.0	0.135	4.8	LOS A	0.6	3.9	0.39	0.57	38.3
All Vehicles		891	1.0	0.213	4.4	LOS A	1.3	9.1	0.28	0.48	38.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

Site: 3 [WS Roundabout Saturday PM 2017 TN1 Assessment Base Flows]

Wolseley Street Roundabout
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Wolseley Street											
1	L2	12	1.0	0.249	5.4	LOS A	1.3	9.2	0.56	0.60	37.9
2	T1	445	1.0	0.249	4.7	LOS A	1.3	9.2	0.56	0.60	38.6
3u	U	5	1.0	0.249	9.4	LOS A	1.3	9.1	0.57	0.61	39.1
Approach		462	1.0	0.249	4.8	LOS A	1.3	9.2	0.56	0.60	38.6
North: Wolseley Street											
8	T1	396	1.0	0.286	2.5	LOS A	1.9	13.7	0.23	0.32	39.3
9	R2	461	1.0	0.312	5.7	LOS A	2.2	15.6	0.23	0.54	38.1
9u	U	36	1.0	0.312	7.1	LOS A	2.2	15.6	0.23	0.54	38.6
Approach		893	1.0	0.312	4.3	LOS A	2.2	15.6	0.23	0.44	38.7
West: Central Parking Aisle											
10	L2	213	1.0	0.324	4.8	LOS A	1.5	10.6	0.57	0.71	37.8
12	R2	43	1.0	0.324	7.8	LOS A	1.5	10.6	0.57	0.71	38.5
12u	U	5	1.0	0.324	9.2	LOS A	1.5	10.6	0.57	0.71	39.0
Approach		261	1.0	0.324	5.4	LOS A	1.5	10.6	0.57	0.71	38.0
All Vehicles		1616	1.0	0.324	4.6	LOS A	2.2	15.6	0.38	0.53	38.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

Site: 1 [WS Roundabout Thursday TN1 Flows & Design]

WSR + TN1 Flows + TN1 Modelling Design
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Wolseley Street											
1	L2	11	1.0	0.216	3.2	LOS A	1.0	7.1	0.48	0.42	29.6
2	T1	179	1.0	0.216	2.4	LOS A	1.0	7.1	0.48	0.42	30.0
3	R2	1	1.0	0.216	5.5	LOS A	1.0	7.1	0.48	0.42	30.2
3u	U	1	1.0	0.216	6.5	LOS A	1.0	7.1	0.48	0.42	30.6
Approach		192	1.0	0.216	2.5	LOS A	1.0	7.1	0.48	0.42	30.0
East: Eastern Aisle											
4	L2	1	1.0	0.084	3.3	LOS A	0.3	2.1	0.47	0.65	29.0
5	T1	2	1.0	0.084	2.6	LOS A	0.3	2.1	0.47	0.65	29.4
6	R2	63	1.0	0.084	5.7	LOS A	0.3	2.1	0.47	0.65	29.5
6u	U	1	1.0	0.084	6.6	LOS A	0.3	2.1	0.47	0.65	29.9
Approach		67	1.0	0.084	5.5	LOS A	0.3	2.1	0.47	0.65	29.5
North: Wolseley Street											
7	L2	137	1.0	0.267	1.8	LOS A	1.5	10.6	0.16	0.17	29.8
8	T1	253	1.0	0.267	0.6	LOS A	1.5	10.6	0.16	0.17	30.3
9	R2	274	1.0	0.225	3.7	LOS A	1.2	8.4	0.16	0.46	29.9
9u	U	21	1.0	0.225	4.6	LOS A	1.2	8.4	0.16	0.46	30.2
Approach		684	1.0	0.267	2.2	LOS A	1.5	10.6	0.16	0.29	30.0
West: Central Aisle											
10	L2	442	1.0	0.495	3.1	LOS A	3.1	22.0	0.55	0.54	29.4
11	T1	5	1.0	0.495	2.3	LOS A	3.1	22.0	0.55	0.54	29.9
12	R2	32	1.0	0.495	5.4	LOS A	3.1	22.0	0.55	0.54	30.0
12u	U	1	1.0	0.495	6.4	LOS A	3.1	22.0	0.55	0.54	30.5
Approach		480	1.0	0.495	3.2	LOS A	3.1	22.0	0.55	0.54	29.5
All Vehicles		1423	1.0	0.495	2.7	LOS A	3.1	22.0	0.35	0.41	29.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Organisation: ANTON REISCH CONSULTING PTY LTD | Processed: Thursday, 21 September 2017 12:17:26 PM
Project: C:\ARC\Jobs 2016\Harvey Norman Penrith\SIDRA\Penrith Homemaker Centre Wolseley Roundabout Tests.sip7

MOVEMENT SUMMARY

Site: 101 [WS Roundabout Thursday TN1 Flows & Proposal Design]

WSR + TN1 Flows + Proposed Design
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Wolseley Street											
1	L2	11	1.0	0.092	3.1	LOS A	0.4	2.9	0.42	0.34	29.6
2	T1	179	1.0	0.092	1.9	LOS A	0.4	2.9	0.42	0.34	30.1
3	R2	1	1.0	0.092	5.0	LOS A	0.4	2.8	0.42	0.34	30.2
3u	U	1	1.0	0.092	5.9	LOS A	0.4	2.8	0.42	0.34	30.6
Approach		192	1.0	0.092	2.0	LOS A	0.4	2.9	0.42	0.34	30.0
East: Eastern Aisle											
4	L2	1	1.0	0.090	4.3	LOS A	0.4	2.9	0.55	0.66	28.8
5	T1	2	1.0	0.090	3.5	LOS A	0.4	2.9	0.55	0.66	29.2
6	R2	63	1.0	0.090	6.6	LOS A	0.4	2.9	0.55	0.66	29.3
6u	U	1	1.0	0.090	7.6	LOS A	0.4	2.9	0.55	0.66	29.7
Approach		67	1.0	0.090	6.5	LOS A	0.4	2.9	0.55	0.66	29.3
North: Wolseley Street											
7	L2	137	1.0	0.153	2.0	LOS A	0.7	4.8	0.17	0.31	29.7
8	T1	253	1.0	0.367	0.6	LOS A	2.2	15.6	0.17	0.32	30.0
9	R2	274	1.0	0.367	3.7	LOS A	2.2	15.6	0.17	0.32	30.2
9u	U	21	1.0	0.367	4.6	LOS A	2.2	15.6	0.17	0.32	30.6
Approach		684	1.0	0.367	2.2	LOS A	2.2	15.6	0.17	0.32	30.0
West: Central Aisle											
10	L2	442	1.0	0.217	2.7	LOS A	1.0	6.8	0.38	0.46	29.4
11	T1	5	1.0	0.217	1.4	LOS A	1.0	6.8	0.39	0.47	29.9
12	R2	32	1.0	0.217	4.5	LOS A	1.0	6.8	0.39	0.47	30.0
12u	U	1	1.0	0.217	5.5	LOS A	1.0	6.8	0.39	0.47	30.4
Approach		480	1.0	0.217	2.8	LOS A	1.0	6.8	0.39	0.46	29.5
All Vehicles		1423	1.0	0.367	2.6	LOS A	2.2	15.6	0.30	0.38	29.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Project: C:\ARC\Jobs 2016\Harvey Norman Penrith\SIDRA\Penrith Homemaker Centre Wolseley Roundabout Tests.sip7

MOVEMENT SUMMARY

Site: 101 [WS Roundabout Thursday TN1 Flows & ARC Distribution & Proposal Design]

WSR + TN1 Flows Redistributed + Proposed Design
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Wolseley Street											
1	L2	5	1.0	0.116	3.2	LOS A	0.5	3.7	0.44	0.35	29.6
2	T1	226	1.0	0.116	2.0	LOS A	0.5	3.7	0.44	0.36	30.0
3	R2	5	1.0	0.116	5.1	LOS A	0.5	3.7	0.44	0.37	30.2
3u	U	1	1.0	0.116	6.0	LOS A	0.5	3.7	0.44	0.37	30.6
Approach		238	1.0	0.116	2.1	LOS A	0.5	3.7	0.44	0.36	30.0
East: Eastern Aisle											
4	L2	5	1.0	0.094	3.6	LOS A	0.4	2.8	0.50	0.62	29.0
5	T1	5	1.0	0.094	2.8	LOS A	0.4	2.8	0.50	0.62	29.4
6	R2	64	1.0	0.094	5.9	LOS A	0.4	2.8	0.50	0.62	29.5
6u	U	1	1.0	0.094	6.9	LOS A	0.4	2.8	0.50	0.62	29.9
Approach		76	1.0	0.094	5.6	LOS A	0.4	2.8	0.50	0.62	29.5
North: Wolseley Street											
7	L2	49	1.0	0.077	2.0	LOS A	0.3	2.2	0.18	0.27	29.7
8	T1	175	1.0	0.319	0.6	LOS A	1.8	12.7	0.17	0.35	30.0
9	R2	275	1.0	0.319	3.7	LOS A	1.8	12.7	0.17	0.36	30.1
9u	U	33	1.0	0.319	4.6	LOS A	1.8	12.7	0.17	0.36	30.5
Approach		532	1.0	0.319	2.6	LOS A	1.8	12.7	0.17	0.35	30.0
West: Central Aisle											
10	L2	356	1.0	0.185	2.9	LOS A	0.8	5.6	0.41	0.49	29.4
11	T1	5	1.0	0.185	1.6	LOS A	0.8	5.6	0.41	0.50	29.8
12	R2	32	1.0	0.185	4.7	LOS A	0.8	5.6	0.41	0.50	30.0
12u	U	1	1.0	0.185	5.7	LOS A	0.8	5.6	0.41	0.50	30.4
Approach		394	1.0	0.185	3.0	LOS A	0.8	5.6	0.41	0.49	29.5
All Vehicles		1239	1.0	0.319	2.8	LOS A	1.8	12.7	0.32	0.41	29.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

Site: 1 [WS Roundabout Saturday TN1 Flows & Design]

WSR + TN1 Flows + TN1 Modelling Design
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Wolseley Street											
1	L2	11	1.0	0.544	7.8	LOS A	4.0	28.5	0.77	0.91	28.6
2	T1	368	1.0	0.544	7.1	LOS A	4.0	28.5	0.77	0.91	29.0
3	R2	5	1.0	0.544	10.2	LOS A	4.0	28.5	0.77	0.91	29.2
3u	U	1	1.0	0.544	11.1	LOS A	4.0	28.5	0.77	0.91	29.5
Approach		385	1.0	0.544	7.2	LOS A	4.0	28.5	0.77	0.91	29.0
East: Eastern Aisle											
4	L2	5	1.0	0.199	4.8	LOS A	0.8	5.4	0.62	0.79	28.6
5	T1	5	1.0	0.199	4.1	LOS A	0.8	5.4	0.62	0.79	29.1
6	R2	116	1.0	0.199	7.2	LOS A	0.8	5.4	0.62	0.79	29.2
6u	U	1	1.0	0.199	8.1	LOS A	0.8	5.4	0.62	0.79	29.6
Approach		127	1.0	0.199	7.0	LOS A	0.8	5.4	0.62	0.79	29.2
North: Wolseley Street											
7	L2	158	1.0	0.435	2.0	LOS A	3.4	23.7	0.31	0.19	29.7
8	T1	453	1.0	0.435	0.8	LOS A	3.4	23.7	0.31	0.19	30.2
9	R2	474	1.0	0.397	3.9	LOS A	2.9	20.1	0.30	0.47	29.7
9u	U	37	1.0	0.397	4.8	LOS A	2.9	20.1	0.30	0.47	30.1
Approach		1121	1.0	0.435	2.4	LOS A	3.4	23.7	0.30	0.32	29.9
West: Central Aisle											
10	L2	579	1.0	0.871	16.9	LOS B	14.3	100.6	1.00	1.55	26.5
11	T1	11	1.0	0.871	16.1	LOS B	14.3	100.6	1.00	1.55	26.9
12	R2	53	1.0	0.871	19.2	LOS B	14.3	100.6	1.00	1.55	27.0
12u	U	1	1.0	0.871	20.2	LOS B	14.3	100.6	1.00	1.55	27.3
Approach		643	1.0	0.871	17.1	LOS B	14.3	100.6	1.00	1.55	26.6
All Vehicles		2277	1.0	0.871	7.6	LOS A	14.3	100.6	0.60	0.79	28.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Project: C:\ARC\Jobs 2016\Harvey Norman Penrith\SIDRA\Penrith Homemaker Centre Wolseley Roundabout Tests.sip7

MOVEMENT SUMMARY

Site: 1 [WS Roundabout Saturday TN1 Flows & Proposal Design]

WSR + TN1 Flows + Proposed Design
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Wolseley Street											
1	L2	11	1.0	0.235	4.9	LOS A	1.3	9.1	0.64	0.59	29.3
2	T1	368	1.0	0.235	3.8	LOS A	1.3	9.1	0.64	0.60	29.8
3	R2	5	1.0	0.235	7.0	LOS A	1.3	8.9	0.65	0.60	29.9
3u	U	1	1.0	0.235	7.9	LOS A	1.3	8.9	0.65	0.60	30.3
Approach		385	1.0	0.235	3.9	LOS A	1.3	9.1	0.64	0.60	29.8
East: Eastern Aisle											
4	L2	5	1.0	0.278	10.0	LOS A	1.6	11.5	0.84	0.91	27.5
5	T1	5	1.0	0.278	9.3	LOS A	1.6	11.5	0.84	0.91	27.9
6	R2	116	1.0	0.278	12.4	LOS A	1.6	11.5	0.84	0.91	28.1
6u	U	1	1.0	0.278	13.3	LOS A	1.6	11.5	0.84	0.91	28.4
Approach		127	1.0	0.278	12.2	LOS A	1.6	11.5	0.84	0.91	28.0
North: Wolseley Street											
7	L2	158	1.0	0.190	2.3	LOS A	0.9	6.4	0.26	0.35	29.6
8	T1	453	1.0	0.663	0.9	LOS A	6.7	47.3	0.39	0.35	29.8
9	R2	474	1.0	0.663	4.0	LOS A	6.7	47.3	0.39	0.35	30.0
9u	U	37	1.0	0.663	5.0	LOS A	6.7	47.3	0.39	0.35	30.4
Approach		1121	1.0	0.663	2.6	LOS A	6.7	47.3	0.37	0.35	29.9
West: Central Aisle											
10	L2	579	1.0	0.347	3.8	LOS A	1.7	12.1	0.57	0.65	29.3
11	T1	11	1.0	0.347	2.6	LOS A	1.7	11.9	0.58	0.66	29.7
12	R2	53	1.0	0.347	5.7	LOS A	1.7	11.9	0.58	0.66	29.8
12u	U	1	1.0	0.347	6.6	LOS A	1.7	11.9	0.58	0.66	30.2
Approach		643	1.0	0.347	3.9	LOS A	1.7	12.1	0.57	0.65	29.3
All Vehicles		2277	1.0	0.663	3.7	LOS A	6.7	47.3	0.50	0.51	29.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Project: C:\ARC\Jobs 2016\Harvey Norman Penrith\SIDRA\Penrith Homemaker Centre Wolseley Roundabout Tests.sip7

MOVEMENT SUMMARY

Site: 1 [WS Roundabout Saturday TN1 Flows & ARC Distribution & Proposal Design]

WSR + TN1 Flows Redistributed + Proposed Design
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Wolseley Street											
1	L2	5	1.0	0.229	4.6	LOS A	1.2	8.4	0.59	0.54	29.4
2	T1	391	1.0	0.229	3.4	LOS A	1.2	8.4	0.59	0.55	29.8
3	R2	5	1.0	0.229	6.6	LOS A	1.2	8.3	0.60	0.55	30.0
3u	U	1	1.0	0.229	7.5	LOS A	1.2	8.3	0.60	0.55	30.4
Approach		402	1.0	0.229	3.5	LOS A	1.2	8.4	0.59	0.55	29.8
East: Eastern Aisle											
4	L2	5	1.0	0.174	6.0	LOS A	0.8	5.8	0.67	0.79	28.4
5	T1	5	1.0	0.174	5.3	LOS A	0.8	5.8	0.67	0.79	28.8
6	R2	98	1.0	0.174	8.4	LOS A	0.8	5.8	0.67	0.79	28.9
6u	U	1	1.0	0.174	9.4	LOS A	0.8	5.8	0.67	0.79	29.3
Approach		109	1.0	0.174	8.2	LOS A	0.8	5.8	0.67	0.79	28.9
North: Wolseley Street											
7	L2	89	1.0	0.128	1.9	LOS A	0.6	4.0	0.16	0.27	29.7
8	T1	357	1.0	0.526	0.6	LOS A	4.1	29.3	0.20	0.33	30.0
9	R2	445	1.0	0.526	3.7	LOS A	4.1	29.3	0.20	0.33	30.1
9u	U	36	1.0	0.526	4.6	LOS A	4.1	29.3	0.20	0.33	30.5
Approach		927	1.0	0.526	2.4	LOS A	4.1	29.3	0.19	0.32	30.0
West: Central Aisle											
10	L2	487	1.0	0.277	3.6	LOS A	1.3	9.1	0.54	0.62	29.3
11	T1	5	1.0	0.277	2.4	LOS A	1.3	9.0	0.55	0.63	29.8
12	R2	21	1.0	0.277	5.5	LOS A	1.3	9.0	0.55	0.63	29.9
12u	U	1	1.0	0.277	6.5	LOS A	1.3	9.0	0.55	0.63	30.3
Approach		515	1.0	0.277	3.7	LOS A	1.3	9.1	0.55	0.62	29.3
All Vehicles		1954	1.0	0.526	3.3	LOS A	4.1	29.3	0.40	0.47	29.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Organisation: ANTON REISCH CONSULTING PTY LTD | Processed: Thursday, 21 September 2017 12:17:29 PM
Project: C:\ARC\Jobs 2016\Harvey Norman Penrith\SIDRA\Penrith Homemaker Centre Wolseley Roundabout Tests.sip7

Penrith Homemaker Centre Expansion

Traffic Impact Assessment

October 2017

Appendix C Parking Surveys (Source All – Matrix Traffic & Transport Data)

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Figure C1 Homemaker Centre Parking Survey Locations

Table C1 Parking Survey, Thursday 23rd June 2016

Side of the Street	Parking Restriction	Available Spaces	11:00	12:00	16:00	17:00
Zone A						
	No Restriction	504	127	126	170	158
	Disabled	8	1	4	1	0
	Parents with Pram	10	2	2	0	1
	Bike Parking	4	0	0	0	0
	Loading Zone	1	0	0	0	0
	Total	**527**	**130**	**132**	**171**	**159**
	% Capacity		**25%**	**25%**	**32%**	**30%**
Zone B						
	No Restriction	75	38	57	59	58
	Disabled	6	0	3	2	1
	Parents with Pram	4	2	3	1	0
	Loadine Zone	7	3	1	0	0
	Total	**92**	**43**	**64**	**62**	**59**
	% Capacity		**47%**	**70%**	**67%**	**64%**
Zone C						
	No Restriction	32	15	17	12	15
	Disabled	4	0	0	1	0
	Total	**36**	**15**	**17**	**13**	**15**
	% Capacity		**42%**	**47%**	**36%**	**42%**
Zone D						
	No Restriction	163	53	44	43	44
	Disabled	2	1	1	1	1
	Total	**165**	**54**	**45**	**44**	**45**
	% Capacity		**33%**	**27%**	**27%**	**27%**
Zone E						
	No Restriction	53	35	33	28	32
	Disabled	3	0	0	0	0
	No Parking	2	0	0	0	0
	Total	**58**	**35**	**33**	**28**	**32**
	% Capacity		**60%**	**57%**	**48%**	**55%**
Zone F						
	No Restriction	11	6	4	10	9
	Total	**11**	**6**	**4**	**10**	**9**
	% Capacity		**55%**	**36%**	**91%**	**82%**
Zone G						
	No Restriction	150	51	42	34	28
	Disabled	2	2	2	0	0
	Total	**152**	**53**	**44**	**34**	**28**
	% Capacity		**35%**	**29%**	**22%**	**18%**
Zone H						
	No Restriction	69	25	22	23	17
	Total	**69**	**25**	**22**	**23**	**17**
	% Capacity		**36%**	**32%**	**33%**	**25%**
Zone I						
	No Restriction	150	48	45	41	34
	Disabled	2	1	1	0	0
	Total	**152**	**49**	**46**	**41**	**34**
	% Capacity		**32%**	**30%**	**27%**	**22%**
Zone J						
	No Restriction	136	48	46	34	44
	Trailer Bay	7	0	0	2	0
	Disabled	6	1	3	0	0
	Total	**149**	**49**	**49**	**36**	**44**
	% Capacity		**33%**	**33%**	**24%**	**30%**
Zone K						
	No Restriction	37	15	14	18	24
	Disabled	2	1	0	0	0
	Total	**39**	**16**	**14**	**18**	**24**
	% Capacity		**41%**	**36%**	**46%**	**62%**
Zone L						
	No Restriction	89	58	62	60	60
	Disabled	4	2	2	1	1
	Total	**93**	**60**	**64**	**61**	**61**
	% Capacity		**65%**	**69%**	**66%**	**66%**

Table C2 Parking Survey, Saturday 25th June 2016

Side of the Street	Parking Restriction	Available Spaces	10:00	11:00	12:00	13:00	14:00	15:00
Zone A - Under Parking								
	No Restriction	504	103	126	106	138	135	114
	Disabled	8	1	0	2	4	2	1
	Parents with Pram	10	1	2	1	2	1	3
	Bike Parking	4	0	0	0	0	0	0
	Total	**526**	**105**	**128**	**109**	**144**	**138**	**118**
	% Capacity		**20%**	**24%**	**21%**	**27%**	**26%**	**22%**
Zone B								
	No Restriction	75	72	73	74	71	68	70
	Disabled	6	3	4	5	2	4	5
	Parents with Pram	4	4	4	4	3	4	3
	Total	**85**	**79**	**81**	**83**	**76**	**76**	**78**
	% Capacity		**93%**	**95%**	**98%**	**89%**	**89%**	**92%**
Zone C								
	No Restriction	32	24	26	16	25	25	24
	Disabled	4	3	3	1	1	0	0
	Total	**36**	**27**	**29**	**17**	**26**	**25**	**24**
	% Capacity		**75%**	**81%**	**47%**	**72%**	**69%**	**67%**
Zone D								
	No Restriction	163	66	93	109	118	135	121
	Disabled	2	0	1	2	0	2	1
	Total	**165**	**66**	**94**	**111**	**118**	**137**	**122**
	% Capacity		**40%**	**57%**	**67%**	**72%**	**83%**	**74%**
Zone E								
	No Restriction	53	28	32	36	40	34	30
	Disabled	3	1	1	1	2	0	0
	No Parking	2	0	0	0	0	0	0
	Total	**58**	**29**	**33**	**37**	**42**	**34**	**30**
	% Capacity		**50%**	**57%**	**64%**	**72%**	**59%**	**52%**
Zone F								
	No Restriction	11	5	6	5	2	5	5
	Total	**11**	**5**	**6**	**5**	**2**	**5**	**5**
	% Capacity		**45%**	**55%**	**45%**	**18%**	**45%**	**45%**
Zone G								
	No Restriction	150	44	87	92	74	82	74
	Disabled	2	2	1	2	0	1	0
	Total	**152**	**46**	**88**	**94**	**74**	**83**	**74**
	% Capacity		**30%**	**58%**	**62%**	**49%**	**55%**	**49%**
Zone H								
	No Restriction	69	26	42	49	43	52	44
	Total	**69**	**26**	**42**	**49**	**43**	**52**	**44**
	% Capacity		**38%**	**61%**	**71%**	**62%**	**75%**	**64%**
Zone I								
	No Restriction	150	61	82	98	103	101	90
	Disabled	2	0	1	2	2	1	0
	Total	**152**	**61**	**83**	**100**	**105**	**102**	**90**
	% Capacity		**40%**	**55%**	**66%**	**69%**	**67%**	**59%**
Zone J								
	No Restriction	136	55	62	68	78	69	74
	Trailer Bay	7	0	2	0	0	1	0
	Disabled	6	1	3	1	4	1	1
	Total	**149**	**56**	**67**	**69**	**82**	**71**	**75**
	% Capacity		**38%**	**45%**	**46%**	**55%**	**48%**	**50%**
Zone K								
	No Restriction	37	8	14	17	20	25	31
	Disabled	2	0	0	0	1	0	0
	Total	**39**	**8**	**14**	**17**	**21**	**25**	**31**
	% Capacity		**21%**	**36%**	**44%**	**54%**	**64%**	**79%**
Zone L								
	No Restriction	89	48	53	73	82	85	79
	Disabled	4	3	2	3	3	2	2
	Total	**93**	**51**	**55**	**76**	**85**	**87**	**81**
	% Capacity		**55%**	**59%**	**82%**	**91%**	**94%**	**87%**