GTAconsultants

Menangle Park Planning Proposal
Transport Impact Assessment

Client //	Dahua Group
Office //	NSW
Reference //	N124910
Date //	07/12/18

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Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
A	08/05/18	Final	Okka Maw Maic Tanguy	Maic Tanguy	Nicole Vukic	Nicole Vukic
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D	07/12/18	Final – correction Appendix and Table 6.12	Okka Maw Maic Tanguy	Maic Tanguy	Brett Maynard	Brett Maynard

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1. Introduction

1.1 Background

The Menangle Park Urban Release Area (URA) has been identified by the Department of Planning and Environment as a priority release area for housing growth within the greater Sydney region and Greater Macarthur Priority Growth Area. The Menangle Park URA is set to support the employment growth in the greater Western Sydney region as well as Campbelltown-Macarthur, a strategic centre to meet expected population growth to 2036.

This transport assessment has been to support an amendment to Campbelltown Local Environmental 2015 (Campbelltown LEP 2015) in relation to the Menangle Park Urban Release Area (URA), which comprises of 898 hectares of land at Menangle Park. The URA incorporates 498 ha of land owned or under the control of Dahua Group (Aust) Pty Ltd (Dahua) with the remaining area owned or under the control of other landowners.

The URA was rezoned from rural land to urban purposes on 18 November 2017 to accommodate approximately 3,400 residential lots, a retail/ commercial town centre, employment lands and community and recreational facilities.

The proposed amendment builds upon the previous rezoning and associated Structure Plan to create a new sustainable, healthy and high quality residential community comprising:

- 5,250 dwellings (an increase of 1,850 dwellings);
- a new major town centre comprising 30,000m² of retail/ employment gross floor area;
- a new neighborhood centre (approximately 3,500m² of employment floor space);
- a revised road and street network to provide better permeability throughout the site;
- sporting fields and parks;
- integrated passive recreation area within a riparian corridor network;
- land for environmental conservation;
- community facilities to support the proposed increase to the population; and
- primary school.

GTA Consultants (GTA) has been engaged by Dahua to prepare a transport assessment of the planning proposal. This includes the following considerations:

i Existing transport conditions surrounding the site.
ii Strategic planning context and existing policies.
iii Traffic generating characteristics of the Menangle Park URA.
iv Transport impact of the planning proposal on the surrounding road network.

The transport assessment undertaken and reported herein has identified the transport infrastructure improvements which are likely to be required in addition to those already planned.

It is noted that three development applications (DAs) have been lodged with Council for the first phase of the development, including Stages 1(3885/2017/DA-SW), 2A (292/2018/DA-SW) and 2B (681/2018/DA-SW) of Menangle Park URA. These development stages are located in the south-eastern pocket of the site, north of Menangle Road. Stages 1, 2A and 2B DAs are generally in accordance with the approved Campbelltown LEP 2016 including provision for 438 dwellings.

1.2 References

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

- Site inspections of the site and its surrounds

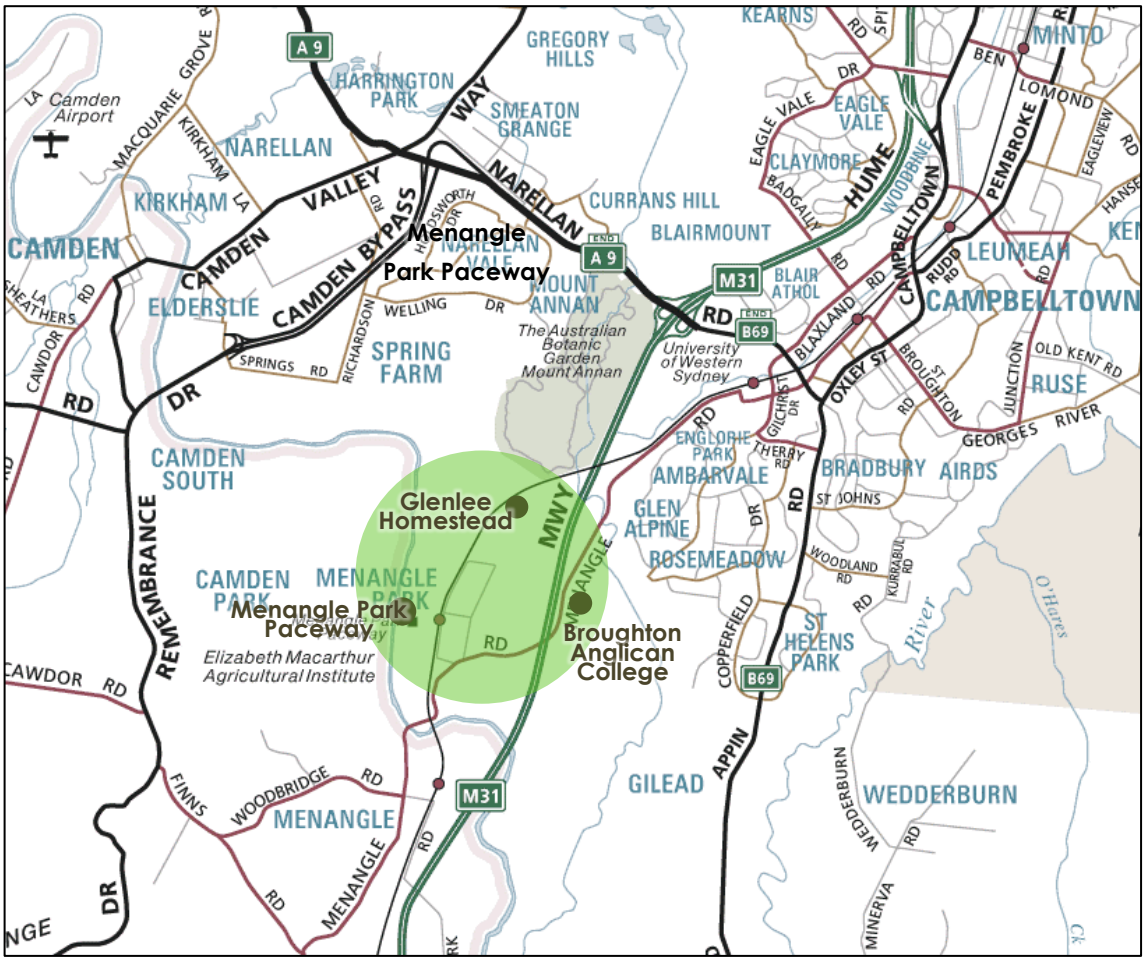
- Menangle Park Planning Proposal by Campbelltown City Council October 2016)
- Campbelltown City Council Development Control Plan 2016 (DCP 2016)
- Menangle Park Transport Management and Access Plan 2010 (TMAP 2010) as prepared by AECOM on 1 June 2010
- Greater Macarthur Investigation Area Strategic Transport Infrastructure Study prepared by Jacobs on 7 December 207
- Plans for the Menangle Park Masterplan prepared by Roberts Day, reference number DHU-MEN, drawing number 4, Revision E, dated 31/10/18
- Consultation and meetings with Roads and Maritime Services
- Other documents and data as referenced in the context of this report.

2. Study Area

Menangle Park is located approximately 60 kilometres to the south west of the Sydney CBD and six kilometres south west of Campbelltown City Centre, as shown in Figure 2.1.

Located within the Campbelltown City Local Government Area (LGA), Menangle Park is largely a rural area, with some existing rural and low-density residential dwellings. It is located next to the Hume Highway as well as containing Menangle Park train station within the study area.

Figure 2.1: Menangle Park location



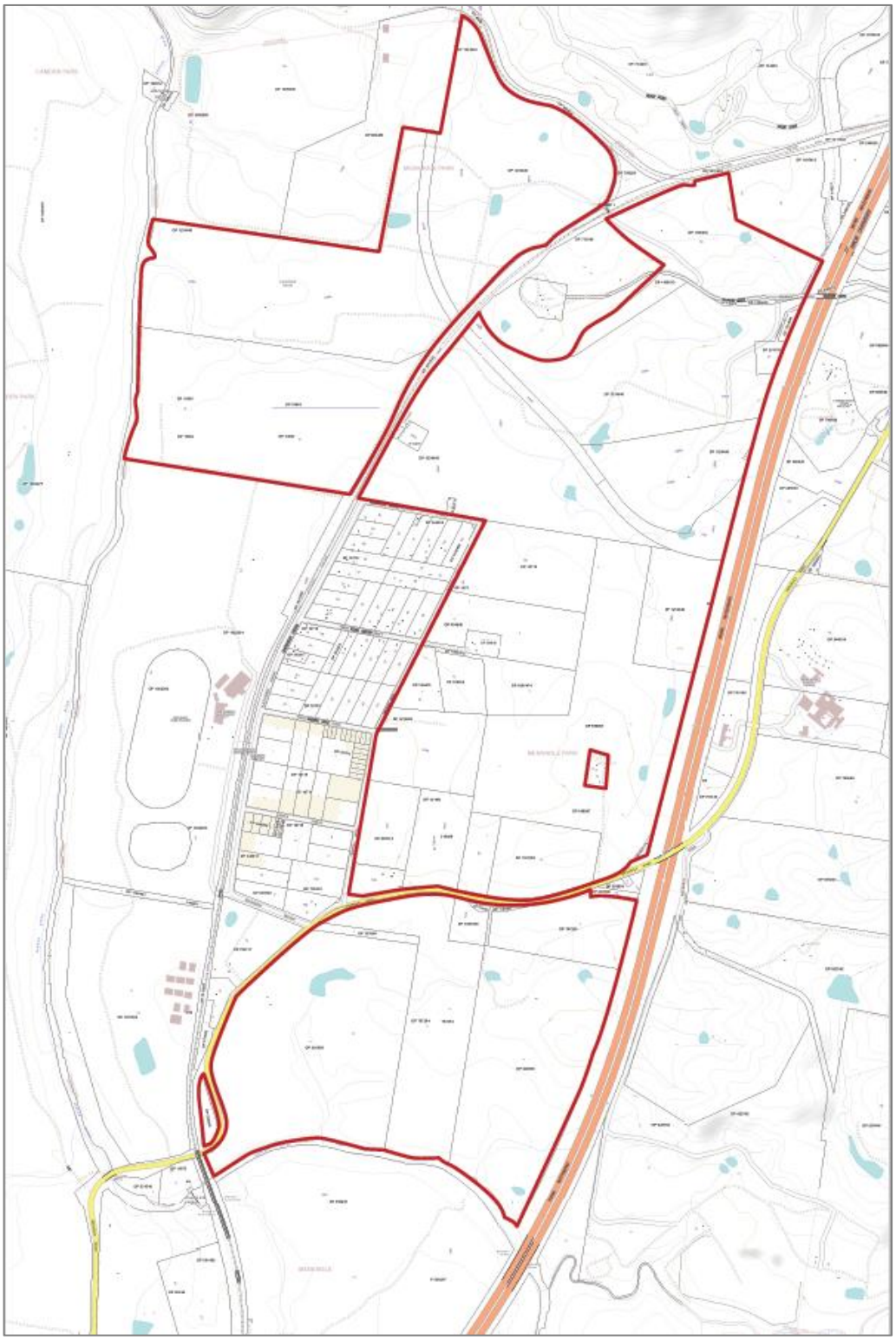
Basemap source: Sydway

The surrounding land uses include the following:

- Club Menangle (also known as Menangle Park Paceway), a harness racing venue, with function centre, restaurant and other facilities
- Glenlee Homestead, a rural cultural landscape of significant Aboriginal and early European heritage
- Broughton Anglican College, a kindergarten to year 12 private school.

Menangle Park URA and the location of Dahua controlled land is shown in Figure 2.2.

Figure 2.2: Menangle Park URA and Dahua controlled land boundary



Basemap source: Roberts Day

3. Strategic Planning Context

3.1 State and Regional Strategic Policies

State and regional policies provide future direction for the development of NSW and, in this case, Greater Sydney. This includes plans for how infrastructure, housing and employment will be planned and implemented throughout Greater Sydney, and the local South-west Sydney region which in-turn have informed the transport planning and assumptions for the Menangle Park URA. policies and plans that would apply and be relevant to the Menangle Park URA include:

- Greater Sydney Region Plan – A Metropolis of Three Cities (Greater Sydney Commission, 2018)
- Western City District Plan (Greater Sydney Commission, 2018)
- Future Transport 2056 (Transport for NSW, 2018)
- Greater Macarthur Investigation Area (Department of Planning and Environment, 2015-2017).

In addition to the above, several infrastructure works packages have been planned by Campbelltown City Council and Roads and Maritime Services. These have also been considered in the context of Menangle Park URA.

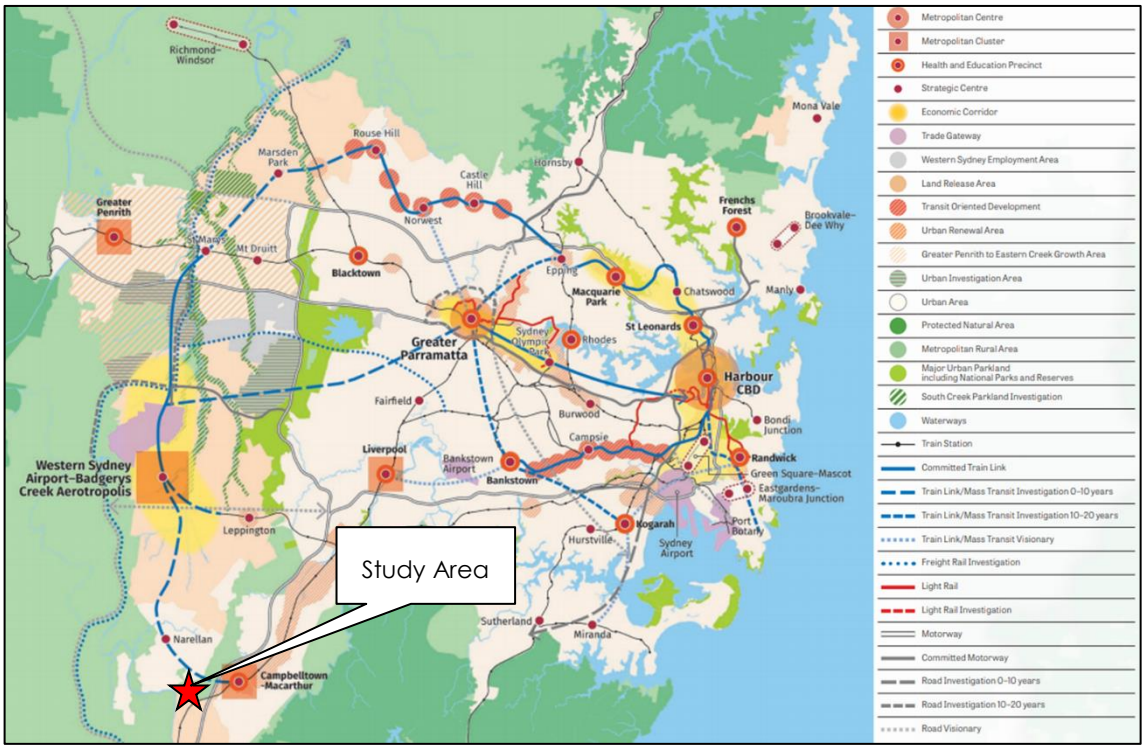
3.1.1 Greater Sydney Region Plan – A Metropolis of Three Cities

The *Greater Sydney Region Plan*, published in March 2018 by the Greater Sydney Commission, provides a 40-year vision and a 20-year plan to 2036. Within the document, the Greater Sydney Region is split into the three following cities:

- The Western Parklands City encompassing Campbelltown and Macarthur, Liverpool and Penrith as well as the to-be-build Western Sydney Airport Aerotropolis and Employment area.
- The Central River City encompassing Greater Parramatta and surrounding regions including the North-west Growth Area.
- The Eastern Harbour City encompassing Sydney CBD, and its eastern, northern and southern suburbs.

The 20-year plan as proposed within the *Greater Sydney Region Plan* outlines a range of transport and infrastructure initiatives to support already established and yet-to-be developed precincts, centres and clusters. This includes mass transit investigations, committed train links, urban area investigations and protected natural areas. These initiatives and investigations are a result of directions within the plan to increase and diversify housing supply within Greater Sydney. It is also intended that the provision of efficient and connected places will ultimately enable residents to access their employment and other amenities within 30 minutes. The vision for the *Greater Sydney Region Plan* results from collaboration between local, State and Federal Government as well as other key stakeholders and is intended to uphold Sydney's status as one of the top cities of the world.

Figure 3.1: Greater Sydney Region Plan

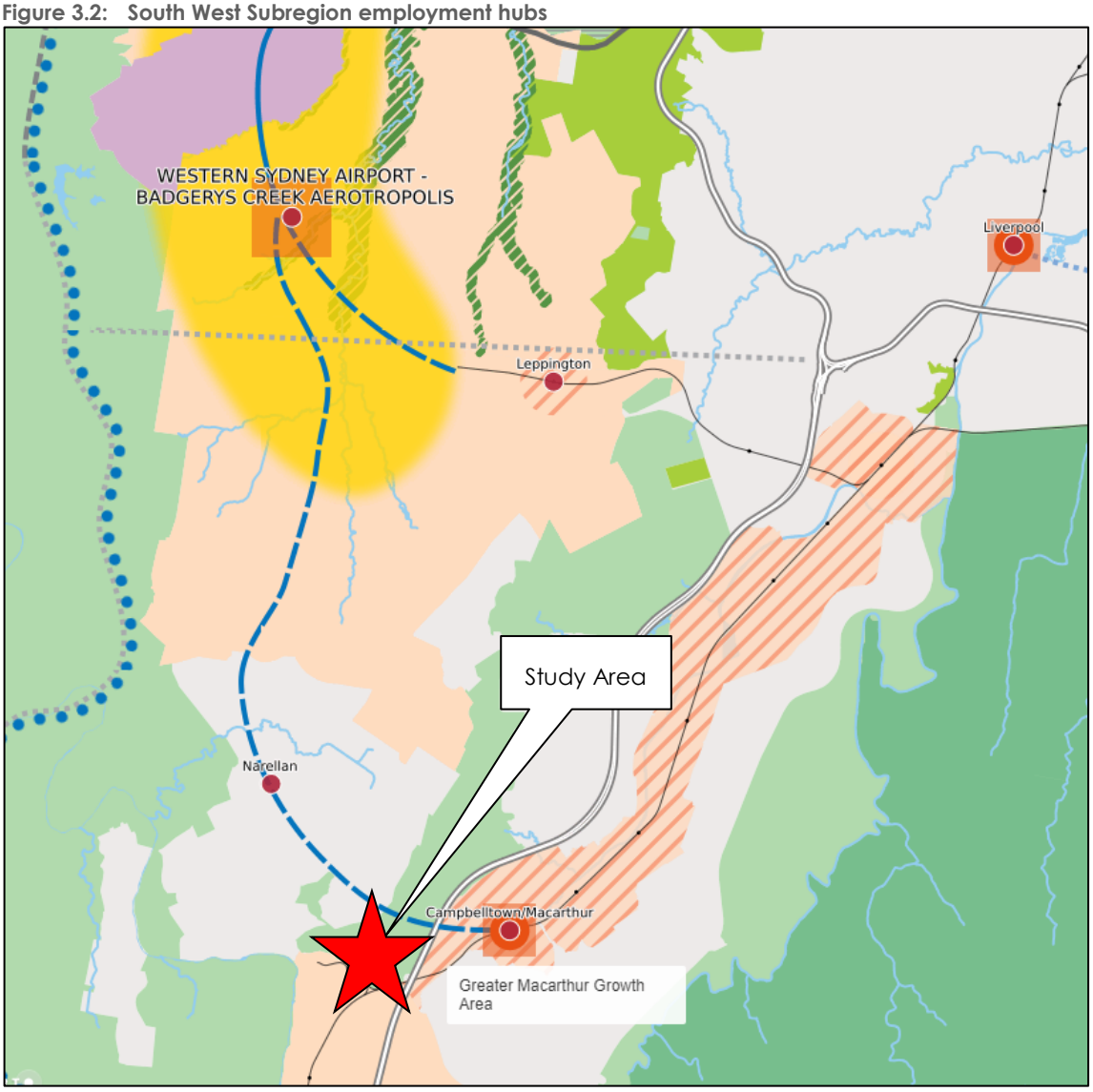


Source: *Greater Sydney Region Plan – A Metropolis of Three Cities* (2018) Greater Sydney Commission

In South West Sydney, the plan identifies the need to grow the Campbelltown-Macarthur and Liverpool strategic centres by providing continued employment and housing growth to support their surrounding communities.

The potential for a new priority growth area comprising greenfield sites located south and south-west of Campbelltown-Macarthur, known as the Macarthur South Investigation Area was identified to support regional housing targets. Likewise, in achieving the goal of locating workplaces closer to homes, key employment areas are proposed throughout the Western Sydney region. These include the Western Sydney Employment Area and Badgerys Creek Airport Precinct. The proximity of these major employment hubs to the Greater Macarthur Growth Area is illustrated in Figure 3.2.

Figure 3.2: South West Subregion employment hubs



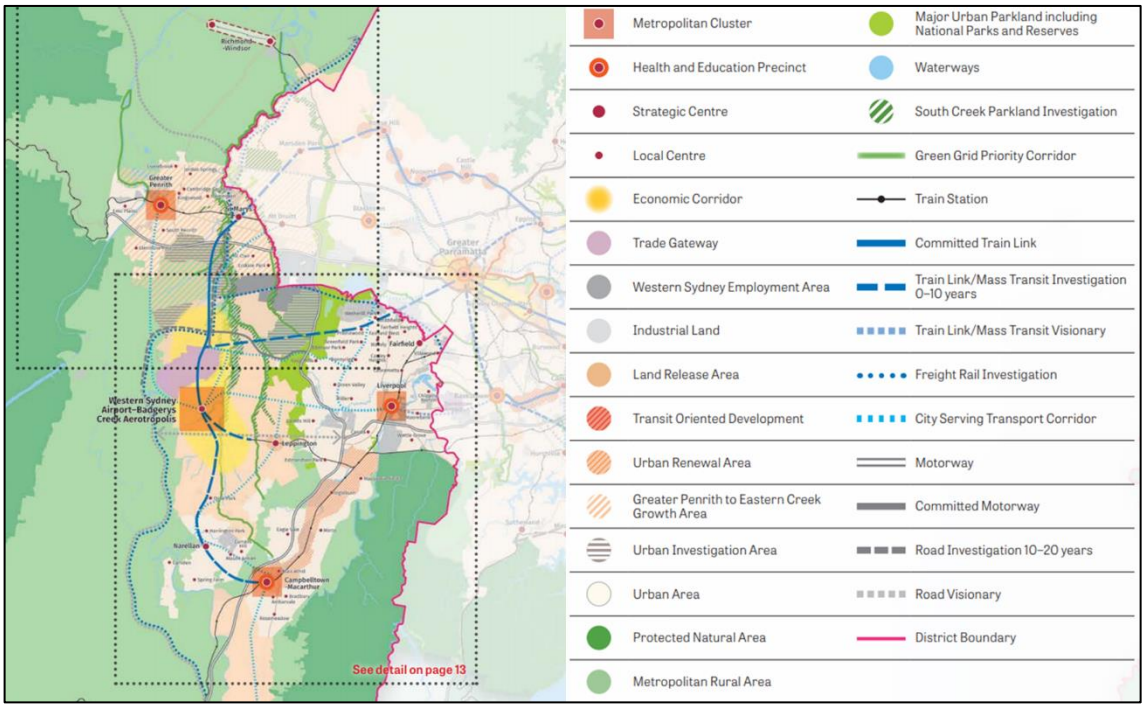
Source: *Greater Sydney Region Plan – A Metropolis of Three Cities* (2018) Greater Sydney Commission

3.1.2 Western City District Plan

The *Western City District Plan* is a continuation of the *Greater Sydney Region Plan* and focusses on the Western Parklands City and district. The *Western City District Plan* proposes a package of priority growth areas, urban investigations, transport and infrastructure to support growth in a number of strategic centres and metropolitan city clusters such as Campbelltown-Macarthur, Greater Penrith, Liverpool and Western Sydney Airport by 2036. Activities in these four locations will be influenced by a significant population growth, diversification of jobs in Western Sydney and bringing jobs closer to homes. Estimates of between 6,300 and 10,600 new jobs are proposed for Campbelltown-Macarthur by 2036.

The infrastructure plan as part of the *Western City District Plan* is shown in Figure 3.3.

Figure 3.3: Western City District infrastructure plan



Source: *Greater Sydney Region Plan* (2018) Greater Sydney Commission

The Menangle Park URA forms part of the south-western area of land release within the Western City District which includes boosting housing supply and diversity, as well as jobs.

3.1.3 Future Transport 2056

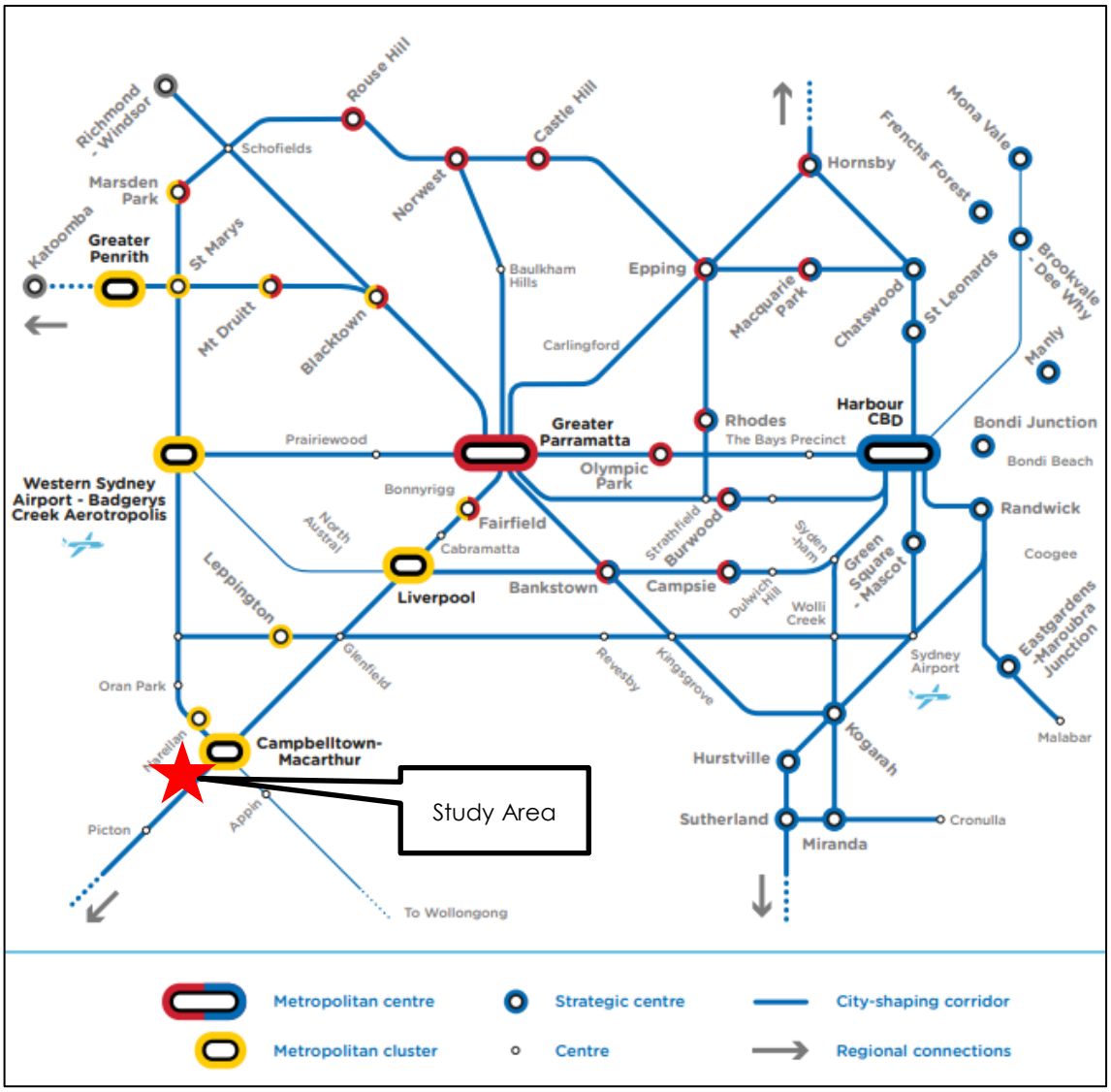
Published in 2018 by the NSW Government, *Future Transport 2056* provides a 40-year strategy for the planning and delivery of transport across NSW, both regional and metropolitan, to support the expected 12 million residents within the state. *Future Transport 2056* follows from the 2012 *Long Term Transport Master Plan* which listed over 700 transport projects, the majority of which are completed or in progress. It also ties in with *Greater Sydney Region Plan* and the subsequent district plans to support the three cities metropolis vision.

Future Transport 2056 is supported by two key documents, *Greater Sydney Services and Infrastructure Plan* and *Regional NSW Services and Infrastructure Plan*, which provide guidance and planning for these areas. The aim of Future Transport 2056 is to ensure that the state will be prepared for the rapid changes in technology and innovation, and provide safe, efficient and reliable transport in the future.

From a metropolitan view, Future Transport 2056 and associated plans include the 30-minute city where jobs and services are within 30 minutes of residents within Greater Sydney. Additionally, strategic transport corridors to move people and goods are outlined between metropolitan and strategic centres, clusters and surrounds. The Movement and Place framework is also emphasised to support liveability, productivity and sustainability. City-shaping transport networks will provide high capacity turn-up-and-go services between the three cities, and City-serving networks will provide on-demand and high-frequency services to customers within 10km of the three cities.

For the Campbelltown and Macarthur Region, a city-shaping corridor is planned which can take the form or road or rail. The 2056 network vision for Greater Sydney is shown in Figure 3.4.

Figure 3.4: Future Transport 2056 network vision



Source: *Future Transport 2056* (2018) NSW Government

The initiatives, projects and investigations as outlined within *Future Transport 2056* relevant to the site are listed in Table 3.1.

Table 3.1: Transport Initiatives and Investigations

Timeframe	Mode	Initiative/ Investigation
0-10 years committed	Road	Western Sydney Infrastructure Plan including the Northern Road Upgrade from Peter Brock Drive to Jamison Road
0-10 years investigation	Rail	North-South Rail Link extension from WSA-Badgerys Creek Aerotropolis to Campbelltown-Macarthur
0-10 years investigation	Bus	Infrastructure to support rapid bus connections between WSA-Badgerys Creek Aerotropolis and Greater Penrith, Liverpool, Blacktown and Campbelltown-Macarthur.
0-10 years investigation	Rail	Passenger train improvements to support growth at Wilton.
0-10 years investigation	Bus	Improved bus connections between South-west Sydney and Illawarra
0-10 years investigation	Road	Appin and Picton Road improvements.
0-10 years investigation	Rail	Completion of Maldon to Dombarton railway line
20+ years investigation	Road	Outer Sydney Orbital from Western Sydney Airport – Badgerys Creek Aerotropolis to Hume Motorway.
20+ years investigation	Road	Outer Sydney Orbital from Hume Motorway to Illawarra

3.1.4 Greater Macarthur Investigation Area

Greater Macarthur and Wilton have been identified in the *Greater Sydney Region Plan* as growth areas to meet expected housing needs for a projected population growth to 2036.

Greater Macarthur Land Release Investigation – Preliminary Strategy & Action Plan (2015)

The *Greater Macarthur Land Release Investigation - Preliminary Strategy & Action Plan* has been issued by the NSW Department of Planning and Environment to guide land release within the Greater Macarthur area.

The Greater Macarthur Land Release Investigation proposes urban development within two distinct Priority Precincts along the Hume Highway; the Menangle Park/ Mount Gilead Precinct and the Wilton Precinct.

Both Menangle Park and Mount Gilead are proposed to include town centres thereby being somewhat self-sustaining but with additional services and employment opportunities available in Campbelltown, Camden and the broader Western Sydney region.

Wilton would present a new major centre with associated employment, retail, health and other services for the region. Wilton would cater for a growing population within Wollondilly Shire including housing and employment and services.

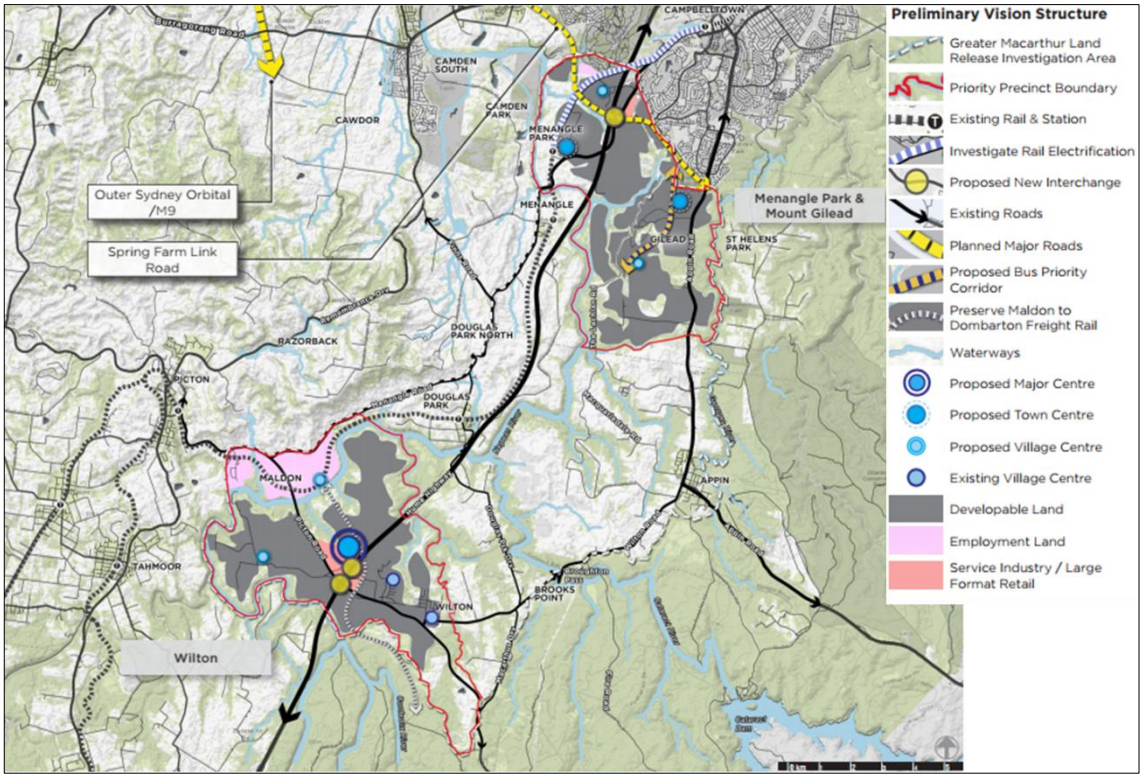
Overall, Menangle Park and Mount Gilead are expected to yield an estimated 18,100 dwellings (combined) whilst Wilton has the potential for 16,600 dwellings.

In terms of transport infrastructure, the Preliminary Strategy and Action Plan for the Greater Macarthur Priority Growth Area outlines the following for Greater Macarthur, which has been considered in the context of this Proposal:

- Construction of Spring Farm Parkway, linking the Menangle Park subdivision area to Menangle Road, Appin Road, Hume Highway and Camden Bypass, and new access ramps to the Hume Highway
- Upgrades to Menangle Road, Appin Road and Picton Road
- Upgrade of the Hume Highway between Picton Road and Raby Road and upgrade of Picton Road/ Hume Highway interchange including the provision of new northern access ramps
- Construction of a bus priority corridor and further corridor protection
- Further investigation of the feasibility of the electrification of the Southern Highland Rail Line to Menangle Park.

The Greater Macarthur Priority Growth Area and the Menangle Park URA are shown in Figure 3.5.

Figure 3.5: Greater Macarthur Priority Growth Area



Source: *Greater Macarthur Land Release Investigation – Preliminary Strategy and Action* Plan, (2015) Department of Planning & Environment, http://www.planning.nsw.gov.au/~/media/Files/DPE/Plans-and-policies/greater-macarthur-land-release-investigation-land-use-and-infrastructure-analysis-preliminary-strategy-and-action-plan.ashx (accessed August 2017)

Greater Macarthur Investigation Area – Strategic Transport Infrastructure Study (2017)

The Strategic Transport Infrastructure Study prepared by Jacobs in 2017 for Department of Planning & Environment proposes a new structure plan for the Greater Macarthur Investigation Area (GMIA) for the 2051 long-term vision. It is understood that the preferred structure plan has not yet been endorsed by the Government.

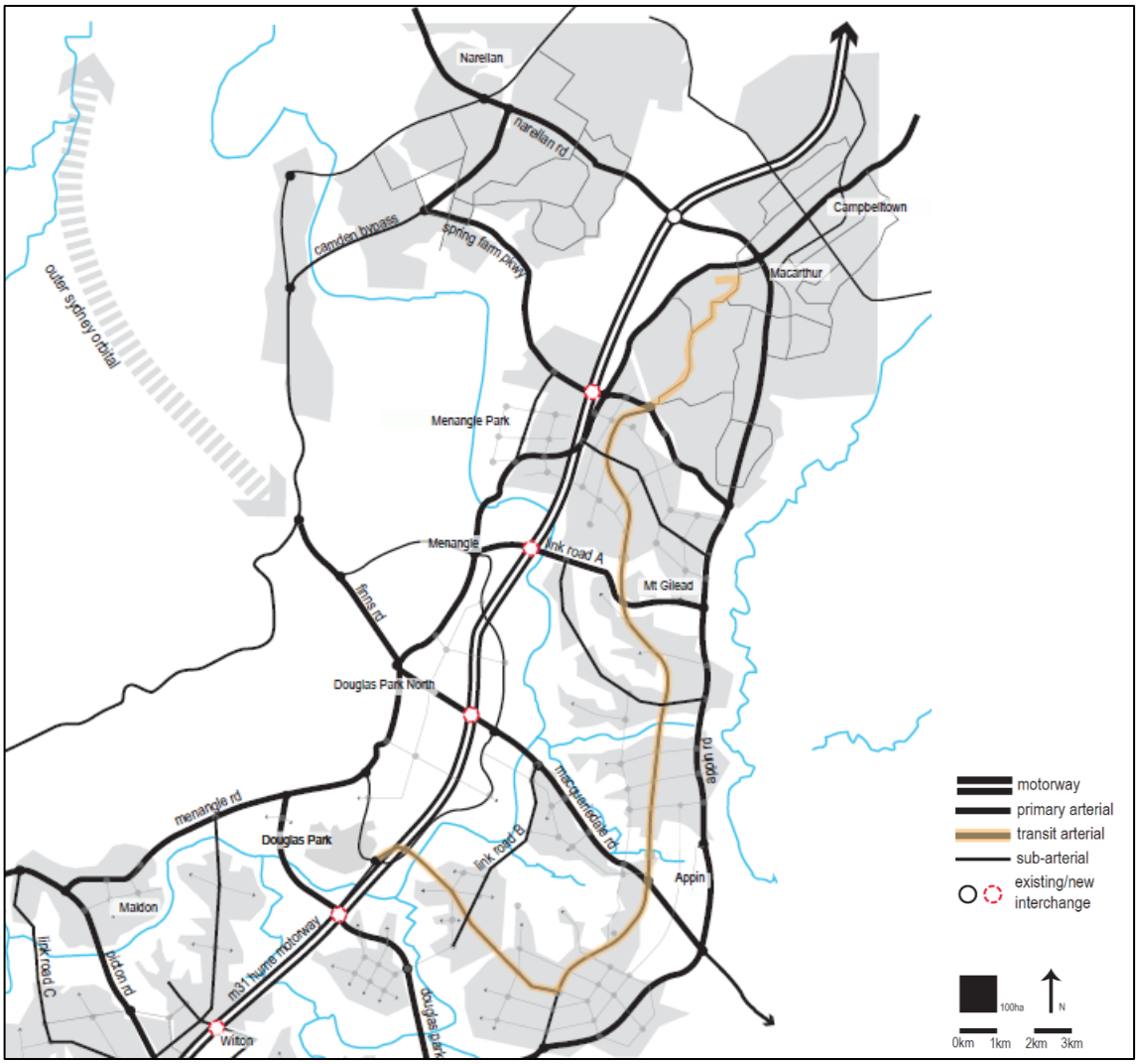
The study considers the following long-term land use scenario for the year 2051 (Table 3.2). It includes new developments in West Appin in addition to already identified precincts in Mt Gilead, Menangle Park and Wilton.

Table 3.2: Population and employment projections 2051

Precinct	Population	Jobs
Mt Gilead & Menangle Park	60,000	10,000
West Appin	60,000	9,000
Wilton	40,000	11,000
Total	160,000	37,000

The future strategic road transport network proposed in the study is presented in Figure 3.6.

Figure 3.6: Strategic road network



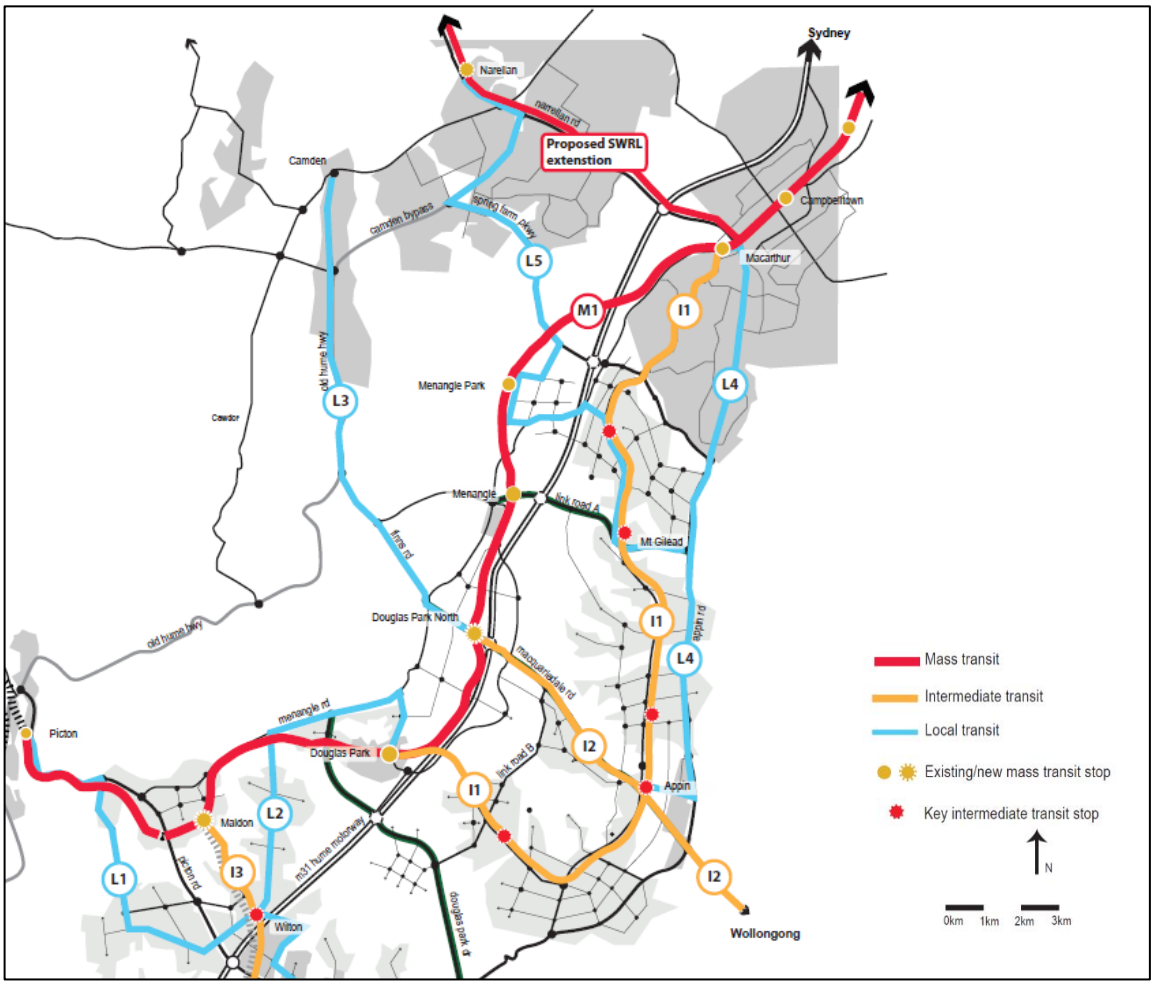
Source: Greater Macarthur Investigation Area – Strategic Transport Infrastructure Study (2017), Department of Planning & Environment

Additional road infrastructure proposed in this study in relation to the previous plan include:

- New Southeast-Northwest oriented connections across the Macarthur Area, including new links between Menangle/ Menangle Park and Gilead
- Upgrades to the Hume highway and additional new interchanges.

The future public transport network proposed in the study is presented in Figure 3.7.

Figure 3.7: Strategic public transport network



Source: Greater Macarthur Investigation Area – Strategic Transport Infrastructure Study (2017), Department of Planning & Environment

Additional road infrastructure proposed in this study in relation to the previous plan include:

- Long-term electrification and quadruplication of the Southern Highlands rail line (South of Macarthur to Picton)
- Additional train stations along the Southern Highland Line at Douglas Park North and Maldon
- New Southeast-Northwest oriented intermediate transit connections to link new developments to the Southern Highland Line train stations
- New propositions on local transit links, including a route from Appin to Narellan via Menangle Park.

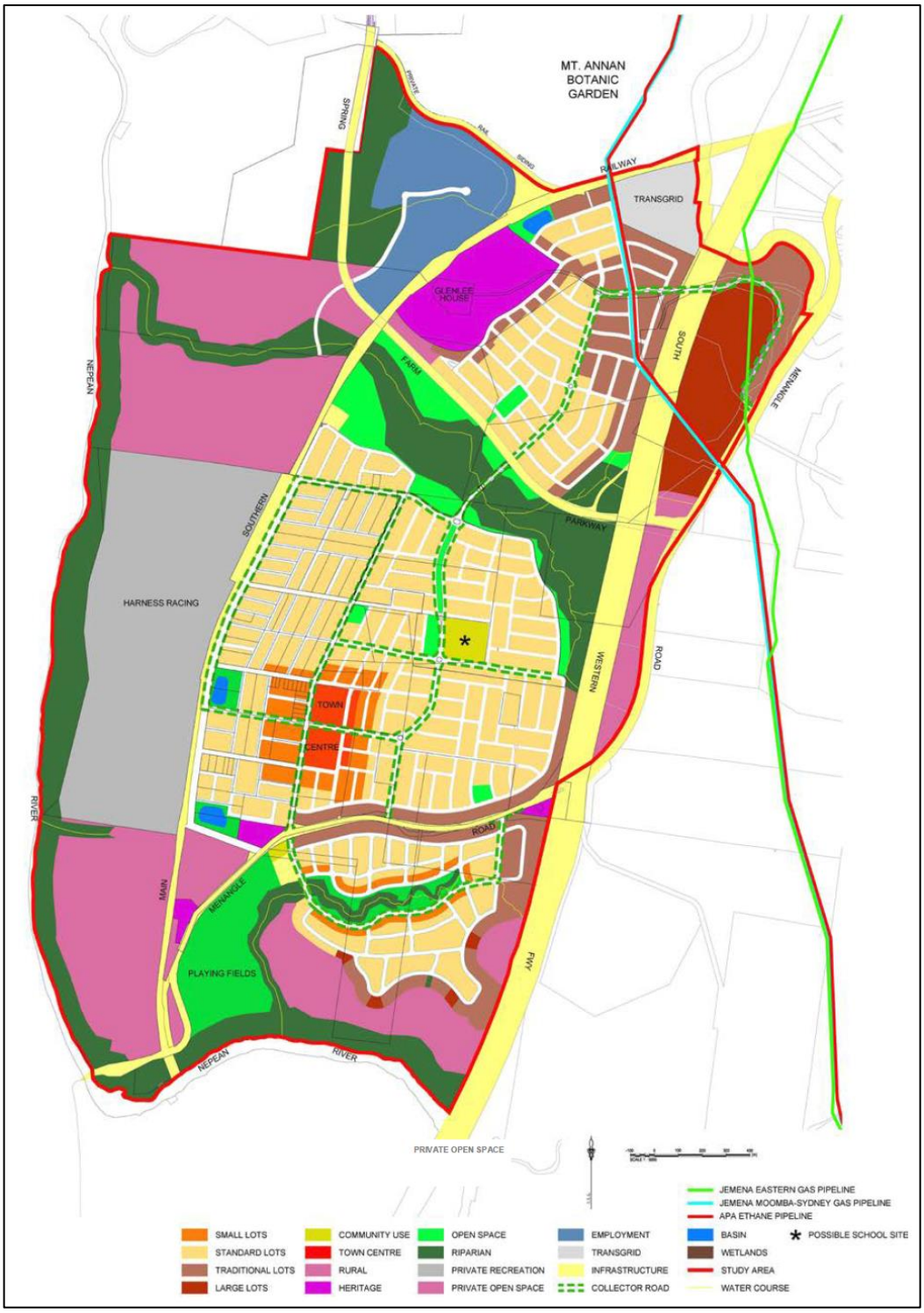
3.2 Precinct Planning Context

3.2.1 Menangle Park URA and existing Urban Structure Plan

The Menangle Park URA is 958 hectares in area and accommodates 3,400 residential allotments, as well as a town centre and associated land uses.

The existing urban structure from DCP 2016 is shown in Figure 3.8.

Figure 3.8: Menangle Park URA urban structure plan



Source: DCP 2016, Campbelltown City Council

3.2.2 Transport Infrastructure upgrades

As identified in Section 3.1.4 of this report, there are several actions stemming from the Greater Macarthur Priority Growth Area. This includes the construction of Spring Farm Parkway, widening of Menangle Road and new access ramps to the Hume Highway.

Planning for the Spring Farm Parkway is currently underway with a design and business case expected to be completed in 2018. The provision of the road is likely to be staged, with the section between the Hume Motorway and Camden Bypass completed first to support development in the Menangle Park area.

The timing of the other projects is subject to the development timeframe, funding and associated preparation of a business case.

More details on the Spring Farm Parkway project are presented below.

Spring Farm Parkway

Roads and Maritime Services (Roads and Maritime) is planning to construct Spring Farm Parkway to ultimately link Spring Farm with Menangle Park, with a potential future link to Appin. The first stage of Spring Farm Parkway has been announced and will include 2.5 kilometres of road linking the Menangle Park URA with the Hume Motorway via northbound facing entry and exit-ramps.

Stage 1 has been announced at the time of writing as a fast-tracked project under the Housing Affordability Fund program. This would provide critical road infrastructure to support housing in the area. Additional funding would also be provided by developer contribution.

Strategic planning is currently being undertaken to preserve land for Stage 2 of the Spring Farm Parkway between Menangle Park and Spring Farm. Stage 2 is noted to be subject to funding being allocated.

Once complete, Spring Farm Parkway will provide the key access to the Hume Motorway for land release areas in Menangle Park and Spring Farm, thereby reducing traffic volumes on Menangle Road, Camden Bypass and Narellan Road to the north.

Furthermore, Spring Farm Parkway would provide a key connection between Menangle Park and key employment hubs including Narellan and destinations further to the west via The Northern Road. This connection would operate as an alternative to the congested Narellan Road, which would otherwise accommodate these trips.

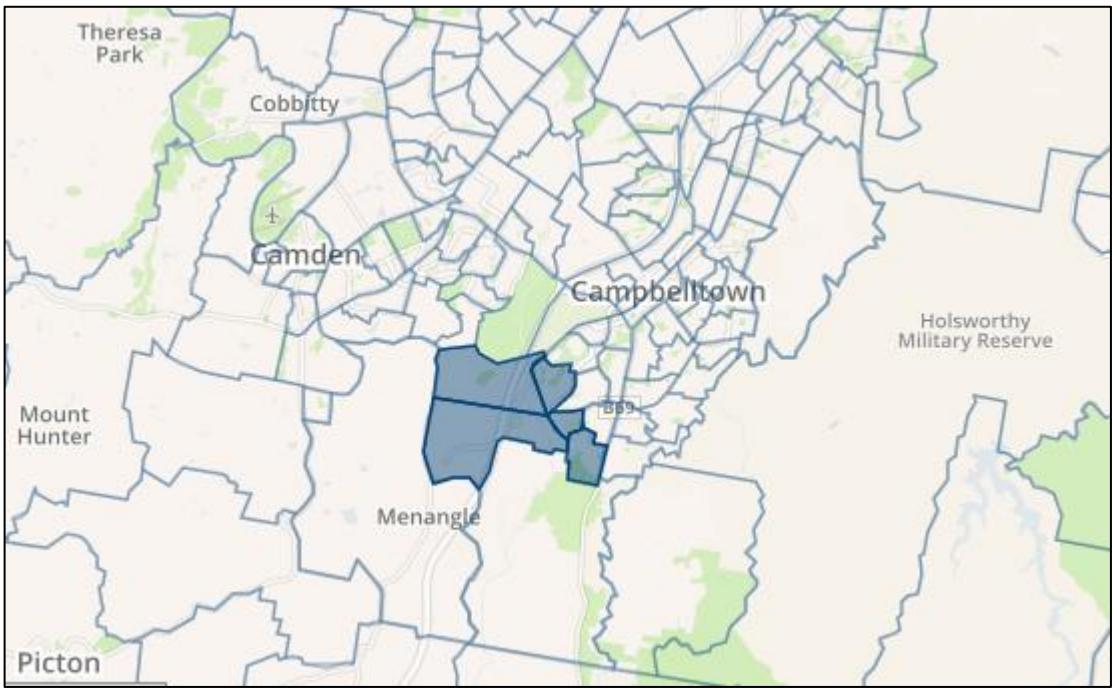
4. Existing Transport Conditions

4.1 Travel Patterns

The 2011 Census by the Australian Bureau of Statistics (ABS) has been reviewed to determine the demographic and travel demand characteristics for Travel Zones including and surrounding the Menangle Park URA. These are TZ 3300, TZ 3301, TZ 3304, TZ 3305 and TZ 3306. The Travel Zone (TZ) is the smallest geographical area for which Journey to Work data is available.

Travel zones near and including the Menangle Park URA site were analysed to understand travel behaviour for those living in the area including destination and mode of travel. The travel zones are shown in Figure 4.1.

Figure 4.1: Analysed JtW travel zones (TZ 3300, TZ 3301, TZ 3304, TZ 3305, TZ 3306)



Source: NSW Government Bureau of Transport Statistics, JTW Explorer

The JTW data indicates that approximately 4,500 people reside in the above TZs. The Journey to Work data indicates that the residents within the selected travel zones commute to the following top destinations:

- 40 per cent travel to Campbelltown
- 19 per cent travel to the Liverpool and Bankstown area
- 8 per cent to Sydney CBD
- 6 per cent to Camden
- 2 per cent to Parramatta
- 20 per cent to other.

As such, there is a large amount of travel to the Campbelltown, Liverpool and Bankstown area for employment. Of those travellers surveyed on the day, approximately 73 per cent travelled to work by private vehicle (either as the driver or passenger) and 12 per cent utilised public transport. The JTW data for the selected TZs are presented in Table 4.1.

Table 4.1: JTW 2011 travel mode splits for selected TZs (TZ 3300, TZ 3301, TZ 3304, TZ 3305, TZ 3306)

Mode of travel	Residents living in select travel zones	Employees working in select travel zones
Car driver	76%	83%
Car passenger	7%	7%
Train	12%	1%
Bus	1%	1%
Walked	1%	4%
Other	1%	1%
Mode not specified	2%	3%

Source: NSW Government Bureau of Transport Statistics

The 2011 JTW mode splits indicate a high reliance on private car (either as driver or passenger) for the select TZs for both residents in the TZs (83 per cent) as well as employees (90 per cent).

The NSW Household Travel Survey (HTS) was also analysed to understand travel patterns for all trips made during the day (and not only the journey to work). HST data is compiled based on Statistical Area Level 3 (SA3) which consists of a number of suburbs. The Campbelltown and Wollondilly SA3s have been considered in understanding HST travel behaviour for the Menangle Park URA. The SA3s are shown in Figure 4.2 and Figure 4.3 with a summary of travel modes within each presented in Table 4.2.

Figure 4.2: Campbelltown SA3

Figure 4.3: Wollondilly SA3

Source: Transport for NSW

Table 4.2: HST modes of travel for Campbelltown and Wollondilly SA3s

Mode of Travel	Campbelltown SA3	Wollondilly SA3
Vehicle Driver	50%	64%
Vehicle Passenger	26%	20%
Train	7%	1%
Bus	6%	7%
Walk Only	10%	9%
Other	0%	0%

Source: Transport for NSW

The proportion of trips made by private vehicle, as a driver or a passenger, is 76 per cent for Campbelltown SA3 and 84 per cent for Wollondilly SA3. The share of the private vehicle for all trips made during the day remains high but is slightly lower than for the journey to work. The occupancy of private cars is also higher when all trip purposes are considered, compared to only the JTW data.

4.2 Road Network

4.2.1 Description

Menangle Road

Menangle Road is generally a north-south road linking with Campbelltown to the north at Narellan Road and Maldon to the south, at Picton Road.

Menangle Road is classified as a State Road, north of Nepean River, and a Regional Road south of Nepean River.

Near the proposed development, Menangle Road is aligned in an east-west direction and is generally configured with one lane in each direction. It has a road reserve width of approximately 15 metres and a posted speed limit of 80 km/h.

Figure 4.4: Menangle Road looking south

Figure 4.5: Menangle Road looking north

Hume Motorway M31

Near Menangle Park, the Hume Motorway M31 provides a key north-south connection from the Southern Highlands (i.e. Mittagong, Bowral, Moss Vale) to Campbelltown and beyond. To the north, the Hume Motorway splits into the Westlink M7 Motorway and the M5 South-West Motorway.

At this junction, the Westlink M7 Motorway provides a key access to the north-western suburbs of Sydney including Blacktown and Marsden Park. The M5 South-West Motorway provides access to regional centres such as Liverpool, and the Sydney CBD.

Access to the Hume Motorway is facilitated by on and off-ramps from Narellan Road, approximately five kilometres north of Menangle Park.

Hume Motorway near Menangle Park is configured as a dual carriageway with two lanes in each direction of travel. Roads and Maritime Traffic Volume Viewer indicates an average daily traffic volume of approximately 25,000 to 27,000 vehicles per day in each direction of travel. Hume Motorway in the area of Menangle Park, as seen from Glenlee Road, is shown in Figure 4.6

Figure 4.6: Hume Highway looking north

Adjoining local road network

Within Menangle Park, the local road network generally consists of Glenlee Road, Cummins Road and Beersheba Parade, all of which intersect with Menangle Road.

Glenlee Road is located approximately 1.5 kilometres north of the proposed development and generally operates as an access road for Glenlee Homestead and Macarthur Substation.

Cummins Road is aligned in a north-south direction and forms a T-intersection with Menangle Road, west of the proposed development. Cummins Road has a posted speed limit of 50 km/h and provides access to the local residential area.

Beersheba Parade is also aligned in a north-south direction and provides access to the local residential area, as well as Menangle Park Railway Station and Club Menangle. Beersheba Parade has a posted speed limit of 50 km/h.

Figure 4.7: Glenlee Road

Figure 4.8: Cummins Road

Figure 4.9: Beersheba Parade

Surrounding Intersections

The following unsignalised intersections currently exist near the site:

- Cummins Road/ Menangle Road
- Beersheba Parade/ Menangle Road
- Glenlee Road/ Menangle Road
- Menangle Road/ Glen Alpine Road
- Menangle Road/ Gilchrist Drive.

4.2.2 Traffic Volumes

GTA commissioned traffic counts along Menangle Road in the vicinity of the Menangle Park URA to understand road network peak traffic periods and daily traffic volumes along the route. The traffic counts were conducted north of Broughton Anglican College and at the Nepean River.

Key findings from the traffic counts include:

- The weekday road network peak periods along Menangle Road occur at approximately 7am to 9am and 4pm to 6pm.
- The weekday average daily traffic (in both directions) along Menangle Road is approximately 11,300 vehicles.
- Significantly fewer vehicles use Menangle Road on a weekend compared with typical weekday use. Weekend use is approximately 4,500 vehicles per day.
- The AM peak hour occurs between 8am and 9am and comprises approximately 1,000 northbound vehicles and 400 southbound vehicles.
- The PM peak hour occurs between 4pm and 5pm and comprises approximately 350 northbound vehicles 750 southbound vehicles.

The results of the traffic counts along Menangle Road, north of Broughton Anglican College, are shown in Figure 4.10 and Figure 4.11.

Figure 4.10: Menangle Road average daily traffic profile

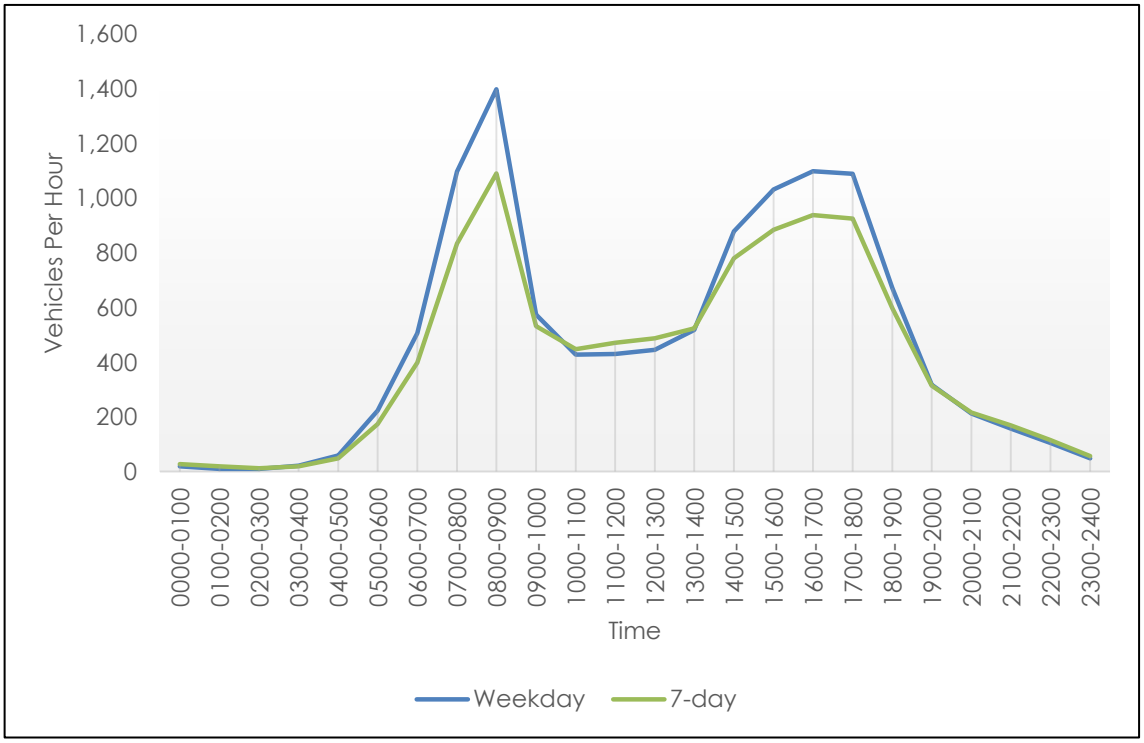
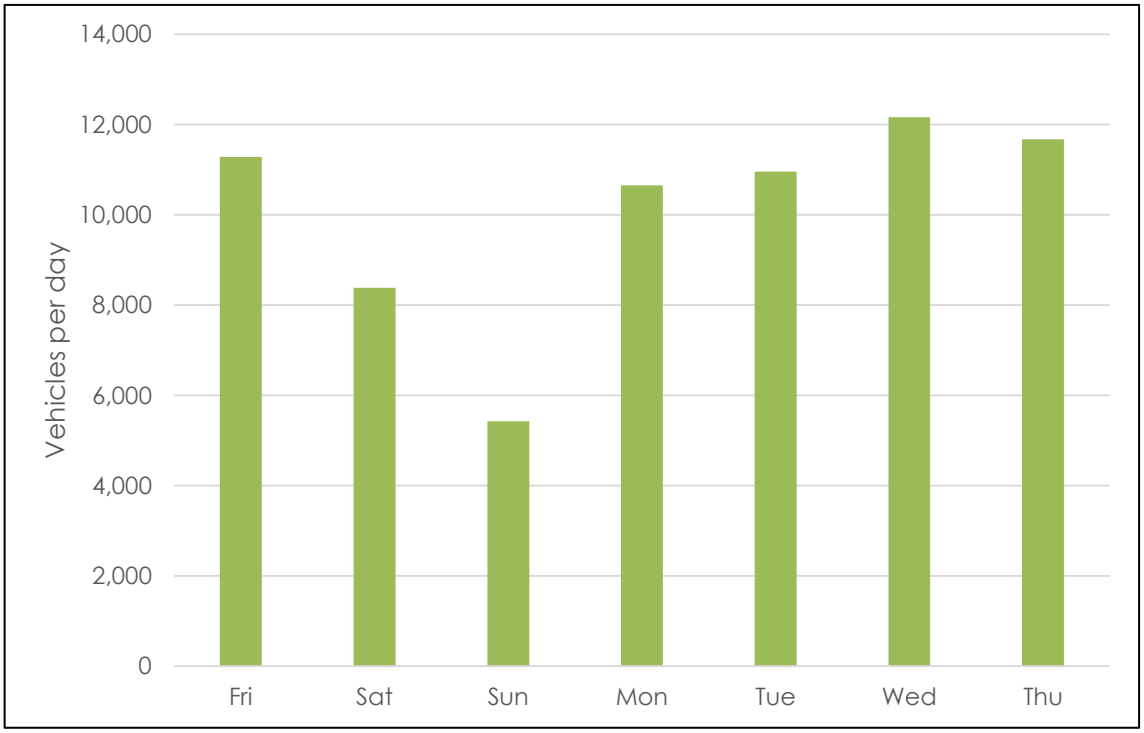


Figure 4.11: Menangle Road daily total traffic volumes (both directions)



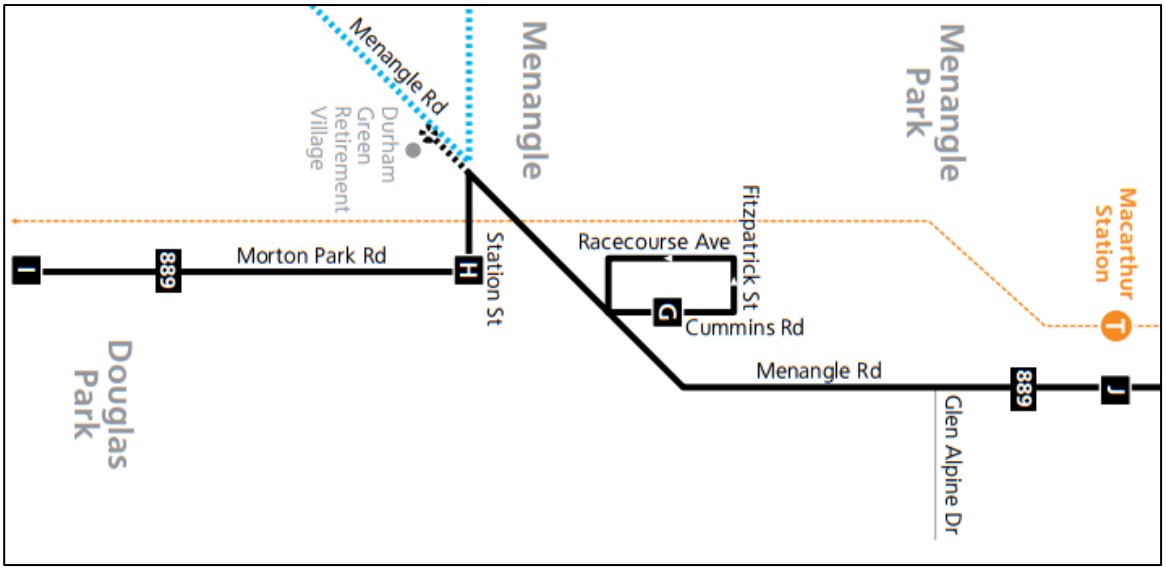
With consideration of the survey results, and Roads and Maritime historical traffic volumes along Menangle Road for 2008, daily traffic volumes have increased from 6,900 vehicles in 2008 to 11,300 vehicles in 2017.

4.3 Public Transport

Public transport provision within Menangle park includes the 889 bus route between Menangle and Campbelltown, as well as the Southern Highlands train line between Moss Vale and Campbelltown.

Bus stops for the 889 bus route are located at Menangle Park railway station and along Cummins Road, approximately 100 metres south of Station Road. The bus network map is shown in Figure 4.12.

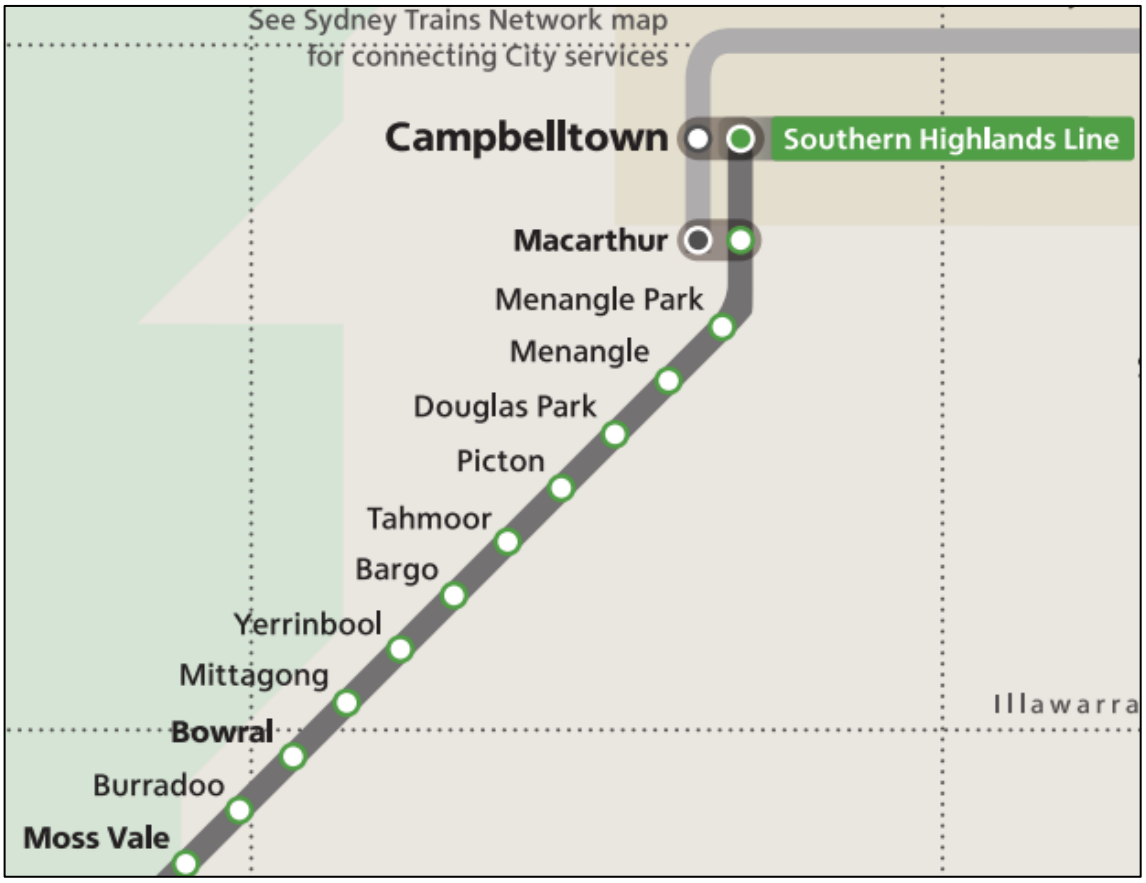
Figure 4.12: Bus network map



Source: Busabout and Transport for NSW Buses, https://busabout.com.au/pdf/maps/49_889_map.pdf, accessed 19/9/17

The train network map is shown in Figure 4.13. Train service frequencies are typically 30 minutes to the Southern Highlands during the AM peak and hourly for other periods. Hourly train services are generally provided between Menangle Park and Campbelltown during the AM and PM peak periods

Figure 4.13: Menangle Park train network map



Source: Transport for NSW TrainLink, http://www.sydneytrains.info/stations/pdf/intercity_map.pdf, accessed 19/917

4.4 Walking and Cycling Infrastructure

Currently there are only limited walking and cycling provisions within and around the precinct. Neither Cummins Road or Menangle Road have footpaths.

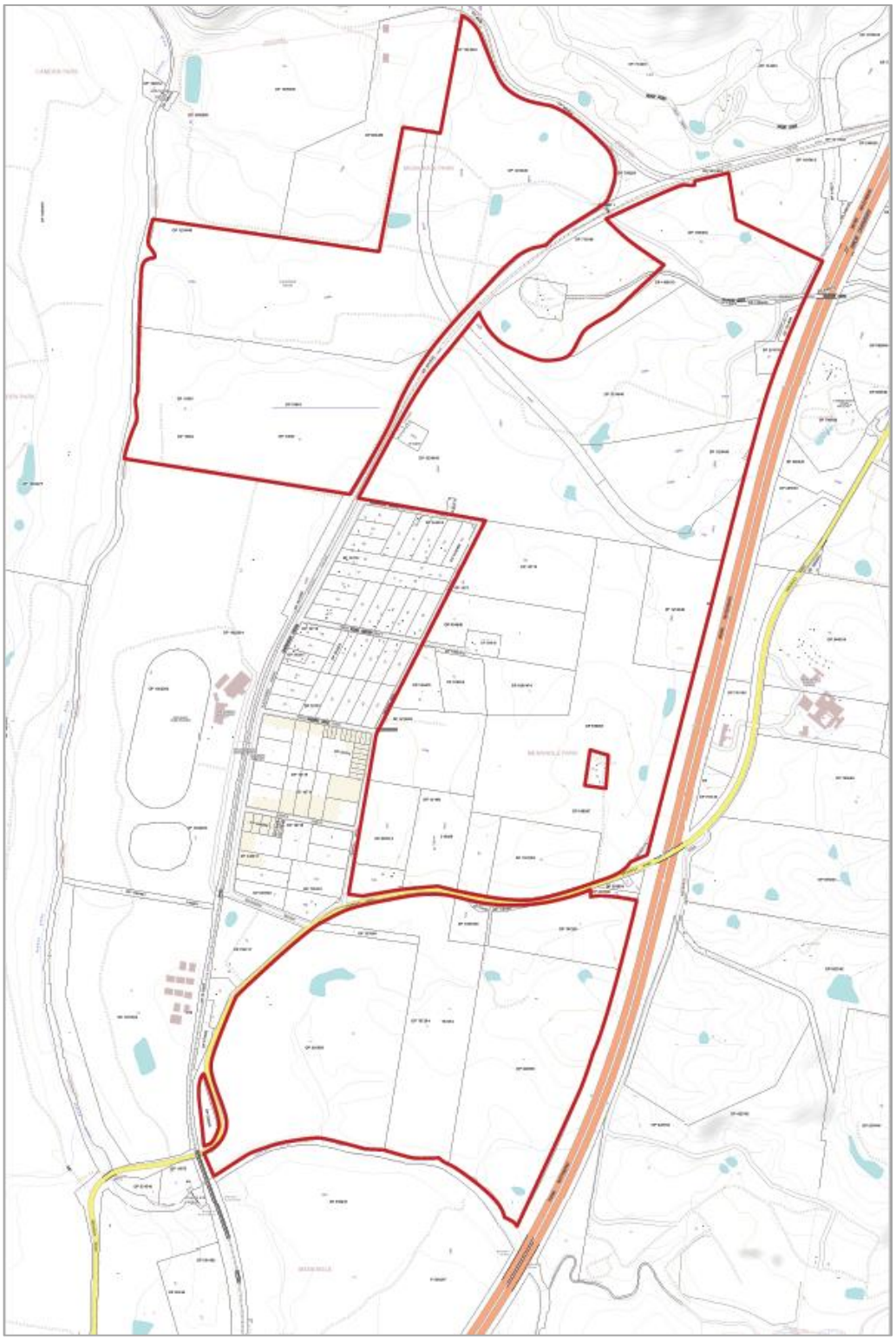
5. Planning Proposal

5.1 Objective of Planning Proposal

The proposal seeks to amend the current approved Structure Plan as set out by Campbelltown City Council in DCP 2016 to provide more housing options, employment opportunities and retail choices within lands owned by Dahua in the Menangle Park URA. The land to which the proposed LEP amendment and planning proposal relates (the site) includes all land owned or under the control of Dahua and six (6) additional properties on the eastern side of Cummins Road owned or under the control of other landowners (refer to legal description of the site and land application map included at Appendix A). The Structure Plan, as proposed to be amended, continues to relate to all land within the Menangle Park URA.

Menangle Park URA and land controlled by Dahua are shown in Figure 5.1.

Figure 5.1: Menangle Park URA



Source: Roberts Day

5.2 Proposed Land Uses

The full development of the Menangle Park URA includes land owned by Dahua and other private owners. The full development distribution and yield, and its comparison with previous plans, is summarised in Table 5.1 together with a comparison with previous planning for the site.

Table 5.1: Proposed land uses for Menangle Park URA

Precinct	Proposed yields (Dahua land)	Proposed yields (other private owners)	Proposed yields (total Menangle Park)	Comparison DCP 2016	Comparison TMAP 2010
Residential					
<30 dwellings/ha	2,500 dwellings	1,130 dwellings	3,630 dwellings	2,839 dwellings	No information
30-60 dwellings/ha	700 dwellings	120 dwellings-	820 dwellings	580 dwellings	No information
>60 dwellings/ha	800 dwellings	-	800 dwellings	-	No information
Total dwelling yields	4,000 dwellings	1,250 dwellings	5,250 dwellings	3,419 dwellings	3,400 dwellings
Retail					
Town centre	30,000 m^2	-	30,000 m^2	20,000 m^2	50,000 m^2
Neighbourhood centre	3,500 m^2	-	3,500 m^2	-	-
Community and Recreational					
School	1 primary school (maximum capacity of 1,000 students)	-	1 primary school (maximum capacity of 1,000 students)	1 school	1 primary school
Sportsgrounds	4 sports fields	-	4 sports fields	Playing fields (not specified)	No information
Employment Lands					
Employment Lands	180,000 m^2	-	180,000 m^2	No information	150,000 m^2

In comparison with the residential dwelling target of approximatively 3,400 dwellings from the existing Structure Plan, the new proposal would add approximately 1,850 dwellings. This change is associated with a reduction in the average size of lots and a reconfiguration of the urban structure to support the new yields.

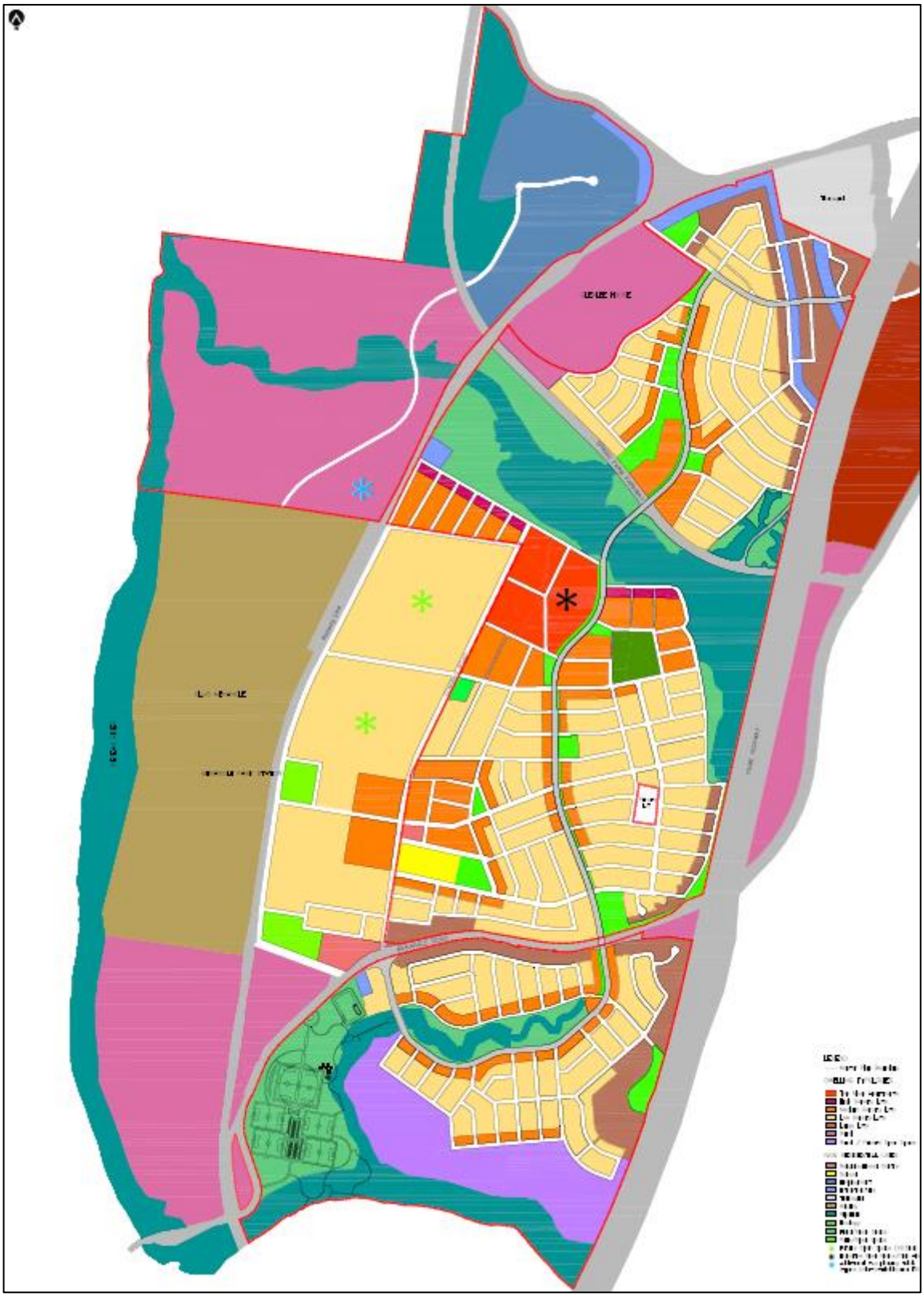
5.3 Proposed Masterplan

The proposed amendment builds upon the site's previous rezoning and associated Structure Plan to create a new sustainable, healthy and high quality residential community comprising the following:

- 5,250 dwellings (an increase of 1,850 dwellings)
- a new major town centre comprising 30,000 square metres of retail/ employment gross floor area
- a new neighbourhood centre (approximately 3,500 square metres of retail/ employment floor space)
- a revised road and street network to provide better permeability throughout the site
- four sports fields with other associated playing areas and facilities
- integrated passive recreation area within a riparian corridor network
- land for environmental conservation
- community facilities to support the proposed increaser to the population
- a primary school with a maximum capacity of 1,000 students.

The preliminary concept masterplan of the subject site is shown in Figure 5.2.

Figure 5.2: Proposed masterplan



Source: Roberts Day RD04.6, Revision E, dated 27 April 2018

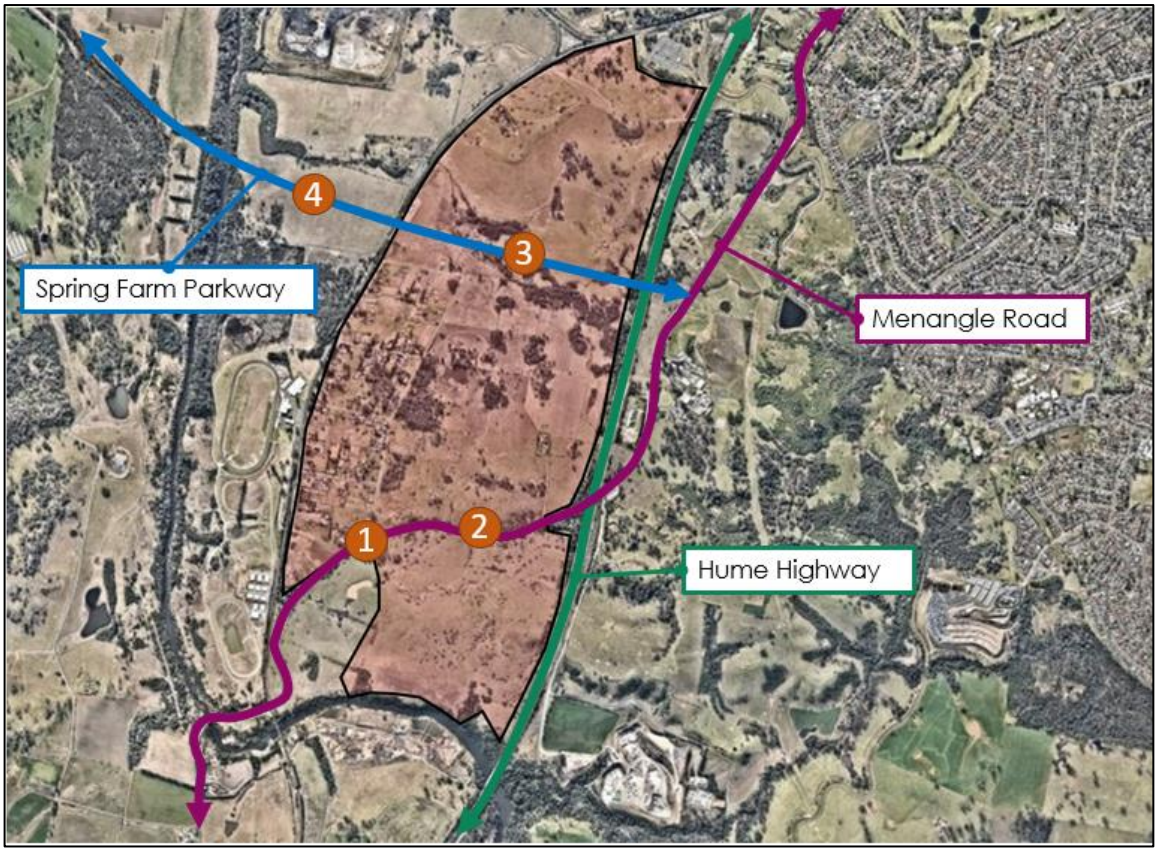
5.4 Vehicular Access Strategy

Proposed vehicular access to the development will be provided by two arterial roads; Menangle Road, and the future Spring Farm Parkway. Access to the development would be via intersections along Menangle Road and Spring Farm Parkway including connections via Cummins Road and a proposed North-South Collector Road.

Access to the proposed residential development will consider the following phases and indicative timing according to the overall staging of the development:

1. Access via Menangle Road and Cummins Road intersection (2020).
2. Access via a new intersection of North-South Collector Road and Menangle Road (2021) in addition to Cummins Road.
3. Access via a new intersection of north-south collector road and Spring Farm Parkway (2022) – Assumes Spring Farm Parkway Stage 1 is completed.
4. Access to employment lands via a new intersection with Spring Farm Parkway (2026) – Assumes Spring Farm Parkway Stage 2 is completed.

Figure 5.3: Proposed access strategy



Basemap source: Nearmap

In addition to the above, there are existing access points to the precinct at Beersheba Parade and Glenlee Road.

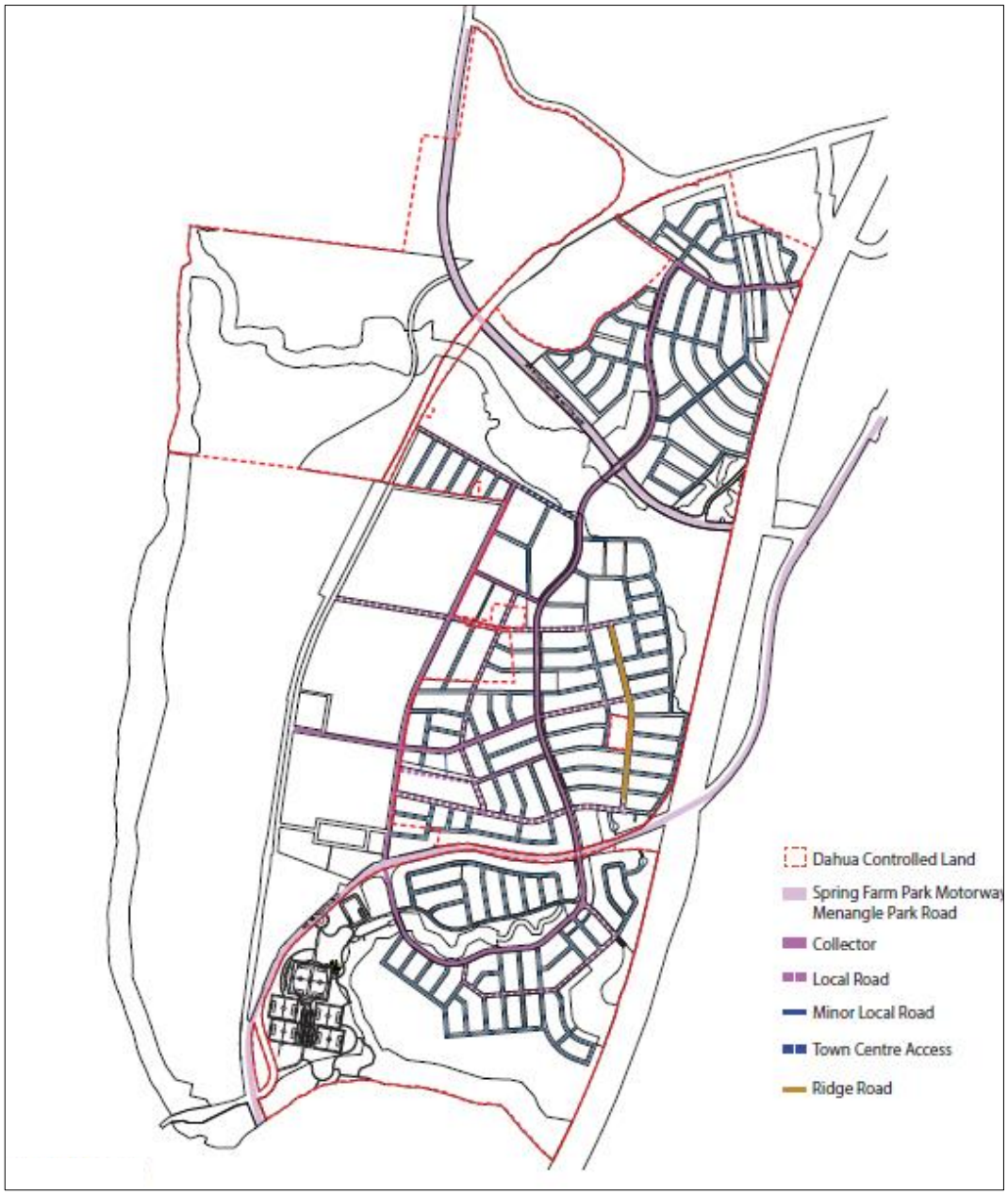
5.5 Proposed Internal Road Network

Internal access will be provided via a collector road orientated predominantly in a north-south direction (North-South Collector Road), connecting the residential development to Menangle Road and the future Spring Farm Parkway. The collector road will be serviced by a number of sub-

collector roads and major local roads which will in turn distribute traffic to the local street network for residential access.

The proposed road network is illustrated in Figure 5.4.

Figure 5.4: Proposed road network



Source: Roberts Day

The road cross-sections for collector and local roads within the site would be designed in accordance with the urban design report. Footpaths will be provided along both sides of new roads.

5.6 Staging of Development

Given the size of the development, the construction of different sections and precincts within Menangle Park URA will occur in the following three major phases:

- Phase 1 (2020): 450 dwellings completed

- Phase 2 (2022): 1,800 dwellings completed
- Phase 3 (2026): 5,250 dwellings completed.

Phase 1 of the development considers Stages 1, 2A and 2B, which are DAs that have been already been submitted, and largely align with the existing DCP 2016. The number of lots proposed by Stage 1, 2A and 2B adds up to 438 lots.

6. Strategic Transport Assessment

6.1 Preliminary considerations

The following provides a preliminary strategic transport assessment of the subject site for the ultimate development of the site in 2026. It is emphasised that this assessment and associated findings are preliminary only. It has been assumed that key intersections on the broader road network are being adequately assessed and designed as part of regional and/or corridor studies as required (including detailed modelling for the GMIA).

This assessment considers key roads providing direct access to the Menangle Park URA site and the key major access points to the proposed development, which are:

- Menangle Road/ Cummins Road
- Menangle Road/ North-South Collector Road
- Spring Farm Parkway/ North-South Collector Road.

Minor accesses have not been included in the traffic modelling at this stage, which include:

- Spring Farm Parkway/ Employment Lands: future key intersection to be assessed with Spring Farm Parkway Stage 2.
- Cummins Road/ Menangle Road: it has been assumed that most of the traffic would use the improved intersection at Cummins Rd/ Menangle Road instead.
- Glenlee Road/ Menangle Road: likely upgrade to a dual-circulating lane roundabout in accordance with the TMAP (2010) and Menangle Park Contributions Plan (2018).

Special event traffic from Club Menangle has not been considered in this preliminary assessment, as events do not typically coincide with the road network peak periods. However, it is noted that the detailed design of internal roads should consider the needs of equine transport vehicles to safely navigate local intersections. The proposed treatment at Cummins Road will not impact the use of the Beersheba Road intersection and will improve the overall road network operation.

Glenlee Road will be further investigated following planning proposal lodgement in relation to ownership and capacity.

This assessment considers the following road upgrades as outlined in the *Greater Macarthur Land Use and Infrastructure Plan* and the *Greater Macarthur Investigation Area Strategic Transport Infrastructure Study*:

- Upgrade of Menangle Road to four lanes of traffic (two traffic lanes in each direction) from Beersheba Parade to Gilchrist Drive.
- Construction of Spring Farm Parkway Stage 1 and 2 completed.

These projects are included within planning documentation for the area and have been considered in previous transport studies. It is understood, however, that the funding and timing of these projects have not been confirmed.

Finally, it is also noted that this assessment is based on assumptions that have been discussed with Roads and Maritime with regard to background growth and trip generation rates.

6.2 Future mode share

The future mode share for residents within Menangle Park has been assessed based on the existing mode share, assuming that there will be no increase in the use of public transport or sustainable modes of transport. The JTW 2011 mode share was used as a primary reference and compared to

the mode share from the HTS, which includes all trip purposes but is only available at the SA3 level. Mode share for Menangle Park was estimated based on:

- JTW mode share of residents of surrounding travel zones
- Average of Campbelltown and Wollondilly SA3 HTS mode share
- Wider analysis of the difference of travel patterns by purpose at the metropolitan level.

The aim was to incorporate other purposes of trips that are made during the peak hour, such as trips to school in the morning peak and trips to the shopping centre or to social activities in the evening peak. Vehicle occupancy was also adjusted to consider that the other purpose trips generally have a higher vehicle occupancy than the JTW trips[1].

Table 6.1: Expected future mode share for Menangle Park residents

Mode share	HTS 2015/16 Campbelltown SA3	HTS 2015/16 Wollondilly SA3	JTW 2011 Menangle Park residents	Expected future mode share for Menangle Park residents (ultimate development)
	Daily (all trips)	Daily (all trips)	Daily (commute trips only)	AM and PM peaks (external trips only)
Vehicle driver	**50%**	**64%**	**76%**	**68%**
Vehicle passenger	26%	20%	7%	21%
Train	7%	1%	12%	8%
Bus	6%	7%	1%	3%
Walk only	10%	9%	1%	0%
Other/ not stated	0%	0%	2%	0%
Total	**100%**	**100%**	**100%**	**100%**
Total private vehicle	**76%**	**84%**	**83%**	**89%**
Vehicle occupancy	1.52	1.31	1.09	1.31
Maximum vehicle driver share (considering 66% trips to train station are made by car)	**55%**	**65%**	**84%**	**73%**

Source: NSW Government Bureau of Transport Statistics, HTS 2015/16, JTW 2011 (TZs 3300, 3301, 3304, 3305 and 3306)

6.3 Traffic Impact Assessment

6.3.1 Traffic generation rates

Traffic generation estimates for the proposal have been sourced from Roads and Maritime *Guide to Traffic Generating Developments (2002)* and Roads and Maritime Technical Direction *Updated traffic surveys* (TDT 2013/04a). *Guide to Traffic Generating Developments* has historically been referenced when assessing the future traffic generation for a given development. TDT 2013/04a provides updated guidance based on more recent surveys.

In addition, first-principles trip generation analysis has been conducted based on mode share and is presented in Appendix A. This analysis has been used to verify and adjust traffic generation rates where necessary.

The traffic generation rates for the various peak periods are set out in Table 6.2.

[1] Vehicle occupancy observed from the low-density residential dwellings trip generation surveys vary from 1.18 to 1.70, with an average of 1.36 in the AM peak and 1.30 in the PM peak. 1.31 is within the average and is conservative considering that vehicle occupancy from the Household Travel Survey is 1.46 for the 3-hours AM peak (based on linked trips arriving at their destination between 6.31 am and 9.30 am).

Table 6.2: Weekday peak trip generation rates

Land use	Area/ dwellings[1]	Traffic generation rate (vehicle-trips)		Source
		AM	PM	
Residential Use				
Low density residential (<30 dwellings/ha)	3630 dwellings[5]	0.95	0.99	TDT 2013/04a (average metropolitan Sydney for site peak) Roads and Maritime recommendation
Medium density residential (30-60 dwellings/ha)	820 dwellings[5]	0.65	0.65	Guide to Traffic Generating Developments (2002) – highest range First-principles trip generation and mode share
High density residential (>60 dwellings/ha)	800 dwellings[5]	0.5	0.5	First-principles trip generation and mode share
Retail Use				
Town Centre	22,500m^2 GLFA[2]	4 per 100 m^2 GFLA [3]	6 per 100 m^2 GFLA	TDT 2013/04a
Neighbourhood Centre	3,500m^2 GLFA[2]	6.66 per 100 m^2 GFLA [3]	10 per 100 m^2 GFLA	TDT 2013/04a Roads and Maritime recommendation
Community and Recreation				
School	1,000 students	0.89 per student	0.67 per student	GTA Database
Sports field	4	3 per field	30 per field	GTA Database
Employment Lands				
Bulky goods and warehouse retail	Maximum 15,000 m^2 GFA[4]	0 trips as opening hours outside of AM peak period	1.31 per 100 m^2 GFA	TDT 2013/04a (average)
Hardware and building supply	Maximum 15,000 m^2 GFA[4]	2.05 per 100 m^2 GFA	2.85 per 100 m^2 GFA	TDT 2013/04a (average)
Industrial and business park	180,000 m^2 GFA	0.58 per 100 100 m^2 GFA	0.58 per 100 100 m^2 GFA	TDT 2013/04a (average)

[1] includes all land within Menangle Park URA (including land owned by Dahua and land owned by other parties)
[2] based on a 75 per cent ratio for GFA to GLFA
[3] based on a two-thirds ratio for morning to evening peak hour generation
[4] preferred land use scenario only includes 180,000 m^2 of business park, with no large format retail use. However, a maximum of 30,000 m^2 of large format retail use (15,000 m^2 of bulky foods/warehouse retail and 15,000 m^2 of hardware and building supply) were maintained in the traffic assessment and represents a contingency buffer
[5] following the density definition, high density dwellings would incorporate small terrace/ townhouse product on subject 200m^2 lots and medium density would include townhouses and small lot detached dwellings.

Community and recreational facilities, including the primary school and sporting fields, are expected to be used by the local community. As such, those facilities would generate predominantly internal trips only. Internal trips generated by community and recreational uses are already accounted for in the internal trips generated by the residents. To avoid double counting, community and recreational uses have not been included in traffic generation calculations. Assumptions on internal and external trips are further described in the following section.

6.3.2 Characteristic Trip Types

An important characteristic of the traffic generation is the different types of trips which may occur. These different types of trips correspond to:

- 'Primary trips'
- 'Link-diverted trips'
- 'Non-link-diverted trips'.

Primary trips and link-diverted trips involve a vehicle either making a special trip or a modification of the route for an existing trip. On the other hand, non-link-diverted trips correspond to the trips that do not involve a diversion from the route that would otherwise have been taken, or in other words are trips generated by passing traffic. The important distinction is that it is only primary trips and link-diverted trips, which are considered to impact the external road network. Non-link diverted trips are on the road network, and although these trips need to be considered in the design of the internal road network for the proposed development, they do not constitute additional traffic on the external road network.

In addition, internal trips and external trips are differentiated, since internal trips do not impact on the regional road network. A proportion of internal trips crossing from one sub-precinct to another would, however, impact intersection operation on Menangle Road and Spring Farm Parkway. Internal trips have been included in the assessment of these intersections and in the assessment of the internal road network.

Considering the characteristic trip types for the numerous land uses proposed for Menangle Park URA, the following assumptions have been considered for trip generation:

- The neighbourhood centre is assumed to not generate any trips external to the development, given the small size and local nature of these shops.
- 30 per cent of trips generated by the town centre are expected to be contained within the Menangle Park URA. Therefore, 70 per cent of trips associated with these uses will be generated external to the greater development.
- 10 per cent of trips generated by the employment lands are expected to be contained within the Menangle Park URA.
- 15 per cent of trips generated by the residential use are expected to be contained within the Menangle Park URA, considering that rates from TDT 2013/04a are external trips only for subdivisions that only include limited uses other than residential.
- Community and recreational uses (i.e. school and sport fields) are assumed to be mostly internal trips made by residents with negligible traffic generated externally to the development.

6.3.3 Generated Traffic

Based on the assumptions specified, a summary of the anticipated vehicular traffic generated by the proposal is outlined in Table 6.3.

Table 6.3: Traffic generation summary for the AM peak

Land use	AM peak			PM peak		
	Total	Internal	External	Total	Internal	External
Residential	4,583	687	3,895	4,755	713	4,041
Town centre (retail) [1]	630	-	630	945	-	945
Employment lands [1]	1,216	-	1,216	1,355	-	1,355
Total trips generated	**6,429**	**687**	**5,741**	**7,055**	**713**	**6,342**

[1] Internal trips associated with non-residential land uses have been discounted from traffic generation calculations to avoid double counting (those movements are assumed to be made by residents and are already accounted for within the residential use).

The proposal is expected to generate in the order of 6,000 external vehicles movements on the regional road network within the weekday morning and afternoon peak hour. In addition, the proposal would generate approximatively 700 internal vehicles movements.

The comparison of the traffic generation of the proposal with the TMAP is outlined within Table 6.4. The TMAP assessed the traffic impact for the AM peak only, and as such the comparison has been provided for the AM peak only.

Table 6.4: Traffic generation summary for the AM peak (TMAP 2010)

Land Use	TMAP 2010, AM peak (AECOM)		
	Total	Internal	External
Residential	2,316	579	1,737
Town centre (retail) [1]	895	-	895
Employment lands[1]	1,500	-	1,500
Total trips generated	**4,711**	**579**	**4,132**

[1] Internal trips associated with non-residential land uses have been discounted from traffic generation calculations to avoid double counting (those movements are assumed to be made by residents and are already accounted for within the residential use).

The proposal would generate approximately 1,600 more trips than those estimated in the TMAP (AECOM, 2010). It is observed, however, that the TMAP is based on an average trip generation rate per dwelling of 0.73, which is significantly lower than the rate used in this study (observing that the rates of this study were revised following Roads and Maritime consultation). When using the same rates as in the TMAP, the proposal would only generate 1,000 additional vehicle trips.

6.3.4 Trip Distribution and Assignment

The direction distribution and assignment of traffic generated by the Menangle Park URA would be influenced by several factors, including the following:

- Configuration and connectivity of the arterial road network including connections to Hume Motorway M31 and to the Spring Farm Parkway.
- Designation of collector road between and within the area and the arterial road network.
- Configuration of access points to the area.
- Distribution of dwellings within the site.
- Location of employment centres, retail centres and schools in relation to the site.

Considering these factors, as well as for the 2011 JTW data, the assumed directional distributions for the Menangle Park URA are shown in Figure 6.1 to Figure 6.4.

Figure 6.1: AM peak residential distribution

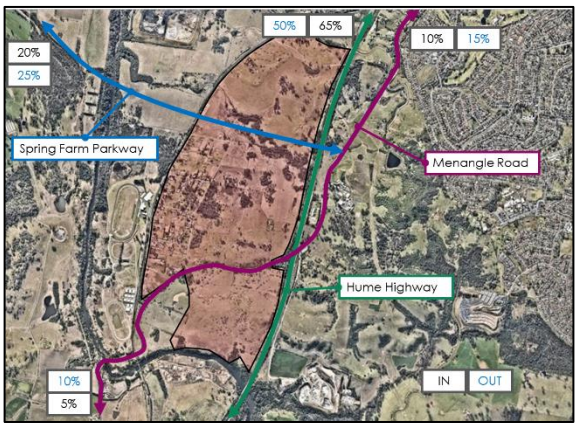
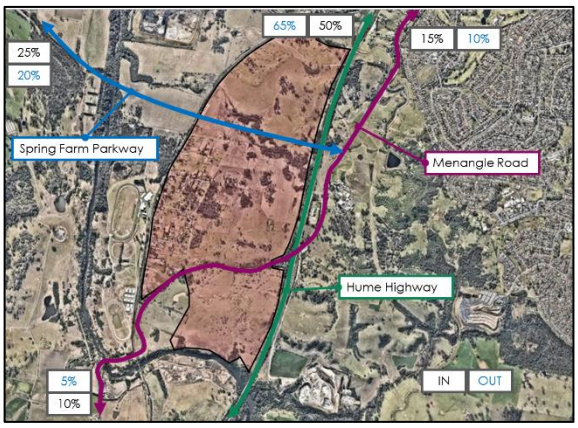
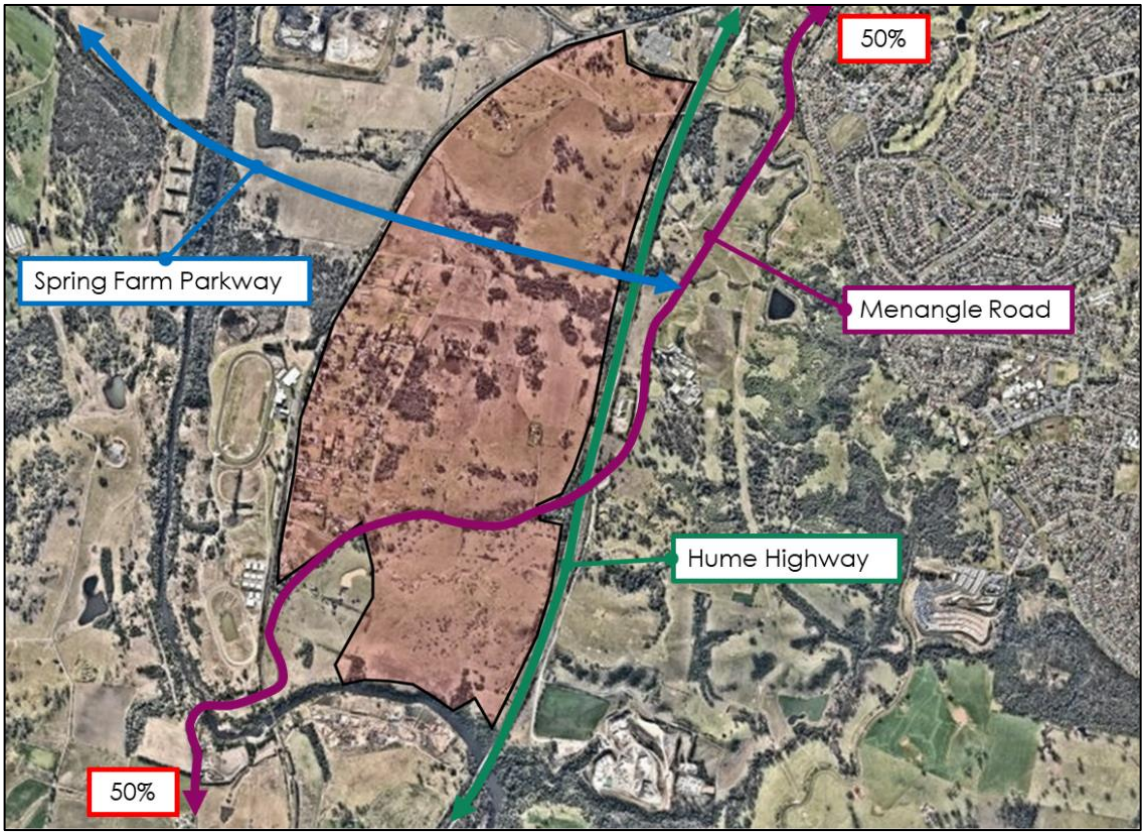


Figure 6.2: PM peak residential distribution



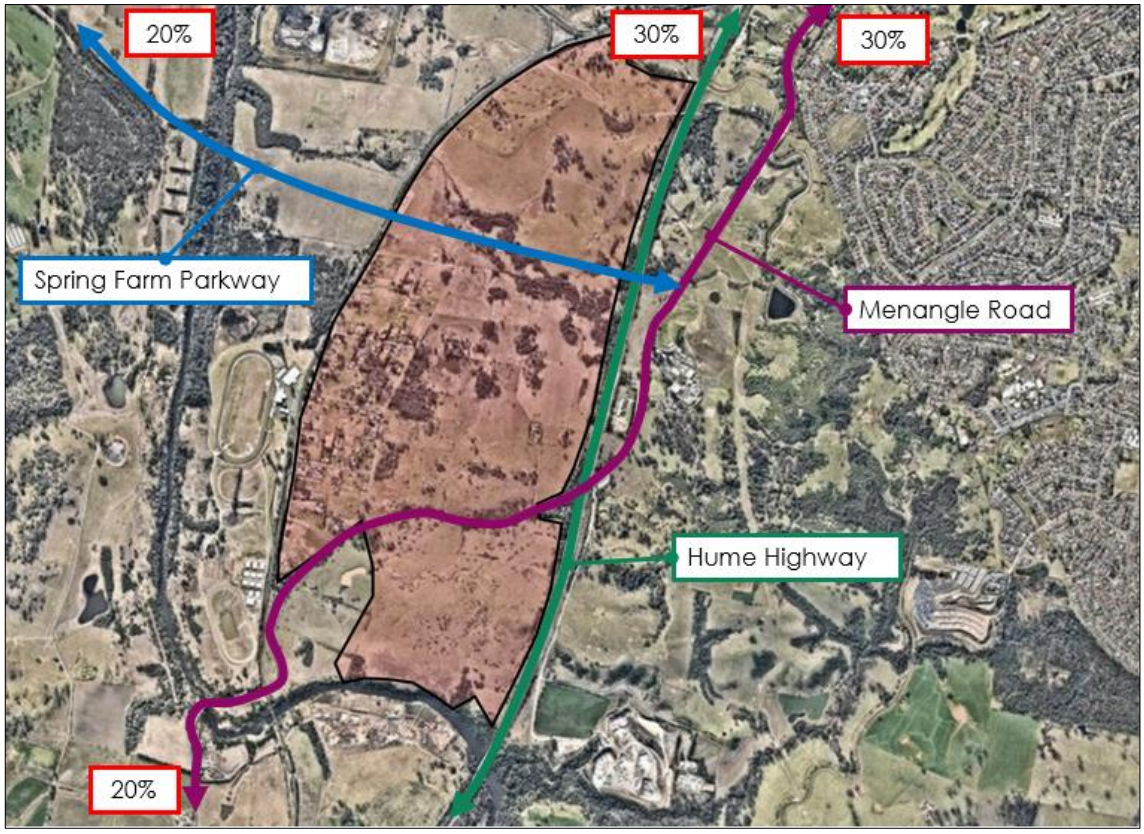
Basemap source: Nearmap

Figure 6.3: Town Centre retail and commercial distribution



Basemap source: Nearmap

Figure 6.4: Employment lands distribution



Basemap source: Nearmap

In addition, the directional split of traffic (i.e. the ratio between inbound and outbound traffic movements) are summarised in Table 6.5 and Table 6.6 for weekday AM and PM peaks, respectively.

Table 6.5: Weekday AM peak direction traffic split (external trips)

Land use type	Total vehicle trips	Directional split		Total vehicles trips/ peak hour	
		In	Out	In	Out
Residential	3,895	20%	80%	779	3,116
Town centre	630	50%	50%	315	315
Bulky goods and warehouse retail	0	-	-	0	0
Hardware and building supply	277	90%	10%	249	28
Industrial and business park	940	80%	20%	752	188
Weekday AM Peak Total	**5,741**	**-**	**-**	**2095**	**3,647**

Table 6.6: Weekday PM peak direction traffic split

Land use type	Total vehicle trips	Directional split		Total vehicles trips/ peak hour	
		In	Out	In	Out
Residential	4,041	80%	20%	3,233	808
Town centre	945	50%	50%	473	473
Bulky goods and warehouse retail	177	50%	50%	88	88
Hardware and building supply	385	50%	50%	192	192

Industrial and business park	794	20%	80%	159	635
Weekday AM Peak Total	**6,342**	**-**	**-**	**4,145**	**2196**

6.3.5 Background Traffic

Future background traffic volumes for Menangle Road and Spring Farm Parkway in 2026 were estimated based on the TMAP and on information provided by Roads and Maritime. For the purposes of this assessment, the assumptions include the following:

- 3.5 per cent per annum background traffic growth rate for Menangle Road
- approximately 30 per cent of the Menangle Road background traffic would transfer to the completed Spring Farm Parkway considering that currently trips originating from Camden use Menangle Road to bypass the congested Narellan Road
- traffic volumes on Spring Farm Parkway were extracted from the TMAP (AECOM, 2010).

The background traffic will account for traffic generated by developments south of Menangle Park, including Wilton. It is expected that only a small proportion of trips would use Menangle Road, considering that Wilton has access to the Hume Highway from Picton Road.

6.3.6 Future Mid-Block Traffic

An assessment of the mid-block performance of the following road corridors near Menangle Park was conducted and includes the following:

- Menangle Road
- Spring Farm Parkway.

Typical mid-block capacities for uninterrupted flow and interrupted flow facilities are provided in *Guide to Traffic management – Part 3: Traffic Studies and Analysis* (Austroads, 2017).

Under existing conditions, Menangle Road presents uninterrupted flow conditions. The single-lane capacity for Menangle Road can be calculated by using the formula shown in Figure 6.5.

Figure 6.5: Uninterrupted single lane capacity

$$C = 1800\, f_W\, f_{HV}$$

where

C = capacity in veh/h under prevailing roadway and traffic conditions

f_W = adjustment factor for narrow lanes and lateral clearances, obtained from Table 4.1

f_{HV} = adjustment factor for heavy vehicles

$= 1/[1+ P_{HV} (E_{HV} - 1)]$

P_{HV} = the proportion of heavy vehicles in the traffic stream, expressed as a decimal

E_{HV} = the average passenger car equivalents for heavy vehicles obtained from Table 4.2.

Table 4.1: Adjustment factors for lane width and lateral clearance

Lateral clearances on each side (m)	Lane width		
	3.7 m	3.2 m	2.7 m
2	1.00	0.90	0.70
1	0.90	0.80	0.63
0	0.65	0.60	0.50

Table 4.2: Average passenger car equivalents for heavy vehicles on grades with single-lane flow

Grade	Passenger car equivalents
Level	2.00
Moderate	4.0
Long sustained	8.0

Source: Section 4.1.1 of Austroads Guide to Traffic management – Part 3: Traffic Studies and Analysis

Along the site frontage, Menangle Road is considered to have:

- Four-metre wide lanes and two to three-metre wide shoulders
- Seven per cent heavy vehicles (daily average)
- Level to moderate grade.

Therefore, in its current state, Menangle Road has a capacity of approximately 1,500 to 1,680 vehicles per lane.

Understanding the future development of Menangle Park and of the Greater Macarthur Area, and the provision of additional access points, the capacity per lane of Menangle Road is expected to decrease and present interrupted flow conditions. Typical mid-block capacities for urban roads with interrupted flow are provided in Table 6.7.

Table 6.7: Typical mid-block capacity for urban roads with interrupted flow

Type of lane	One-way mid-block capacity (passenger cars per lane, per hour)
Median or inner lane	
Divided road	1,000
Undivided road	900
Middle lane (of a three lane carriageway)	
Divided road	900
Undivided road	1,000
Kerb lane	
Adjacent to parking lane	900
Occasional parked vehicles	600
Clearway condition	900

Source: Table 5.1 of Austroads Guide to Traffic management – Part 3: Traffic Studies and Analysis

The capacities shown in Table 6.7 are for roads with unflared major intersections and with interruptions from cross and turning traffic at minor intersections. Peak-period mid-block capacities may increase to 1,200 or 1,400 passenger cars per hour, per lane when the following conditions exist or can be implemented:

- adequate flaring at major upstream intersections
- uninterrupted flow from a wider carriageway upstream of an intersection approach and flowing at capacity
- control or absence of crossing or entering traffic at minor intersections by major road
- priority controls
- control or absence of parking
- control or absence of right turns by banning turning at difficult intersections

- high volume flows of traffic from upstream intersections during more than one phase of a signal cycle
- good coordination of traffic signals along the corridor.

The future roads in the area, Menangle Road and Spring Farm Parkway, will only have a limited number of intersections and exhibit the following characteristics:

- adequate flaring at major upstream intersections
- uninterrupted flow from a wider carriageway upstream of an intersection approach and flowing at capacity
- control or absence of parking
- good coordination of traffic signals along the route.

Therefore, a future mid-block capacity of 1,200 passenger cars per hour per lane has been adopted in future conditions for Spring Farm Parkway and Menangle Road, north of Beersheba Parade.

Based on these parameters, the mid-block capacity for a number regional road sections within and surrounding the Menangle Park URA was conducted. The findings of this analysis are outlined in Table 6.8.

Table 6.8: Summary of mid-block capacity in future conditions

Road	Capacity per lane (vehicles per hour)	Number of lanes provided per direction	Theoretical capacity per direction (passenger cars per hour)
Menangle Road	1,200 [1]	2	2,400
Spring Farm Parkway	1,200[2]	2	2,400

[1] Based on Section 4.1.1 of *Austroads Guide to Traffic Management part 3: Traffic Studies and Analysis*

[1] Based on increased road capacity from Table 5.1 of *Austroads Guide to Traffic Management part 3: Traffic Studies and Analysis*

Analysis of mid-block level of service was conducted based on criteria set out by the Roads and Maritime as well as experience with comparable developments. A summary is provided in Table 6.9.

Table 6.9: Mid-block level of service criteria

Level of service	Description	Volume to capacity ratio (VCR) range
A	A condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.	0.00 – 0.34
B	In the zone of stable flow and drivers still have the reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is a little less than LoS A.	0.35 – 0.50
C	Also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.	0.51 – 0.74
D	Close to the limit of stable flow and approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.	0.75 – 0.89
E	Occurs when traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause break-down.	0.90 – 0.99

Source: Based on values as supplied in Guide to Traffic Generating Developments (RMS, 2002)

Based on these criteria, an assessment of the post-development weekday peak hour traffic volumes (critical peak hour) for locations as listed in Table 6.10 was conducted. The results of this assessment are summarised in Table 6.10.

Table 6.10: Post development mid-block level of service assessment

Road	Direction	Theoretical capacity per direction (passenger cars per hour)	Weekday AM peak hour traffic volume (per direction)	VCR	Level of service	Weekday PM peak hour traffic volume (per direction)	VCR	Level of service
Menangle Road - South of Beersheba Parade (south of Menangle Park URA)	South of Beersheba Parade (south of Menangle Park URA).	2,400	1,498	0.62	C	1,373	0.57	C
Menangle Road - Between Cummins Road and North-South Collector Road (within Menangle Park URA).	Between Cummins Road and North-South Collector Road (within Menangle Park URA).	2,400	1,524	0.64	C	1,307	0.54	C
Menangle Road - Between North-South Collector Road and Spring Farm Parkway (within Menangle Park URA).	Between North-South Collector Road and Spring Farm Parkway (within Menangle Park URA).	2,400	1,674	0.70	C	1,514	0.63	C

Road	Direction	Theoretical capacity per direction (passenger cars per hour)	Weekday AM peak hour traffic volume (per direction)	VCR	Level of service	Weekday PM peak hour traffic volume (per direction)	VCR	Level of service
Menangle Road - North of Spring Farm Parkway (north of Menangle Park URA).	North of Spring Farm Parkway (north of Menangle Park URA).	2,400	1,336	0.56	C	1,136	0.47	C
Spring Farm Parkway - From Hume Motorway to Narellan.	From Hume Motorway to Narellan.	2,400	1,975	0.82	D	1,799	0.75	D

Based on the results of this assessment, Menangle Road is expected to operate at satisfactory levels of service of C in the AM and PM peaks. Spring Farm Parkway will operate at an acceptable level of service of D in the AM and PM peaks.

6.3.7 Future Intersection Operation

Key Access Points

Future intersection performance has been assessed for the following three key access points:

- Menangle Road/ North-South Collector Road
- Menangle Road/ Cummins Road
- Spring Farm Parkway/ North-South Collector Road.

The proposed arrangements for these intersections for the ultimate development scenario are illustrated in Figure 6.6, Figure 6.7 and Figure 6.8. Compared to the intersection arrangements in the TMAP (2010) and the LEP (2016), the intersections have been modified to respond to the new masterplan and higher traffic generation rates adopted. The intersection layouts shown are indicative only and are subject to future detailed modelling.

Two of the key intersections include traffic signals. Prior to installation of any traffic signals, Roads and Maritime traffic signal warrants must be met to avoid potential road safety and operational issues. The primary warrant is based on traffic volumes and includes the following requirements:

- *Traffic demand – in each of four one-hour periods of an average day:*
  - *Major road flow exceeds 600vph in each direction; and*
  - *Minor road flow exceeds 200vph in one direction.*

Assuming the full development of Menangle Park URA, and with consideration of the estimated background growth, this would result in traffic flows that meet the warrants for traffic signals at the two intersections. While permanent solutions are preferred, interim treatments to support the various development stages may be required until signal warrants are met.

Estimated future traffic volumes for the intersections analysed are shown in Appendix B.

Figure 6.6: Indicative Menangle Road/ North-South Collector Road intersection layout

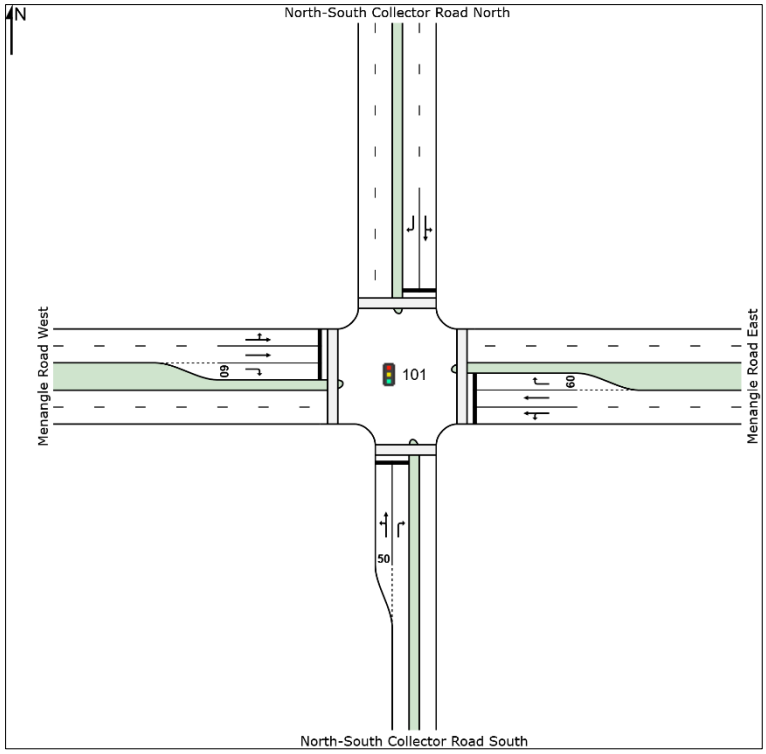


Figure 6.7: Indicative Menangle Road/ Cummins Road intersection layout

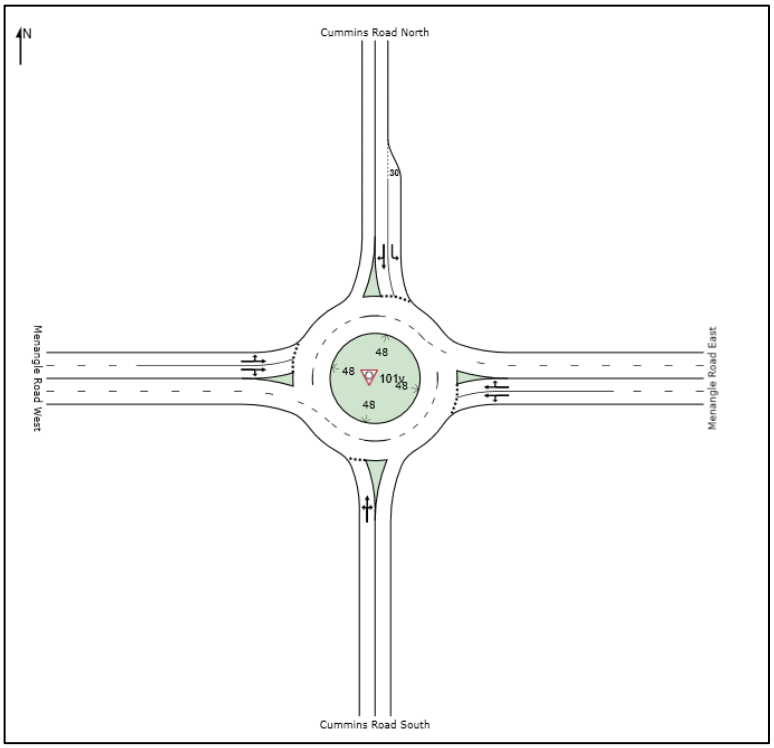
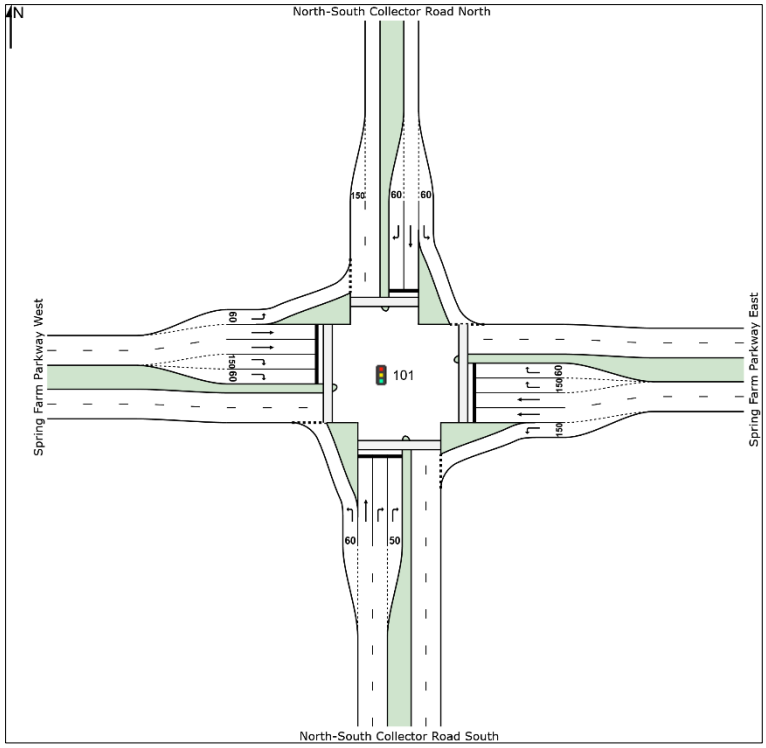


Figure 6.8: Indicative Spring Farm Parkway/ North-South Collector Road intersection layout



The operation of these intersections has been assessed using SIDRA Intersection[2], a computer-based modelling package which calculates intersection performance. The commonly used measure of intersection performance, as defined by Roads and Maritime, is vehicle Delay. SIDRA Intersection determines the average delay that vehicles encounter and provides a measure of the level of service. Table 6.11 shows the criteria that SIDRA Intersection adopts in assessing the level of service with the operation of the key intersection summarised in Table 6.12. A level of service D or better is generally considered acceptable operating conditions.

Table 6.11: SIDRA Intersection level of service criteria

Level of service	Average delay per vehicle (secs/veh)	Traffic signals, roundabout	Give way and stop sign
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

Table 6.12: Intersection operation summary

[2] Program used under license from Akcelik & Associates Pty Ltd.

Intersection	Peak period	Degree of saturation	Average delay (seconds)	95th percentile queue (metres)	Level of service
Menangle Road/ North-South Collector Road	AM	0.91	39	316	C
	PM	0.81	26	182	B
Menangle Road/ Cummins Road[1]	AM	0.57	14	36	A
	PM	0.63	17	46	B
Spring Farm Parkway/ North-South Collector Road	AM	0.93	48	322	D
	PM	0.96	43	259	D

[1] Worst movement reported for roundabouts

Under the proposed layout arrangements, the key intersections are expected to operate at acceptable levels of service of D or better during both AM and PM peaks for the forecast year 2026 with full development of the Menangle Park URA. It should be noted that the Menangle Road/ North-South Collector Road and Spring Farm Parkway/ North-South Collector Road intersection is expected to be at or near capacity given the degree of saturation.

The full SIDRA Intersection results for the key intersections are presented in Appendix C.

It is observed that the other access points to the site include the following intersections, which have not been assessed in SIDRA Intersection at this stage:

- Spring Farm Parkway/ Employment Lands: Future key intersection to be assessed with Spring Farm Parkway Stage 2.
- Cummins Road/ Menangle Road: minor access likely to become a left-in/ left-out only. It has been assumed that most of the traffic would use the improved intersection at Cummins Rd/ Menangle Road instead.
- Glenlee Road/ Menangle Road: Minor access, likely upgrade to a dual-circulating lane roundabout (in accordance with the TMAP prepared in 2010 and Menangle Park Contribution Plan prepared in 2018).

Other intersections

Intersections identified in the TMAP (2010) that will be impacted by the development include the following locations:

- Spring Farm Parkway/ Hume Motorway M31 ramps
- Spring Farm Parkway/ Menangle Road
- Menangle Road/ Glen Alpine Drive
- Menangle Road/ Gilchrist Drive.

It has been assumed that these intersections and the broader road network are being adequately assessed and designed as part of regional and/or corridor studies as required (including detailed modelling for the GMIA).

6.3.8 Precinct Traffic

The traffic distribution within the Menangle Park URA was assessed and analysed to understand general traffic volumes along select roads within the development, and to determine the number of lanes required for key road links throughout the site. These distributions account for the locations of various precincts, attractors and generators within the proposed development. The locations of select mid-block volume screen lines are shown in Figure 6.9 with the traffic volumes for the respective locations shown in Table 6.13 and Table 6.14.

Figure 6.9: Menangle Park URA development mid-block traffic volumes

Basemap source: Roberts Day

Table 6.13: AM peak Menangle Park URA precinct distribution

Location	Road	Direction 1		Direction 2		Lanes required (two way)
		Direction	Mid-block volume	Direction	Mid-block volume	
A	Spring Farm Parkway	Eastbound	1,975	Westbound	1,043	4
B	Spring Farm Parkway	Eastbound	1,293	Westbound	1,731	4
C	North-South Collector	Northbound	374	Southbound	654	2
D	North-South Collector	Northbound	1,916	Southbound	825	4
E	North-South Collector	Northbound	907	Southbound	437	4
F	North-South Collector	Northbound	474	Southbound	427	2
G	Cummins Road	Northbound	696	Southbound	181	2
H	Menangle Road	Eastbound	1,674	Westbound	605	4
I	Menangle Road	Eastbound	1,524	Westbound	752	4
J	Menangle Road	Eastbound	1,498	Westbound	748	4

Table 6.14: PM peak Menangle Park URA precinct distribution

Location	Road	Direction 1		Direction 2		Lanes required (two way)
		Direction	Mid-block volume	Direction	Mid-block volume	
A	Spring Farm Parkway	Eastbound	1,799	Westbound	1,125	4
B	Spring Farm Parkway	Eastbound	1,097	Westbound	1,647	4
C	North-South Collector	Northbound	691	Southbound	500	2

D	North-South Collector	Northbound	915	Southbound	1,948	4
E	North-South Collector	Northbound	460	Southbound	1,166	4
F	North-South Collector	Northbound	525	Southbound	463	2
G	Cummins Road	Northbound	356	Southbound	411	2
H	Menangle Road	Eastbound	549	Westbound	1,514	4
I	Menangle Road	Eastbound	766	Westbound	1,307	4
J	Menangle Road	Eastbound	989	Westbound	1,373	4

Mid-block capacity requirements for Menangle Road and Spring Farm Parkway have been assessed in section 6.3.6, which indicates that the provision of four traffic lanes (two lanes per direction) will be required to meet expected future demand.

Within the development area, the North-South Collector will be the key internal link passing through the centre of the site and town centre, providing a connection to Spring Farm Parkway. Based on the expected volumes, this road would need to provide four lanes of traffic (two lanes per direction). It is noted that at mid-block location D, along North-South Collector Road near the Spring Farm Parkway intersection, traffic demand is expected to approach capacity following full development of the area. This is as a result of the traffic distribution as well as the town centre location. As traffic demand increases and approaches capacity, it is expected that drivers are likely to redistribute across the network to account for the increase in expected delays. Future detailed mesoscopic modelling for the precinct and the wider Greater Macarthur Priority Growth Area will enable a more detailed assessment of the network operation.

Other roads within the precinct would only require two lanes of traffic (one lane per direction).

In addition to the number of mid-block lanes, most roads are expected to be flared with additional lanes at signalised intersection to provide additional capacity.

The design of collector and local roads within the site would generally be designed in accordance with the existing DCP for Menangle Park (October 2016). The North-South Collector Road cross-section would need to be revised to include the widening to four lanes of traffic.

The detailed design of internal roads should consider the need of equine transport vehicles to safely navigate local intersections.

6.4 Public Transport

6.4.1 Bus Services

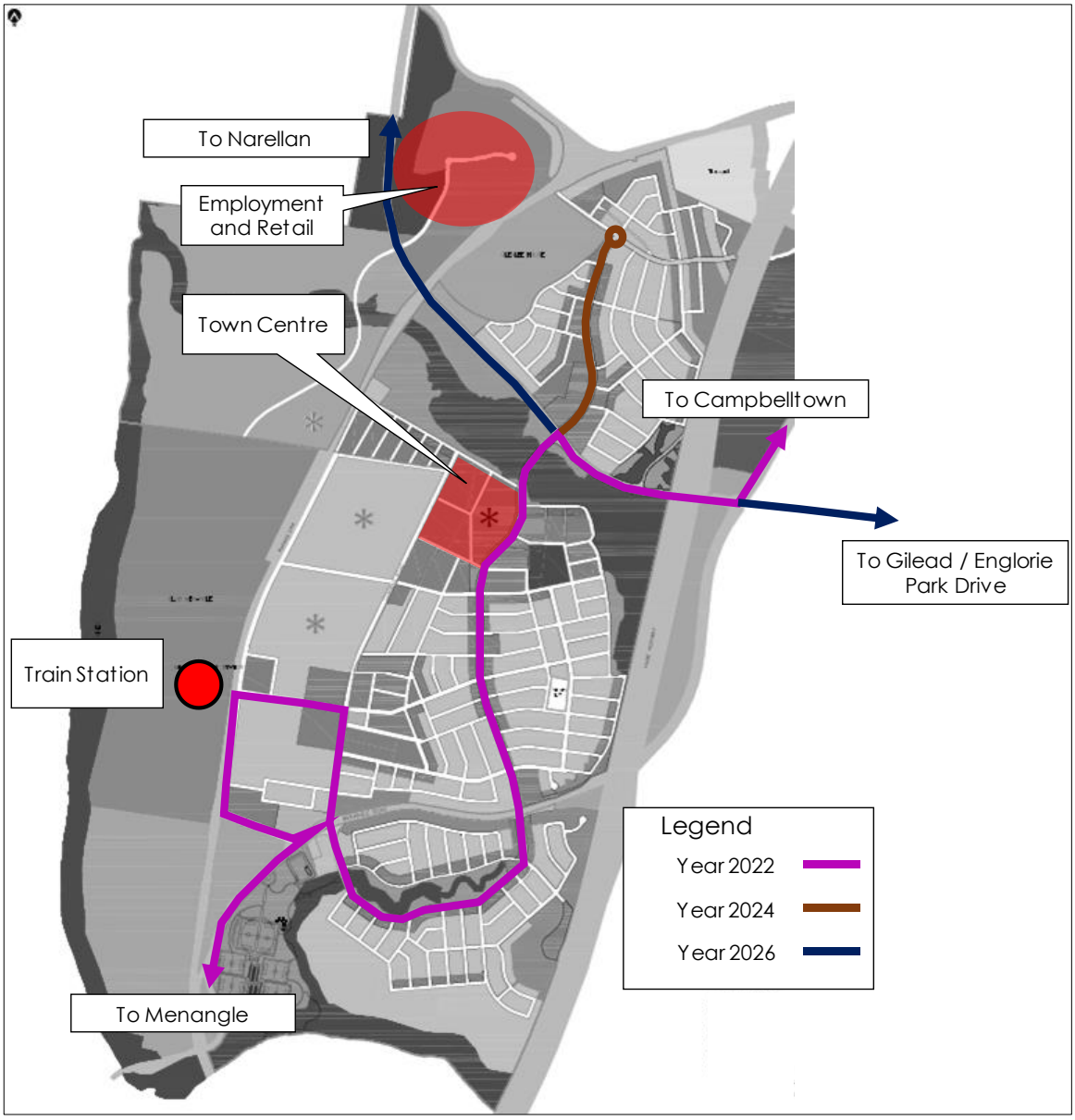
Bus Service Planning Guidelines for Metropolitan Sydney require 90 per cent of households to be within 400 metres radius of a bus stop, ferry, light rail station or train station between 6am and 10pm. The existing 889 bus route will need be adjusted according to the new masterplan to meet this requirement. Temporary bus routes could be considered for the earlier stages of the development, however, bus stops would preferably remain in the same locations to minimise impact on existing and new residents.

The frequency of services will also have to be increased to respond to the demand generated by the proposed development and attract new users to use public transport. In the ultimate development scenario, two bus routes have been considered. The first route would largely follow the existing 889 route which connects Menangle, Menangle Park Railway Station, the Town Centre and Campbelltown. A secondary option would include connection to Narellan and beyond (including Western Sydney Employment Area and Aerotropolis) as well as the retail, employment and light industry lands immediately west of Glenlee House. Those routes would also connect to

key existing and future train stations, including Menangle Park station, Macarthur-Campbelltown station and future Narellan station. Services to the Campbelltown interchange will also provide a connection for residents to other buses and the wider public transport network.

Preliminary proposed bus routes to service the Menangle Park URA is shown in Figure 6.10.

Figure 6.10: Bus provision (preliminary)



Basemap source: Roberts Day

It is proposed that in the southbound direction, buses would turn left at the Beersheba Parade/ Menangle Road intersection and use the roundabout at Cummins Road/ Menangle Road to turn back south on Menangle Road.

This proposed bus routes would be refined in conjunction with Transport for NSW and the local bus operator(s) at a later stage and in response to both broader bus network strategy and patronage demand. The internal road network should include a network of bus-capable roads to offer some flexibility.

The proposed routes are local/ coverage routes that will integrate with the broader public transport network for the Greater Macarthur Investigation Area, which has been addressed in the Strategic Transport Study and is described in Section 3.1.4.

It is proposed that in addition to traditional services, on-demand services using smaller vehicles would provide alternative services to major activities centres (such as education, shopping, employment and leisure facilities) and transport hubs. On-demand services would also be able to provide suitable public transport coverage for the initial stages of the development before the completion of the North-South collector and Spring Farm Parkway (before 2022).

The NSW Government is currently trialling on-demand buses in various locations in the Greater Sydney Region, including Bankstown and Greystanes to connect to transport hubs and shops. As such, it is noted that the above proposed bus routes would be considered to change in the future based on community feedback and roll-out of on-demand transport in the area.

6.4.2 Rail Services and Access to the Rail Network

The Menangle Park URA currently benefits from the existing Menangle Park Railway Station, which offers hourly services to Campbelltown and Moss Vale starting at 4:40am.

Bus services proposed in Section 6.4.1 would also provide improved connections to Macarthur-Campbelltown Station.

Furthermore, the release of the Western Sydney Deal and North-South Rail Link to support the Western Sydney Employment Area, Airport and Aerotropolis considers a rail link between Macarthur and St Marys. This includes provision of a station at Narellan, to which a future bus connection would be recommended.

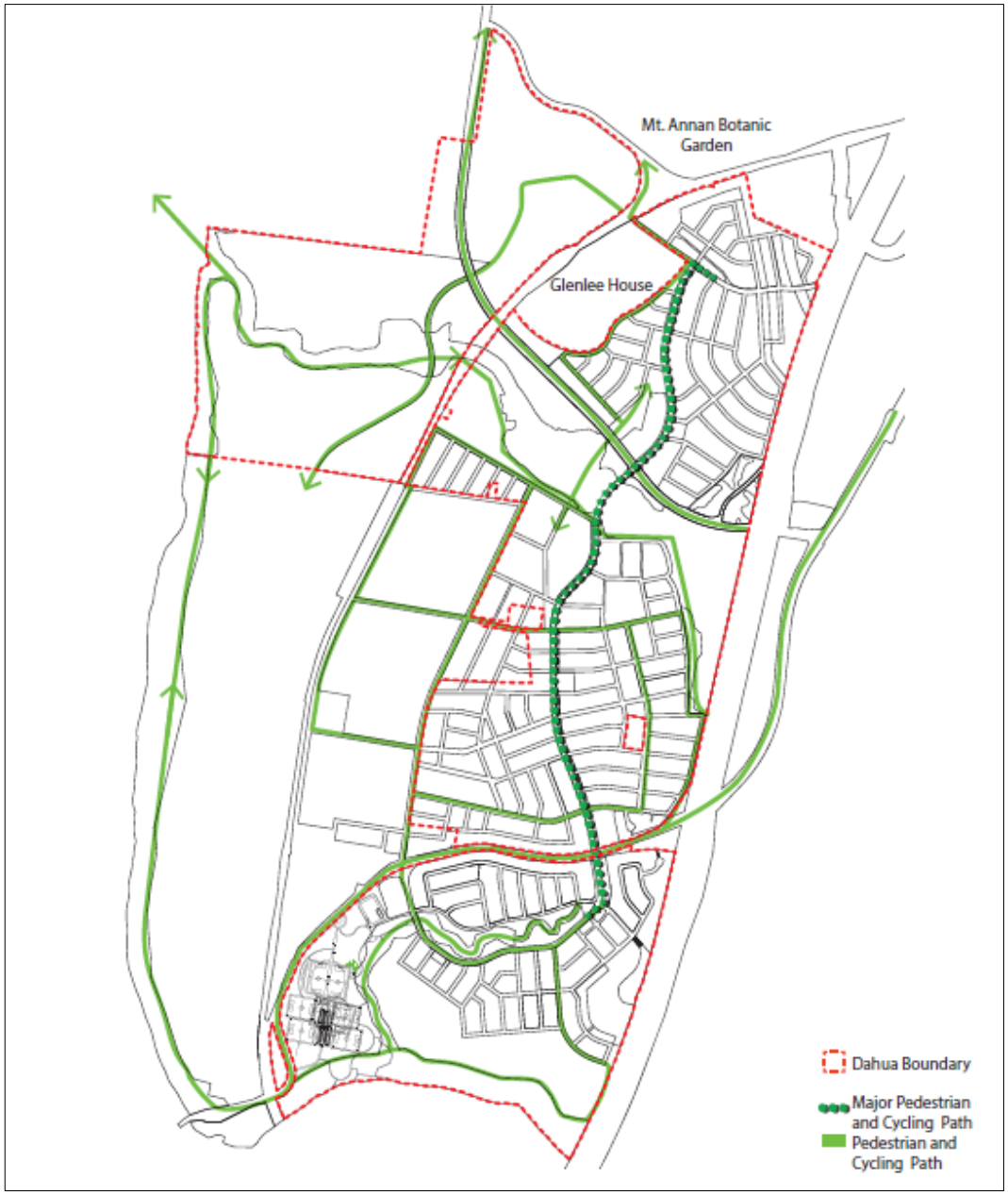
Finally, should the electrification of the Southern Highland Rail Line be extended to Menangle Park, access to this station should be further improved by additional bus services or alternative "last mile" solutions should also be provided to Menangle Park Station.

6.5 Active Travel

Encouraging the use of walking and cycling is central to reducing motor vehicle usage across the Menangle Park URA, especially in the context of the town centre and train station. The planning proposal seeks to encourage active travel by provision of a walking and cycling network. Signalised intersections at major access points are preferred to roundabouts to provide improved amenity and safety for pedestrians and cyclists. As a result, there is expected to be an improvement in active transport links between the precincts within the development, and across major roads within Menangle Park. Accessibility across Spring Farm Parkway will need to be provided and should be discussed further with RMS.

Cycling infrastructure is proposed to follow the alignment of key road connections such as collector roads and arterial roads as well as adjacent to parklands and river/ creek reserved. This will be provided by way of shared paths. In addition to the provision of shared paths adjacent to collector and arterial roads, shared paths are also proposed along local street which connect residents to major attractors such as schools, sporting fields, business/ commercial areas and transport hubs. The cycling network proposed for the Menangle Park URA is shown in Figure 6.11 and is expected to integrate with the regional cycle network.

Figure 6.11: Proposed cycling network



Source: Roberts Day

Pedestrian infrastructure is proposed by way of footpaths or shared paths along all local, collector and arterial road.

7. Summary of Proposed Infrastructure Upgrades

Proposed infrastructure upgrades to the region to support the Menangle Park URA have been based on previous studies and on the results of the transport assessment and identified in Section 6. These are summarised in Table 7.1.

Table 7.1: Proposed infrastructure upgrades

Type	Location/ name	Description
Road upgrades and new roads	Spring Farm Parkway Stage 1 and 2	○ Construction of a new four-lane road, linking the Menangle Park subdivision area to Menangle Road, Hume Highway and Camden Bypass ○ New access ramps to the Hume Highway.
	Menangle Road upgrade	○ Upgrade to four lanes from Beersheba Parade to Gilchrist Drive.
	Internal Road network	○ As per concept plan.
Intersections upgrades or new intersections	Menangle Road/ North-South Collector Road	○ As per preliminary layout in Figure 6.6 .
	Menangle Road/ Cummins Road	○ As per preliminary layout in Figure 6.7.
	Spring Farm Parkway/ North-South Collector Road	○ As per preliminary layout in Figure 6.8.
	Menangle Road/ Glenlee Rd	○ Roundabout.
	Menangle Road/ Beersheba Parade	○ Left-in/ Left-out only.
	Spring Farm Parkway/Access Employment Lands	○ To be assessed with Spring Farm Parkway Stage 2.
	Other intersections	○ To be assessed in addition to the other developments within Greater Macarthur Priority Growth Area (cumulative impacts).
Bus related infrastructure and services	Changes to 889 bus route and additional services	○ As per preliminary in Figure 6.10 (subject to consultation with Transport for NSW).
	New bus stops	○ As required.
	New bus service to Macarthur-Campbelltown Station / future Narellan Station	○ New service to connect Menangle Park to the rail system.
Walking and cycling infrastructure	Across the site	○ Adequate infrastructure along internal roads to encourage walking and cycling to public transport and to key destinations within Menangle Park (shop, school, etc.).

The timing for the above measures will be further assessed according to the proposed staging of this development and other known and likely future developments within the Greater Macarthur Priority Growth Area. It is noted that, in addition to the above measures, interim road and intersection upgrades are likely to be required for the intermediate stages of the development. These would be suitably assessed in future detailed modelling and with subsequent development applications.

8. Conclusion

Based on the analysis and discussions presented within this report, the following conclusions are made:

i It is proposed to modify the currently existing Menangle Park Structure Plan to include approximatively 5,250 dwellings, one neighbourhood centre, one town centre, employment lands, and ancillary uses (school, active recreation).

ii Based on the preliminary concept masterplan, it is anticipated that the site could generated in the order of 6,000 external and 700 internal vehicle movements during a peak hour.

iii The site forms part of the Menangle Park Urban Release Area (URA), which is located within the Greater Macarthur Priority Growth Area, area identified to meet expected housing needs for projected population growth to 2036.

iv Initial development is expected to occur near Menangle Road, development near Spring Farm Parkway will occur once Spring Farm Parkway Stage 1 is completed

v Menangle Park will have the following key four access points: Two signalised intersections on Menangle Road (one with Cummins Road and one with a new North-South Collector Road) and two signalised intersections on Spring Farm Parkway (one east of the railway line to access the main precinct and one west of the railway line to access the employment lands).

vi Existing accesses at Beersheba Parade and Glenlee Road will be upgraded but will remain as unsignalised intersections. A left-in/ left-out intersection configuration at Beersheba Parade and a roundabout at Glenlee Road are the likely future layouts.

vii A new north-south major collector road is proposed through the centre of the site. This road is anticipated to be a four-lane road.

viii A number of two lane streets are proposed to connect the remainder of the site and to link key non-residential uses.

ix It is expected that cyclist facilities would generally follow the alignment of key road connections, as well as adjacent to parkland, river/ creek reserves, through the provision of shared paths along these corridors.

x Existing bus services would need to be rerouted and expanded. Two bus services could be considered to service the site, one to Campbelltown and another to Narellan and beyond. Those routes would connect Menangle Road to existing and future key employment centres and transport hubs (railway stations).

xi Mesoscopic modelling for the proposal that includes other future developments and road infrastructure upgrades within the Greater Macarthur Priority Growth Area will need to be completed to confirm the proposed measures for the ultimate stage and assess interim development scenarios and associated treatments and trigger points for road network upgrades.

xii Glenlee Road will be further investigated following planning proposal lodgement in relation to ownership and capacity.

Appendix A

First Principles Trip Generation

An analysis based on first-principles trip generation was undertaken for Menangle Park to estimate future generated trips per mode and compare the resulting vehicle-trip generation rates with the ones from Roads and Maritime guidelines, including *Guide to Traffic Generating Developments (2002)* and Roads and Maritime Technical Direction *Updated traffic surveys* (TDT 2013/04a).

Table A.1: First-principles trip generation

Trips and mode share	Low density (<30 dwellings/ha)	Medium density (30 to 60 dwellings/ha)	High density (>60 dwellings/ha)
(A) People per dwelling (source ABS 2016 for Campbelltown LGA)	3.2	2.5	1.9
(B) Daily trips per person (HTS 2015/16 for Campbelltown SA3)[1]	3.6	3.6	3.6
(C)% trips during the 1-hour peak AM or PM (source HTS 2015/16 for Greater Sydney)	10%	10%	10%
(D) trips per person during the 1-hour peak AM or PM (D) = (B) x (C)	0.36	0.36	0.36
(E) Peak hour person-trips per dwelling (1 hour), as per first-principles trip generation (E) = (D) x (A)	1.15	0.90	0.69
(F) Mode share for Menangle Park (source Table 6.1)	73% vehicle driver (including +5% to account for vehicle trips to train station) 21% vehicle passenger 8% train 3% bus		
(G) Peak hour trip generation rate per dwelling (1 hour) per mode as per first-principles trip generation (G) = (E) x (F)	0.84 vehicle 0.09 train 0.03 bus	0.66 vehicle 0.07 train 0.03 bus	0.50 vehicle 0.06 train 0.02 bus

[1] Trips per person are all trips made by residents during one weekday, including trips realised outside of the area of residence and including trips that are not linked to the residence. Additionally, trips linked to the residence can include trips from visitors that are not included in this rate. Overall, it is considered that this rate is conservative and gives a good basis for residential trip generation calculation for a high-level analysis.

Following consultation with Roads and Maritime, the vehicle-trip generation rate per dwelling was increased to 0.95 and 0.99 in the AM and PM peak respectively, which is sourced from the TDT 2013/14a and corresponds to the average rate for metropolitan Sydney for the peak of the surveyed development site

Appendix B

Future Traffic Volumes

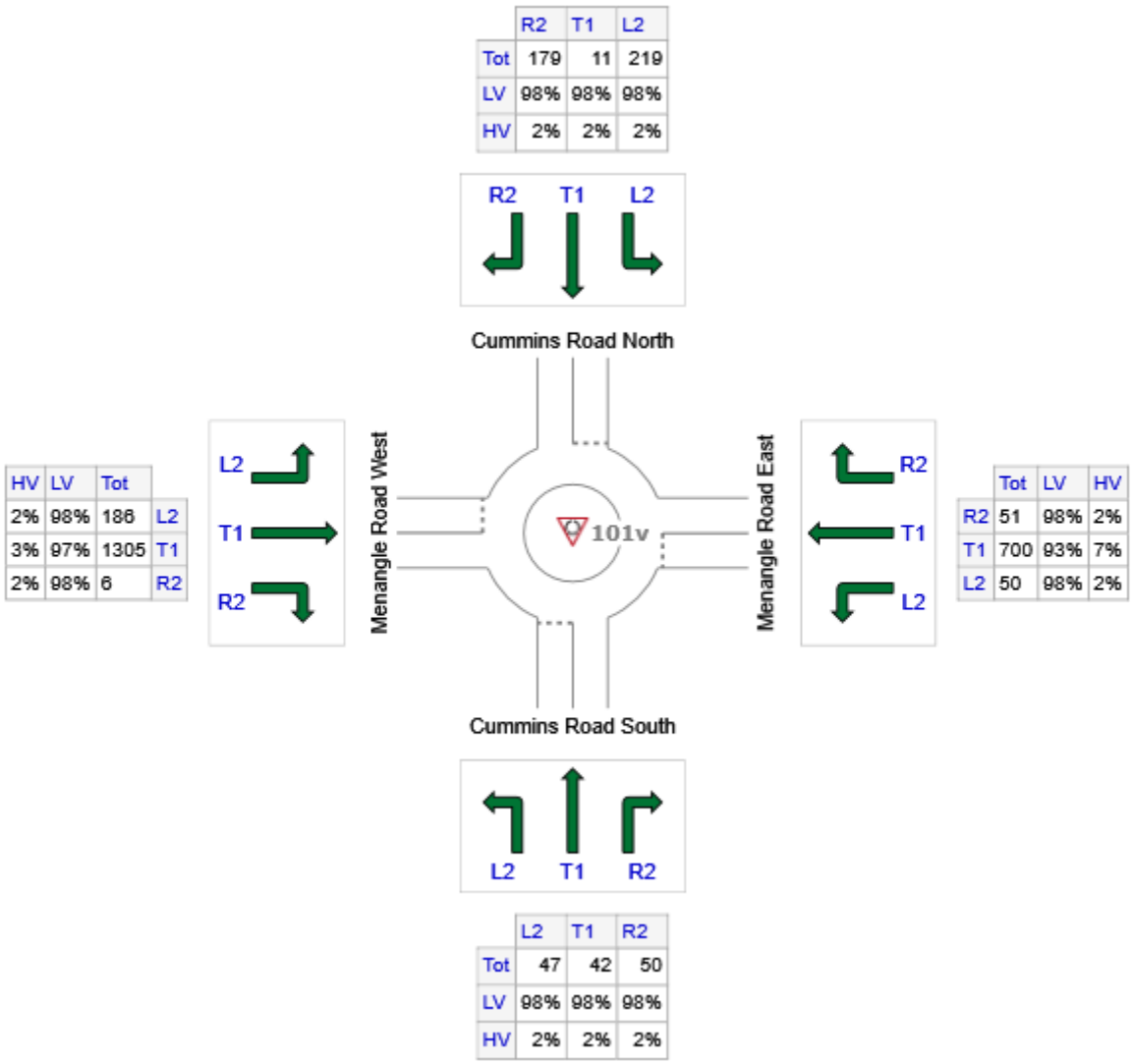
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: 101v [Menangle Rd_Cummins Rd - GTA Roundabout - AM Peak]

New Site
Roundabout

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Cummins Road South	139	136	3
E: Menangle Road East	801	750	51
N: Cummins Road North	409	401	8
W: Menangle Road West	1497	1454	43
Total	2846	2741	105

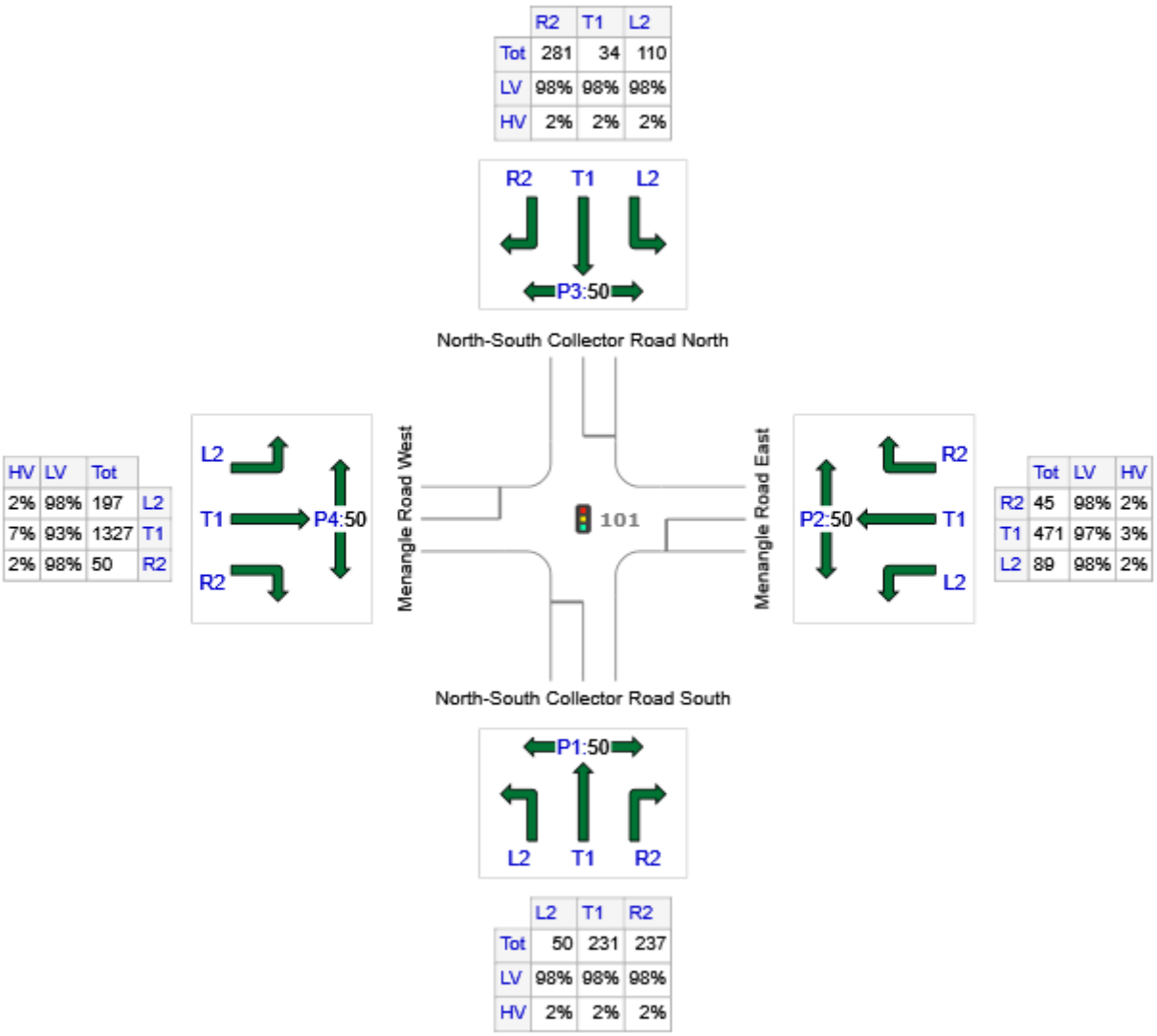
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: 101 [Menangle Rd_N-S Collector Rd - GTA Signals - AM Peak]

New Site
Signals - Fixed Time Isolated

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: North-South Collector Road South	518	508	10
E: Menangle Road East	605	588	17
N: North-South Collector Road North	425	417	9
W: Menangle Road West	1574	1476	98
Total	3122	2989	134

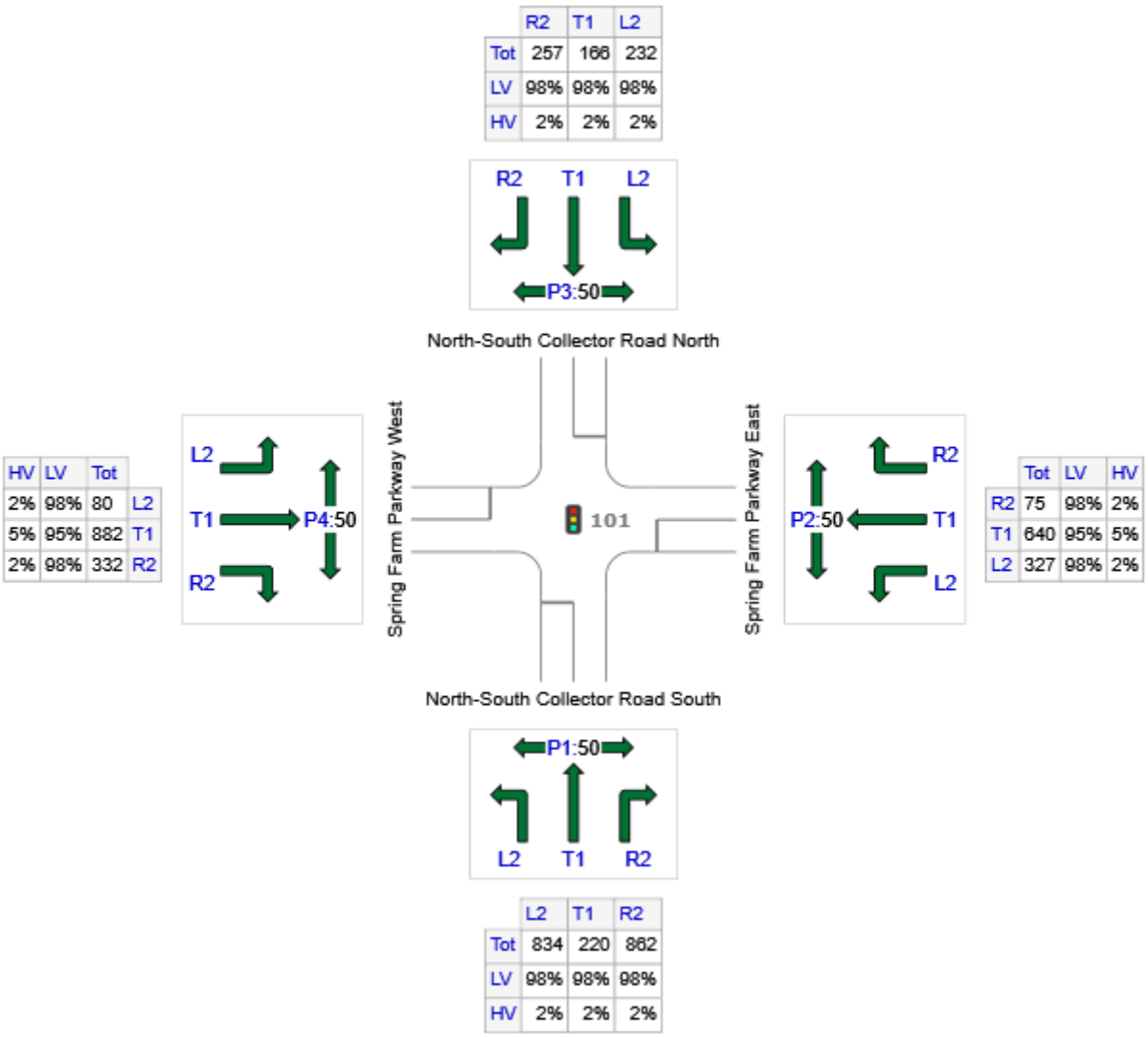
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: 101 [Spring Farm Pkwy_N-S Collector Rd - GTA Signals - AM Peak]

New Site
Signals - Fixed Time Isolated

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: North-South Collector Road South	1916	1878	38
E: Spring Farm Parkway East	1042	1002	40
N: North-South Collector Road North	655	642	13
W: Spring Farm Parkway West	1294	1242	52
Total	4907	4763	144

Organisation: GTA CONSULTANTS | Created: Thursday, 6 December 2018 10:02:21 AM
Project: \\gta.com.au\projectfiles\ProjectFilesSyd\N12400-12499\N124910 - Menangle Park Development\Modelling\Masterplan SIDRA\Final Planning Proposal\SIDRA Models Traffic Report\180502sid-N124910 Menangle Park Planning Proposal AM.sip7

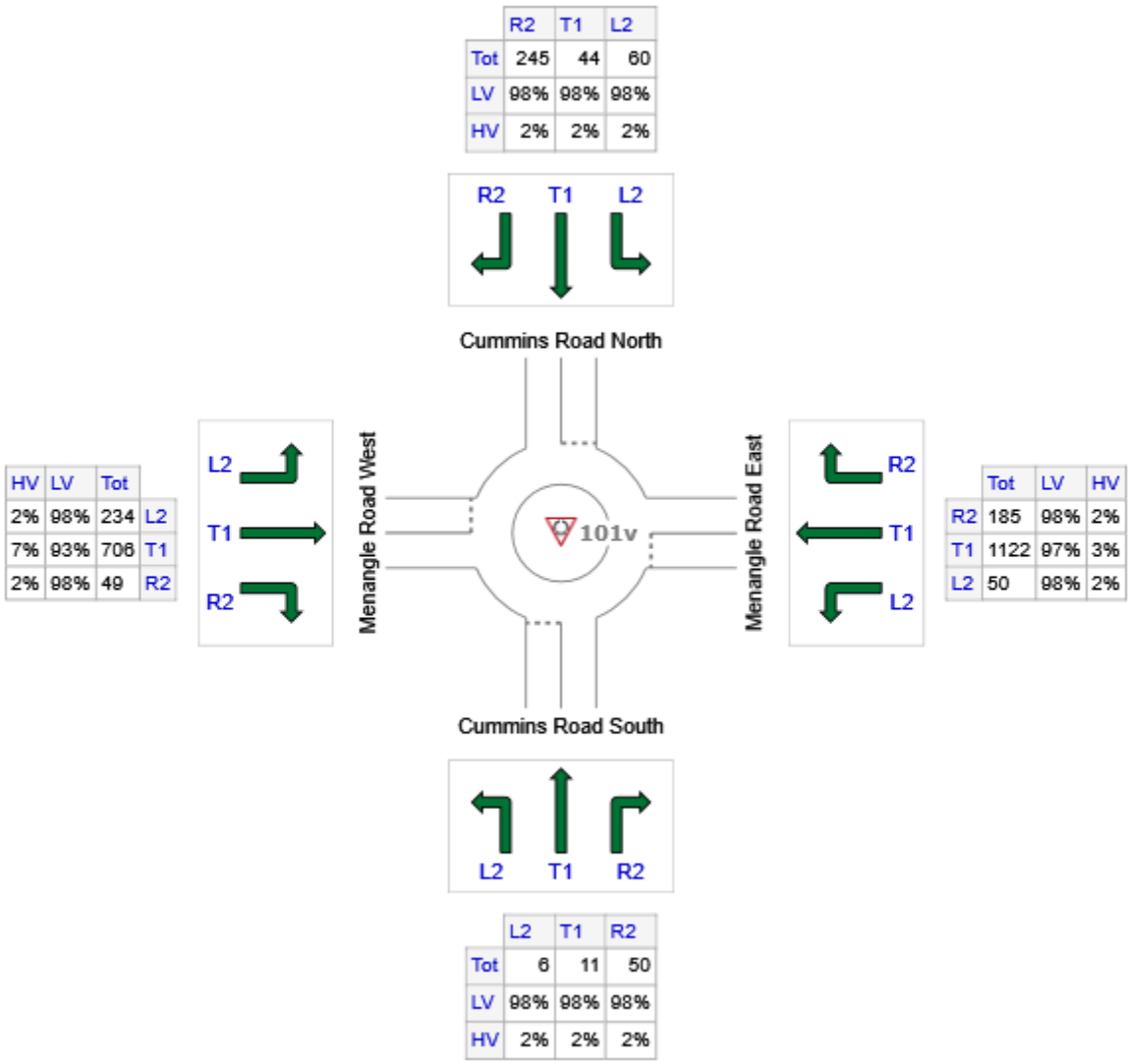
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: 101v [Menangle Rd_Cummins Rd - GTA Roundabout - PM Peak]

New Site
Roundabout

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Cummins Road South	67	66	1
E: Menangle Road East	1357	1319	38
N: Cummins Road North	349	342	7
W: Menangle Road West	989	934	55
Total	2762	2660	102

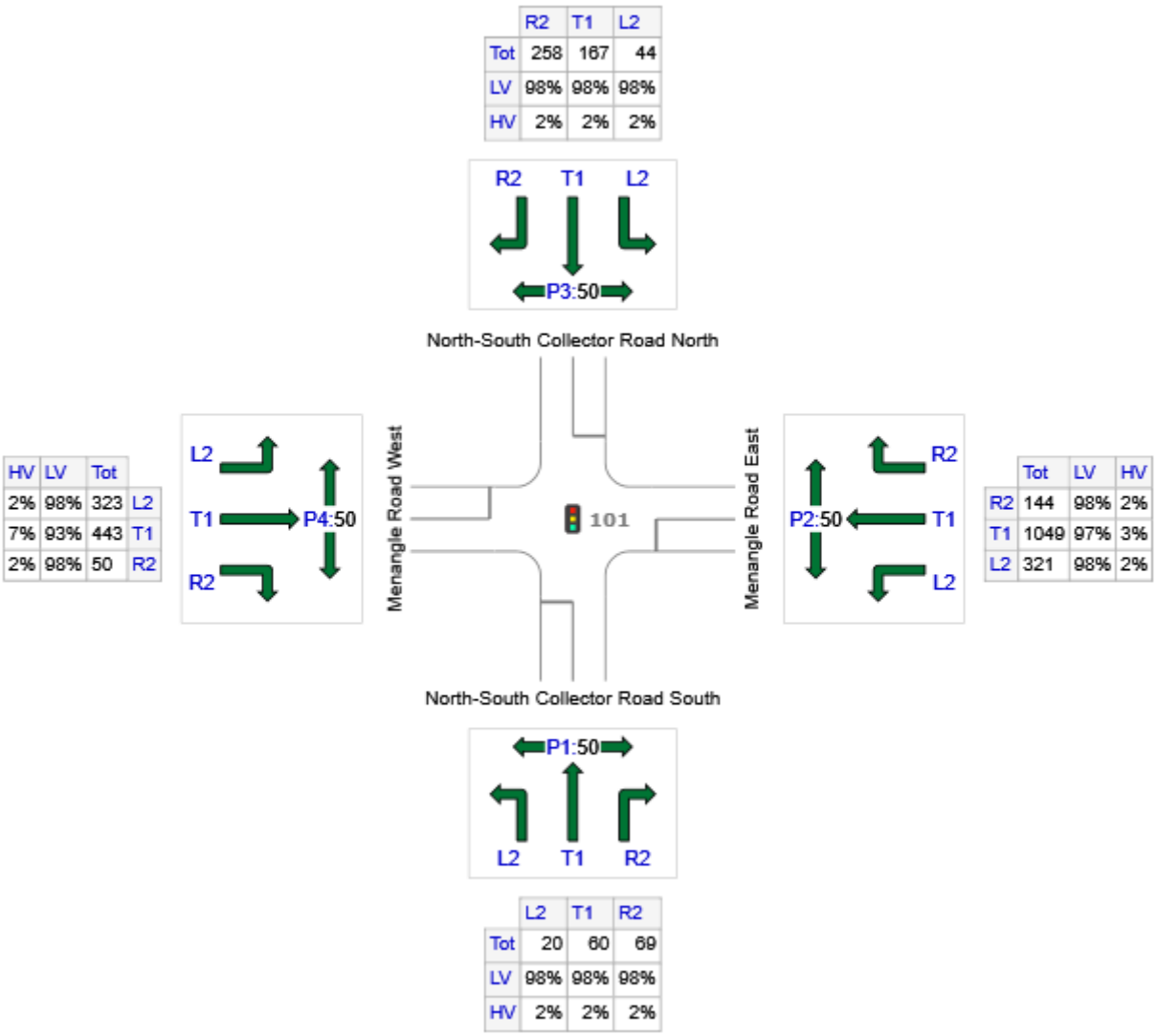
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: 101 [Menangle Rd_N-S Collector Rd - GTA Signals - PM Peak]

New Site
Signals - Fixed Time Isolated

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: North-South Collector Road South	149	146	3
E: Menangle Road East	1514	1473	41
N: North-South Collector Road North	469	460	9
W: Menangle Road West	816	778	38
Total	2948	2856	92

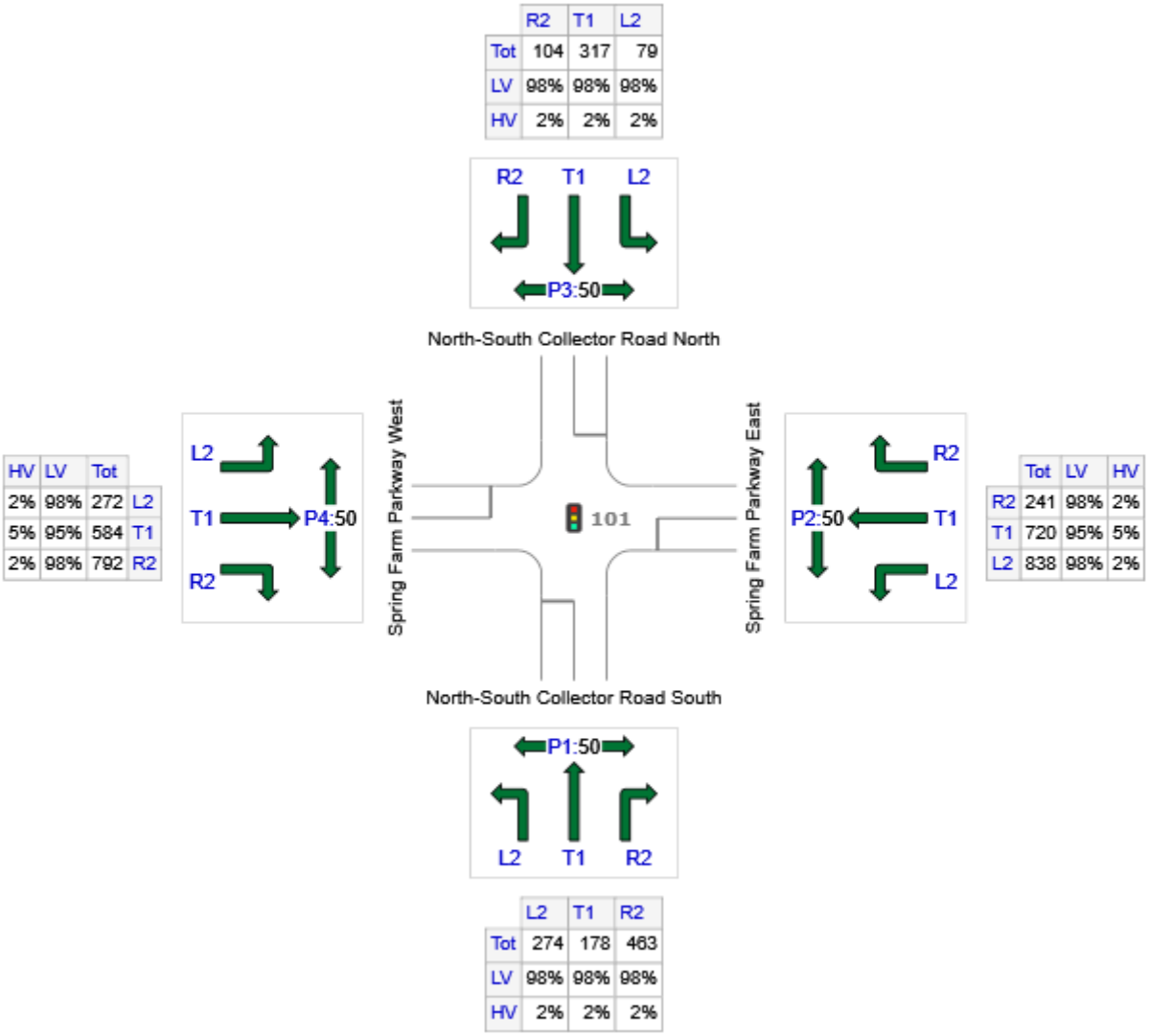
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: 101 [Spring Farm Pkwy_N-S Collector Rd - GTA Signals - PM Peak]

New Site
Signals - Fixed Time Isolated

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: North-South Collector Road South	915	897	18
E: Spring Farm Parkway East	1799	1741	58
N: North-South Collector Road North	500	490	10
W: Spring Farm Parkway West	1648	1598	50
Total	4862	4726	136

Organisation: GTA CONSULTANTS | Created: Thursday, 6 December 2018 10:03:21 AM
Project: \\gta.com.au\projectfiles\ProjectFilesSyd\N12400-12499\N124910 - Menangle Park Development\Modelling\Masterplan SIDRA\Final Planning Proposal\SIDRA Models Traffic Report\180502sid-N124910 Menangle Park Planning Proposal PM.sip7

Appendix C

Sidra Intersection Results

MOVEMENT SUMMARY

Site: 101v [Menangle Rd_Cummins Rd - GTA Roundabout - AM Peak]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Cummins Road South											
1	L2	49	2.0	0.181	4.2	LOS A	0.8	5.7	0.63	0.66	53.7
2	T1	44	2.0	0.181	3.3	LOS A	0.8	5.7	0.63	0.66	48.6
3	R2	53	2.0	0.181	10.1	LOS A	0.8	5.7	0.63	0.66	55.8
Approach		146	2.0	0.181	6.1	LOS A	0.8	5.7	0.63	0.66	52.7
East: Menangle Road East											
4	L2	53	2.0	0.337	5.8	LOS A	2.4	18.1	0.48	0.49	56.0
5	T1	737	7.0	0.337	6.2	LOS A	2.4	18.1	0.49	0.51	67.3
6	R2	54	2.0	0.337	13.9	LOS A	2.4	17.4	0.50	0.54	60.0
Approach		843	6.4	0.337	6.6	LOS A	2.4	18.1	0.49	0.51	66.0
North: Cummins Road North											
7	L2	231	2.0	0.293	5.4	LOS A	1.7	11.8	0.81	0.81	54.7
8	T1	12	2.0	0.376	7.2	LOS A	2.0	14.5	0.82	0.96	44.9
9	R2	188	2.0	0.376	14.0	LOS A	2.0	14.5	0.82	0.96	50.8
Approach		431	2.0	0.376	9.2	LOS A	2.0	14.5	0.81	0.88	52.5
West: Menangle Road West											
10	L2	196	2.0	0.567	5.9	LOS A	5.0	36.1	0.49	0.49	56.1
11	T1	1374	3.0	0.567	6.1	LOS A	5.0	36.1	0.50	0.50	68.7
12	R2	6	2.0	0.567	13.9	LOS A	4.9	35.4	0.52	0.50	60.4
Approach		1576	2.9	0.567	6.1	LOS A	5.0	36.1	0.50	0.50	66.8
All Vehicles		2996	3.7	0.567	6.7	LOS A	5.0	36.1	0.55	0.56	63.3

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

MOVEMENT SUMMARY

Site: 101 [Menangle Rd_N-S Collector Rd - GTA Signals - AM Peak]

New Site
Signals - Fixed Time Isolated Cycle Time = 90 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: North-South Collector Road South											
1	L2	53	2.0	0.869	54.8	LOS D	14.5	103.1	1.00	1.05	32.4
2	T1	243	2.0	0.869	49.2	LOS D	14.5	103.1	1.00	1.05	32.9
3	R2	249	2.0	0.599	36.2	LOS C	9.5	67.3	0.94	0.86	37.0
Approach		545	2.0	0.869	43.8	LOS D	14.5	103.1	0.97	0.96	34.6
East: Menangle Road East											
4	L2	94	2.0	0.449	31.0	LOS C	9.1	65.5	0.82	0.76	45.0
5	T1	496	3.0	0.449	24.4	LOS B	10.1	72.6	0.82	0.73	51.5
6	R2	47	2.0	0.507	53.7	LOS D	2.2	15.7	0.99	0.77	33.6
Approach		637	2.8	0.507	27.6	LOS B	10.1	72.6	0.83	0.74	48.5
North: North-South Collector Road North											
7	L2	116	2.0	0.459	42.3	LOS C	6.1	43.7	0.94	0.79	35.3
8	T1	36	2.0	0.459	36.7	LOS C	6.1	43.7	0.94	0.79	35.9
9	R2	296	2.0	0.906	59.8	LOS E	14.2	101.2	1.00	1.16	30.0
Approach		447	2.0	0.906	53.4	LOS D	14.2	101.2	0.98	1.04	31.6
West: Menangle Road West											
10	L2	207	2.0	0.908	44.3	LOS D	43.1	316.3	0.99	1.07	38.9
11	T1	1397	7.0	0.908	37.5	LOS C	43.1	316.3	0.96	1.04	43.5
12	R2	53	2.0	0.140	22.6	LOS B	1.3	9.2	0.74	0.72	47.1
Approach		1657	6.2	0.908	37.9	LOS C	43.1	316.3	0.96	1.03	43.0
All Vehicles		3286	4.3	0.908	39.0	LOS C	43.1	316.3	0.94	0.96	40.3

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	25.7	LOS C	0.1	0.1	0.76	0.76
P2	East Full Crossing	53	39.3	LOS D	0.1	0.1	0.94	0.94
P3	North Full Crossing	53	28.1	LOS C	0.1	0.1	0.79	0.79
P4	West Full Crossing	53	39.3	LOS D	0.1	0.1	0.94	0.94
All Pedestrians		211	33.1	LOS D			0.85	0.85

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

MOVEMENT SUMMARY

Site: 101 [Spring Farm Pkwy_N-S Collector Rd - GTA Signals - AM Peak]

New Site
Signals - Fixed Time Isolated Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: North-South Collector Road South											
1	L2	878	2.0	0.934	48.7	LOS D	45.2	321.8	0.97	1.09	33.2
2	T1	232	2.0	0.436	33.8	LOS C	9.8	69.9	0.87	0.73	38.7
3	R2	907	2.0	0.897	48.2	LOS D	19.5	139.2	1.00	1.07	33.4
Approach		2017	2.0	0.934	46.8	LOS D	45.2	321.8	0.97	1.04	33.8
East: Spring Farm Parkway East											
4	L2	344	2.0	0.285	9.6	LOS A	5.1	36.1	0.38	0.67	51.2
5	T1	674	5.0	0.892	56.5	LOS E	19.9	145.3	1.00	1.06	31.2
6	R2	79	2.0	0.414	60.8	LOS E	2.3	16.4	1.00	0.73	29.7
Approach		1097	3.8	0.892	42.1	LOS C	19.9	145.3	0.81	0.91	35.4
North: North-South Collector Road North											
7	L2	244	2.0	0.344	25.3	LOS B	8.0	56.6	0.74	0.77	42.0
8	T1	175	2.0	0.866	59.3	LOS E	10.1	71.8	1.00	0.99	30.6
9	R2	271	2.0	0.913	68.1	LOS E	16.6	118.3	1.00	1.04	28.3
Approach		689	2.0	0.913	50.7	LOS D	16.6	118.3	0.91	0.93	32.7
West: Spring Farm Parkway West											
10	L2	84	2.0	0.062	7.5	LOS A	0.8	5.4	0.25	0.61	52.7
11	T1	928	5.0	0.923	58.2	LOS E	30.2	220.2	1.00	1.13	30.8
12	R2	349	2.0	0.716	55.8	LOS D	9.1	65.0	1.00	0.86	31.1
Approach		1362	4.0	0.923	54.4	LOS D	30.2	220.2	0.95	1.03	31.7
All Vehicles		5165	2.9	0.934	48.3	LOS D	45.2	321.8	0.92	0.99	33.4

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	46.8	LOS E	0.1	0.1	0.94	0.94
P2	East Full Crossing	53	46.8	LOS E	0.1	0.1	0.94	0.94
P3	North Full Crossing	53	46.8	LOS E	0.1	0.1	0.94	0.94
P4	West Full Crossing	53	46.8	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		211	46.8	LOS E			0.94	0.94

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

MOVEMENT SUMMARY

Site: 101v [Menangle Rd_Cummins Rd - GTA Roundabout - PM Peak]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Cummins Road South											
1	L2	6	2.0	0.134	6.0	LOS A	0.7	4.7	0.79	0.87	51.1
2	T1	12	2.0	0.134	5.1	LOS A	0.7	4.7	0.79	0.87	46.5
3	R2	53	2.0	0.134	11.9	LOS A	0.7	4.7	0.79	0.87	52.9
Approach		71	2.0	0.134	10.3	LOS A	0.7	4.7	0.79	0.87	51.6
East: Menangle Road East											
4	L2	53	2.0	0.629	7.8	LOS A	6.4	45.8	0.76	0.66	54.4
5	T1	1181	3.0	0.629	8.3	LOS A	6.4	45.8	0.77	0.71	65.6
6	R2	195	2.0	0.629	16.6	LOS B	6.3	45.2	0.78	0.78	57.3
Approach		1428	2.8	0.629	9.4	LOS A	6.4	45.8	0.77	0.72	63.9
North: Cummins Road North											
7	L2	63	2.0	0.100	5.3	LOS A	0.5	3.3	0.67	0.69	55.0
8	T1	46	2.0	0.311	3.2	LOS A	1.8	12.7	0.71	0.77	46.8
9	R2	258	2.0	0.311	10.0	LOS A	1.8	12.7	0.71	0.77	53.3
Approach		367	2.0	0.311	8.3	LOS A	1.8	12.7	0.70	0.75	52.6
West: Menangle Road West											
10	L2	246	2.0	0.429	6.2	LOS A	3.2	23.6	0.55	0.55	55.8
11	T1	743	7.0	0.429	6.6	LOS A	3.2	23.6	0.57	0.56	66.8
12	R2	52	2.0	0.429	14.4	LOS A	3.1	22.9	0.58	0.57	59.6
Approach		1041	5.6	0.429	6.9	LOS A	3.2	23.6	0.56	0.56	63.5
All Vehicles		2907	3.7	0.629	8.4	LOS A	6.4	45.8	0.69	0.67	61.7

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

MOVEMENT SUMMARY

Site: 101 [Menangle Rd_N-S Collector Rd - GTA Signals - PM Peak]

New Site
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: North-South Collector Road South											
1	L2	21	2.0	0.337	40.7	LOS C	3.1	22.1	0.95	0.74	36.9
2	T1	63	2.0	0.337	35.1	LOS C	3.1	22.1	0.95	0.74	37.6
3	R2	73	2.0	0.264	36.4	LOS C	2.6	18.2	0.92	0.73	36.9
Approach		157	2.0	0.337	36.5	LOS C	3.1	22.1	0.93	0.73	37.2
East: Menangle Road East											
4	L2	338	2.0	0.788	24.2	LOS B	25.4	182.0	0.84	0.83	48.6
5	T1	1104	3.0	0.788	17.1	LOS B	25.4	182.0	0.79	0.76	57.2
6	R2	152	2.0	0.404	29.8	LOS C	4.9	34.6	0.88	0.80	43.1
Approach		1594	2.7	0.788	19.8	LOS B	25.4	182.0	0.81	0.78	53.5
North: North-South Collector Road North											
7	L2	46	2.0	0.811	47.0	LOS D	9.5	67.6	1.00	0.96	34.8
8	T1	176	2.0	0.811	41.4	LOS C	9.5	67.6	1.00	0.96	35.4
9	R2	272	2.0	0.765	39.4	LOS C	10.1	71.9	1.00	0.97	36.0
Approach		494	2.0	0.811	40.8	LOS C	10.1	71.9	1.00	0.96	35.6
West: Menangle Road West											
10	L2	340	2.0	0.622	30.1	LOS C	12.9	92.4	0.87	0.82	43.5
11	T1	466	7.0	0.622	23.5	LOS B	13.4	99.1	0.89	0.78	52.3
12	R2	53	2.0	0.541	51.9	LOS D	2.2	15.9	1.00	0.74	34.2
Approach		859	4.7	0.622	27.9	LOS B	13.4	99.1	0.89	0.79	47.0
All Vehicles		3103	3.1	0.811	26.2	LOS B	25.4	182.0	0.87	0.81	46.9

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	23.3	LOS C	0.1	0.1	0.76	0.76
P2	East Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
P3	North Full Crossing	53	25.7	LOS C	0.1	0.1	0.80	0.80
P4	West Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
All Pedestrians		211	29.4	LOS C			0.86	0.86

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

MOVEMENT SUMMARY

Site: 101 [Spring Farm Pkwy_N-S Collector Rd - GTA Signals - PM Peak]

New Site
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: North-South Collector Road South											
1	L2	288	2.0	0.253	12.1	LOS A	5.2	37.3	0.47	0.69	49.5
2	T1	187	2.0	0.811	52.3	LOS D	9.9	70.3	1.00	0.94	32.5
3	R2	487	2.0	0.837	58.6	LOS E	12.1	86.1	1.00	1.09	30.5
Approach		963	2.0	0.837	43.4	LOS D	12.1	86.1	0.84	0.94	34.9
East: Spring Farm Parkway East											
4	L2	882	2.0	0.860	27.0	LOS B	36.4	259.3	0.92	0.92	41.2
5	T1	758	5.0	0.955	68.7	LOS E	24.7	180.0	1.00	1.20	28.3
6	R2	254	2.0	0.584	51.1	LOS D	6.6	47.3	0.98	0.79	32.2
Approach		1894	3.2	0.955	46.9	LOS D	36.4	259.3	0.96	1.02	33.8
North: North-South Collector Road North											
7	L2	83	2.0	0.843	52.7	LOS D	10.0	70.9	1.00	0.99	33.0
8	T1	334	2.0	0.843	51.1	LOS D	11.3	80.8	1.00	0.98	32.5
9	R2	109	2.0	0.460	50.6	LOS D	5.1	36.5	0.97	0.78	32.7
Approach		526	2.0	0.843	51.2	LOS D	11.3	80.8	0.99	0.94	32.6
West: Spring Farm Parkway West											
10	L2	286	2.0	0.219	9.1	LOS A	3.8	27.3	0.35	0.65	51.5
11	T1	615	5.0	0.428	24.7	LOS B	11.1	81.0	0.79	0.68	42.8
12	R2	834	2.0	0.949	51.8	LOS D	18.4	130.7	1.00	1.07	32.2
Approach		1735	3.1	0.949	35.2	LOS C	18.4	130.7	0.82	0.86	37.9
All Vehicles		5118	2.8	0.955	42.7	LOS D	36.4	259.3	0.89	0.94	35.2

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P2	East Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P3	North Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P4	West Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		211	44.3	LOS E			0.94	0.94

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

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