Attachment C

Traffic and Parking Report

Traffic Impact and Parking Report

Yarralumla Brickworks

Prepared for Doma Group

19 July 2023

Calibre Professional Services Pty Ltd
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Contents

Tables

Figures

Appendices

1. Introduction

The DOMA Group (DOMA) and BLOC are currently progressing the development of the Yarralumla Brickworks Estate, located within Yarralumla on the Old Canberra Brickworks site. As part of the previous investigations undertaken for this development, AECOM prepared a Traffic Impact and Parking Assessment (TIPA) report for road network surrounding the site in April 2021. In September 2021, an additional study by AECOM has been conducted for the nearby Kent-Novar Street intersection upgrades and surrounding road network.

Since the completion of the two aforementioned reports, an update to the site masterplan has occurred. This update resulted in changes to the development yields of the site, including a shift in residential dwellings to focus more on two- and three-bedroom units over one-bedroom units and changes to non-residential land uses.

Calibre was initially engaged in October 2021 by DOMA to undertake an update of the previous AECOM TIPA report to account for the current site conditions. A memorandum of the changes to traffic conditions along the surrounding road network was submitted by Calibre in February 2022 to provide preliminary feedback on this matter.

To better present the changes to the traffic operation in and surrounding the site, Calibre has compiled the relevant information from all three previous documents into a single, up-to-date TIPA report for the site. This document will serve to present this information.

1.1 Site of Works

The site of the Yarralumla Brickworks development is located within Block 1, 7 and 20 of Section 102, Yarralumla. Currently, Blocks 7 and 20 are unoccupied while Block 1 is occupied by the Old Canberra Brickworks site. Canberra Brickworks is currently not in operation and so traffic to and from the site should be minimal. Access to the Brickworks is currently provided via Denman Street.

Under the Territory Plan, all three blocks are currently classified as CZ6: Leisure and Accommodation zones. Figure 1.1 identifies the location of the site and classification of each section.

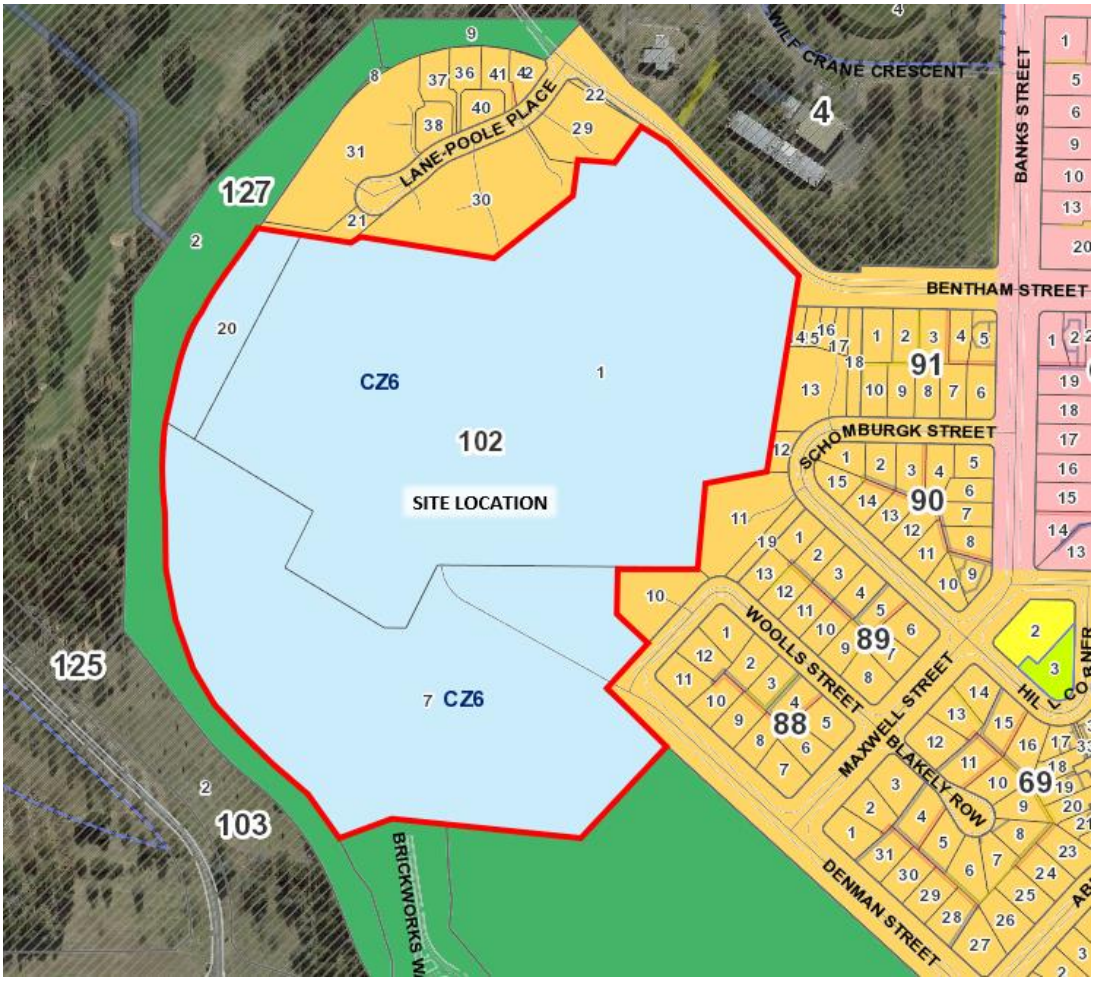


Figure 1.1 Site Location

1.2 Scope of Investigation

- This TIPA aims to review the previous AECOM reports along with the current site plans and block yields to provide up-to-date commentary on transport impacts for the site. All changes to site yields and the expected impact to traffic conditions will be detailed as part of this report. The scope of this assessment is as follows:
- Assessment of the existing parking conditions surrounding the site
- Suitability of the proposed parking provision and requirements for the Brickworks Precinct
- Assessment of the existing active travel and public transport facilities
- Traffic generating characteristics of the Brickworks Precinct
- Review of the previously undertaken AIMSUN traffic modelling for the Brickworks Precinct and the Kent Street / Novar Street intersection and assessment of the difference in traffic assumptions
- Suitability of the proposed access arrangements for the site

2. Existing Conditions

2.1 Surrounding Road Network

Adelaide Avenue is an arterial road which runs eastward into Capital Hill, and transitions into two other arterial roads, Yarra Glen and Cotter Road, to the west. Adelaide Avenue consists of two carriageways, separated on average by an 11m wide grassed median. The eastbound carriageway typically consists of three traffic lanes and a dedicated cycle lane along the outside edge while adjacent to the site. The westbound carriageway typically consists of three traffic lanes as well, although the innermost lane is reserved as a T2 transit bus lane for parts. An on-road cycle lane is also present along the outside edge of the carriageway. The speed environment for the full length of the road is posted at 80km/hr.

Cotter Road is an arterial road with a posted speed of 80km/hr that runs between John Gorton Drive to the east and Adelaide Avenue to the west. Cotter Road provides two carriageways, each typically consisting of two traffic lanes and a dedicated on-road carriageway. These carriageways are typically separated by a 6m wide median.

Kent Street is a major collector road with a posted speed of 60km/hr. The road travels between Kitchener Street to the south and Novar Street to the north. Kent Street provides a single carriageway with one lane in each direction.

Novar Street is a major collector road with a posted speed of 60km/hr, traveling between Alexandria Drive / Brown Street to the north and Kent Street / Dudley Street / Adelaide Avenue. Novar Street provides a single carriageway with one lane in each direction.

Dudley Street is a major collector road with a posted speed of 60km/hr, traveling between Cotter Road the west and Novar Street / Adelaide Avenue to the east. Dudley Street provides a roundabout for the new connection of Brickworks Way and shall be one of the main connections into the new proposed site. Dudley Street provides a single carriageway with one lane in each direction.

Bentham Street is a minor collector road that extends between Novar Street to the east and then finishes at the Royal Canberra Golf Club to the west. Bentham Street provides a single carriageway with one lane in each direction. There is no posted speed limit along the road and as such, the speed limit is assumed to be the default speed limit of 50km/hr for urban areas.

Brickworks Way is a minor collector road that will continue the recently constructed stub off the northern leg of the Dudley Street roundabout The road will act as the main access route between the Brickworks precinct and the wider road network. Brickworks Way will consist of a dual carriageway separated by a 4.5m wide landscaped median. Each carriageway consists of a single traffic lane, which allows for one-way movement either northbound or southbound. There is no posted speed limit along the road and as such, the speed limit is assumed to be the default speed limit of 50km/hr for urban areas.

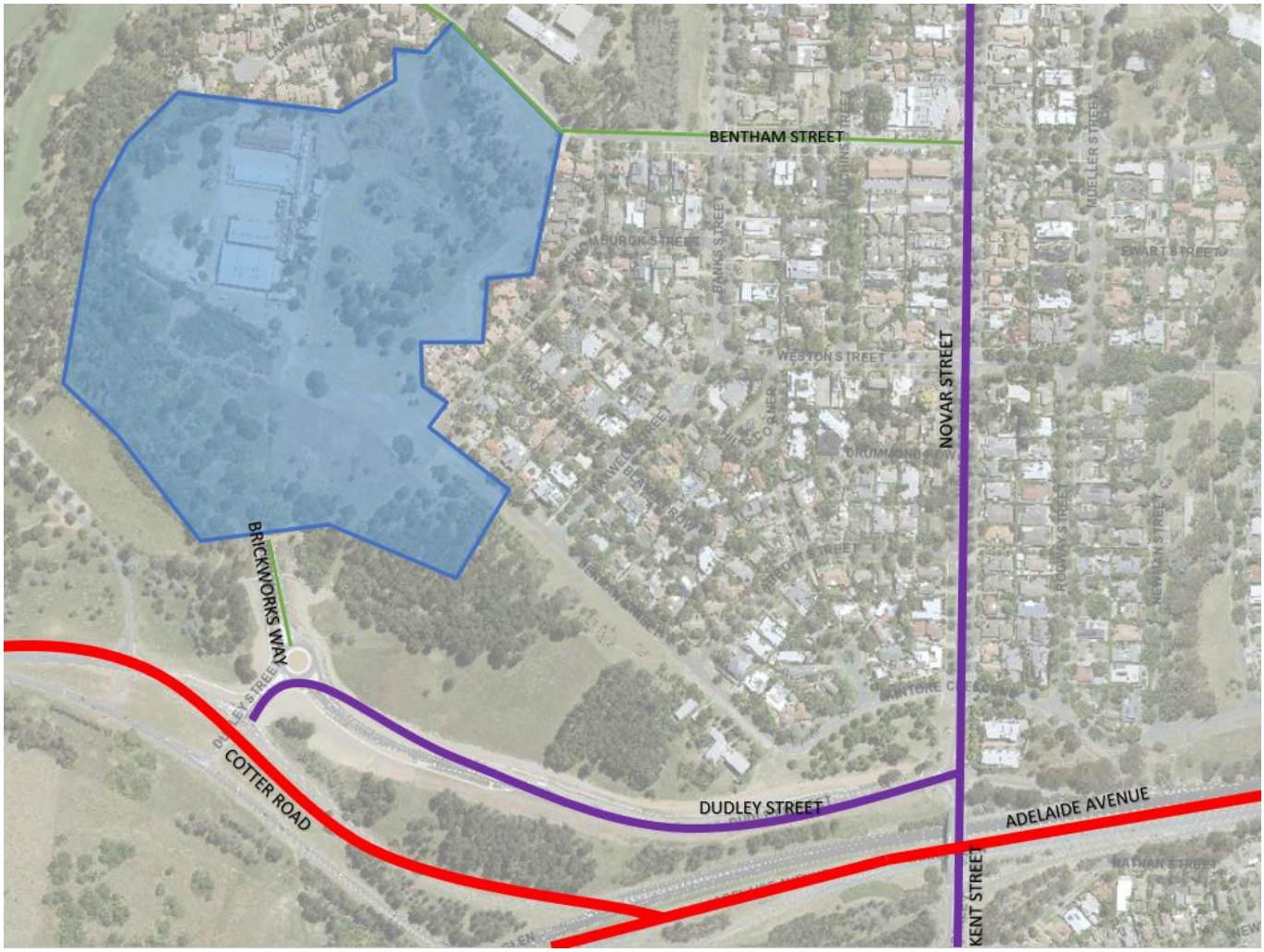


Figure 2.1 Existing Road Network

2.2 Existing Parking Facilities

High level observations on the parking demand and availability of existing car parking were conducted by Calibre during the preparation of the supporting memo. This assessment reviewed the findings of the previous AECOM parking assessment undertaken in 2015 with subsequent spot counts. Due to the ongoing effects of COVID-19 and lockdown efforts adopted by the ACT, the parking demand was noted to be significantly reduced compared to the 2015 count observations. As changes to the parking generators in the area have been limited since 2015, the findings from the original parking assessment have been adopted to be conservative. Both on-site dedicated parking and nearby on-street parking was considered as part of this assessment.

The main parking generator in close proximity to the proposed Brickworks Precinct was identified as the Yarralumla Shops along Bentham Street. Site surveys also identified a primary school within proximity to the site, however parking for this site is assumed to have its own short-term dedicated parking on-site, and as such will not utilise or provide any parking spaces for the surrounding network.

Similarly, site surveys for the Uniting Church along Denman Street were conducted, however all parking for this site is expected to be provided onsite during normal peak usages. The church parking is provided for by the informal gravel carpark located at the church entrance, with overflow parking available within the grassed area to the northwest of the church building. Surveys suggest that there will be occasional heavy demand periods associated with this site during special events, such as funerals, weddings, or fetes. Parking for these events is expected to be mostly provided by the grassed overflow parking area but may also extend along the adjacent roads.

The St Nicholas Greek-Australian Pre School & Child Care Centre was also identified as being in close proximity to the site. As with the primary school, this land use was identified as having its own dedicated on-site parking provisions. From

the 2015 spot counts, parking was observed to be contained within the site throughout the day with Hill Corner used for peak pick up and drop off times. Few vehicles were observed to park along Maxwell Street associated with this centre.

Overflow parking at lunch times linked with the restaurant and café trade at the Yarralumla Shops occurs on the adjacent streets and parking restrictions generally limit short term parking to one side of these roads. This was not observed to cause operational issues under normal demand and available parking is considered appropriate for this site peak demand.

2.2.1 Yarralumla Shops Parking

2.2.1.1 On-Street Parking

The local requirements for various types of parking are outlined within the Parking and Vehicular Access General Code (PVAGC) within the Territory Plan. For local centres within Yarralumla, parking should be accommodated onsite or within 200m. As such, a 200m radius around the Yarralumla Shops central building has been assessed and can be found in Figure 2.2. The 200m walking distances based on the footpath network has also been shown in the figure as well, as this is the basis for the parking constraints.

Figure 2.2 On-Street parking restrictions Yarralumla Shops

On-site parking is available for Yarralumla Shops along the rear of buildings 16 and 18 Bentham Street (south side between Novar Street and Hutchins Street). The spot counts in this area identified that there was some capacity in these rear carparks. This is likely due to visitors of these tenancies utilising the available on-street parking along Bentham Street out of convenience.

Within the 200m walkable distance area, there are approximately 70 spaces. These include unrestricted and time restricted parking. There are also approximately 25 time restricted no parking spaces along Novar Street and Bentham Street. These parking supply numbers do not include full time no parking zones or illegal parking.

2.2.1.2 On-Site Parking

Yarralumla Shops provides a variety of time restricted on-site parking options. It is assumed to have been developed over time in consultation with the community and users, and as such is workable despite the complicated layout. A summary of parking restrictions and onsite parking supply associated with the Yarralumla Shops can be seen in Figure 2.3.

Figure 2.3 Yarralumla Shops onsite parking restrictions and supply

2.2.1.3 Parking Utilisation

The on-street parking utilisation throughout Yarralumla was, on average, very low. The preference of residents to park their vehicles in garages resulted in the observed parking levels on-street to be generally 0 and 2 vehicles for any local access road. The three observed exceptions to this were the on-street parking vicinity of the shops, the on-street parking in the vicinity of the church during peak use periods and on-street parking adjacent to construction zones.

The parking utilisation of the shops onsite supply was at 95% or greater for all spot counts conducted, for both weekdays and weekends. The overflow parking associated with the shops is located primarily along Hutchins Street and Bentham, Street west of the shop complex. The utilisation of the overflow parking was low on weekend days and high on weekdays, particularly during the lunch peak period. A summary of utilisation of parking associated with the shops which includes all available on-street parking within 200m walkable distance can be seen in Figure 2.4 and Figure 2.5

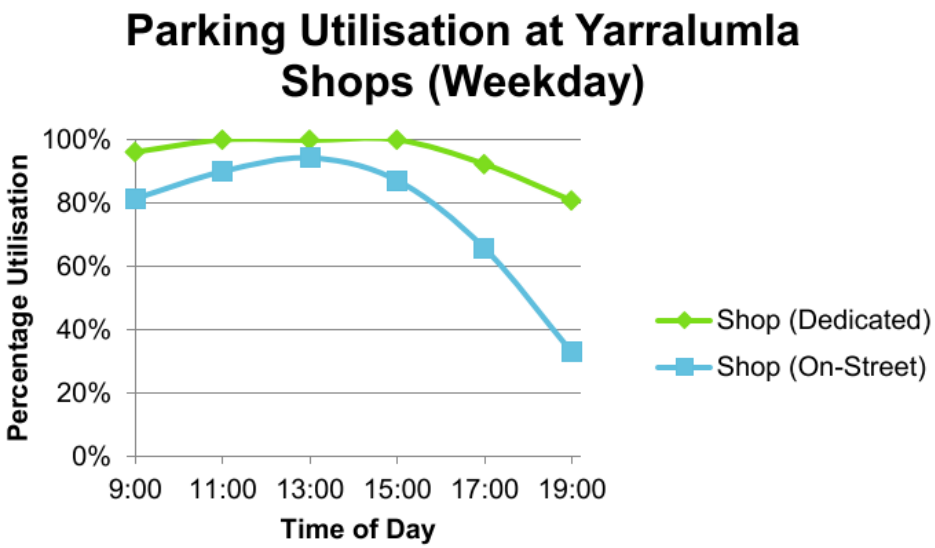


Figure 2.4 Parking Utilisation at Yarralumla Shops (Weekday)

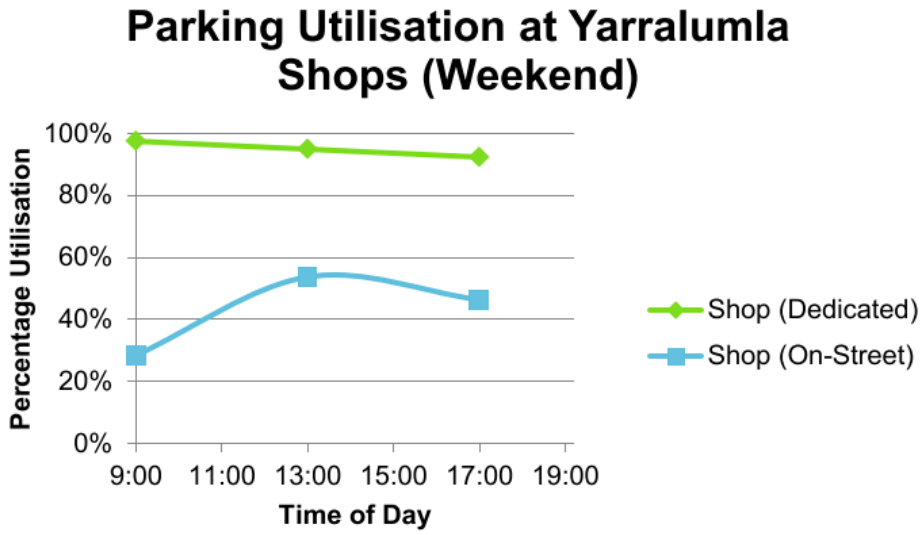


Figure 2.5 Parking Utilisation at Yarralumla Shops (Weekend)

The above graphs indicate that the weekend supply of parking is adequate at the Yarralumla Shops, however the weekday parking availability shows to be over capacity. Based on site observations, there is limited available on-street supply during the weekday peak.

2.3 Public Transport

While there are a large number of bus routes operating along Adelaide Avenue, including a number of rapid routes, there is only one bus route currently operating through Yarralumla. This route is number 57 and travels between Woden Interchange and City Interchange via Parkes, Deakin, Yarralumla, Hughes, and Garran. The frequency of the bus route is every 20 minutes during peak hour and every 60 minutes during off peak. The route map for the Woden area can be seen in Figure 2.6.

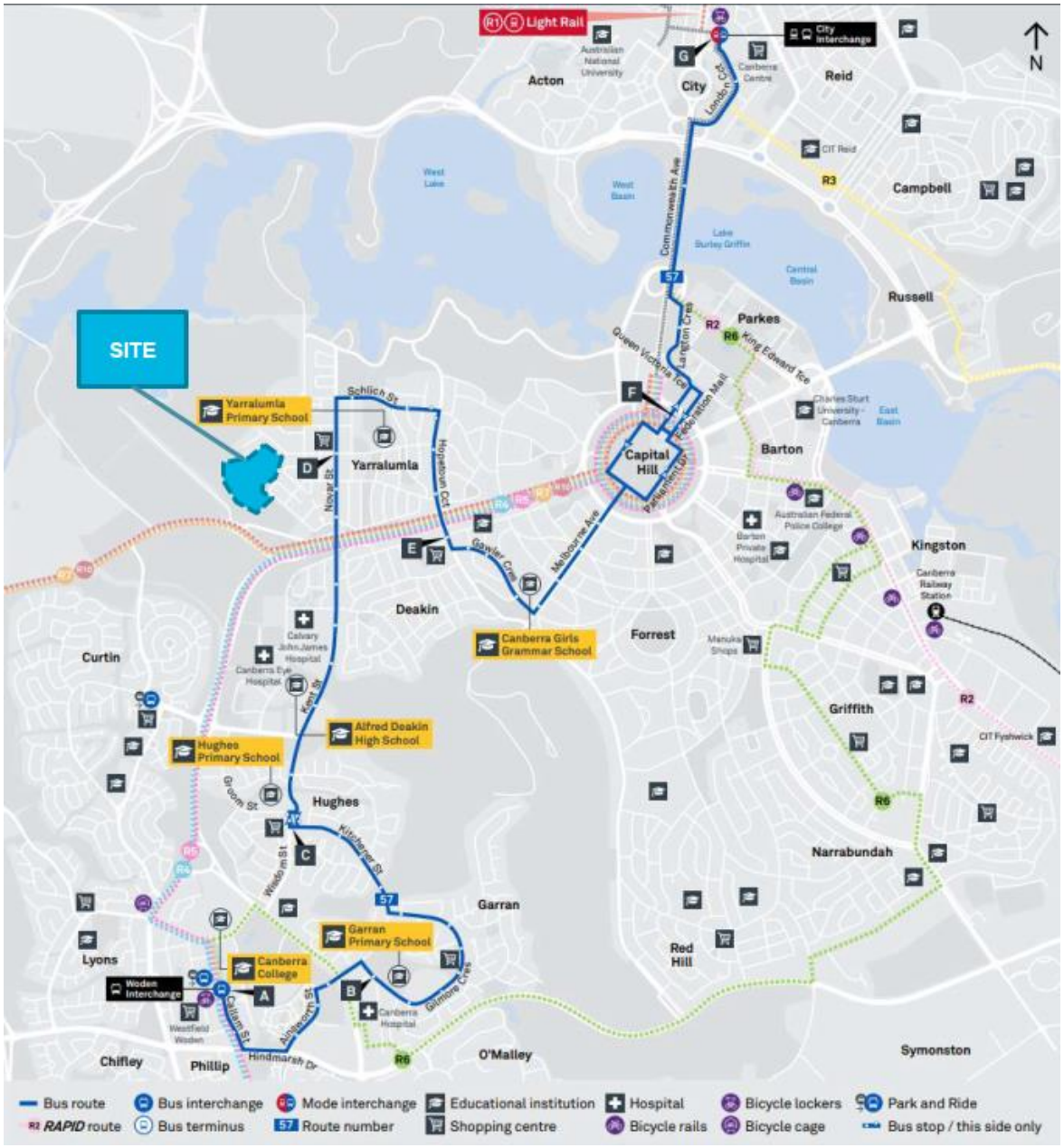


Figure 2.6 Public Transport Route for Yarralumla

This bus route has several stops along Novar Street, including next to the Yarralumla Shops and near Dudley Street, between Kintore Crescent and Abbot Street. These stops lie approximately 600m to 800m away from the Brickworks Precinct and are considered a long walk for residents to reach a local access route. Although not currently operating, it is also noted that a bus stop is present along either side of the newly constructed Dudley Street. This stop will be approximately 650m away from the site. Confirmation of a new route or relocation of an existing route is not available within the ACTION bus website, but when operational, this new stop is expected to service users of the Brickworks site.

2.4 Active Travel

Active infrastructure online tool was used to review the Yarralumla area. The suburb has an excellent provision of footpaths with almost all verges containing paths. The quality of these paths was observed to be reasonable, although areas of localised cracking are present.

On-road cycle lanes are provided along Cotter Road and Adelaide Avenue. With the recent construction of Dudley Street and Brickworks Way, several additional active travel routes are now also available for use to and from the proposed

Brickworks site. A shared path is present along the northern verge of Dudley Street, while smaller cycle paths are located along the southern verge and provides connection from the Cotter Road on-road cycle route. The recent upgrade to the Kent / Novar bridge intersections are also seen to provide further enhancement to the active travel amenity at this location. A summary of the active travel network can be seen below in Figure 2.7 noting the website has yet to update the changes on Dudley Street.

Figure 2.7 Active Travel Network (2022)

2.5 Crash Analysis

A recorded road crash data map from the 1st January 2015 to 31st December 2019 can be seen below in Figure 2.8. Through an analysis of the crash diagram, intersections with points of conflicted recorded the highest cluster of clashes. These points of conflict included the approach to Novar Street and Kent Street intersections. There are also a recorded cluster of clashes near the Yarralumla shops area, which is likely due to conflict of vehicles manoeuvring from the car parks. The highest severity of crashes recorded in the area was a fatal crash near the intersection of Strickland Crescent and Ken Street. There were also 36 injury crashes recorded, mostly occurring along Cotter Road, Novar Street and Kent Street.

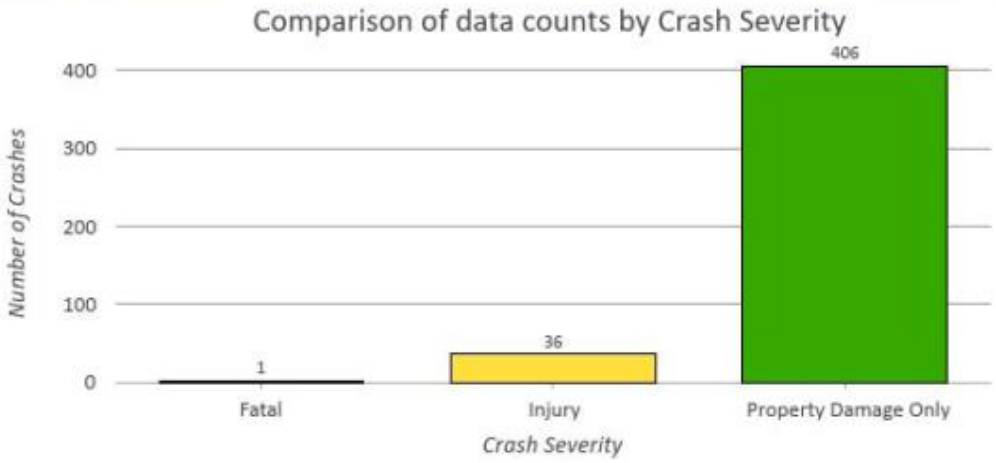


Figure 2.8 Yarralumla Road Crashes (2015-2019)

3. Proposed Site Development

3.1 Currently Proposed Layout

3.1.1 Land Use

An updated masterplan for the site has been prepared by DOMA in June 2022. This plan can be seen in Figure 3.1. This masterplan saw several changes to the size and quantity of land uses compared to the plans which were used within the AECOM report. A summary of the changes between the current and previous plans can be seen in Table 3.1.

This updated masterplan maintains the same total number of residential dwellings within the site, noting a cap of 380 dwellings. The key change is within the type of residential dwellings, seeing the new plan favouring the construction of 3-bedroom dwellings over the 1 and 2-bedroom apartments. The non-residential land uses within the site are also seen to change, with both type and sizes differing compared to the previous report.

Table 3.1 Yarralumla Brickworks Site Yield Comparison – Current Vs Previous

Land Use	Quantity (Current Plan)	Quantity (Previous Plan)	Difference
Houses (3+Bed)	22 dwellings	18 dwellings	+4 dwellings
Apartments	239 dwellings	303 dwellings	-64 dwellings
1-bed Apartment	*1 dwelling*	*5 dwellings*	*-4 dwellings*
2-bed Apartment	*140 dwellings*	*196 dwellings*	*-56 dwellings*
3-bed Apartment	*98 dwellings*	*102 dwellings*	*-4 dwellings*
Townhouse (3+bed)	119 dwellings	59 dwellings	+60 dwellings
Sub-Total	380 dwellings	380 dwellings	0 dwellings
Commercial (Office)	1,358 sqm	1,500 sqm	-142 sqm
Commercial (Non-Retail)	706 sqm	0 sqm	+706 sqm
Food / Beverage Space	1,830 sqm	1,320 sqm	+510 sqm
Fitness & Wellness Space (Indoor Recreation)	1,156 sqm	2,310 sqm	-1,154 sqm
Health Facility Space	1,836 sqm	795 sqm	+1,041 sqm
Speciality Retail	473 sqm	0 sqm	+473 sqm
Store (Retail)	265 sqm	0 sqm	+265 sqm
Sub-Total	7,624 sqm	5,925 sqm	+1,699 sqm

The measurement area for the non-residential land uses has been measured in Net Lettable Area (NLA) as opposed to the traditionally used Gross Floor Area (GFA) for the ground floor land uses. This change was adopted due to the thick external walls present within the heritage core buildings, with some walls having a thickness of up to 1m. As GFA is measured from the normal inside face of the exterior walls, the parking generation for the developments were viewed as overly conservative for the proposed land uses. With NLA, measurements are taken from the internal finished surface of the exterior walls. This allowed for the removal of the additional wall area and is viewed to provide a more accurate representation of the land usage. GFA was still used for the non-residential land uses for floors above ground level.

Figure 3.1 Proposed Brickworks Development

In addition to the commercial and residential land uses noted in the table above, the estate is also proposing the inclusion of several areas of parkland. These are noted as the Quarry Parkland and as The Remnants within Figure 3.1 above. These areas are expected to facilitate leisure activities for local residents of the estate and the nearby surrounding suburbs.

3.1.2 Access Locations

The main access to the proposed Brickworks development will be via the completion of Brickworks Way, which extends from the northern leg of the roundabout on Dudley Street. There will also be access to the development via Bentham Street and Denman Street, which will serve the townhouses and single residential lots on the east side of the site.

Service access is proposed via the extension of Brickworks Way. A central waste collection facility is proposed for both residential and commercial waste within the heritage precinct.

An edge road off Brickworks Way which runs along the south-eastern boundary of the development is proposed. This road is proposed to end in a cul-de-sac prior to intersecting with Denman Street however a fire access track will be included to allow direct access between Denman Street and Brickworks Way for emergency vehicles. Access to this fire access track will be restricted for public vehicles through the use of a ranger gate at the connection of the edge road to Denman Street. This physical barrier prevents though traffic from using this link to navigate through the suburbs and prevents any possible rat-running through the site. As through movements are not achievable along this road, the addition of this road to the development is not expected to impact the currently modelled traffic operations or performance through the surrounding road network. As such, no additional traffic assessment around this road has been completed.

3.2 Parking Requirements and Provision

3.2.1 Car Parking Supply

Based off the current layout of the Yarralumla Brickworks Precinct, the number of spaces to be provided for parking of both public and private vehicles is shown in Table 3.2 below.

Table 3.2 Parking Supply Summary for Yarralumla Brickworks

Parking Type	Quantity (Current Plan)	Quantity (Previous Plan)	Differences
Public Spaces (suitable for all visitors)	336 spaces	327 spaces	+9 spaces
Private Spaces (suitable for residents, staff, and visitors to houses)	1017 spaces	771 spaces	+246 spaces

For the private vehicle spaces associated with the residential developments, these are proposed to be located on-site through the use of garages, or internally within private basement carparks located directly below each precinct. Houses and townhouses (Precinct 2, 6 & 7) have been generally assumed to have 3 car garages, while the 2 and 3 bed apartments / townhouses are presumed to be provided 2 private parking spaces each and the single bed apartment is assumed to be provided a single parking space. The breakdown of private car parking spaces for each precinct can be seen within Table 3.3. This placement of the private parking spaces meets the locational requirements specified for residential dwellings within the PVAGC (*Section 3.1.5*).

Table 3.3 Parking Supply for Private Use within Precincts

Precinct	Dwellings	Private Use Parking Supply	Provision
Precinct 1	134	307 spaces	Shared basement carpark
Precinct 2	21	96 spaces	Internal personal garages
Precinct 3	22	77 spaces	Shared basement carpark
Precinct 4	44	92 spaces	Shared basement carpark
Precinct 5	40	215 spaces	Shared basement carpark
Precinct 6	28	68 spaces	Internal personal garages
Precinct 7	18	54 spaces	Internal personal garages
Precinct 8	10	20 spaces	Shared basement carpark
Precinct 9	41	Shared with Precinct 5	Shared basement carpark
House Blocks	22	88 spaces	Internal personal garages
Shared Basement Subtotal	*319*	*779 spaces*	
Personal Garage Subtotal	*61*	*238 spaces*	
Total	**380**	**1,017 spaces**	

For the public car spaces provided within the site, these spaces are provided within a public basement carpark located under Precinct 3. This public access carpark is designed to accommodate the visitor parking requirements for the Heritage Core, as well as the apartment and townhouse dwellings located within Precincts 1, 3, 4, 5, 8, and 9.

As per the PVAGC, visitor parking within a CZ6 zone is required to be within 200m of the sites it is servicing. This proximity is achieved by the Heritage Core area. For the residential land uses, visitor parking is required to be within 100m of the site. This is achieved by all the dependent Precincts. The distance limitations for public parking placement for each of the sites has been shown within Figure 3.2 below.

It is noted that the visitor parking provisions for the single residential lots (houses), the townhouses within Precinct 2, and the terrace housing within Precincts 6 and 7 are expected to be provided internally within each premise. All of these dwellings are proposed to have private garages accessible from either a public road or non-gated laneway, and have allowance for additional garage space beyond the required parking rate specified by the PVAGC. Due to these additional garage spaces, it is assumed that visitor parking can be accounted for within the premises, and so does not require additional public parking spaces elsewhere within the site. The visitor parking for these residences has therefore not been included within this parking assessment.

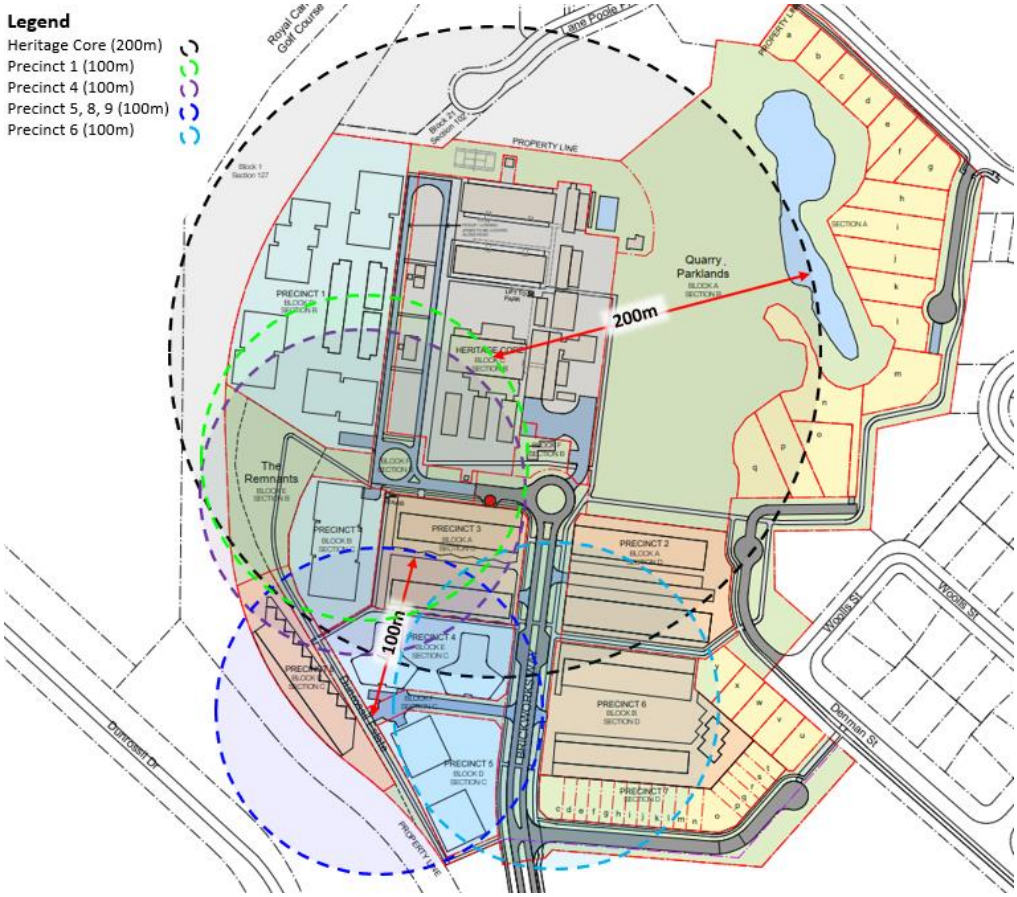


Figure 3.2 Serviceable Radius for the Public Basement Carpark

3.2.2 Car Parking Requirement

The car parking provision requirements for various types of developments are detailed in Parking and Vehicular Access General Code (PVAGC) included within the Territory Plan. Although residential development is permitted in a CZ6 zone, no specific rates for parking are provided in the code. As such, the proposed development was designed using the standard residential parking rates from the PVAGC (*Section 3.1.5*), which are accepted as the general parking rates for residential dwellings in the ACT. The rates used are the same that were used in the Memo by Calibre and are outlined below.

Houses, Townhouses, and Apartments

- 1 space per single bedroom dwelling
- 1.5 spaces per two-bedroom dwelling
- 2 spaces per three or more-bedroom dwelling
- 1 visitor space per four dwellings

Commercial (Office, Agency, and Non-Retail Commercial)

- 2.5 spaces per 100 sqm NLA

Food and Beverage

- 10 spaces per 100sqm NLA

Fitness and Wellness (Gym) & Health Centre

- 3.5 spaces per 100sqm NLA

Retail (Speciality & Store)

- 3 Spaces per 100sqm NLA

Based off these above rates, the total required parking spaces for the developments within the Yarralumla Brickworks site have been calculated as per Table 3.4. Due to the increased allowance for garage parking spaces provided for townhouse developments, it has been assumed that all associated visitor parking can be housed internally as part of their personal parking space allowance. As such, these volumes are not included within the total public parking requirements for the site.

Table 3.4 Car Parking Requirements

Land Use	Parking Rate	Current Plan		Previous Plan	
		Yield	Spaces	Yield	Spaces
Private Parking Spaces					
House (3-bed)	2 spaces / dwelling	22 dwellings	44 spaces	18 dwellings	36 spaces
Apartments (1-bed)	1 spaces / dwelling	1 dwelling	1 space	5 dwellings	5 spaces
Apartments (2-bed)	1.5 spaces / dwelling	140 dwellings	210 spaces	196 dwellings	294 spaces
Apartments (3-bed)	2 spaces / dwelling	98 dwellings	196 spaces	102 dwellings	204 spaces
Townhouses (3-bed	2 spaces / dwelling	119 dwellings	238 spaces	59 dwellings	118 spaces
Private Subtotal			**689 spaces**		**657 spaces**
Visitor Parking Spaces					
Apartment Visitors	0.25 spaces / dwelling	239 dwellings	60 spaces	303 dwellings	76 spaces
Townhouse Visitors*	0.25 spaces / dwelling	80 dwellings	20 spaces	59 dwellings	15 spaces
Commercial (Office)	0.025 spaces / sqm	1,358 sqm	34 spaces	1,500 sqm	38 spaces
Commercial (Non-Retail)	0.025 spaces / sqm	706 sqm	18 spaces		
Food / Beverage	0.1 spaces / sqm	1,830 sqm	183 spaces	1,320 sqm	132 spaces
Fitness & Wellness / Health Centre	0.035 spaces / sqm	2,992 sqm	105 spaces	2,310 sqm	81 spaces
Medical Health Facility	4 spaces / practitioner	N/A	N/A	795 sqm (~8 practitioners)	32 spaces
Specialty Retail	0.03 spaces / sqm	473 sqm	15 spaces	N/A	N/A
Store (Retail)	0.03 spaces / sqm	265 sqm	8 spaces		
Public subtotal			**443 spaces**		**374 spaces**
Development Total			**1,132 spaces**		**1,031 spaces**

**Townhouses and Terrace houses within Precincts 1, 3, and 8 require visitor parking*

For this assessment, the number of practitioners associated with the currently proposed health centre are not known, and so the heath facility rate for commercial zones of 3.5 spaces per 100 sqm has instead been adopted.

It is noted that the above calculations for car parking requirements do not include any car parking allowance for visitors to the Quarry Park or Remnants Park present within the site. These areas are to be classified as Minor Use areas, and operate as incidental to the rest of the Brickworks development. No specific rate for Parkland or Minor Use is advised within the PVAGC for any zone, with both listed as "subject to individual assessment".

Given the location and layout of these two parks, it is expected that any usage of these areas will be either from residents of the estate or nearby suburbs, or from visitors to the heritage core area. These usages are not expected to generate any additional vehicle trips through the network, or require any additional carparks to what has already been provided for residential and commercial land uses. As such, it has been concluded that the Brickworks development is not required to provide separate parking spaces for the community parklands.

3.2.3 Car Parking Provision and Adequacy

Table 3.5 Summary of Parking Supply and Requirement (Maximum – No Temporal Analysis)

Land Use	Car Park Requirement	Car Park Supply	Difference
Private Parking			
Precinct 1	*234*	*307*	*+73*
Precinct 2	*42*	*96*	*+54*
Precinct 3	*44*	*77*	*+33*
Precinct 4	*75*	*92*	*+17*
Precinct 5	*68*	*215*	*+77*
Precinct 6	*56*	*68*	*+12*
Precinct 7	*36*	*54*	*+18*
Precinct 8	*20*	*20*	*0*
Precinct 9	*70*	*Shared with Precinct 5*	
Houses	*44*	*88*	*+44*
Sub-Total	**689**	**1017**	**+328**
Public Parking	435	336	-99
TOTAL	**1,124**	**1,353**	**+229**

From Table 3.5 above, it can be seen that there are 328 additional parking spaces for the residential land uses, which is a commercial decision to supply more storage for cars, bicycles, and other uses. As mentioned earlier, the excess storage of the houses and townhouses that is provided by their garages will be acceptable for use by the visitors to these dwellings, provided the garages are not located along gated laneways. As such, the visitors for all housing blocks and the dwellings within Precincts 2, 6, and 7 have not been included in the total public parking requirements.

When considering the requirements for all land uses independently, it can be seen that all the private car parking provisions are expected to meet or exceed the required number of parking spaces. As such, all basement carparks specified for private use are considered suitable as per the PVAGC.

There is however a deficit of 99 parking spaces within the proposed development for the publicly available parking spaces as per the PVAGC rates. The public parking requirement for each of the land uses throughout the estate are however not expected to be operating at 100% capacity at all periods of the day. To identify the maximum expected parking requirement at any given time of a typical day, Calibre has completed a temporal profile analysis for all the key land uses within the Brickworks development. The temporal graph for this can be used as seen below in Figure 3.3.

The expected parking demand for these sites was calculated hourly over a typical day based on parking usage trends observed for similar land uses within other sites. These trends are consistent with what was adopted within the previous AECOM temporal analysis.

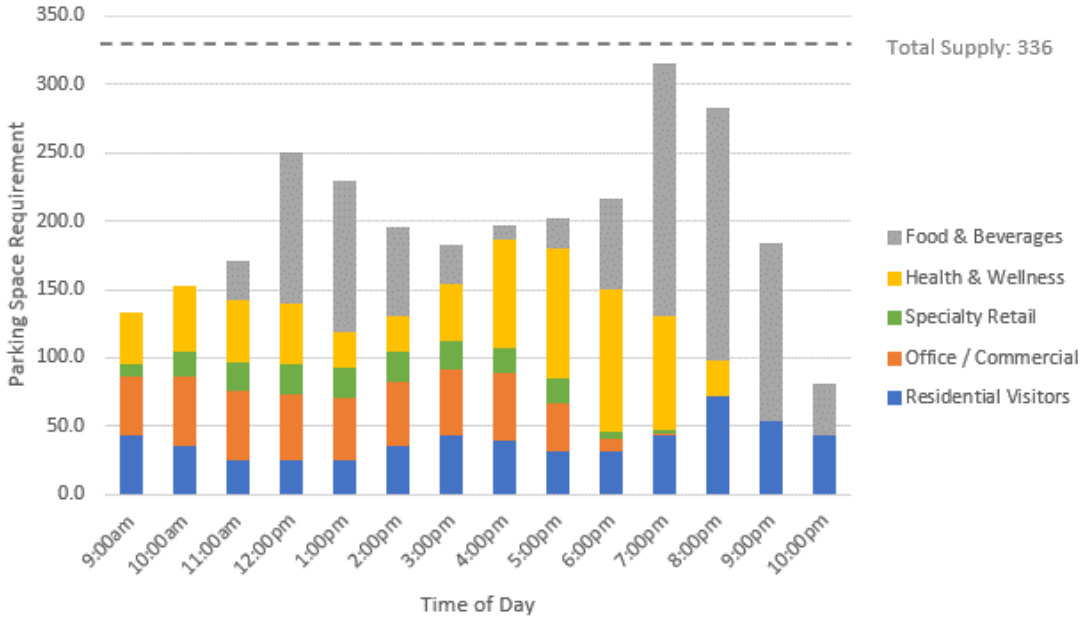


Figure 3.3 Temporal Profile for Public Parking Requirements within the Development

When considering the temporal parking demand, it is estimated that the peak demand will occur at 7:00pm for the site and require a total of 315 public parking spaces across the site. This results in a surplus of 21 public parking spaces during the peak usage period. As such, the current public parking quantities are viewed as appropriate to cater for site demands at any period of the day. A summary of this can be seen in Table 3.6.

Table 3.6 Summary of Parking Supply and Requirement (Temporal Analysis Rates)

Land Use	Car Park Requirement	Car Park Supply	Difference
Private Parking			
Precinct 1	*234*	*307*	*+73*
Precinct 2	*42*	*96*	*+54*
Precinct 3	*44*	*77*	*+33*
Precinct 4	*75*	*92*	*+17*
Precinct 5	*68*	*215*	*+77*
Precinct 6	*56*	*68*	*+12*
Precinct 7	*36*	*54*	*+18*
Precinct 8	*20*	*20*	*0*
Precinct 9	*70*	*Shared with Precinct 5*	
Houses	*44*	*88*	*+44*
Sub-Total	**689**	**1,017**	**+328**
Public Parking	315	336	+21
TOTAL	**1,004**	**1,353**	**+349**

3.2.4 Accessible Car Parking Requirements

Accessible Parking needs to be provided within the site as per the ACT Parking and Vehicular General Code (PVAGC). From this document, a rate of 3% of the applicable parking demand is required to be suitable for accessible parking. This requirement does not apply to any of the residential parking or residential visitor parking provided within garages, as these spaces are the subject to the adaptable housing requirements. As such, this requirement only applies to the public parking demand for the site. Given the maximum requirement of 315 spaces required for the site, a total of 10 disability accessible parking spaces are required. At present, 10 accessible parking spaces have been allowed, meaning the design complies with the minimum requirements of the PVAGC.

3.2.5 Motorcycle Car Parking Requirements

The PVAGC states that parking for motorcycles must be provided at a rate of 3% with a minimum provision of 1 motorcycle parking space within a carpark with 30 or more car spaces. For residential parking on site, each dwelling has been allowed dedicated parking spaces which could be utilised for storing either a car or a motorcycle. As such, no dedicated motorcycle parking is deemed as required in addition to the current proposed parking spaces. For publicly available parking, the parking allowance of 3% was used and 10 motorcycle parking spaces are required in the development.

3.2.6 Active Travel End of Trip Requirements and Provision

Since the completion of the previous AECOM assessment of this site, an update to the bicycle parking code has been undertaken. This update has resulted in the previously used Bicycle Parking General Code (BPGC) being superseded by the End of Trip Facilities General Code (EOTFGC) as of November 2022. This results in different rates and requirements than what was previously allowed, including allowance for shower and storage locker facilities in addition to bicycle parking provisions.

3.2.6.1 Bicycle Parking Requirements

As mentioned above, the rates used to calculate the bicycle parking have been adapted from the EOTFGC. They can be found below:

Houses & Townhouses

- Not required to meet the EOTFGC (code does not apply to single residential dwellings)

Apartments

- 1 long-stay space per 1 and 2-bedroom apartments
- 2 long-stay spaces per 3+ bedroom apartments
- 1 short-stay space per 10 apartments

Commercial (Office and Non-Retail)

- 1 long-stay space per 250 sqm NLA
- 1 short-stay space per 400 sqm NLA

Food and Beverage

- 1 long-stay space per 150 sqm NLA
- 1 short-stay space per 150 sqm NLA

Health Facility

- 1 long-stay space per 1,500 sqm NLA
- 1 short-stay space per 75 sqm NLA

Indoor Recreation Facility

- 1 long-stay space per 3,000 sqm NLA
- 1 short-stay space per 150 sqm NLA

Retail

- 1 long-stay space per 250 sqm NLA
- 1 short-stay space per 150 sqm NLA

A summary of how the bicycle parking requirements apply to the proposed development is presented in Table 3.7 (long-stay parking) and Table 3.8 (visitor parking) below.

Table 3.7 Long-Stay Bicycle Parking Requirements – Current Plan vs. Previous Plan

Land Use	Parking Rate (EOTFGC)	Current Plan (EOTFGC)		Previous Plan (BPGC)	
		Yield (NLA)	Spaces	Yield	Spaces
Residential Dwellings					
Apartments				303 dwellings	303 spaces
1-bed	*1 per dwelling*	*1 dwelling*	*1 space*		
2-bed	*1 per dwelling*	*140 dwelling*	*140 spaces*		
3-bed	*2 per dwelling*	*98 dwelling*	*196 spaces*		
		Sub-Total	**337 spaces**		**303 spaces**
Non-Residential Land Use					
Commercial	1 per 200 sqm NLA	1,754 sqm	9 spaces	1,500 sqm	5 spaces
Food / Beverage	1 per 150 sqm NLA	1,740 sqm	12 spaces	1,320 sqm	3 spaces
Health Facility	1 per 1,500 sqm NLA	1,696 sqm	1 space	795 sqm	1 space
Indoor Recreation	1 per 3,000 sqm NLA	983 sqm	1 space	2,310 sqm	Nil
Retail	1 per 250 sqm NLA	698 sqm	3 spaces	0 sqm	0 spaces
		Sub-Total	**26 spaces**		**9 spaces**
Total			**363 spaces**		**312 spaces**

Table 3.8 Visitor Bicycle Parking Requirements – Current Plan vs. Previous Plan

Land Use	Parking Rate (EOTFGC)	Current Plan (EOTFGC)		Previous Plan (BPGC)	
		Yield (NLA)	Spaces	Dwellings	Spaces
Visitor Bicycle Parking Spaces					
Apartment Visitors	1 per 10 dwellings	239 dwellings	24 spaces	303 dwellings	25 spaces
Commercial	1 per 400 sqm NLA	1,754 sqm	5 spaces	1,500 sqm	2 spaces
Food / Beverage	1 per 150 sqm NLA	1,740 sqm	12 spaces	1,320 sqm	6 spaces
Health Facility	1 per 75 sqm NLA	1,696 sqm	23 spaces	8 practitioners	2 spaces
Indoor Recreation	1 per 150 sqm NLA	983 sqm	7 spaces	81 car spaces	10 spaces
Retail	1 per 100 sqm NLA	698 sqm	5 spaces	0 sqm	0 spaces
Total			**76 spaces**		**45 spaces**

From these tables it can be seen that the change in code and updated land use layout result in an increase to both the long-stay and visitor parking spaces required within the development site. For the long-stay parking, a total of 363 spaces are required within the site. These spaces are required to be provided to security level A or B, as defined in Table 1.1 of *AS 2890.3 Bicycle Parking*. This level of security required either an individual locker with a high security locking mechanism, or a secure weatherproof structure with self-closing, self-locking gate (for communal use).

For the residential apartment parking, it is assumed that these spaces shall be provided within the personal storage cages provided for each apartments use, and as such should be met to a suitable degree by the development. For the non-residential land uses associated with the Heritage Core area, the 28 bicycle spaces required are proposed to be provided within a communal bicycle storage area within the H15 building. This area provides space for all 28 bicycle spaces and so meets the requirements of the EOTFGC.

For the visitor bicycle parking, a total of 76 spaces are required within the site. These spaces require a lower level of security compared to the long-stay spaces, needing security level C as defined within Table 1.1 of *AS 2890.3 Bicycle Parking*. This level required a space which is suitable to allow the bicycle frame and both wheels to be locked to a parking device with the owners own locking device (such as a bicycle rail).

It is recommended that 38 bicycle rails, each appropriate for use by two visitor bicycles to be locked up, be provided within proximity to the Heritage Core and residential apartment complexes to cater for the visitors to these locations. These spaces should be located in well-lit areas, and in areas where passive surveillance is likely.

As the Brickworks is being developed to encourage active travel through the area, there is a commitment for the development to contain additional parking allocations for bicycles over the required generation listed above.

3.2.6.2 End of Trip Facilities

In addition to the above advised bicycle parking spaces, end of trip facilities are required to be provided within the development for use by long-stay active travel users. These facilities are expected to include showers, changerooms, toilets, and lockers. Due to the nature of multi-unit housing, with internal shower facilities available within each dwelling, there is no requirement within the EOTFGC to provide shower and change facilities for this land use. As such, the apartment complexes within the Brickworks are not required to meet these provisions. The non-residential land uses are still required to provide facilities as per the below specified rates:

- One shower facility for the first 5 long stay spaces, then an additional shower for every 10 long stay spaces thereafter (number to be rounded up to nearest even number, allowing for equal male and female facilities).

- A minimum of one change room is provided per shower as a combined shower/change room, or direct access to a communal change room is provided.
- A minimum of one toilet, wash basin and drying area to be provided per shower and change facility.
- Two personal storage facilities (lockers) for every long stay space.

Based on the above rates and assumptions, a summary of the quantity of end of trip facilities required for the site can be seen within Table 3.9.

Table 3.9 Shower and Change Facility Requirements Summary

Land Use	Long Stay Spaces	Showers & Changerooms		Storage Lockers	
		Rate	Yield	Rate	Yield
Non-Residential Land Use	26 spaces	1 for first 5 long-stay spaces, then 1 per 10 spaces thereafter	4 showers	2 per long-stay space	52 lockers

As can be seen in the above table, four shower and change facilities are required to cater for the active travel users associated with the Heritage Core area. As per the code, these amenities must be evenly distributed between male and female facilities (i.e. two male and two female shower and changerooms). At least one toilet is required within each of the male and female facilities, unless separate toilet facilities are already included at a convenient location for use by these changerooms. The 56 lockers required for use by these facilities should also be located within close proximity of the bicycle parking area and changerooms. These facilities are expected to be provided within the H15 building along with the long stay bicycle parking spaces in a quantity that meets code requirements.

3.2.7 Parking Allowance for Delivery and Removalist Vans

As per Rule 85 of the Multi Unit Housing Development Code within the Territory Plan, there is a requirement for developments with 40 or more dwellings to allow for at least one short stay parking space and associated access for delivery trucks. This is proposed to be provided independently for each of the precincts which meet this criterion through on-street parking spaces present along Brickworks Way.

Based on the current dwelling volumes for each precinct, this rule is expected to be applicable to Precincts 1, 4, 5, and 9. An allowance for one space suitable for delivery truck usage is required for each affected Precincts. Given the proximity of Precincts 5 and 9 however, it is assumed that a single truck space is acceptable to service both sites. As such, a total of 3 truck-suitable on-road parking spaces are required.

3.2.8 Service Access and Delivery

As per Rule 22 of the Commercial Zones Development Code within the Territory Plan, there is a requirement for commercial zones to provide goods loading and unloading facilities that are located within the site and allow for service vehicles to enter and leave the site in a forward direction. This is a requirement for the Heritage Core land uses, and is proposed to be met by the loading and unloading dock present at the southeast of the Heritage Core. This dock is accessible off the northern Brickworks Roundabout, and allows for forward entry and exit of a single unit truck. Details into the vehicle movement can be seen within DWG 18-01 of the Civil drawing set.

This arrangement is viewed as suitable to meet this criterion for the Heritage Core.

4. Traffic Analysis

4.1 Study Area Definition and Consideration

The Aimsun modelling extents were determined based on TCCS requirements to include the internal Yarralumla road network, as advised to AECOM within 2020. This extent aims to provide commentary on the impact of not just the major roads, but also the local access roads within the suburb of Yarralumla. As such, greater commentary on the performance impacts for local residents could be provided. The extent of the modelling is shown in Figure 4.1 below.

As the 2017 survey count data and the COVID impacted 2020 survey count data were unlikely to correlate at the interface between the two data sets, TCCS agreed to reduce the calibration requirements. The agreement involved ensuring that the core 2017 site area (2017 Aimsun Base Model) met the calibration criteria for these intersections as per the ACT Microsimulation Modelling Guidelines. The COVID impacted 2020 demands were scaled up to meet the 2017 demands ensuring a conservative base demand volume.

Figure 4.1 Yarralumla Brickworks Aimsun Model Area

4.2 Traffic generation

Traffic Generation for this development has been calculated based on the aforementioned development yields combined with trip generation rates provided within the *ACT Estate Development Code* Table 2A notes. This document states that for residential and CZ5 zones, a generation rate of 6 vehicles per day per dwelling is expected for multi-unit developments, and a generation rate of 7 vehicles per day per dwelling where the blocks are less than 360sqm. Although the zoning for

this site is primarily classified as CZ6: Leisure and Accommodation Zone, the high quantity of residential dwellings proposed within the estate is expected to operate in a similar manner to residential zones, and as such these rates were deemed as acceptable.

A 10% peak hour factor was adopted for these developments in both commuter peak periods, as identified in *RTA Guide to Traffic Generating Developments (2002)*. As such, in both AM and PM peak periods, hourly trip generation rates of 0.6 and 0.7 vehicles per dwelling were adopted for apartments and townhouses, respectively. It is noted that rates for townhouses and houses adopted within the initial AECOM assessment are slightly higher than what has been assumed within this assessment. The previously adopted generation rate was 0.85 vehicles per hour per dwelling for both houses and townhouses. This rate is taken from Section 3.3.1 of the *RTA Guide to Traffic Generation Developments,* which details the rate for dwelling houses. This rate was viewed as conservative given the expected behaviour of vehicles from the houses and townhouses, and as such the rates outlined in the *ACT Estate Development Code* were adopted instead. The apartment rate was the same between assessments.

The traffic generation for the non-residential development areas was determined based upon rates *RTA Guide to Traffic Generating Developments* Version 2.2. These rates match what was used within the previous assessment:

- A trip rate of 2 vehicles per 100 sqm NLA in a peak hour was applied to the commercial/office NLA as per the RTA Guide.
- A trip rate of 5 vehicles per 100 sqm NLA in a peak hour was applied to the food and beverage NLA as per the restaurant rate in the RTA Guide.
- A trip rate of 3 vehicles per 100sqm NLA in a peak hour was applied to the fitness and wellness NLA as per the gymnasium rate in the RTA Guide.
- A trip rate of 10.4 vehicles per 100sqm NLA in a peak hour was applied to the health facility NLA as per the extended hours medical centre rates in the RTA Guide.
- A trip grate of 4.6 vehicles per 100sqm NLA in a peak hour was applied to the specialty store NLA as per the shopping centre rates breakdown for a Thursday specified in the RTA Guide.

The traffic generation for each of the land uses being developed can be seen in Table 4.1.

Table 4.1 Traffic Peak hour Generation

Land Use	Units	Current Plan			Previous Plan		
		Yield	Hourly Rate	Trips	Yield	Hourly Rate	Trips
Houses	dwellings	22	0.8	18 vph	18	0.85	15 vph
Townhouses	dwellings	119	0.7	84 vph	59	0.85	50 vph
Multi-Unit (Apartments)	dwellings	239	0.6	143 vph	303	0.6	182 vph
Commercial (Office, Agency, and Non-Retail)	sqm	2,064	0.02	41 vph	1,500	0.02	30 vph
Food and Beverage	sqm	1,830	0.05	91 vph	1,320	0.05	66 vph
Fitness and Wellness	sqm	2,992	0.03	90 vph	2,310	0.03	69 vph
Medical Facility	sqm	0	N/A	0	795	0.104	83 vph
Retail	sqm	738	0.046	34 vph	0	N/A	0
TOTAL	-	-	-	**501 vph**			**495 vph**

The changes to the development layout and utilised rates result in an increase of 6 vehicles per hour in the current plan compared to the previous yields and assessment. As the volume of traffic within the network has only increased by a minute amount, the expected performance of the network is not expected to worsen, and it was not deemed as necessary to undertake additional traffic impact modelling for the surrounding road network.

The assumptions surrounding traffic distribution and route selection from the site through the network are consistent with the previous AECOM report, as no major changes to the road network or conditions surrounding the site are expected. The previous assessment included the future case with the recently constructed Dudley Street upgrade and Kent/ Novar upgrades about to commence construction.

4.3 Traffic Distribution

There has been no changes to the trip distribution since the previous AECOM report therefore, the percentages derived have been kept the same for this section.

The trip distribution assigned to the site generated traffic was determined using existing turning movement patterns and the 2016 Australian Bureau of Statistics (ABS) journey to work data. For a driver of a vehicle from the Yarralumla area to their destination of full-time work is split between the key areas within the ACT as follows:

Table 4.2 Work Trip Distribution

Destination	Percentage Split
Belconnen	8%
City North and Canberra South	46%
Gungahlin	1%
Woden/Tuggeranong	45%

Given the journey to work data the following percentage splits in Table 4.3 were used in the Aimsun model, created by AECOM, to each key destination point. Calibre have reviewed these and find them appropriate.

Table 4.3 Traffic Distribution Percentage Splits

Destination	Percentage Split
Novar Street	5%
Adelaide Avenue	27%
Cotter Road East	17%
Cotter Road West	19%
Kent Street	32%

The In and Out splits for the Brickworks site land uses are summarised below in Table 4.4

Table 4.4 In and Out Peak Hour Distribution

Land Use	AM PEAK		PM PEAK	
	IN	OUT	IN	OUT
Residential	20%	80%	80%	20%
Commercial (office)	80%	20%	20%	80%
Commercial (Agency)	80%	20%	20%	80%
Fitness and Wellness	50%	50%	50%	50%
Food and Beverage	50%	50%	70%	30%

Applying the distributions results in the inbound and outbound movement for the AM and PM peaks as outlined in Table 4.5 and

Table 4.6 respectively.

Table 4.5 AM Peak Hour Traffic Generation

AM Peak Hour Traffic Generation					
Land Use	Traffic Rate (vph)	In %	Out %	In	Out
Houses	18	20	80	4	14
Apartments	143	20	80	29	114
Townhouses	84	20	80	17	67
Commercial	41	80	20	33	8
Food and Beverage	91	50	50	46	45
Fitness and Wellness	90	50	50	45	45
Retail	34	70	30	24	10
Total	**501**	**-**	**-**	**198**	**303**

Table 4.6 PM Peak Hour Traffic Generation

PM Peak Hour Traffic Generation					
Land Use	Traffic Rate (vph)	In %	Out %	In	Out
Houses	18	80	20	14	4
Apartments	143	80	20	114	29
Townhouses	84	80	20	67	17
Commercial	41	20	80	8	33
Food and Beverage	91	70	30	64	28
Fitness and Wellness	90	50	50	45	45
Retail (Speciality)	34	30	70	10	24
Total	**487**	**-**	**-**	**322**	**180**

4.4 Traffic Modelling

There have been several iterations of the traffic modelling for the Yarralumla area near the Brickworks Precinct. The initial traffic modelling was undertaken by AECOM as part of the Yarralumla Brickworks Traffic and Parking Report (April 2021). The traffic modelling for this report consisted of an AIMSUN microsimulation model and was last updated in October 2020. As such, the model did not account for the changes to the development yield of the site shown in the January 2021 Brickworks Masterplan, or changes in the design of the three intersections along Kent Street and Novar Street which are now being adopted. The extent of this model can be seen in Figure 4.2 and the results can be seen in Appendix B.

In March 2021, AECOM prepared a new AIMSUN traffic model for the Yarralumla area. The extent of the road network modelled was the same as that adopted in the previously mentioned modelling for the Yarralumla Brickworks. The purpose of this new model focussed on the upgrade of the three intersections along Kent Street and Novar Street, and finalised intersection layouts for each. It is noted that as this modelling was not completed as part of the Brickworks Precinct development, it did not account for the changes in the updated masterplan, and instead assumed the same traffic volumes and percentage splits used for the previous modelling.

No additional modelling was undertaken as part of this assessment of the works. Instead, the modelling results from the Kent Street / Novar Street Intersection Upgrade report have been assumed to be an acceptable representation of the road network and traffic conditions surrounding the site. A summary of the model development, calibration and results is provided in the sections below.

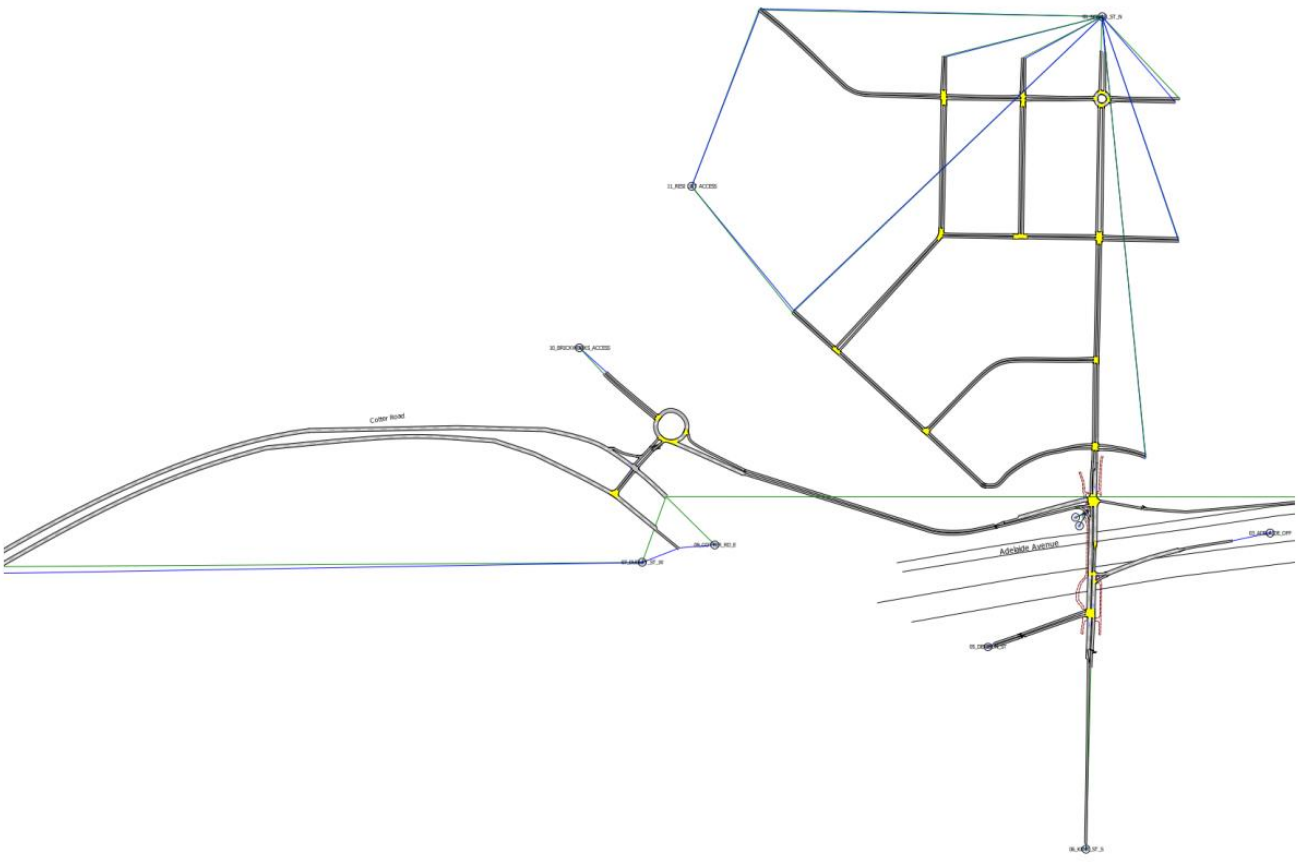


Figure 4.2 Yarralumla Brickworks Aimsun Network

4.4.1 Traffic Model Development

The traffic model prepared for 2020 AECOM Report on Yarralumla Brickworks was a 3-hour model, consisting of the peak hour and one hour either side of this. As generation rates not measured in the survey were only for the peak hour period, the distribution of these volumes throughout the time period was assumed to be 100% in the peak period, then 50% in each

of the hours surrounding the peak. This is considered appropriate and generates a 'shoulder peak' where the network preloads vehicles. The base traffic volumes throughout the road network were adopted from the 2017 traffic count volumes, as the impact of COVID-19 on the 2020 traffic volumes was seen to reduce travel through the road network significantly. Although the volumes of the 2020 traffic counts were not used, the percentage of traffic travelling between each of the traffic generators was adopted as per this data.

For the more recent Kent Street Design modelling, the abovementioned 2020 AECOM traffic modelling was used as the base. Existing conditions and model criteria were assumed to be the same between these two models, and as such the calibration for the earlier assessment is also assumed to apply for the later model as well. The data on the forecasted traffic volumes in future years was reviewed as part of this updated traffic forecasts for Kent-Novar intersections. This review allows for consideration of the network post construction of the Cotter Road duplication and the updated Canberra Strategic Model (CSTM) forecasts. It provides better certainty on the future traffic volumes to the community and other stakeholders. The future model outputs have also been revised to align with current TCCS requirements which were not developed at the time of the previous works. Details of the changes between the two model criteria can be found in the TIPA reports for each of the sites, attached in Appendix A and Appendix B.

The focus of these traffic works is the optimisation of the future layout determined by a through optioneering design process. The base calibration previously approved by the TCCS, and the process and count information remain valid for these works.

These refined forecast values were used to assess the concept suitability in line with the civil constraints and safety considerations. This will help ensure a safe, efficient design. The review indicated that most approaches have a slightly higher volume than the previous projections.

4.4.1.1 GEH Results

The traffic modelling package used to assess this job is Aimsun Next. An origin destination matrix was developed based on turning count data. At the key intersections outlined in Figure 4.3, the model achieved the GEH results outlined in Table 4.7 and Table 4.8 in the AM and PM peak periods respectively. These align with the GEH targets outlined in the *ACT Traffic Microsimulation Modelling Guidelines.*

Figure 4.3 Model Calibration Area

Table 4.7 AM Model Calibration Area GEH Results

Time Period	Number of Turns	Number of Turns with GEH<5	Number of Turns with GEH<10
7am-8am	23	23 (100%)	23 (100%)
8am-9am	23	20 (87%)	23 (100%)
9am-10am	23	22 (96%)	23 (100%)

Table 4.8 PM Model Calibration Area GEH Results

Time Period	Number of Turns	Number of Turns with GEH<5	Number of Turns with GEH<10
3:30pm4:30pm	23	22 (96%)	23 (100%)
4:30pm-5:30pm	23	23 (100%)	23 (100%)
5:30pm-6:30pm	23	23 (100%)	23 (100%)

4.4.1.2 R2 Value

Figure 4.4 shows that the AM peak R2 values are between 0.97 and 0.98 for the core calibration area. Similarly, for the PM peak, the R2 values for the core calibration area are between 0.98 and 0.99. This also meets the R2 target outlined in the *ACT Traffic Microsimulation Modelling Guidelines* where the required value is greater than 0.95.

AM Peak

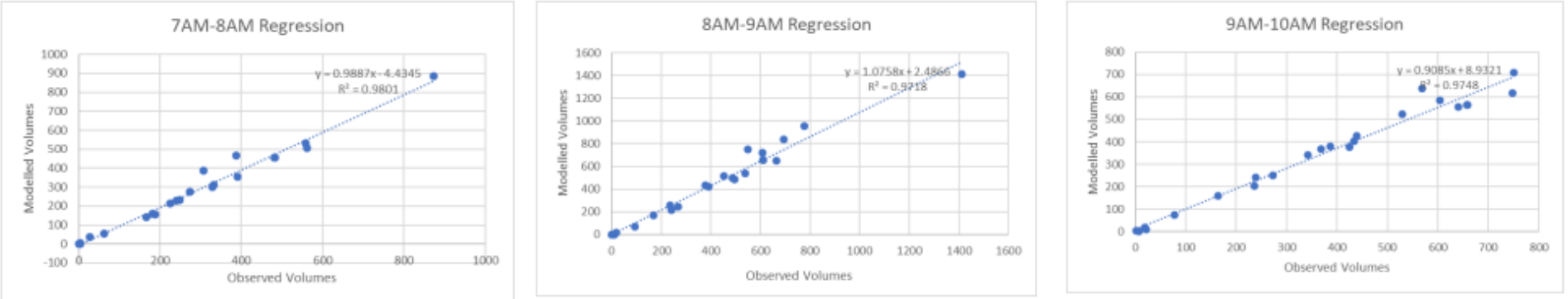


Figure 4.4 AM Peak Base R2 Plot

PM Peak

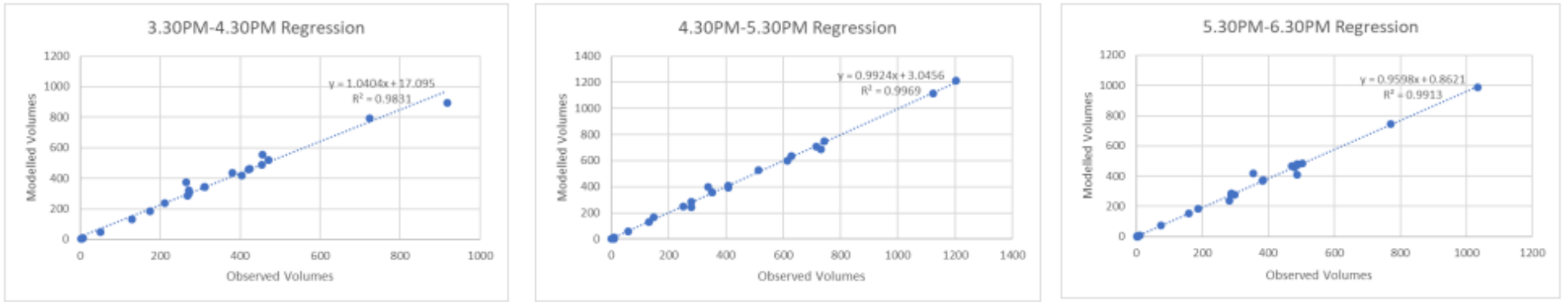


Figure 4.5 PM Peak Base R2 Plot

4.4.1.3 Base Model Stability

A summary of the model stability analysis, comparing the stability of the base model between seed value is shown in Table 4.9.

The model stability is analysed by comparing differences in travel times, measured in vehicle hours travelled (VHT), between seed runs based on the "coefficient of variation" metric, where a variation of less than 5% is considered to indicate a good level of stability. The stability analysis shows that the coefficient of variation is 4% and 3% for the AM and PM periods, respectively.

Therefore, it is considered that both the AM and PM periods are stable and can reliably be used to forecast future scenarios.

As outlined previously, seed number 86524 showed an unusual "lock-up" at the Dudley Street / Novar Street roundabout and hence was omitted from the modelling results in the AM peak period.

Table 4.9 Model Stability Analysis – Base Model

VHT	Seed 28	Seed 560	Seed 2849	Seed 7771	Seed 86524	Avg	Standard Deviation	Coefficient of Variation
AM Peak	495.11	747.74	456.05	454.23	N/A	470.03	13.12	4%
PM Peak	285.32	271.52	284.59	285.59	293.07	284.02	7.79	3%

Table 4.10 Model Stability Analysis – Future Model

VHT	Seed 28	Seed 560	Seed 2849	Seed 7771	Seed 86524	Avg	Standard Deviation	Coefficient of Variation
AM Peak	949.56	958.83	949.57	1005.11	964.44	956.50	26.59	3%
PM Peak	615.05	595.27	616.65	666.85	640.65	626.89	27.53	4%

4.4.2 Traffic Growth Rate

For the forecast modelling undertaken, a growth rate of 1.3% has been used. This growth rate has been based on three alternative approaches which are detailed in the AECOM report. A summary of the approaches is shown in Table 4.11. Based on the review of the various approaches and datasets a rate of 1.3% was chosen per annum between 2016 and 2031.

Table 4.11 Summary of approaches to forecast growth rate

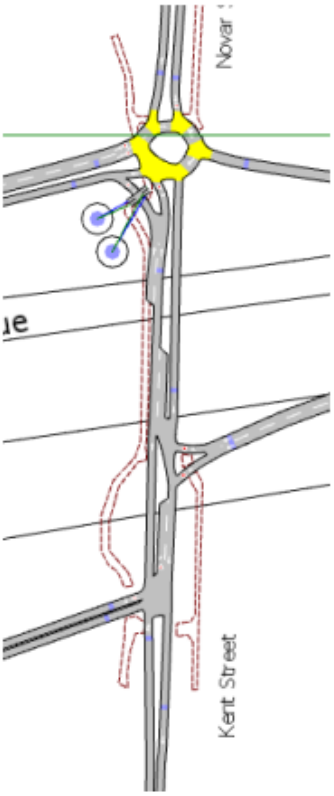
Approach	Growth Rate (per annum)
SCATS data comparative assessment	1%
Canberra Strategic Transport Model (CSTM) volume projections	1.3%
CSTM land use forecast value	1.5%

4.4.3 Options Testing and Results

While the yields and distribution of traffic throughout the network were originally detailed and modelled within the Yarralumla Brickworks Traffic and Parking Report by AECOM, it is noted that a more recent traffic assessment has been completed for the road network surrounding Dudley Street. The later report is also written by AECOM and is a Traffic Options and Analysis Report for the Kent Street / Novar Street Intersection Upgrade. Although the commentary of the report was focussed on different areas of the road network, the completed modelling for both includes much of the same network extents and so are comparable.

While both reports were last updated at similar times, around mid to late 2021, we understand that updates to the traffic models were not undertaken for either project as part of this update. It is understood that the Yarralumla Brickworks traffic modelling was completed in Oct 2020 and has not been updated since. As such, this modelling predates the revised layout of the intersections along Kent Street, which were finalised and modelled as part of the Kent Street / Novar Street Intersection report in March 2021. Therefore, it appears that the adopted layout for the Kent Street intersections upgrade may not fully represent the layout that was finally adopted for the Kent Street project. This is supported by Figure 29 of the Yarralumla Brickworks Report (see Figure 4.6 of this report) showing the Kent Street design option with a single southbound lane on the Kent Street bridge as compared to the two full lanes adopted within the Kent Street / Novar Street Report (see Figure 4.7). As such, the performance results for the road network have been taken from the Kent Street / Novar Street Report.

Base Case



Future Case

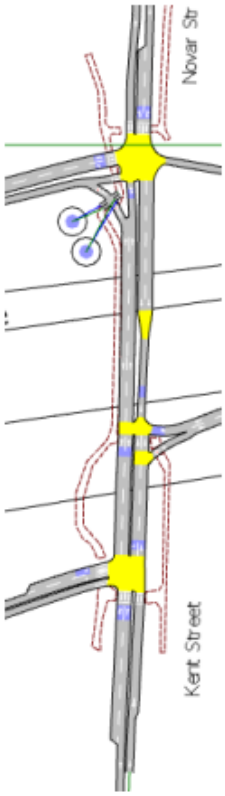


Figure 4.6 Kent Street Proposed Future Design from the Yarralumla Brickworks Report

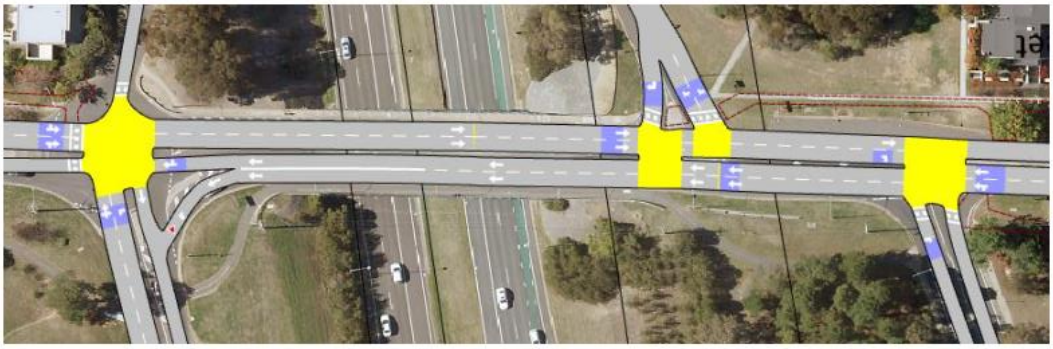


Figure 4.7 Kent Street / Novar Street Proposed Future Design from the Kent Street / Novar Street Report

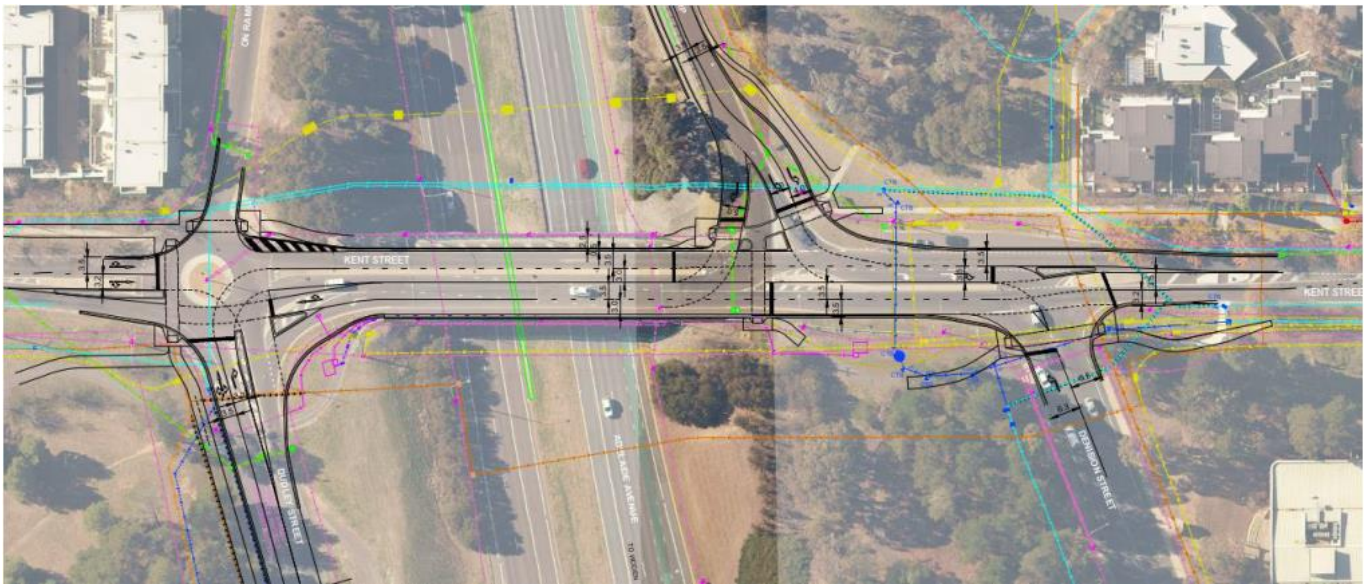
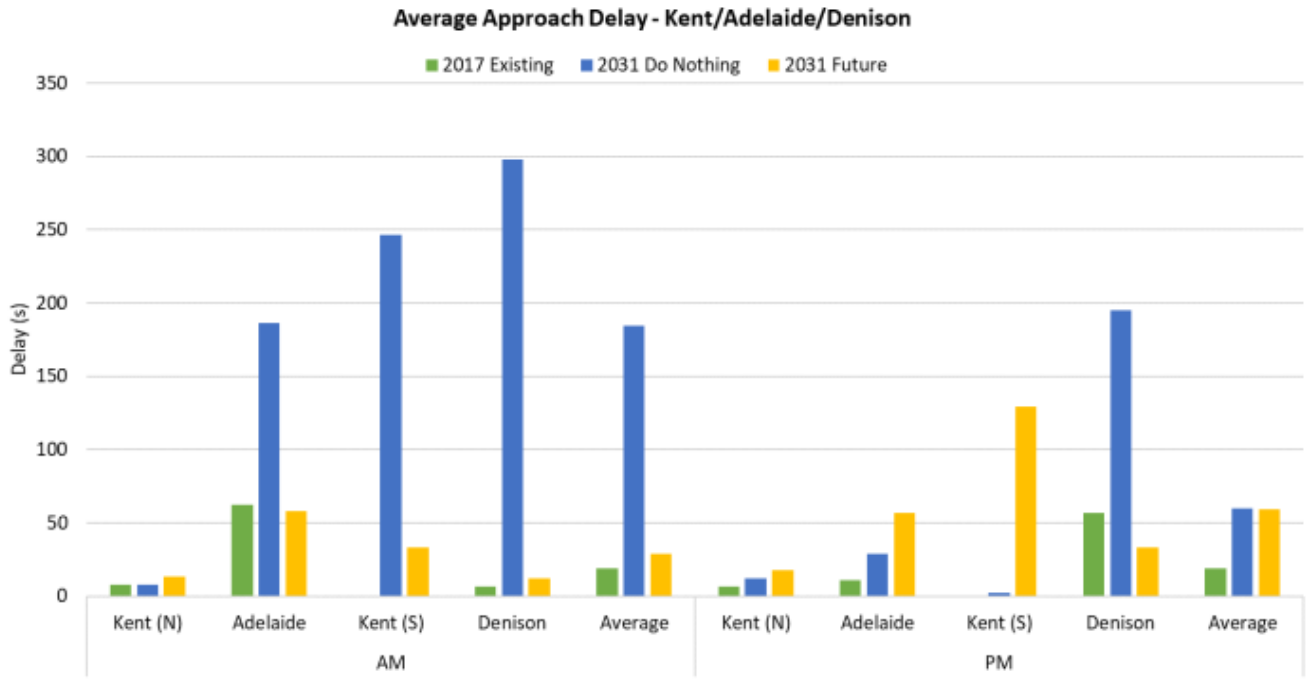


Figure 4.8 Concept Future Design from Kent Street / Novar Street Report

The performance of the network as reported in the Kent Street / Novar Street Report shows the majority of the intersections in the network operating at acceptable levels. The key intersections are the ones along Kent Street, which showed significant improvements along most legs compared to the undeveloped conditions, as can be seen in



and Figure 4.10.

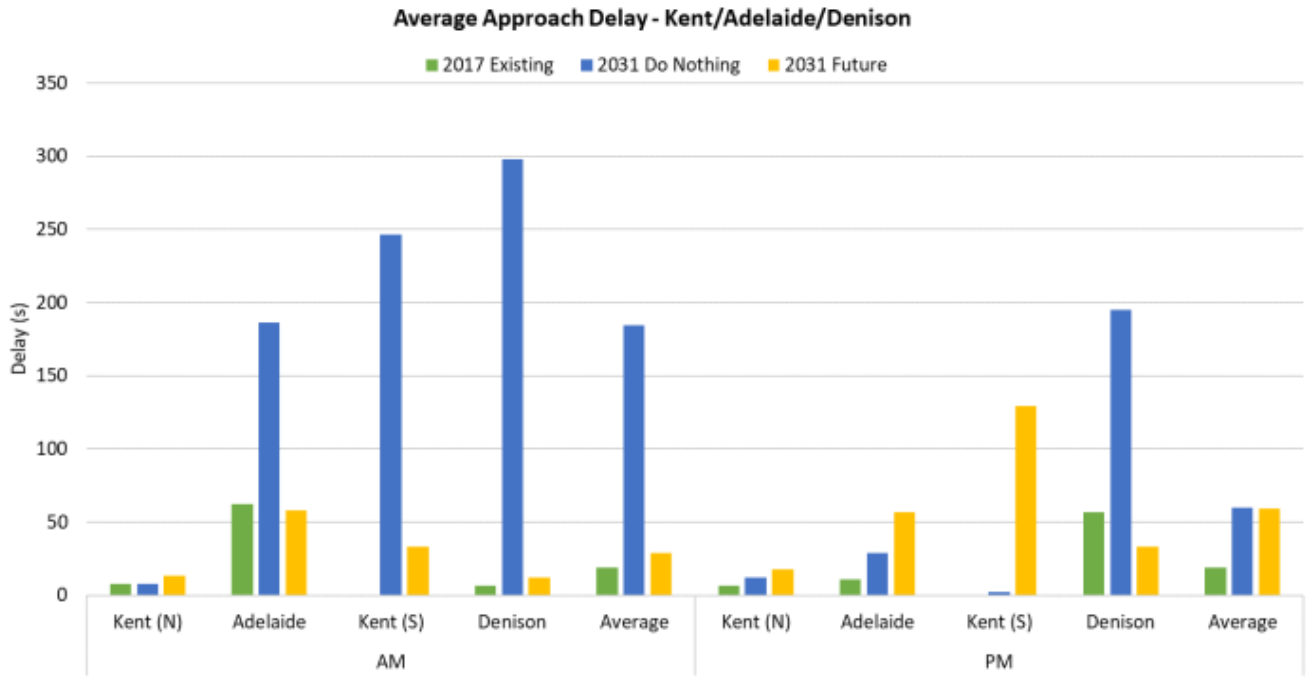


Figure 4.9 Performance Summary of Key Intersections – Novar / Kent / Dudley

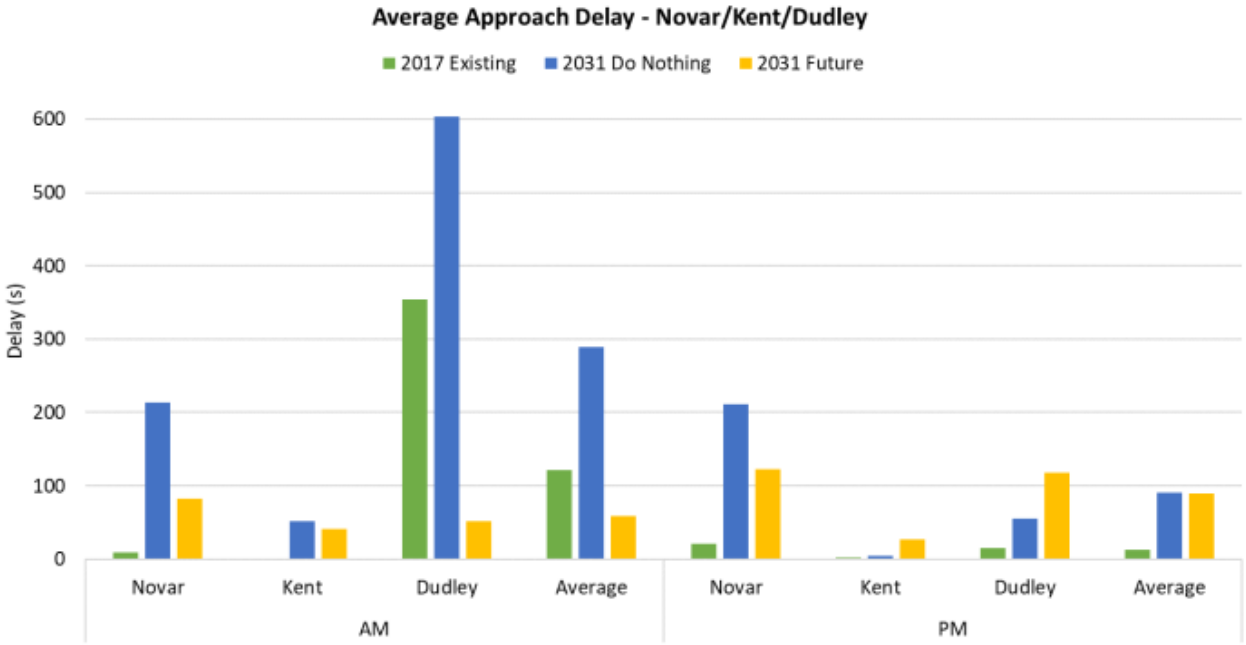


Figure 4.10 Performance Summary of Key Intersections – Kent / Adelaide / Denison

4.4.4 Impacts to Performance From the Updated Brickworks Masterplan

The yields form the current brickworks development in 2022 are expected to generate in the order of 20 vehicles less in the peak hours. As such, the previous traffic assessment is considered suitable as any revised modelling would reduce vehicle numbers.

The increase in Yarralumla's population due to the inclusion of the Brickworks development is expected to put additional pressure on several existing land uses, including the Yarralumla Shops. The proximity of these shops to the brickworks is around 500m and it is expected that many of these trips will be via walking rather than driving. The main access to the Yarralumla Brickworks will be via the new access road 'Brickworks Way' onto Dudley Street and it is anticipated that many residents of the site will see the Curtin Shops as an attractive alternative from the Yarralumla shops, particularly if driving. This behaviour is expected to increase the traffic volume slightly along McCulloch Street, as along Cotter Road and down McCulloch Street is the most direct route. Although the increase in traffic along McCulloch has not been quantified at this stage, it is noted that McCulloch Street is classified as a major collector road and operates in a traffic carrying capacity. As such, the increase in volumes is considered appropriate for this type of road.

The introduction of the Cotter Road Upgrade Stage 3 and Mint Interchange which is assumed in the 2031 AM Canberra Strategic Transport Model changes demand drastically in this area. This causes large fluctuations in the distribution of vehicles and therefore unusual growth rates compared to the current conditions without the Mint Interchange.

Two scenarios were analysed in the CSTM, one with the Mint Interchange and one without the Mint Interchange. The average growth rate between the two scenarios was approximately 1.25%.

Note that the light rail stage 2 project may alter the timing and configuration of the Mint Interchange project from the assumptions included in the CSTM. However, this detail is not available and the future demand forecasts therefore had to be based on the current CSTM.

4.4.5 Operation of Northern Brickworks Way Roundabout

The northmost roundabout along Brickworks Way is noted to lie within close proximity to several driveway and access locations, with the closest of these being the Precinct 3 public carpark access. Due to a large portion of development traffic expected to be moving through this intersection, concerns around the queue lengths off this roundabout have been raised and whether queues would block vehicle movements out of the public carpark in peak periods.

Due to the tidal nature of residential movements and arrangement of the carpark access roundabout, it is expected that the worst queuing would be observed within the AM peak period. During this period, a higher degree of vehicles would be exiting the site and passing in front of the public access, causing increased interaction between exiting shopping vehicles and residential movements. During this peak, based on the location of each of the land use parking and the generation rates discussed in Section 4.2, it is estimated that 160 vehicles per hour will be travelling into the development and passing through the roundabout, while 230 vehicles per hour will be exiting through the roundabout during this AM peak. This correlates to approximately 2.7 vehicles per minute in and 3.8 vehicles per minute out, which is not viewed as sufficient volumes to block traffic for enough time to result in queue lengths that block the carpark access.

With the roundabout only having 3 legs, and the northeast leg being only used infrequently for heavy vehicle access to the heritage core, vehicle movements through the roundabout are also expected to be complementary. Vehicles entering the site and using the roundabout will predominantly turn left toward the public carpark and not interrupt the flow of exiting vehicles through the roundabout. Only infrequent heavy vehicles accessing the heritage core would disrupt the movements and cause small queues to form.

Based on this review of volumes and operation of this intersection, no significant queues are expected to form at this intersection.

4.4.6 Construction Access

The primary construction access route will be via the new stub of the Dudley Street Brickworks Way roundabout. Construction of this link has been completed and should offer minimal impact to the operation given the stub is currently a no through road. Traffic volumes for construction are typically expected to occur outside of the peak hour.

In the civil works stage of the project, some construction access will be via Denman Street whilst Brickworks Way is being completed. There will be low volumes of workers in this stage of the project and only short-term minimal impact on the existing road network is expected.

The recently completed Dudley Street is built to cater for bus and other heavy vehicle moments. Construction traffic is not expected to deform or damage the pavement along Dudley Street.

5. Conclusion

In October 2021, DOMA Group (DOMA) engaged Calibre to prepare a Traffic Impact and Parking Assessment for the Yarralumla Brickworks development. This report has assessed the traffic volumes created by the Yarralumla Brickworks development on the surrounding road network as well as a parking assessment.

The site of the Yarralumla Brickworks development is located within Block 1, 7 and 20 of Section 102, Yarralumla. Currently, Blocks 7 and 20 are unoccupied while Block 1 is occupied by the Old Canberra Brickworks site. Canberra Brickworks is currently not in operation and so traffic to and from the site is minimal. Access to the Brickworks is currently provided off Denman Street. Under the Territory Plan, all three blocks are classified as CZ6: Leisure and Accommodation zones.

The main parking generators in close proximity to the proposed brickworks development are the shopping centre and the Uniting church on Denman Street, as well as the two schools within the area. Overflow parking at lunch times linked with the restaurant and café trade at the Yarralumla shops occurs on the adjacent streets and parking restrictions generally restrict short term parking to one side of these roads. This seems to work for normal demand. The normal church parking demand is catered within the unmarked gravel area located at the church entrance. There will be occasional heavy demand for infrequent weekday funerals and the large annual fete, with parking for this catered within the grassed area to the northwest of the church. Both schools have parking provided internally within the site, and so do not provide or use any external parking while operating.

One local bus route (Route 57) runs along Novar Street connecting Civic to the Woden bus Interchange via Capital Hill. The location of the nearest bus stops to the site are located along Dudley Street, approximately a 650m walk from the site.

On road cycle lanes are provided along Cotter Road and Adelaide Avenue with improved facilities along the newly constructed Dudley Street. Upgrades to the Kent Street / Novar Street bridge works completed early 2023 have further improve amenity.

From a review of the Parking and Vehicular Access General Code, It is expected that a total parking requirement of 1,004 spaces consisting of 689 private and 315 public (accounting for peak parking periods for each land use) is needed within the site. The overall parking supply for the site is proposed to be 1,353 spaces, with 1,017 spaces provided for private parking and 336 spaces provided for public parking within the basement carpark under Precinct 3. This results in a surplus of 21 public parking spaces and 328 private parking spaces within the site while at peak usage. It is noted that a temporal analysis of the public parking provisions was completed to determine the suitability of the public parking provision against the expected maximum usage of the spaces throughout the day. This analysis was calculated hourly over a typical day based on parking usage trends observed for similar land uses within other sites, and was completed to rationalise parking usage across the site and reduce conservative parking estimates to more realistic values.

Through analysis Yarralumla Brickworks Traffic and Parking Report as well as the Traffic Options and Analysis Report for the Kent Street / Novar Street Intersection Upgrade, both published by AECOM, it was seen that the modelling for both includes much of the same network extents and are thus comparable. The revised yields results in 6 additional vehicles being generated in the peak hour compared to the previous studies. As this difference is considered minimal, the assessment in considered appropriate. The performance of the network as reported in the Kent Street / Novar Street Report shows the majority of the intersections in the network operating at acceptable levels. The key intersections are the ones along Kent Street, which showed significant improvements along most legs compared to the undeveloped conditions.

Appendix A AECOM F08 Yarralumla Brickworks Traffic and Parking Report.

Yarralumla Brickworks

Traffic and Parking Report

Yarralumla Brickworks

Traffic and Parking Report

Client: Canberra Brickworks Developments Pty Ltd

ABN: 616 498 670

Prepared by

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29-Apr-2021

Job No.: 60636275

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Quality Information

Document Yarralumla Brickworks

Ref 60636275

Date 29-Apr-2021

Prepared by Nethmei Senarath and Danny Ma

Reviewed by Tim Heffernan

Revision History

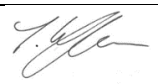
Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	28-Oct-2020	Draft	Tim Heffernan	
A	04-Nov-2020	Minor update	Tim Heffernan	
B1	15-Mar-2021	For Submission	Tim Heffernan Senior Transport Engineer	
C	29-Apr-2021	For Submission, after updates to the land use mix	Ronnie Paulus Transport Advisory Team Lead	

Table of Contents

Executive Summary

The proposed Yarralumla Brickworks Development on Blocks 1,7, and 20 of Section 100, Yarralumla include the following land uses:

- 18 single residential lots (houses)
- 303 apartments
- 59 townhouses
- 1500 m^2 of commercial/office space
- 1320 m^2 of food and beverage space
- 2310 m^2 of fitness and wellness space
- 795 m^2 of medical facility space
- Parklands and open spaces

A summary of the key findings of this report are detailed below:

Adequacy of Car Parking

- The parking for the proposed development will meet the demand for both the private and public land uses.
- For the residential apartments, 150 parking spaces in excess of the requirements in the *Parking and Vehicular Access General Code* (PVAGC) are proposed for the development.
- For the public uses, there is a deficit of 47 parking spaces when compared against the direct application of PVAGC requirements. However, it must be highlighted that in a mixed-use facility such as this development, generally the parking spaces would be shared by different facilities during different peaks of the day. Given such temporal nature of the parking demand, the temporal profile analysis indicated that the peak demand will be 288 parking spaces, while there is a total of 327 public parking spaces proposed for the development. There is a low risk of insufficient public parking being provided on site based on the analysis undertaken.

Impact on Traffic Operations

- AIMSUN modelling showed that the increase in background traffic demand to 2031 has notable impact on the overall performance of the network in the study area. There is notable increase in delays particularly at the intersections along Kent Street. This could also be attributed to the proposed signalisation of the intersections along the road where there are added delays to traffic along Kent Street, whereas in the existing base case, traffic along Kent Street has priority. It should be emphasised that AECOM has not undertaken sensitivity analysis on the proposed future augmentation of the road as part of the traffic modelling for the Yarralumla Brickworks development. This was undertaken as part of the optioneering analysis for the Kent Street upgrade project and the future layout from the Kent Street upgrade analysis has been used as the layout for the future Brickworks analysis in this report.
- AECOM undertook sensitivity analysis to optimise signal timing at the intersections along Kent Street. The signals were modelled as actuated signals with more favourable green time for traffic along Kent Street.
- As a result of this study, it has been determined that the proportional impact to the traffic network that can be attributed to the future Brickworks development will not have a material impact in terms of increases in delay or level of service operation at key intersections or throughout the study area in 2031.

Accessible, Motorcycle and Bicycle Parking

- The ACT Parking and Vehicular Access General Code requires that 3% of public spaces to be provided be compliant for disabled parking. This amounts to 10 disabled parking spaces required for the site.
- There is a requirement to provide motorcycle parking at a rate of 3 spaces per 100 public car parking spaces in addition to the car parks. This results in 10 motorcycle spaces for the development
- The Bicycle Parking General Code for the ACT was used to determine the required supply of bicycle parking spaces. According to the code a supply of 347 bicycle parking spaces must be provided in total, with 312 spaces allocated for residents, and 35 for visitors and guests. In addition to this, an extra 10 bicycle parking spaces was allocated for fitness & wellness centre visitors, totalling to 357 spaces.

Site Access and Service Vehicles

- The main access to the site is proposed via the new Brickworks Access Road which connects to Dudley Street and Cotter Road. Service vehicles will also use this access.
- Other access to the site is through Denman Street which serves 5 townhouses and 7 residential lots and via Bentham Street which serves for 11 residential lots.

1.0 Introduction

1.1 Background

Canberra Brickworks Developments Pty Ltd (ACN 616 498 670) has briefed AECOM Australia Pty Ltd (ABN 20 093 846 925) to prepare a Transport Impact Assessment to support the Yarralumla Brickworks development in Yarralumla, ACT.

1.2 Purpose of this Report

i. Existing traffic and parking conditions surrounding the site;

ii. Suitability of the proposed parking in terms of supply (quantum) and layout;

iii. Service vehicle requirements;

iv. Pedestrian and bicycle requirements;

v. The traffic generating characteristics of the proposed development;

vi. Suitability of the proposed access arrangements for the site;

vii. The transport impact of the development proposal on the surrounding road network

1.3 References

In preparing this report, reference has been made to the following:

- An inspection of the site and its surrounds;
- Australian Standard/ New Zealand Standard, Parking Facilities, Part 1: Off-Street Car Parking AS/NZS 2890.1:2004
- Australian Standard, Parking Facilities, Part 2: Off-Street Commercial Vehicle Facilities AS 2890.2:2002
- Australian Standard / New Zealand Standard, Parking Facilities, Part 6: Off-Street Parking for People with Disabilities AS/NZS 2890.6:2009
- Environment, Planning and Sustainable Development Directorate (EPSDD) Parking and Vehicular Access Code (formerly ACTPLA)
- Environment, Planning and Sustainable Development Directorate (EPSDD) Bicycle Parking General Code (formerly ACTPLA)
- EPD (formerly ACTPLA) Residential Subdivision Development Code
- RMS NSW Guide to Traffic Generating Developments (October 2002 Version 2.2)
- Traffic and car parking observations undertaken and as referenced in the context of this report
- Other documents and data as referenced in this report
- Transport Canberra And City Services Standard Drawings.
- Transport Canberra And City Services Microsimulation Modelling Guidelines.

2.0 Existing Conditions

2.1 The Site

The subject site is located on Blocks 1,7, and 20 of Section 100, Yarralumla (Figure 1). Current access to the site area is available via Denman Street.

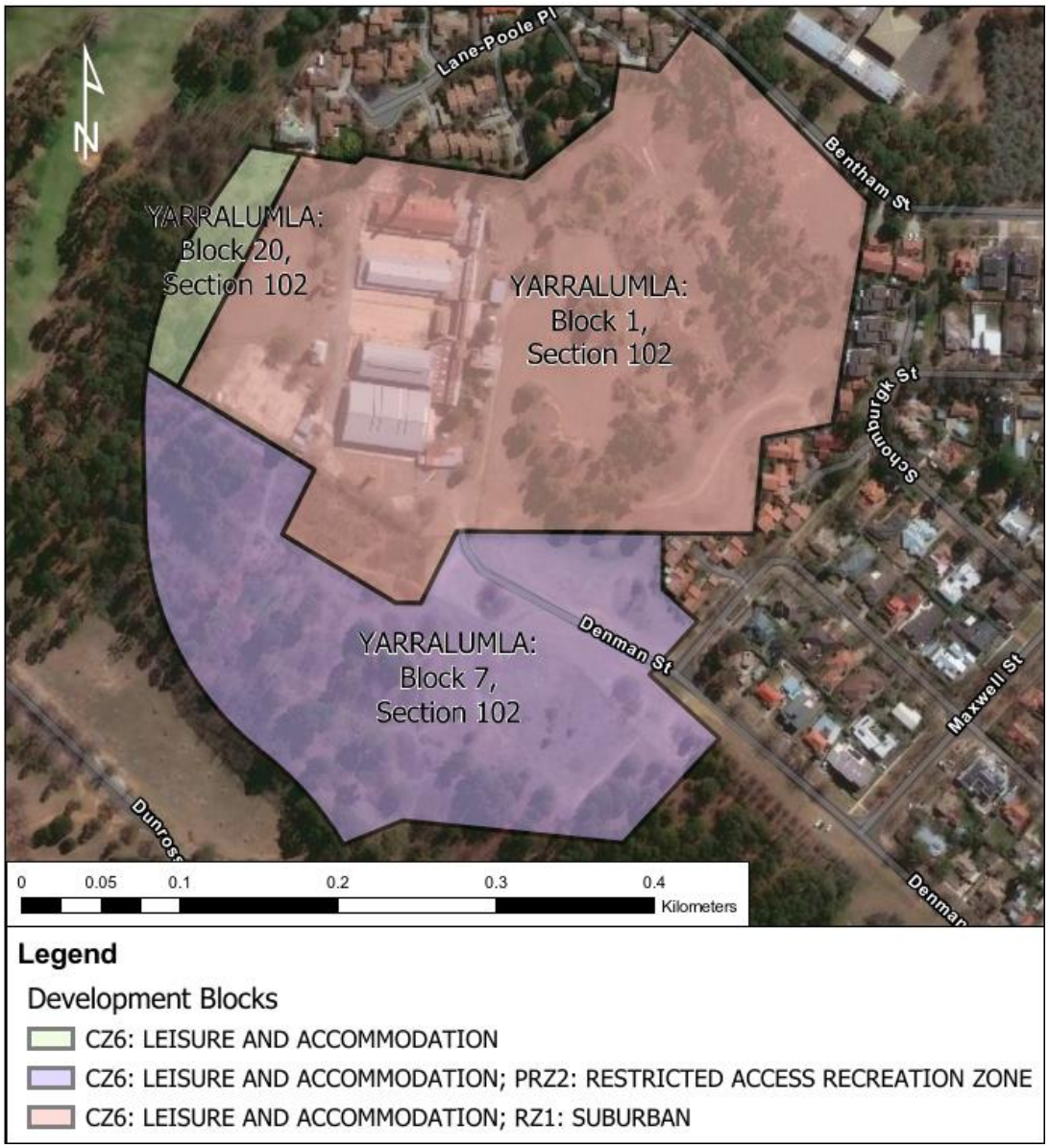


Figure 1 Study Area

2.1.1 Current Land Use

Currently, Block 1, Section 102, Yarralumla accommodates the Old Canberra Brickworks site. Blocks 7 and 20, Section 102 Yarralumla are currently unoccupied. Under the Territory Plan, all three blocks are classified as a CZ6: Leisure and Accommodation zone. Additionally, Block 1 is also classified as a RZ1: Suburban Zone and Block 7 is classified as a PRZ2: Restricted Access Recreation Zone.

2.2 Road Network

2.2.1 Hierarchy

The classification of roads in the ACT is based on a formal road hierarchy. The classification fundamentally relates to the predominant function of a road and to the extent it serves the two basic purposes of the road network – the movement of traffic and access to property. The road classifications used are outline below.

2.2.1.1 Arterial Roads

Arterial roads predominantly serve longer distance travel within a district and through traffic from one district to another. They include limited access roads and parkways (or freeways) having full access control and grade separated inter-sections. A small number have higher levels of property access for urban design reasons, for example Northbourne Avenue, or reflect the planning and design parameters of the time of their construction, for example, Limestone Avenue. Traffic capacity is a function of the design of the road rather than being constrained by environmental objectives.

2.2.1.2 Major Collector Roads

Major collector roads collect and distribute traffic within residential, industrial and commercial areas. They form the link between the primary network and the roads within local areas and should carry only traffic originating or terminating in the area. The volume of traffic carried is constrained by environmental objectives - safety and traffic noise - rather than road geometry and reflects the limited area that they serve. Direct property access is still permissible, but the level of traffic may dictate that access and egress arrangements should be such that vehicles can exit properties in a forward direction.

2.2.1.3 Minor Collector Roads

Minor collector roads collect and distribute traffic from access streets, linking to the major collector roads within the neighbourhood. They can also provide secondary connections direct to the external arterial road network. Traffic volumes are compatible with direct property access.

2.2.1.4 Access Streets

Access streets are used where the residential environment is dominant, traffic is subservient, speed and traffic volumes are low, and pedestrian and cycle movements are facilitated. The primary role of Access Streets is to provide direct property access. Access streets can link traffic from the local network (including rear lanes) to collector roads. In most cases they will not have direct connections to Arterial roads.

2.2.2 Yarralumla Road network

Adelaide Avenue and Cotter Road are the arterial roads which feed traffic into Yarralumla. Novar Street and Hopetoun Circuit are the main north/south connections in the form of major collector roads. These then feed into the minor collectors which include Bentham Street, Weston Street and Schlich Street. A summary of the road classifications in the study area can be seen in Figure 2 below.

Figure 2 Road Classification Summary

2.3 Traffic Volumes

AECOM were previously engaged by the ACT Government to carry out Preliminary Sketch Plan (PSP) design for the Canberra Brickworks Precinct (CBP) Access Road upgrade of Dudley Street. As a part of this project Aimsun traffic modelling was undertaken for the network extents shown in Figure 3.

Note that at the time of writing this design and report, it was determined that using data collected in 2017 was still the best source to use in the following analyses due to the significant impact and limitations of collecting traffic data due to COVID-19 in 2020.This model utilised AM (7:00AM-10AM) and PM (3:30PM-6:30PM) count data undertaken on Wednesday, 21 June 2017 for the following intersections:

- Novar Street / Dudley Street / Adelaide Ave off-ramp
- Kent Street / Denison Street
- Kent Street / Adelaide Ave on-ramp

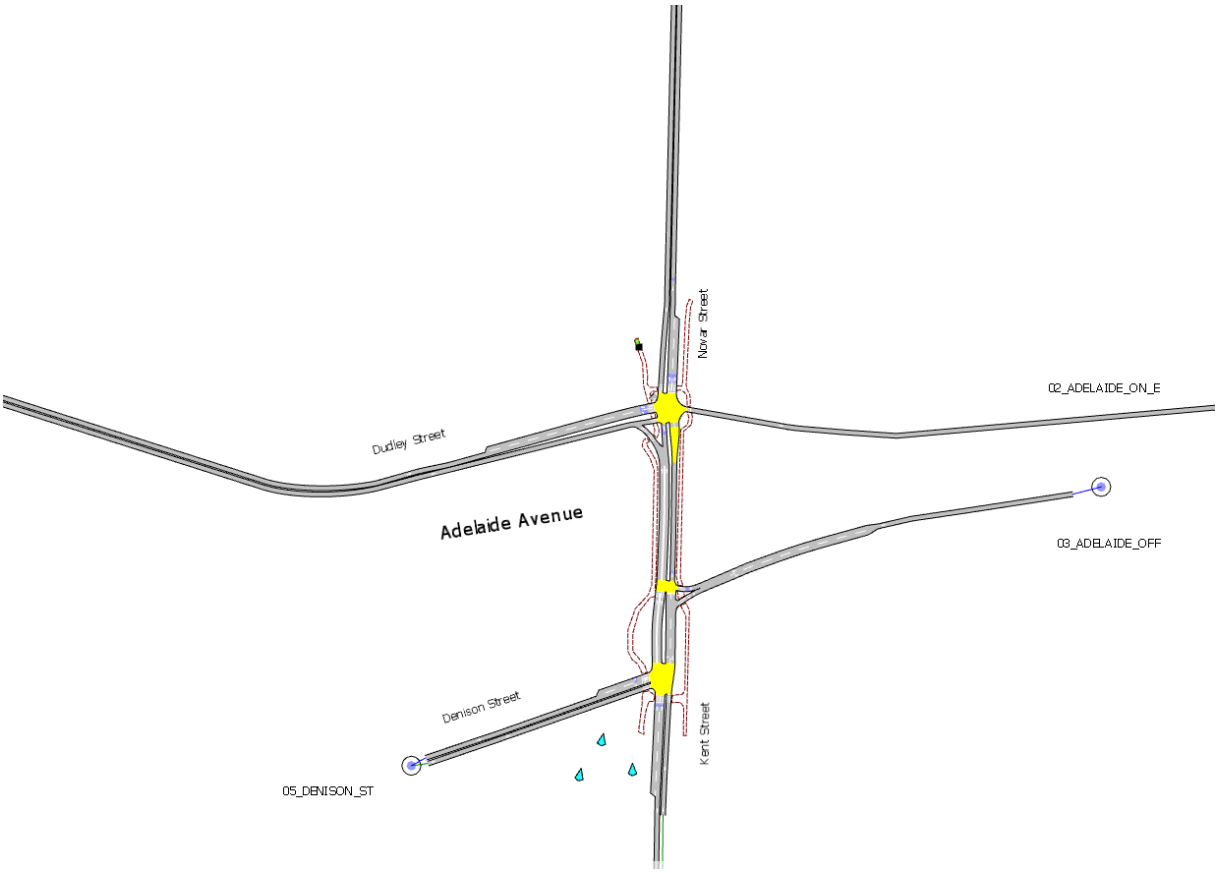


Figure 3 Original Dudley Street Model Extents

In addition to the 2017 traffic counts, AM (7:00AM-10AM) and PM (3:30PM-6:30PM) traffic surveys were undertaken on Tuesday, 25 August 2020 for the following intersections:

- Dudley Street / Cotter Road
- Maxwell Street / Denman Street
- Abbot Street / Denman Street
- Novar Street / Kintore Crescent
- Novar Street / Abbott Street

- Banks St / Weston St / Maxwell St
- Banks St / Bentham St
- Novar St / Bentham St
- Novar St / Weston St
- Hutchins St / Bentham St

A summary of the 2017 and 2020 AM and PM traffic volumes for the intersections outlined above are shown in Figure 4 and Figure 5 below.

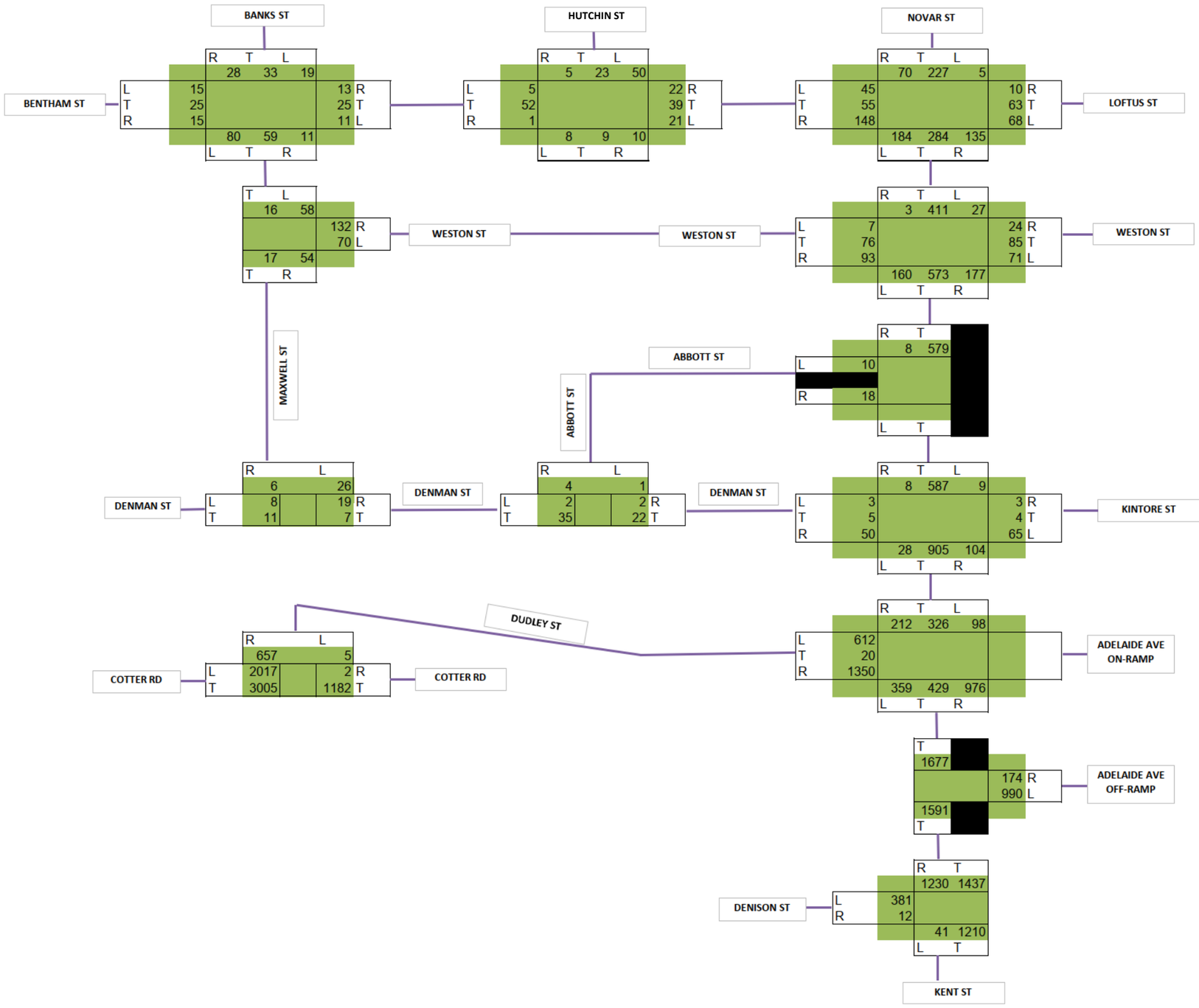


Figure 4 7AM-10AM Yarralumla Traffic Survey Volumes

Notes:

- Traffic counts at Dudley St / Novar St, Kent St / Denison St and Kent St / Adelaide Ave are 2017 counts as part of the originally modelled “core” traffic area
- All other intersection counts are 2020 counts at the request of TCCS

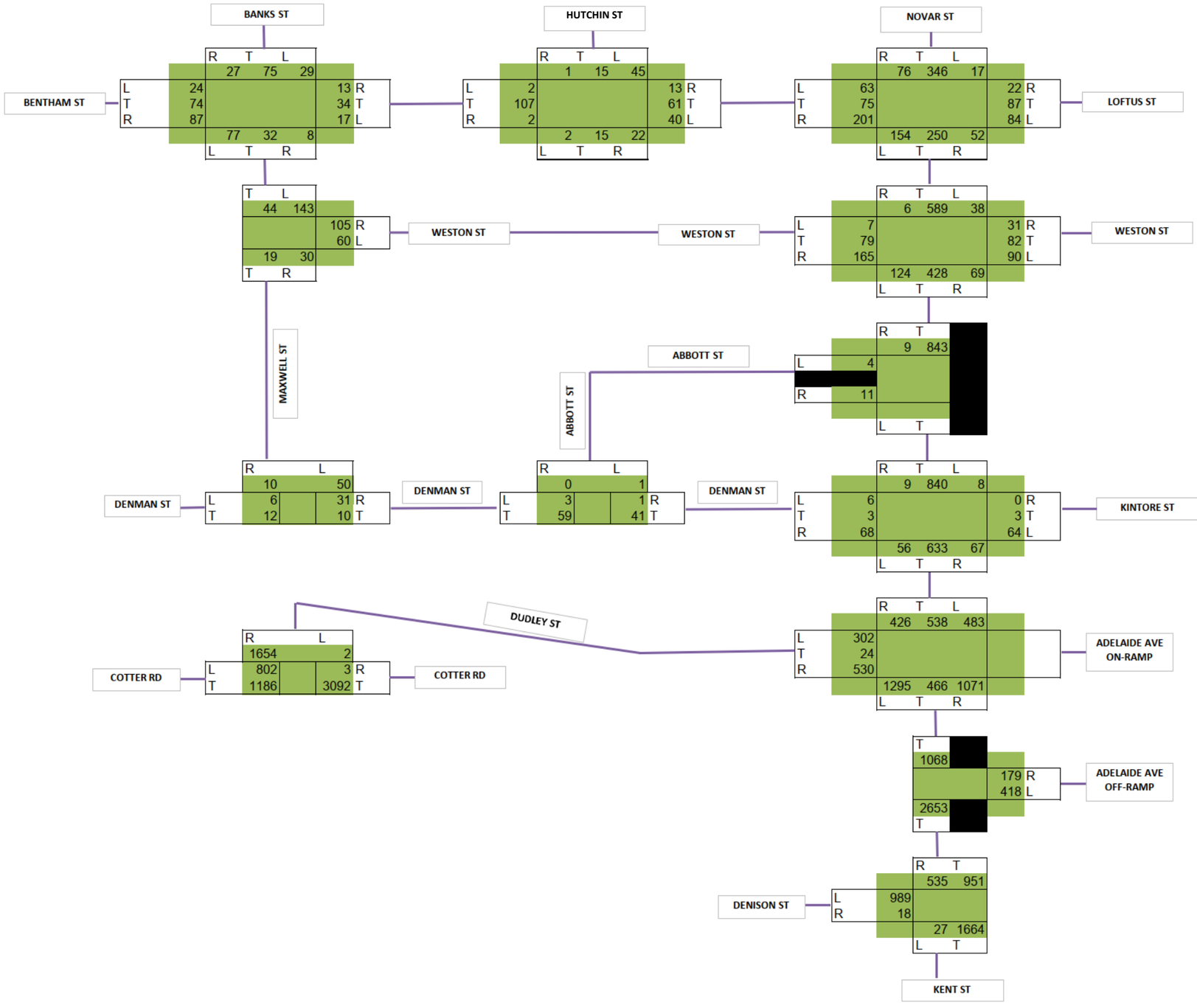


Figure 5 3.30PM-6.30PM Yarralumla Traffic Survey Volumes

Notes:

- Traffic counts at Dudley St / Novar St, Kent St / Denison St and Kent St / Adelaide Ave are 2017 counts as part of the originally modelled “core” traffic area
- All other intersection counts are 2020 counts at the request of TCCS

2.4 Car Parking

A number of weekday and weekend spot counts were undertaken in 2015 in AECOM's previous site investigation for the Yarralumla Brickworks development. This was to determine the key parking attractors, on-street parking utilisation and dedicated parking utilisation in Yarralumla. Note that the 2015 data was used due to the limitations in collecting reliable parking data in 2020 given the impact of COVID-19.

The main parking generators in the study area impacting on the proposed development are the shopping centre and the Uniting church on Denman Street. The Yarralumla Primary school has its own short-term parking demand, and this has not been studied in detail.

The St Nicholas Greek-Australian Pre School & Child Care Centre has on-site parking provisions. Parking was observed to be contained within the site throughout the day with Hill Corner used for peak pickup and drop off times. Few vehicles were observed to park along Maxwell Street associated with the centre.

Overflow parking at lunch times associated with the restaurant and café trade at the Yarralumla shops occurs on the adjacent streets and parking restrictions generally restrict short term parking to one side of these roads. This seems to work for normal demand.

The normal church parking demand is mostly catered within the unmarked gravel area located at the church entrance. There will be occasional heavy demand for infrequent weekday funerals and the large annual fete.

2.4.1 Parking Supply and Restrictions

Parking supply and restrictions have been focused around the two key generators within close proximity of the site. These are the Shops and Church.

Shops On-street

The locational requirements for various types of parking are outlined within the Parking and Vehicular Access General Code within the Territory Plan. For local centres, within Yarralumla parking should be accommodated onsite or within 200m. As such, a 200m radius from the central shop building has been included within the image. The actual 200m walking distances based on the path network are also shown and is the basis of the parking supply numbers.

A summary of the on-street parking restrictions observed on site can be seen in Figure 6.

Figure 6 On-Street Parking Restrictions (2021)

Onsite parking is available at the rear of buildings on 16 and 18 Bentham Street (south side between Novar and Hutchins St). This parking was observed to have some capacity. Visitors to these tenancies may be utilising parking on Bentham Street rather than parking at the rear. Mueller Street has a wider cross section (approx. 9.3m) which can accommodate parking on both sides of the road.

Within the 200m walkable distance area, there are approximately 70 spaces. These include un-restricted and time restricted parking. There are also approximately 25 time restricted no parking

spaces along Novar Street and Bentham Street. These supply numbers do not include full time no parking zones or illegal parking.

Shops onsite supply and demand

A summary of the parking restrictions and onsite supply associated with the Yarralumla shops can be seen in Figure 7

Figure 7 Yarralumla shops parking restrictions and Supply (2021)

The wide variety of parking time restrictions seems overly complicated but has probably been developed over time in consultation with users and may well be very workable.

Church

The available parking supply and restrictions associated with the Church can be seen in Figure 8.The peak period of parking associated with the church located on Denman Street was observed to be during mass on Sunday mornings. The peak demand results from a spot count during this peak utilisation period (9:30-10:30 AM on a Sunday, 2015) can be seen in Figure 11. Occasionally, during one-off services or community events the parking demand further increases.

Figure 8 Spot count of parking utilisation associated with church (2021)

It should be noted that this parking is currently informal and does not comply with local territory standards. As part of the off-site works associated with the Yarralumla Brickworks project, a footpath is proposed to be installed along Denman St such that it allows the Church or ACT government to install 15 parallel parking spaces whilst maintaining 1.5m clearance to light poles. It should be highlighted that the provision of these kerbs and new parking spaces are not part of the Yarralumla Brickworks project scope and needs to be implemented and financed by the respective landowners. A concept layout of the proposed parking arrangement is shown in Figure 9

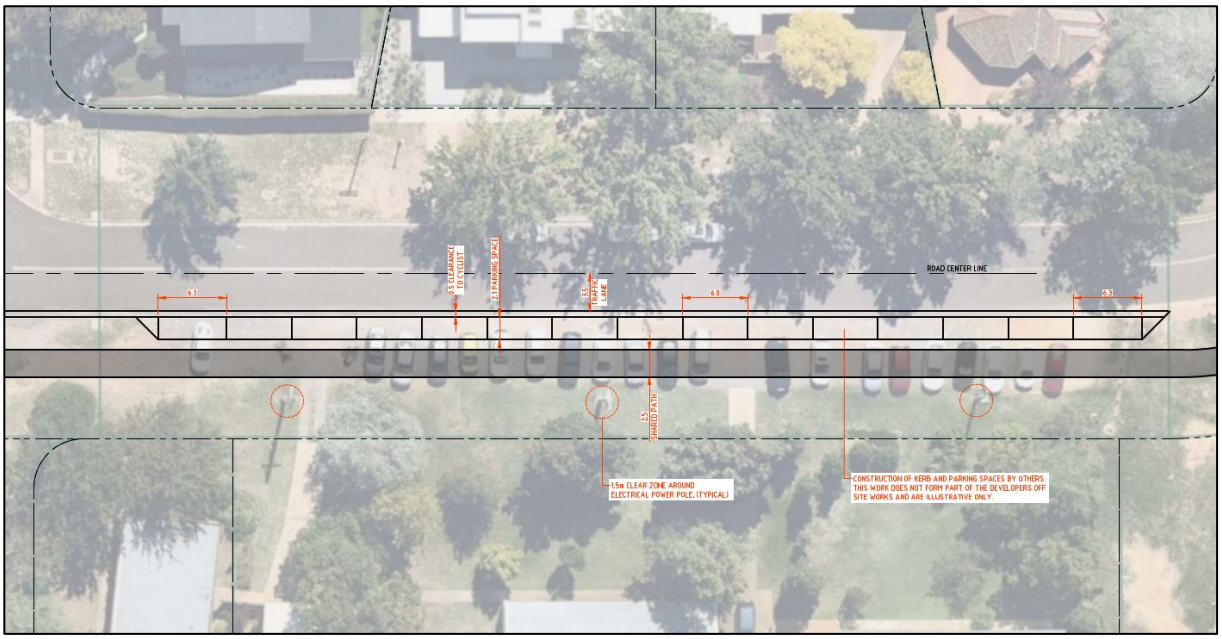


Figure 9 Church Car Parking Option

2.4.2 Parking Utilisation

The on-street parking utilisation throughout Yarralumla was, on average, very low. The preference of residents to park their vehicles in garages resulted in the observed parking levels on-street to be generally between 0 and 2 vehicles for any local access road. The three observed exceptions to this were the on-street parking in the vicinity of the shops, the on-street parking in the vicinity of the church during peak use periods and on-street parking adjacent to construction zones.

The parking utilisation of the shops onsite supply was at 95% or greater for all spot counts conducted, for both weekdays and weekends. The overflow parking associated with the shops is located primarily along Hutchins Street and Bentham Street west of the shop complex. The utilisation of the overflow parking was low on weekend days and high on weekdays, particularly during the lunch peak period. A summary of utilisation of parking associated with the shops which includes all available on-street parking within 200m walkable distance can be seen in Figure 10 and Figure 11.

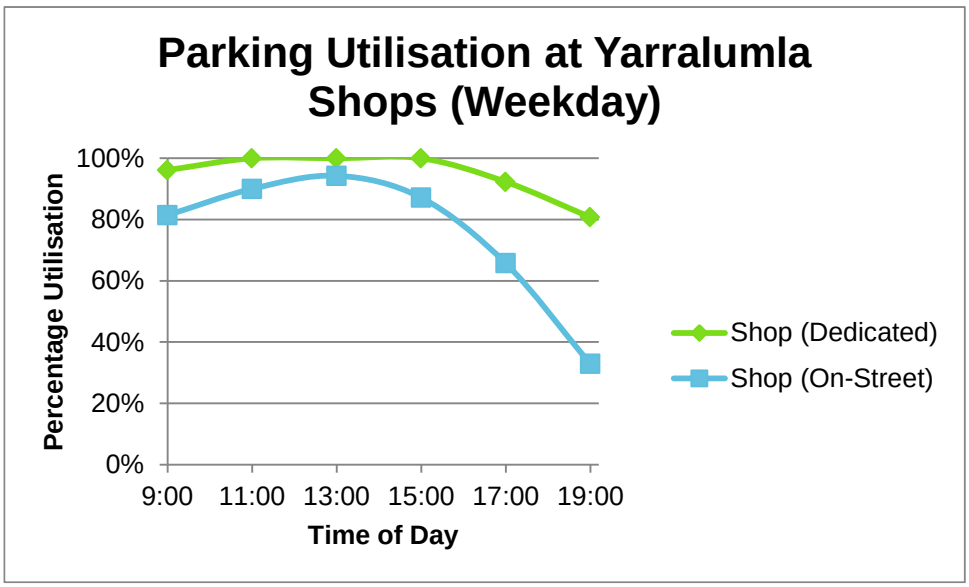


Figure 10 Parking Utilisation on a Weekday (2015).

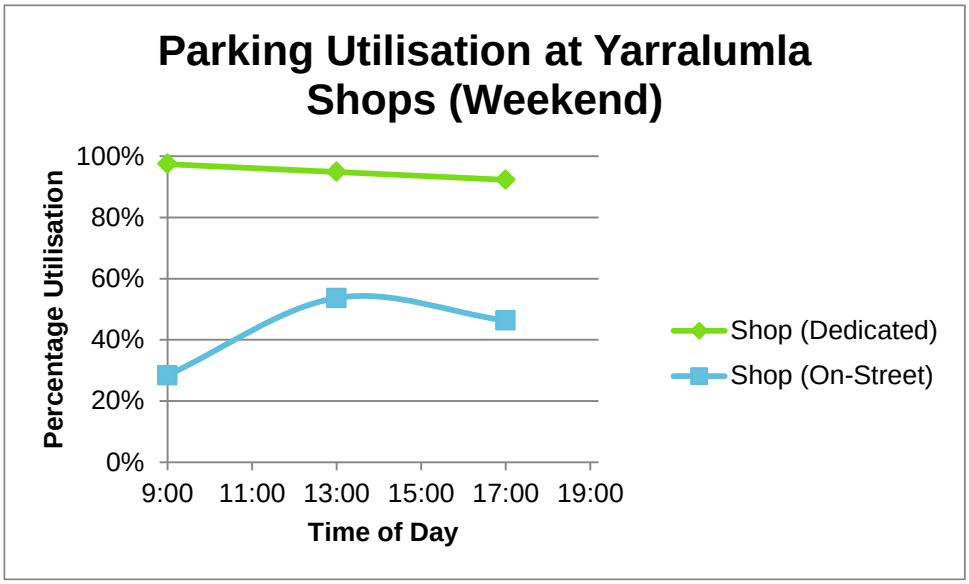


Figure 11 Parking Utilisation on a Weekend (2015).

The above graphs indicate that there is an adequate parking supply for weekend use, however the parking associated with the shops is over capacity during the working week. Based on site observations, there is limited available on-street supply during the weekday peak.

2.5 Public Transport

While there are a large number of bus routes which travel along Adelaide Avenue, there are currently no stops which give residents of Yarralumla access to these services. There is currently a single route (route number 57) which services Yarralumla. Service 57 travels between Woden Town Centre and the City Interchange. Within Yarralumla, the route travels along Novar Street, Schlich Street and Hopetoun Circuit.

A summary of the bus route through Yarralumla can be seen in Figure 12.

Figure 12 Public Transport Routes

A review of the public transport available in the vicinity of the site is summarised in Table 1.

Table 1 Public Transport Provision

Route #	Route Description	Frequency (Peak/Off-Peak)
57	City Interchange, Parkes, Deakin, Yarralumla, Hughes, Garran, Phillip, Woden Interchange	20 mins / 60 mins

2.6 Active Travel

The existing path network was reviewed for the study area. The paths included shared paths, footpaths and recreational trails (Figure 13).

The suburb has an excellent provision of footpaths with almost all verges containing paths. The quality of the paths is generally reasonable although there are isolated areas of cracking or level differences.

Major trip attractors of shops, schools and churches were reviewed for their travel patterns. The Yarralumla Primary school had a fairly dispersed pedestrian movement and the churches had relatively low pedestrian activity. Informal connections through the suburb along access trails were well worn especially closer to the lake.

On-road cycle lanes are provided along Cotter Road and Adelaide Avenue. There is limited connectivity between the local path network and on-road cycle lanes with only one direct connection near the eastern end of the on-ramp from Novar Street south of the intersection of Guilfoyle Street and Newman Street.

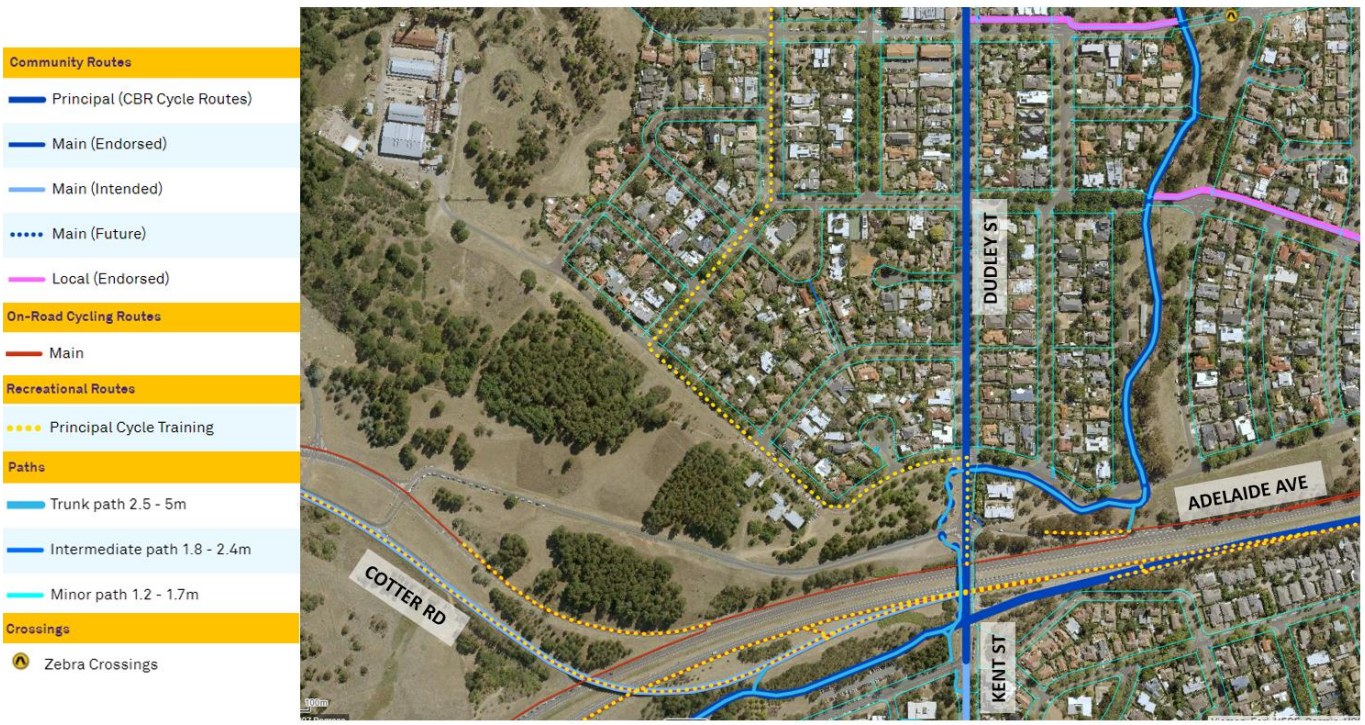


Figure 13 Active Travel Links

(Source: ACTMapi, 2020)

2.7 Crash Analysis

Figure 14 shows recorded road crash data from 1st January 2015 to 31st December 2019. Analysis of the crash diagram shows that many of the crashes are clustered around intersections where there are more conflict points. In the study area, these are mostly on approach to Novar Street and Kent Street intersection. There are also a cluster of crashes near the Yarralumla shops area, which is likely due to conflict of vehicles manoeuvring from the car parks. The highest severity of crashes observed in the area was a fatal crash near the intersection of Strickland Crescent and Ken Street. There were also 36 injury crashes observed, which mostly occurred along Cotter Road, Novar Street and Kent Street.

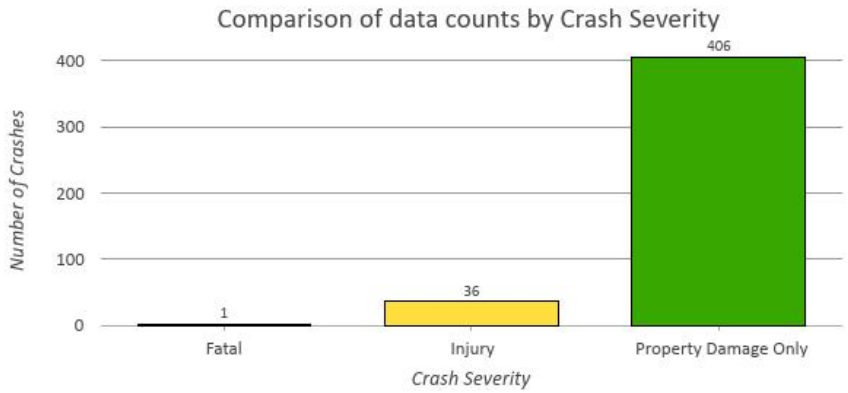


Figure 14 Yarralumla Road Crashes (2015-2019)

3.0 Proposed Land Use

3.1 Land Use

The proposed land use for the Yarralumla Brickworks precinct include the following:

- 18 single residential lots (houses)
- 303 apartments
- 59 townhouses
- 1500 m^2 of commercial/office space
- 1320 m^2 of food and beverage space
- 2310 m^2 of fitness and wellness space
- 795 m^2 of medical health facility space
- Parklands and open spaces

It is understood that the final mix of residential uses may change slightly as the project progresses. However, this is not expected to be significant. The block details plan for the precinct is shown in Figure 15.

Figure 15 Yarralumla Brickworks Block Details Plan

3.2 Vehicle Access

The main vehicle access to the development will be via the new Brickworks Access Road which connects to Dudley Street. There is also other accesses to the site via Denman Street and Bentham Street which serves the townhouses and single residential lots on the east side of the site.

3.3 Service Access

Service access is proposed via the new Brickworks Access Road. A central waste collection facility is proposed for both residential and commercial waste within the heritage precinct as shown in Figure 16.

Figure 16 Waste Collection Location

3.4 Car Parking

The following parking supply is proposed for the Yarralumla Brickworks site:

- 327 public parking spaces
- 771 private parking spaces

The final site parking provision will be subject to consistent with the final mix of residential property types constructed.

4.0 Car Parking

4.1 Car Parking Requirement

The car parking provision requirements for various types of developments are detailed in the Environmental, Planning and Sustainable Development Directorate (EPSDD) (formerly ACTPLA), Parking and Vehicular Access General Code (PVAGC). Although residential development is permitted in a CZ6 zone, no specific rates for parking are provided in the code. The proposed development was designed using the standard residential parking rates from the PVAGC (3.1.5 schedule 1), which are accepted as the general parking rates for residential in the ACT. There are no issues identified in the minor differences in the objectives between sections 3.1.1 and 3.2.1 of the PVAGC. The rates used are outlined below.

The code indicates the following parking rates for the CZ6 zone (unless stated otherwise) in the Yarralumla area:

Townhouses and Apartments (section 3.1.5 schedule 1 of the PVAGC):

- 1 space per single bedroom dwelling
- 1.5 spaces per two-bedroom dwelling
- 2 spaces per three or more-bedroom dwelling
- 1 visitor space per four dwellings

Commercial (Office) and Commercial (Agency)

- 2.5 spaces per 100 m^2 GFA

Food and Beverage

- 10 spaces per 100 m^2 GFA

Fitness and Wellness (Gym)

- 3.5 spaces per 100 m^2 GFA

Medical (Health Facility)

- 4 spaces per practitioner

Note: The parking provisions for the single residential lots are to be provided within each lot and thus these parking spaces (resident and visitor parking including bike storage) are not considered in this assessment.

Table 2 outlines the expected peak demand from the development as per the rates above.

Table 2 Yarralumla Brickworks Car Parking Requirements

Use	Yield	Units	Provision Rate	Units	Parking Requirement
Apartments	303	Apartments	*See Table 3		503
Townhouses	59	Townhouses	*See Table 4		118
Private Subtotal					**621**
Commercial (office)	1500	m^2 GFA	0.025	spaces/m^2	38

Use	Yield	Units	Provision Rate	Units	Parking Requirement
Food and Beverage	1320	m^2 GFA	0.1	spaces/m^2	132
Fitness and Wellness	2310	m^2 GFA	0.035	spaces/m^2	81
Medical	795	m^2 GFA	4	spaces/practitioner	32 (assuming 8)
Apartment Visitors	303	Apartments	0.25	spaces/m^2	76
Townhouses Visitors	59	Townhouses	0.25	spaces/m^2	15
Public Subtotal					**374**
DEVELOPMENT TOTAL					**995**

Table 3 Apartment Breakdown

Apartment Type	Number of Unites	Rate (per unit)	Parking Requirement
1 BR	5	1	5
2 BR	196	1.5	294
3+ BR	102	2	204
TOTAL	**303**		**503**

Note: Visitor parking shown in Table 2.

Table 4 Townhouse Breakdown

Townhouse Type	Number of Units	Rate (per unit)	Parking Requirement
3+ BR	59	2	118
TOTAL	**54**		**118**

Note: Visitor parking shown in Table 2.

4.2 Adequacy of Parking Supply

Table 5 Land Use Parking Supply and Demand

Land Use	Car Park Requirement	Car Park Supply	Difference
Private Parking	621	771	+150[Comment 1]
Public Parking	374	327	-47[Comment 2]
TOTAL			**+103**

As seen in Table 5 above, there is an excess of 103 car parks supplied for the proposed development.

There are 150 excess parking spaces for residential apartments and townhouses, which is a commercial decision to supply more storage space for cars, bicycles and other uses.

There are 47 less public parking spaces than the requirement in the PVAGC. Given the temporal nature of parking demand for the non-residential land uses, a temporal profile analysis based on observations from past projects for similar land uses has been undertaken as shown in Figure 17 below. The analysis shows that the peak demand of 288 parking spaces will occur around 8:00pm for the site. The 327 carparks provided for the public is 39 spaces more than the estimated peak demand. Therefore, the shortfall in public parking of 47 spaces is not a significant risk in terms of ensuring the sufficient parking supply for the site considering the peak demand analysis.

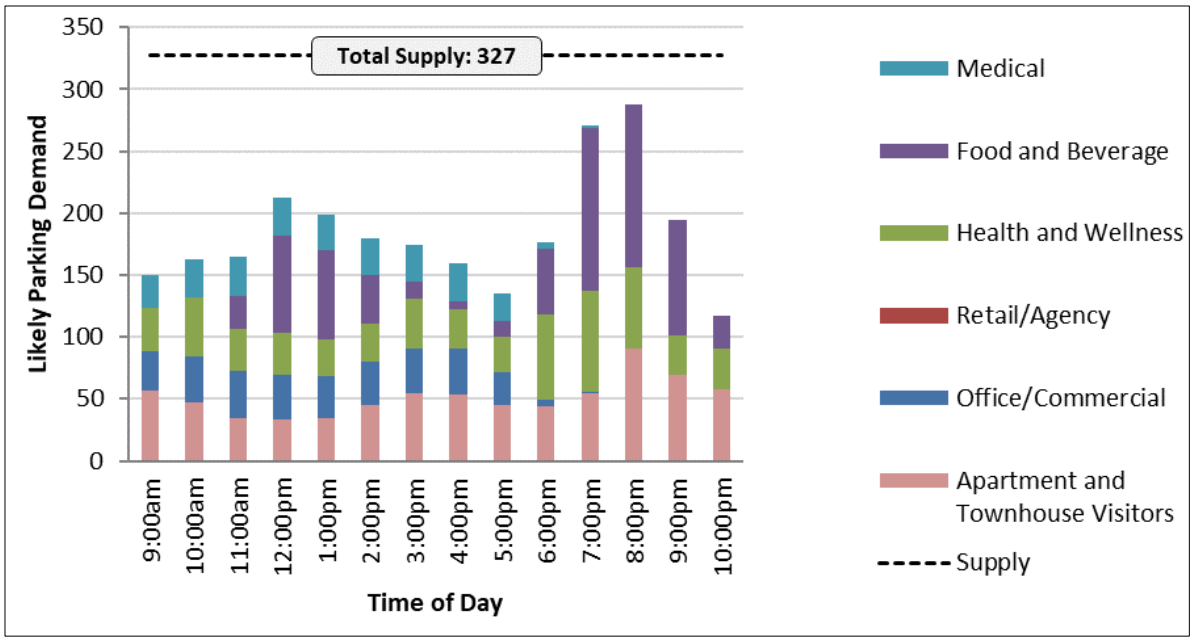


Figure 17 Temporal Parking Supply and Demand for Public Land Uses

4.2.1 Accessible Parking Provision

Accessible parking needs to be provided in accordance with the ACT Parking and Vehicular Access General Code. The code requires that a minimum of 3% of spaces be provided for people with disabilities. In this proposal, this amounts to 10 spaces for the public land uses.

4.2.2 Motorcycle Parking Provision

There is a requirement to provide motorcycle parking at a rate of 3 spaces per 100 public car parking spaces in addition to the car parks. This results in 10 motorcycle spaces for the development

5.0 Sustainable Transport Infrastructure

5.1 Bicycle End Trip Facilities

The Bicycle Parking General Code (BPGC) for the ACT was used to determine the required supply of bicycle parking spaces. The bicycle parking space requirements are summarised in Table 6.These are based on the following rates of supply of bicycle parking spaces.

Apartments

- 1 per apartment for residents
- 1 per 12 apartments after the first 12 apartments for visitors and guest

Townhouses

- Nil for residents
- Nil for visitors and guests

Commercial (Office) and Commercial (Agency)

- 1 space per 250 m^2 GFA after the first 250 m^2 GFA for employees; and
- 1 space per 950 m^2 GFA after the first 400 m^2 GFA for visitors and guests.

Food and Beverage

- 1 space per 400 m^2 GFA after the first 400 m^2 GFA for employees; and
- 1 space per 200 m^2 GFA after the first 200 m^2 GFA for visitors and guests. (Minimum 2)

Medical (Health Facility)

- 1 space per 8 practitioners after the first 8 practitioners for employees; and
- 1 space per 4 practitioners for visitors and guests

The Fitness and Wellness centre has been classified as an “Indoor Recreation Facility”. The BPGC does not provide bicycle parking requirements for this use. Rather, it is subject to individual assessment. In order to promote active travel and wellbeing within the site, the Wellness Centre has been allocated a provision of bicycle parking spaces equivalent to 10% of the total car parking spaces. This equates to 10 ‘Class 3’ bicycle racks to be provided in close proximity to the Fitness and Wellness centre.

The single residential lots have no minimum bicycle parking requirement.

A summary of how the bicycle parking requirements apply to the proposed development is presented in Table 6.

Table 6 Bicycle Parking Space Requirement - Residents and Employees

Land Use	Yield	Spaces per unit	Class	Total
Apartments	303 apartments	1 per apartment	1,2	*303*
Commercial (Office)	1500 m^2 GFA	1 per 250m^2 GFA after the first 250m^2 GFA	1,2	*5*
Food and Beverage	1320 m^2 GFA	1 per 400m^2 GFA after the first 400 m^2 GFA	1,2	*3*
Medical	795 m^2 GFA	1 per 8 practitioners after the first 8 practitioners	1, 2	*1*
TOTAL				***312***

Table 7 Bicycle Parking Space Requirement - Visitors and Guests

Land Use	Yield	Visitors and Guests		
		Spaces per unit	Class	Total
Apartments	303 apartments	1 per 12 apartments after the first 12 apartments	3	*25*
Commercial (Office)	1500 m^2 GFA	1 per 950 m^2 GFA after the first 400m^2 GFA	3	*2*
Food and Beverage	1320 m^2 GFA	1 per 200 m^2 GFA after the first 200m^2 GFA (minimum 2)	3	*6*
Medical	795 m^2 GFA	1 per 4 practitioners	3	*2*
Fitness and Wellness	2310 m^2 GFA	10% of total car parking spaces	3	*10*
TOTAL				***45***

Residential visitor parking spaces will be interspersed across site at an appropriate distribution.

Note: Bicycle parking for residential purposes can also be accommodated through storage areas, given these are provided for the apartments. It is proposed that bike cages will be provided for the employees within the facilities and bike racks will be provided for residents.

5.2 Walkability Score

Yarralumla has a walk score of 51 out of 100, making it a “somewhat walkable”.[1] Scores between 50-69 outline that some errands can be accomplished on foot. Points are awarded based on the distance to amenities in the following categories: dining and drinking, groceries, shopping, errands, parks, schools and culture and entertainment. Amenities within a 5-minute walk are given maximum points. A decay function is used to give points to more distant amenities, with no points given after a 30-minute walk. Walk Score also measures pedestrian friendliness by analysing population density and road metrics such as block length and intersection density.

[1] www.walkscore.com

6.0 Impact of the Development

6.1 Traffic Generation

The traffic generation for the development was determined based upon rates RTA Guide to Traffic Generating Developments version 2.2.

- A trip rate of 0.85 vehicles per dwelling in a peak hour was applied to houses and townhouses as per dwelling houses rate in the RTA Guide.
- A trip rate of 0.6 vehicles per dwelling in a peak hour was applied to apartments as per the medium density residential flat building rate in the RTA Guide.
- A trip rate of 2 vehicles per 100 m^2 GFA in a peak hour was applied to the commercial/office and commercial/agency GFA as per the RTA Guide.
- A trip rate of 5 vehicles per 100 m^2 GFA in a peak hour was applied to the food and beverage GFA as per the restaurant rate in the RTA Guide.
- A trip rate of 3 vehicles per 100 m^2 GFA in a peak hour was applied to the health and wellness GFA as per the gymnasium rate in the RTA Guide.

A summary of the peak hour trip generation for the development is as follows:

Table 8 Peak Hour Site Traffic Generation

Land Use	Yield	Units	Vehicle Trips per Peak Hour	Peak Hour Generation
Houses	18	houses	0.85	15
Townhouses	59	townhouses	0.85	50
Apartments	303	units	0.6	182
Commercial/Office	1500	m^2 GFA	0.02	30
Food and Beverage	1320	m^2 GFA	0.05	66
Fitness and Wellness	2310	m^2 GFA	0.03	69
Medical	795	m^2 GFA	0.104	83
TOTAL				**495 veh/hr**

6.2 Traffic Distribution

The trip distribution assigned to the site generated traffic was determined using existing turning movement patterns and the 2016 Australian Bureau of Statistics (ABS) journey to work data. For a driver of a vehicle from the Yarralumla area to their destination of full-time work is split between the key areas within the ACT as follows:

- Belconnen 8%
- City North and South Canberra 46%
- Gungahlin 1%
- Woden/Tuggeranong 45%

Given the journey to work data the following percentage splits shown in Table 9 to each key destination points in the Aimsun model have been estimated.

Table 9 Traffic Distribution Percentage Splits

Destination	Percentage Split
Novar Street	5%
Adelaide Avenue	27%
Cotter Road East	17%
Cotter Road West	19%
Kent Street	32%

The inbound/outbound splits for the site land uses are summarised in Table 10.

Table 10 Inbound and Outbound Splits

Land Use	Peak	INBOUND	OUTBOUND
Residential	AM	20%	80%
	PM	80%	20%
Commercial (Office)	AM	80%	20%
	PM	20%	80%
Commercial (Agency)	AM	80%	20%
	PM	20%	80%
Fitness and Wellness	AM	50%	50%
	PM	50%	50%
Food and Beverage	AM	50%	50%
	PM	70%	30%

Applying the distributions results in the inbound and outbound movement for the AM and PM peaks as outlined in Table 11 and Table 12 respectively.

Table 11 Site AM Peak Hour Traffic Generation

AM Peak Hour Traffic Generation						
Land Use	**Traffic Rate**	**In %**	**Out %**	**In**	**Out**	**Total**
Houses	15	20%	80%	3	12	15
Apartments	50	20%	80%	10	40	50
Townhouses	182	20%	80%	36	145	182
Commercial (Office)	30	80%	20%	24	6	30
Food and Beverage	66	50%	50%	33	33	66
Fitness and Wellness	69	50%	50%	35	35	70
Medical	83	50%	50%	41	41	82
TOTAL				**182**	**312**	**495**

Table 12 Site PM Peak Hour Traffic Generation

PM Peak Hour Traffic Generation						
Land Use	**Traffic Rate**	**In %**	**Out %**	**In**	**Out**	**Total**
Houses	15	80%	20%	12	3	15
Apartments	50	80%	20%	40	10	50
Townhouses	182	80%	20%	145	36	182
Commercial (Office)	30	20%	80%	6	24	30
Food and Beverage	66	70%	30%	46	20	66
Fitness and Wellness	69	50%	50%	35	35	70
Medical	83	50%	50%	41	41	82
TOTAL				**325**	**169**	**495**

7.0 Queuing Analysis

7.1 Public Car Park Queuing Analysis

Queueing theory from 'Austroads Guide to Traffic Management Part 2: Traffic Theory' was used to determine the 95th percentile queue along the access to the public carpark. A processing time of 12 seconds per vehicle has been applied. This is the average number of seconds to service a vehicle under a ticketed machine boom gate scenario. This processing time accounts for the approximate time to open a boom gate. Introduction of automatic number plate recognition gates would significantly improve operation and peak queue durations. Table 13 summarises the results of the analysis.

Table 13 Public car park access queuing

Location		AM		PM	
		Ingress	**Egress**	**Ingress**	**Egress**
Basement Ramp Access / Egress	Peak Arrival Rate (vph)	113	81	93	101
	Peak Queue (vehicles)	3	2	2	2
	Probability of more than 1 vehicle in queue*	14.2%	7.3%	9.6%	11.3%

*includes vehicle using the facility.

Across all time periods the expected maximum queue is three vehicles. AS/NZS 2890.1 *Parking Facilities, Part 1: Off-Street Car Parking,* requires that the maximum grade is 10% for not less than 0.8 of the queue length.

8.0 Network Analysis

8.1 Study Area Definition

The Aimsun modelling extents were determined based on TCCS requirements to include the internal Yarralumla road network. The extents if the modelling is shown in Figure 18 and Figure 19 below. The original network area in 2017 did not include the residential streets of Yarralumla (north of Denman/Kintore/Novar intersection). Upon request from TCCS, AECOM extended the model in 2020 to include the Yarralumla residential streets shown below. As the 2017 survey count data and the COVID impacted 2020 survey count data were unlikely to correlate at the interface between the two data sets, TCCS agreed to reduce the calibration requirements. The agreement involved ensuring that the core 2017 site area (2017 Aimsun Base Model) met the calibration criteria for these intersections as per the ACT Microsimulation Modelling Guidelines, and factoring the COVID impacted 2020 demands up to meet the 2017 demands, acknowledging that calibration in the Yarralumla residential streets may not meet requirements of the guidelines, however ensuring the conservative 2017 demands would be modelled as the base demand volumes.

Figure 18 Yarralumla Brickworks Aimsun Modelling Area

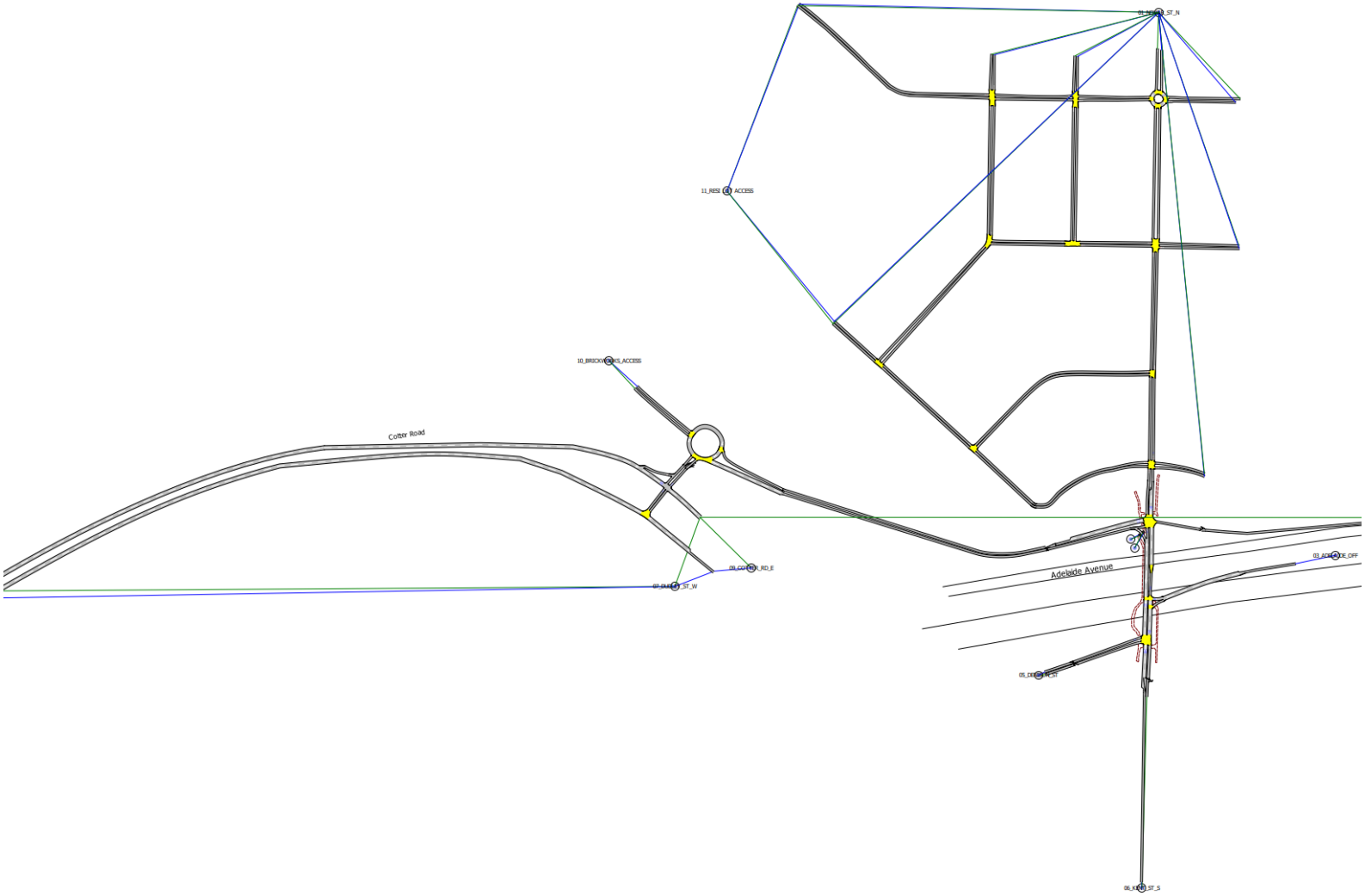


Figure 19 Yarralumla Brickworks Aimsun Network

8.2 Base Year Model – Calibration and Validation

In comparing the 3-hour 2017 base counts for the AM and PM peaks to the August 2020 counts, the 2017 base counts were higher than the 2020 counts for all Origins/Destinations, apart from the AM destination volumes to centroid *07_Dudley Street* and AM origin volumes from centroid *01_Novar St_N*.

For centroid *07_Dudley Street*, the difference between the original 2017 counts and the 2020 counts was 90 vehicles across the 3-hour period. For centroid *01_Novar St_N*, the 3-hour difference between the 2017 counts and 2020 counts were 57 vehicles. The 57 and 90 vehicles were proportioned based on the 2017 origin/destination proportions and was added to the demand matrix.

The 2020 counts were also used to determine the proportion of vehicles attracted and generated to the centroid *01_Novar St_N* from the side street. These side streets include Bentham St, Denman St. Loftus St, Weston St and Kintore Cres (Figure 20).

The 2020 counts were also used as inputs into the base model for the through movements on Cotter Road.

The model calibration has been undertaken as outlined in Section 8.2.1. Validation of the model was not undertaken due to the unavailability of 2017 travel time and queue length data.

The base model was extended to include the local area network of Yarralumla at the request of TCCS to understand the traffic impacts on the lower order local street network

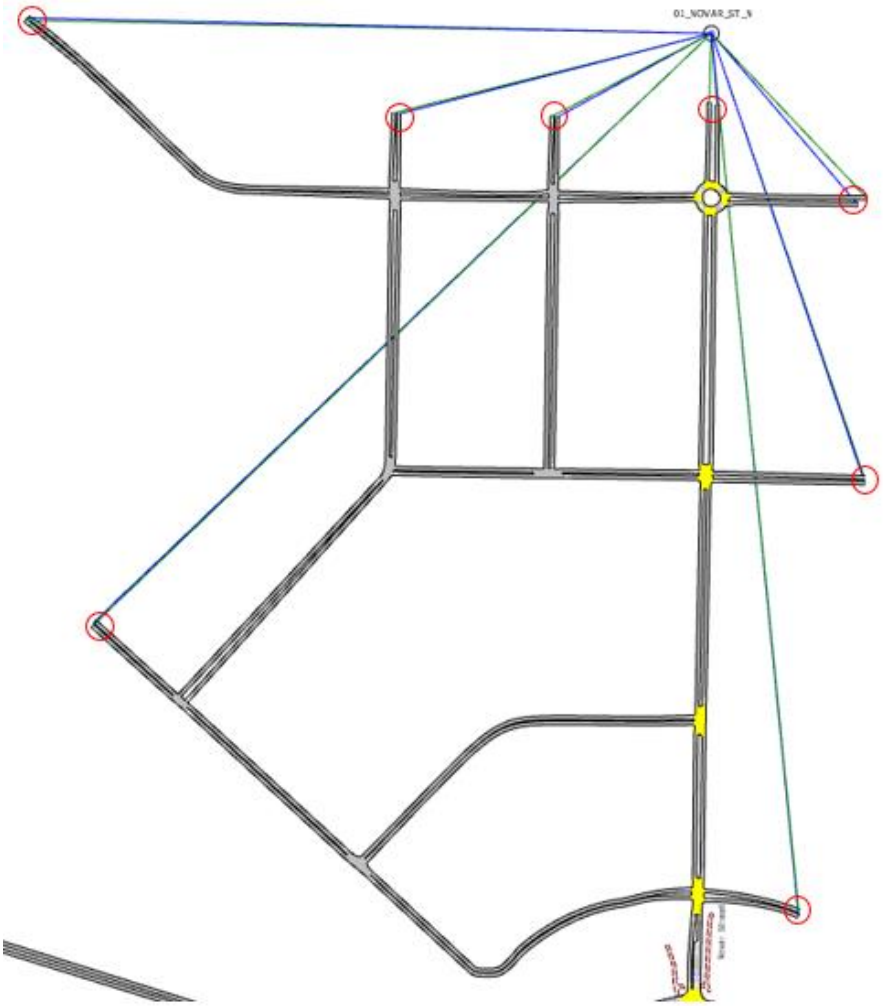


Figure 20 Centroid 01_Novar St_N Attractions and Generators

8.2.1 GEH

Given the 2017 base counts were utilised for the core of the model, a simple validation exercise has been undertaken to check flow volumes along Kent Street, Novar Street, Dudley Street and Cotter Road. The core calibration area and secondary calibration area are shown in Figure 21. Turn volumes along the suburban side streets were not analysed as the volumes generated from the side streets are a proportion of the 2017 volumes and hence won't match the 2020 counts.

Figure 21 Aimsun Model Calibration Area

Table 14 and Table 15 show the GEH results (the comparison between the modelled and survey traffic data) for the base model turn volumes in the core calibration area. As per the targets outlined in the *ACT Traffic Microsimulation Modelling Guidelines*, more than 85% of turn volumes have a GEH of less than 6 and a 100% of turn volumes have a GEH of less than 10.

Note that the GEH values are based on the average of the seed runs. In the AM peak, seed number 86524 showed an unusual lock-up at the Dudley Street / Novar Street roundabout and hence was omitted from the model.

Table 16 and Table 17 show the AM and PM peak GEH values for the northbound and southbound link volumes along Novar Street in the secondary calibration area. For the AM peak, the GEH targets in the *ACT Traffic Microsimulation Modelling Guidelines* are met. However, in the PM peak there is a significant deviation from the GEH targets outlined in the guidelines. The reason for this is that on Novar Street approach at the Novar Street / Dudley Street intersection, there is a 475 vehicle difference for the 3.30PM-6.30PM period between the 2017 counts and the 2020 counts. Since the

2017 counts are the higher counts and were maintained in the model, the GEH values will not match the 2020 count volumes in the secondary calibration area along Novar Street. Approaching the traffic modelling in this manner for the Yarralumla area is conservative, given the higher counts are utilised and results in a more robust traffic model.

Detailed GEH results for the core calibration area and the secondary calibration area are available in Appendix A.

Table 14 AM Core Calibration Area GEH results

Time Period	Number of Turns (Core Calibration Area)	Number of Turns with GEH<5	Number of Turns with GEH<10
7am-8am	23	23 (100%)	23 (100%)
8am-9am	23	20 (87%)	23 (100%)
9am-10am	23	22 (96%)	23 (100%)

Table 15 PM Core Calibration Area GEH results

Time Period	Number of Turns (Core Calibration Area)	Number of Turns with GEH<5	Number of Turns with GEH<10
3.30pm-4.30pm	23	22 (96%)	23 (100%)
4.30pm-5.30pm	23	23 (100%)	23 (100%)
5.30pm-6.30pm	23	23 (100%)	23 (100%)

Table 16 AM Secondary Calibration Area GEH results

Time Period	Number of Links (Core Calibration Area)	Number of Links with GEH<5	Number of Links with GEH<10
7am-8am	16	16 (100%)	16 (100%)
8am-9am	16	15 (94%)	16 (100%)
9am-10am	16	16 (100%)	16 (100%)

Table 17 PM Peak Secondary Calibration Area GEH results

Time Period	Number of Links (Core Calibration Area)	Number of Links with GEH<5	Number of Links with GEH<10
3.30pm-4.30pm	16	15 (94%)	16 (100%)
4.30pm-5.30pm	16	11 (69%)	15 (94%)
5.30pm-6.30pm	16	4 (25%)	16 (100%)

8.2.2 R^2 Value

Figure 22 to Figure 24 shows that the AM peak R^2 values are between 0.97 and 0.98 for the core calibration area. Similarly, for the PM peak, the R^2 values for the core calibration area are between 0.98 and 0.99. This also meets the R^2 target outlined in the *ACT Traffic Microsimulation Modelling Guidelines* where the required value is greater than 0.95.

AM Peak

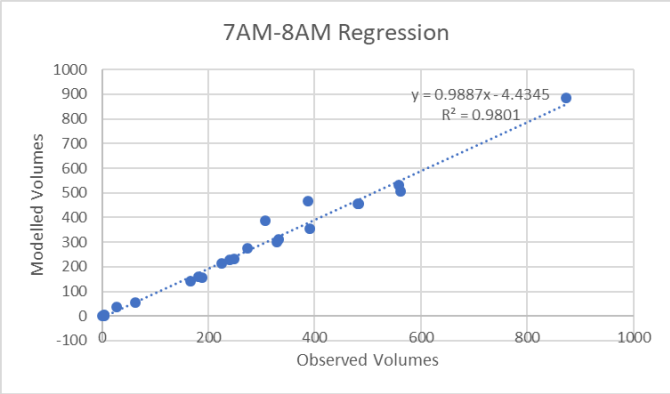


Figure 22 7AM-8AM Base R^2 Plot

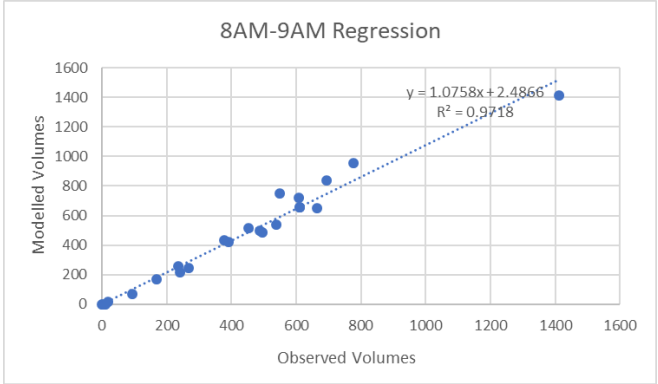


Figure 23 8AM-9AM Base R^2 Plot

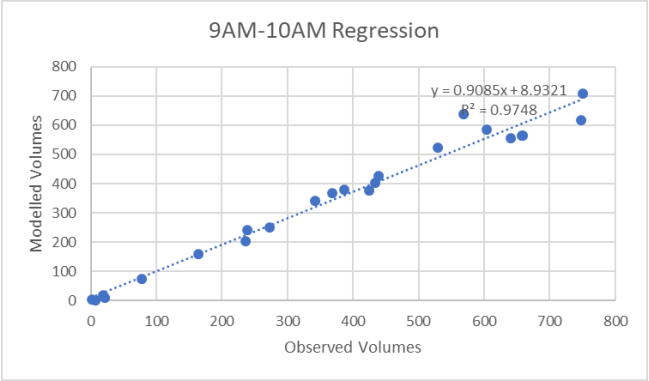


Figure 24 9AM-10AM Base R^2 Plot

PM Peak

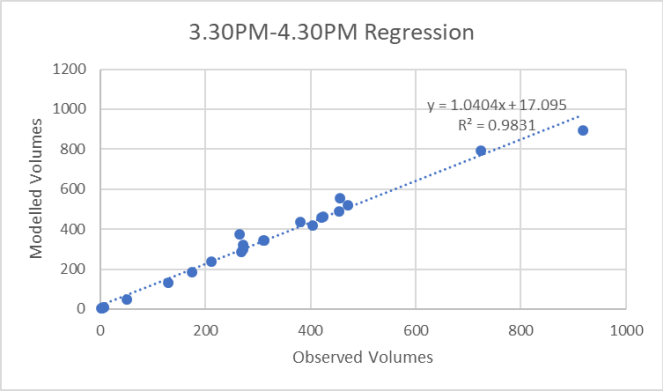


Figure 25 3.30PM-4.30PM Base R^2 Plot

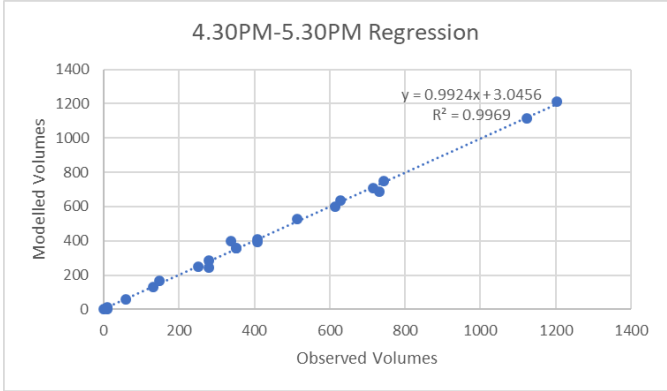


Figure 26 4.30PM-5.30PM Base R^2 Plot

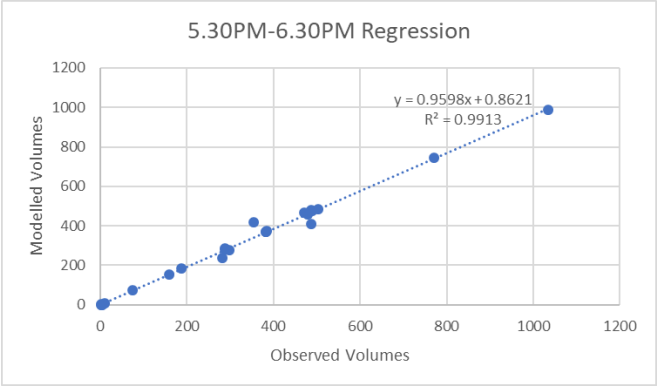


Figure 27 5.30PM-6.30PM Base R^2 Plot

8.2.3 Base Model Stability

A summary of the model stability analysis, comparing the stability of the base model between seed value runs is shown in Table 18.

The model stability is analysed by comparing differences in travel times between seed runs based on the “coefficient of variation” metric, where a variation of less than 5% is considered to indicate a good level of stability. The stability analysis shoes that the coefficient of variation is 4% and 3% for the AM and PM peak periods respectively.

Therefore, it is considered that both the AM and PM peak periods are stable and can reliably be used to forecast future scenarios.

As outlined previously, seed number 86524 showed an unusual lock-up at the Dudley Street / Novar Street roundabout and hence was omitted from the model in the AM peak.

Table 18 Model Stability Analysis

VHT	Seed 28	Seed 560	Seed 2849	Seed 7771	Seed 86524	Avg	Standard Deviation	Coefficient of Variation
AM Peak	495.11	474.74	456.05	454.23	N/A	470.03	19.12	4%
PM Peak	285.32	271.52	284.59	285.59	293.07	284.02	7.79	3%

8.3 Future Year Base Model

8.3.1 Future Year Base Model Geometry

The 2031 future year base model was updated to include the following changes:

- Canberra Brickworks Access Road and Dudley Street upgrade (Figure 28)
- Ken Street upgrades (Figure 29) which include
  - Signalisation of the Dudley Street/Kent Street, Kent Street / Adelaide Avenue off-ramp and Kent Street/ Denison Street intersection
  - Upgrades to the road alignment along Kent Street

Base Case

Future Case

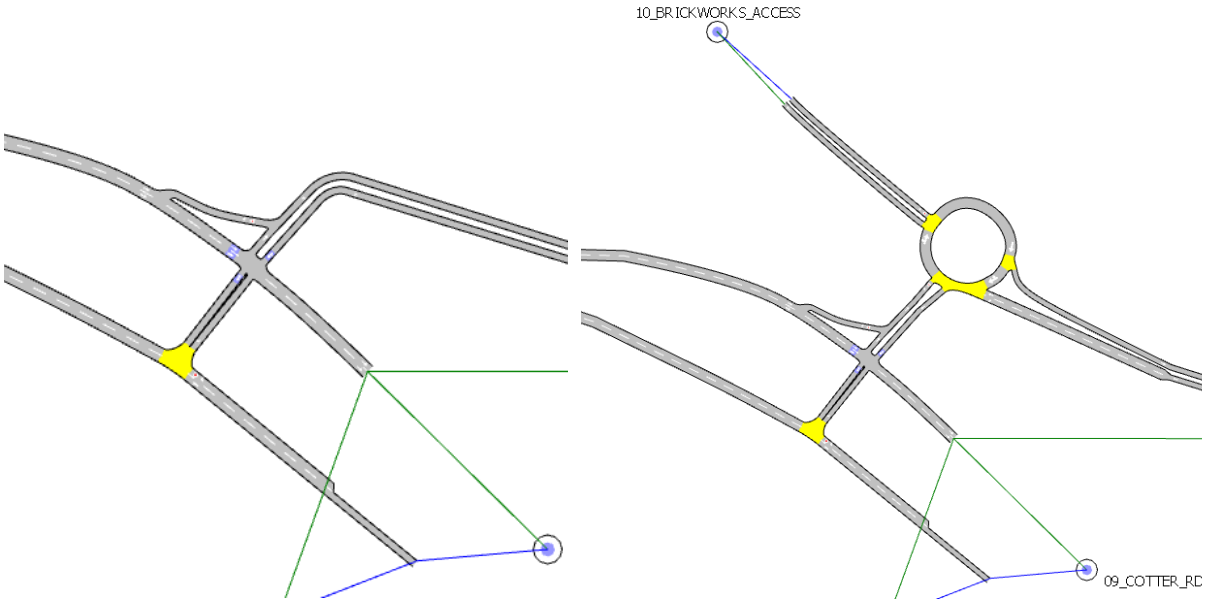


Figure 28 Brickworks Access Dudley Street Upgrades

Base Case

Future Case

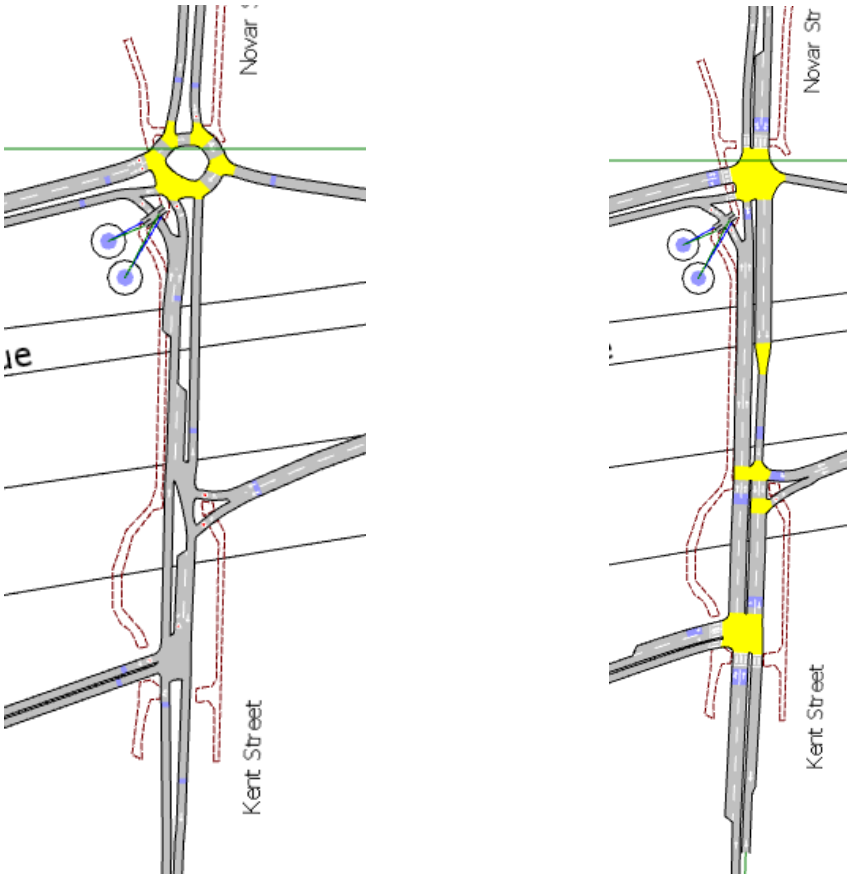


Figure 29 Kent Street Upgrades

8.3.2 Background Traffic Growth

A background traffic growth rate of 1.3% per annum has been utilised for the future year 2031 scenario. Details of how the growth rate was determined is available in Appendix B. A summary of the approaches to forecast growth rate is shown in Table 19.

Table 19 Summary of Approaches to Forecast Growth Rate

Approach	Annual Growth Rate
SCATS data and comparative assessment	1%
Canberra Strategic Transport Model (CSTM) volume projections	1.3%
CSTM land use forecast values	1.5%

Based on the review of the various approaches and datasets a rate of 1.3% was chosen per annum between 2017 to 2031.

CSTM is the most accurate model available for determination of the traffic growth in the ACT and is the preferred traffic growth method for TCCS.

8.4 Future Year Scenario Model

The peak hour trip generation for the site as outlined in Section 6.1 was added to the 2031 future year base model to determine 2031 future year scenario model. Since the model is a 3-hour model for both the AM and PM peaks, a trip generation of 100% was utilised for the peak 1 hour and a trip generation of 50% was utilised for each hour either side of the peak 1-hour period.

Please note that there were minor revisions to the Yarralumla masterplan and the land use mix after the future year modelling exercise was concluded. It must be stressed that the trip generation and parking estimates presented in the previous sections reflect the latest estimates, yet the same is not applicable to the Aimsun modelling. AECOM has reviewed the changes to the masterplan layout and considers that internal circulation has not altered significantly. Whereas, the overall peak hour trips of the revised masterplan have increased by 54 vehicles, given the maximum traffic distribution split in Table 9 of the Kent St (32%), these changes will result in an additional 17 vehicles during the peak hour which is considered insignificant to the overall traffic demand of this street and its intersections. Hence AECOM has not undertaken model re-runs and assumes that there will not significant deviations to the results and discussions presented in the following sections.

8.5 Network Performance

To assess network performance, the base model and two traffic demand scenarios were tested for AM and PM weekday peaks:

1. Existing Base
2. 2031 without development
3. 2031 with development

8.5.1 Network Demand

The total network demand for each of the scenarios listed above is shown below in Figure 30. The number of vehicles waiting to enter the network is shown in Figure 31. The maximum number of vehicles waiting to enter the network is 14 vehicles for all scenarios. This indicates the scenarios are operating reasonably and that there are no unusual lock-ups or operational issues in the models during their operation.

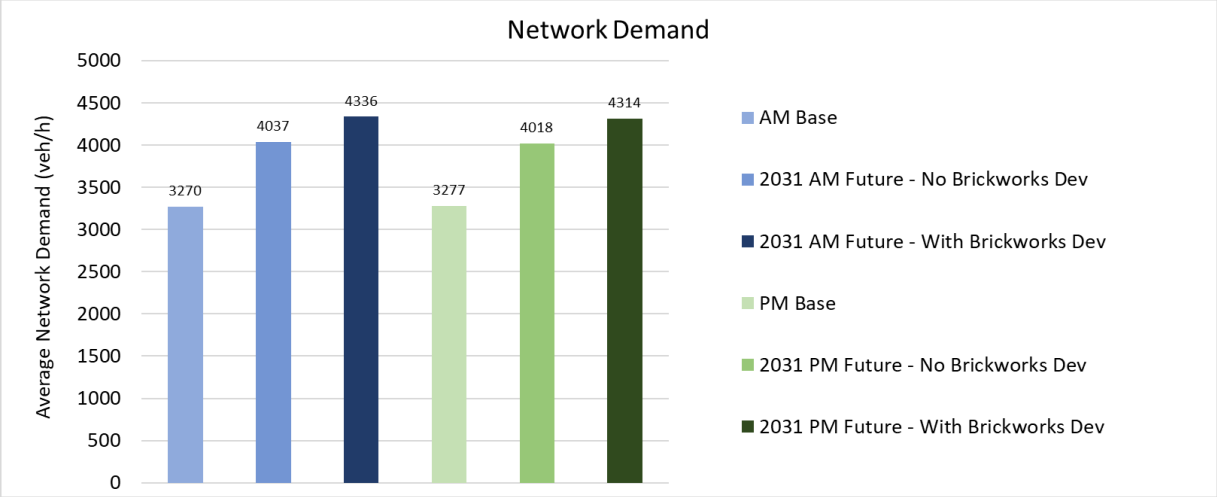


Figure 30 Average Network Demand

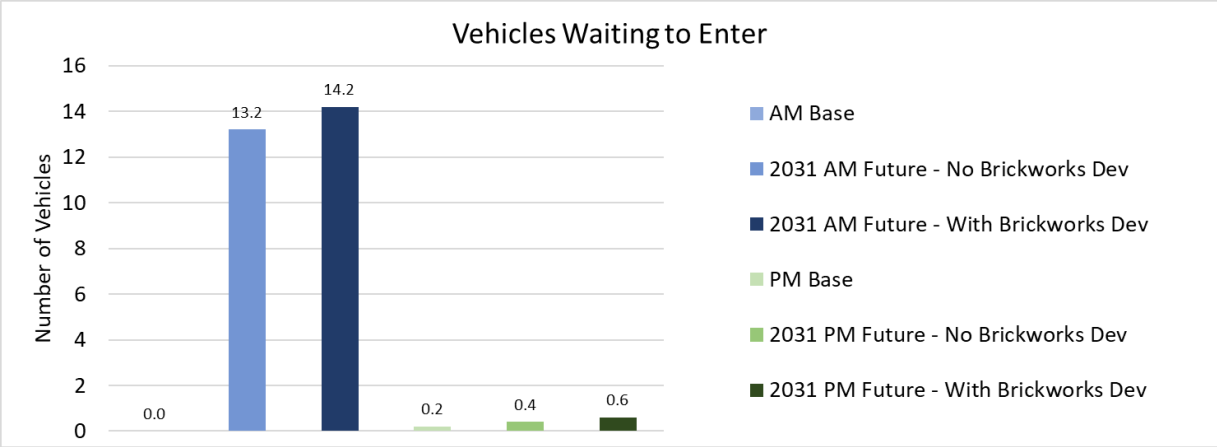


Figure 31 Vehicles Waiting to Enter the Network

8.5.2 Network Results

For each of the demand scenarios, overall network performance in the study area network was summarised in Figure 32 to Figure 35, expressed in terms of a range of performance criteria:

- Average network delay times in the study area (Figure 32)
- Number of missed turns in the study area network (Figure 33)
- Total vehicle hours travelled in the study area network (Figure 34)
- Total vehicle kilometres travelled in the study area network (Figure 35)

These show that the increase in travel times and delays from the existing base to 2031 is mostly due to the increase in background traffic growth in 2031.Compared to the base 2031 data, the additional demand from the Yarralumla Brickworks site has minor impact to the road network. The most noticeable delays are delays along Kent Street which consequently increase delays along Dudley Street. To alleviate these delays, additional green time was allowed for vehicles along the Kent Street approach at the Dudley Street / Kent Street intersection which resulted in better performance of the intersection.

The number of missed turns represent the number of vehicles that deviated from their original assigned path. This is mostly attributed to congestion in the model and vehicles undertaking an alternate route. The AM base model has more missed turns than 2031 base and 2031 scenario model.

This higher number of missed turns in the existing scenario can be attributed to the different intersection layouts between the existing and 2031 scenarios.

The vehicle hours travelled (VHT), and vehicle kilometres travelled (VKT) give an overall indication of additional congestion in the network because of the proposed development. As a result of the Yarralumla Brickworks development, there is only a minor increase in the VHT and VKT over the total 3-hour model period for the AM and PM peaks.

Other network results plots, including vehicle density and average delay can be found in Appendix C. These plots show the most critical 1-hour period for the AM and PM peaks which are 8.30AM-9.30AM and 4.45PM-5.45PM respectively.

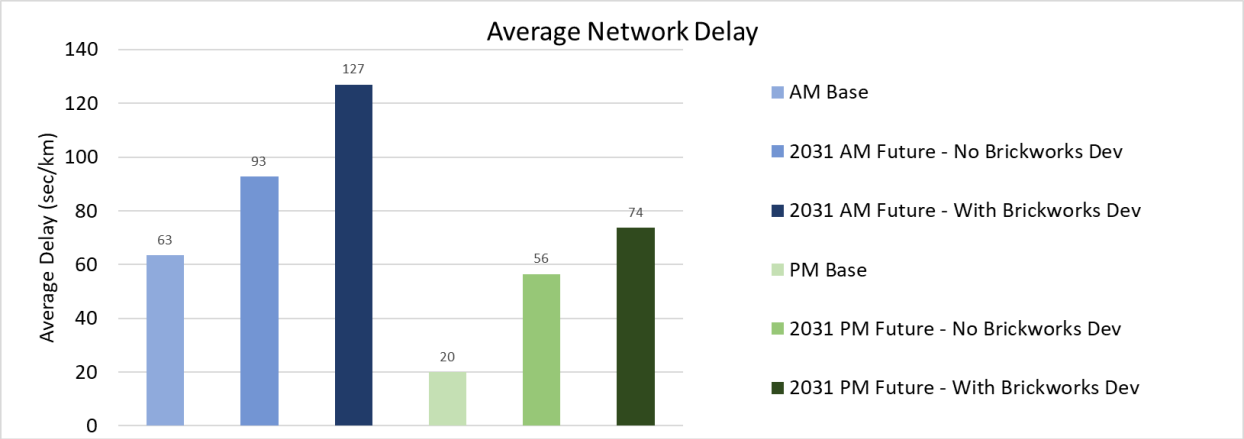


Figure 32 Average Network Delay

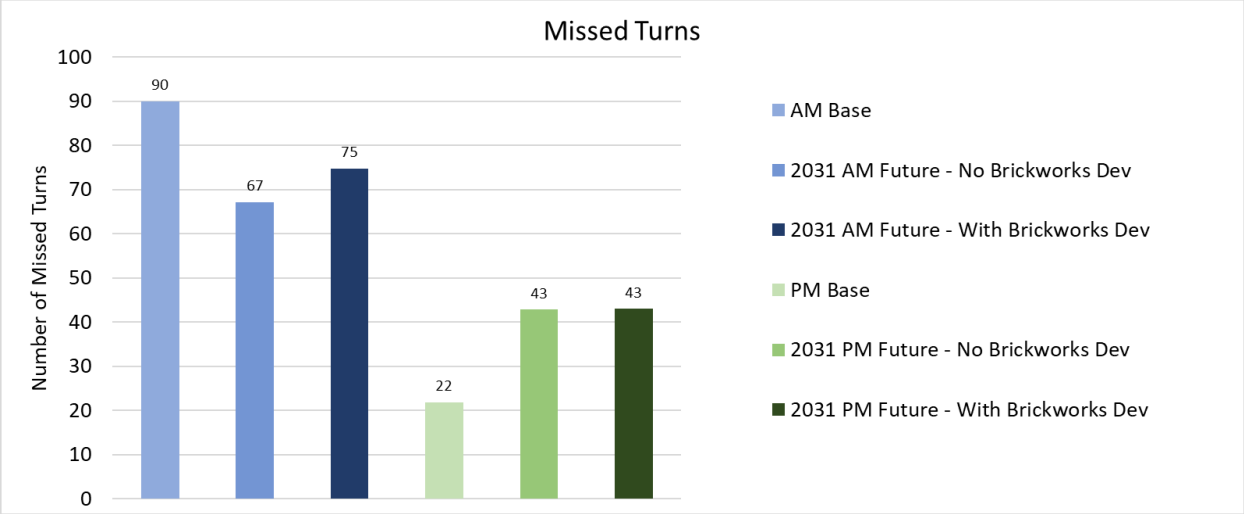


Figure 33 Number of Missed Turns

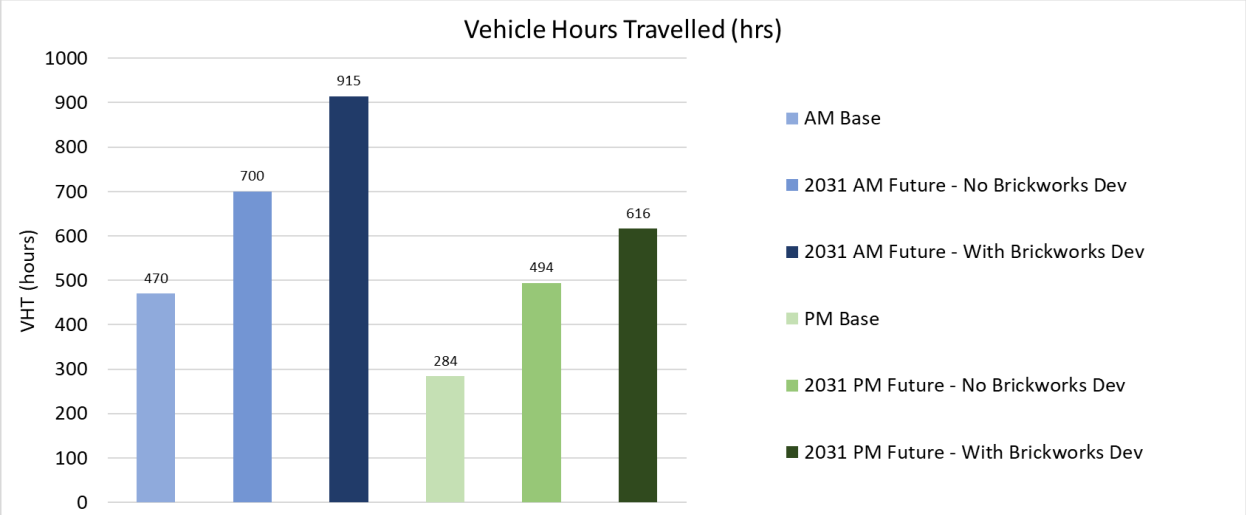


Figure 34 Vehicle Hours Travelled (hrs)

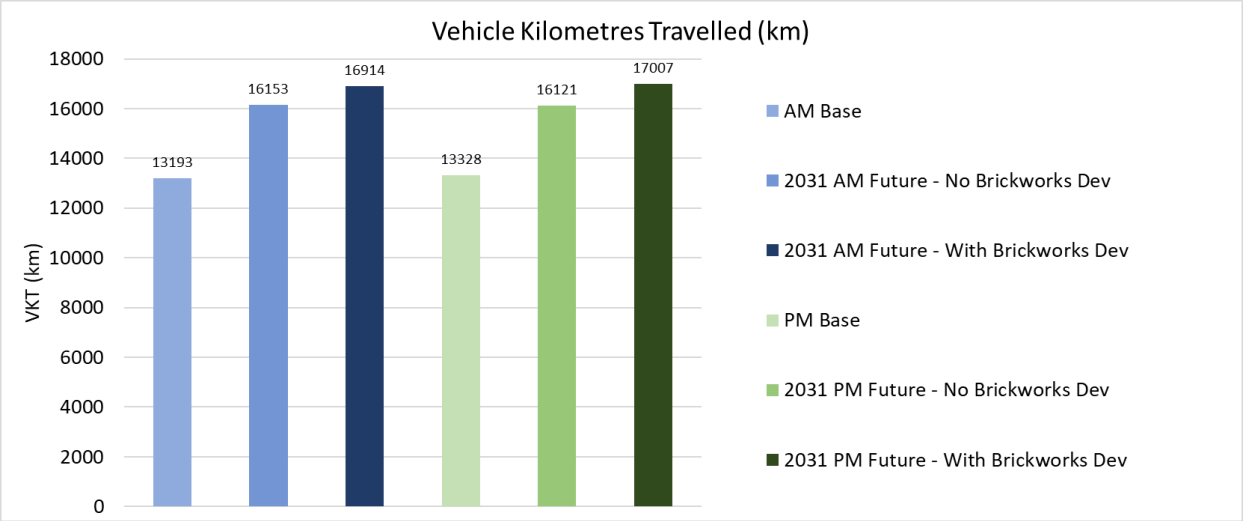


Figure 35 Vehicle Kilometres Travelled (km)

8.6 Intersection Performance

8.6.1 Key Intersection Performance

Intersection performance was analysed at each of the major intersections possibly impacted by the proposed development in the model in both the AM and PM peaks. The results of this analysis are shown in Figure 36. The average intersection delay as a result of the proposed development typically had less than a 5 second increase in delay at any of the key intersections in model. The maximum increase in delays is 13 seconds at the Dudley Street / Kent Street intersection in the PM peak between the base 2031 and 2031 development year scenarios, this is a result of the demand generated from the Brickworks site increasing the traffic movements from Dudley Street turning right into Kent Street southbound. As can be seen in Figure 36, the increase in intersection delay between the existing base model and the 2031 models are mostly attributed to background traffic growth.

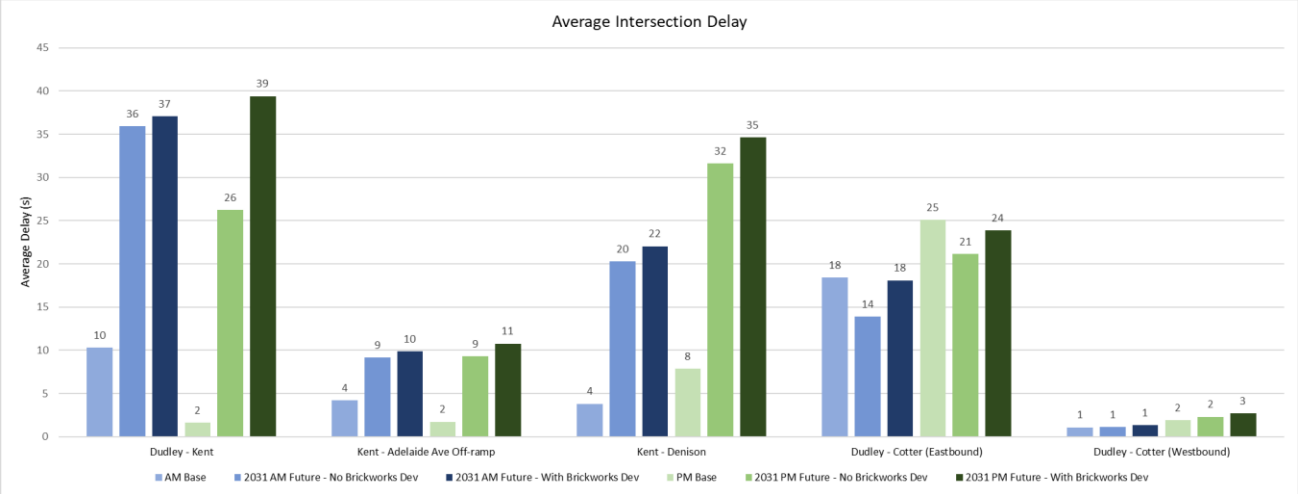


Figure 36 Average Intersection Delay

8.6.2 Overall Intersection Performance

Intersection performance is commonly presented in terms of level of service (LOS), ranging from A to F as shown in Table 20.

Table 20 Level of Service Criteria - Intersections

Level of Service	Description
A	Good Operation
B	Good with acceptable delays & spare capacity
C	Satisfactory
D	Operating near capacity
E	At capacity; incidents will cause excessive delays
F	Flow break down occurs

The results of the level of service analyses for the existing and future AM and PM peak scenarios are shown in Figure 37 to Figure 42. The AM and PM peaks shown represent the most critical 1-hour period which are 8.30AM-9.30AM and 4.45PM-5.45PM. In the existing base case, the worst level of service recorded is LOS F in the AM peak. This is along the Dudley Street leg on approach to the Dudley Street / Kent Street roundabout. The low level of service on this leg is largely due to the high volumes from the Kent Street approach.

When comparing the LOS with the added traffic from Brickworks development with the 2031 forecast volumes, there is decrease in serviceability at the Dudley Street / Kent Street and Denison Street / Kent Street intersections. This is mostly due to the increase in demand along the Kent Street and the delays at the traffic lights. AECOM have undertaken sensitivity analysis and have optimised signal timing along Kent Street to minimise delays.

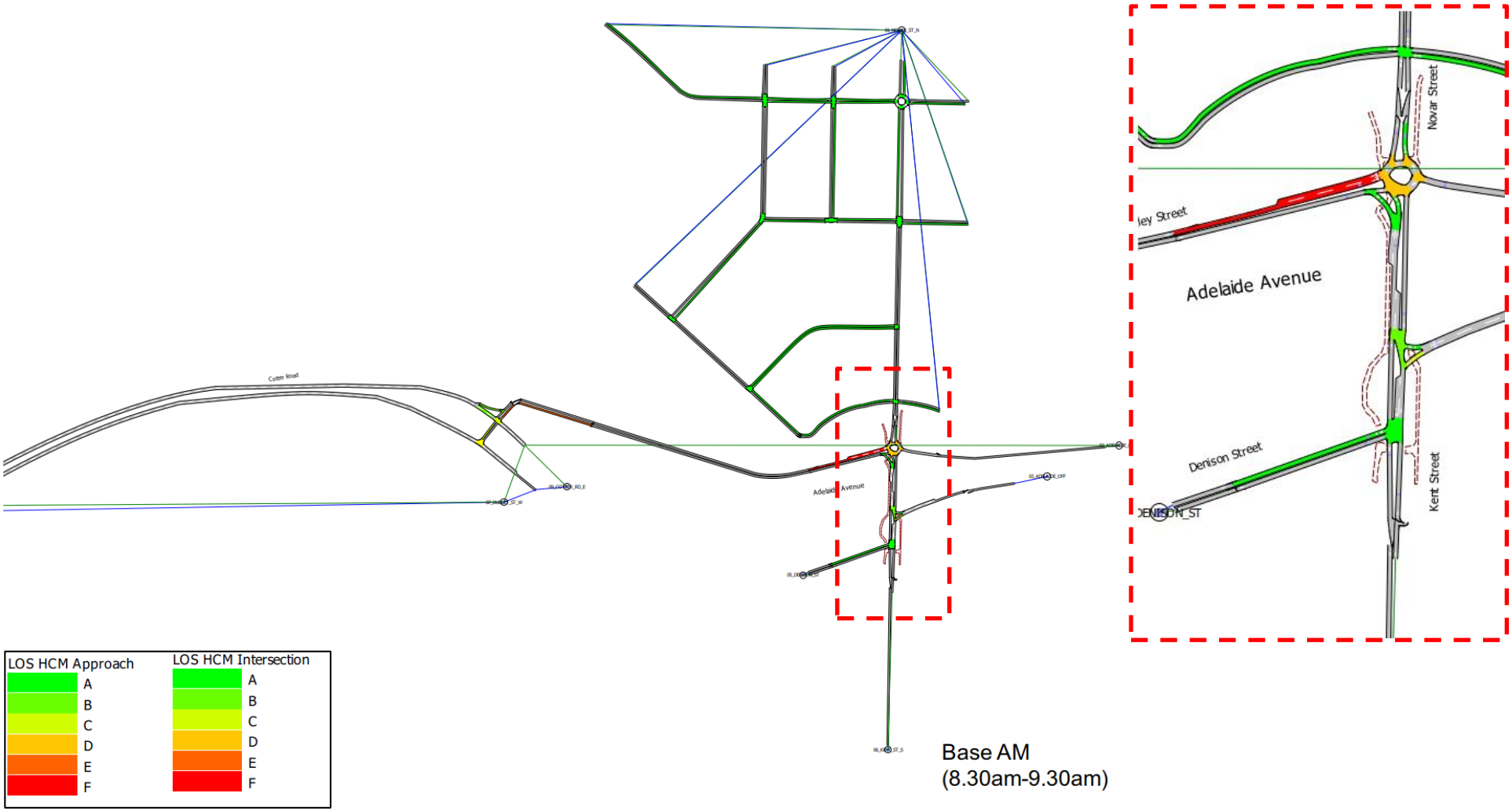


Figure 37 Base AM LOS – 8.30AM-9.30AM

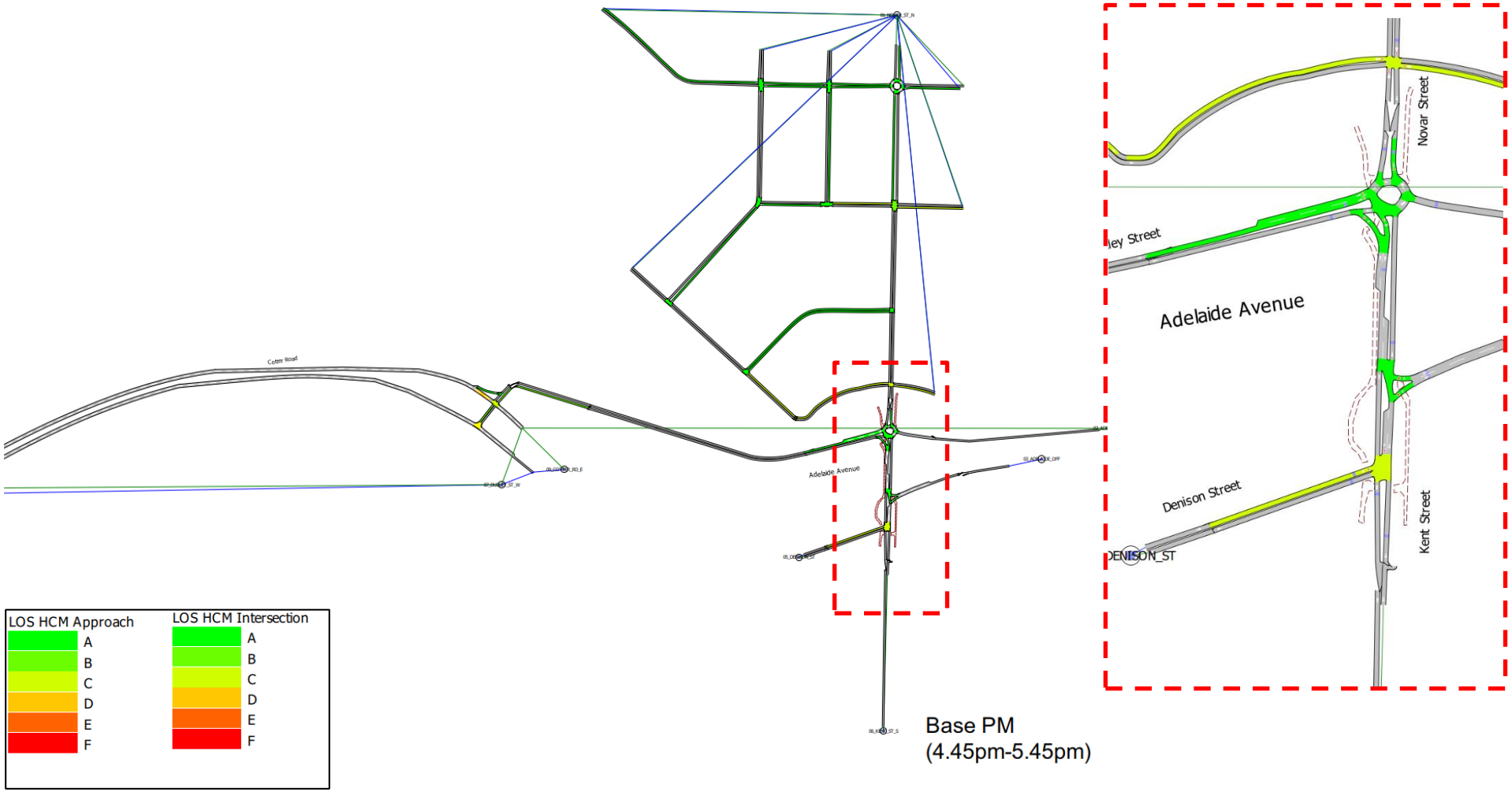


Figure 38 Base PM LOS – 4.45PM-5.45PM

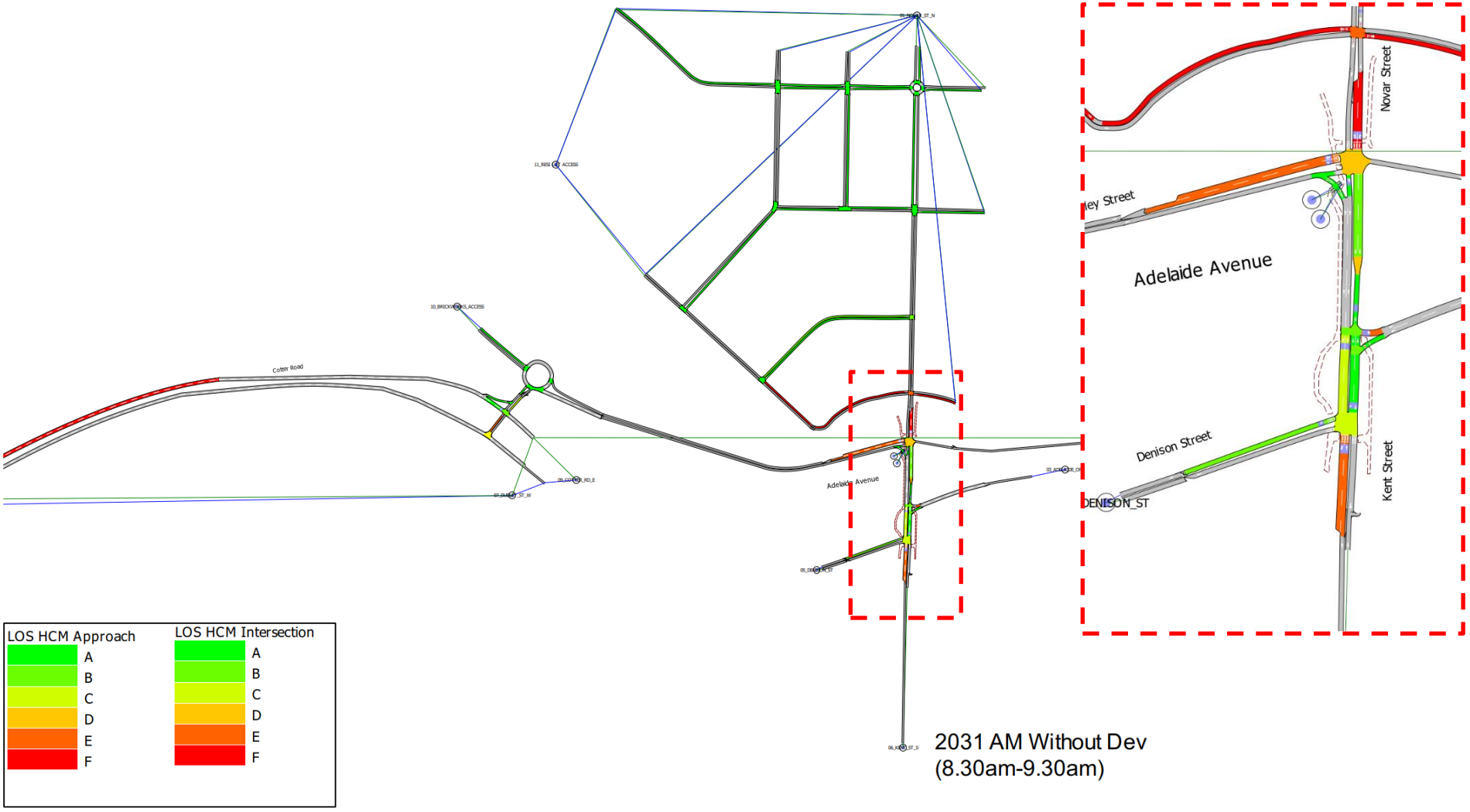


Figure 39 2031 AM Without Dev LOS – 8.30AM-9.30AM

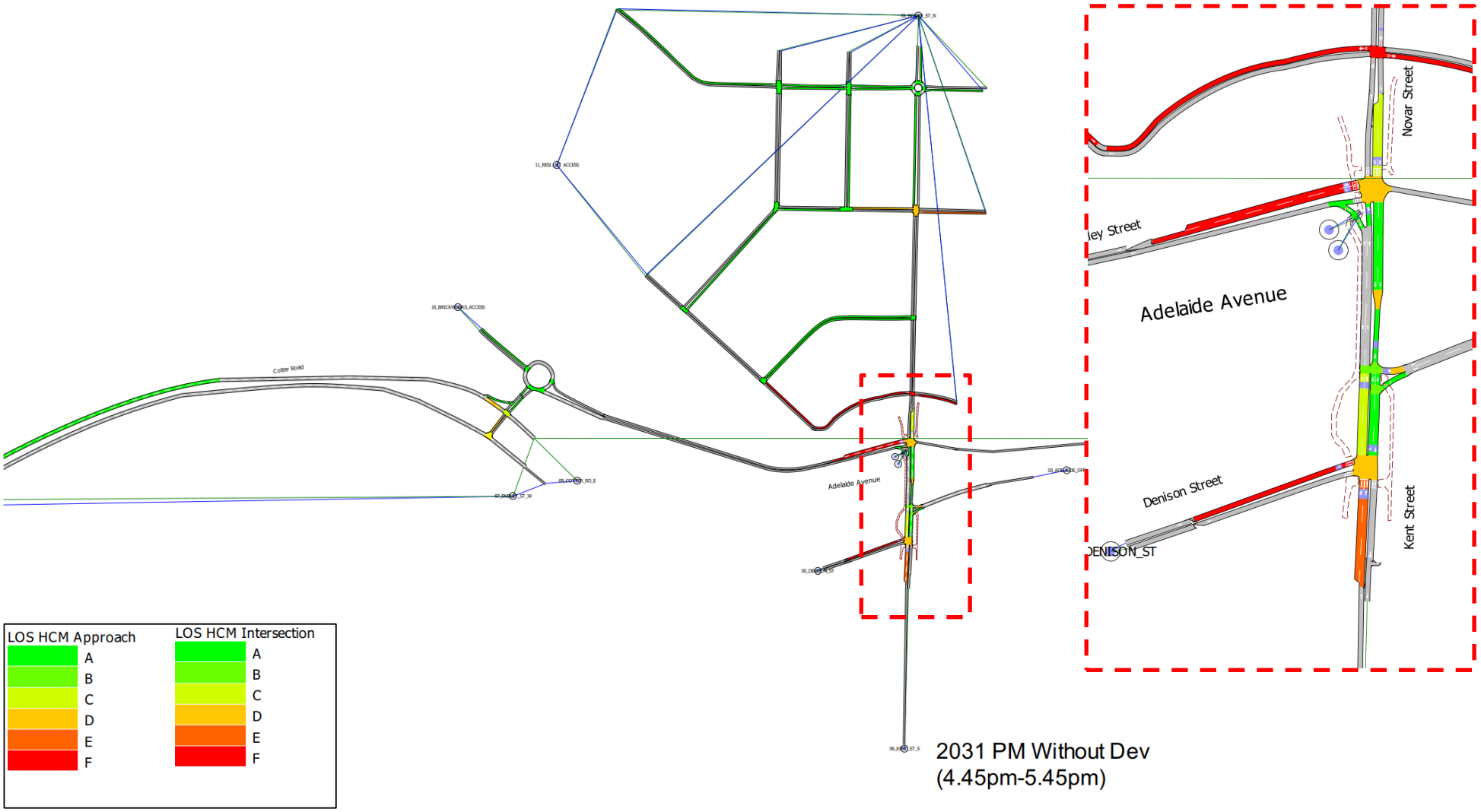


Figure 40 2031 PM Without Dev LOS – 4.45PM-5.45PM

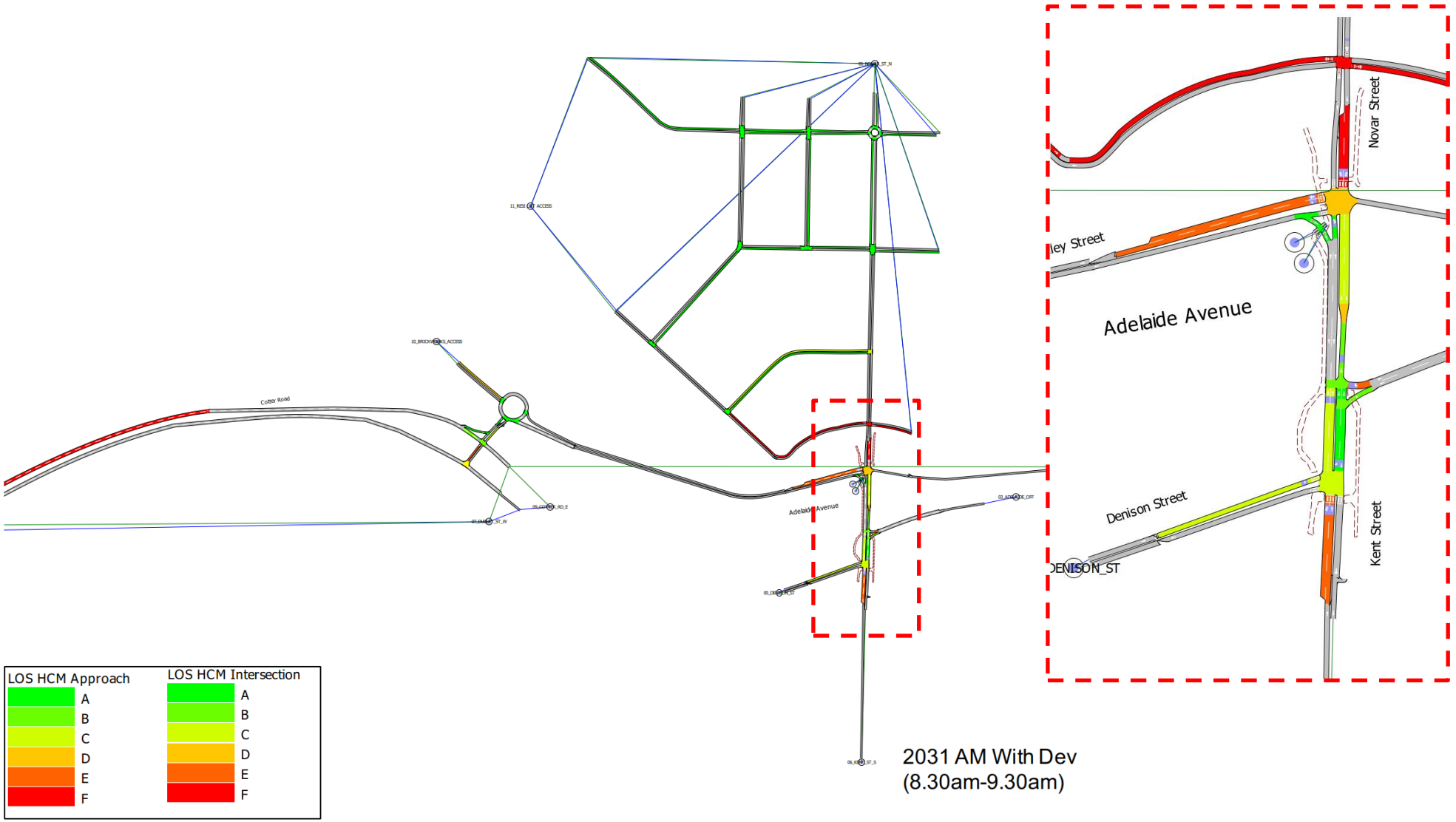


Figure 41 2031 AM With Dev LOS – 8.30AM-9.30AM

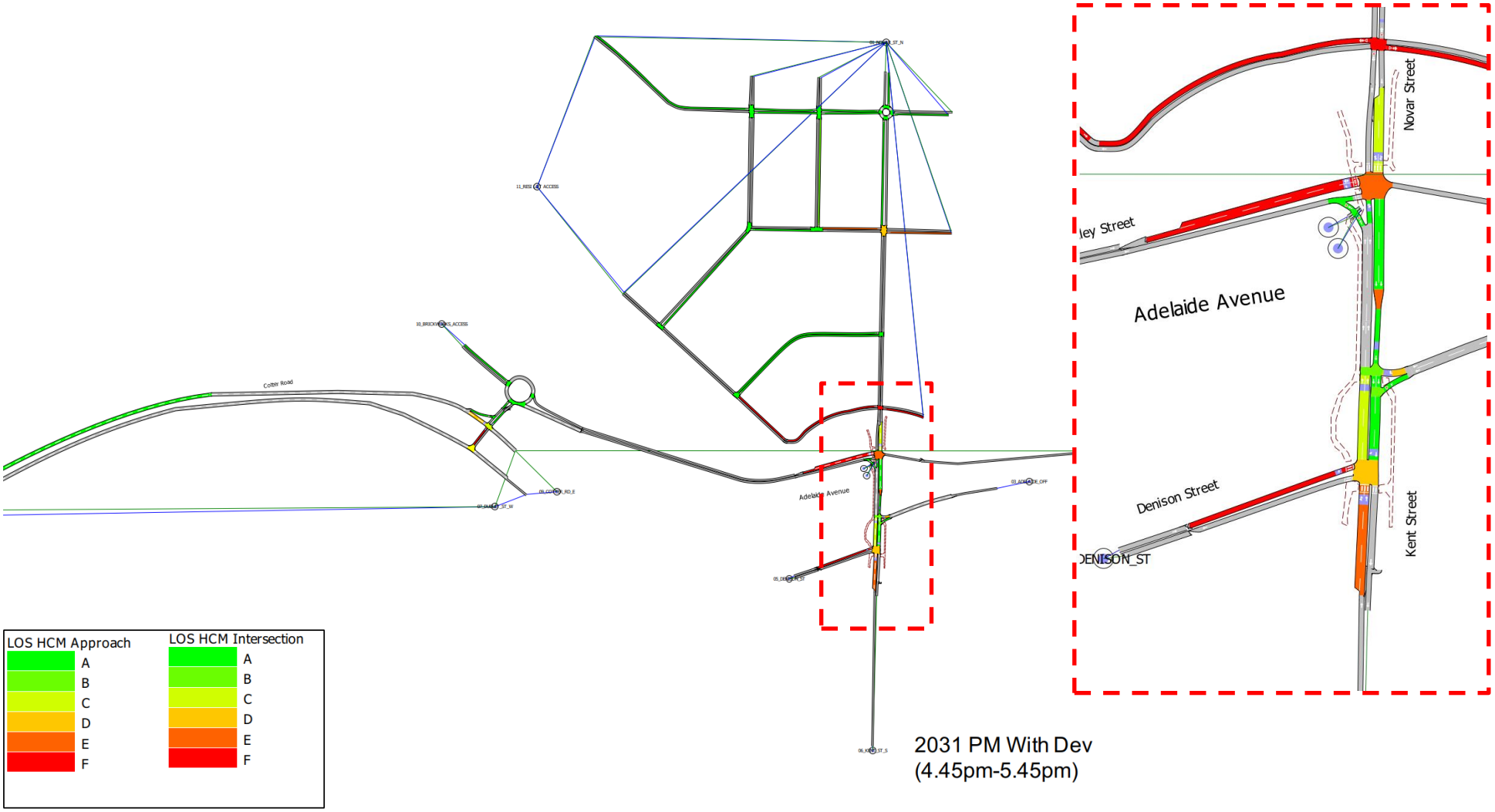


Figure 42 2031 PM With Dev LOS – 4.45PM-5.45PM

8.7 Network Issues and Mitigation Measures

Following on from the results analysis in Sections 8.5 and 8.6, there is a notable increase in network delays and decrease in level of service as a result of the background growth in Yarralumla through to 2031 in both the AM and PM peak periods.

AECOM has not undertaken a thorough review of the suitability on the future road network augmentations as a part of the traffic modelling for the Yarralumla Brickworks development. The future road augmentations and network extents are as per TCCS's requirements for the Aimsun model network coding and the proposed Kent Street and Dudley Street designs previously undertaken by AECOM.

The critical factor relating to this project is identifying the individual impact on the future traffic network of the Yarralumla Brickworks development. The traffic distributions outlined in Section 6.2 indicate that most of the traffic to the site is generated from Kent Street and the Adelaide Avenue off-ramp, whilst traffic exiting the site travel mostly via Cotter Road. The site traffic distribution is also shown in Figure 43.

As noted above and in Section 8.6.1, the increase in delays in 2031 are mostly due to the increase in background traffic growth. There is notable increase in delays particularly at the intersections along Kent Street. This could also be attributed to the proposed signalisation of the intersections along the road where there are added delays to traffic along Kent Street. Whereas in the existing base case, traffic along Kent Street has priority. When comparing the 2031 development with the base 2031 scenario, the is a slight decrease in LOS at the Denison Street and Dudley Street intersections along Kent Street. However, overall increase in delays at the intersections are only minor with the maximum increase being 13 seconds.

AECOM also undertook sensitivity analysis to optimise signal timing at the intersections along Kent Street. The signals were modelled as actuated signals with more favourable green time for traffic along Kent Street.

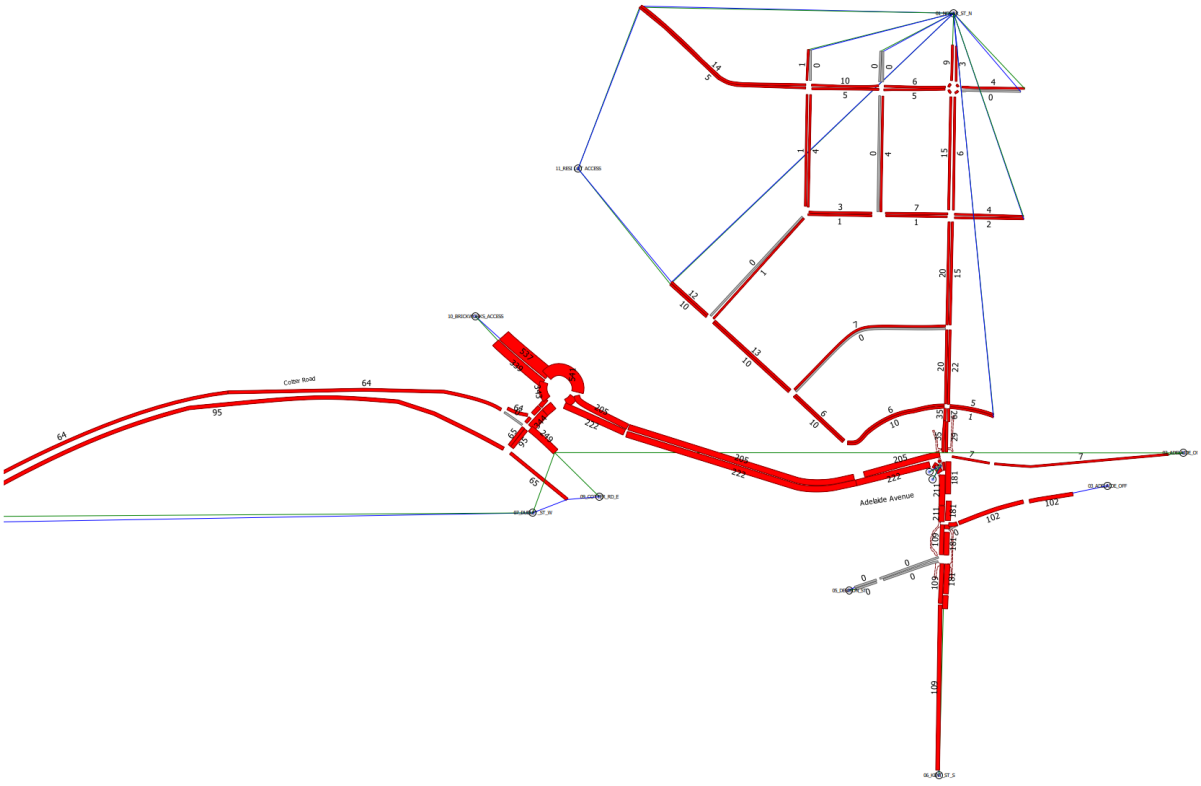


Figure 43 2031 7AM-10AM – Yarralumla Brickworks Traffic Distribution

8.8 Network Analysis Summary

In summary, the analysis undertaken as part of this study has determined the operational impacts which will occur throughout the study area in 2031 in the peak AM and PM periods as a result of background growth and the proposed Yarralumla Brickworks Development. As a result of this study, it has been determined that the proportional impact to the traffic network that can be attributed to the future Brickworks development is not significant in terms of increases in delay or level of service operation at key intersections or throughout the study area in 2031.

9.0 Conclusions and Recommendations

A summary of the key findings of the report are detailed below:

Adequacy of Car Parking

- The parking for the proposed development will meet the demand for both the private and public land uses.
- For the residential apartments, 150 parking spaces in excess of the requirements in the *Parking and Vehicular Access General Code* (PVAGC) are proposed for the development.
- For the public uses, there are 47 less parking spaces than the direct application of requirements in the PVAGC. However, given the temporal nature of the parking demand, the temporal profile analysis indicated that the peak demand will be 288 parking spaces, while there is a total of 327 public parking spaces proposed for the development. There is a low risk of insufficient public parking being provided on site based on the analysis undertaken.

Impact on Traffic Operations

- AIMSUN modelling showed that the increase in background traffic demand 2031 has notable impact on the overall performance of the network in the study area. There is notable increase in delays particularly at the intersections along Kent Street. This could also be attributed to the proposed signalisation of the intersections along the road where there are added delays to traffic along Kent Street, whereas in the existing base case traffic along Kent Street has priority. It should be emphasised that AECOM has not undertaken sensitivity analysis on the proposed future augmentation of the road as part of the traffic modelling for the Yarralumla Brickworks development. This was undertaken as part of the optioneering analysis for the Kent Street upgrade project and the currently proposed future layout from the Kent Street upgrade analysis has been used as the layout for the future Brickworks analysis in this report.
- AECOM undertook sensitivity analysis to optimise signal timing at the intersections along Kent Street. The signals were modelled as actuated signals with more favourable green time for traffic along Kent Street optimising the overall operation of the road network.
- As a result of this study, it has been determined that the proportional impact to the traffic network that can be attributed to the future Brickworks development is not significant in terms of increases in delay or level of service operation at key intersections or throughout the study area in 2031.

Accessible, Motorcycle and Bicycle Parking

- The ACT Parking and Vehicular Access General Code requires that 3% of public spaces to be provided be compliant for disabled parking. This amounts to 10 disabled parking spaces required for the site.
- The Bicycle Parking General Code for the ACT was used to determine the required supply of bicycle parking spaces. According to the code a supply of 347 bicycle parking spaces must be provided in total, with 312 spaces allocated for residents, and 35 for visitors and guests. The design for the Yarralumla brickworks accommodates this need and additionally an extra 10 bicycle parking spaces has been provided for the Fitness and Wellness Centre totalling to 357 spces.

Site Access and Service Vehicles

- The main access to the site is proposed via the new Brickworks Access Road which connects to Dudley Street and Cotter Road. Service vehicles will also use this access.
- There are other accesses to the site via Denman Street and Bentham Street which provides access to the townhouses and the residential lots on the east side of the development.

Appendix A

GEH Results

Appendix A GEH Results

AM Base Existing - 7am-8am - Core Calibration Area		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	1.269040131
Kent St/Denison St	North_T	3.753785968
Kent St/Denison St	West_L	0.949414688
Kent St/Denison St	West_R	0.358568583
Kent St/Denison St	South_L	0.393919299
Kent St/Denison St	South_T	1.536278286
Kent St/Adelaide Avenue	North_T	1.142392192
Kent St/Adelaide Avenue	East_L	0.818463256
Kent St/Adelaide Avenue	East_R	1.461264561
Kent St/Adelaide Avenue	South_T	1.785743948
Dudley St/ Kent St	North_Entry	2.140649838
Dudley St/ Kent St	North_Exit	1.032795559
Dudley St/ Kent St	South_Entry	4.237890068
Dudley St/ Kent St	South_Exit	1.211950882
Dudley St/ Kent St	West_Entry	1.18990815
Dudley St/ Kent St	West_Exit	2.48352234
Dudley St/ Kent St	East_Exit	0.709119614
Dudley St/Cotter Rd	North_R	1.785163617
Dudley St/Cotter Rd	North_L	0.447213595
Dudley St/Cotter Rd	West_L	2.336808541
Dudley St/Cotter Rd	West_T	0.396289487
Dudley St/Cotter Rd	East_R	2.915475947
Dudley St/Cotter Rd	East_T	0.030219894
AM Base Existing - 7am-8am - Secondary Calibration Area		
Intersection	**Turn**	**GEH**
Novar St/Denman St/Kintore St	North_Entry	1.36438208
Novar St/Denman St/Kintore St	North_Exit	2.787849459
Novar St/Denman St/Kintore St	South_Entry	3.490011487
Novar St/Denman St/Kintore St	South_Exit	1.226341047
Novar St/Abbot St	North_Entry	1.793223961
Novar St/Abbot St	North_Exit	2.895520661
Novar St/Abbot St	South_Entry	2.821382463
Novar St/Abbot St	South_Exit	1.36438208
Novar St/Weston St	North_Entry	2.311494736
Novar St/Weston St	North_Exit	3.328074235
Novar St/Weston St	South_Entry	2.828427125
Novar St/Weston St	South_Exit	3.681758696
Novar St/Loftus St/Bentham St	North_Entry	2.246987105
Novar St/Loftus St/Bentham St	North_Exit	1.678744119
Novar St/Loftus St/Bentham St	South_Entry	3.34688303
Novar St/Loftus St/Bentham St	South_Exit	2.612833391

AM Base Existing - 8am-9am – Core Calibration Area		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	2.929549265
Kent St/Denison St	North_T	7.944231357
Kent St/Denison St	West_L	0.211930708
Kent St/Denison St	West_R	0
Kent St/Denison St	South_L	0.058722022
Kent St/Denison St	South_T	0.497183076
Kent St/Adelaide Avenue	North_T	1.728628455
Kent St/Adelaide Avenue	East_L	1.514155837
Kent St/Adelaide Avenue	East_R	2.760671363
Kent St/Adelaide Avenue	South_T	0.497282977
Dudley St/ Kent St	North_Entry	1.354424
Dudley St/ Kent St	North_Exit	2.756966388
Dudley St/ Kent St	South_Entry	4.25872517
Dudley St/ Kent St	South_Exit	1.728628455
Dudley St/ Kent St	West_Entry	5.12456341
Dudley St/ Kent St	West_Exit	1.790082569
Dudley St/ Kent St	East_Exit	0.596523158
Dudley St/Cotter Rd	North_R	1.305044379
Dudley St/Cotter Rd	North_L	1.58113883
Dudley St/Cotter Rd	West_L	6.019920661
Dudley St/Cotter Rd	West_T	0
Dudley St/Cotter Rd	East_R	3.900142448
Dudley St/Cotter Rd	East_T	0.075369097
AM Base Existing - 8am-9am – Secondary Calibration Area		
Intersection	**Turn**	**GEH**
Novar St/Denman St/Kintore St	North_Entry	1.328120274
Novar St/Denman St/Kintore St	North_Exit	4.093156081
Novar St/Denman St/Kintore St	South_Entry	5.638394056
Novar St/Denman St/Kintore St	South_Exit	0.137665542
Novar St/Abbot St	North_Entry	1.524079423
Novar St/Abbot St	North_Exit	4.238336246
Novar St/Abbot St	South_Entry	4.093156081
Novar St/Abbot St	South_Exit	1.391447324
Novar St/Weston St	North_Entry	3.363329729
Novar St/Weston St	North_Exit	0.805451674
Novar St/Weston St	South_Entry	4.334816858
Novar St/Weston St	South_Exit	1.571481405
Novar St/Loftus St/Bentham St	North_Entry	2.546818464
Novar St/Loftus St/Bentham St	North_Exit	0.453609212
Novar St/Loftus St/Bentham St	South_Entry	2.662559326
Novar St/Loftus St/Bentham St	South_Exit	3.352716832

AM Base Existing - 9am-10am – Core Calibration Area		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	1.503357461
Kent St/Denison St	North_T	2.879670749
Kent St/Denison St	West_L	0.412957192
Kent St/Denison St	West_R	3.464718387
Kent St/Denison St	South_L	0
Kent St/Denison St	South_T	0.649707074
Kent St/Adelaide Avenue	North_T	3.799724792
Kent St/Adelaide Avenue	East_L	0.013520923
Kent St/Adelaide Avenue	East_R	0.458831468
Kent St/Adelaide Avenue	South_T	0.830780155
Dudley St/ Kent St	North_Entry	1.470440253
Dudley St/ Kent St	North_Exit	2.460578423
Dudley St/ Kent St	South_Entry	0.250503645
Dudley St/ Kent St	South_Exit	3.751112423
Dudley St/ Kent St	West_Entry	5.036318409
Dudley St/ Kent St	West_Exit	2.297507087
Dudley St/ Kent St	East_Exit	0.34474016
Dudley St/Cotter Rd	North_R	0.193447764
Dudley St/Cotter Rd	North_L	1.326977605
Dudley St/Cotter Rd	West_L	3.432146955
Dudley St/Cotter Rd	West_T	1.555555556
Dudley St/Cotter Rd	East_R	3
Dudley St/Cotter Rd	East_T	0.013034365
AM Base Existing - 9am-10am – Secondary Calibration Area		
Intersection	**Turn**	**GEH**
Novar St/Denman St/Kintore St	North_Entry	1.429914923
Novar St/Denman St/Kintore St	North_Exit	4.111180494
Novar St/Denman St/Kintore St	South_Entry	4.011518446
Novar St/Denman St/Kintore St	South_Exit	0.644018619
Novar St/Abbot St	North_Entry	1.56492329
Novar St/Abbot St	North_Exit	4.237455139
Novar St/Abbot St	South_Entry	4.12387141
Novar St/Abbot St	South_Exit	1.367061337
Novar St/Weston St	North_Entry	2.237103826
Novar St/Weston St	North_Exit	4.701293556
Novar St/Weston St	South_Entry	4.395783103
Novar St/Weston St	South_Exit	2.186462366
Novar St/Loftus St/Bentham St	North_Entry	1.93792558
Novar St/Loftus St/Bentham St	North_Exit	0.87038828
Novar St/Loftus St/Bentham St	South_Entry	4.619536525
Novar St/Loftus St/Bentham St	South_Exit	2.07291272

PM Base Existing - 3.30pm-4.30pm – Core Calibration Area		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	0.67363307
Kent St/Denison St	North_T	6.083293825
Kent St/Denison St	West_L	1.773937188
Kent St/Denison St	West_R	0.905725667
Kent St/Denison St	South_L	0.518163247
Kent St/Denison St	South_T	1.610152972
Kent St/Adelaide Avenue	North_T	1.726949027
Kent St/Adelaide Avenue	East_L	0.140221462
Kent St/Adelaide Avenue	East_R	0.342159569
Kent St/Adelaide Avenue	South_T	2.441780509
Dudley St/ Kent St	North_Entry	2.77241312
Dudley St/ Kent St	North_Exit	1.68224449
Dudley St/ Kent St	South_Entry	1.75516915
Dudley St/ Kent St	South_Exit	1.681638182
Dudley St/ Kent St	West_Entry	1.032702477
Dudley St/ Kent St	West_Exit	2.141191853
Dudley St/ Kent St	East_Exit	1.908022451
Dudley St/Cotter Rd	North_R	4.454873556
Dudley St/Cotter Rd	North_L	1.056996395
Dudley St/Cotter Rd	West_L	2.906190969
Dudley St/Cotter Rd	West_T	0.621739119
Dudley St/Cotter Rd	East_R	0.14509525
Dudley St/Cotter Rd	East_T	0.837398799
PM Base Existing - 3.30pm-4.30pm – Secondary Calibration Area		
Intersection	**Turn**	**GEH**
Novar St/Denman St/Kintore St	North_Entry	3.706929312
Novar St/Denman St/Kintore St	North_Exit	3.022155991
Novar St/Denman St/Kintore St	South_Entry	4.211550416
Novar St/Denman St/Kintore St	South_Exit	2.540429395
Novar St/Abbot St	North_Entry	4.007850345
Novar St/Abbot St	North_Exit	2.833640327
Novar St/Abbot St	South_Entry	3.094149027
Novar St/Abbot St	South_Exit	2.66505862
Novar St/Weston St	North_Entry	1.402865919
Novar St/Weston St	North_Exit	2.466042212
Novar St/Weston St	South_Entry	2.386358407
Novar St/Weston St	South_Exit	4.292702287
Novar St/Loftus St/Bentham St	North_Entry	2.666666667
Novar St/Loftus St/Bentham St	North_Exit	6.630119074
Novar St/Loftus St/Bentham St	South_Entry	2.49878019
Novar St/Loftus St/Bentham St	South_Exit	1.142857143

PM Base Existing - 4.30pm-5.30pm – Core Calibration Area		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	1.673320053
Kent St/Denison St	North_T	3.121109401
Kent St/Denison St	West_L	0.088993393
Kent St/Denison St	West_R	0.311399578
Kent St/Denison St	South_L	0.372104204
Kent St/Denison St	South_T	0.330165124
Kent St/Adelaide Avenue	North_T	0.361110026
Kent St/Adelaide Avenue	East_L	0.069473347
Kent St/Adelaide Avenue	East_R	0.077915507
Kent St/Adelaide Avenue	South_T	0.233079984
Dudley St/ Kent St	North_Entry	0.630996578
Dudley St/ Kent St	North_Exit	0.228232408
Dudley St/ Kent St	South_Entry	0.55164357
Dudley St/ Kent St	South_Exit	0.32910819
Dudley St/ Kent St	West_Entry	0.309985441
Dudley St/ Kent St	West_Exit	0.124541289
Dudley St/ Kent St	East_Exit	0.230693362
Dudley St/Cotter Rd	North_R	1.652454686
Dudley St/Cotter Rd	North_L	4.38178046
Dudley St/Cotter Rd	West_L	2.076607682
Dudley St/Cotter Rd	West_T	0.548971641
Dudley St/Cotter Rd	East_R	1.549193338
Dudley St/Cotter Rd	East_T	0.172702099
PM Base Existing - 4.30pm-5.30pm – Secondary Calibration Area		
Intersection	**Turn**	**GEH**
Novar St/Denman St/Kintore St	North_Entry	9.679671342
Novar St/Denman St/Kintore St	North_Exit	0.539637207
Novar St/Denman St/Kintore St	South_Entry	0.88659463
Novar St/Denman St/Kintore St	South_Exit	9.398150073
Novar St/Abbot St	North_Entry	9.914890658
Novar St/Abbot St	North_Exit	0.343325955
Novar St/Abbot St	South_Entry	0.539637207
Novar St/Abbot St	South_Exit	9.857741018
Novar St/Weston St	North_Entry	1.377725865
Novar St/Weston St	North_Exit	0.738898886
Novar St/Weston St	South_Entry	0.684566176
Novar St/Weston St	South_Exit	10.17086979
Novar St/Loftus St/Bentham St	North_Entry	1.647616878
Novar St/Loftus St/Bentham St	North_Exit	4.647890234
Novar St/Loftus St/Bentham St	South_Entry	0.977067169
Novar St/Loftus St/Bentham St	South_Exit	3.61359675

PM Base Existing - 5.30pm-6.30pm		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	0.264106838
Kent St/Denison St	North_T	3.29141862
Kent St/Denison St	West_L	1.224801493
Kent St/Denison St	West_R	0.894427191
Kent St/Denison St	South_L	0.603361371
Kent St/Denison St	South_T	0.16609096
Kent St/Adelaide Avenue	North_T	0.763861429
Kent St/Adelaide Avenue	East_L	0.543739068
Kent St/Adelaide Avenue	East_R	0.442039804
Kent St/Adelaide Avenue	South_T	0.914943174
Dudley St/ Kent St	North_Entry	0.900754698
Dudley St/ Kent St	North_Exit	0.307160418
Dudley St/ Kent St	South_Entry	0.400662801
Dudley St/ Kent St	South_Exit	0.733187095
Dudley St/ Kent St	West_Entry	0.331831824
Dudley St/ Kent St	West_Exit	1.118525901
Dudley St/ Kent St	East_Exit	0.691910513
Dudley St/Cotter Rd	North_R	3.559535357
Dudley St/Cotter Rd	North_L	2.898275349
Dudley St/Cotter Rd	West_L	2.870174285
Dudley St/Cotter Rd	West_T	0.626589248
Dudley St/Cotter Rd	East_R	2.607680962
Dudley St/Cotter Rd	East_T	1.445997611
Novar St/Denman St/Kintore St	North_Entry	9.397840981
Novar St/Denman St/Kintore St	North_Exit	6.398595123
Novar St/Denman St/Kintore St	South_Entry	5.126672383
Novar St/Denman St/Kintore St	South_Exit	9.143033508
Novar St/Abbot St	North_Entry	9.002931119
Novar St/Abbot St	North_Exit	6.892250015
Novar St/Abbot St	South_Entry	6.435034221
Novar St/Abbot St	South_Exit	9.177935787
Novar St/Weston St	North_Entry	2.884058845
Novar St/Weston St	North_Exit	6.326678736
Novar St/Weston St	South_Entry	7.082425891
Novar St/Weston St	South_Exit	8.996755649
Novar St/Loftus St/Bentham St	North_Entry	3.109118942
Novar St/Loftus St/Bentham St	North_Exit	0.764919329
Novar St/Loftus St/Bentham St	South_Entry	6.469962847
Novar St/Loftus St/Bentham St	South_Exit	2.792948679

Appendix B

Background Traffic Growth Approach

Appendix B Background Traffic Growth Approach

Three approaches were utilised to forecast the future growth rate that could be expected between 2016 and 2031. These approaches were:

1. Use of SCATs volumes collected in 2016, 2017and 2019.
2. Use of the CSTM population assumptions for 2016 and 2031 to provide an estimate of growth in this area.
3. Lastly, the CSTM was used focusing on its predictions for traffic volumes and the expected growth calculated between the 2016 and 2031 models.

Growth based on SCATs data

SCATS data is a useful comparison across various time periods and can be used to help rationalise and substitute other traffic count information. The signalised intersection in proximity to the site is the intersection of Dudley Street and Cotter Road. Data was collected in 2016 – pre cotter road duplication construction, 2017 - during construction and 2019 - post construction.

As expected, the number of vehicles utilising Cotter Road during the peak periods has increased as indicated in Figure 44 and Figure 45. Note that the detector definitions are given in Figure 46.

It appears that construction traffic had an effect indicated by the drop-in volumes between the 2016 counts and the 2017 counts. Traffic counts have then increased between 2017 and 2019. This study is especially interested in Dudley Street which has grown linearly between 2016 and 2019 by an average of 1.0% per annum in the peaks.

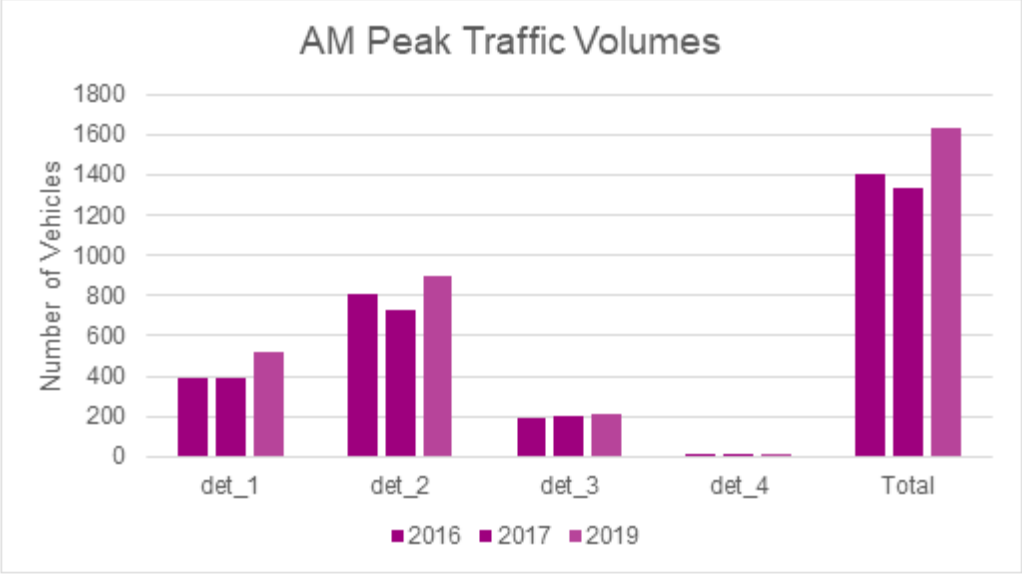


Figure 44: AM Peak Traffic Volumes

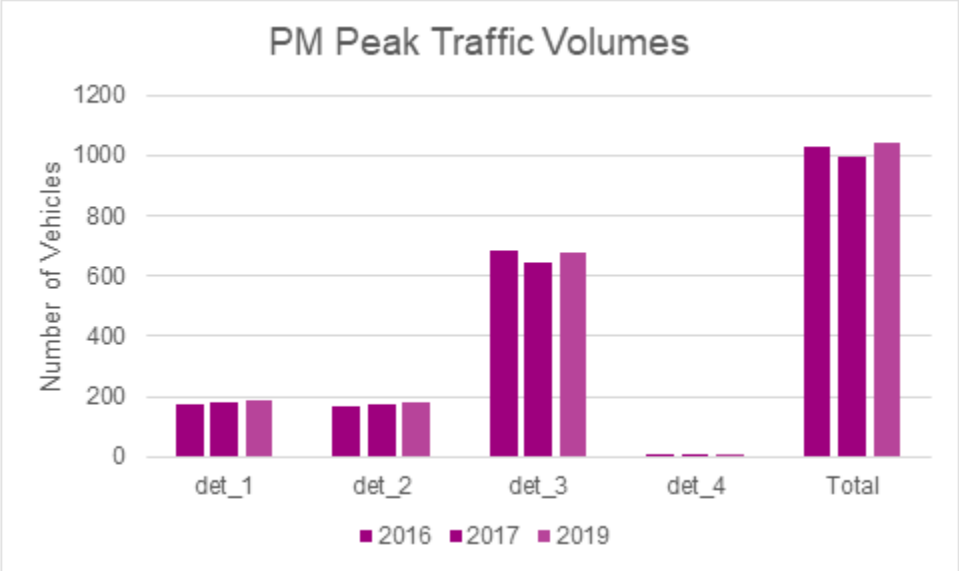


Figure 45: PM Peak Traffic Volumes

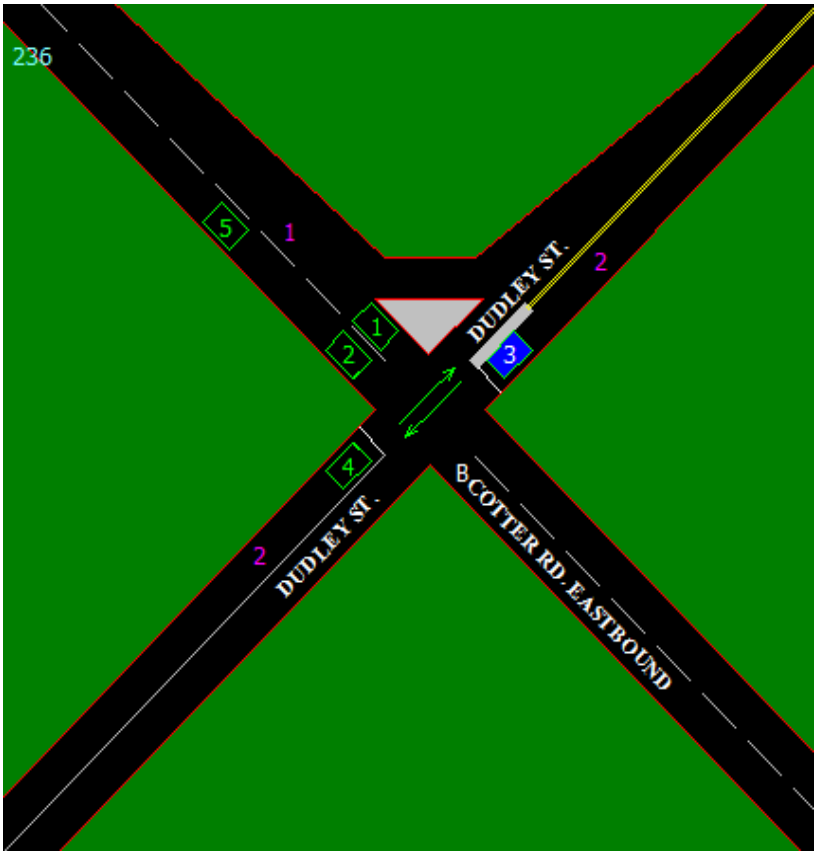


Figure 46: Detector identifications and locations

Growth based on CSTM Population forecasts

Another method to forecast the level of traffic growth in the region would be to determine the rates of growth in the surrounding area and use this rate to forecast existing volumes. This has been undertaken by utilizing the Canberra Strategic Transport Model assumptions which specifies land use characteristics for zones across Canberra. The zones used in this analysis are shown in Figure 47 and are:

- 051107
- 051106
- 051104
- 050302
- 050303

Note that these zones have been classified as either North or South of the Kent Street and Novar Street intersection.

Figure 47: Zones in the vicinity of the Kent Street and Novar Street Intersection

Table 21 utilises the CSTM population forecasts to arrive at a background level of growth. Importantly it can be seen that the total growth rate is very similar to the growth rate in the original approach. If this approach is used the following will be considered:

- The forecasted traffic volumes would be used as a base level of traffic volumes. The new residential development will be included in addition to this base level. While the development may already be included in the CSTM population forecasts this would be expected to be a conservative approach.
- Construction traffic will no longer need to be accounted for as growth will utilise SCATs data from 2019 after the Cotter Road duplication has been finished.

Table 21: Growth forecasts

Growth Statistics	North	South	Total
2016 Population	2208	2263	4471
2031 Population	3122	2378	5500
2016 – 2031 Population Difference	914	115	1029
Population Growth %	41.39%	5.08%	23.01%
Linear Growth Rate per annum	2.76%	0.34%	1.53%
Exponential Growth Rate per annum	2.34%	0.33%	1.39%

The land uses represented in the CSTM have been provided below for reference.

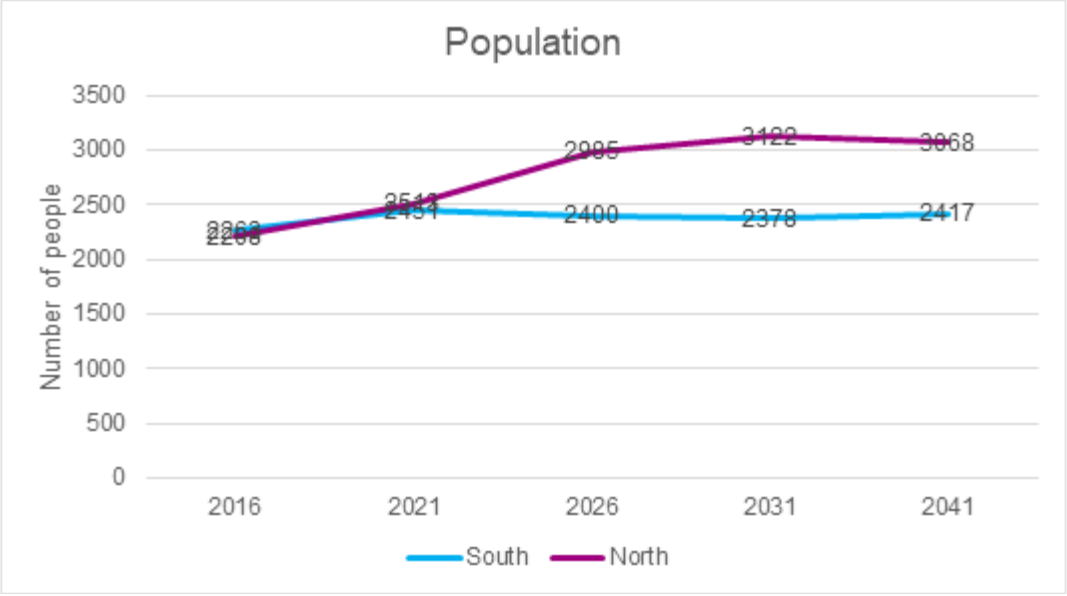


Figure 48: Population present in the five zones identified across the CSTM model years

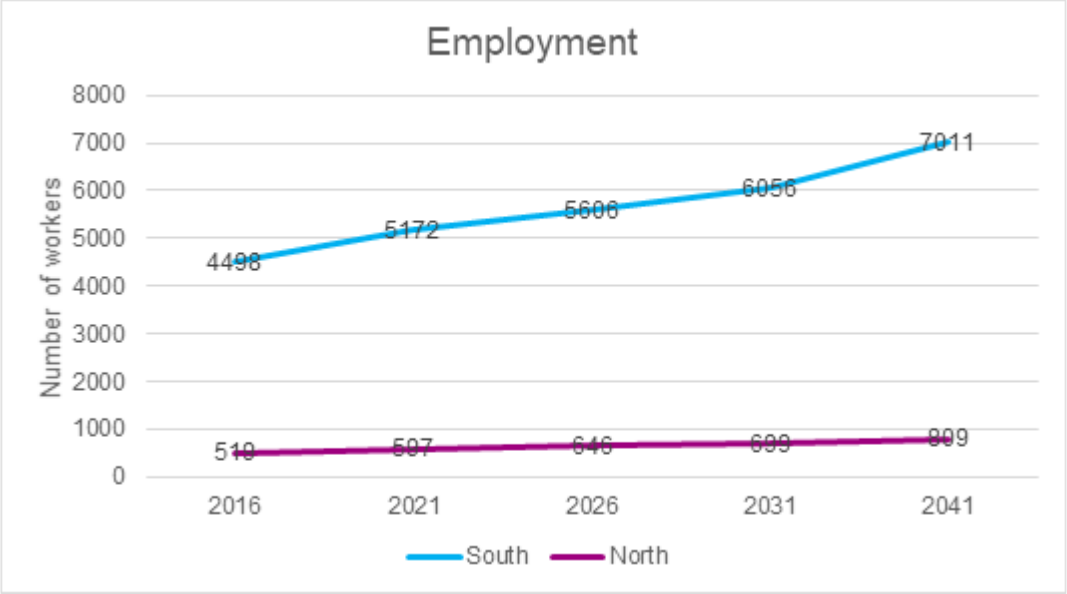


Figure 49: Number of people employed in the five zones identified across the CSTM model years

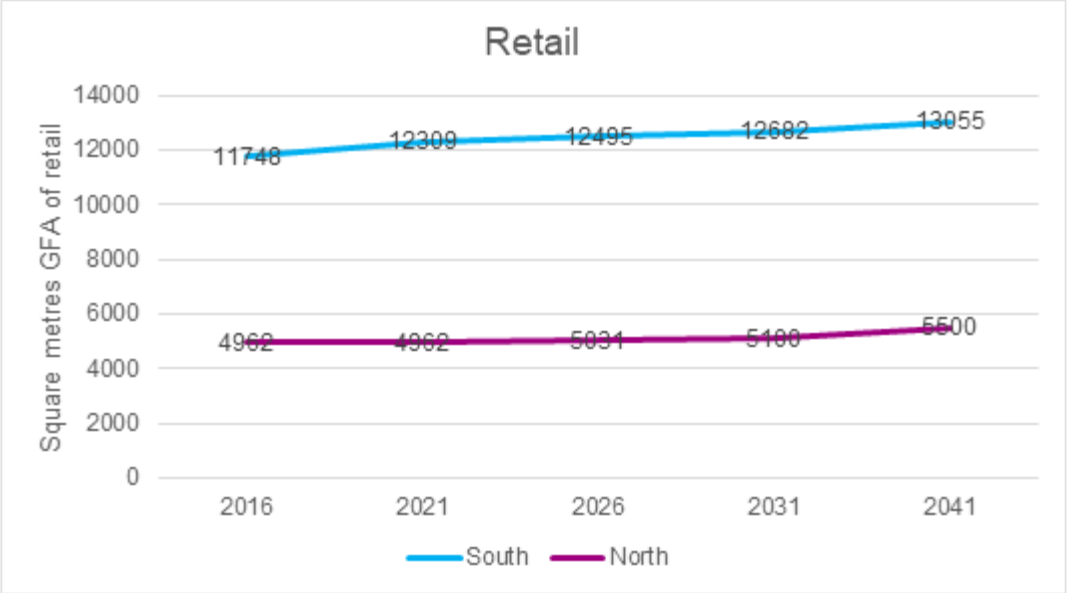


Figure 50: Floor area of retail present in the five zones identified across the model years

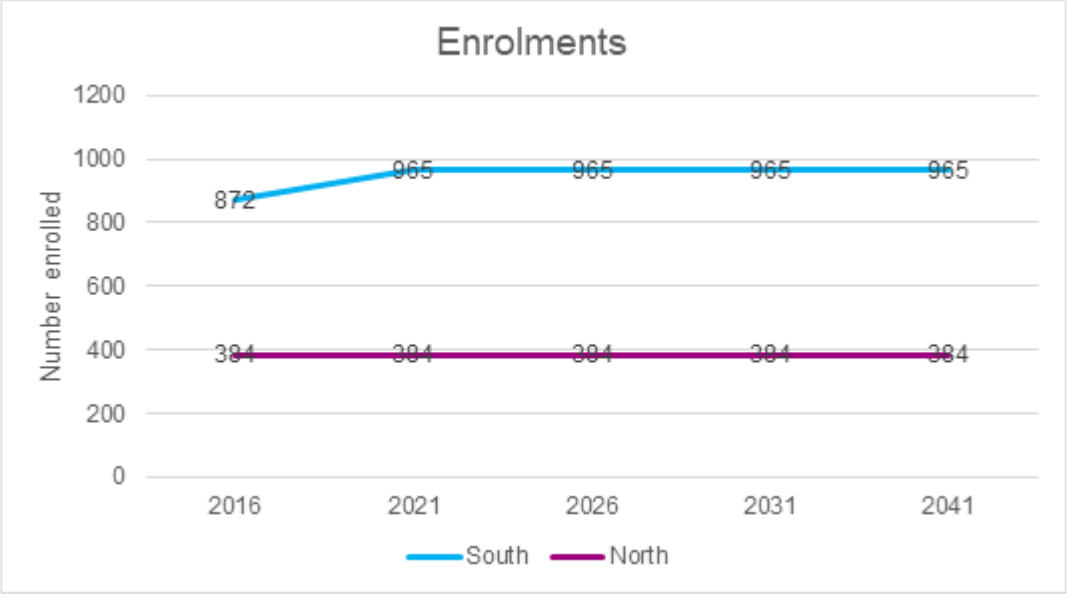


Figure 51: Number of students in the five zones identified across the model years

Canberra Strategic Transport Model

While the CSTM provides demand forecasts in the medium and long-term planning horizons, the preferred method of estimating future demand when conducting detailed traffic modelling and analysis is to grow current traffic volumes using growth rates extracted from the CSTM.

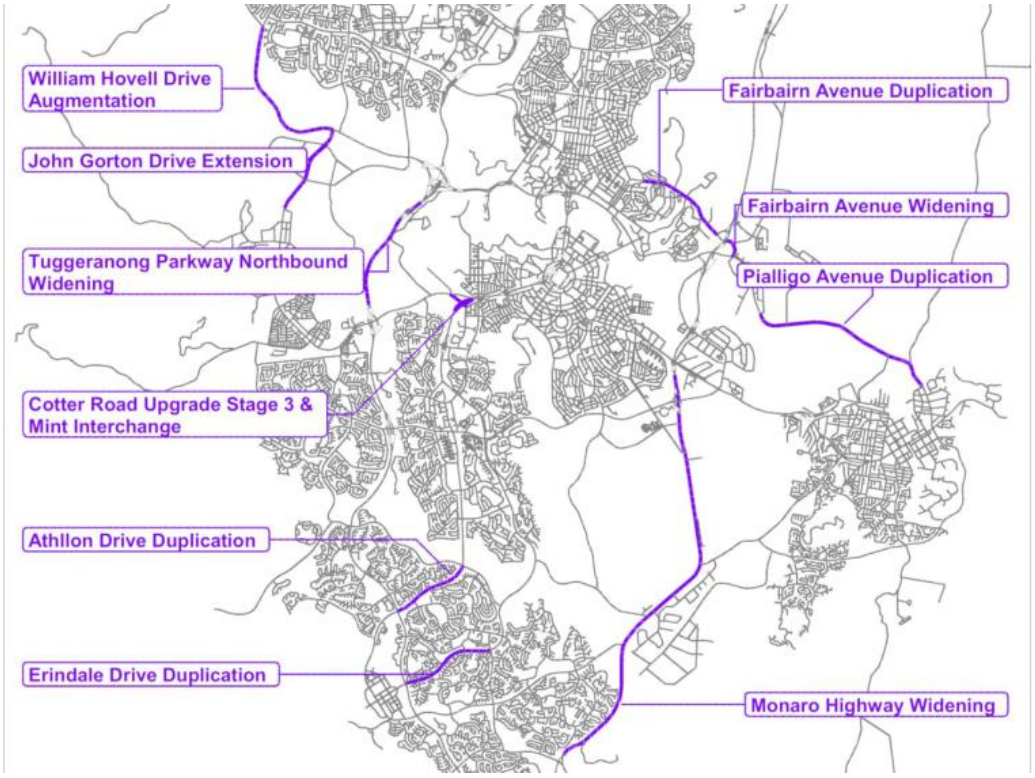


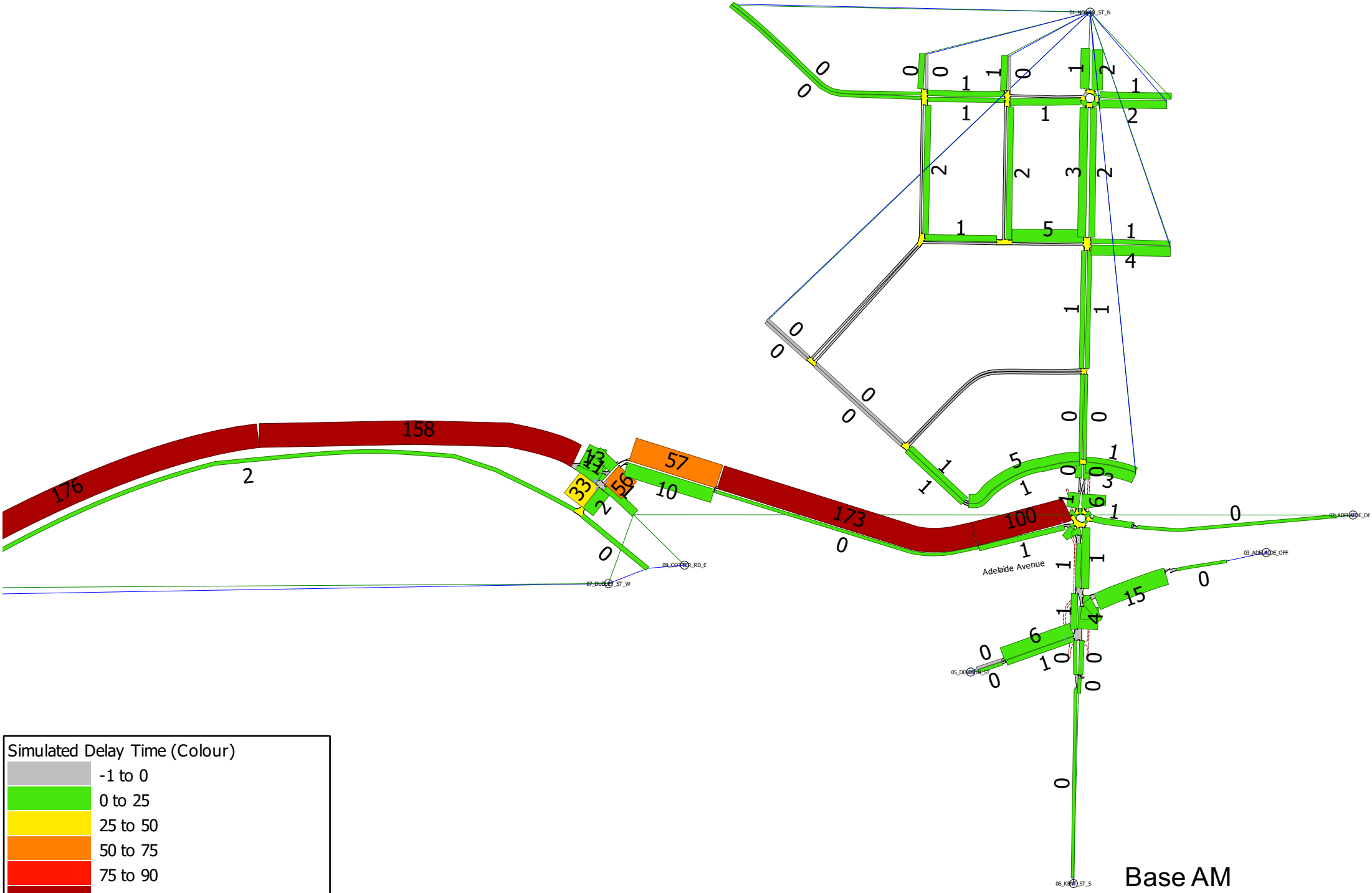
Figure 52: 2026 CSTM assumed road upgrades

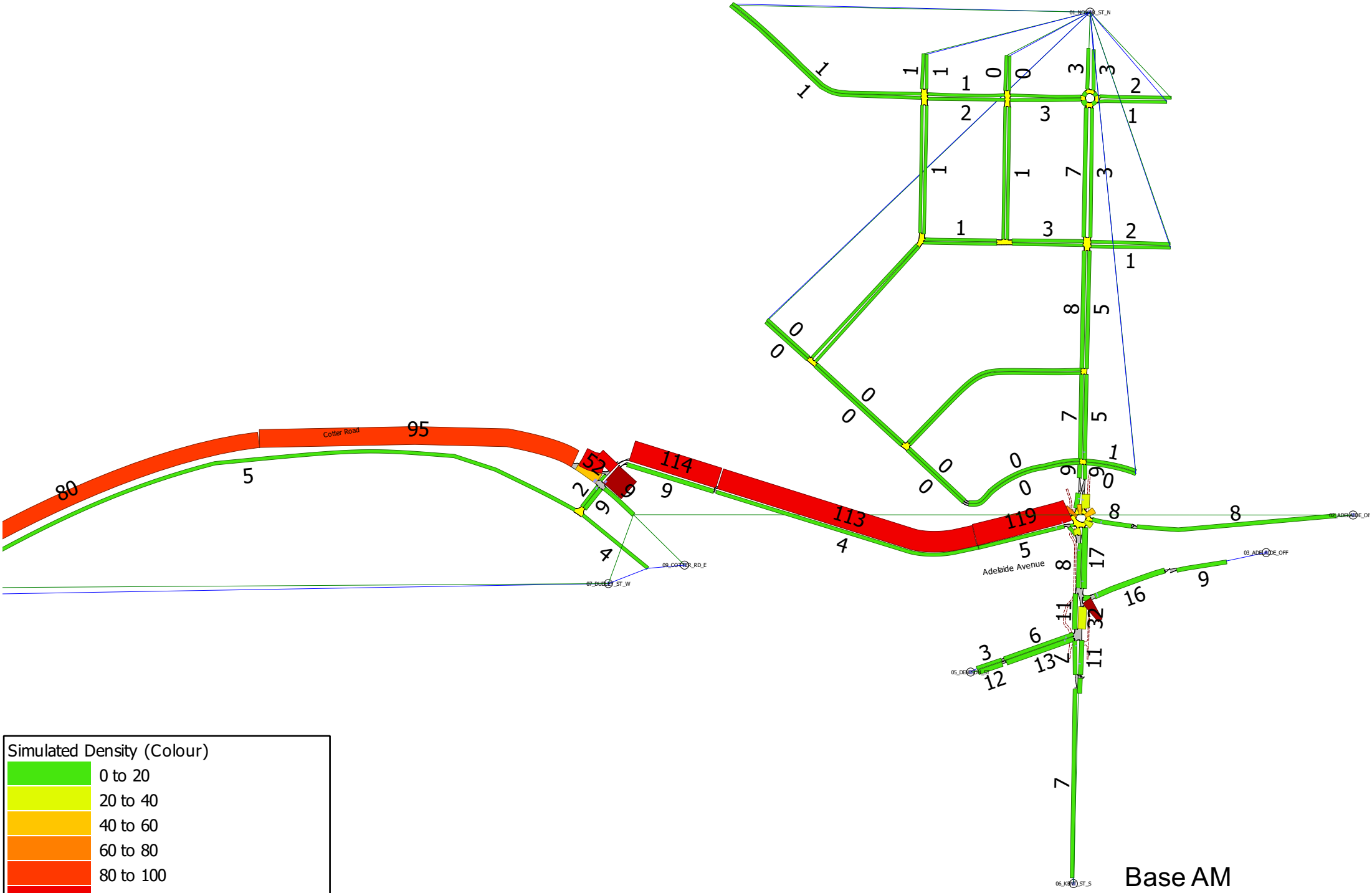
The introduction of the Cotter Road and Mint Interchange which is assumed in the 2031 AM Canberra Strategic Model changes demand drastically in this area (Figure 52). This causes large fluctuations in the distribution of vehicles and therefore unusual growth rates compared to the current conditions without the Mint Interchange.

Two scenarios were analysed in the CSTM, one with the Mint Interchange and one without the Mint Interchange. The average growth rate between the two scenarios was approximately 1.25%.

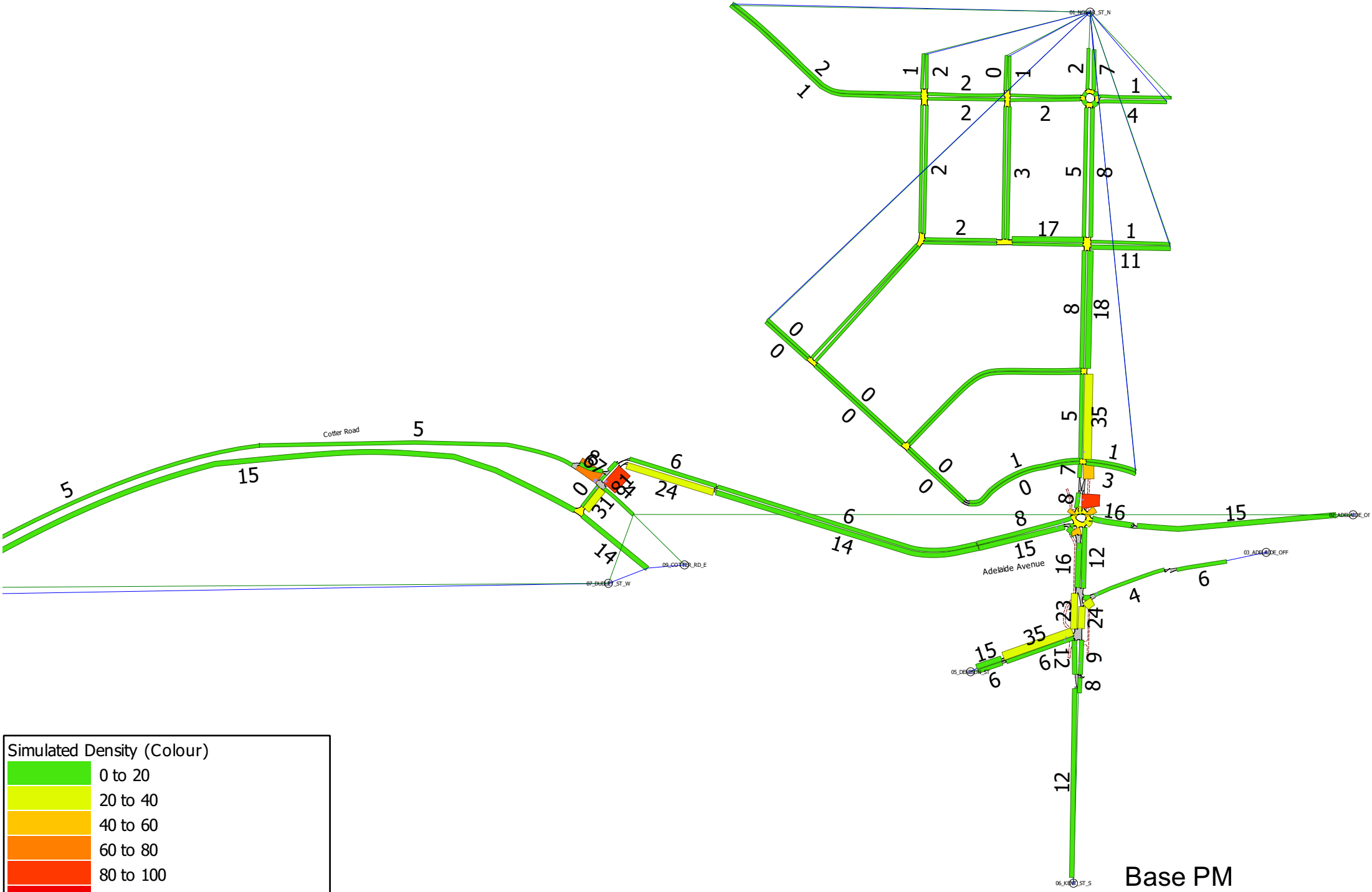
Appendix C

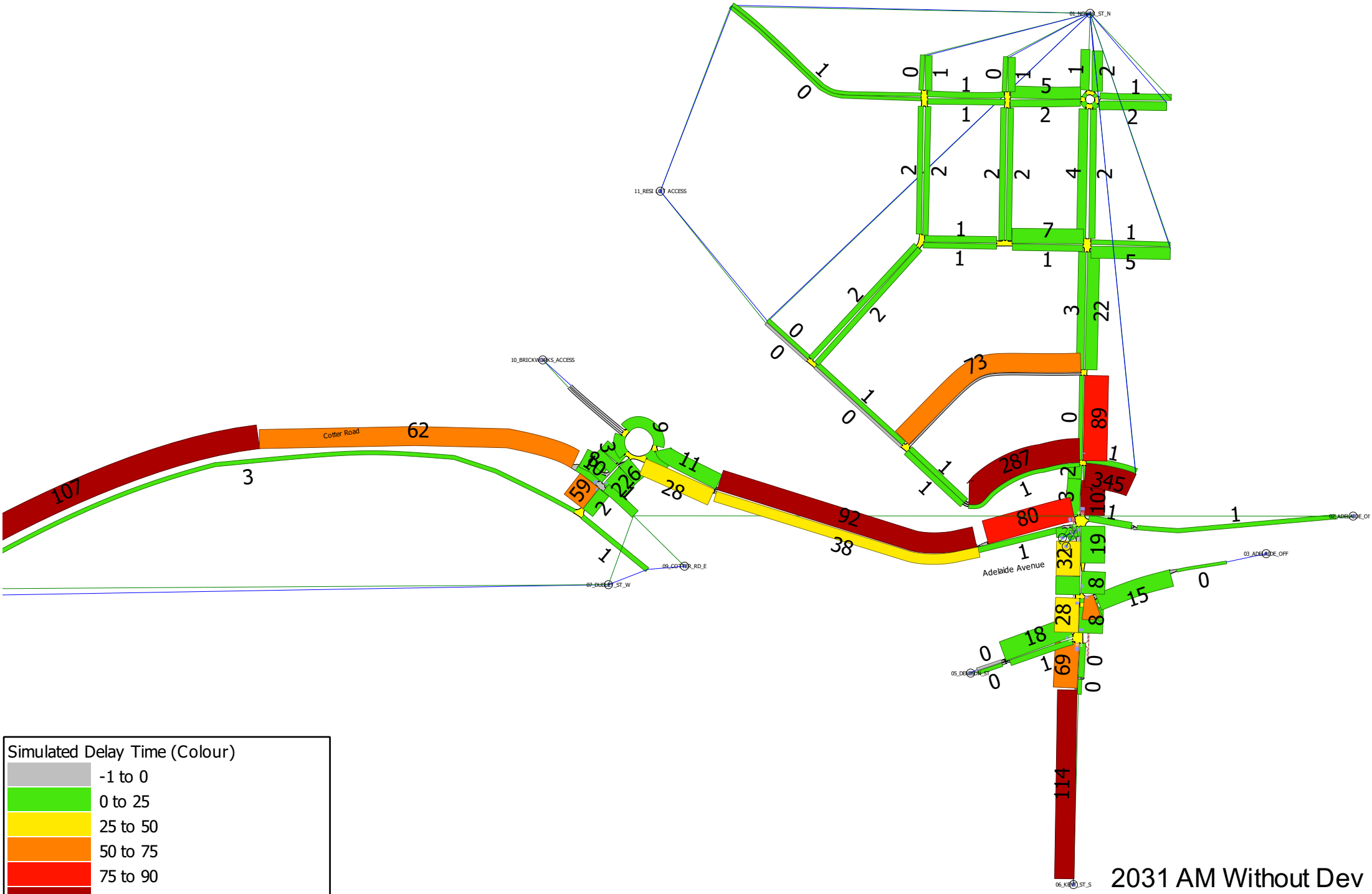
Aimsun Outputs

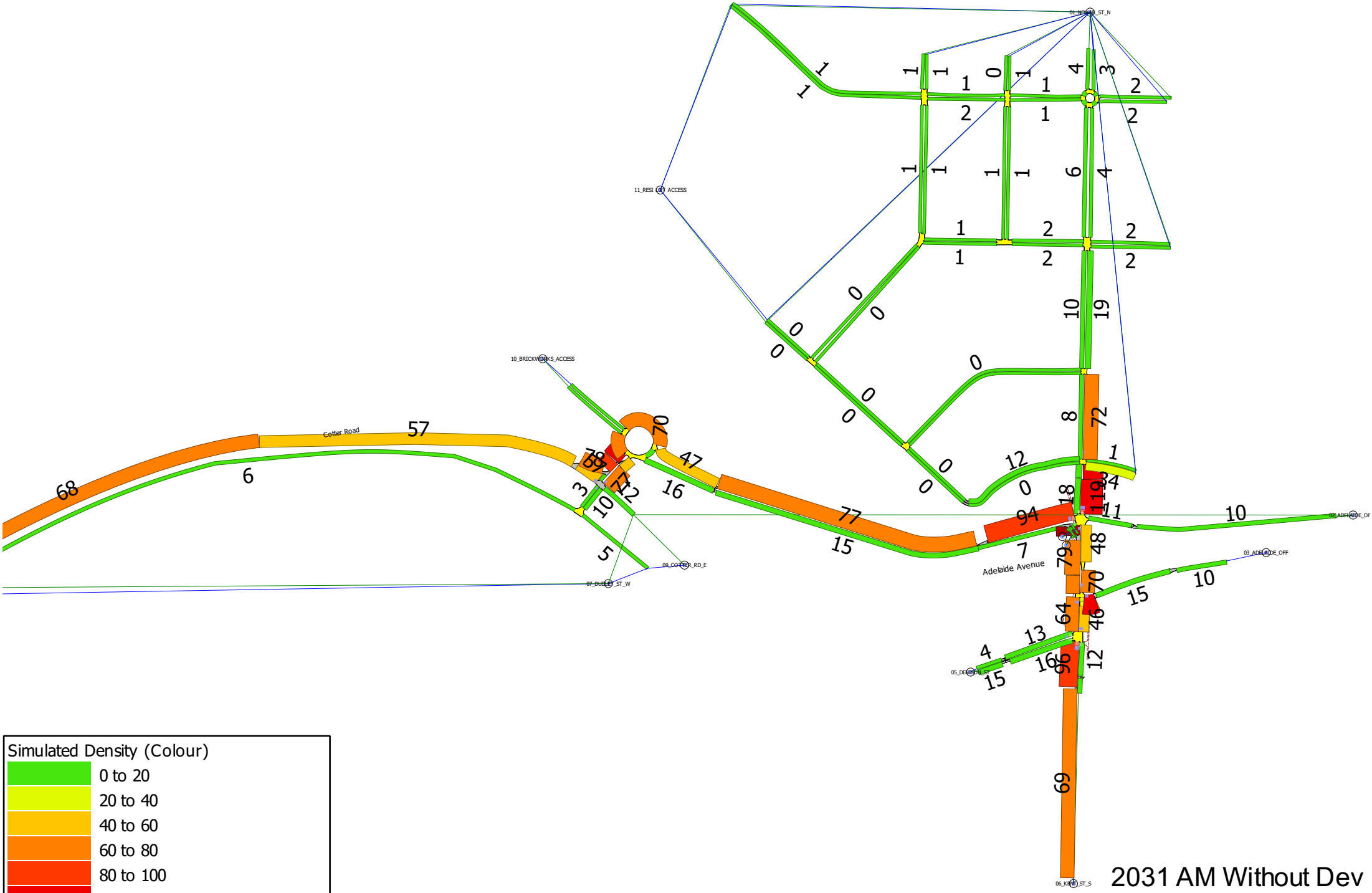

Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
Adelaide Avenue
Base AM
(8.30am-9.30am)


Cotter Road
Adelaide Avenue
Simulated Density (Colour)
0 to 20
20 to 40
40 to 60
60 to 80
80 to 100
100 to 120
120 to 1.79769e+308
Base AM
(8.30am-9.30am)

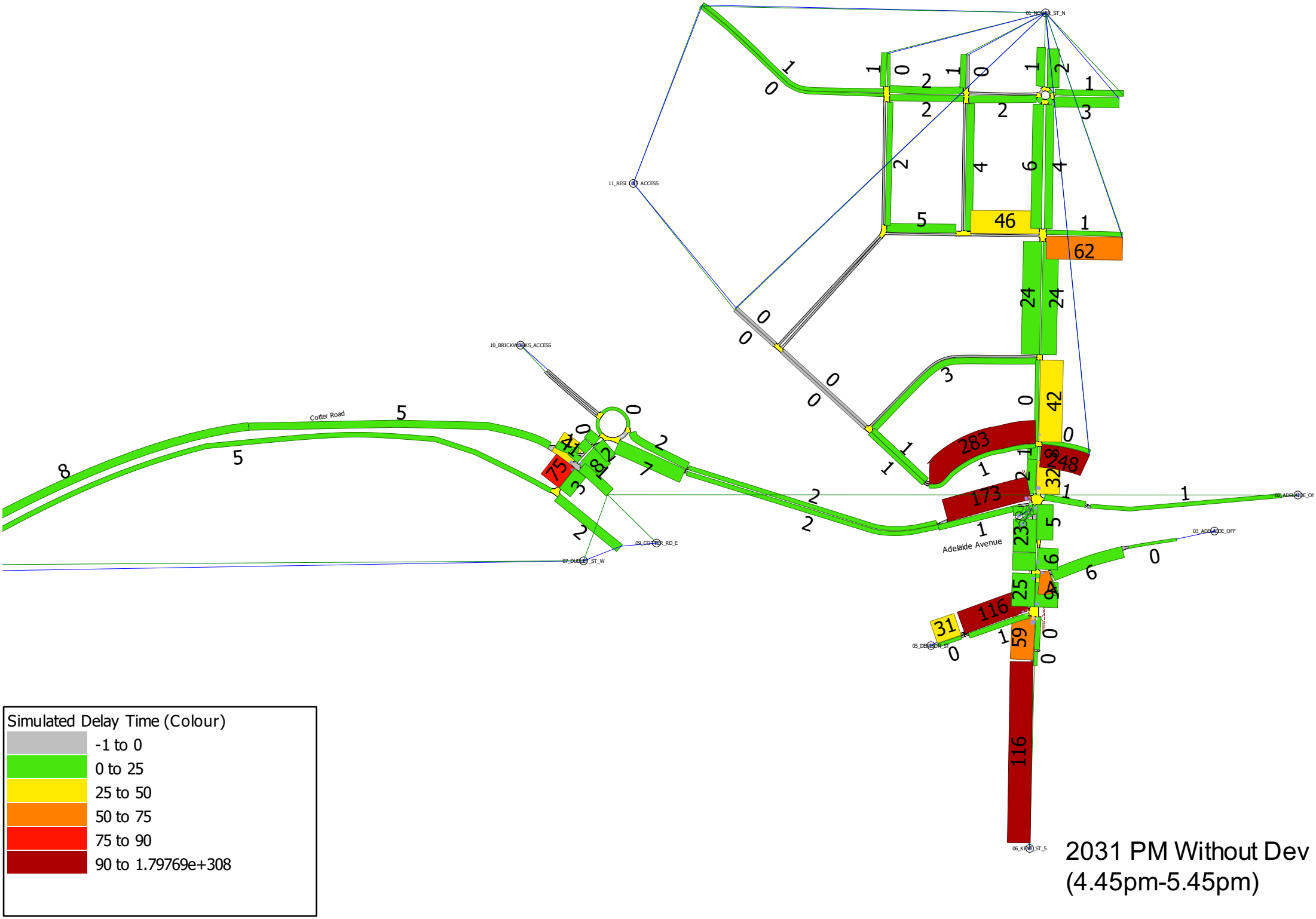

Cotter Road
Adelaide Avenue
01_NORTH_ST_N
02_ADELAIDE_OI
03_ADELAIDE_OFF
05_DENISON_ST
06_KENT_ST_S
07_DUESBURY_ST_W
09_COTTER_RD_E
Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
Base PM
(4.45pm-5.45pm)

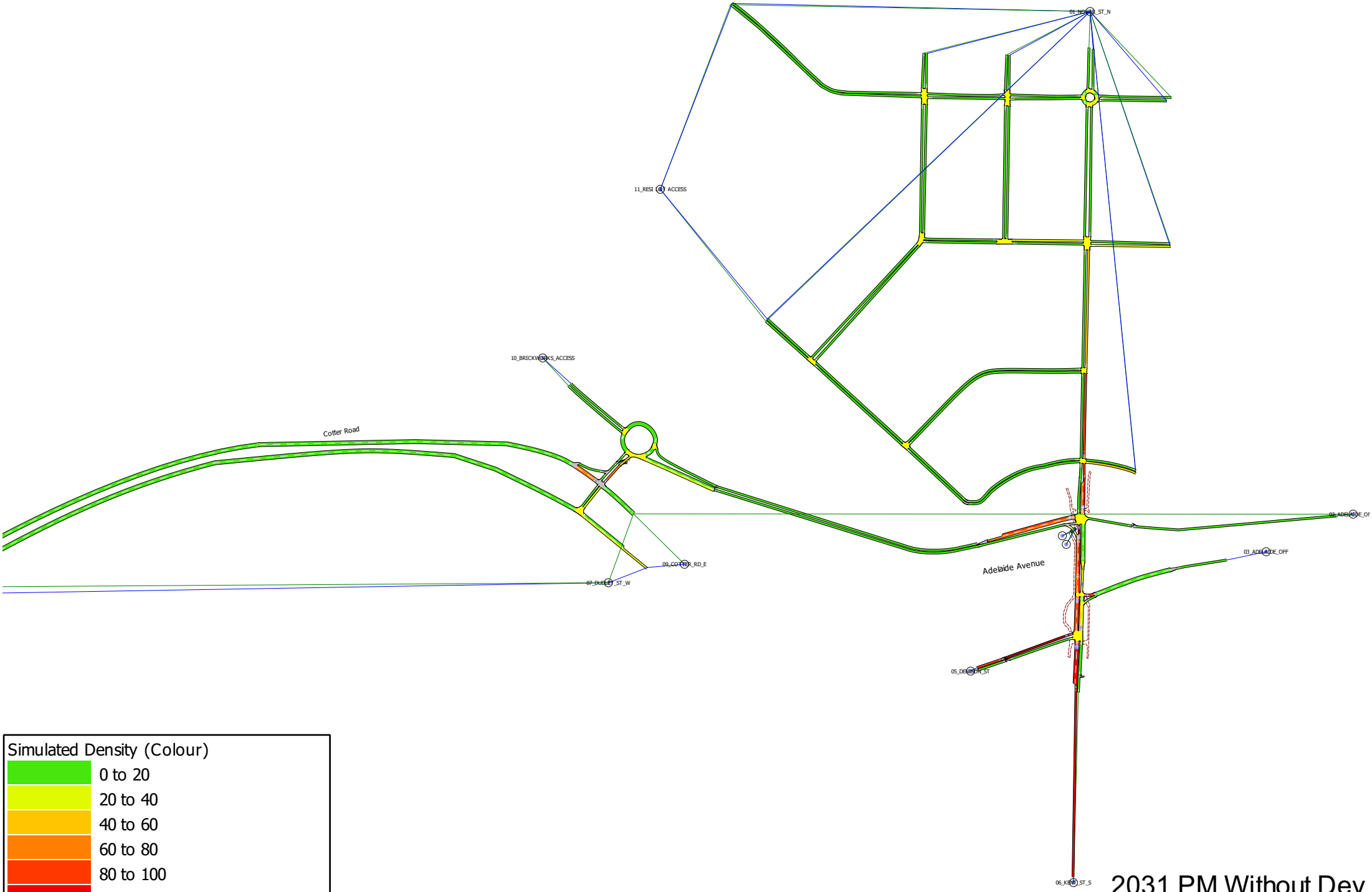

Cotter Road
Adelaide Avenue
01_NORTH_ST_N
02_ADELAIDE_OFF
03_ADELAIDE_OFF
05_DENISON_ST
06_KENT_ST_S
07_QUEEN_ST_W
09_COTTER_RD_E
Simulated Density (Colour)
0 to 20
20 to 40
40 to 60
60 to 80
80 to 100
100 to 120
120 to 1.79769e+308
Base PM
(4.45pm-5.45pm)


Cotter Road
Adelaide Avenue
11_RESI ACCESS
10_BRICKWORKS_ACCESS
09_COTTER_RD_E
07_DUFFY_ST_W
05_DENISON_ST
06_KENT_ST_S
03_ADELAIDE_OFF
Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
2031 AM Without Dev
(8.30am-9.30am)

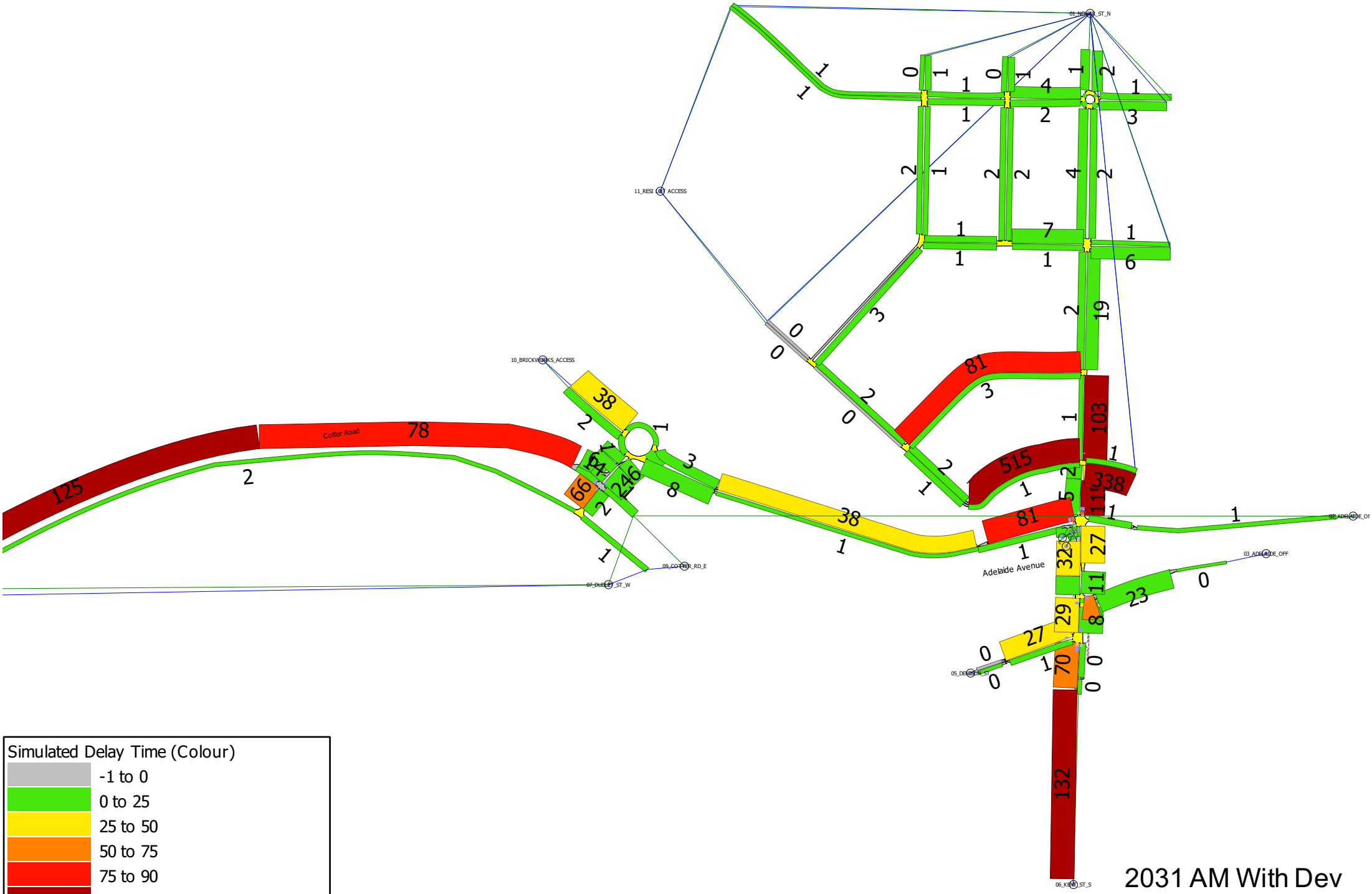


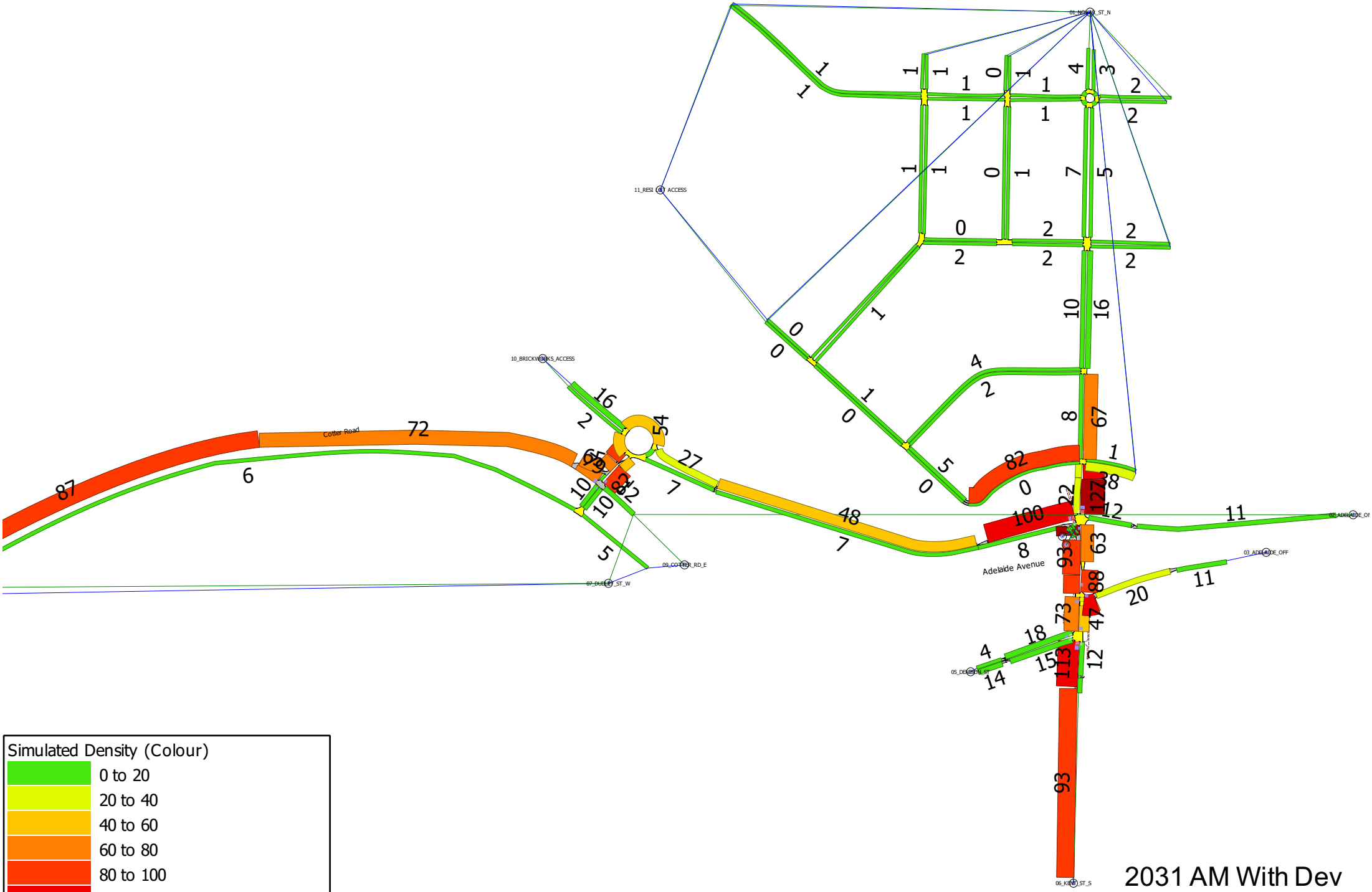
2031 AM Without Dev
(8.30am-9.30am)

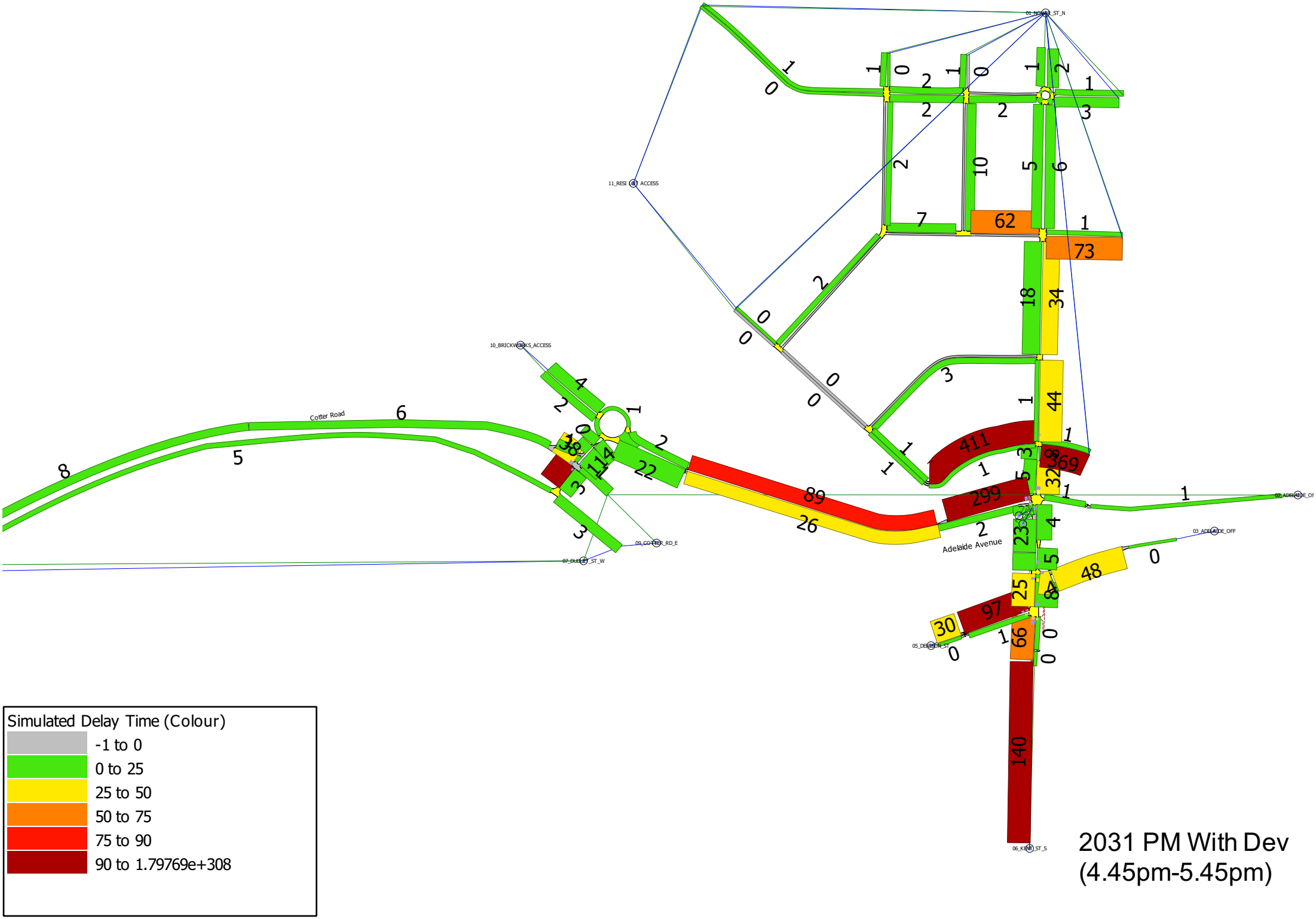

Cotter Road
Adelaide Avenue
10_BRICKWORKS_ACCESS
11_RESI ACCESS
09_COTTER_RD_E
07_DUESBURY_ST_W
05_DENISON_ST
06_KENT_ST_S
03_ADELAIDE_OFF
Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
2031 PM Without Dev
(4.45pm-5.45pm)

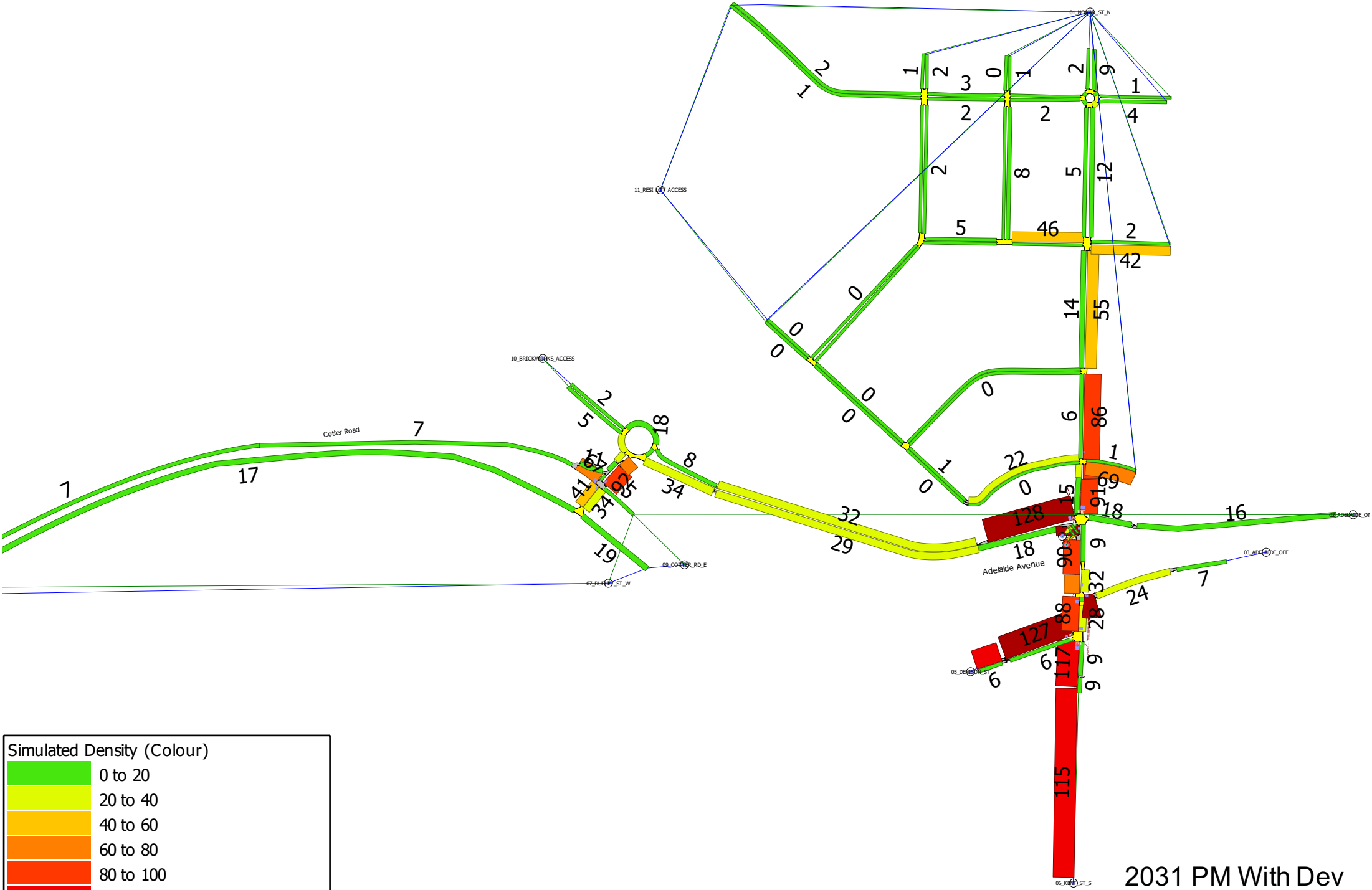


2031 PM Without Dev (4.45pm-5.45pm)


Cotter Road
Adelaide Avenue
10_BRICKWORKS_ACCESS
11_RESI ACCESS
09_COTTER_RD_E
07_DUES_ST_W
05_DENISON_ST
06_KENT_ST_S
03_ADELAIDE_OFF
Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
2031 AM With Dev
(8.30am-9.30am)


Cotter Road
Adelaide Avenue
10_BRICKWORKS_ACCESS
09_COTTER_RD_E
07_DUES_ST_W
06_KENT_ST_S
03_ADELAIDE_OFF
11_RESI ACCESS
Simulated Density (Colour)
0 to 20
20 to 40
40 to 60
60 to 80
80 to 100
100 to 120
120 to 1.79769e+308
2031 AM With Dev
(8.30am-9.30am)


Cotter Road
Adelaide Avenue
10_BRICKWORKS_ACCESS
09_COTTER_RD_E
07_DUESBURY_ST_W
11_RESI ACCESS
01_NORTH_ST_N
02_ADELAIDE_OFF
03_ADELAIDE_OFF
05_DENISON_ST
06_KENT_ST_S
Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
2031 PM With Dev
(4.45pm-5.45pm)



2031 PM With Dev
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Appendix B Kent Street / Novar Street Intersection Upgrade

Kent Street/Novar Street Intersection Upgrade

Traffic Options and Analysis Report

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Revision D – 06-Sep-2021
Prepared for – Land Release Infrastructure Transport Canberra and City Services – ABN: N/A

Kent Street/Novar Street Intersection Upgrade

Traffic Options and Analysis Report

Client: Land Release Infrastructure Transport Canberra and City Services

ABN: N/A

Prepared by

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Document Kent Street/Novar Street Intersection Upgrade

Ref 60613743

Date 06-Sep-2021

Prepared by Alex Miles, Tim Nell, Nethmei Senarath, and Danny Ma

Reviewed by Brendan Hogan and Tim Heffernan

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	05-Mar-2020	Draft Traffic Assessment for Review	Brendan Hogan Traffic Lead	
C	26-Mar-2021	Modelling Assessment Update	Tim Heffernan Senior Traffic Engineer	
D	06-Sep-2021	Minor Figure Updates	Alex Zhao Principal Transport Modeller	

Table of Contents

Project Summary

AECOM have previously undertaken the detailed design and corresponding Transport Assessment for the Dudley Street upgrade works associated with the development of the proposed Canberra Brickworks Precinct in Yarralumla.

The project identified that while the improvements on Dudley Street would help alleviate the impacts of increased traffic that this pressure would be constrained by nearby intersections, most notably the roundabout at the intersection of Kent Street and Dudley Street. A feasibility study was undertaken to determine the possibility of signalising this intersection to improve capacity and safety of the intersection.

These works found that in order to signalise this intersection, the two adjacent intersections would also need to be signalised to efficiently manage traffic flows over the Kent Street Bridge.

These intersections are:

- Kent Street / Dudley Street / Novar Street / Adelaide Avenue on-ramp
- Kent Street / Adelaide Avenue off-ramp
- Kent Street / Denison Street

A concept was developed as a basis for further investigations which looked to minimise impacts on existing verges and kerbs. This led to the development of the concept design as shown in Figure 1.

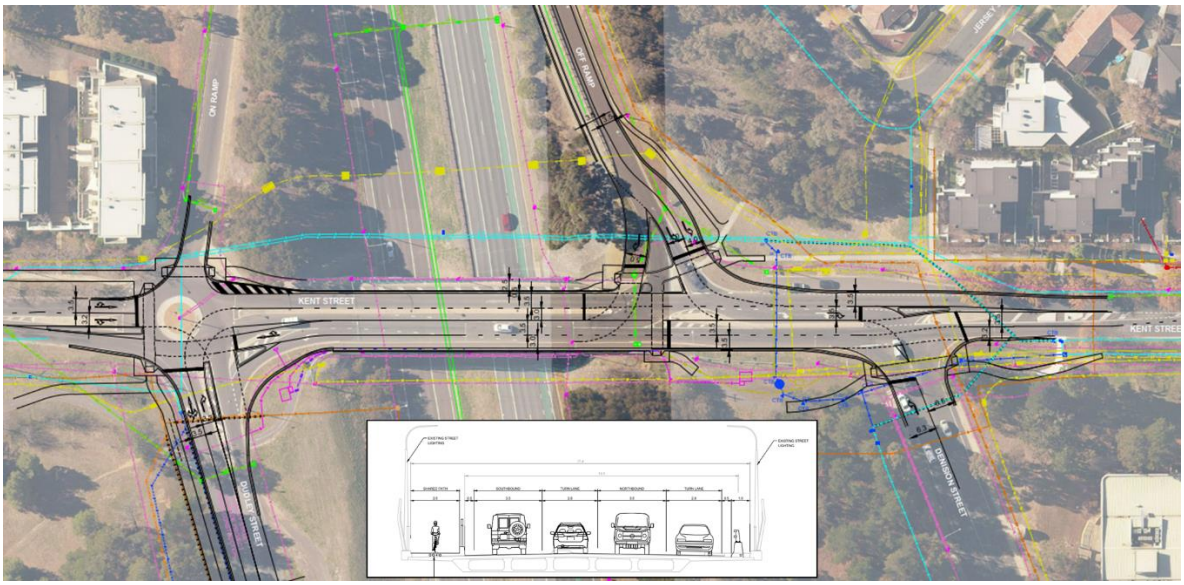


Figure 1: Preliminary concept plan for upgrade of Kent Street Intersections

Key elements of this design included:

- Dedicated right turn lane from Dudley Street and a separate short shared through, right and left turn lane
- Retention of and minor augmentation of the left slip lane form Kent Street to Dudley Street
- Two southbound lanes on Novar Street
- A separate single right and dual left lanes on the Adelaide Avenue off ramp
- Two northbound lanes on approach to the Denison Street intersection.
- Conversion of three intersections to signalised intersections allowing signal coordination which is effective due to their proximity.

This feasibility stage concept did not investigate in detail elements of the bridge structures or impacts to all services.

Infrastructure Delivery Partnership Group (IDPG) on behalf of Land Release Infrastructure (LRI) within Transport Canberra and City Services (TCCS) engaged AECOM to undertake a review of concept design and option analysis of Kent Street/Novar Street intersection design developed by AECOM in January 2018.

The key project objective is to improve the safety and efficiency of the three intersections within the project area, namely Novar Street/Dudley Street/Adelaide Avenue on-ramp intersection, Kent Street/Adelaide Avenue off-ramp intersection and Kent Street/Denison Street intersection for all road users (vehicles, pedestrians and cyclists). This report focuses on the traffic and transport aspects of the design testing and documents the methodology, options and recommendations associated with refining the design to inform the Preliminary Sketch Plan (PSP).

This study built upon this past work and analysed various alternatives to ensure that the network operated efficiently and safely.

It was found that the following design options provided significant benefits over the earlier concept design proposed as part of the Dudley Street Upgrade Works:

- Dual right turning lanes from Dudley Street to Kent Street.
- Dual lanes after turning right from Dudley Street to Kent Street - assists both with storage capacity and hence performance.
- Banning the right turn from Denison Street onto Kent Street has also been recommended as the volume for this movement is very low and delay the overall function of the intersection. There are several alternative routes for vehicles to utilise should this turn be banned.
- While all intersections are proposed to be signalised the following proposed priority controlled left turns are proposed:
    - Priority controlled left turn from Kent Street to Dudley Street
- Actuated and demand dependent signal phases.

The analysis of the base Aimsun model showed the existing layout was not expected to manage the increased traffic demands in the future, particularly in the AM peak. A large number of vehicles were unable to enter the network during the simulation period due to the large level of queuing on some legs such as Novar Street and Dudley Street which had downstream impacts at Cotter Road. The proposed PSP layout showed an improvement with vehicles being able to navigate the study area and a maximum average of 14 vehicles waiting to enter the network. This is compared 1280 vehicles in the future AM “do nothing” scenario.

The agreed PSP layout is shown in Figure 2.

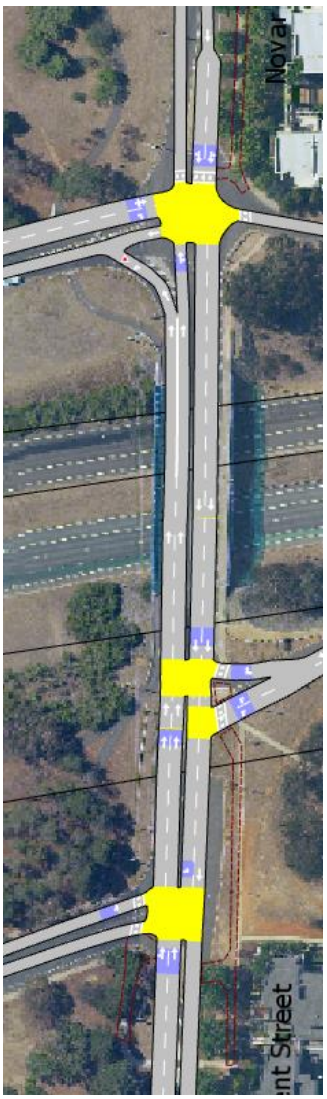


Figure 2 PSP Layout

1.0 Introduction

1.1 Approach

AECOM has developed an Aimsun Next microsimulation model to better understand, investigate and predict the operation of the following intersections in the future:

- Dudley Street / Novar Street/Kent Street /Adelaide on-ramp
- Kent Street / Adelaide Avenue off-ramp
- Kent Street / Denison Street

The base modelling and existing count information including calibration and validation was carried out as part of the feasibility works previously undertaken. Since that work, changes to the Canberra Strategic Model (CSTM) forecasts and known developed in the area can provide a better reflection of expected future conditions and have been assessed in the development of the network testing and layout optimisation considering safety, capacity and constructability.

Further information is provided in Section 2.0.

1.2 Purpose of this Report

This report provides a summary of the key assumptions, outputs and recommendations from the traffic analysis undertaken to inform the PSP design for the Kent Street upgrades.

1.3 Project Background

In conjunction with a parallel project, AECOM updated the original Kent Street Aimsun model in November 2020 to include key connections to the proposed Yarralumla Brickworks Development and Cotter Road. The updated model is a better representation of the future operation of the network and hence has been used to update the traffic study for this project.

1.4 The Study Area

Location of the study area is shown in Figure 3. It considers the approach routes to the three intersections along Kent Street and extends back along Dudley Street and Cotter Road to enable visualisations of the queuing extents and network behaviour.

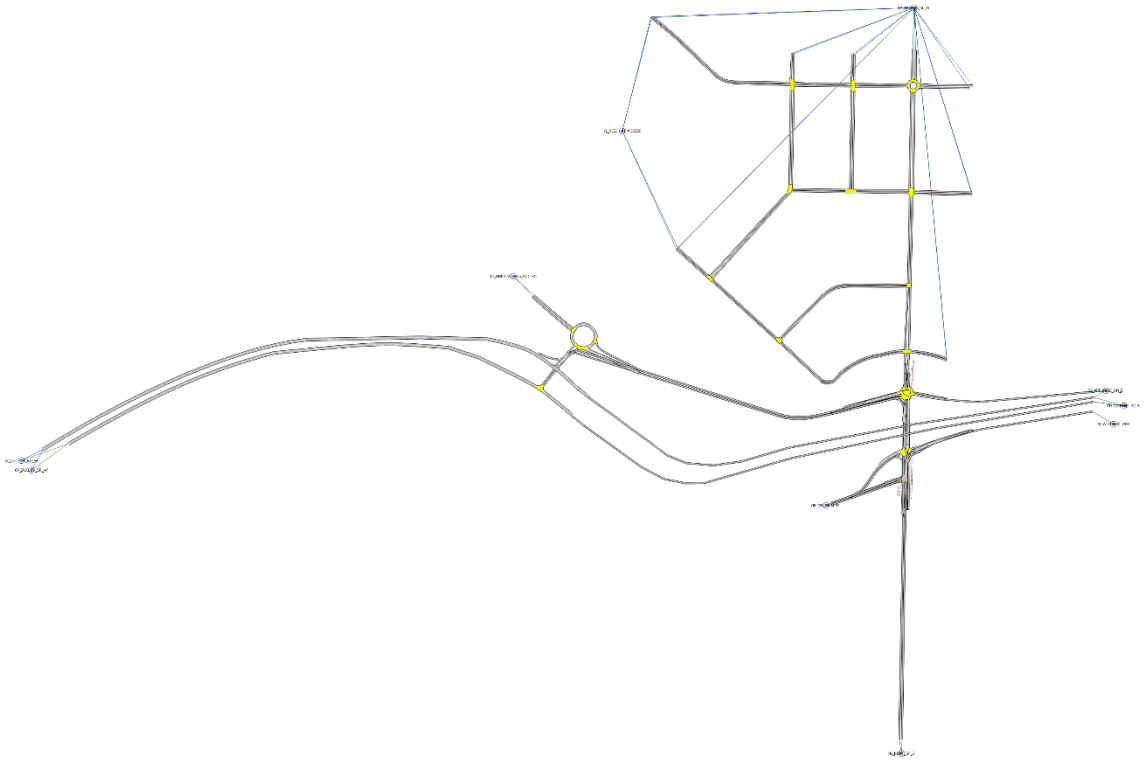


Figure 3: Study Area Extent

2.0 Previous Studies and Concurrent Projects

2.1 Dudley Street Design

AECOM have previously undertaken the detailed design and corresponding Transport Assessment for the Dudley Street upgrade works associated with the development of the proposed Canberra Brickworks Precinct in Yarralumla.

The project identified that while the improvements on Dudley Street would help alleviate the impacts of increased traffic that this pressure would be constrained by nearby intersections most notably the roundabout at the intersection of Kent Street and Dudley Street.

2.2 Kent Street Feasibility Assessment Concept Design Analysis

A feasibility study was undertaken to determine the possibly of signalising this intersection to improve capacity and safety in that area.

These works found that in order to signalise this intersection, the two adjacent intersections would also need to be signalised to manage traffic flows over the Kent Street Bridge.

These intersections are:

- Kent Street / Dudley Street / Novar Street / Adelaide Avenue on-ramp
- Kent Street / Adelaide Avenue off-ramp
- Kent Street / Denison Street

A concept was developed as a basis for further investigations which looked to minimise impacts on existing verges and kerbs.

A concept design was established as part of a previous Traffic and Transport Assessment undertaken for the Dudley Street upgrade works associated with the development of the proposed Canberra Brickworks Precinct in Yarralumla. The project identified that while the improvements on Dudley would help alleviate the impacts of increased traffic that this pressure would be constrained by nearby intersections most notably the roundabout at the intersection of Kent Street and Dudley Street. The transport analysis found that the existing intersections were already approaching capacity and therefore a concept design was produced to help improve this.

Key elements of the previous feasibility design included:

- Dedicated right turn lane from Dudley Street and a separate short shared through and left turn lane
- Retention of and minor augmentation of the left slip lane form Kent Street to Dudley Street
- Two southbound lanes on Novar Street – merging to one lane before the bridge due to geometric constraints over the bridge
- A separate single right and left lane on the Adelaide Avenue off ramp
- Two northbound lanes on approach to the Denison Street intersection.
- Conversion of three intersections to signalised intersections allowing coordination which is effective due to their proximity.

3.0 Data collection and projections

3.1 Traffic data summary

Original intersection traffic counts were undertaken by Trans Traffic Survey in 2017 for each of the key intersections considered in the Kent Street network distribution model. These intersections were as follows:

1. Dudley Street / Novar Street/Kent Street / Adelaide on-ramp
2. Kent Street / Adelaide Avenue off-ramp including Denison Street

The turning movements for intersection 2 were rationalised as one data set to determine number of through traffic movements directly from off-ramp to Denison Street.

For the model update in 2020, additional traffic surveys were undertaken on Tuesday, 25 August 2020 for the following intersections:

3. Dudley Street / Cotter Road
4. Maxwell Street / Denman Street
5. Abbot Street / Denman Street
6. Novar Street / Kintore Crescent
7. Novar Street / Abbott Street
8. Banks St / Weston St / Maxwell St
9. Banks St / Bentham St
10. Novar St / Bentham St
11. Novar St / Weston St
12. Hutchins St / Bentham St

For this study, the 2020 counts undertaken at the intersection of Dudley Street / Cotter Road are the most relevant.

These intersection counts were undertaken in both the AM (7.00am-10:00am) and PM (3.30pm-6.30pm) peak periods and the raw data for intersections 1, 2 and 3 listed above can be found in Appendix A.

3.2 Traffic Model Development

As part of the review of the Kent Street Design, the previous traffic forecasts for the network have been reviewed. This review allows for consideration post construction of the Cotter Road duplication and the updated Canberra Strategic Model (CSTM) forecasts. It provides better certainty on the future traffic volumes to the community and other stakeholders. The future model outputs have also been revised to align with current TCCS requirements which were not developed at the time of the previous works.

The focus of these traffic works is the optimisation of the future layout determined by a thorough optioneering design process. The base calibration previously approved by TCCS and the process and count information remain valid for these works.

These refined forecast values were used to assess the concept suitability in line with civil constraints and safety considerations. This will help ensure a safe efficient design. The review indicated that most approaches had a slightly higher volume than the previous projections.

This report outlines the selected growth rate assumptions and data used for forecasting the growth rate in the vicinity of the Kent Street and Novar Street intersection.

3.2.1 GEH Results

The traffic modelling package used to assess this job is Aimsun Next. An origin destination matrix was developed based on turning count data. At the key intersections outlined in Figure 4, the model achieved the GEH results outlined in Table 1 and Table 2 in the AM and PM peak periods respectively. These align with the GEH targets outlined in the *ACT Traffic Microsimulation Modelling Guidelines.*

Figure 4: Model Calibration Area

Table 1: AM Model Calibration Area GEH results

Time Period	Number of Turns	Number of Turns with GEH<5	Number of Turns with GEH<10
7am-8am	23	23 (100%)	23 (100%)
8am-9am	23	20 (87%)	23 (100%)
9am-10am	23	22 (96%)	23 (100%)

Table 2: PM Model Calibration Area GEH results

Time Period	Number of Turns	Number of Turns with GEH<5	Number of Turns with GEH<10
3.30pm-4.30pm	23	22 (96%)	23 (100%)
4.30pm-5.30pm	23	23 (100%)	23 (100%)
5.30pm-6.30pm	23	23 (100%)	23 (100%)

3.2.2 R^2 Value

Figure 5 to Figure 7 shows that the AM peak R^2 values are between 0.97 and 0.98 for the core calibration area. Similarly, for the PM peak, the R^2 values for the core calibration area are between 0.98 and 0.99. This also meets the R^2 target outlined in the *ACT Traffic Microsimulation Modelling Guidelines* where the required value is greater than 0.95.

AM Peak

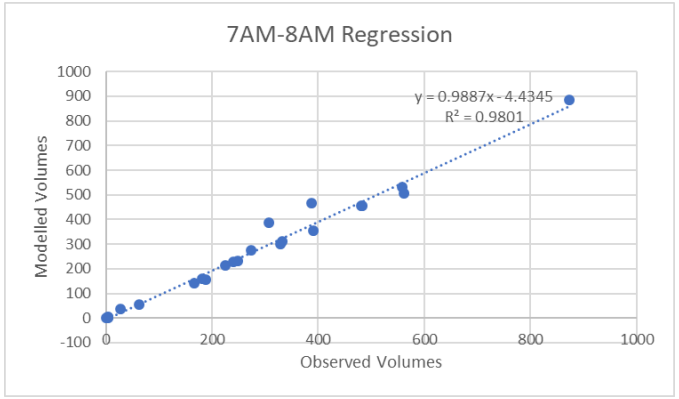


Figure 5: 7AM-8AM Base R^2 Plot

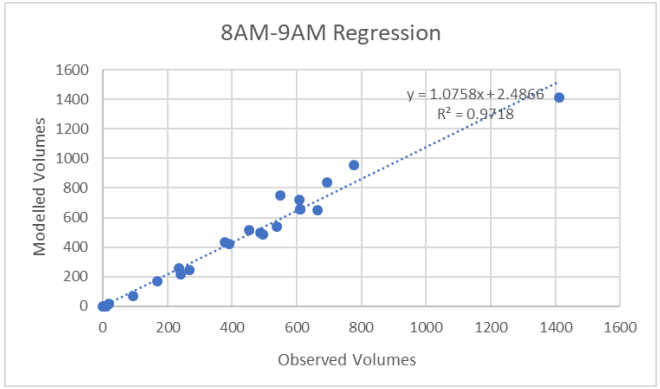


Figure 6: 8AM-9AM Base R^2 Plot

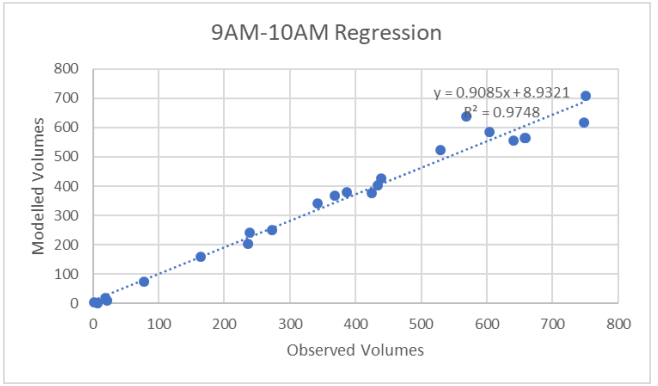


Figure 7: 9AM-10AM Base R^2 Plot

PM Peak

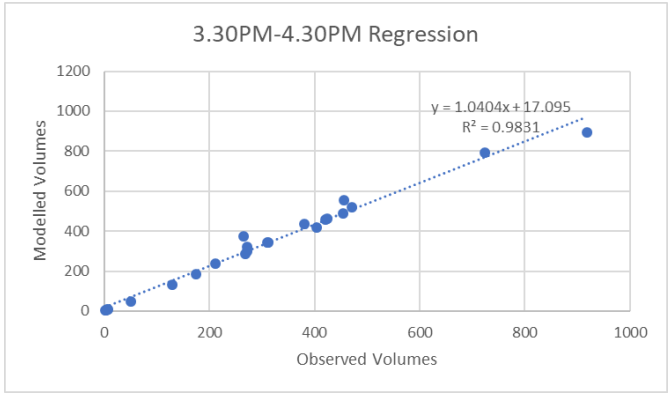


Figure 8: 3.30PM-4.30PM Base R^2 Plot

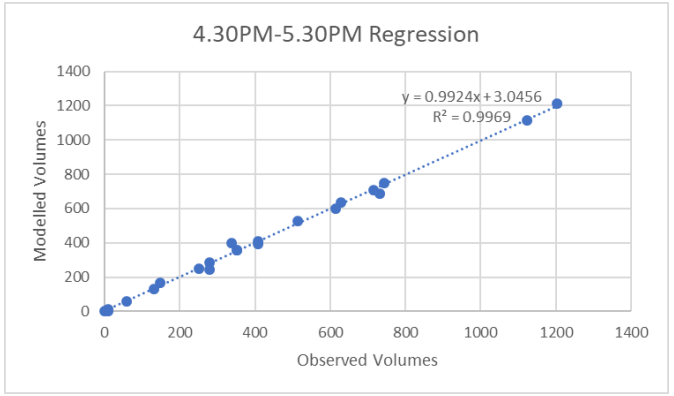


Figure 9: 4.30PM-5.30PM Base R^2 Plot

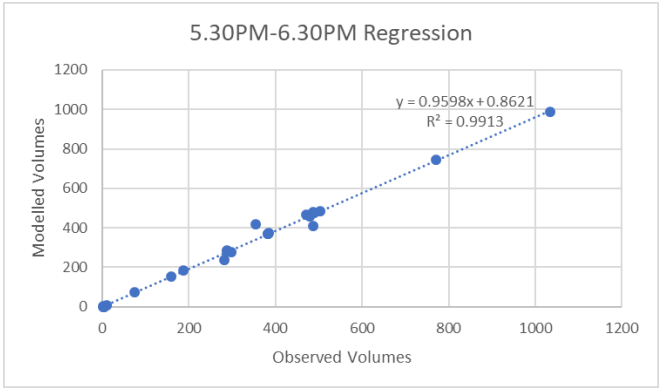


Figure 10: 5.30PM-6.30PM Base R^2 Plot

3.2.3 Base Model Stability

A summary of the model stability analysis, comparing the stability of the base model between seed value runs is shown in Table 3.

The model stability is analysed by comparing differences in travel times, measured in vehicle hours travelled (VHT), between seed runs based on the "coefficient of variation" metric, where a variation of less than 5% is considered to indicate a good level of stability. The stability analysis shows that the coefficient of variation is 4% and 3% for the AM and PM periods respectively.

Therefore, it is considered that both the AM and PM periods are stable and can reliably be used to forecast future scenarios.

As outlined previously, seed number 86524 showed an unusual "lock-up" at the Dudley Street / Novar Street roundabout and hence was omitted from the modelling results in the AM peak period.

Table 3: Model Stability Analysis – Base Model

VHT	Seed 28	Seed 560	Seed 2849	Seed 7771	Seed 86524	Avg	Standard Deviation	Coefficient of Variation
AM Peak	495.11	474.74	456.05	454.23	N/A	470.03	19.12	4%
PM Peak	285.32	271.52	284.59	285.59	293.07	284.02	7.79	3%

3.2.4 Future Model Stability

Similarly, a model stability analysis was conducted on the future models with the summary shown in Table 4. The stability analysis shows that the coefficient of variation is 3% and 4% for the AM and PM peak periods respectively. Therefore, it is considered that both the AM and PM periods are stable and can reliably be used to forecast future scenarios analysis.

Table 4: Model Stability Analysis – Future Model

VHT	Seed 28	Seed 560	Seed 2849	Seed 7771	Seed 86524	Avg	Standard Deviation	Coefficient of Variation
AM Peak	949.56	958.83	949.57	1005.11	964.44	965.50	26.59	3%
PM Peak	615.05	595.27	616.65	666.85	640.65	626.89	27.53	4%

3.3 Traffic Growth Rate

For the forecast modelling undertaken, a growth rate of 1.3% has been used. This growth rate has been based on three alternative approaches which are detailed in Appendix B. A summary of the approaches is shown in Table 5.

Table 5:Summary of approaches to forecast growth rate

Approach	Growth Rate (per annum)
SCATS data and comparative assessment	1%
Canberra Strategic Transport Model (CSTM) volume projections	1.3%
CSTM land use forecast values	1.5%

Based on the review of the various approaches and datasets a rate of 1.3% was chosen per annum between 2016 to 2031.

3.4 Peak Hour Periods

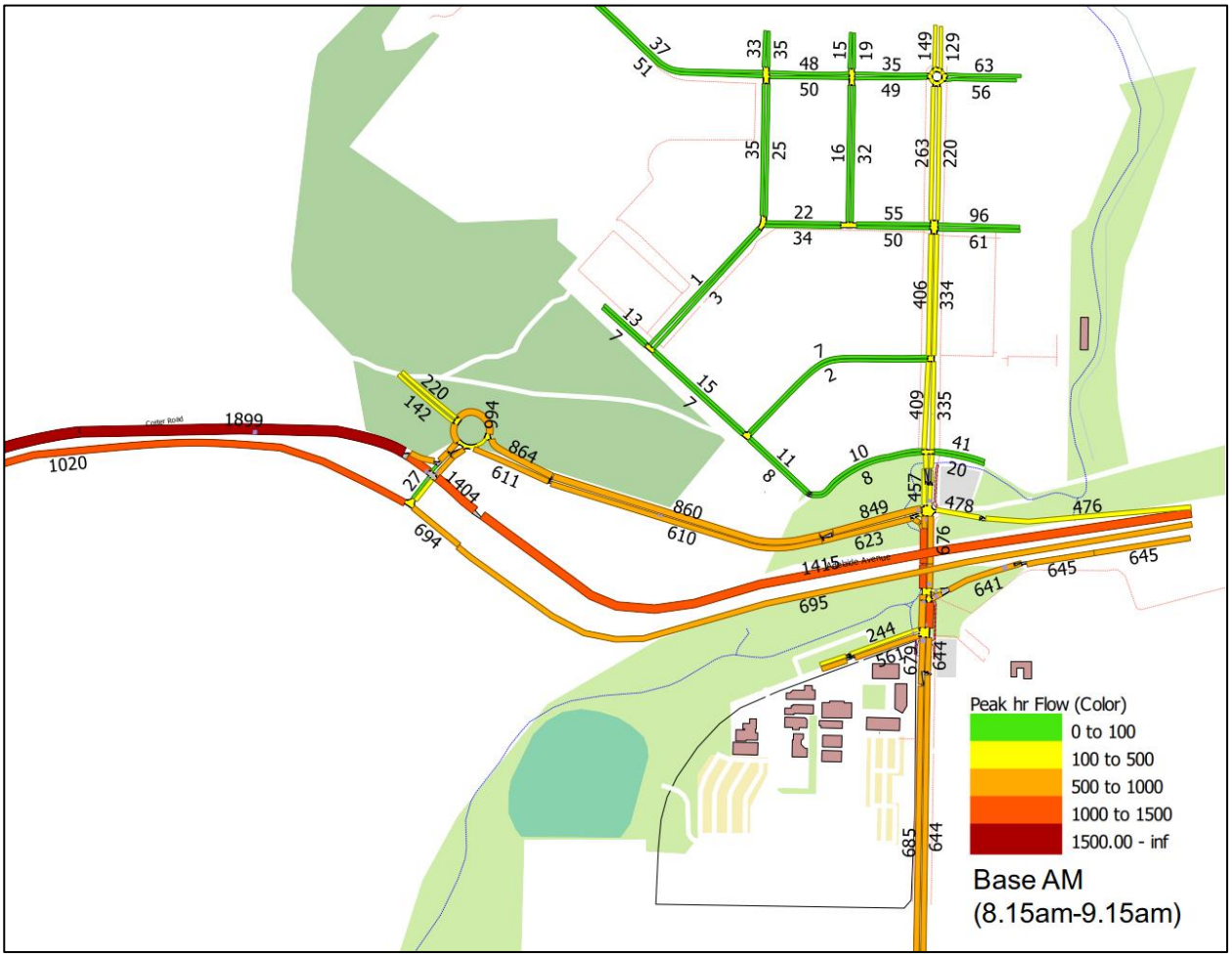
The count data identified the same peak hour period for the network at each of the sites. This was:

- AM Peak Hour - 8:15 am to 9:15 am
- PM Peak Hour - 4:45 pm to 5:45 pm

These peak hour periods have been adopted for the modelling and reporting.

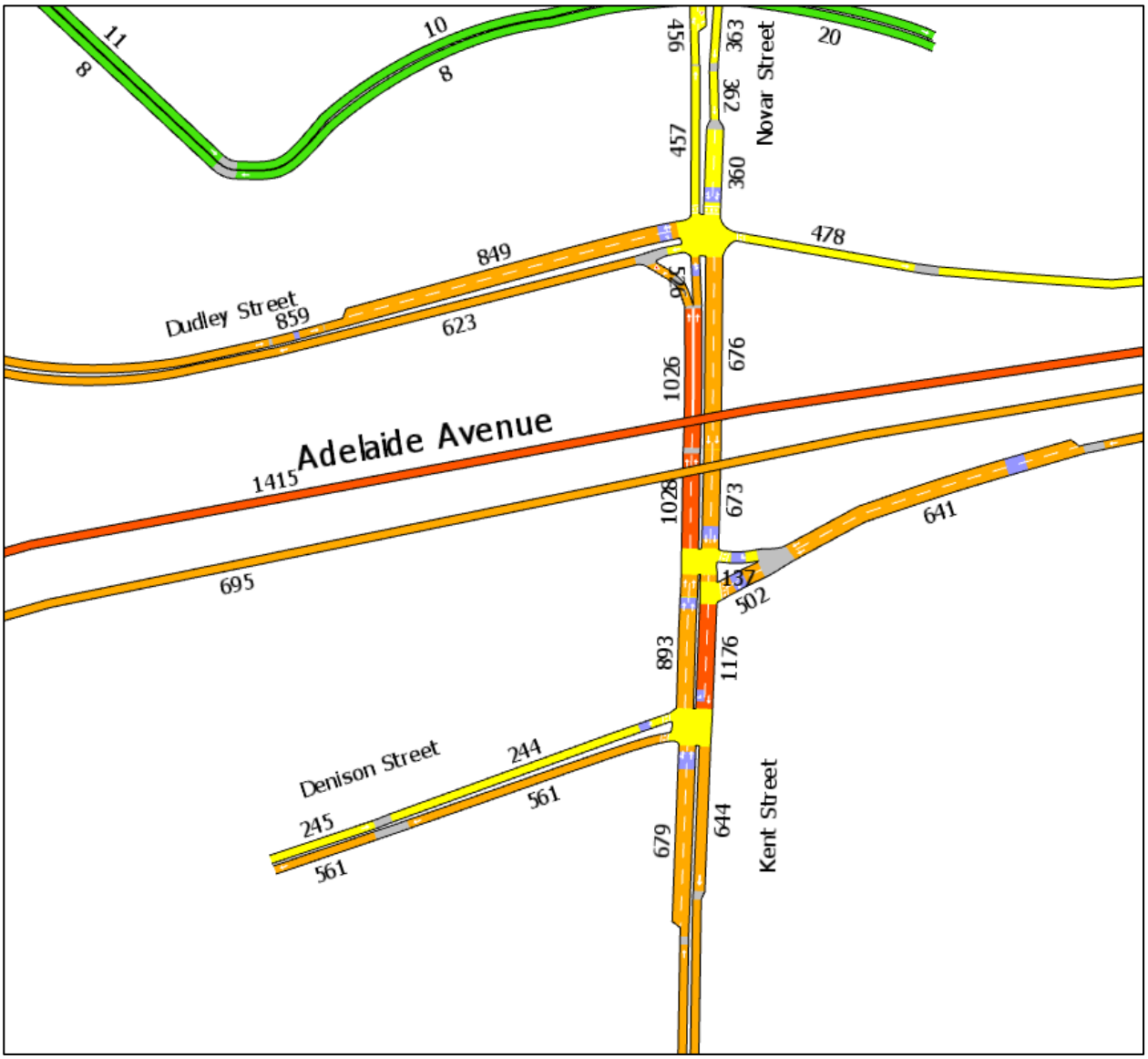
3.5 Traffic Movement Summary

The hourly model flow values for each peak in the 2031 forecast model for the overall study area and the core study area are shown in Figure 11 to Figure 14. The peak hour flows shown in these figures are based on the Agreed PSP Design Layout presented in Section 4.5, which is based on options testing and further design optimisation along Kent Street, Dudley Street and Novar Avenue.



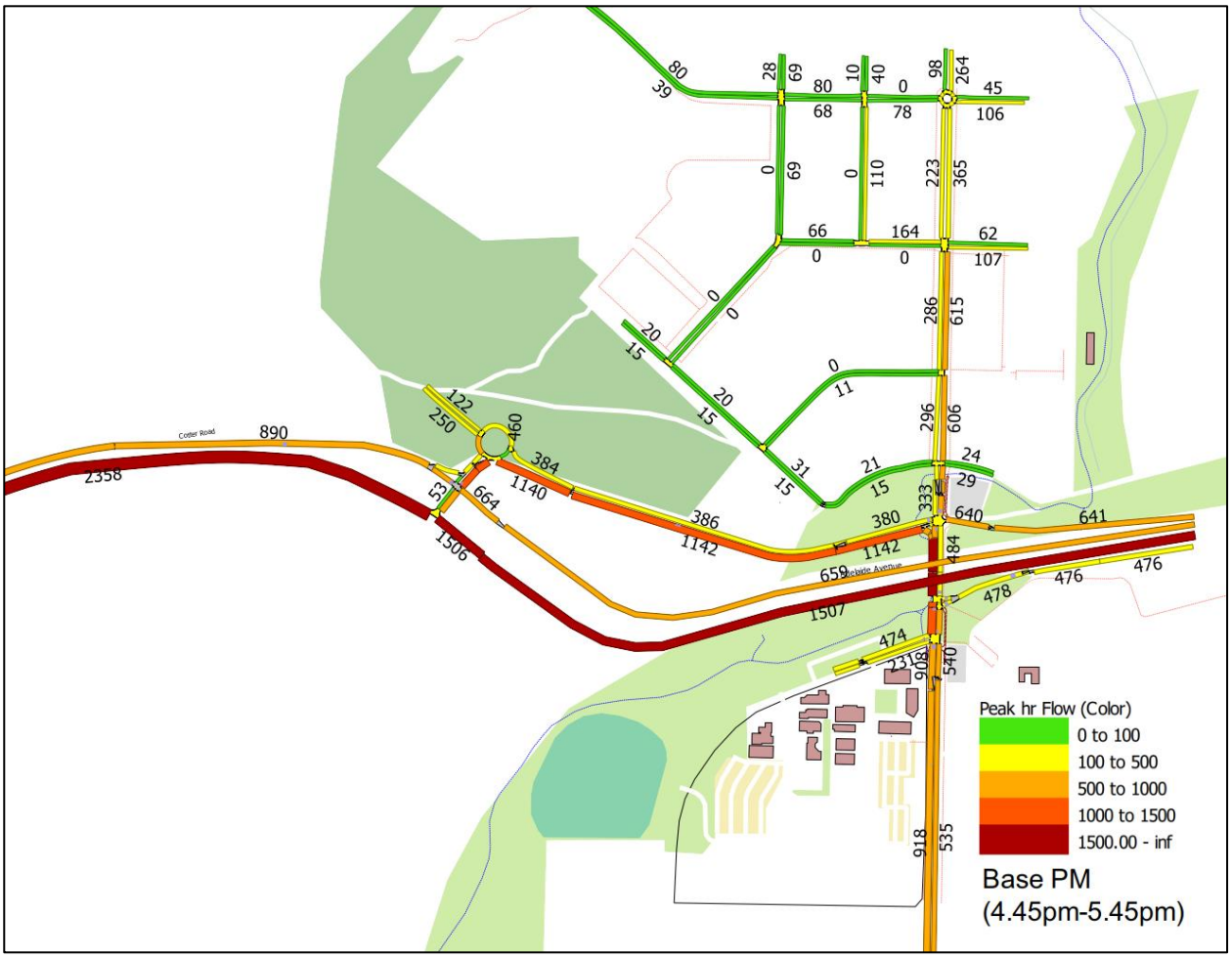
Aimsun Model used: Kent Street Modelling 20210319_v1.16.ang

Figure 11: 2031 AM Peak Hour Traffic Volumes



Aimsun Model used: Kent Street Modelling 20210319_v1.16.ang

Figure 12: 2031 AM Peak Hour Traffic Volumes – Core Area



Aimsun Model used: Kent Street Modelling 20210319_v1.16.ang

Figure 13: 2031 PM Peak Hour Traffic Volumes

Aimsun Model used: Kent Street Modelling 20210319_v1.16.ang

Figure 14: 2031 PM Peak Hour Traffic Volumes – Core Area

4.0 Options Testing and Design Optimisation

4.1 Options Discussion

In undertaking the review of the previously developed Kent Street design, a number of options were considered based on safety, capacity and constructability. Locations where changes in geometry and layout we assessed were:

- Dudley Street / Kent Street / Novar Street / Adelaide Avenue on ramp
- Kent Street bridge (lane configurators and widths)
- Kent Street / Adelaide Avenue off ramp
- Kent Street / Denison Street

The changes were based on testing more detailed survey and utility conflict information, active travel consolidation, wayfinding improvements and further refinement on expected traffic volumes and distributions when comparing the previous forecasts.

The previous arrangement is shown in Figure 15 below.

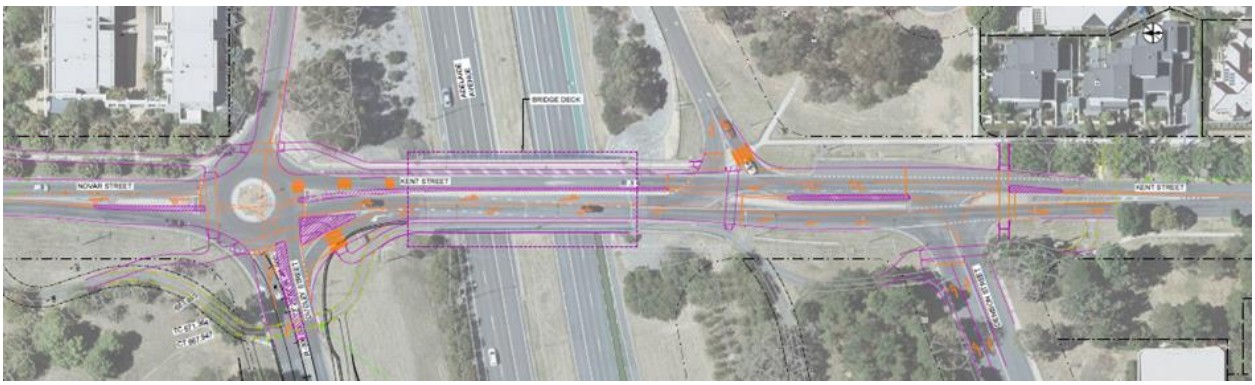


Figure 15: Previous Concept Design

The following sections outline the design process and objectives in the redevelopment of the PSP design.

4.2 Active Travel

The proposed facilities were reviewed to prioritise the key links and provide safe and efficient crossings movements for all users and vehicles given the tight geometric constraints across the existing Kent Street bridge. The facilities are developed to a high standard in terms of width, connectivity, lighting and crossing facilities with intuitive wayfinding and connectivity. Based on this review, the active travel network has been rationalised.

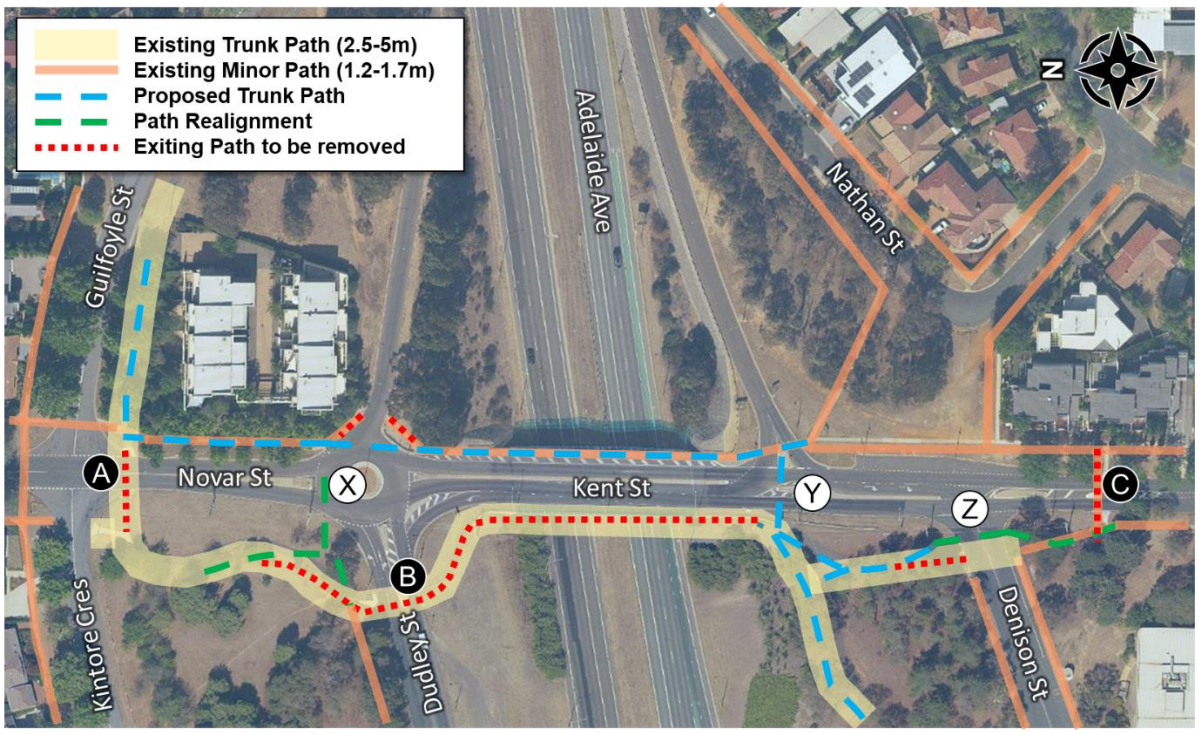


Figure 16 Existing paths and crossings to be removed and new paths proposed

Figure 16 shows the existing paths to be removed and the new paths proposed. The pedestrian links proposed to be removed are indicated by the letters circled in black (A, B, and C). This is primarily about removing the path connection to the west side of the bridge where there are issues with safety, visibility, lighting and high levels of probable conflict with limited pedestrian demand. All active travel road crossings adjacent the bridge will now be signalised to provide safe, controlled crossing points. Summary of the crossings to be removed are as follows:

- A: Crossing on Novar Street at the Novar Street/Kintore Crescent Intersection
    - Being substituted with a signalised crossing ~15 m to the south
- B: Pedestrian refuge on Kent Street at the Kent Street/Denison Street intersection
    - Being substituted with pedestrian crossing refuge ~20 m to the north
- C: Pedestrian refuge on Dudley Street before the Novar Street/Dudley Street Intersection
    - Being substituted with a signalised crossing on the east side of the bridge.

The pedestrian facilities proposed to be added are indicated by the letters circled in white (X, Y, Z). Summary of the crossings proposed are as follows:

- X: Signalised crossings on northern leg of the Novar Street/Kent Street intersection and the Adelaide Avenue on-ramp
- Y: Crossing on Adelaide Avenue off-ramp/Kent Street intersection
- Z: Re alignment of path on Denison street at Kent/Denison Street intersection.

Figure 17: Existing and Proposed Principle Cycle Routes

Figure 17 shows the existing and proposed principle cycling routes. In the existing layout, cyclist travel along the Adelaide Avenue off-ramp, merge with cars and cross the Kent Street intersection to end up on the western verge of the bridge. Cyclists travel along the Kent Street bridge, cross at Dudley Street and then cross further up again just before the Kintore Crescent/Guilfoyle Street intersection to connect to the path along the southern side of Guilfoyle Street. This arrangement has a number of dangerous cyclist and vehicle conflict points which are high risk crash locations.

For the proposed PSP layout, the principal cycling route would be affected. The future principal cycling route is shown in blue in Figure 17. For this proposed path, cyclists would utilise the Adelaide Avenue off-ramp, use the signalised crossing to cross Adelaide Avenue off-ramp onto the Kent Street bridge, cross Adelaide Avenue on-ramp at the signalised crossing, and continue onto Guilfoyle Street. This proposed cyclist route is significantly safer than the existing layout and provides a relatively direct connection for cyclists on local active travel network.

The changes will enable:

- Eliminate merging with vehicles on Kent Street, improving safety.
- More signalised crossings further improving safety.
- Easier route of travel from Adelaide Avenue to Guilfoyle Street with less crossings.
- Maximised traffic efficiency at the Adelaide Avenue off-ramp/Kent Street intersection.
- The removal of the Kent Street roundabout will enable prioritised signalised crossings at the road junction.

4.3 Dudley St / Kent St / Novar St / Adelaide Ave on ramp Options

4.3.1 Dual right turn from Dudley

A key constraint of the network was the right-turn from Dudley Street into Kent Street and southbound across the bridge. Accordingly, one option that was considered was the potential of allowing a dual turning lane from Dudley Street turning right onto Kent Street. This was tested to provide more capacity for the heavy traffic volume movement and enable more effective green time to be given to other approaches when compared to one right turn lane. The dual right is recommended as it provides additional network capacity and reduced queuing as shown by the Aimsun results in Table 6.

Table 6: Aimsun results for the effect of dual turning lanes compared against a single turning lane

Average Network Delay (s)	Dudley Approach configuration	
	Single right turn	Dual right turn
AM	149.90	126.99
PM	159.89	73.51

4.3.2 Signalised left from Kent to Dudley

Another option that was considered was to provide a signalised left turn from Kent Street to Dudley Street, rather than providing a left slip lane. This was considered as it was seen to reduce conflict possibility of traffic movements and could enable two through northbound lanes. Layouts are shown in Figure 18.

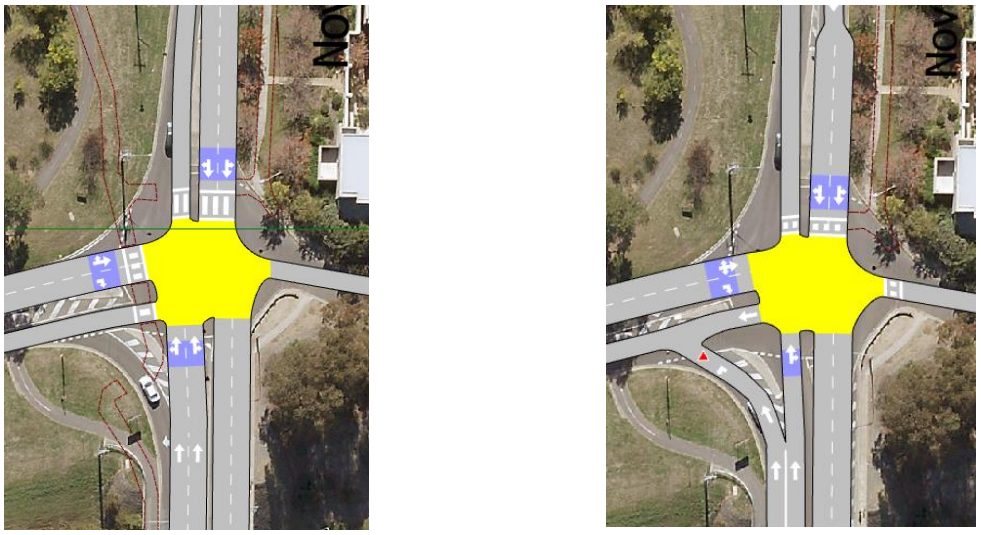


Figure 18: Change in layout to test the effectiveness of providing a signalised left turn lane from Kent Street to Dudley Street

Table 7: Aimsun results for the effect of signalising the Kent Street left turn approach

Average Network Delay (s)	Kent Street Approach configuration	
	Signalised Left	Left Slip Lane
AM	155.02	126.99
PM	226.15	73.51

The model showed that the signalisation of the free left resulted in significant queuing and delays for the approach (particularly in the PM peak) and had considerable downstream impacts. Having the heavy PM left turn movement separate to the signals assisted with minimising queuing across the bridge and was seen to provide a better outcome when balanced across all users.

4.3.3 Dual right turn from Kent

An option that was considered was the provision of a dual right turn from Kent Street to the Adelaide Avenue on-ramp. It was found that there was insufficient width to allow for the provision of an additional lane (which would also be short) while still allowing width for the dual right turn movement from Dudley Street to Kent Street. The dual right turn lane from Dudley Street into Kent Street was considered a higher priority of the two options due to the heavy traffic demand utilising this movement.

4.4 Kent Street / Denison Street

4.4.1 Banning the Right Turn

Consideration was given to banning the right turn out of Denison Street. Removing the right turn will improve the traffic efficiency and operation of the intersections whilst impacting a very low volume of users.

The ban is an acceptable approach as there are only 17 vehicles recorded in the AM peak and 20 vehicles recorded in the PM making this movement over a three-hour period surveyed. These traffic numbers are very low and there are other network links south that can be taken by these vehicles including Denison Street (South) via Stickland Crescent.

Figure 19: Comparison of geometry with right turn versus right turn ban

Figure 19 presents results of banning the right turn. At the Denison Street / Kent Street intersection, banning of the right-turn does not significantly impact intersection delay in both the AM and PM peaks. The benefits of the right-turn ban include simplified signal phasing when coordinating the traffic movements with the other Kent Street intersections and increased pedestrian safety at the crossing along Denison Street.

Table 8: Aimsun Modelling Network Results for right turn ban effects

Average Intersection Delay (s)	Right turn provision	
	Right Allowed	No Right Turn
AM	22.36	22.04
PM	35.36	34.37

4.5 Agreed Layout

The agreed PSP layout is shown in Figure 20 and is characterised by three signalised intersections with the following noteworthy inclusions:

- Dual right turn lanes from Dudley Street to Kent Street over the bridge
- Dual lanes in both directions on bridge.
- Active travel facilities provided on the north side of the bridge.
- Right turn ban for vehicles exiting Denison Street.
- Left slip lane from Kent Street to Dudley Street.

The extent of two-lane approaches in the traffic model reflects observed operation where traffic informally used wider single lane carriageways (around 6m+) as two lanes.

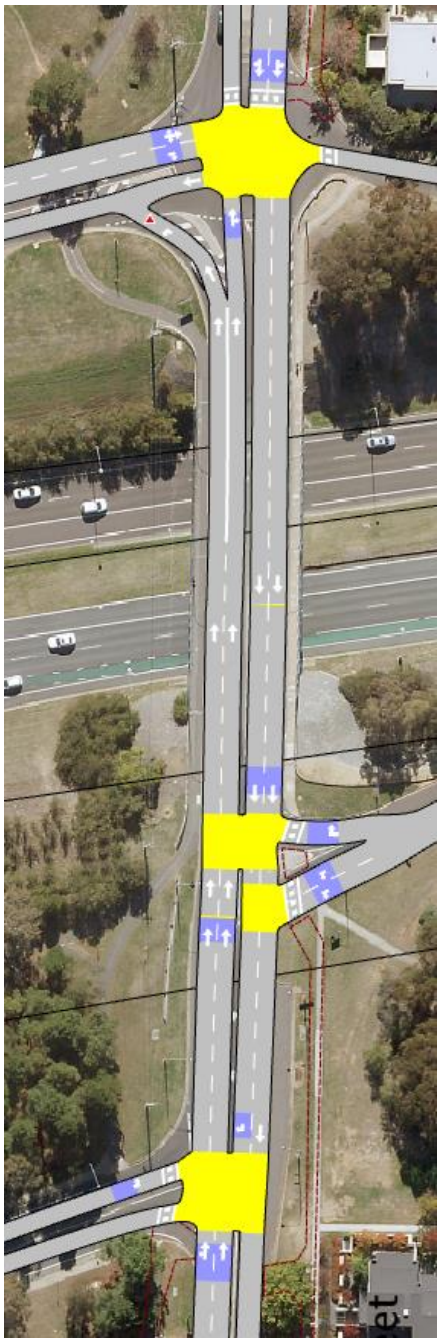


Figure 20: PSP Layout

4.6 Demand Sensitivity Tests

Two sensitivity tests were performed to assess the robustness of the proposed network design and its feasibility to function in a future scenario where specific traffic volumes are higher than predicted. The first sensitivity test involved increasing the traffic demand by 20% on Denison St inbound onto Kent St and the second sensitivity test involved increasing the traffic demand by 20% on the Adelaide Ave off-ramp inbound onto Kent St. Both tests were done using the PM scenario.

4.6.1 Denison St Traffic Demand Sensitivity Test

In this scenario, the traffic demand on Denison St inbound onto Kent St was increased by 20% in the PM peak.

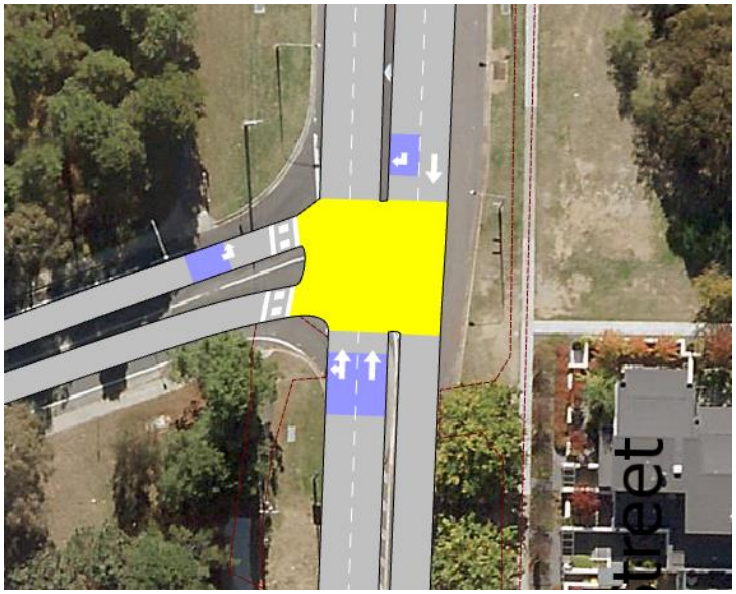


Figure 21: Denison St / Kent St Intersection

Table 9: Denison St 20% traffic volume increase 2031 future network PM sensitivity test

Average Approach Delay (s)	Traffic Demand	
	Base	20%Volume Increase
PM	12.20	56.67

The comparison of the average approach delay on Denison St as a result of its traffic volume increased is shown in Table 9. The simulations show that a 20% increase in traffic volume on Dension St results in an average intersection delay increase from 12.20 s to 56.67 s at the intersection. This indicates that the Denison St / Kent St intersection is sensitive to increases in traffic volumes. However, as the average intersection delay of the volume increased scenario is still only ~57s, a moderate delay in terms of average peak period delays, it is unlikely that the intersection would fail to manage traffic flow at these higher volumes. The effectiveness of the intersection even at higher volumes is due the signal phasing being retained with the same maximum green times as the main forecast model, if maximum green times were increased for this movement, this impact would be reduced (at the expense of other network movements). Furthermore, because of this, it is likely that subsequent volume changes will result in a diminishing increase to the average section delay.

4.6.2 Adelaide Ave Off-Ramp Demand Sensitivity Test

In this scenario, the traffic demand on the Adelaide Ave Off-Ramp was increase by 20% in the PM peak period.

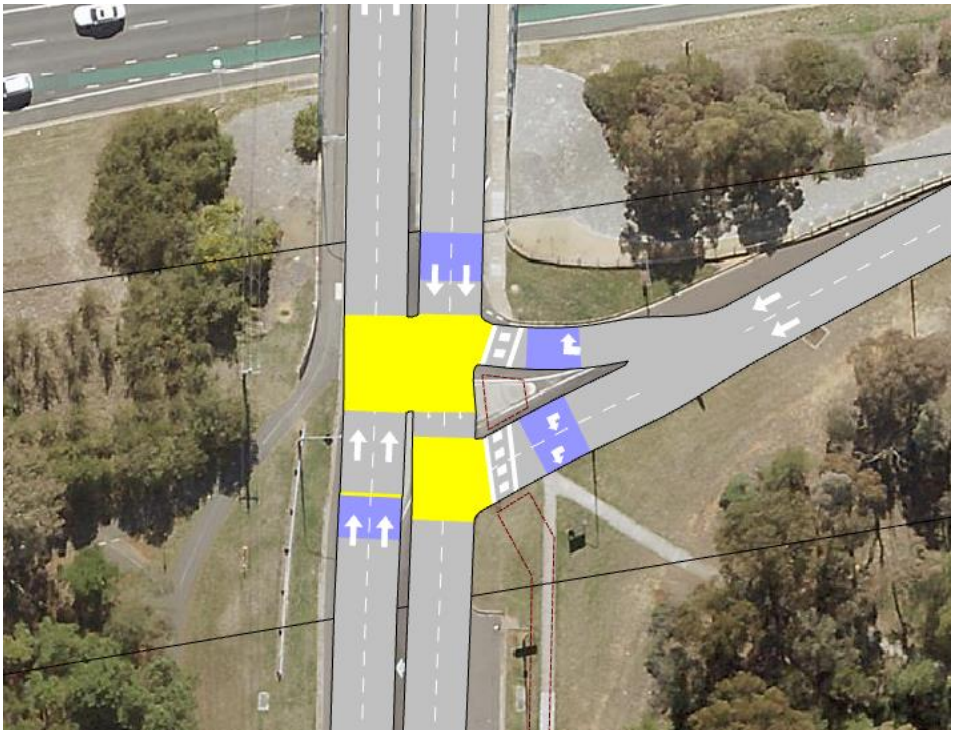


Figure 22: Denison St / Kent St Intersection

Table 10: Adelaide Ave Off-Ramp 20% traffic volume increase 2031 future network PM sensitivity test

Average Approach Delay (s)	Traffic Demand	
	Base	20%Volume Increase
PM	56.69	58.45

The comparison of the average approach delay on Adelaide Avenue Off-ramp as a result of its traffic volume increased is shown in Table 10. The simulations show that a 20% increase in traffic volume on Adelaide Ave results in an increase in average intersection, increasing from 56.69 s to 58.45 s, an increase of 3%. This shows that the Kent/Dudley/Adelaide Intersection is not sensitive to increases in traffic volume on the Adelaide Avenue offramp. Therefore, at unexpectedly high traffic volumes, this intersection could operate to manage traffic flow effectively. Further, as part of the PSP design, a phase extension loop detector is recommended to be installed at the end of the dual lane section on the off-ramp to ensure that if there was ever a traffic demand peak anomaly, where the queuing on the off-ramp reached this point, the Adelaide Avenue off-ramp phase green time would be extended to clear this traffic queue, ensuring there is no excessive queuing which could impact the westbound through traffic movements on Adelaide Avenue.

The lane configuration for the Adelaide Avenue off-ramp was determined based on the highest demand traffic movements in both the AM and PM peak periods. In the AM peak, the peak movements are left off the off-ramp and continuing southbound and left off the off-ramp before turning right into Denison Street. In the PM, the peak movements are left off the off-ramp and continuing southbound and the right turn off the off-ramp. The lane configuration has been designed to accommodate the AM peak primarily, however ensuring the queuing from the short right turn lane in the PM does not adversely affect the operation of the off-ramp. Figure 23 below shows the typically queuing configuration of the off-ramp in the PM peak, whereby the second lane on the off-ramp is utilised by

the right turn queue in the PM without impacting the left-right movement from the off-ramp into Dension Street. The left-right movement from the off-ramp into Dension Street has relatively low volumes in the PM peak compared to the AM peak demand. The line marking and TCD plans in the PSP have been developed to reflect this configuration.

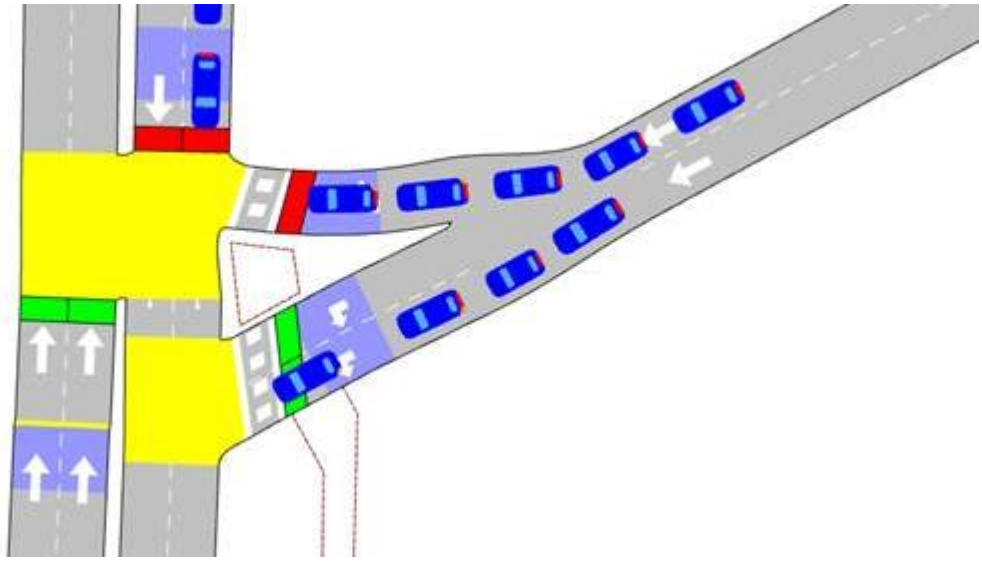


Figure 23: Adelaide Avenue off-ramp PM lane utilisation

5.0 Model results

5.1 Comparison of preferred scheme against future base (do nothing)

The results of the modelling of the proposed layout compared to the future base (do nothing) results are shown below in Figure 24 and Figure 25, for the Kent/Dudley/Adelaide and Kent/Adelaide/Denison intersections.

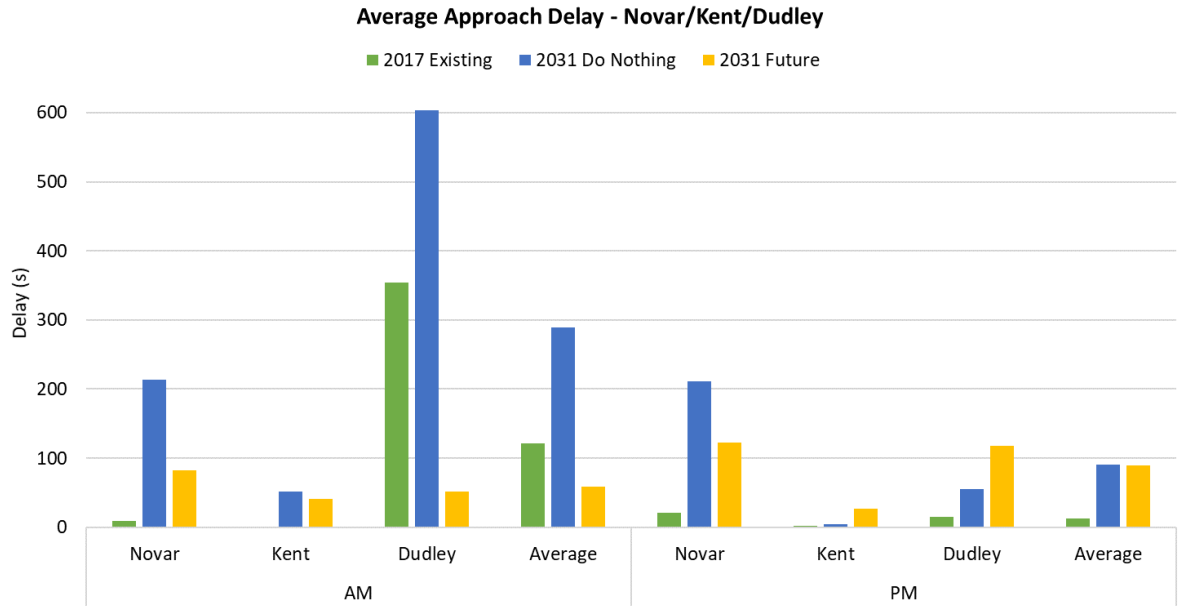


Figure 24: Average Approach Delay - Intersection Novar/Kent/Dudley

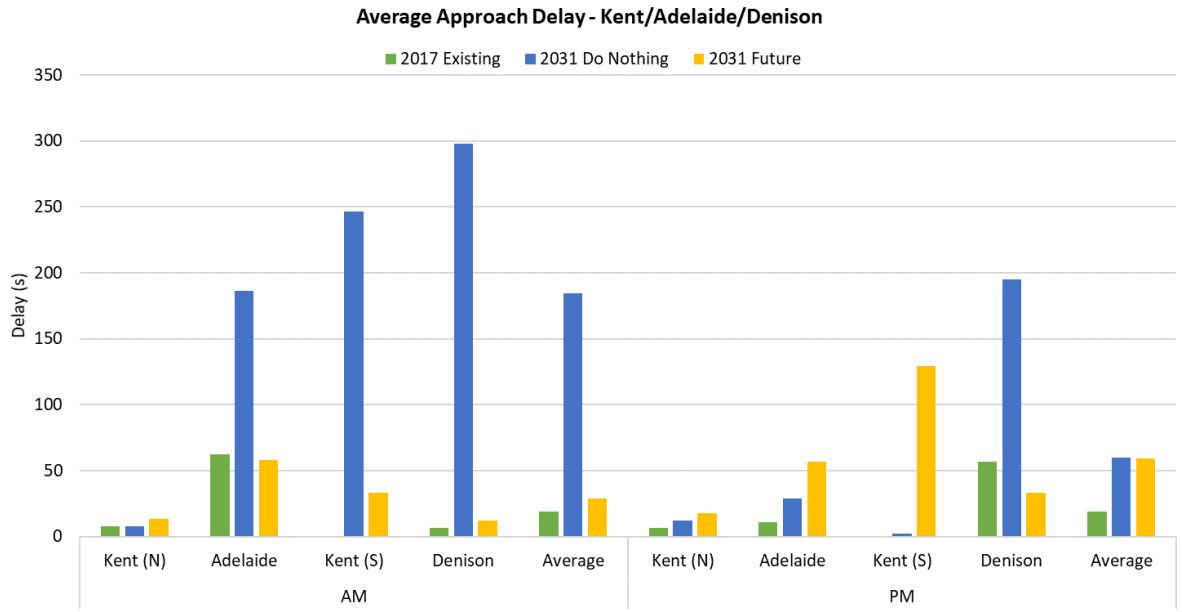


Figure 25: Average Approach Delay - Intersection Kent/Adelaide/Denison

Table 11: Per Intersection Average Delay Comparison

Average Delay (s)				
	Kent/Dudley/Adelaide		Kent/Adelaide/Denison	
Scenario	**AM**	**PM**	**AM**	**PM**
2017 Base	121.66	12.96	19.19	18.82
2031 Do Nothing	289.75	90.32	184.71	59.59
2031 PSP Layout	58.49	89.08	29.20	59.23

In the AM peak, there is a significant improvement in the average network delays between the 2031 Do Nothing scenario and the proposed 2031 PSP layout. The Do Nothing model suffers from congestion on Dudley Street attempting to turn right onto Kent Street which causes both Novar Street and the Adelaide Off-ramp to backup. In addition, the queue along Dudley Street extends back to Cotter Road causing congestion along the Cotter Road as well. This eventually leads to high numbers of vehicles that are unable to enter the network mainly from Cotter Road, during the model simulation which lasts from 7am to 10am during the AM model.

In the PM peak, there is also an improvement in the average intersection delay for the network overall in the 2031 PSP layout compared to the 2031 Do Nothing, however the improvement isn't as great when compared to the AM improvements. There is a heavy northbound movement along Kent Street in the PM peak, which has priority in the Do Nothing scenario. However, with the signalised arrangement in the proposed PSP scenario, these vehicles are forced to stop at the intersections along Kent Street to allow green time for other movements. The extents of the model network do not consider alternate routes throughout Deakin and Hughes, and it is expected that if there are large delays along Kent Street northbound, vehicles would utilise other routes outside of the modelled network.

Analysing the vehicles that are unable to enter the network provides an important measure to understand the congestion present in the various models. As delay times are only recorded after vehicles have travelled over the road section in a model that represents heavy congestion may report unstable and erroneous values for delay times. For these reasons, a low number of unreleased vehicles represents a stable model that accurately reflects the vehicle movements in the model.

The proposed PSP layout allows most vehicles (< 20 unreleased vehicles) through the network in both the AM and PM cases indicating a substantial improvement over the Do Nothing case, particularly in the AM peak. This is largely due to the coordinated signals between the three intersections which are designed to efficiently move the traffic through the major traffic movements in the network. This is also due to the dual right turn from Dudley Street onto Kent Street alleviating delays in this location.

The Do Nothing model conditions utilise a roundabout and priority-controlled intersections and therefore there is no phasing associated with the base case.

In the proposed PSP design all three of the intersections along Kent Street have been signalised largely due to the heavy interaction between them. By signalising these movements, it is possible to coordinate these signal phases to better utilise the existing bridge asset which is necessary to ensure a good outcome. Signalising the intersection of the Adelaide Avenue off-ramp and Kent Street was also seen as desirable from a safety point of view due to the crest and proximity to the intersection of Denison Street and Kent Street. The signal phasing was designed to be actuated and demand dependent to improve traffic flow during higher traffic volume periods.

6.0 Conclusion

This assessment has outlined the development of the PSP layout for the intersections of:

- Kent Street / Dudley Street
- Kent Street / Adelaide Off-ramp
- Kent Street / Denison Street

Due to the proximity of these intersections coordinated signals are preferred as they improve the intersection performance when compared to the existing roundabout and priority-controlled intersections, particularly in the AM peak period.

A concept design was established as part of a previous Traffic and Transport Assessment undertaken for the Dudley Street upgrade works associated with the development of the proposed Canberra Brickworks Precinct in Yarralumla. It was found that through a more detailed assessment of geometry, and confirmation about bridge options, that a layout could be developed that provided benefits over the earlier concept design proposed as part of the Dudley Street Upgrade Works. The improvements include:

- Dual right turning lanes from Dudley Street to Kent Street
- Banning the right turn from Denison Street onto Kent Street
- Priority controlled left turn movement from Kent Street to Dudley Street
- Actuated and demand dependent signal phases

An Aimsun model showed the existing layout was not able to manage with the increased traffic demands in the future AM peak period in particular. A large number of vehicles were unable to enter the network during the simulation period due to the high level of queuing on some legs particularly at Dudley Street and Novar Street. The proposed PSP layout showed an improvement with all vehicles being able to navigate the traffic network with a minimal number of vehicles waiting to enter the network.

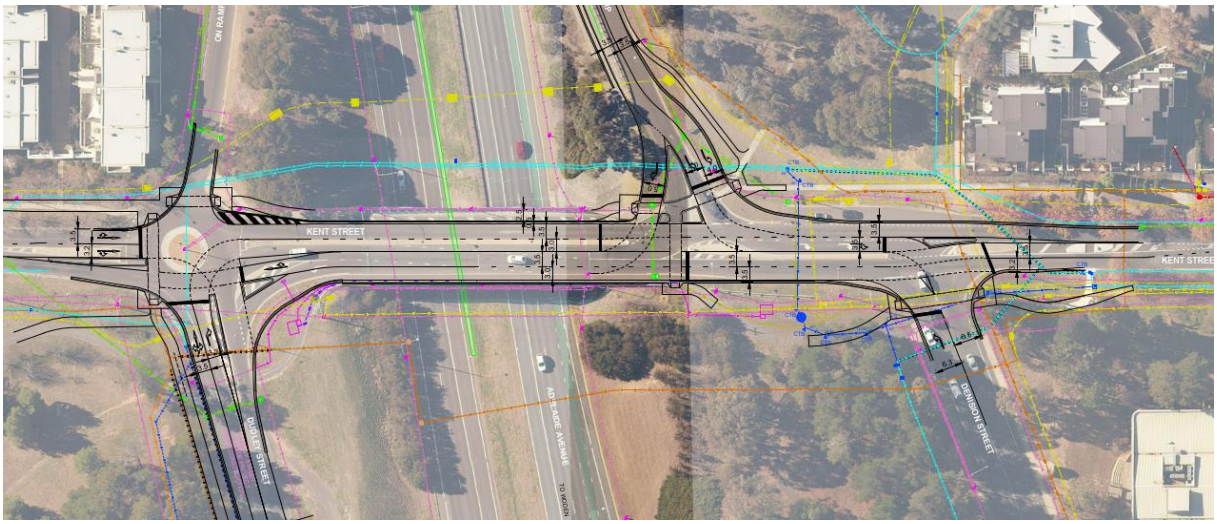


Figure 26: Preliminary concept plan

Appendix A

Traffic Survey Results

Appendix A Traffic Survey Results

Traffic counts for the following intersections were undertaken by Trans Traffic Survey on Wednesday the 21st of the June 2017:

- Dudley Street / Novar Street /Kent Street /Adelaide on-ramp
- Kent Street/Adelaide Avenue off-ramp including Denison Street

Dudley Street and Kent Street

Light Vehicles

Time		North Approach Novar St				East Approach Adelaide Ave				South Approach Novar St				West Approach Dudley St			
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L
7:00	7:15	0	6	11	5	0	0	0	0	1	23	23	20	0	51	0	18
7:15	7:30	0	12	10	4	0	0	0	0	0	39	26	18	0	85	3	34
7:30	7:45	0	16	11	4	0	0	0	0	0	35	27	23	0	105	2	36
7:45	8:00	0	23	27	4	0	0	0	0	0	92	19	32	0	146	0	43
8:00	8:15	0	15	25	13	0	0	0	0	0	102	28	32	0	133	2	55
8:15	8:30	0	25	35	15	0	0	0	0	0	99	26	29	1	145	5	79
8:30	8:45	0	16	26	7	0	0	0	0	0	98	37	29	0	131	2	75
8:45	9:00	0	25	28	6	0	0	0	0	0	139	44	36	0	124	5	75
9:00	9:15	0	11	41	12	0	0	0	0	0	126	48	42	0	135	1	66
9:15	9:30	0	22	38	9	0	0	0	0	0	74	43	31	0	143	0	41
9:30	9:45	0	16	27	7	0	0	0	0	0	77	42	27	0	74	0	46
9:45	10:00	0	17	27	12	0	0	0	0	0	59	46	30	0	65	0	35
15:30	15:45	1	36	50	46	0	0	0	0	0	92	34	91	0	42	1	29
15:45	16:00	0	22	31	29	0	0	0	0	0	73	29	74	0	37	2	25
16:00	16:15	0	41	24	32	0	0	0	0	0	73	35	111	0	50	0	25
16:15	16:30	0	37	52	30	0	0	0	0	0	82	32	103	0	49	0	20
16:30	16:45	0	28	44	32	0	0	0	0	0	109	33	136	0	41	1	24
16:45	17:00	0	36	30	30	0	0	0	0	0	100	31	132	0	44	1	21
17:00	17:15	0	57	50	39	0	0	0	0	0	123	32	166	0	44	2	22
17:15	17:30	0	52	53	75	0	0	0	0	0	120	50	139	0	50	2	30
17:30	17:45	0	44	77	72	0	0	0	0	0	95	49	129	0	47	1	22
17:45	18:00	0	23	58	39	0	0	0	0	0	73	64	71	0	49	3	31
18:00	18:15	0	28	38	41	0	0	0	0	0	72	34	90	0	41	5	32
18:15	18:30	0	21	21	18	0	0	0	0	0	55	33	49	0	34	1	16

Heavy Vehicles

Time		North Approach Novar St				East Approach Adelaide Ave				South Approach Novar St				West Approach Dudley St			
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L
7:00	7:15	0	1	1	0	0	0	0	0	0	0	2	2	0	1	0	0
7:15	7:30	0	1	2	0	0	0	0	0	0	2	1	0	0	1	0	0
7:30	7:45	0	0	1	0	0	0	0	0	0	1	0	0	0	2	0	0
7:45	8:00	0	0	1	0	0	0	0	0	0	0	1	1	0	1	0	2
8:00	8:15	0	0	3	0	0	0	0	0	0	1	4	1	0	0	0	0
8:15	8:30	0	2	1	0	0	0	0	0	0	2	2	0	0	0	0	3
8:30	8:45	0	1	2	2	0	0	0	0	0	2	2	2	0	0	0	1
8:45	9:00	0	1	1	0	0	0	0	0	0	2	2	0	0	1	0	0
9:00	9:15	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0
9:15	9:30	0	0	3	0	0	0	0	0	0	1	2	0	0	2	0	1
9:30	9:45	0	1	3	0	0	0	0	0	0	2	1	0	0	1	0	2
9:45	10:00	0	0	1	1	0	0	0	0	0	0	3	3	0	3	0	0
15:30	15:45	0	0	1	1	0	0	0	0	0	1	2	2	0	1	0	3
15:45	16:00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
16:00	16:15	0	1	2	1	0	0	0	0	0	2	1	0	0	0	0	0
16:15	16:30	0	0	1	1	0	0	0	0	0	1	1	0	0	1	0	0
16:30	16:45	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
16:45	17:00	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
17:00	17:15	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1
17:15	17:30	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
17:30	17:45	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	18:00	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0
18:00	18:15	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
18:15	18:30	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0

Kent Street / Adelaide Avenue off-ramp / Denison Street

Light Vehicles

Time		North Approach Kent St				East Approach Adelaide Ave				South Approach Kent St				West Approach Denison St			
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L
7:00	7:15	0	20	43	0	0	12	15	25	0	0	50	2	0	1	0	5
7:15	7:30	0	51	44	0	0	6	20	35	0	0	69	1	0	2	0	8
7:30	7:45	0	58	58	0	0	6	25	34	0	0	61	1	0	1	0	18
7:45	8:00	0	87	86	0	0	6	30	38	0	0	116	0	0	0	0	21
8:00	8:15	0	74	84	0	0	14	38	58	0	0	120	2	0	0	0	28
8:15	8:30	0	92	88	0	0	14	50	53	0	0	115	6	0	0	0	25
8:30	8:45	0	77	80	0	0	19	52	52	0	0	106	5	0	0	0	39
8:45	9:00	0	80	72	0	0	18	49	60	0	0	133	4	0	0	0	68
9:00	9:15	0	92	84	0	0	22	43	52	0	0	133	8	0	2	0	61
9:15	9:30	0	79	102	0	0	16	45	41	0	0	96	3	0	0	0	36
9:30	9:45	0	44	57	0	0	15	20	55	0	0	102	6	0	2	0	29
9:45	10:00	0	48	44	0	0	18	25	54	0	0	88	2	0	4	0	29
15:30	15:45	0	25	67	0	0	10	20	58	0	0	137	3	0	4	0	70
15:45	16:00	0	28	40	0	0	14	25	49	0	0	107	1	0	2	0	55
16:00	16:15	0	23	51	0	0	12	15	52	0	0	117	2	0	0	0	90
16:15	16:30	0	22	79	0	0	11	23	42	0	0	123	2	0	1	0	83
16:30	16:45	0	18	67	0	0	19	20	68	0	0	148	1	0	3	0	111
16:45	17:00	0	27	47	0	0	14	18	57	0	0	152	2	0	1	0	97
17:00	17:15	0	25	69	0	0	7	15	54	0	0	216	3	0	1	0	98
17:15	17:30	0	23	80	0	0	19	21	92	0	0	187	5	0	2	0	103
17:30	17:45	0	32	92	0	0	19	24	63	0	0	160	3	0	0	0	94
17:45	18:00	0	27	80	0	0	20	25	46	0	0	118	2	0	1	0	70
18:00	18:15	0	18	61	0	0	14	19	42	0	0	115	2	0	0	0	67
18:15	18:30	0	24	31	0	0	17	15	47	0	0	73	1	0	3	0	47

Heavy Vehicles

Time		North Approach Kent St				East Approach Adelaide Ave				South Approach Kent St				West Approach Denison St			
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L
7:00	7:15	0	0	2	0	0	0	0	1	0	0	3	0	0	0	0	1
7:15	7:30	0	0	3	0	0	1	0	1	0	0	1	0	0	0	0	1
7:30	7:45	0	1	2	0	0	0	0	1	0	0	1	0	0	0	0	0
7:45	8:00	0	2	0	0	0	1	1	1	0	0	0	0	0	0	0	1
8:00	8:15	0	0	3	0	0	1	2	2	0	0	4	1	0	0	0	1
8:15	8:30	0	1	0	0	0	1	0	1	0	0	2	0	0	0	0	1
8:30	8:45	0	1	1	0	0	1	1	2	0	0	2	0	0	0	0	3
8:45	9:00	0	0	2	0	0	0	0	1	0	0	2	0	0	0	0	2
9:00	9:15	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:15	9:30	0	2	3	0	0	0	1	1	0	0	2	0	0	0	0	1
9:30	9:45	0	1	3	0	0	1	1	2	0	0	1	0	0	0	0	1
9:45	10:00	0	1	3	0	0	2	0	2	0	0	3	0	0	0	0	1
15:30	15:45	0	1	1	0	0	1	0	0	0	0	2	0	0	0	0	2
15:45	16:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	16:15	0	0	2	0	0	0	0	1	0	0	2	0	0	0	0	1
16:15	16:30	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0
16:30	16:45	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
16:45	17:00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	17:15	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0
17:15	17:30	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
17:30	17:45	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	18:00	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0
18:00	18:15	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
18:15	18:30	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Dudley Street / Cotter Road

Light Vehicles

Time		North Approach Dudley St			East Approach Cotter Rd			West Approach Cotter Rd		
Period Start	Period End	U	R	L	U	R	WB	U	EB	L
7:00	7:15	0	24	0	0	0	51	0	121	82
7:15	7:30	0	39	1	0	0	62	1	189	103
7:30	7:45	0	42	0	0	0	69	0	241	114
7:45	8:00	0	50	0	0	0	69	0	310	205
8:00	8:15	0	55	0	0	0	108	0	346	193
8:15	8:30	0	58	0	0	1	114	0	358	244
8:30	8:45	0	52	0	0	0	158	0	394	273
8:45	9:00	0	85	0	0	0	140	0	292	234
9:00	9:15	0	75	1	0	0	122	0	258	195
9:15	9:30	0	49	1	0	0	92	0	203	136
9:30	9:45	0	65	2	0	1	66	1	126	117
9:45	10:00	0	48	0	0	0	62	0	93	107
15:30	15:45	0	144	0	0	1	275	0	93	67
15:45	16:00	0	145	2	0	0	209	0	112	82
16:00	16:15	0	131	0	0	1	191	0	83	73
16:15	16:30	0	132	0	0	0	198	0	105	96
16:30	16:45	0	150	0	0	1	237	0	71	46
16:45	17:00	0	142	0	0	0	251	2	109	71
17:00	17:15	0	195	0	0	0	332	0	96	62
17:15	17:30	0	197	0	0	0	374	0	103	65
17:30	17:45	0	146	0	0	0	304	1	96	79
17:45	18:00	0	103	0	0	0	266	0	100	79
18:00	18:15	0	100	0	0	0	224	0	69	50
18:15	18:30	0	61	0	0	0	177	0	95	26

Heavy Vehicles

Time		North Approach Dudley St			East Approach Cotter Rd			West Approach Cotter Rd		
Period Start	**Period End**	U	R	L	U	R	WB	U	EB	L
7:00	7:15	0	0	0	0	0	3	0	2	1
7:15	7:30	0	0	0	0	0	5	0	5	1
7:30	7:45	0	2	0	0	0	5	0	10	0
7:45	8:00	0	1	0	0	0	10	0	7	1
8:00	8:15	0	1	0	0	0	2	0	9	3
8:15	8:30	0	2	0	0	0	5	0	5	2
8:30	8:45	0	3	0	0	0	4	0	4	1
8:45	9:00	0	1	0	0	0	9	0	4	3
9:00	9:15	0	2	0	0	0	8	0	7	1
9:15	9:30	0	1	0	0	0	8	0	7	0
9:30	9:45	0	2	0	0	0	7	0	5	0
9:45	10:00	0	0	0	0	0	3	0	9	1
15:30	15:45	0	2	0	0	0	7	0	6	1
15:45	16:00	0	1	0	0	0	3	0	8	0
16:00	16:15	0	1	0	0	0	2	0	4	1
16:15	16:30	0	0	0	0	0	8	0	6	1
16:30	16:45	0	1	0	0	0	4	0	5	1
16:45	17:00	0	0	0	0	0	4	0	4	0
17:00	17:15	0	0	0	0	0	6	0	4	0
17:15	17:30	0	2	0	0	0	2	0	4	0
17:30	17:45	0	0	0	0	0	6	0	1	1
17:45	18:00	0	0	0	0	0	4	0	2	0
18:00	18:15	0	0	0	0	0	6	0	6	0
18:15	18:30	0	1	0	0	0	2	0	4	1

Appendix B

Approaches to forecast growth rate

Appendix B Approaches to forecast growth rate

Three approaches were utilised to forecast the future growth rate that could be expected between 2016 and 2031. These approaches were:

1. Use of SCATs volumes collected in 2016,2017and 2019.
2. Use of the CSTM population assumptions for 2016 and 2031 to provide an estimate of growth in this area.
3. Lastly, the CSTM was used focusing on its predictions for traffic volumes and the expected growth calculated between the 2016 and 2031 models.

Growth based on SCATs data

SCATS data is a useful comparison across various time periods and can be used to help rationalise and substitute other traffic count information. The signalised intersection in proximity to the site is the intersection of Dudley Street and Cotter Road. Data was collected in 2016 – pre cotter road duplication construction, 2017 - during construction and 2019 - post construction.

As expected, the number of vehicles utilising Cotter Road during the peak periods has increased as indicated in Figure 27 and Figure 28. Note that the detector definitions are given in Figure 29.

It appears that construction traffic had an effect indicated by the drop-in volumes between the 2016 counts and the 2017 counts. Traffic counts have then increased between 2017 and 2019. This study is especially interested in Dudley Street which has grown linearly between 2016 and 2019 by an average of 1.0% per annum in the peaks.

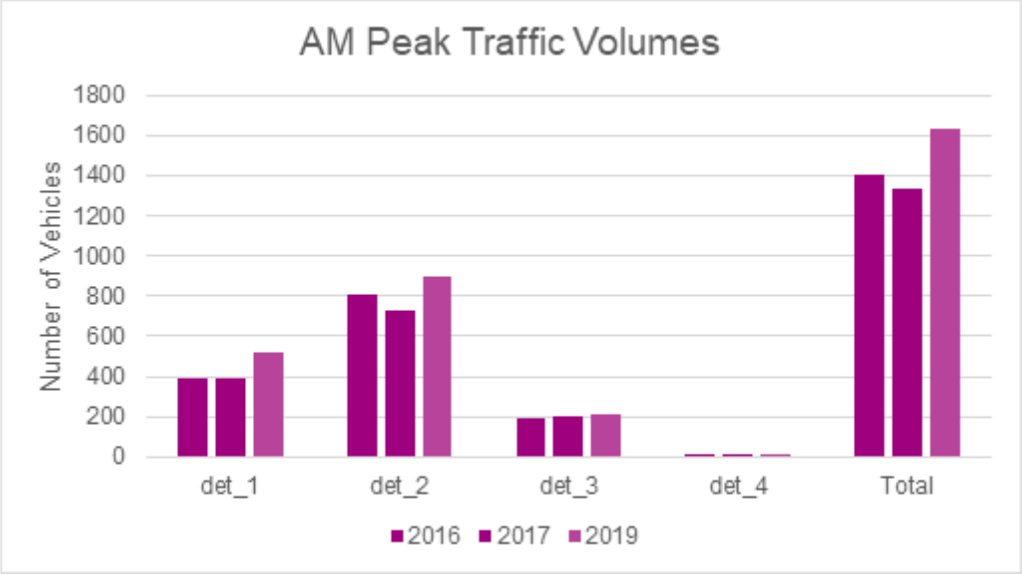


Figure 27: AM Peak Traffic Volumes

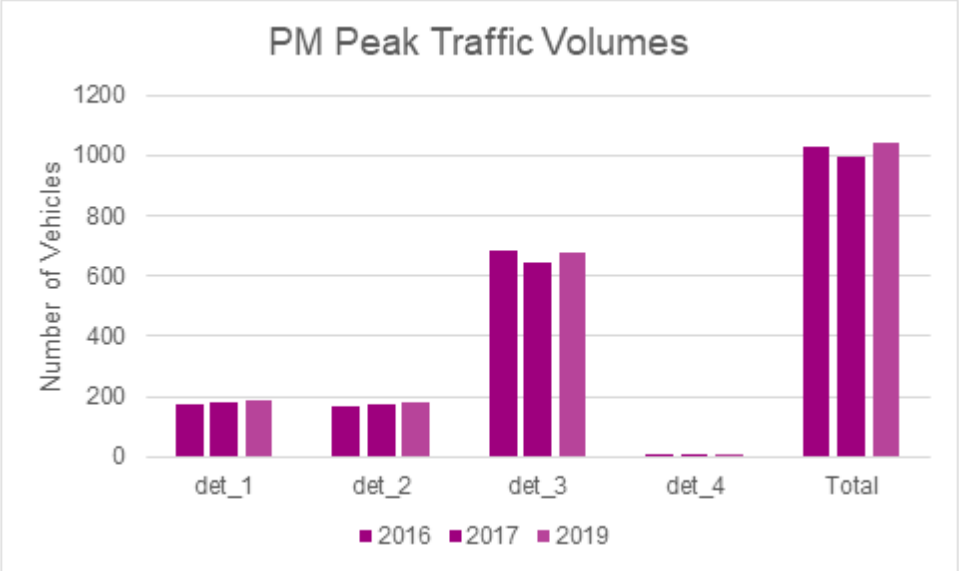


Figure 28: PM Peak Traffic Volumes

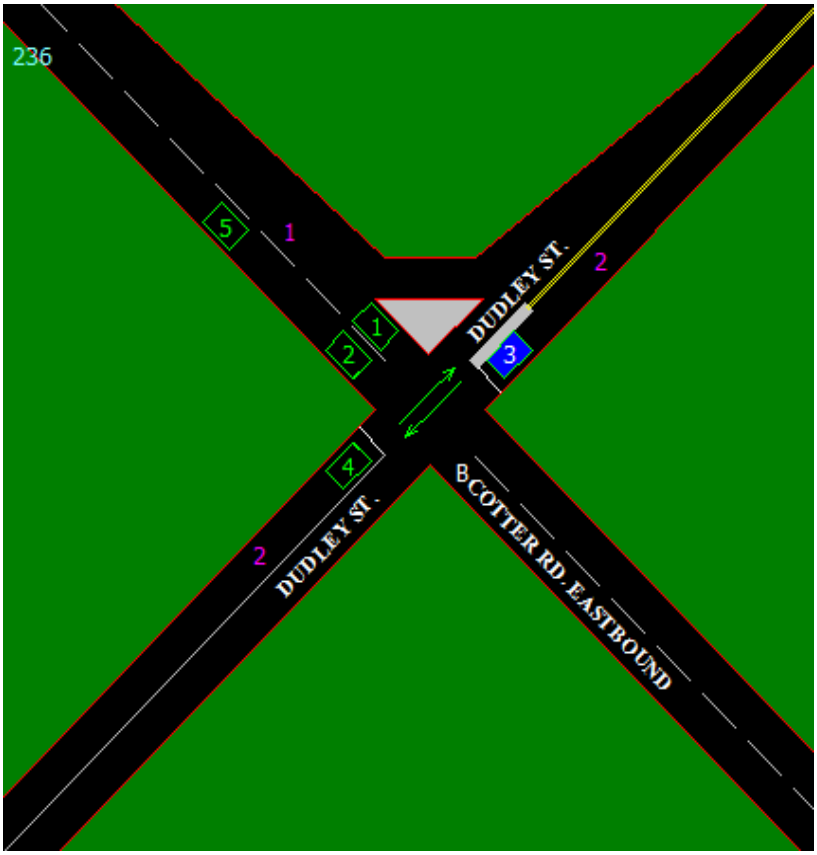


Figure 29: Detector identifications and locations

Growth based on CSTM Population forecasts

Another method to forecast the level of traffic growth in the region would be to determine the rates of growth in the surrounding area and use this rate to forecast existing volumes. This has been undertaken by utilizing the Canberra Strategic Transport Model assumptions which specifies land use characteristics for zones across Canberra. The zones used in this analysis are shown in Figure 30 and are:

- 051107
- 051106
- 051104
- 050302
- 050303

Note that these zones have been classified as either North or South of the Kent Street and Novar Street intersection.

Figure 30: Zones in the vicinity of the Kent Street and Novar Street Intersection

Table 12 utilises the CSTM population forecasts to arrive at a background level of growth. Importantly it can be seen that the total growth rate is very similar to the growth rate in the original approach. If this approach is used the following will be considered:

- The forecasted traffic volumes would be used as a base level of traffic volumes. The new residential development will be included in addition to this base level. While the development may already be included in the CSTM population forecasts this would be expected to be a conservative approach.
- Construction traffic will no longer need to be accounted for as growth will utilise SCATs data from 2019 after the Cotter Road duplication has been finished.

Table 12: Growth forecasts

Growth Statistics	North	South	Total
2016 Population	2208	2263	4471
2031 Population	3122	2378	5500
2016 – 2031 Population Difference	914	115	1029
Population Growth %	41.39%	5.08%	23.01%
Linear Growth Rate per annum	2.76%	0.34%	1.53%
Exponential Growth Rate per annum	2.34%	0.33%	1.39%

The land uses represented in the CSTM have been provided below for reference.

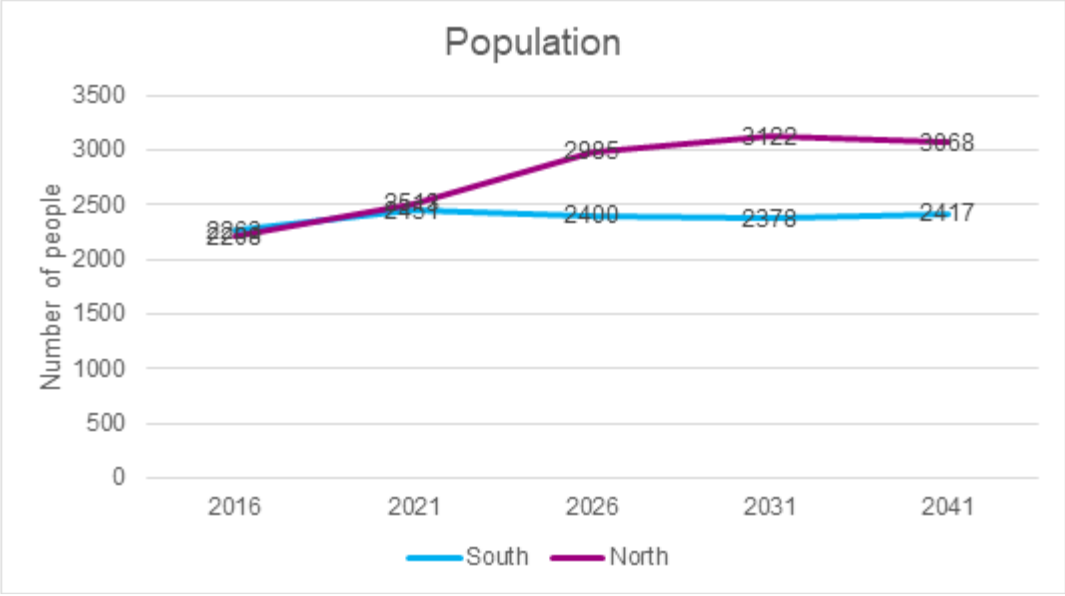


Figure 31: Population present in the five zones identified across the CSTM model years

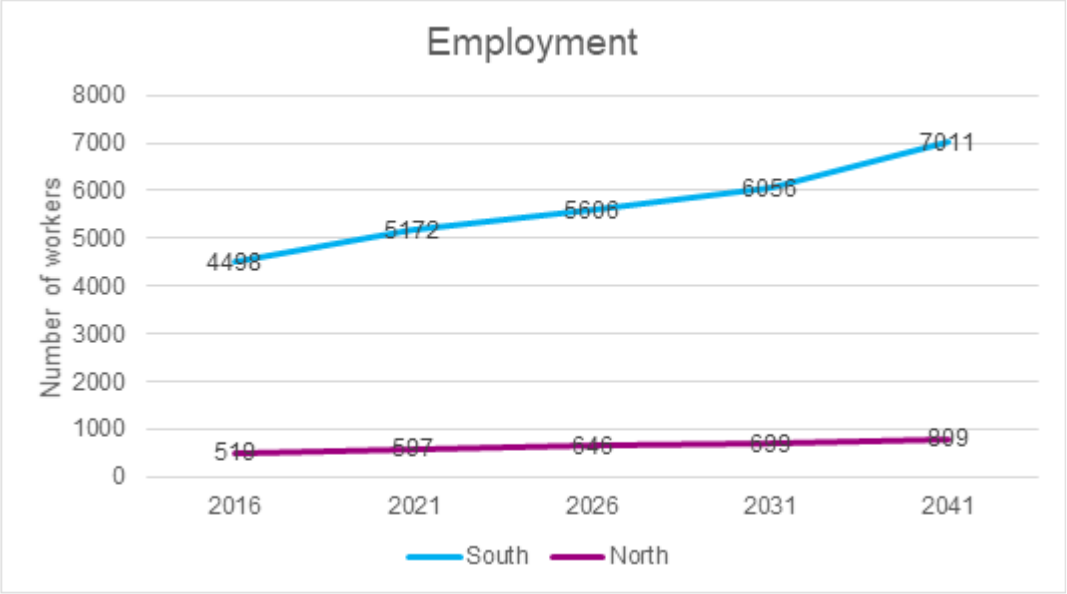


Figure 32: Number of people employed in the five zones identified across the CSTM model years

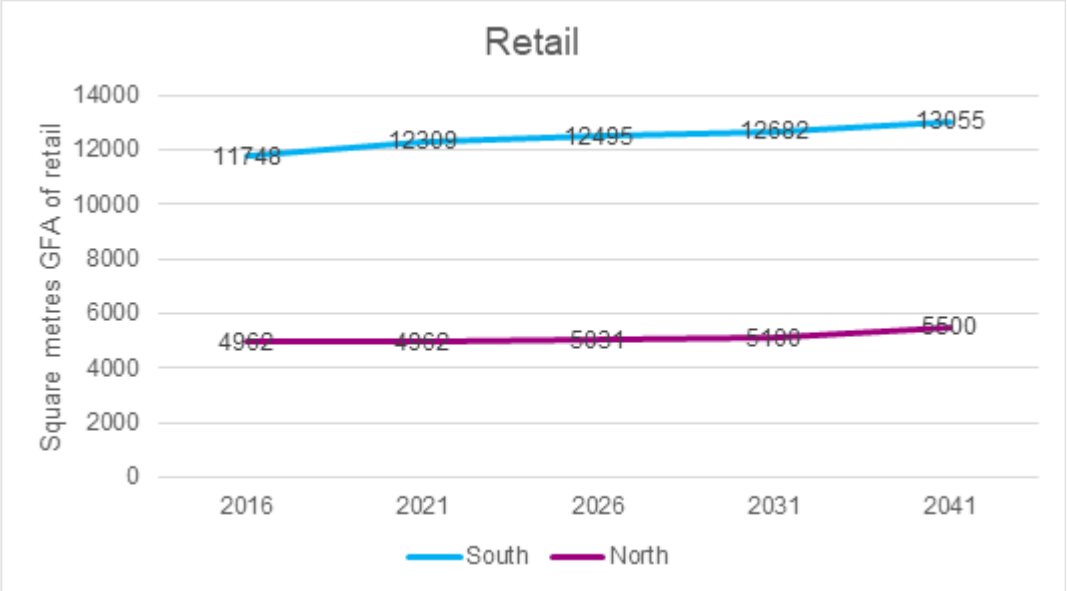


Figure 33: Floor area of retail present in the five zones identified across the model years

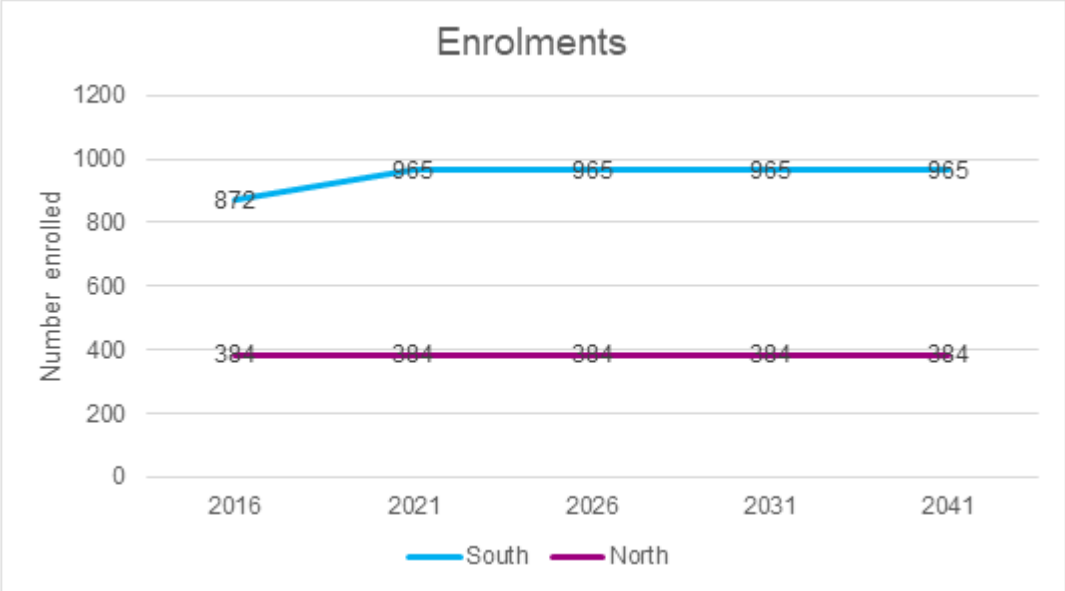


Figure 34: Number of students in the five zones identified across the model years

Canberra Strategic Transport Model

While the CSTM provides demand forecasts in the medium and long-term planning horizons, the preferred method of estimating future demand when conducting detailed traffic modelling and analysis is to grow current traffic volumes using growth rates extracted from the CSTM.

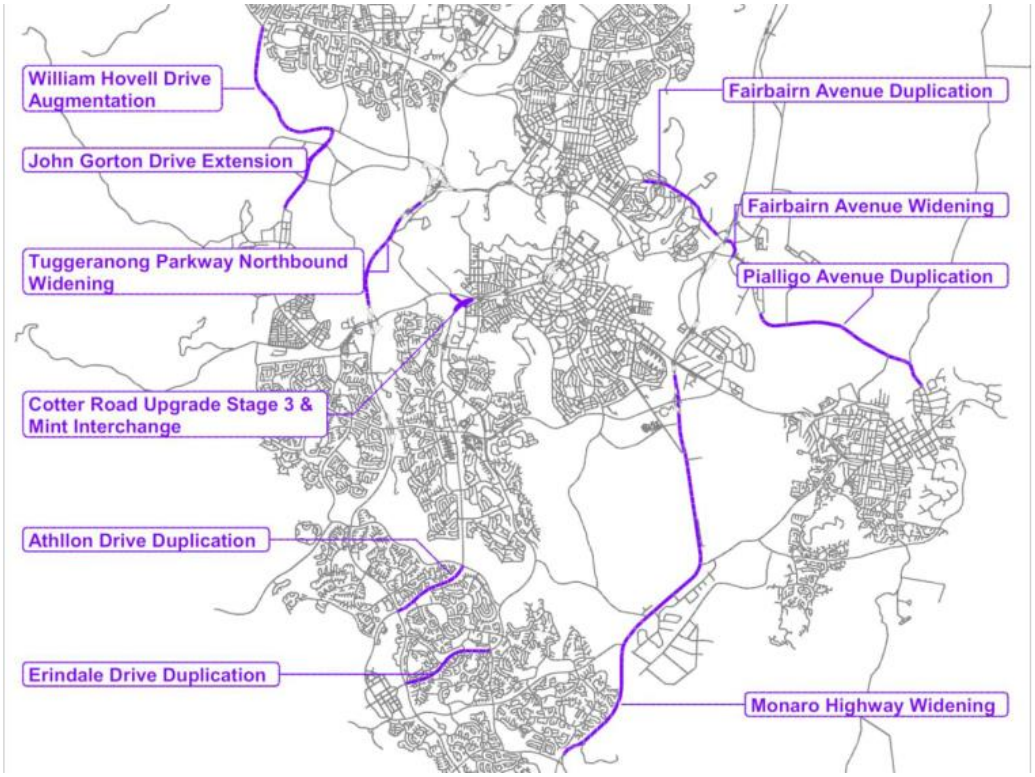


Figure 35: 2026 CSTM assumed road upgrades

The introduction of the Cotter Road Upgrade Stage 3 and Mint Interchange which is assumed in the 2031 AM Canberra Strategic Transport Model changes demand drastically in this area (Figure 35). This causes large fluctuations in the distribution of vehicles and therefore unusual growth rates compared to the current conditions without the Mint Interchange.

Two scenarios were analysed in the CSTM, one with the Mint Interchange and one without the Mint Interchange. The average growth rate between the two scenarios was approximately 1.25%.

It is noted that the light rail stage 2 project may alter the timing and configuration of the Mint Interchange project. However, these details are not currently available and therefore, the future demand forecasts adopted for this project were based on the current CSTM.

Appendix C Calibre Traffic Memorandum

Memorandum

Date:	Wednesday, 16 February 2022	**Pages:**	14
To:	Alex Moulis	**Copy:**	
From:	Nicholas Holmes, Brendan Hogan	**Ref:**	

Subject: **Transport Summary Report – Yarralumla Brickworks**

1. Introduction

In October 2021, DOMA Group (DOMA) engaged Calibre to prepare a Transport Summary Memo for the Yarralumla Brickworks development, Yarralumla to resolve outstanding questions raised during the EIS submission.

1.1 Background

A Traffic Impact Assessment for the Yarralumla Brickworks development was completed by AECOM in April 2021 to support the approval process for the site. This report was included with the EIS submission that also occurred within April 2021. During this submission process, several questions were raised surrounding the traffic conditions within and adjacent to the site.

1.2 Scope of Works

This memorandum aims to review the previous AECOM report along with the current site plans and block yields to identify any changes to the layout that have occurred. All changes and the expected impact traffic conditions of the site will be detailed as part of this memo. This includes but is not limited to:

- Land usage
- Traffic volumes
- Road and intersection operation (based upon previous AECOM Aimsun assessments)
- Parking requirements
- Commentary on rat-runs

In addition to detailing the changes in the site layout and impact on traffic, this report also aims to address the comments raised within the EIS submission to provide greater clarity on these items. As per the entity comments a detailed transport impact assessment report with update land use and network information is proposed to be submitted as part of the EDP.

2. The Site

2.1 Site Location & Current Use

The site of the Yarralumla Brickworks development is located within Block 1, 7 and 20 of Section 102, Yarralumla. Currently, Blocks 7 and 20 are unoccupied while Block 1 is occupied by the Old Canberra Brickworks site. Canberra Brickworks is currently not in operation and so traffic to and from the site should be minimal. Access to the Brickworks is currently provided off Denman Street.

Under the Territory Plan, all three blocks are classified as CZ6: Leisure and Accommodation zones. In addition to CZ6, a minor / irregular portion of Block 1 is also classified as a RZ1: Suburban Zone, while Block 7 is also classified as a PRZ2: Restricted Access Recreation Zone. Figure 2.1 identifies the location of the site and classification of each section.

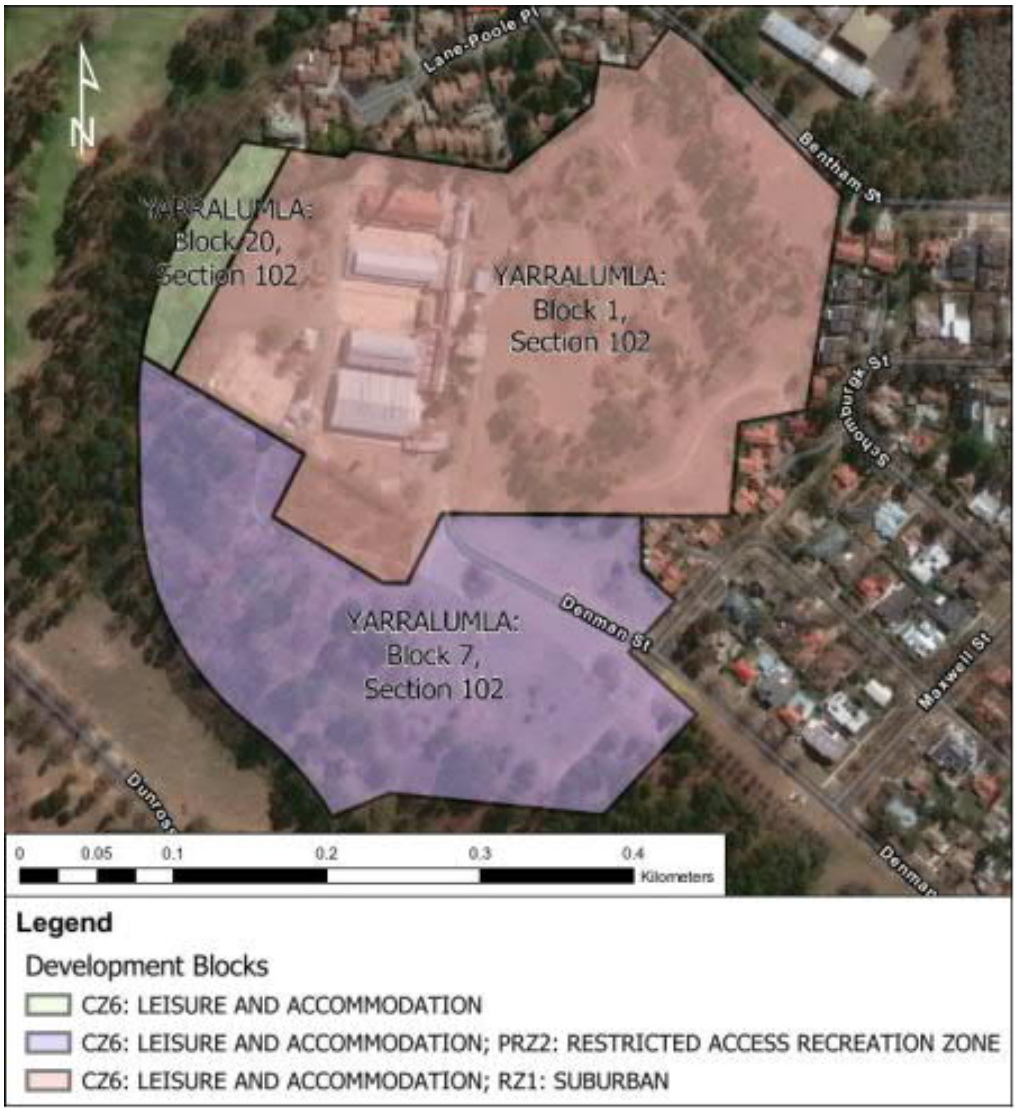


Figure 2.1 Yarralumla Brickworks Development Site Zone

2.2 Current Proposed Yields and Site layout

An updated masterplan for the site has been prepared by DOMA in January 2021. This plan can be seen in Figure 2.2. This masterplan saw several changes to the size and quantity of land uses compared to the plans which were used within the AECOM report. A summary of the changes between the current and previous plans can be seen in Table 2.1.

This updated masterplan maintains the same total number of residential dwellings within the site, noting a cap of 380 dwellings. The key change is within the type of residential dwellings, seeing the new plan favouring the construction of 3-bedroom dwellings over the 1 and 2-bedroom apartments. As per the Area Plans prepared for the site in October 2021, the non-residential land uses within the site are also seen to change, with both type and sizes differing compared to the previous report. The changes to these developments include the removal of the medical centre land use and increase in land usage for office and restaurant uses.

The measurement area for the non-residential land uses has been measured in Net Lettable Area (NLA) as opposed to the traditionally used Gross Floor Area (GFA). This change was adopted due to the thick external walls present within the heritage core buildings, with some walls having a thickness of up to 1m. As GFA is measured from the normal inside face of the exterior walls, the parking generation for the developments were viewed as overly conservative for the proposed land uses. With NLA, measurements are taken from the internal finished surface of the exterior walls. This allowed for the removal of the additional wall area and is viewed to provide a more accurate representation of the land usage. This change only impacts the non-residential components included within the site.

An edge road running along the south-eastern boundary of the development, connecting Denman Street and Brickworks Way is also proposed to be included as part of the development works. A ranger gate is proposed to be installed at the connection of the edge road to Denman Street, and shall remain closed except within an emergency. This physical barrier prevents though traffic from using this link to navigate through the suburbs and prevents any possible rat-running through the site. As through movements are not achievable along this road, the addition of this road to the development is not expected to impact the currently modelled traffic operations or performance through the surrounding road network. As such, no additional traffic assessment around this road has been completed.

Table 2.1 Yarralumla Brickworks Site Yield Comparison – Current vs. Previous

Land Use	Quantity (Current Plan)	Quantity (Previous Plan)	Difference
Houses (3+bed)	20 dwellings	18 dwellings	+2 dwellings
Apartments	258 dwellings	303 dwellings	-45 dwellings
1-bed Apartment	*1 dwelling*	*5 dwellings*	*-4 dwellings*
2-bed Apartment	*150 dwellings*	*196 dwellings*	*-46 dwellings*
3-bed Apartment	*107 dwellings*	*102 dwellings*	*+5 dwellings*
Townhouse (3+bed)	102 dwellings	59 dwellings	+43 dwellings
Sub-Total	**380 dwellings**	**380 dwellings**	**0 dwellings**
Commercial / Office Space	1,500 sqm	1,500 sqm	+0 sqm
Food / Beverage Space	1,740 sqm	1,320 sqm	+420 sqm
Fitness & Wellness Space	2,650 sqm	2,310 sqm	+340 sqm
Medical Health Facility Space	0 sqm	795 sqm	-795 sqm
Specialty Retail	750 sqm	0 sqm	+750 sqm
Sub-Total	**6,640 sqm**	**5,925 sqm**	**+715 sqm**

Figure 2.2 Yarralumla Brickworks Development Masterplan

2.3 Car Parking Provision & Requirements

The changes to the site masterplan have resulted in changes to both the proposed parking spaces within the site, as well as the required spaces for use by residents and visitors. For the private parking spaces, houses and townhouses have been generally assumed to have 3 car garages, while the 2 and 3 bed apartments are presumed to be provided 2 private parking spaces each and the single bed apartment is assumed to be provided a single parking space. A summary of the current total parking spaces and changes from previous plans can be seen in Table 2.2.

Table 2.2 Parking Provisions for Yarralumla Brickworks Development – Current Plan vs. Previous Plan

Parking Type	Quantity (Current Plan)	Quantity (Previous Plan)	Difference
Public Spaces (suitable for all visitors)	321 spaces	327 spaces	-6 spaces
Private Spaces (suitable for residents, staff, and visitors to houses and townhouses)	881 spaces	771 spaces	+110 spaces

The parking requirements for the site have been identified as per the Parking and Vehicle General Access General Code (PVAGC). For this assessment, the parking generation rates specified for commercial CZ6 leisure and accommodation zone within PVAGC (Section 3.4.5) were utilised. Although residential development is permitted in a CZ6 zone, no specific rates for parking are provided in the code. As such, the standard residential parking rates from the PVAGC (Section 3.1.5) were used instead. These rates match what were used during the previous AECOM assessment and are as follows:

Residential

- 1 space per 1-bedroom dwelling
- 1.5 spaces per 2-bedroom dwelling
- 2 spaces per 3+ bedroom dwelling
- 1 visitor space per 4 dwellings

Commercial (Offices)

- 2.5 spaces per 100sqm NLA

Food and Beverage (Restaurant)

- 10 spaces per 100sqm NLA

Fitness and Wellness (Gym)

- 3.5 spaces per 100sqm NLA

Medical (Health Facility)

- 4 spaces per practitioner

Specialty Retail

- 3 spaces per 100sqm NLA

It is noted that both the visitor parking provisions for the single residential lots (houses) and townhouses are expected to be provided internally within each lot. As such, these spaces would not contribute to the external available parking within the site and have not been included within this assessment.

The results of the comparison between parking space requirements can be seen in Table 2.3 below.

Table 2.3 Vehicle Parking Requirements for Yarralumla Brickworks Development – Current Plan vs. Previous Plan

Land Use	Parking Rate	Current Plan		Previous Plan	
		Yield	Spaces	Dwellings	Spaces
Private Parking Spaces					
House (3-bed)	2 spaces / dwelling	20 dwellings	40 spaces	18 dwellings	36 spaces
Apartment (1-bed)	1 space / dwelling	1 dwelling	1 space	5 dwellings	5 spaces
Apartment (2-bed)	1.5 spaces / dwelling	150 dwellings	225 spaces	196 dwelling	294 spaces
Apartment (3-bed)	2 spaces / dwelling	107 dwellings	214 spaces	102 dwelling	204 spaces
Townhouse (3-bed)	2 spaces / dwelling	102 dwellings	204 spaces	59 dwelling	118 spaces
Sub-Total			**684 spaces**		**657 spaces**
Visitor Parking Spaces					
Apartment Visitors	0.25 spaces / dwelling	258 dwellings	65 spaces	303 dwellings	76 spaces
Townhouse Visitors	0.25 spaces / dwelling	102 dwelling	N/A[1]	59 dwelling	15 spaces
Commercial / Office	0.025 spaces / sqm	1,500 sqm	38 spaces	1,500 sqm	38 spaces
Food / Beverage	0.1 spaces / sqm	1,740 sqm	174 spaces	1,320 sqm	132 spaces
Fitness & Wellness	0.035 spaces / sqm	2,650 sqm	93 spaces	2,310 sqm	81 spaces
Medical Health Facility	4 spaces / practitioner	N/A	N/A	795 sqm (~8 practitioners)	32 spaces
Specialty Retail	0.03 spaces / sqm	750 sqm	22 spaces	N/A	N/A
Sub-Total			**392 spaces**		**374 spaces**
Total			**1,076 spaces**		**1,031 spaces**

Note 1: For the Townhouse visitor parking requirements, the current plan allows for visitor parking to be provided internally within the townhouses, as each of these dwellings is proposed to have a 3-4 car garage. Within the previous assessment, visitor parking was required at a rate of 1 space per 4 dwellings.

From the above table, it can be seen that the current development masterplan will result in an increase by 27 parking spaces for private use, and an additional 18 spaces for public use compared to the previously undertaken analysis. The increase of the private land use parking is a result of the shift in dwelling types, with an increase in 3-bedroom townhouses and apartments. For the public parking spaces, the increases are predominantly a result of the increased areas of the Fitness & Wellness land use and Food / Beverage land use.

2.4 Adequacy of Parking Supply

The summary of the suitability of the current masterplan parking supply is outlined in Table 2.4 below. Calculation of car parking requirements does not include any car parks for visitors to the Quarry Park or Railway Remnants Park. Parkland is not included in parking numbers from the Transport impact assessment. The PVAGC lists parkland as “subject to individual assessment”. The brickworks development is not specifically required to provide parking supply for community parklands.

Table 2.4 Land Use Parking Supply and Demand

Land Use	Car Park Requirement	Car Park Supply	Difference
Private Parking	684 spaces	881 spaces	+197 spaces
Public Parking	392 spaces	321 spaces	-71 spaces
Sub-Total	**1,076 spaces**	**1,202 spaces**	

As seen in the above table, there is a deficit of 71 parking spaces within the proposed development for the publicly available parking spaces.

There are however 197 excess parking spaces for residential apartments and townhouses, which is a commercial decision to supply more storage space for cars, bicycles, and other uses. As mentioned earlier, the excess storage of the houses and townhouses that is provided by their garages will be acceptable for use by visitors to these dwellings. As such, these visitors have not been included in the total public parking requirements.

There are 71 less public parking spaces than required as per the PVAGC. Given the temporal nature of parking demand for the non-residential land uses, a temporal profile analysis was conducted for all parking spaces expected to service the non-residential land uses. The expected parking demand for these sites was calculated hourly over a typical day based on trends on parking usage observed for similar previous jobs. The temporal profile for non-residential parking on the site can be seen in Figure 2.3.

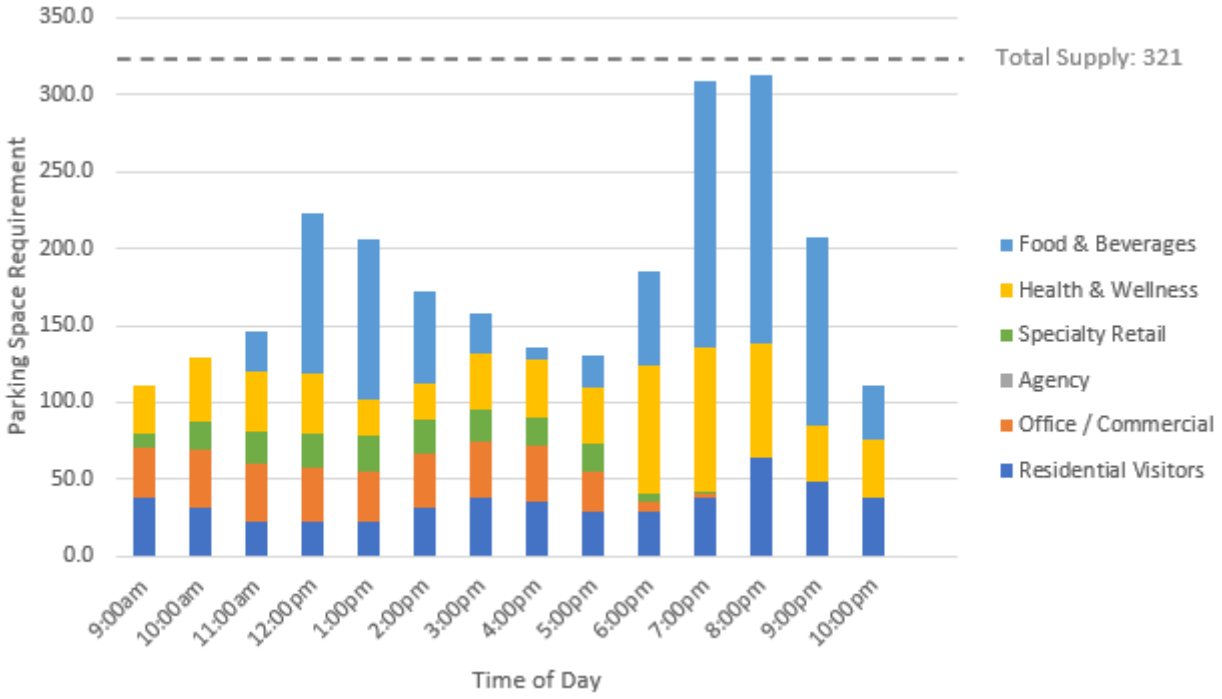


Figure 2.3 Temporal Profile for Non-Residential Parking Requirements within the Development

When considering the temporal parking demand, it is estimated that the peak demand will occur at 8:00pm for the site and require a total of 312 public parking spaces across the site. This results in a surplus of 9 public parking spaces during the peak hour period.

2.4.1 Accessible Parking Provision

Accessible parking needs to be provided within the site as per the ACT Parking and Vehicular Access General Code (PVAGC). From this document, a rate of 3% of the applicable parking spaces are required to be suitable for disabled parking. This requirement does not apply to any of the residential parking or visitor parking for houses or townhouses, as these spaces are subject to the adaptable housing requirements. As such, a total of 12 parking spaces are required to be suitable for this use. At present, 10 accessible parking spaces have been allowed, meaning an additional 4 spaces are required to comply with the PVAGC. Given that there are 9 public parking spaces available during the peak hour, and standard parking spaces can be converted into accessible parking spaces at a rate of 3:2, it is expected that 2 additional accessible parking spaces can be provided while still maintaining suitable parking requirements.

2.4.2 Motorcycle Parking Provision

The PVAGC states that parking for motorcycles must be provided at a rate of 3% with a minimum provision of 1 motorcycle parking space within a carpark with 30 or more car spaces.

For residential parking on site, each dwelling has been allowed dedicated parking spaces which could be utilised for storing either a car or a motorcycle. As such, no dedicated motorcycle parking is deemed as required in addition to the current proposed parking spaces.

For non-residential parking, the parking allowance of 3% was used and 12 motorcycle parking spaces are required in the development.

2.4.3 Bicycle Parking and End of Trip Facilities

As part of the initial assessment, the Bicycle Parking General Code (BPGC) for the ACT was used to determine the required supply of bicycle parking spaces. Due to the changes in residential development provisions, the required bicycle parking allowances have changed slightly. The rates used to calculate bicycle parking have been adapted from the BPGC where possible and match the rates used by AECOM. They can be found below:

Houses

- No minimum bicycle parking requirement (all parking assumed to be accounted for within the dwelling)

Apartments

- 1 per apartment per residents
- 1 per 12 apartment apartments after the first 12 apartments for visitors

Townhouses

- Nil for residents and guests

Commercial Offices

- 1 space per 250sqm NLA after the first 250sqm for employees
- 1 space per 950sqm NLA after the first 400sqm for visitors

Food & Drink

- 1 space per 400sqm after the first 400sqm for employees
- 1 space per 200sqm after the first 200sqm (min 2) for visitors

Medical

- 1 space per 8 practitioners after the first 8 practitioners for employees
- 1 space per 4 practitioners for visitors

Fitness and Wellness Centre

For the Fitness and Wellness centre, the classification of an "Indoor Recreation Facility" is the closest match within the BPGC. As the rates for this type of development are subject to individual assessment. As such, an allowance of 10% of the total car spaces for this land use has been allowed as the visitor bicycle parking rate. No specific rate has been allowed for staff.

Specialty Retail

- 1 space per 500 sqm NLA after the first 500 sqm NLA for employees
- 1 space per 300 sqm NLA for visitors (minimum 2)

A comparison of the bicycle parking requirements under the current layout and previous layout can be seen in Table 2.5.

Table 2.5 Bicycle Parking Requirements for Yarralumla Brickworks Development – Current Plan vs. Previous Plan

Land Use	Parking Rate	Current Plan		Previous Plan	
		Yield	Spaces	Dwellings	Spaces
Private Use Bicycle Parking Spaces					
Apartments	1 per apartment	258 dwellings	258 spaces	303 dwellings	303 spaces
Commercial / Office	1 per 250sqm after first 250sqm NLA	1,500 sqm	5 spaces	1,500 sqm	5 spaces
Food / Beverage	1 per 400sqm after first 400sqm NLA	1,740 sqm	4 spaces	1,320 sqm	3 spaces
Medical Health Facility	1 per 8 practitioners after first 8 practitioners	0 practitioners	0 spaces	795 sqm	1 space
Specialty Retail	1 per 500sqm after first 500sqm NLA	750 sqm	1 space	0 sqm	0 spaces
Sub-Total			**268 spaces**		**312 spaces**
Visitor Bicycle Parking Spaces					
Apartment Visitors	1 per 12 apartments after first 12 apartments	258 dwellings	21 spaces	303 dwellings	25 spaces
Commercial / Office	1 per 950sqm after first 400sqm NLA	1,500 sqm	2 spaces	1,500 sqm	2 spaces
Food / Beverage	1 per 200sqm after first 200sqm NLA	1,740 sqm	8 spaces	1,320 sqm	6 spaces
Fitness & Wellness	10% of total parking spaces	93 car spaces	10 spaces	81 car spaces	10 spaces
Medical Health Facility	1 per 4 practitioners	0 practitioners	0 spaces	8 practitioners	2 spaces
Specialty Retail	1 per 300sqm (min. 2)	750 sqm	3 spaces	0 sqm	0 spaces
Sub-Total			**44 spaces**		**45 spaces**

From this table, it can be seen that the new proposed layout reduces the requirement for private use bicycle spaces by 44 spaces and visitor parking by 1 space. As the Brickworks is being developed to encourage active travel through the area, there is a commitment for the development to contain additional parking allocations for bicycles over the required generation listed above.

3. Impact of Development

3.1 Traffic Generation

Traffic generation for this development has been calculated based on the aforementioned development yields combined with trip generation rates provided within the *ACT Estate Development Code* Table 2A notes. This documents states that for residential and CZ5 zones, a generation rate of 6 vehicles per day per dwelling is expected for multi-unit developments, a generation rate of 7 vehicles per day per dwellings where the blocks are less than 360sqm is expected, and a generation rate of 8 vehicles per day per dwelling for dwellings where block size exceeds 360sqm. Although the zoning for this site is primarily classified as a CZ6: Leisure and Accommodation Zone, the high quantity of residential dwellings proposed within this estate is expected to operate in a similar manner to residential zones, and as such these rates were deemed as acceptable.

A 10% peak hour factor was adopted for these developments in both commuter peak periods, as identified in *RTA Guide to Traffic Generating Developments (2002)*. As such, in both AM and PM peak periods, hourly trip generation rates of 0.6 and 0.7 vehicles per dwelling were adopted for apartments and townhouses respectively. It is noted that rates for townhouses and houses adopted within the initial AECOM assessment are slightly higher than what has been assumed within this assessment. The previously adopted generation rate was 0.85 vehicles per hour per dwelling for both houses and townhouses. This rate is taken from Section 3.3.1 of the *RTA Guide to Traffic Generating* Developments, which details the rate for dwelling houses. This rate was viewed as conservative given the expected behaviour of vehicles from the houses and townhouses, and as such the rates outlined in the *ACT Estate Development Code* were adopted instead. The apartment rate was the same between assessments.

The traffic generation for the non-residential development areas was determined based upon rates RTA Guide to Traffic Generating Developments version 2.2. These rates match what was used within the previous assessment

- A trip rate of 2 vehicles per 100 sqm NLA in a peak hour was applied to the commercial/office NLA as per the RTA Guide.
- A trip rate of 5 vehicles per 100 sqm NLA in a peak hour was applied to the food and beverage NLA as per the restaurant rate in the RTA Guide.
- A trip rate of 3 vehicles per 100 sqm NLA in a peak hour was applied to the fitness and wellness NLA as per the gymnasium rate in the RTA Guide.
- A trip rate of 10.4 vehicles per 100 sqm NLA in a peak hour was applied to the health facility NLA as per the extended hours medical centre rates in the RTA Guide.

The traffic generation for each of the land uses being developed can be seen in Table 3.1.

Table 3.1 Daily Development Traffic Generation – Current Layout vs Previous Layout

Land Use		Current Plan			Previous Plan		
	Units	Yield	Hourly Rate	Trips	Yield	Rate	Trips
Houses	dwellings	20	0.8	16 vph	18	0.85	15 vph
Townhouse	dwellings	102	0.7	72 vph	59	0.85	50 vph
Multi-Unit (Apartments)	dwellings	258	0.6	155 vph	303	0.6	182 vph
Commercial / Office	sqm	1,500	0.02	30 vph	1,500	0.02	30 vph
Food / Beverage	sqm	1,740	0.05	87 vph	1,320	0.05	66 vph
Fitness & Wellness	sqm	2,650	0.03	80 vph	2,310	0.03	69 vph
Medical Health Facility	sqm	0	N/A	0	795	0.104	83 vph
Speciality Retail	sqm	750	0.046	35 vph	0	N/A	0
Total				**475 vph**			**495 vph**

The changes in the development layout and utilised rates results in a decrease of 20 vehicles per hour in the current plan compared the previous yields and assessment. As the volume of traffic within the network has decreased overall, the expected performance of the network is not expected to worsen and it was not deemed as necessary to undertake additional traffic impact modelling for the surrounding road network.

The assumptions surrounding traffic distribution and route selection from the site through the network are consistent with the previous AECOM report, as no major changes to the road network or conditions surrounding the site are expected.

3.2 Performance Summary

While the yields and distribution of traffic throughout the network were originally detailed and modelled within the Yarralumla Brickworks Traffic and Parking Report by AECOM, it is noted that a more recent traffic assessment has been completed for the road network surrounding Dudley Street. The later report is also written by AECOM, and is a Traffic Options and Analysis Report for the Kent Street / Novar Street Intersection Upgrade. Although the commentary of the report was focussed on different areas of the road network, the completed modelling for both includes much of the same network extents and so are comparable.

While both reports were last updated at similar times, around mid to late 2021, we understand that updates to the traffic models were not undertaken for either project as part of this update. It is understood that the Yarralumla Brickworks traffic modelling was completed in Oct 2020 and has not been updated since. As such, this modelling predates the revised layout of the intersections along Kent Street, which were finalised and modelled as part of the Kent Street / Novar Street Intersection report in March 2021. Therefore, it appears that the adopted layout for the Kent Street intersections upgrade may not fully represent the layout that was finally adopted for the Kent Street project. This is supported by Figure 29 of the Yarralumla Brickworks Report (see Figure 3.1 of this report) showing the Kent Street design option with a single southbound lane on the Kent Street bridge as compared to the two full lanes adopted within the Kent Street / Novar Street Report (see Figure 3.2). As such, the performance results for the road network have been taken from the Kent Street / Novar Street Report.

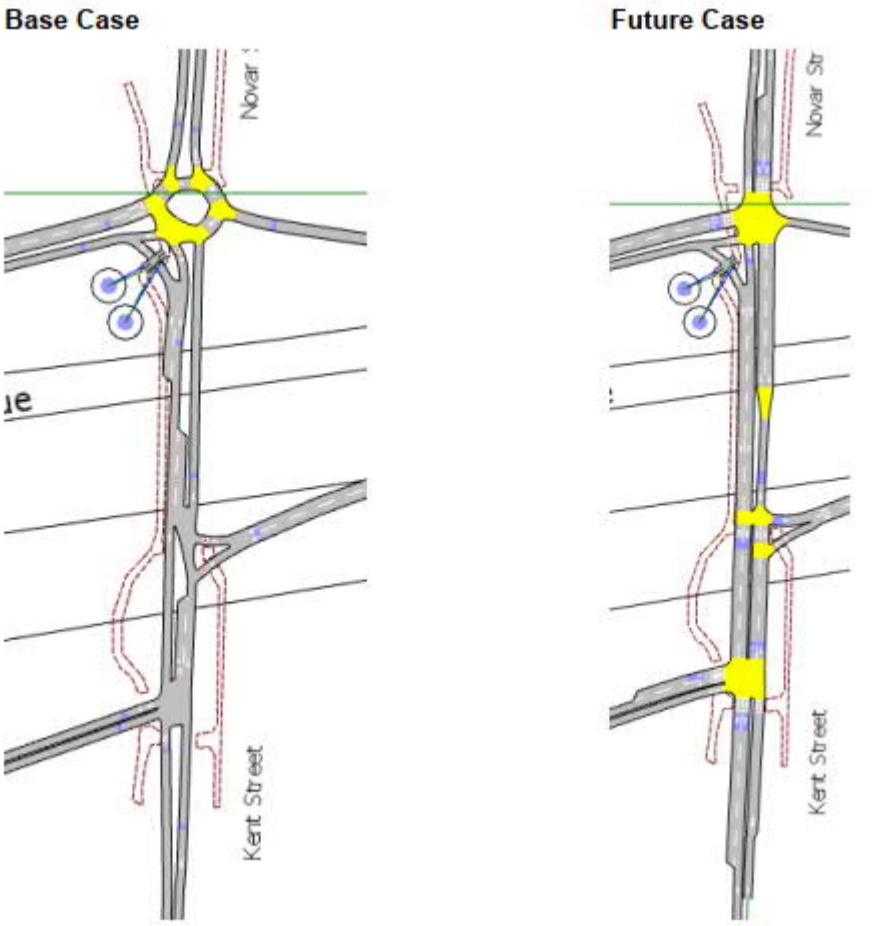


Figure 3.1 Kent Street Proposed Future Design from the Yarralumla Brickworks Report

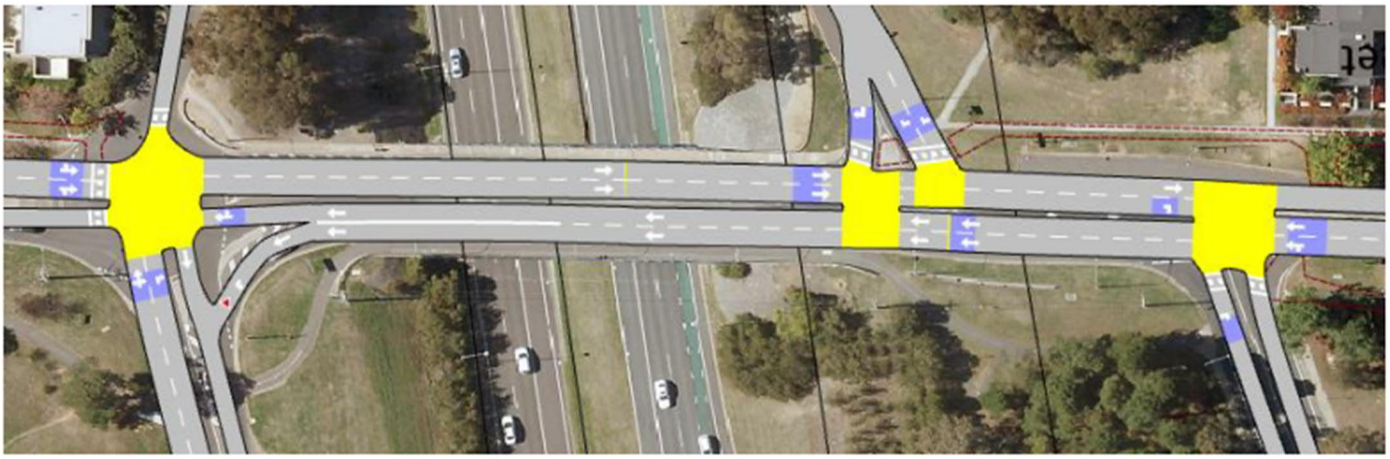


Figure 3.2 Kent Street Proposed Future Design from the Kent Street / Novar Street Report

The performance of the network as reported in the Kent Street / Novar Street Report shows the majority of the intersections in the network operating at acceptable levels. The key intersections are the ones along Kent Street, which showed significant improvements along most legs compared to the undeveloped conditions, as can be seen in Figure 3.3 and Figure 3.4.

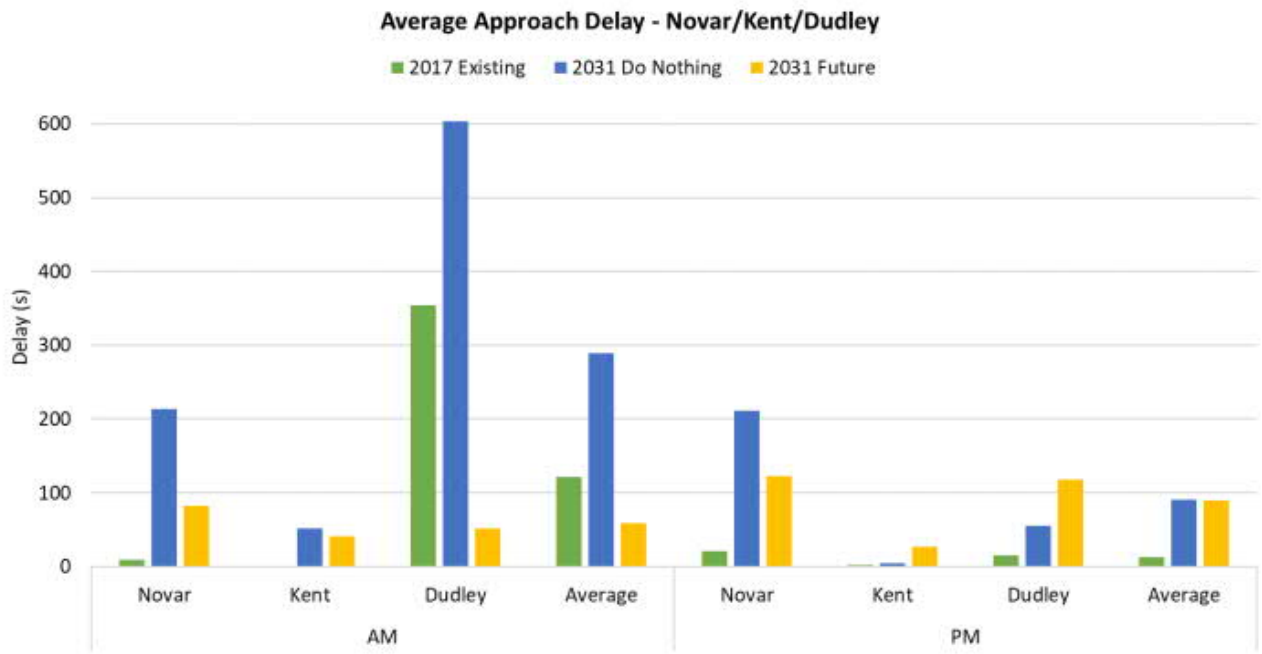


Figure 3.3 Performance Summary of Key Intersections – Novar / Kent / Dudley

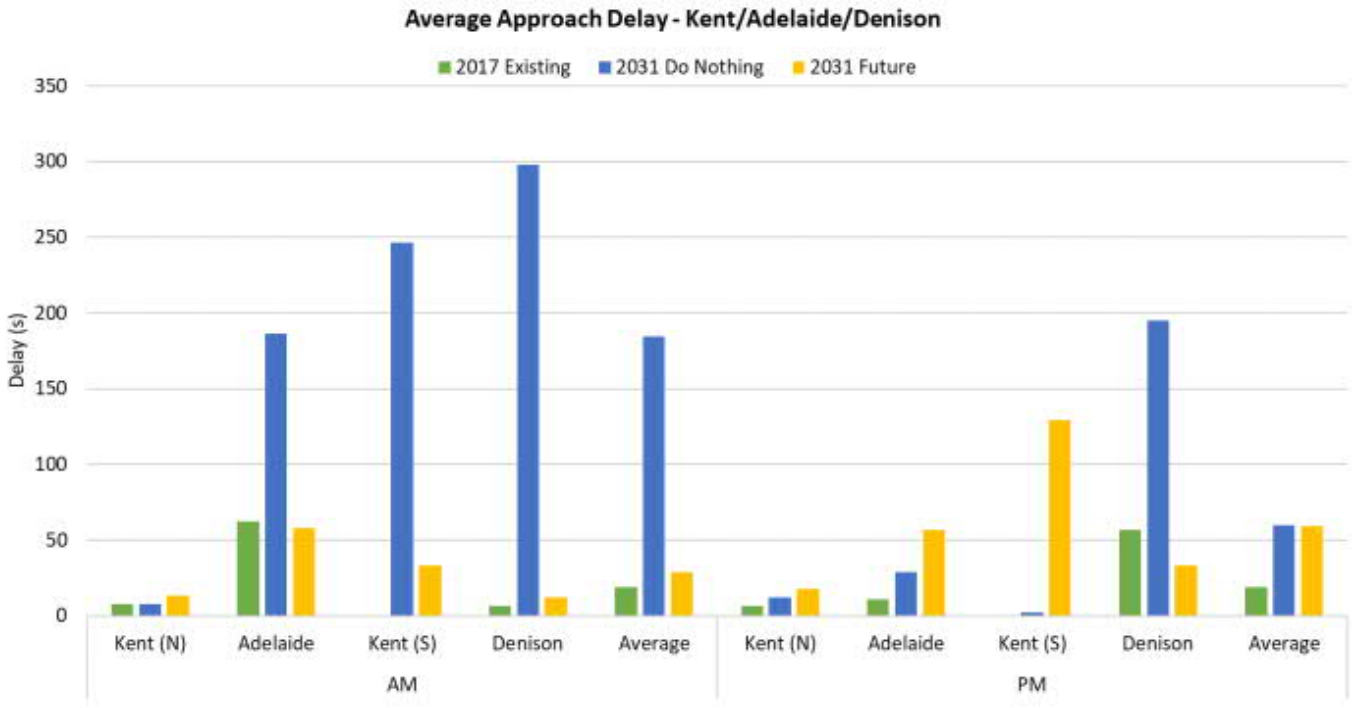


Figure 3.4 Performance Summary of Key Intersections – Kent / Adelaide / Denison

3.3 Wider Network Impacts

The increase in Yarralumla's population due to the inclusion of the Brickworks development is expected to put additional pressure on several existing land uses, including the Yarralumla Shops. The main access to the Yarralumla Brickworks will be via the new access road onto Dudley Street and it is anticipated that many residents of the site will see the Curtin Shops as an attractive alternative from the Yarralumla shops, particularly if driving. This behaviour is expected to increase the traffic volume slightly along McCulloch Street, as along Cotter Road and down McCulloch Street is the most direct route. Although the increase in traffic along McCulloch hasn't been quantified at this stage, it is noted that McCulloch Street is classified as a major collector road and operates in a traffic carrying capacity. As such, the increase in volumes are considered appropriate for this type of road.

The introduction of the Cotter Road Upgrade stage 3 and Mint Interchange which is assumed in the 2031 AM Canberra Strategic Transport Model changes demand drastically in this area. This causes large fluctuations in the distribution of vehicles and therefore unusual growth rates compared to the current conditions without the Mint Interchange.

Two scenarios were analysed in the CSTM, one with the Mint Interchange and one without the Mint Interchange. The average growth rate between the two scenarios was approximately 1.25%.

Note that the light rail stage 2 project may alter the timing and configuration of the Mint Interchange project from the assumptions included in the CSTM. However, this detail is not available and the future demand forecasts therefore had to be based on the current CSTM.

3.4 Construction Access

The primary construction access route will be via the new stub of the Dudley Street Brickworks Way roundabout. Construction of this link has largely been completed and should offer minimal impact to the operation. Traffic volumes for construction are typically expected to occur outside of the peak hour.

In the civil works stage of the project, construction access will be via Denman Street whilst Brickworks Way is being completed. There will be low volumes of workers in this stage of the project and no impact on the existing road network is expected.

The recently completed Dudley Street is built to cater for bus and other heavy vehicle moments. Construction traffic is not expected to deform or damage the pavement.

4. Active Travel Considerations

The current masterplan for the Yarralumla Brickworks incorporates a number of active travel allowances, including shared paths and road crossings throughout the site. These paths are proposed to connect into the external path networks along Bentham Street, Denman Street, and Brickworks Way to Dudley Street. These connections will provide a superior outcome to the existing amenity and allow active travel options to key nearby locations including nearby bus stops, Yarralumla Shops, and the Yarralumla Uniting Church. The current proposed path layout within the site can be seen in Figure 2.2.

The location of the nearest bus stops to the site are located along Dudley Street, approximately a 650m walk from the site. The location of the Dudley Street bus stops was largely prescribed by TCCS and provide stops as close as practical to the new development. The active travel amenities mentioned above connect into these bus stops for ease of access, and pedestrian crossing islands are present along Dudley Street to facilitate pedestrian amenity and safety.

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