Traffic Impact Assessment Stage 5-9

1881 Tullimbar

82018151

Prepared for

Dahua Group

17 September 2019

Cardno

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1 Introduction

1.1 Overview

Cardno (NSW/ACT) Pty Ltd (Cardno) has been commissioned by Dahua Group to carry out a Traffic Impact Assessment (TIA) study for the proposed development (Stages 5-9) of residential subdivision in Tullimbar, NSW 2527. The overall proposed development is expected to comprise approximately 498 residential lots with construction perspective of detached houses.

Cardno has previously undertaken a traffic impact assessment for the 2021 design year for Stages 1-4 of the 1881 Tullimbar development, which has been documented on the *"1881 Tullimbar – Traffic Impact Assessment (version 10)"* report, dated 17th May 2019.

1.2 Scope of Works

Cardno will undertake the following scope of works as part of this TIA:

- Review background data to extract relevant information with regards to traffic generation rates and background traffic volumes from previous studies undertaken in the study area.
- Identify traffic generating potential, distribution and assignment of the proposed development.
- Review and use the data of the traffic surveys, carried out at the following key intersections:
  - Illawarra Highway / Escarpment Drive / Yellow Rock Road
  - Illawarra Highway / Broughton Avenue / Tongarra Road
  - Illawarra Highway / Church Street
- Update 2026 APRB Interim Stage 1 Aimsun model to obtain turning count volumes of key intersections.
- Undertake SIDRA modelling analysis for a typical AM and PM peak period. Assess intersection performance and identify mitigation measures (if required).
- Assess public transport availability near site bus and rail access.
- Assess pedestrian and cyclist facilities in the vicinity of the site.

1.3 Reference Documents

The following documents have been reviewed prior the preparation of this report:

- *"1881 Tullimbar – Traffic Impact Assessment "* report prepared by Cardno (2019);
- *"Tullimbar Village Technical Memorandum"* prepared by GTA consultants (2015).
- *"Guide to Traffic Generating Developments Updated Traffic Surveys TDT 2013 / 04a"* Roads and Maritime (2013).

1.4 Report Structure

The structure of this report is as follows:

Section 1 - Introduction;

Section 2 - Existing Conditions;

Section 3 - Proposed Development;

Section 4 - Traffic Assessment;

Section 5 - Transport & Accessibility; and

Section 6 - Conclusion and Recommendations.

2 Existing Conditions

2.1 Study Area

1881 Tullimbar is a large tract of rural land located within the foothills of the Illawarra escapement. The development site is wholly within the Shellharbour City Council Local Government Area, situated within the suburb of Tullimbar, NSW. 1881 Tullimbar is bordered by the Illawarra Highway to the north and private properties undergoing varying stages of development to the south, east and west.

The site offers the future residents the convenience of access to major transportation, such as the Princess Highway, a direct rail link to Sydney and the Illawarra Regional Airport, while providing escapism into a picturesque rural community that is surrounded by natural watercourses and bushland.

The development site is an irregular shaped parcel of land of, located on the southern side of the Illawarra Highway, approximately 5 km west of the Princes Highway and 2.5 km west of Albion Park town centre along Tongarra Road. It is approximately 25 km south of Wollongong and 105 km south of Sydney**. Figure 2-1** shows the location of the proposed development site with respect to Albion Park, Dapto, Oak Flats, nearby railway stations and existing road network.

The land is bordered along its eastern boundary by the Hazelton Creek riparian corridor. Immediately to the west is a developing residential neighbourhood off Yellow Rock Road and further west are rural lands. Immediately to the north is Tullimbar Primary School and further to the north is the Tullimbar Village development fronting the Illawarra Highway (Tongarra Road).

Yellow Rock Road, which provides secondary access to the site, is situated along the northern side, and Cooby Road is to the west of the site. Pockets of existing vegetation associated with the riparian corridor provide desirable views at the local scale through the centre of the site. Albion Park is located further to the east approximately 5.5km away, with Shellharbour City Centre at a distance of approximately 12.6km.

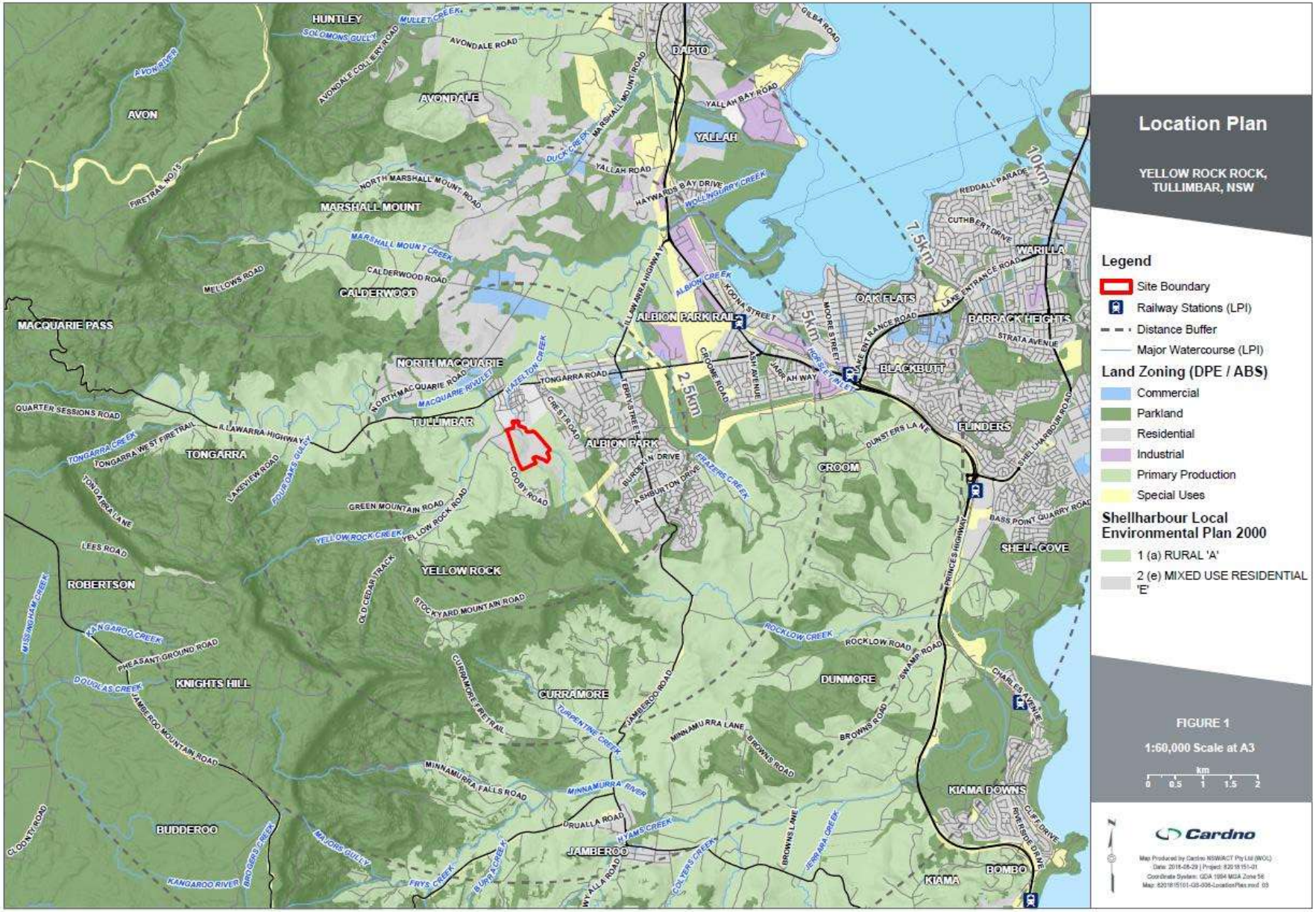


Figure 2-1 1881 Tullimbar Development Control Plan and Site Boundary

2.2 Existing and Future Access Arrangements

At present, the proposed development (Stage 1-4 and Stage 5-9) site (DA073/2018) can be accessed via a proposed bridge along Broughton Avenue (to the west of the Tullimbar Primary School) and Yellow Rock Road to the west of the site. Via the existing road network, these two points of access to 1881 Tullimbar development, provide three access points to the Illawarra Highway/Tongara Road, as shown in **Figure 2-2.**

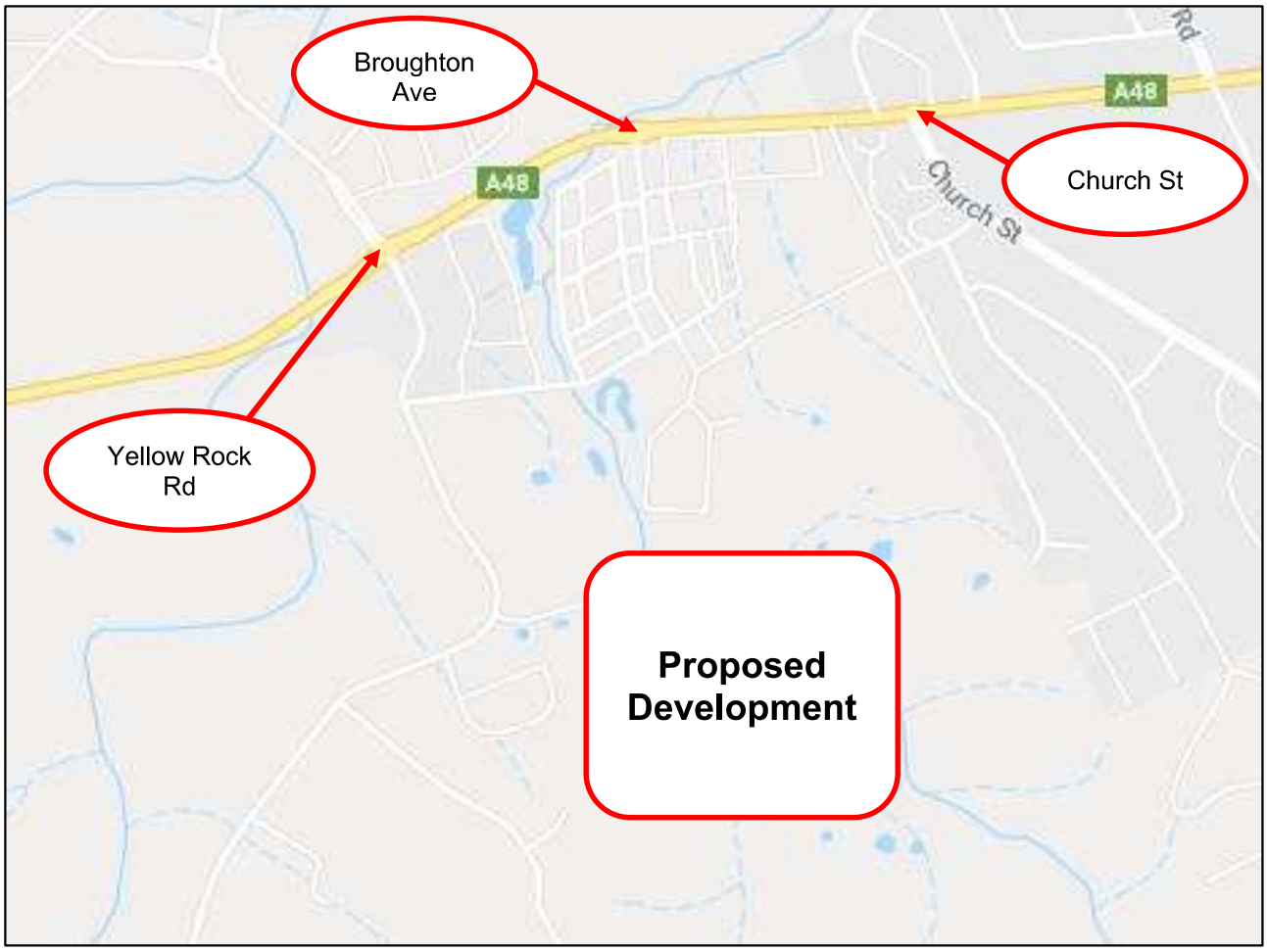


Figure 2-2 Tullimbar Village Existing Accesses

It is understood that, by 2026, a bridge will be constructed connecting the proposed Stage 3 of the Dahua Development, to the Ravenwood development to the east. This bridge connection is expected provide an alternate traffic route for proposed development to Tongarra Road / Church Street intersection resulting in reduced traffic demand at Illawarra Highway / Broughton Avenue and Illawarra Highway / Yellow Rock Road intersections.

It is also understood that the additional road infrastructure that will be introduced by 2026, which will impact on access to the site, primarily Albion Park Rail Bypass (APRB) and Tripoli Way (Albion Park bypass). The Tripoli Way link is proposed to connect the APRB with Calderwood Road and Broughton Avenue to the west. Tripoli Way will provide opportunity for new residents to access APRB, as illustrated in **Figure 2-3**, allowing for improved connections to important employment centres such as Wollongong, Campbelltown and Sydney.

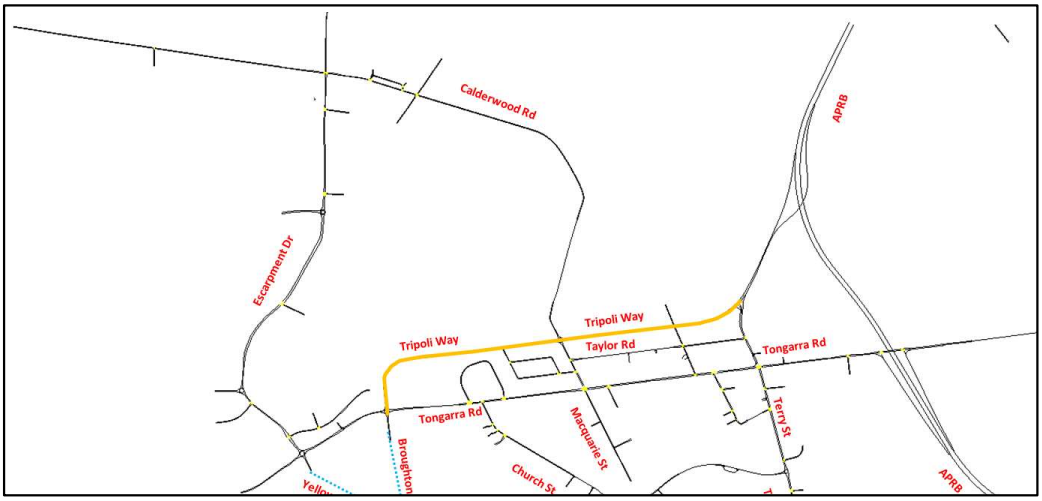


Figure 2-3 Tripoli Way Connection with Broughton Avenue

2.3 Road Hierarchy

2.3.1 Illawarra Highway

Illawarra Highway is located north-west of the proposed development site and is an arterial road at the southern edge of Albion Park Town Centre. Illawarra Highway is an undivided carriageway with one lane per direction for most of its length, except for short sections with additional auxiliary lanes to the eastern extend across Tongarra Road and Albion Park Town Centre. Its speed limit is posted at 60 km/hr with 40 km/hr school limits in the vicinity of the east side of Tongarra Road. The posted speed at its western extend is 100 km/hr. This arterial road serves as a main east-west access to Shellharbour and the greater area.

2.3.2 Broughton Avenue

Broughton Avenue is located south of Illawarra Highway / Tongarra Road and north of the proposed development site. It is an undivided collector carriageway with a single lane per direction and a posted speed of 50 km/hr. The road mainly serves as a connection to Illawarra Highway, entrance to the existing Tullimbar Village.

2.3.3 Yellow Rock Road

Yellow Rock Road is located south of Illawarra Highway and west of the proposed development site. It is an undivided carriageway with a single lane per direction and its posted speed is 50 km/hr. The road mainly serves as a connection to Illawarra Highway, a secondary entrance to the existing Tullimbar Village and is considered a secondary access point to the proposed residential development.

2.3.4 Church Street

Church Street is located south of Tongarra Road and east of the proposed development site. It is an undivided collector carriageway with a single lane per direction and its posted speed is 60 km/hr. It runs in east and north-west direction connecting with Terry Street and Tongarra Road at both ends. As stated in **Section 2.2**, major portion of the proposed development traffic will use Church Street to access Tongarra Road.

2.4 Existing Public Transport

The Premier Illawarra Bus Service (Route 75) currently operates between Shellharbour City Centre and Albion Park via Tullimbar and Calderwood as a loop service. The weekday and weekend route frequency is described in **Table 2-1** with no bus services provided on the weekends or public holidays.

Table 2-1 Bus Route 75 Frequency

Day	AM Peak (0500-0900)	Inter-Peak	PM Peak (1530-2030)
Weekdays	4	6	5
Weekends & Public Holidays	NA	NA	NA

Currently the bus service connects the surrounding suburbs of Albion Park, Calderwood and Tullimbar to the Shellharbour City Centre and Oak Flats railway station. In the future, the expansion of Tullimbar, Calderwood and other development sites may justify more frequent and direct services to better connect residents to key centres in the Illawarra region. **Figure 2-4** shows the complete route map and location of the bus stops in the vicinity of the proposed development site.

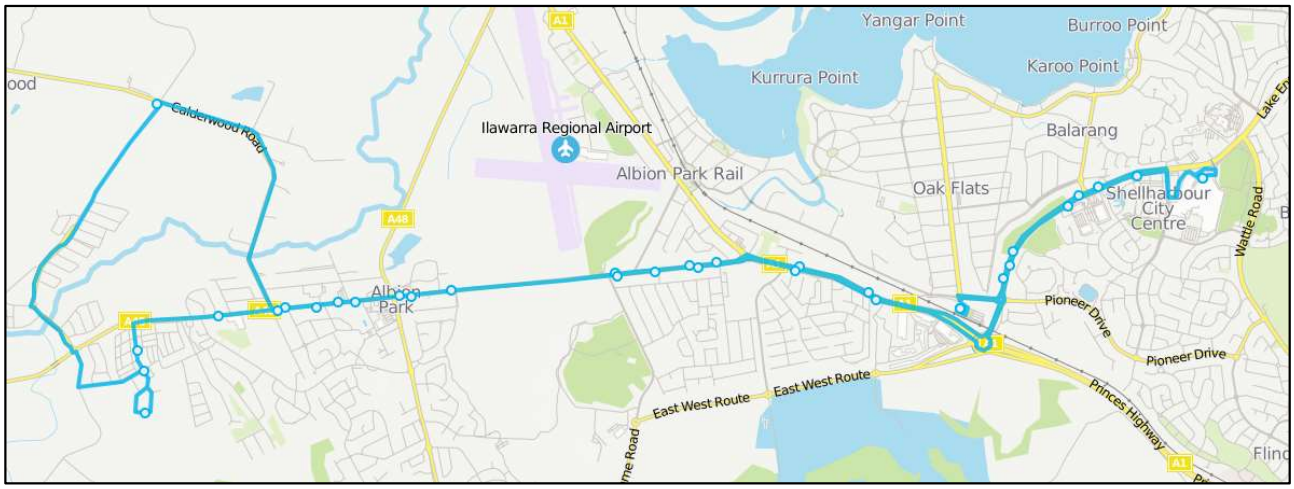


Figure 2-4 Bus Service 75 Stops

Source: https://moovitapp.com/sydney-442/lines/75/695314/3308012/en?customerId=4908&ref=4

2.5 Existing Approvals

The Tullimbar Master Plan proposed to facilitate 1,500 lots across this area of Tullimbar. DA 0073/2018 and DA 0249/2018 are currently under assessment by Council propose 290 and 37 lots respectively, with a combined 316 lots and 10 lots for Stage X1 future DAs. Once added to the dwellings already constructed and under construction, the Tullimbar yield increases to 498 lots, which is well below the 1,500 identified within the Tullimbar Master Plan. A Planning Proposal lodged on behalf of Cardno in June 2018 would allow 271 residential lots.

3 Proposed Development

3.1 1881 Tullimbar Development Details

The overall revised1881 Tullimbar development, comprising circa 498 lots, has been divided into nine release stages. A preliminary breakdown of the number of lots per release stage is summarised below.

- Release Stage X1: Construction of 39 lots
- Release Stage 1: Construction of 131 lots
- Release Stage 2: Construction of 77 lots
- Release Stage 3: Construction of 27 lots
- Release Stage 4: Construction of 60 lots
- Release Stage 5: Construction of 19 lots
- Release Stage 6 and Stage 7: Construction of 13 + 44 = 57 lots
- Release Stage 8: Construction of 64 lots
- Release Stage 9: Construction of 24 lots.

Figure 3-1 shows the indicative plan of 1881 Tullimbar development Stage 1 – 9. Detailed development layout and staging masterplan can be found in **Appendix A**.

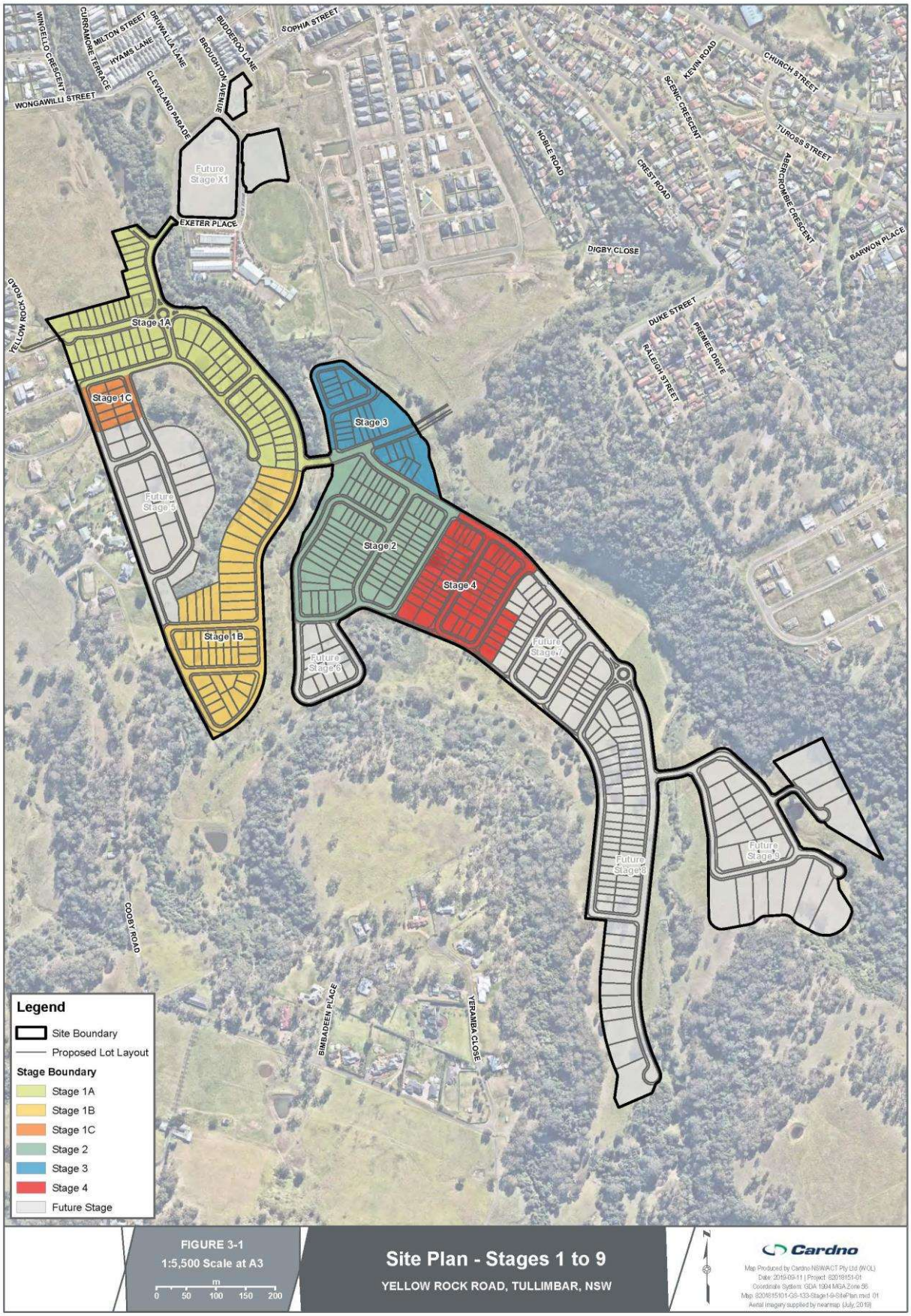


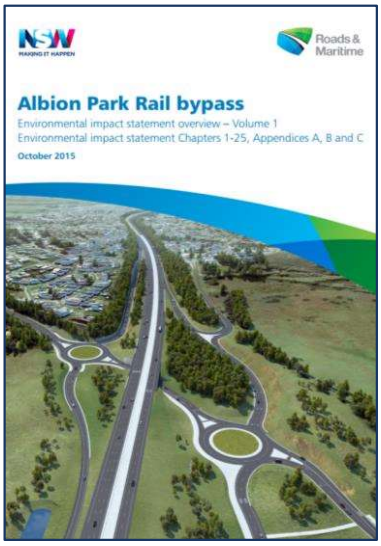
Figure 3-1 1881 Tullimbar Lot Layout, Staging and Site Plan

4 Traffic Assessment

4.1 APRB Background Information

The Princes Highway is the main north–south transport corridor linking Sydney and Wollongong to the NSW south coast and north-eastern Victoria. The highway is an important commuter, freight, bus and tourist route for the south coast. The section of the highway between Yallah and Oak Flats is also used as a local route for areas such as Albion Park, Albion Park Rail, Oak Flats, Yallah and Dapto.

Roads and Maritime is planning for an extension of the M1 Princes Motorway between Yallah and Oak Flats to bypass Albion Park Rail, also known as the Albion Park Rail bypass. The bypass would complete the 'missing link' for a high standard road between Sydney and Bomaderry. It would provide easy access to Dapto, Albion Park and Oak Flats. The bypass would reduce travel times for through and local traffic, improve the reliability of journeys through greater flood immunity and provide more consistent driving conditions. It would also divert a substantial proportion of through traffic onto the new motorway, reducing traffic volumes on the A1 Princes Highway through Albion Park Rail. This would improve local amenity and access, and reduce other traffic related impacts such as noise for nearby residents. The full construction of the bypass is assumed to be completed by 2021.



The previous report, Environmental Impact Statement Technical Paper 1 – Traffic and Transport, October 2015 (Hyder Cardno Joint Venture, 2015) details potential traffic and transport impacts of the project. The EIS (including the Traffic and Transport technical paper) was placed on public exhibition for community and stakeholder comment between October and November 2015. The EIS details the key construction and operational impacts including issues associated with traffic and transport, biodiversity, socio-economic, flooding and noise.

4.2 APRB Traffic Models

Subsequent to the 2015 Traffic and Transport report and EIS, Roads and Maritime developed APRB TRACKS and AIMSUN models for 2026 and 2041 design year horizons and tested a number of different options for each year.

The traffic modelling used to assess inbound/outbound traffic flows from the Tullimbar site used the 2026 APRB Interim Year Stage 1 AIMSUN model, which have been described as robust and fit-for-purpose and was officially issued by Roads and Maritime for the purpose of assessing traffic impacts of the Tullimbar development. The following model was used for this assessment:

> 2026 APRB Interim Stage 1: Scheme assessment 5 years after opening year without the Northern Interchange in place.

It is important to mention that the above model has already incorporated the trip generation/attraction of the following existing / proposed developments:

> Calderwood development (approximately 2,000 dwellings and employment).

> 1881 Tullimbar development.

> Other developments in the surrounding, expected to be developed by 2026.

Figure 4-1 below is the focused study area emphasizing on the Albion Park Town Centre area, Tripoli Way connection to Broughton Road and the two key accesses in/out of Tullimbar.

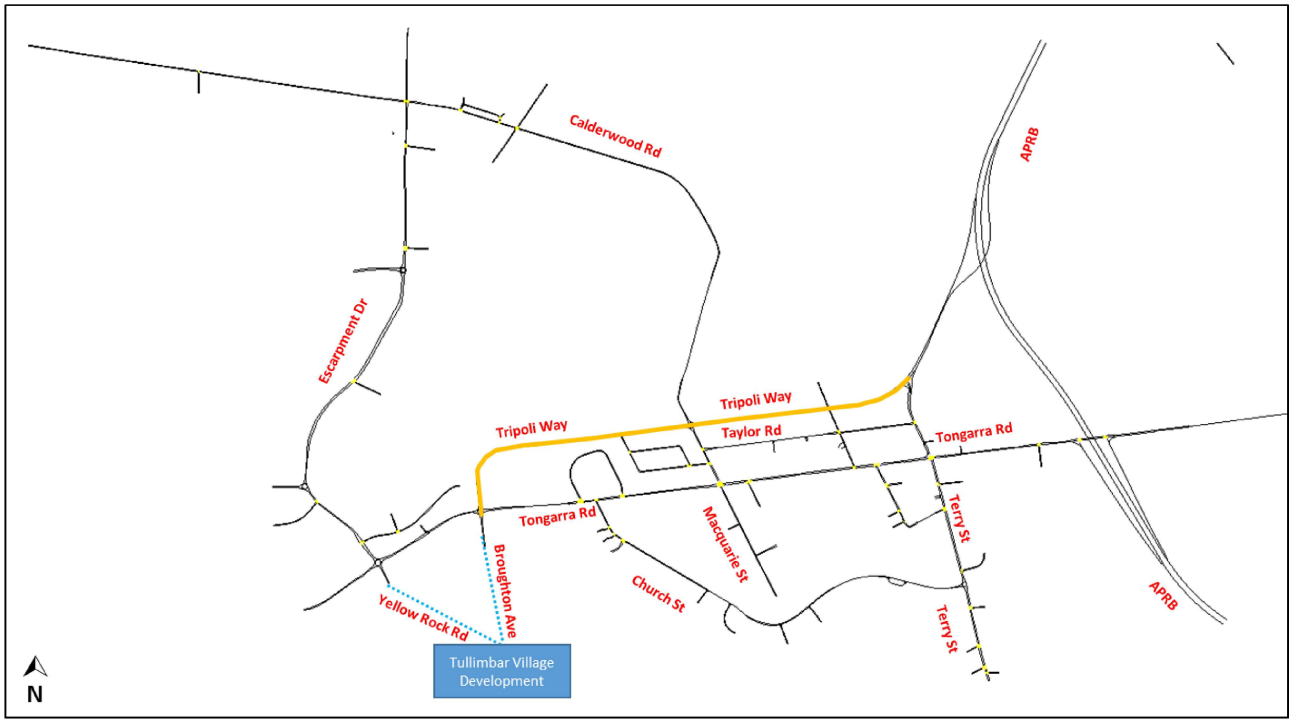


Figure 4-1 2026 Interim Year Stage 1 AIMSUN model layout

4.2.2 Model Update

Previous versions of this TIA (1 to 5) assumed only two (2) access points to/from the complete Tullimbar development in 2026, one at Broughton Avenue and the other at Yellow Rock Road. The current site plan now includes a third access point on Church Street. The APRB TRACKS and AIMSUN models for 2026 were updated to include the development's internal road network plan as shown in **Figure 3-1**.

Given the higher level of detail now available for the development site plan in 2026, the traffic assignment and assessment for the complete development scenario in 2026 is based on the updated AIMSUN model.

4.3 Trip Rate and Generation

4.3.1 Design Horizon Year 2021

Cardno has previously undertaken an assessment for the 2021 design year for Stages 1-4, which has been documented on the *"1881 Tullimbar – Traffic Impact Assessment (version 10)"* report, dated 17th May 2019.

Modelling results of the 2021 assessment focused on the revised yield of 337 lots for stages X1 and 1-4. Since the completion of this assessment, multiple revisions of layout plans for the 1881 Tullimbar development have been prepared with the total number of lots (Stage X1 and 1-4) been reduced to 334. Considering the lower residential yield of overall Tullimbar stage X1 and 1-4, the traffic assessment can be described as a conservative approach.

4.3.2 Design Horizon Year 2026

As described in **Section 4.2.2 "Model Update"**, the APRB TRACKS and AIMSUN models for 2026 were updated to include the latest Tullimbar development site plan and lot yield (498 lots). These models were used to estimate the development's trip generation, distribution and assignment for the 2026 traffic assessment.

4.4 Traffic Assignment Methodology

> The intersection assessment for 2026 scenario is based on AM and PM peak turning counts sourced from the updated Aimsun model.

4.5 Trip Apportionment

The percentage of trips attributable to the complete Tullimbar development (including all known zoned development areas not owned by Dahua) and Stage 5-9 using the key intersections of Yellow Rock Road / Illawarra Highway, Broughton Avenue / Tongarra Road and Church Street / Tongarra Road in 2026 was determined from the updated 2026 AIMSUM model.

Table 4-1, **Table 4-2** and **Table 4-3** summarises the trip apportionment at the key intersections.

Table 4-1 Trip Apportionment at Yellow Rock Road / Illawarra Highway

2026 Peak hour	Tullimbar in/out total (vehicles)	Tullimbar in/out total (Stage 5-9) (vehicles)	Intersection total (vehicles)	Percentage of trips attributable to Tullimbar (S1-9)	Percentage of trips attributable to Tullimbar (S5-9)
AM	60	19	1,672	3.6%	1.1%
PM	57	19	1,725	3.3%	1.1%
			Average	3.4%	1.1%

Table 4-2 Trip Apportionment at Broughton Avenue / Tongarra Road

2026 Peak hour	Tullimbar in/out total (vehicles)	Tullimbar in/out total (Stage 5-9) (vehicles)	Intersection total (vehicles)	Percentage of trips attributable to Tullimbar (S1-9)	Percentage of trips attributable to Tullimbar (S5-9)
AM	79	21	1,656	4.8%	1.3%
PM	88	20	1,741	5.1%	1.1%
			Average	4.9%	1.2%

Table 4-3 Trip Apportionment at Church Street / Tongarra Road

2026 Peak hour	Tullimbar in/out total (vehicles)	Tullimbar in/out total (Stage 5-9) (vehicles)	Intersection total (vehicles)	Percentage of trips attributable to Tullimbar (S1-9)	Percentage of trips attributable to Tullimbar (S5-9)
AM	96	44	1,386	6.9%	3.2%
PM	138	49	1,588	8.7%	3.1%
			Average	7.8%	3.1%

The trip distribution of the complete Tullimbar development area has significantly changed from previous versions of this TIA (1 to 5) due to the third access point at Church Street, and the consideration of traffic calming in Yellow Rock Road connection (via Aurelan Terrace) to discourage trips in this direction. The Church Street access is attractive given it is located to the east where vehicular traffic will be heading to/from major destinations such as Wollongong, Port Kembla and Shellharbour.

4.6 SIDRA Assessment

As part of this study there is a need to assess intersection performance for key intersections at different design horizon years. This is done to identify capacity issues and propose mitigation measures (if any) that would ensure satisfactory performance in all design years. This assessment focuses on one design year and is in line with the proposed staging development as outlined in **Section 3.1** and **Section 4.2.2**:

> Assessing ultimate requirements five year post-opening (2026).

Detailed SIDRA results are provided in **Appendix B**.

4.6.1 Intersections Performance Criteria

In an urban area, the capacity of a road network can be largely determined by the capacity of the controlling intersections. The key indicator of intersection performance level of service (LoS) is delay, where results are place on a continuum from 'A' to 'F' as shown in **Table 4-4**.

Table 4-4 Level of Service Criteria

Level of Service	Average Delay per Vehicle (seconds)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays	At capacity, requires other control mode
F	>70	Unsatisfactory and requires additional capacity	Unsatisfactory and requires additional capacity

**Source: RMS Traffic Modelling Guidelines (2013)*

Roads and Maritime guidelines state that for roundabouts and priority control intersections a Level of Service (LoS) assessment should be reported based on the worst performing movement of the intersection. For traffic signals, the average movement delay and corresponding Level of Service over all movements should be determined and reported.

4.6.2 SIDRA Layouts

The 2026 APRB Interim Stage 1 Aimsun model assumed the following network geometry specifications, which were used as an initial basis for the traffic impact assessment of the 2026 design year. The 2026 traffic assessment also includes the Tongarra Road / Church Street intersection given the Tullimbar development would have access to Church Street in 2026.

Illawarra Highway / Yellow Rock Road

- Roundabout controlled intersection with single lane approaches;
- Speed limit of 60 km/hr across Illawarra Highway/Escarpment Drive and 50 km/hr at Yellow Rock Road.

Tongarra Road / Broughton Avenue / Tripoli Way

- Roundabout with single lane approach on all four arms. This network geometry configuration follows the existing road layout with the only exception of the additional northern arm of Tripoli Way. It is anticipated that Tripoli Way will be in place by the time the Tullimbar Village development has been completed;
- Speed limit of 60 km/hr across Tongarra Road, 50 km/hr at Broughton Avenue and 70 km/hr at Tripoli Way.

Tongarra Road / Church Street

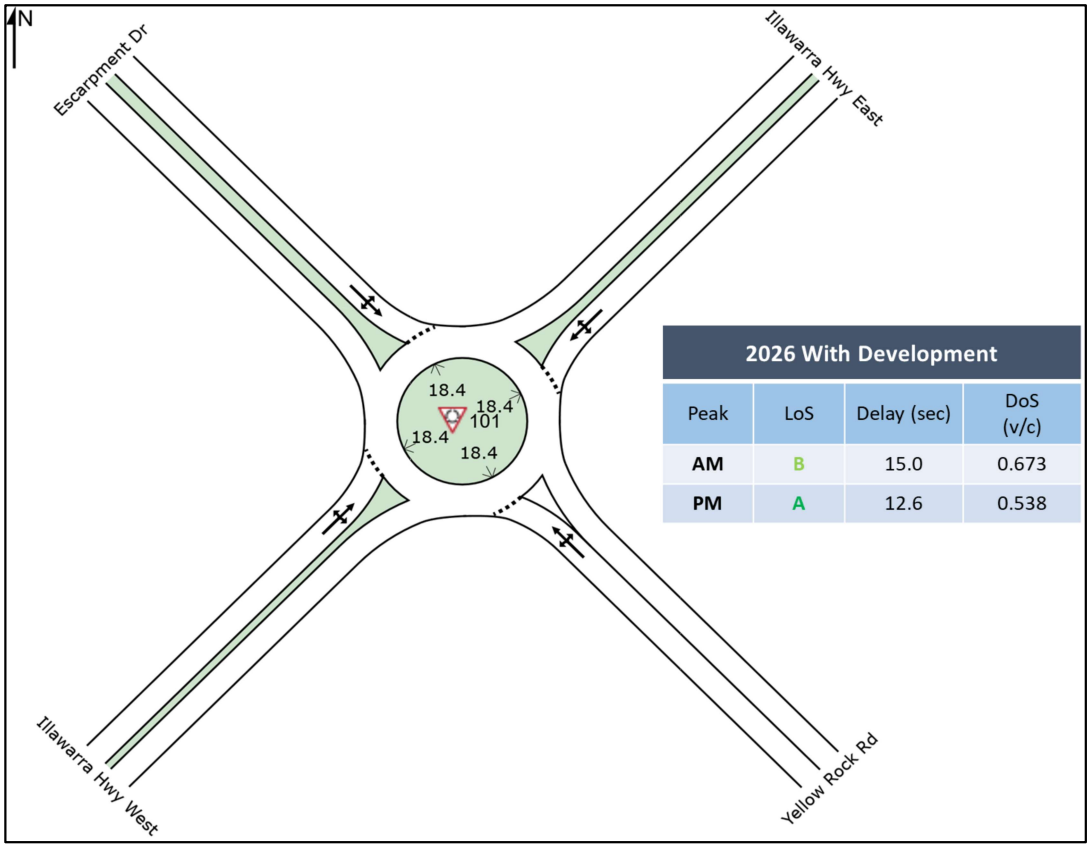
- Signalised intersection with pedestrian crossing on two approaches;
- Speed limit of 60 km/hr across Tongarra Road and 60 km/hr at Church Street.

4.6.3 Future Traffic Flow Estimation (2026)

The traffic demand / flow for 2026 scenario is based on the updated Aimsun model outputs.

4.6.4 Intersection Performance Analysis (2026)

Figure 4-2, **Figure 4-3** and **Figure 4-4** illustrate the geometry based on the network geometry of 2026 APRB Interim Stage 1 model and the performance results of the key intersections in 2026 scenario.



2026 With Development			
Peak	LoS	Delay (sec)	DoS (v/c)
AM	B	15.0	0.673
PM	A	12.6	0.538

Figure 4-2 Illawarra Highway / Yellow Rock Road Intersection Performance Results (2026)

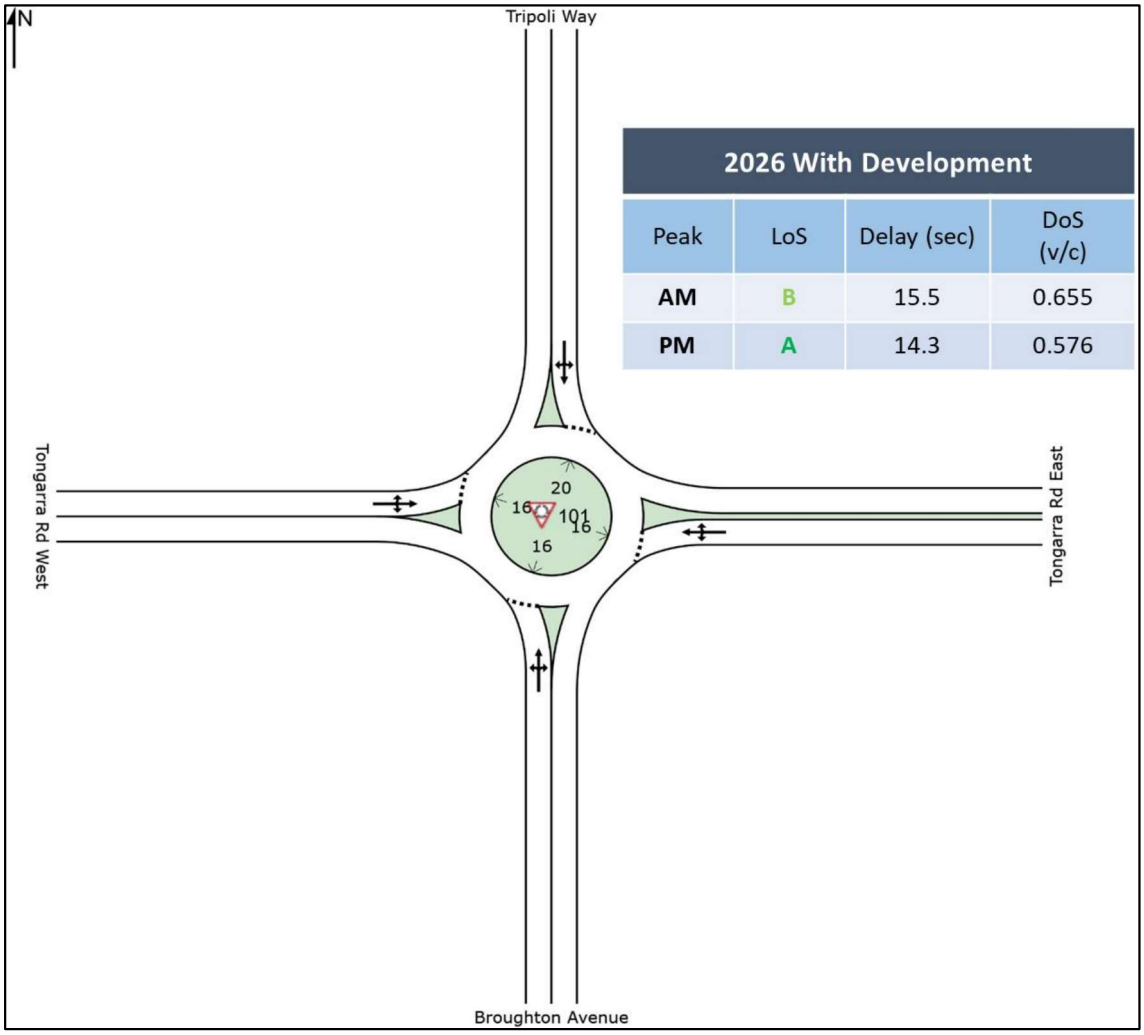


Figure 4-3 Tongarra Road / Broughton Avenue / Tripoli Way Intersection Performance Results (2026)

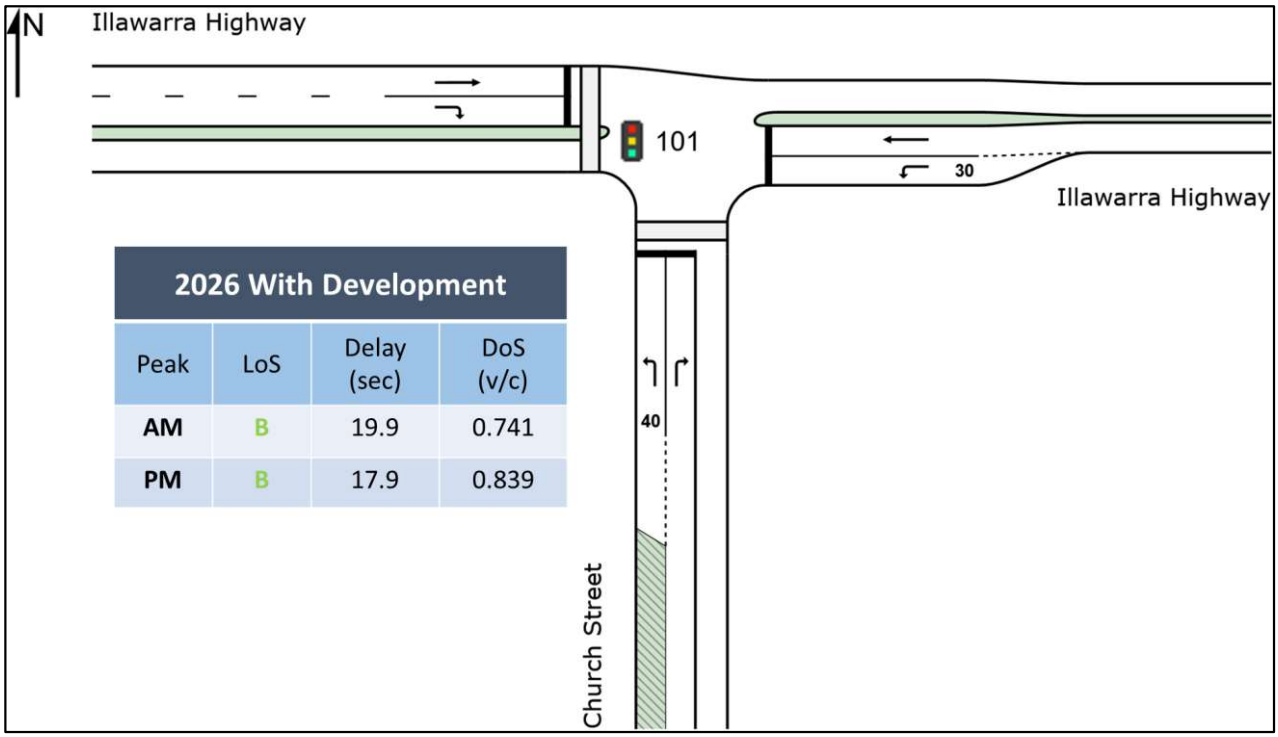


Figure 4-4 Tongarra Road / Church Street Intersection Performance Results (2026)

It is evident from **Figure 4-2, Figure 4-3** and **Figure 4-4** that the key intersections are expected to operate at a satisfactory level of service (LoS) i.e. LoS B or better in the both AM and PM peak scenarios. It is important to note that based on the information provided, it has been assumed that the Tongarra Road / Church Street intersection will be signalised by 2021 as identified in previous studies. The layout of the aforementioned intersection is indicative only and is subject to change.

4.7 Development Access Reconfiguration

The 1881 development (Stage 1-4) will be configured to have primary access via the proposed Broughton Avenue bridge that connects the development to the existing Tullimbar Village, and Dahua Stage X1 development. Via this point of access, vehicles have the flexibility to utilise all three highway intersections assessed as part of this investigation.

In 2021, a secondary point of access to the development is proposed for Yellow Rock Road. This connection would be via the existing Aurelan Terrace and Yellow Rock Road intersection. Modelling of this connection, without the implementation of traffic calming, or deterring, devices has identified that approximately 40 trips in the peak AM hour, and 50 trips in the peak PM hour would be generated. This equates to less than one (1) vehicle per minute using this point of access. The addition of a single speed hump, and the proposed constriction of the road width at the connection of Aurelan Terrace would reduce this traffic movement further.

The 2026 scenario includes the bridge connection to the neighbouring Ravenwood development. As the road connection the proposed bridge is reliant on the Ravenwood lands has not been constructed, this bridge connection was not included in the 2021 scenario. It is predicted that once the bridge is established, it would be the primary point of access and egress for Stages 2 3 and 4 of the current proposed development, and for the majority of the developable lands to the south (currently under a separate planning approval).

5 Transport & Accessibility

5.1 Road Hierarchy

Figure 5-1 shows the proposed road hierarchy of the proposed development, Stage 1 – 9 of 1881 Tullimbar. It is evident that the following two types of streets have been proposed, being collector and access roads.

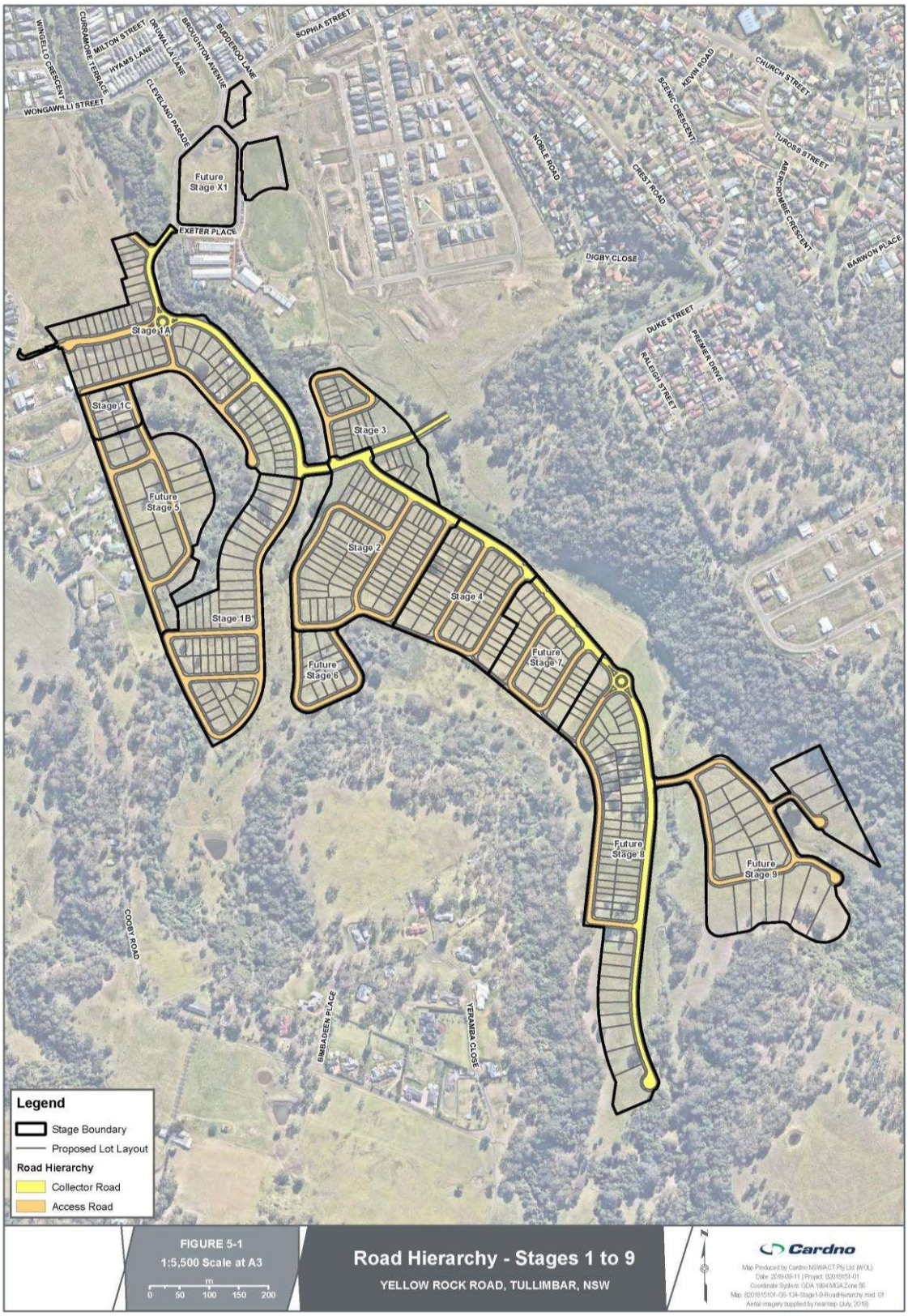


Figure 5-1 Proposed Road Hierarchy

As per Shellharbour Council DCP, a collector road has the capacity for 3,000 vehicles per day, which translates to 300 dwellings based on a conversion of 10 vehicles per day per dwelling.

Referring to the RMS Technical Direction, regional dwellings generate 7.4 trips per day. Additionally, the RMS Guide stipulates an environmental capacity of up to 500 vehicles per hour for residential collector roads.

The collector road is estimated to carry less than 500 vehicles per hour at any one location along this roadway. It is considered that the collector road has sufficient capacity to service the proposed development.

Council's DCP states that access streets have a capacity for 1,500 vehicles per day, translating to 150 dwellings. The RMS Guide equivalent is a Local Street which has an environmental capacity of up to 300 vehicles per hour. This equates to circa 380 dwellings accessing one local road. The proposed road layout will not result in the environmental capacity of local roads being exceeded within the proposed development.

5.2 Bus Planning

Based on discussions between Premier Illawarra and Cardno, the following points were concluded as preliminary outcomes.

- The existing Premier Illawarra Route 75 has a 15 minute buffer built into the current timetable as the operator recognises that future development and demand is eventually going to occur. Buses currently layover in Shellharbour for 15 minutes. Once development occurs in Tullimbar, to the point where the bus route can be extended, the service times for the existing route are unlikely to be significantly modified due to the current buffer;
- Proposed bus route through the site is likely to be delivered in stages, coinciding with the expected development staging of the site (i.e Stages 1-4 and 5-9 separately).
- Current topography of the site and therefore the resulting road gradients limit the bus route options through the site;
- Premier Illawarra's long term plan is for bi-directional express services for Tullimbar / Calderwood linking the two major local centres of Shellharbour and Dapto.
- **Figure 5-2** illustrates the proposed public transport plan including bus route, bus stops and walking catchment for the new residents. It is evident that nearly 90% of the residential lots are within easy walking distance (less than 400m) of the proposed bus stops, giving new residents a viable public transport option to access Shellharbour City Centre and mainline rail services.

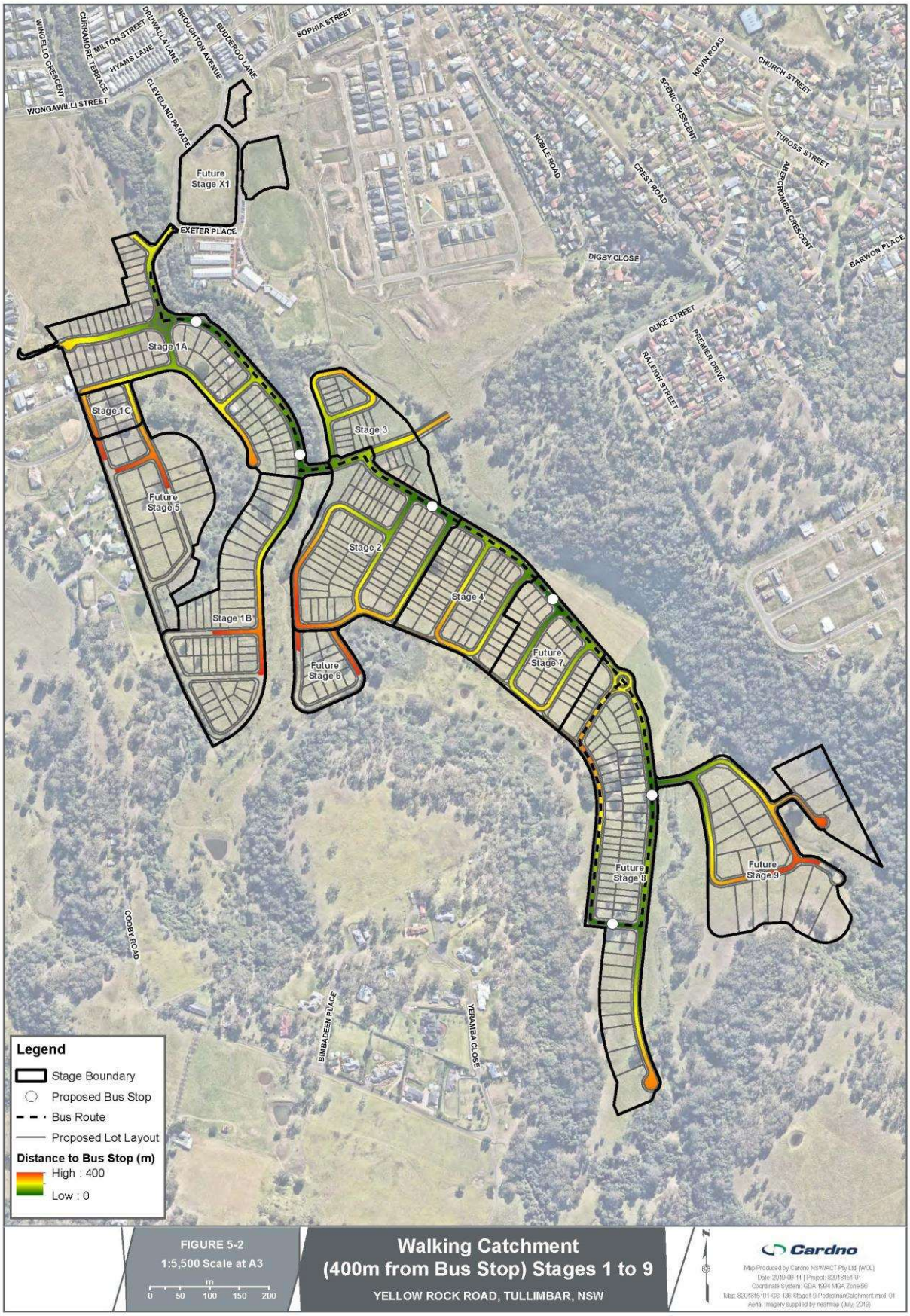


Figure 5-2 Proposed Bus Route

5.3 Pedestrian & Cycle Networks

As shown in **Figure 5-3**, network of shared paths and footpaths will be constructed across all new proposed streets of the development in accordance with the Shellharbour DCP.

Separated cycle paths/tracks through the proposed 1881 Tullimbar are not proposed, rather on-street bicycle and car mix will be sufficient for the local residential streets.

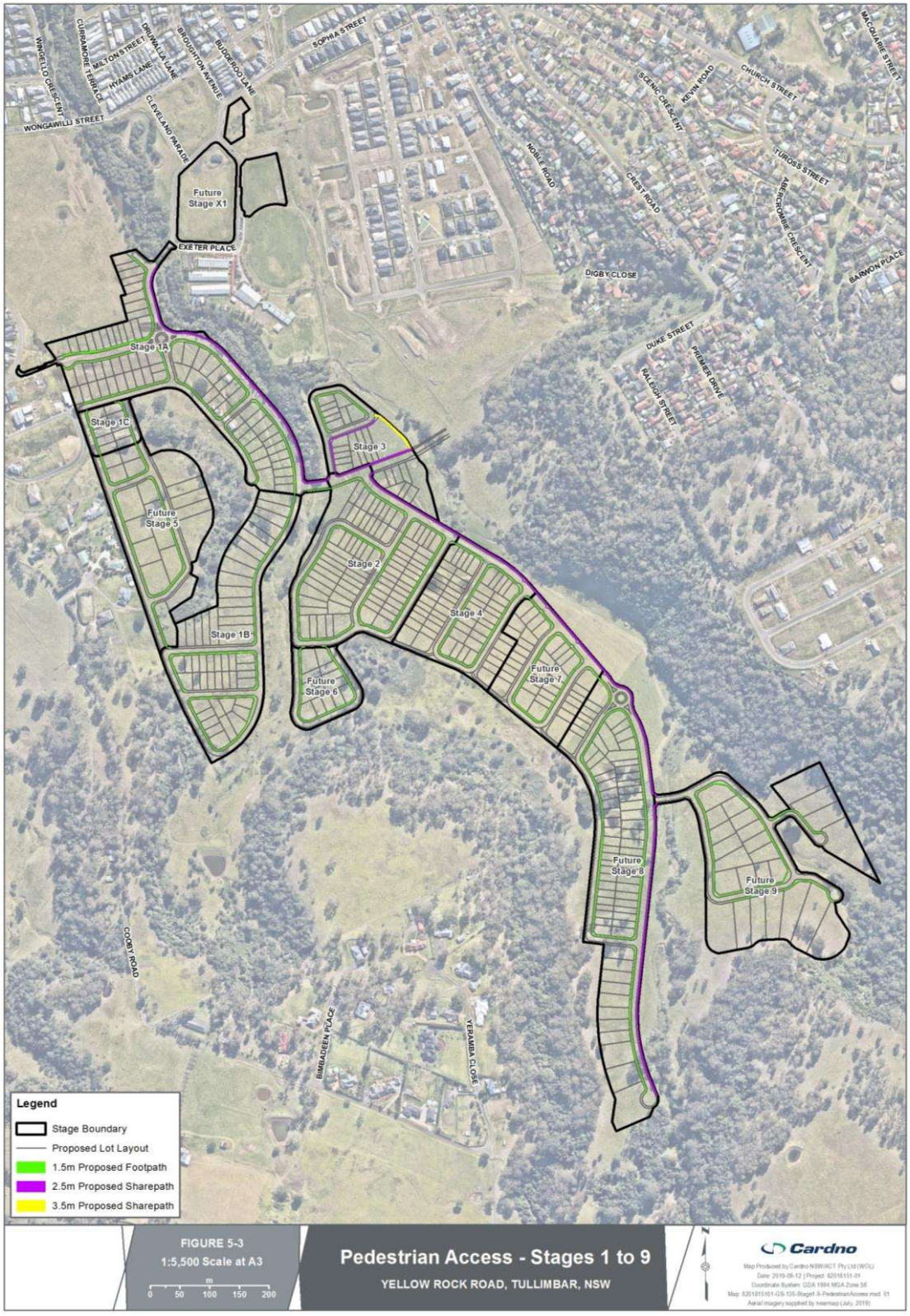


Figure 5-3 Proposed Pedestrian and Cycle Network

6 Conclusion and Recommendations

A summary of the main findings based on the traffic modelling and investigations undertaken as part of this study is listed below:

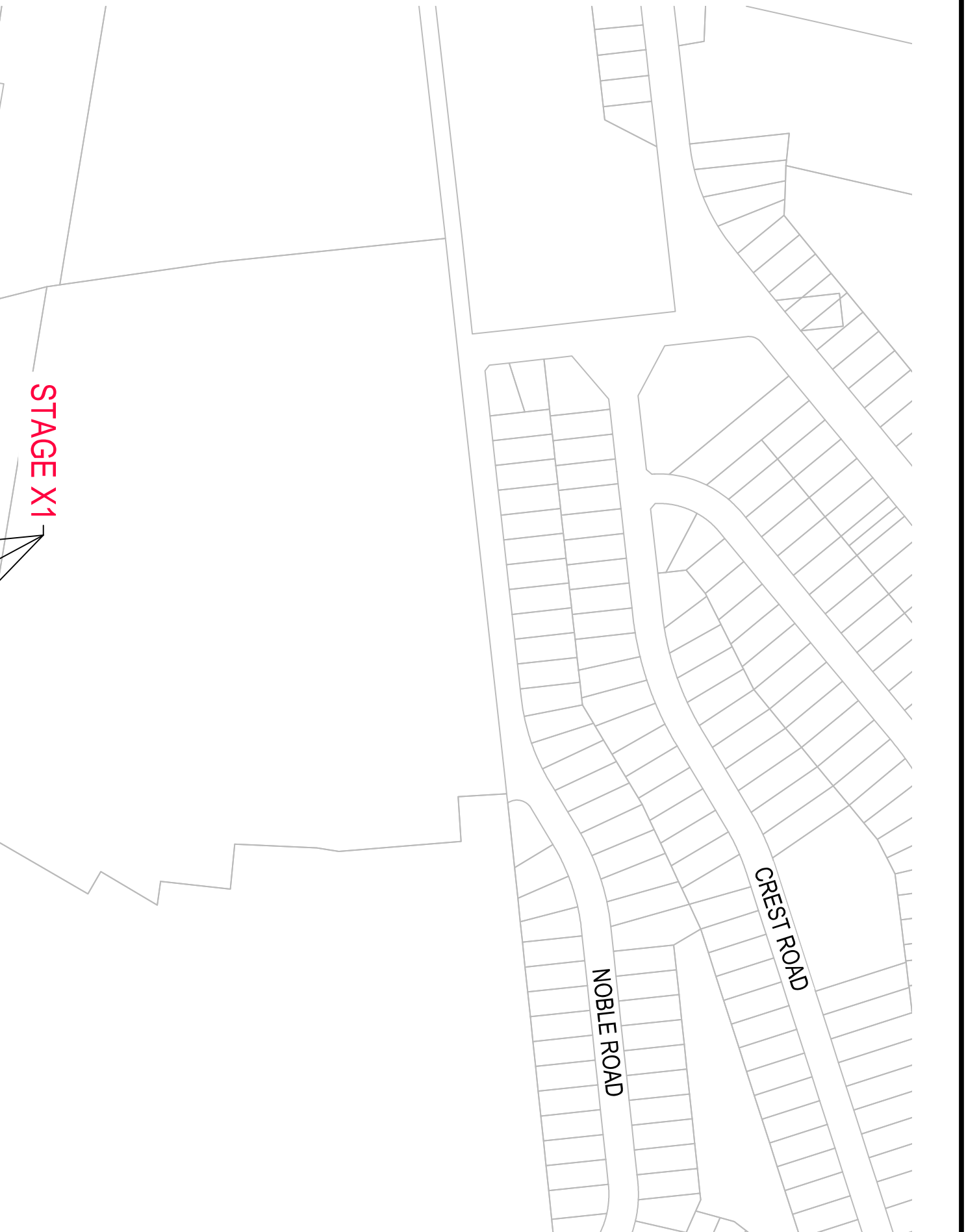
- Revised yield for 1881 Tullimbar development comprises circa 498 lots and is divided into nine release stages. Stage X1 and 1-4 is split into 334 lots and Stage 5-9 into 164 lots.
- Previous traffic assessments (*1881 Tullimbar – Traffic Impact Assessment (version 10)"* report, dated 17th May 2019) undertaken by Cardno have shown that:
  - the Client is proposing to develop Stage 1 – 4 of 1881 Tullimbar development comprising 290 residential lots. The development is expected that the proposed development will be completed by 2021.
  - It is noted that the Client is also planning to develop Stage X1 comprising 37 residential lots and a commercial space of the proposed development. Due to the uncertainty concerning the commercial/retail space, an equivalent of 10 residential lots were included in the model. Therefore, it is expected that by 2021, approximately 337 lots will be developed at 1881 Tullimbar generating 239 and 264 trips in the AM and PM peak hour respectively.
  - **Modelling results of the 2021 assessment previously undertaken by Cardno (***1881 Tullimbar – Traffic Impact Assessment (version 10)"* report, dated 17th May 2019**) focused on the revised yield of 337 lots for stages X1 and 1-4. Since the completion of this assessment, multiple revisions of layout plans for the 1881 Tullimbar development have been prepared with the total number of lots (Stage X1 and 1-4) been reduced to 334. Considering the lower residential yield of overall Tullimbar stage X1 and 1-4, the traffic assessment can be described as a conservative approach**.
- Considering the existing access points and the potential key routes to and from the proposed development site, the following key intersections have been assessed as part of this study:
  - Illawarra Highway / Escarpment Drive / Yellow Rock Road;
  - Tongarra Road / Broughton Avenue; and
  - Tongarra Road / Church Street.
- By 2026 and with all the Tullimbar development in place (1,410 lots), which includes all known zoned developable areas not in Dahua's ownership, the modelling results indicated that the intersections of Illawarra Highway / Yellow Rock Road, Tongarra Road / Broughton Avenue and Tongarra Road / Church Street are expected to operate at satisfactory level (LoS B or better for both AM and PM peaks).
- The existing Premier Illawarra Route 75 has a 15 minute buffer built into the existing timetable to allow for future diversion of this service into Tullimbar. Once development occurs in 1881 Tullimbar, to the point where the bus route can extended, the service times for the existing route are unlikely to be significantly modified due to the current buffer.
- The proposed diversion in the bus route provide adequate accessibility for future 1881 Tullimbar residents.

1881 Tullimbar

APPENDIX A

SITE PLAN

DATE PLOTTED: 10 September 2019 9:37 AM BY : ZAC PHILIPPA



1881 Tullimbar

APPENDIX B

SIDRA RESULTS

MOVEMENT SUMMARY

Site: 101 [Illawarra Hwy / Yellow Rock Rd - AM Peak 2026]

Illawarra Hwy / Yellow Rock Rd
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
SouthEast: Yellow Rock Rd												
1	L2	9	11.1	0.316	11.0	LOS A	2.2	15.9	0.90	0.91	0.90	45.2
2	T1	85	0.0	0.316	10.4	LOS A	2.2	15.9	0.90	0.91	0.90	46.3
3	R2	79	6.3	0.316	15.0	LOS B	2.2	15.9	0.90	0.91	0.90	46.0
Approach		173	3.5	0.316	12.5	LOS A	2.2	15.9	0.90	0.91	0.90	46.1
NorthEast: Illawarra Hwy East												
4	L2	37	8.1	0.673	4.9	LOS A	7.9	58.7	0.51	0.55	0.51	48.1
5	T1	310	11.0	0.673	5.2	LOS A	7.9	58.7	0.51	0.55	0.51	52.4
6	R2	582	4.5	0.673	9.5	LOS A	7.9	58.7	0.51	0.55	0.51	52.4
Approach		929	6.8	0.673	7.9	LOS A	7.9	58.7	0.51	0.55	0.51	52.2
NorthWest: Escarpment Dr												
7	L2	374	5.6	0.417	5.7	LOS A	3.0	21.8	0.56	0.62	0.56	53.2
8	T1	70	1.4	0.417	5.8	LOS A	3.0	21.8	0.56	0.62	0.56	50.8
9	R2	12	0.0	0.417	10.2	LOS A	3.0	21.8	0.56	0.62	0.56	54.5
Approach		456	4.8	0.417	5.8	LOS A	3.0	21.8	0.56	0.62	0.56	52.8
SouthWest: Illawarra Hwy West												
10	L2	11	0.0	0.249	9.1	LOS A	1.6	11.5	0.78	0.80	0.78	51.3
11	T1	158	3.2	0.249	9.5	LOS A	1.6	11.5	0.78	0.80	0.78	52.3
12	R2	3	0.0	0.249	13.7	LOS A	1.6	11.5	0.78	0.80	0.78	49.1
Approach		172	2.9	0.249	9.5	LOS A	1.6	11.5	0.78	0.80	0.78	52.2
All Vehicles		1730	5.5	0.673	8.0	LOS A	7.9	58.7	0.59	0.63	0.59	51.7

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 [Illawarra Hwy / Yellow Rock Rd - PM Peak 2026]

Illawarra Hwy / Yellow Rock Rd
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
SouthEast: Yellow Rock Rd												
1	L2	14	0.0	0.207	6.4	LOS A	1.3	9.1	0.69	0.72	0.69	48.0
2	T1	100	1.0	0.207	6.4	LOS A	1.3	9.1	0.69	0.72	0.69	49.0
3	R2	54	7.4	0.207	10.9	LOS A	1.3	9.1	0.69	0.72	0.69	48.6
Approach		168	3.0	0.207	7.9	LOS A	1.3	9.1	0.69	0.72	0.69	48.8
NorthEast: Illawarra Hwy East												
4	L2	83	4.8	0.492	4.9	LOS A	4.2	30.4	0.45	0.60	0.45	48.1
5	T1	99	2.0	0.492	5.1	LOS A	4.2	30.4	0.45	0.60	0.45	52.6
6	R2	456	4.4	0.492	9.5	LOS A	4.2	30.4	0.45	0.60	0.45	52.4
Approach		638	4.1	0.492	8.2	LOS A	4.2	30.4	0.45	0.60	0.45	51.9
NorthWest: Escarpment Dr												
7	L2	470	3.6	0.538	6.2	LOS A	4.4	31.5	0.67	0.67	0.67	52.9
8	T1	88	1.1	0.538	6.3	LOS A	4.4	31.5	0.67	0.67	0.67	50.5
9	R2	20	0.0	0.538	10.7	LOS A	4.4	31.5	0.67	0.67	0.67	54.1
Approach		578	3.1	0.538	6.4	LOS A	4.4	31.5	0.67	0.67	0.67	52.5
SouthWest: Illawarra Hwy West												
10	L2	12	8.3	0.293	8.3	LOS A	1.8	13.4	0.72	0.76	0.72	51.6
11	T1	209	3.8	0.293	8.4	LOS A	1.8	13.4	0.72	0.76	0.72	52.9
12	R2	12	0.0	0.293	12.6	LOS A	1.8	13.4	0.72	0.76	0.72	49.7
Approach		233	3.9	0.293	8.6	LOS A	1.8	13.4	0.72	0.76	0.72	52.7
All Vehicles		1617	3.6	0.538	7.6	LOS A	4.4	31.5	0.59	0.66	0.59	51.9

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.
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 [Tongarra Rd / Broughton Ave - AM Peak 2026]

Tongarra Rd / Broughton Ave
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Broughton Avenue												
1	L2	59	1.7	0.373	11.0	LOS A	2.6	19.4	0.91	0.95	0.93	45.5
2	T1	104	7.7	0.373	11.4	LOS A	2.6	19.4	0.91	0.95	0.93	47.0
3	R2	30	10.0	0.373	15.5	LOS B	2.6	19.4	0.91	0.95	0.93	46.0
Approach		193	6.2	0.373	11.9	LOS A	2.6	19.4	0.91	0.95	0.93	46.4
East: Tongarra Rd East												
4	L2	14	7.1	0.655	9.3	LOS A	7.0	50.6	0.82	0.84	0.96	47.6
5	T1	603	3.8	0.655	9.4	LOS A	7.0	50.6	0.82	0.84	0.96	52.0
6	R2	1	0.0	0.655	13.1	LOS A	7.0	50.6	0.82	0.84	0.96	54.3
Approach		618	3.9	0.655	9.4	LOS A	7.0	50.6	0.82	0.84	0.96	51.8
North: Tripoli Way												
7	L2	3	0.0	0.354	7.2	LOS A	2.3	18.1	0.63	0.76	0.63	53.3
8	T1	55	12.7	0.354	8.1	LOS A	2.3	18.1	0.63	0.76	0.63	50.5
9	R2	266	15.0	0.354	12.3	LOS A	2.3	18.1	0.63	0.76	0.63	53.4
Approach		324	14.5	0.354	11.5	LOS A	2.3	18.1	0.63	0.76	0.63	52.9
West: Tongarra Rd West												
10	L2	277	6.1	0.506	5.3	LOS A	4.6	33.3	0.53	0.55	0.53	54.1
11	T1	314	4.5	0.506	5.4	LOS A	4.6	33.3	0.53	0.55	0.53	54.1
12	R2	17	0.0	0.506	9.5	LOS A	4.6	33.3	0.53	0.55	0.53	50.4
Approach		608	5.1	0.506	5.5	LOS A	4.6	33.3	0.53	0.55	0.53	54.0
All Vehicles		1743	6.5	0.655	8.7	LOS A	7.0	50.6	0.69	0.73	0.74	52.1

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 [Tongarra Rd / Broughton Ave - PM Peak 2026]

Tongarra Rd / Broughton Ave
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Broughton Avenue												
1	L2	42	2.4	0.200	7.1	LOS A	1.2	8.9	0.70	0.74	0.70	47.6
2	T1	73	12.3	0.200	7.5	LOS A	1.2	8.9	0.70	0.74	0.70	48.5
3	R2	32	3.1	0.200	11.1	LOS A	1.2	8.9	0.70	0.74	0.70	48.5
Approach		147	7.5	0.200	8.1	LOS A	1.2	8.9	0.70	0.74	0.70	48.2
East: Tongarra Rd East												
4	L2	26	3.8	0.435	7.2	LOS A	3.1	22.4	0.72	0.73	0.72	48.3
5	T1	360	1.9	0.435	7.3	LOS A	3.1	22.4	0.72	0.73	0.72	52.8
6	R2	1	0.0	0.435	11.2	LOS A	3.1	22.4	0.72	0.73	0.72	55.2
Approach		387	2.1	0.435	7.3	LOS A	3.1	22.4	0.72	0.73	0.72	52.5
North: Tripoli Way												
7	L2	4	0.0	0.452	9.3	LOS A	3.3	24.9	0.79	0.87	0.84	52.3
8	T1	119	7.6	0.452	10.2	LOS A	3.3	24.9	0.79	0.87	0.84	49.7
9	R2	236	7.6	0.452	14.3	LOS A	3.3	24.9	0.79	0.87	0.84	52.7
Approach		359	7.5	0.452	12.9	LOS A	3.3	24.9	0.79	0.87	0.84	51.6
West: Tongarra Rd West												
10	L2	198	9.6	0.576	5.3	LOS A	5.7	41.2	0.50	0.51	0.50	53.2
11	T1	511	2.2	0.576	5.3	LOS A	5.7	41.2	0.50	0.51	0.50	54.0
12	R2	33	0.0	0.576	9.4	LOS A	5.7	41.2	0.50	0.51	0.50	50.4
Approach		742	4.0	0.576	5.4	LOS A	5.7	41.2	0.50	0.51	0.50	53.6
All Vehicles		1635	4.6	0.576	7.8	LOS A	5.7	41.2	0.64	0.66	0.64	52.4

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.
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 [Tongarra Rd / Church St - AM Peak 2026]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 55 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Church Street												
1	L2	266	2.0	0.334	16.8	LOS B	4.8	34.1	0.70	0.76	0.70	26.1
3	R2	309	5.8	0.736	29.5	LOS C	8.6	62.9	0.98	0.90	1.14	21.1
Approach		576	4.0	0.736	23.6	LOS B	8.6	62.9	0.85	0.83	0.93	22.9
East: Tongarra Road												
4	L2	119	10.6	0.224	21.1	LOS B	2.4	18.6	0.78	0.75	0.78	25.5
5	T1	421	4.8	0.741	19.9	LOS B	10.8	78.9	0.92	0.86	1.04	17.7
Approach		540	6.0	0.741	20.1	LOS B	10.8	78.9	0.89	0.84	0.99	20.0
West: Tongarra Road												
11	T1	271	6.2	0.265	7.2	LOS A	3.9	28.6	0.56	0.48	0.56	32.1
12	R2	106	1.0	0.528	30.4	LOS C	2.9	20.8	0.99	0.78	1.01	18.3
Approach		377	4.7	0.528	13.7	LOS A	3.9	28.6	0.68	0.56	0.69	24.6
All Vehicles		1493	4.9	0.741	19.9	LOS B	10.8	78.9	0.82	0.77	0.89	22.2

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
P1	South Full Crossing	53	17.6	LOS B	0.1	0.1	0.80	0.80
P4	West Full Crossing	53	21.9	LOS C	0.1	0.1	0.89	0.89
All Pedestrians		105	19.8	LOS B			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 [Tongarra Rd / Church St - PM Peak 2026]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Church Street												
1	L2	104	2.0	0.127	12.6	LOS A	1.2	8.6	0.61	0.71	0.61	29.8
3	R2	262	5.2	0.839	29.0	LOS C	6.2	45.3	1.00	1.03	1.53	21.3
Approach		366	4.3	0.839	24.3	LOS B	6.2	45.3	0.89	0.94	1.27	22.9
East: Tongarra Road												
4	L2	271	3.5	0.750	25.1	LOS B	5.8	41.8	0.99	0.93	1.26	23.7
5	T1	316	2.3	0.731	18.2	LOS B	6.5	46.6	0.98	0.91	1.18	18.8
Approach		586	2.9	0.750	21.4	LOS B	6.5	46.6	0.99	0.92	1.22	21.7
West: Tongarra Road												
11	T1	433	2.4	0.429	6.4	LOS A	5.3	37.9	0.65	0.56	0.65	33.8
12	R2	145	0.7	0.524	21.7	LOS B	2.9	20.2	0.97	0.79	0.99	22.5
Approach		578	2.0	0.524	10.3	LOS A	5.3	37.9	0.73	0.62	0.74	28.5
All Vehicles		1531	2.9	0.839	17.9	LOS B	6.5	46.6	0.87	0.81	1.05	23.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
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
P1	South Full Crossing	53	14.5	LOS B	0.1	0.1	0.85	0.85
P4	West Full Crossing	53	14.5	LOS B	0.1	0.1	0.85	0.85
All Pedestrians		105	14.5	LOS B			0.85	0.85

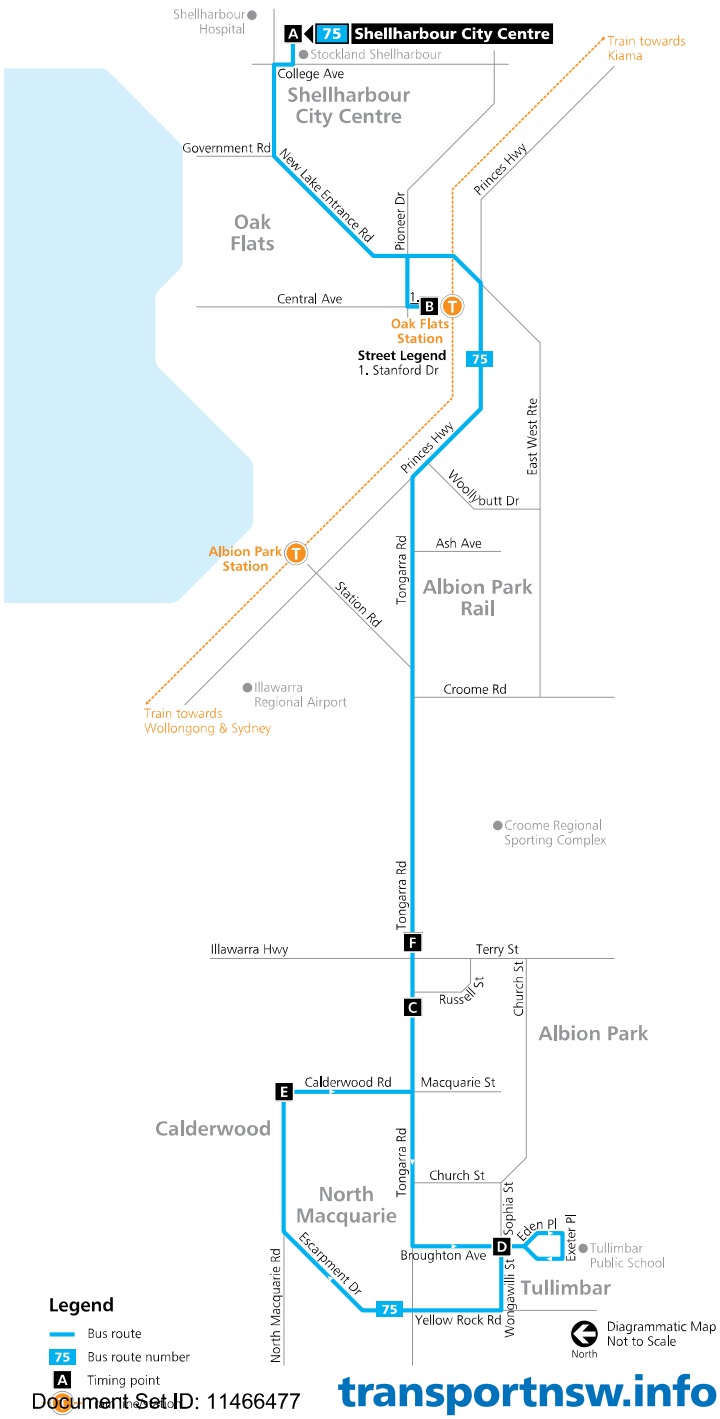
Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

1881 Tullimbar

APPENDIX C

PUBLIC TRANSPORT INFORMATION

Route 75



transportnsw.info

75 B

Shellharbour City Centre to Calderwood

servicing Shellharbour City Centre, Oak Flats, Albion Park Rail, Albion Park, Tullimbar, North Macquarie & Calderwood

NSW GOVERNMENT | Transport

Shellharbour City Centre to Calderwood (loop)

	Monday to Friday	♿	♿	♿	♿	♿	♿	♿	♿	♿
map ref	Route Number	75	75	75	75	75	75	75	75	75
A	Stockland Shellharbour	05:27	06:38	07:21	08:21	10:00	12:00	13:00	14:00	15:00
B	Oak Flats Station	05:33	06:45	07:28	08:28	10:07	12:07	13:07	14:07	15:07
C	Tongarra Rd after Russell St	05:41	06:55	07:38	08:38	10:17	12:17	13:17	14:17	15:17
D	Tullimbar Village	05:45	07:00	07:43	08:43	10:22	12:22	13:22	14:22	15:22
E	North Macquarie & Calderwood	05:53	07:08	07:51	08:51	10:30	12:30	13:30	14:30	15:30
F	Tongarra Rd after Terry St	06:00	07:15	07:58	08:58	10:37	12:37	13:37	14:37	15:37
B	Oak Flats Station	06:10	07:25	08:08	09:08	10:47	12:47	13:47	14:47	15:47
A	Stockland Shellharbour	06:17	07:32	08:15	09:15	10:54	12:54	13:54	14:54	15:54

	Monday to Friday (continued...)	♿	♿	♿	♿	♿	♿
map ref	Route Number	75	75	75	75	75	75
A	Stockland Shellharbour	16:00	17:00	18:00	19:00	20:00	21:23
B	Oak Flats Station	16:07	17:07	18:07	19:07	20:07	21:30
C	Tongarra Rd after Russell St	16:17	17:17	18:17	19:17	20:17	21:40
D	Tullimbar Village	16:22	17:22	18:22	19:22	20:22	21:45
E	North Macquarie & Calderwood	16:30	17:30	18:30	19:30	20:30	21:53
F	Tongarra Rd after Terry St	16:37	17:37	18:37	19:37	20:37	22:00
B	Oak Flats Station	16:47	17:47	18:47	19:47	20:47	22:10
A	Stockland Shellharbour	16:54	17:54	18:54	19:54	20:54	22:17

How to use this timetable

This timetable provides a snap shot of service information in 24-hour time (e.g. 5am = 05:00, 5pm = 17:00). Information contained in this timetable is subject to change without notice. Please note that timetables do not include minor stops, additional trips for special events, short term changes, holiday timetable changes, real-time information or any disruption alerts.

For the most up-to-date times, use the Trip Planner or Departures on **transportnsw.info**

Explanation of definitions and symbols

♿ Wheelchair Accessible.

Who is providing my bus services?

The bus services shown in this timetable are run by Premier Illawarra.

Valid from: 26/11/2017

NOTE: Information is correct as of the above date. For the most up-to-date times, use the Trip Planner on **transportnsw.info**