APPENDIX C

TRAFFIC ASSESSMENT

Traffic and Transport Impact Assessment

Tripoli Way Extension

820162601

Prepared for
Shellharbour City Council

19 July 2021

Cardno

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Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Background to the Project

Shellharbour City Council (Council) propose to develop the Tripoli Way Extension project (the Project), which would traverse and extend the existing Tripoli Way and The Expressway running parallel and to the north of Tongarra Road/Illawarra Highway. The project encompasses the full length of the existing Tripoli Way, connecting with Tongarra Road/Illawarra Highway at the intersection with Broughton Avenue at the western extent and continuing east to connect with Terry Street/Illawarra Highway.

The primary function of the project will be to alleviate the impacts of traffic growth along Tongarra Road, ease traffic congestion within the Albion Park town centre, increase the safety of roads within Albion Park and provide a valuable addition to the transport network.

Council commissioned Cardno to undertake traffic modelling for the Project and to test the 2026 and 2041 horizon scenarios for the number of travel lanes required, to confirm the preferred intersection treatments for Calderwood Road and Illawarra Highway/Terry St and to ultimately inform design development for the project.

1.2 Preliminary review and REF scope

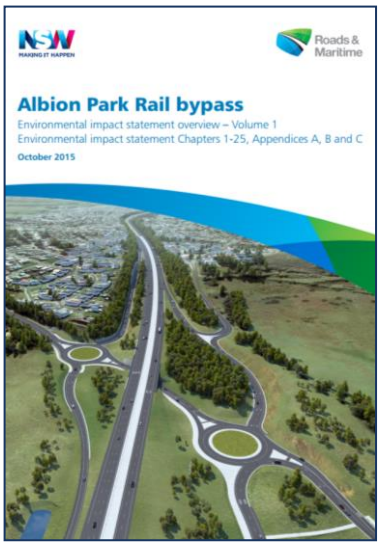
Traffic movements would be increased in the local area during both construction and operation. Operational traffic movements would be associated with ongoing vehicles travel along Tripoli Way. A Traffic and Transport Assessment was undertaken to quantify the extent of traffic and transport movements and potential for impact. The objectives of the assessment were to:

- Provide traffic inputs to inform the roads design
- Identify impacts from the significant future developments and land uses changes in the area
- Assess the traffic and transportation impacts in the Albion Park Town Centre (APTC)
- Undertake assessment of the Tripoli Way Extension intersections through the means of robust traffic modelling assistance
- Identify operational traffic impacts and areas/intersections where the model performs poorly
- Provide mitigation measurements and recommendations to improve model performance as well as input to the road design team
- Prepare supporting information of the traffic and transport impacts suitable for the REF report.

The ultimate purpose of the Tripoli Way traffic modelling assessment was to support the Concept Design and REF for the Project.

1.3 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.



TfNSW is currently constructing 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 (APRB). 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 Tripoli Way Extension is designed to tie into the southern end of the APRB, with both projects joining just north of the Illawarra Highway / Tripoli Way intersection.

The Environmental Impact Statement Technical Paper 1 – Traffic and Transport, October 2015 (Hyder Cardno Joint Venture, 2015) details potential traffic and transport impacts associated with the APRB. 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.

1.3.1 APRB traffic models

Subsequent to the 2015 Traffic and Transport report and EIS, TfNSW 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 test the proposed modifications to the Tripoli Way Extension adopted the APRB AIMSUN models, which have been described as robust and fit-for-purpose and were officially issued by TfNSW. The following models were developed as part of the EIS:

- **2026 APRB Interim Stage 1**: Scheme assessment 5 years after APRB opening year without the Northern Interchange in place
- **2026 APRB Interim Stage 2**: Scheme assessment 5 years after APRB opening year with the Northern Interchange in place
- **2041 APRB Concept Design Stage 1**: Scheme assessment 20 years after APRB opening year without the Northern Interchange in place
- **2041 APRB Design for Approval**: Scheme assessment 20 years after APRB opening year with the Northern Interchange in place.

1.4 Report structure

The structure of this report is outlined below:

- **Section 1 – Review of Environmental Factors (REF) Traffic Input**: Outline of the background, project objective, scope of works and study area
- **Section 2 – Existing Conditions**: Describes in detail the existing traffic and transport conditions within the study area
- **Section 3 – Traffic Modelling Assumptions**: Assumptions and parameters used in the future modelling.
- **Section 4 – Operational Traffic Assessment**: Describes the performance of the option model testing and outlines a comparison of the modelling outputs between the assessed scenarios
- **Section 5 – Conclusions**: Outlines main outcomes, results and recommendations.

2 Existing Conditions

2.1 Study area

The study area, shown in **Figure 2-1**, is located approximately 95km south of Sydney's CBD and belongs to the City of Shellharbour Local Government Area.

Figure 2-1 Study area

The study area is bounded by Illawarra Highway to the west, Calderwood Road and Terry Street / Illawarra Highway to the north, Tongarra Road to the east and Terry Street to the south. Tongarra Road is a main arterial road connecting the APTC to Shellharbour's City Centre.

2.2 Local road network and access

Tripoli Way and The Expressway provide access to a number of private residential dwellings. In addition, the surrounding road network provides access to residential dwellings, commercial and recreational facilities.

Construction of the Tripoli Way Extension would result in temporary traffic and transport related impacts. Potential impacts may include:

- Construction traffic including an increase in heavy vehicle movements
- Temporary changes to the road network
- Disruption to property access
- Minor traffic delays.

The Tripoli Way Extension would provide access to the APRB northbound on-ramp and southbound off-ramp. The APRB would be constructed and delivered by TfNSW. The proposed Tripoli Way Extension would need to consider the consistency of design standards with the APRB, options for entry/exit locations and changes to the performance of the APRB as discussed in Section 3.2 and in the *Tripoli Way Extension Conceptual Design Report* (Cardno, May 2020).

2.3 Road hierarchy

2.3.1 Schedule of Road Classification

TfNSW in partnership with local government established an administrative framework of State, Regional and Local Road categories to help manage the extensive network of roads.

State roads are managed and financed by TfNSW, and Regional / Local Roads are managed and financed by Councils. Notwithstanding, Regional Roads perform an intermediate function between the main arterial network of State Roads and Council controlled Local Roads and therefore received financial assistance from TfNSW.

The key road network surrounding the subject site consists of:

- Tripoli Way Extension
- Tongarra Road / Illawarra Highway
- Calderwood Road
- Terry Street / Illawarra Highway
- Church Street.

2.3.2 Tripoli Way

Tripoli Way is an unclassified road under the care and maintenance of Council. It is currently a two-lane carriageway with one lane in each direction. It is a no through road separated by a median for the eastern 230 meters with street side parking. Under the existing configuration, Tripoli Way serves only to provide access to private properties from Hamilton Road. There is no posted speed limit hence a default speed of 50km/h applies.

2.3.3 Illawarra Highway / Tongarra Road

Tongarra Road / Illawarra Highway is a state road, part of the Illawarra Highway and under the care and control of TfNSW for the length between Princes Highway, 0.8km south of Albion Park Railway Station to Albion Park. Tongarra Road / Illawarra Highway is a two-lane carriageway with one lane in each direction, expanding into a four-lane configuration from the Eastern entry to Albion Park until 490 meters west of Terry Street. Tongarra Road serves as the major east-west distributor to Shellharbour and the greater area. The road is approved for B-doubles up to 26m from Princes Highway until Calderwood Road. Its speed limit is posted at 60km/hr with 40km/hr school limits in the vicinity of the east side of Tongarra Road. The posted speed at its western extend (west of Yellow Rock Road) is 100km/hr.

2.3.4 Calderwood Road

Calderwood Road is a local road under the care and maintenance of Council. It is a two-lane carriageway with one lane in each direction with street side parking on both sides. Calderwood Road runs north-south from the intersection with Tongarra Road until approximately 1.25km north of Tongarra Road where it reorientates west. The proposed alignment of Tripoli Way is planned to join with Calderwood Road. The posted speed limit is 60km/h.

2.3.5 Terry Street / Illawarra Highway

Terry Street is a state road and a part of the Illawarra Highway. It is a primarily two-lane carriageway with one lane in each direction, expanding to four lanes (two lanes per direction) between the intersection with Tongarra Road and Cawdell Drive. It becomes part of the Illawarra north of the Tongarra intersection and carries traffic northbound along the north western boundary of Illawarra Regional Airport. Terry Street south of the Tongarra Road intersection carries a significant volume of the Albion Park residential traffic. The posted speed limit is 60km/h, which changes to 90km/h on its northern extremity (north of Taylor Road)

2.3.6 Church Street

Church Street is a local road under the care and control of Council. It is a two-lane carriageway with one lane in each direction and street side parking on both sides. Church Street meets Tongarra Road on the west portion the Albion Park residential area and carries mostly residential traffic south of Tongarra Road until Terry Street. The posted speed limit is 60km/h.

2.4 Crash data analysis

Crash data was sourced from the online TfNSW database that provides 5 years of crash data in the vicinity of the APTC until December 2018. **Table 2-1** provides a summary of all the crash data along Illawarra Highway / Tongarra Road (between Escarpment Drive and Terry Street) and across Terry Street (between north of Taylor Road and Church Street). **Figure 2-2** illustrates the locations the crashes occurred.

Crash definitions and descriptions are provided in **Appendix A**.

Table 2-1 Crash data

Intersection	ID	Crash ID	Year	Degree of Crash	RUM Code	RUM Description
Illawarra Highway / Escarpment Drive	1	1015411	2014	Non-casualty (towaway)	13	Right near
	2	1059272	2015	Serious injury	13	Right near
Illawarra Highway / Broughton Avenue	3	1047854	2014	Non-casualty (towaway)	71	Off road left
	4	1031993	2014	Minor/Other Injury	72	Off road to right
	5	1066155	2015	Serious injury	20	Head on
Illawarra Highway / Church Street	6	1061762	2015	Serious injury	20	Head on
	7	1123395	2016	Moderate injury	13	Right near
	8	1138587	2017	Moderate injury	36	Right turn sideswipe
Illawarra Highway / Calderwood Road	9	1086613	2015	Serious injury	33	Lane sideswipe
	10	1114662	2016	Non-casualty (towaway)	11	Right far
	11	1127716	2017	Non-casualty (towaway)	36	Right turn sideswipe
Tongarra Road between Amaral Avenue and Russell Street	12	1024709	2014	Serious injury	30	Rear end
	13	1054962	2014	Non-casualty (towaway)	30	Rear end
	14	1057327	2014	Moderate injury	47	Emerging from drive
	15	1078864	2015	Minor/Other injury	16	Left rear
	16	1104236	2016	Non-casualty (towaway)	32	Right rear
	17	1138143	2017	Non-casualty (towaway)	39	Other same direction
	18	1155202	2017	Serious injury	10	Cross traffic
	19	1189628	2018	Non-casualty (towaway)	71	Off road left
Intersection	**ID**	**Crash ID**	**Year**	**Degree of Crash**	**RUM Code**	**RUM Description**
Terry Street / Tongarra Road	20	1014287	2014	Non-casualty (towaway)	71	Off road left
	21	1015166	2014	Serious injury	71	Off road left

	22	1020389	2014	Non-casualty (towaway)	71	Off road left
	23	1022692	2014	Non-casualty (towaway)	40	U turn
	24	1023725	2014	Non-casualty (towaway)	30	Rear end
	25	1025393	2014	Serious injury	71	Off road left
	26	1026988	2014	Serious injury	10	Cross traffic
	27	1040164	2014	Non-casualty (towaway)	30	Rear end
	28	1057055	2015	Moderate injury	21	Right through
	29	1062654	2015	Non-casualty (towaway)	74	On road-out of cont.
	30	1075114	2015	Serious injury	2	Ped far side
	31	1089945	2015	Non-casualty (towaway)	71	Off road left
	32	1098941	2016	Serious injury	20	Head on
	33	1112045	2016	Non-casualty (towaway)	46	Reversing into obj
	34	1112448	2016	Non-casualty (towaway)	13	Right near
	35	1113259	2016	Moderate injury	47	Emerging from drive
	36	1114528	2016	Non-casualty (towaway)	30	Rear end
	37	1130882	2017	Non-casualty (towaway)	71	Off road left
	38	1134475	2017	Serious injury	74	On road-out of cont.
	39	1141923	2017	Non-casualty (towaway)	71	Off road left
	40	1143984	2017	Non-casualty (towaway)	13	Right near
	41	1148217	2017	Moderate injury	48	From footpath
	42	1148720	2017	Non-casualty (towaway)	70	Off road to left
	43	1149152	2017	Serious injury	48	From footpath
	44	1150880	2017	Minor/Other injury	45	Reversing
	45	1167923	2018	Serious injury	20	Head on

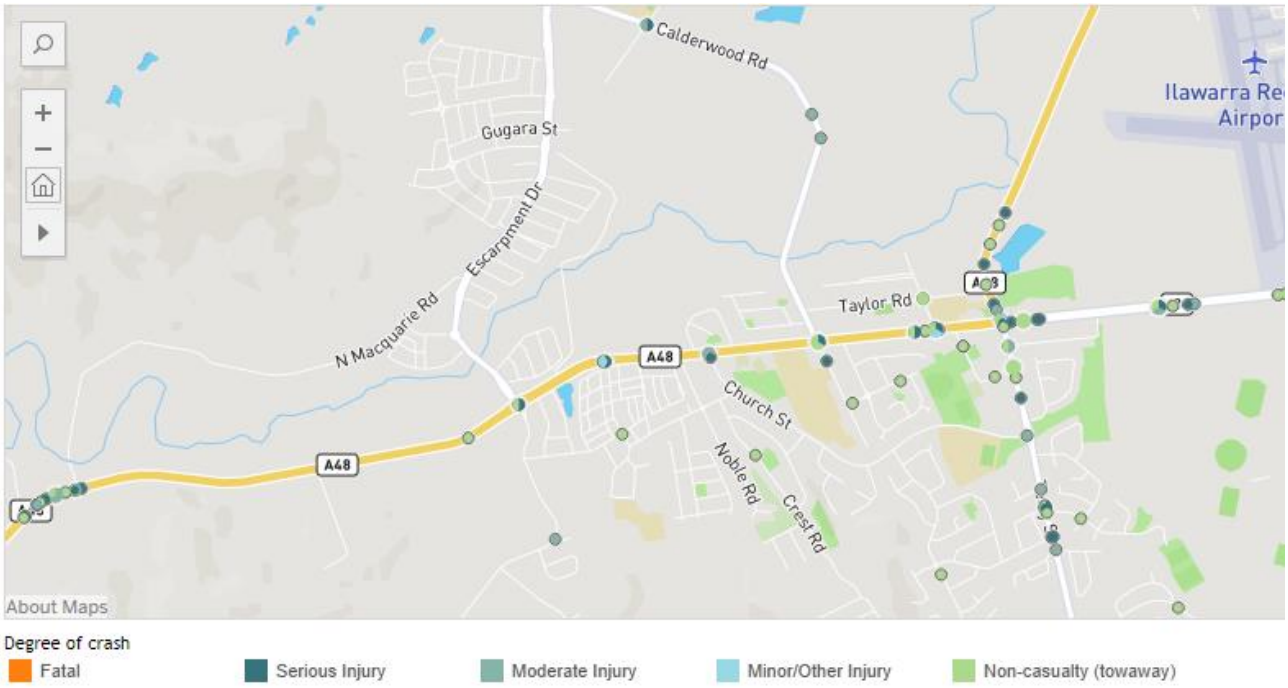


Figure 2-2 Crash locations

Source: https://roadsafety.transport.nsw.gov.au/statistics/interactivecrashstats/lga_stats.html?tablga=1

The crash statistics show that in the five years to the end of 2018, there were a total of 45 crashes that have been recorded across Illawarra Highway (between Escarpment Drive and Terry Street) and Terry Street (between Taylor Road and Church Street) corridors. Additional crashes have been recorded within the wider network of the study area, however, only the crashes occurred at the key corridors have been reported.

According to the RUM codes, none of the crashes across the study network over the 5 years of data involved pedestrians. 23 of the crashes recorded in the 5-year period resulted in injuries (14 serious, six moderate and three minor) but no fatalities. The remaining 22 crashes involved incidents relating to towaway (non-casualty).

The types of crashes mainly occur along Terry Street and the eastern section of Tongarra Road / Terry Street intersection with 18 (40%) of the accidents occurring along the route. Two hotspots for accidents are the Russell Street and Terry Street.

The most common classification of incident was the “off road left”, “right near” and “rear end” accounting for 42% of the total crashes.

2.5 Public transport

2.5.1 Trains

The core study area is located approximately 2.5 kilometres west of Albion Park Station and 3.5 kilometres north-west of Oak Flats Station. South Coast Line services operate from Albion Park and Oak Flats north to Wollongong and Sydney and south to Kiama. In 2014, 260 passengers used Albion Park Station and 400 passengers used Oak Flats Station, with the majority of trips undertaken during peak hours (Transport for NSW, 2014). Services depart hourly in both directions throughout most of the day with additional services provided during peak hours.

2.5.2 Buses

Bus routes 76 and 77 operate in the study area. Both routes operate from Shellharbour to Albion Park. Within the core study area, the buses use Tongarra Road, Terry Street, Church Street and other local roads. Route 76 connects to Oak Flats Station and Route 77 connects to Albion Park Station before continuing to Shellharbour. Services depart approximately hourly on each route throughout most of the day with additional services provided during peak hours.

Bus stops on Tongarra road are situated approximately 200 metres apart. Bus stops provide direct access to St Paul’s Catholic Parish Primary School, St Joseph’s Catholic High School and Albion Park High School. Some routes make diversions around school starting and finishing times.

Figure 2-3 shows the local bus network.

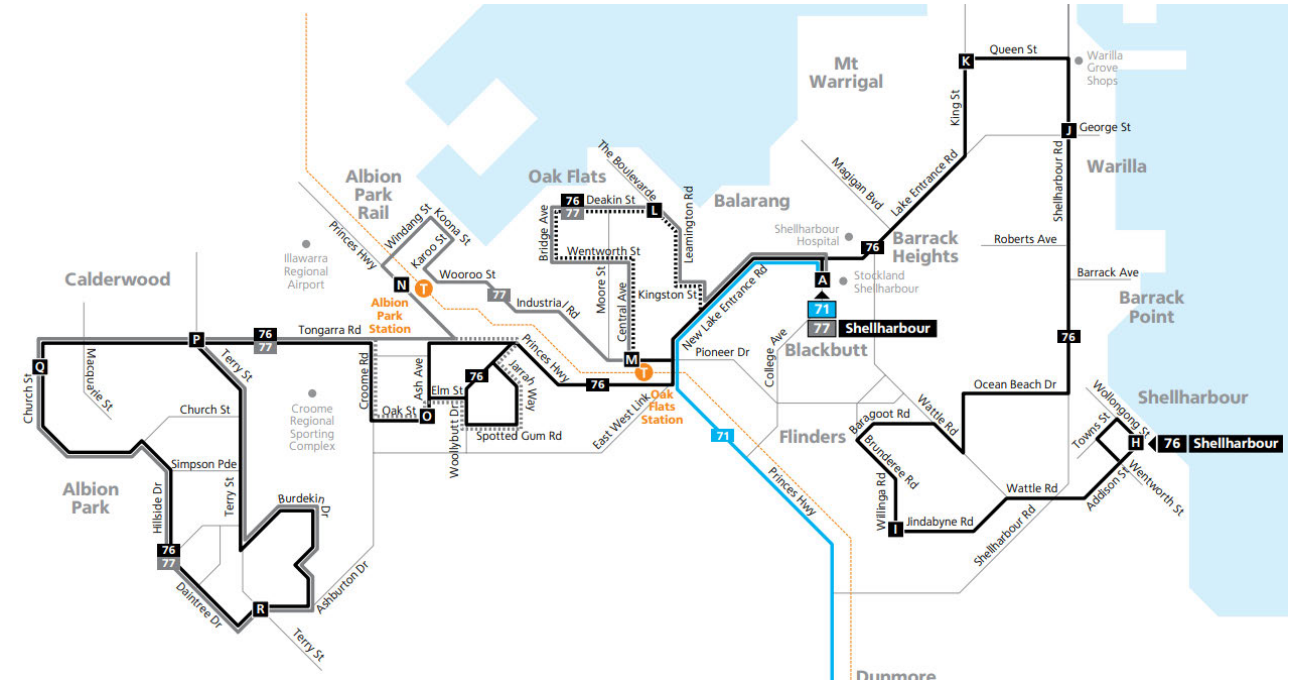


Figure 2-3 Bus services

Source: *Premier Illawarra*

Figure 2-4 shows the location of bus stops within the core study area.

Figure 2-4 Bus stop locations

2.5.3 Coaches

NSW TrainLink operates a coach service between Wollongong and Moss Vale/Bundanoon in the Southern Highlands. This service stops to pick up and set down passengers at Albion Park Station before proceeding west via Tongarra Road. The coach service does not make any stops within the core study area.

2.6 Pedestrian and cycling facilities

Paved pedestrian footpaths are provided on both sides of Tongarra Road through the centre of town and on at least one side in all residential areas in Albion Park. Paved footpaths are also provided on Terry Street, parts of Calderwood Road and limited local roads.

A non-signalised children's crossing is situated on Tongarra Road directly outside St Paul's Catholic Parish Primary School. Signalised pedestrian crossings are provided on all legs of signalised intersections within the core study area. A zebra crossing is provided on Church Street outside Albion Park High School.

There are no dedicated cycling paths within the study area and cyclists must share the roads with motorised vehicles. **Figure 2-5** shows the pedestrian infrastructure within the APTC.

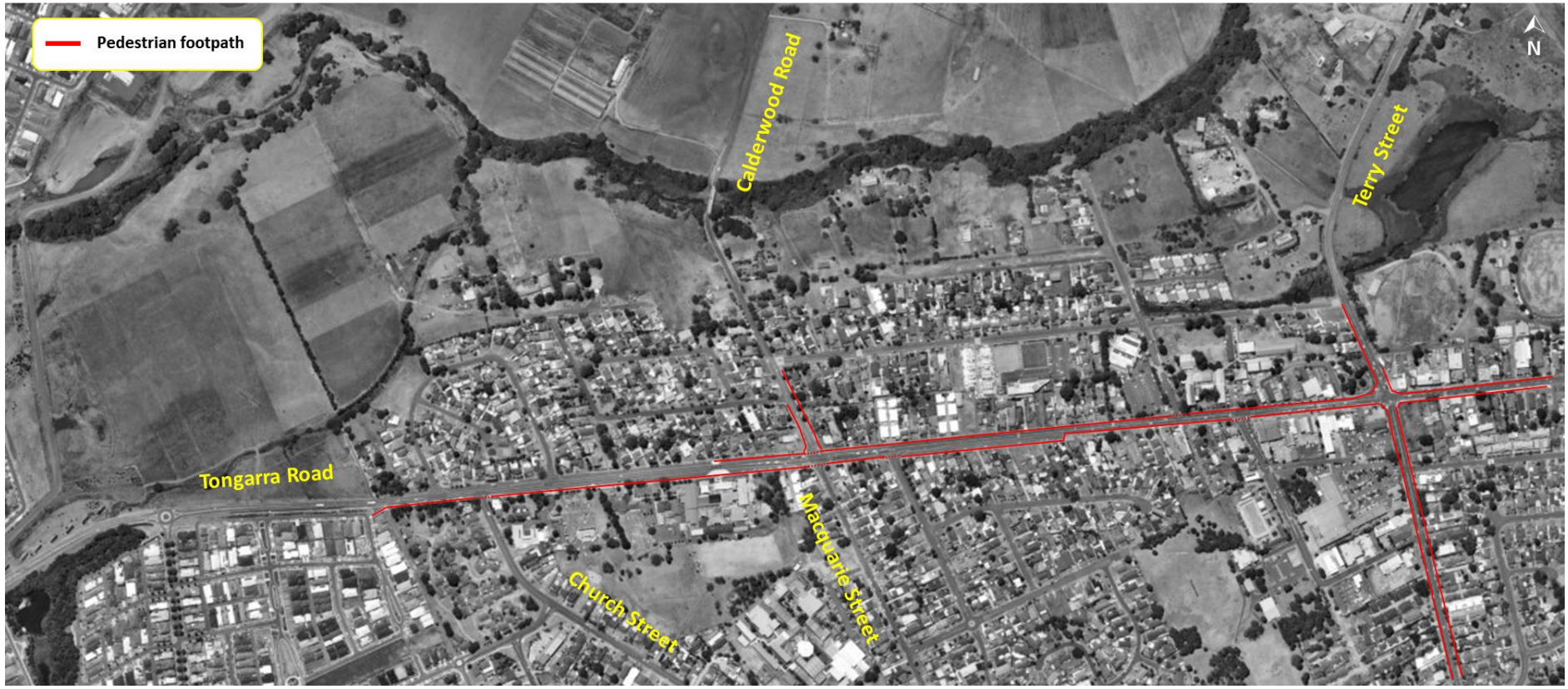


Figure 2-5 Pedestrian amenities

3 Traffic Modelling Assumptions

3.1 Methodology

Cardno adopted the following methodology for the Tripoli Way Extension assessment:

- Initially adopt the *2026 APRB Interim Year Stage 1* and *2041 APRB Design for Approval* AIMSUN models along with all approved land use and other assumptions (modelling exercise was based on AIMSUN v8.1.5 R501029)
- Re-run AIMSUN models using dynamic user equilibrium assignment method available within the software platform to replicate an accurate traffic assignment within the wider APRB network
- Extract traffic demand for smaller specified cordoned area along with assumed infrastructure upgrades
- Smaller cordoned networks were extracted from the larger models that focused on the local traffic operation around the APTC. The core model area is shown in **Figure 2-1**
- The cordon networks were further defined to develop a Build and No Build option. Build option refers to the Tripoli Way Extension construction. A full list of drawings included in the 100% Complete Concept Design is provided in **Appendix B**. The Build option followed the 100% concept design alignment (Drawing reference: 82016126-01 Tripoli Way Extension 100% Complete Concept Design) in the 2026 year with the addition of a signalised intersection at the intersection of Broughton Avenue, Illawarra Highway, Tongarra Road in the 2041 year (to be constructed by others).
- Modelling results and statistics focused on the APTC network performance.
- The modelling network performance statistics only quantify impacts on drivers and does not consider benefits to other users such as pedestrians and cyclists.

3.2 APRB Network geometry assumptions

The Tripoli Way Extension modelling exercise was based on the APRB AIMSUN models, *2026 APRB Interim Stage 1* and *2041 APRB Design for Approval*. The assessment adopted the Albion Park local road network and traffic demand assumptions, while investigating/testing further network geometry refinements, which ensured more detailed modelling around the Albion Park Town Centre (APTC) area. The Tripoli Way Extension models did not incorporate the infrastructure alignment of Tripoli Way as set in the aforementioned APRB models but followed the 100% concept design instead. Other local network mitigation measures identified in the APRB models were carried over to the Tripoli Way Extensions models.

The network geometry and infrastructure assumptions applied to the *2026 APRB Interim Year Stage 1* model are summarised below and depicted in **Figure 3-1**:

- Tripoli Way Extension assumed to be a two-lane carriageway with one lane in each direction between Broughton Avenue / Illawarra Highway and Terry Street / APRB ramps. Posted speed limit of 60km/h
- Terry Street / Tongarra Road intersection operates as existing (right turn bans on the eastern and western approach only) with additional 50m of parking removed
- Tripoli Way / Hamilton Road intersection is operating as a 4-approach give-way intersection with Hamilton Road giving way to major flow of Tripoli Way
- The Calderwood Development road network and Tripoli Way follows the alignment of the Calderwood Transport Management Accessibility Plan (TMAP) (2010)
- A simplified Calderwood Development road network is coded to contain the sub-arterial routes to capture major route choice in this area
- The Broughton Avenue / Illawarra Highway / Tripoli Way / Tongarra Road intersection operates as per the 100% concept design (i.e. single lane roundabout).

The network geometry and infrastructure assumptions applied to the *2041 APRB Design for Approval* model are summarised below and depicted in **Figure 3-2**:

- Tripoli Way Extension assumed to be a two-lane carriageway with two lanes in each direction between Broughton Avenue / Illawarra Highway and Terry Street / APRB ramps. Posted speed limit of 60km/h
- Terry Street / Tongarra Road intersection operates as current geometry configuration (all right turn bans) with additional 200m of parking removed in the eastern approach. Traffic signal operation was also adjusted to cater for additional traffic demand and growth

- Tripoli Way / Hamilton Road intersection is operating as a 4-approach give-way intersection with Hamilton Road giving way to major flow of Tripoli Way
- Terry Street / Church Street northern approach to and within the roundabout was widened to two lanes
- The Calderwood Development road network and Tripoli Way follows the alignment of the Calderwood Transport Management Accessibility Plan (TMAP) (2010)
- A simplified Calderwood Development road network is coded to contain the sub-arterial routes to capture major route choice in this area
- The Broughton Avenue / Illawarra Highway / Tripoli Way / Tongarra Road intersection operates as a signalised intersection (to be constructed by others).

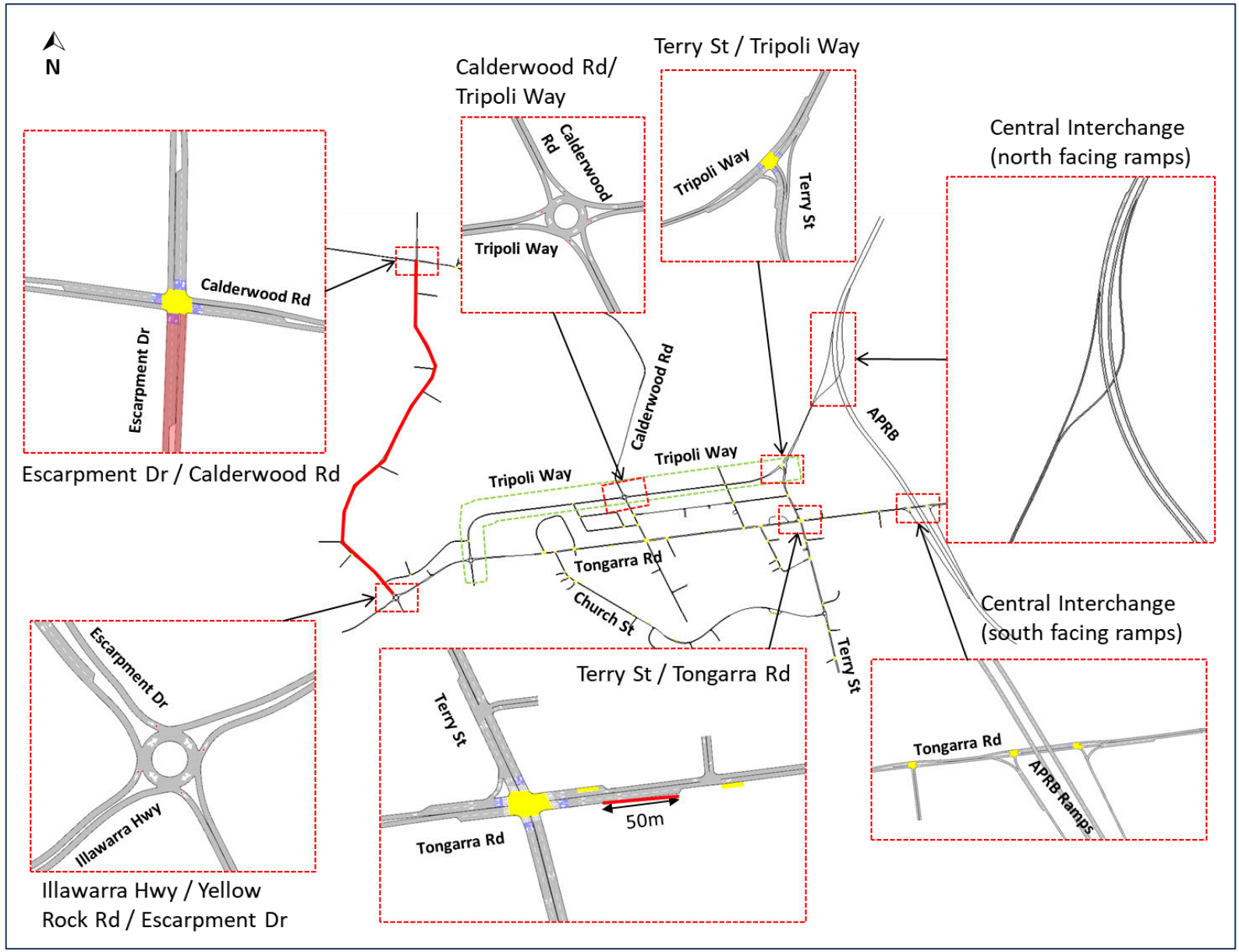


Figure 3-1 2026 APRB Interim Stage 1 model network layout

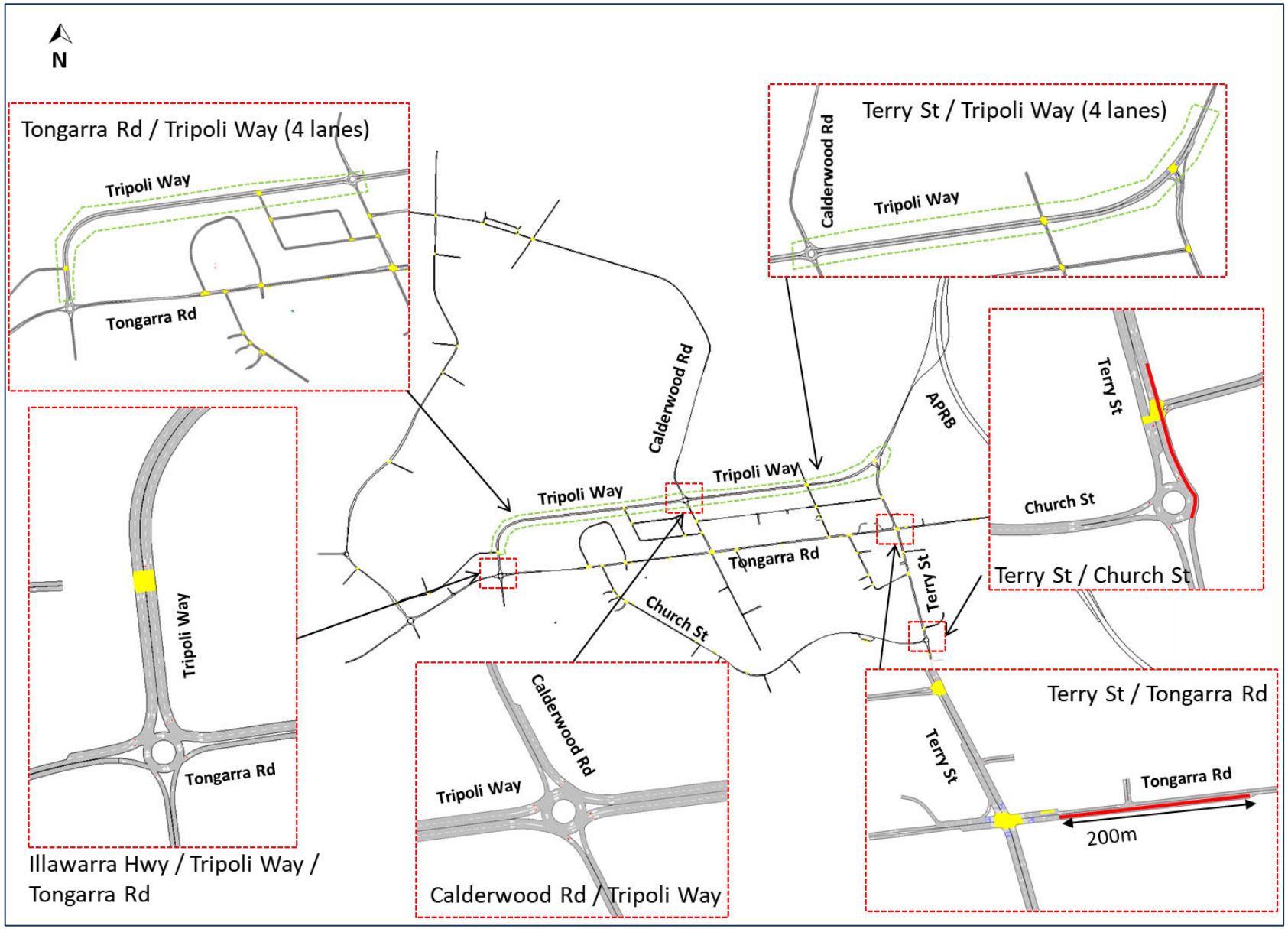


Figure 3-2 2041 APRB Design for Approval model network layout

3.3 Land use

The Department of Planning and Environment (DP&E) provided TfNSW with dwellings and employment forecasts for the West Lake Illawarra region out to 2067. Wollongong City Council supplemented these forecasts to reflect historical development and employment release rates to date.

Consultation between TfNSW, Wollongong City Council and the Department of Planning was undertaken to agree on the updated land use and employment forecasts for the project design horizons 2026 and 2041. The agreed forecasts for dwelling numbers and employment land for the West Lake Illawarra Region are outlined in **Table 3-1**. These numbers were adopted in the traffic assessment and are consistent with the ones adopted in the Albion Park Rail Bypass project.

Table 3-1 Agreed residential and employment forecasts for 2026 and 2041 model horizon years

Residential Development	2026 Forecast (Released Dwellings)	2041 Forecast (Released Dwellings)
West Dapto, stage 1	1,916	3,121
West Dapto, stage 2	1,202	1,962
West Dapto, stage 3	450	2,830
West Dapto, stage 4	470	470
West Dapto, stage 5	830	2,930
Tallawarra	504	600
Calderwood	2,068	5,068
Tullimbar	817	1,410
Total Residential Development	**8,257**	**18,391**
Employment Land	**2026 Forecast (Developable Hectares)**	**2041 Forecast (Developable Hectares)**
Heavy Industrial	12,8	34.4
Light Industrial	101.5	131.5

Figure 3-3 and **Figure 3-4** shows the agreed residential and employment land use along with the total number of dwellings and employment jobs per region for the proposed developments. An indication of the overall percentage of construction by 2026 and 2041 is also included. The ultimate development year is 2067.

These land use assumptions were adopted at the already existing *2026 APRB Interim Stage 1* and *2041 APRB Design for Approval* and carried forward for the purpose of the Tripoli Way Extension assessment.

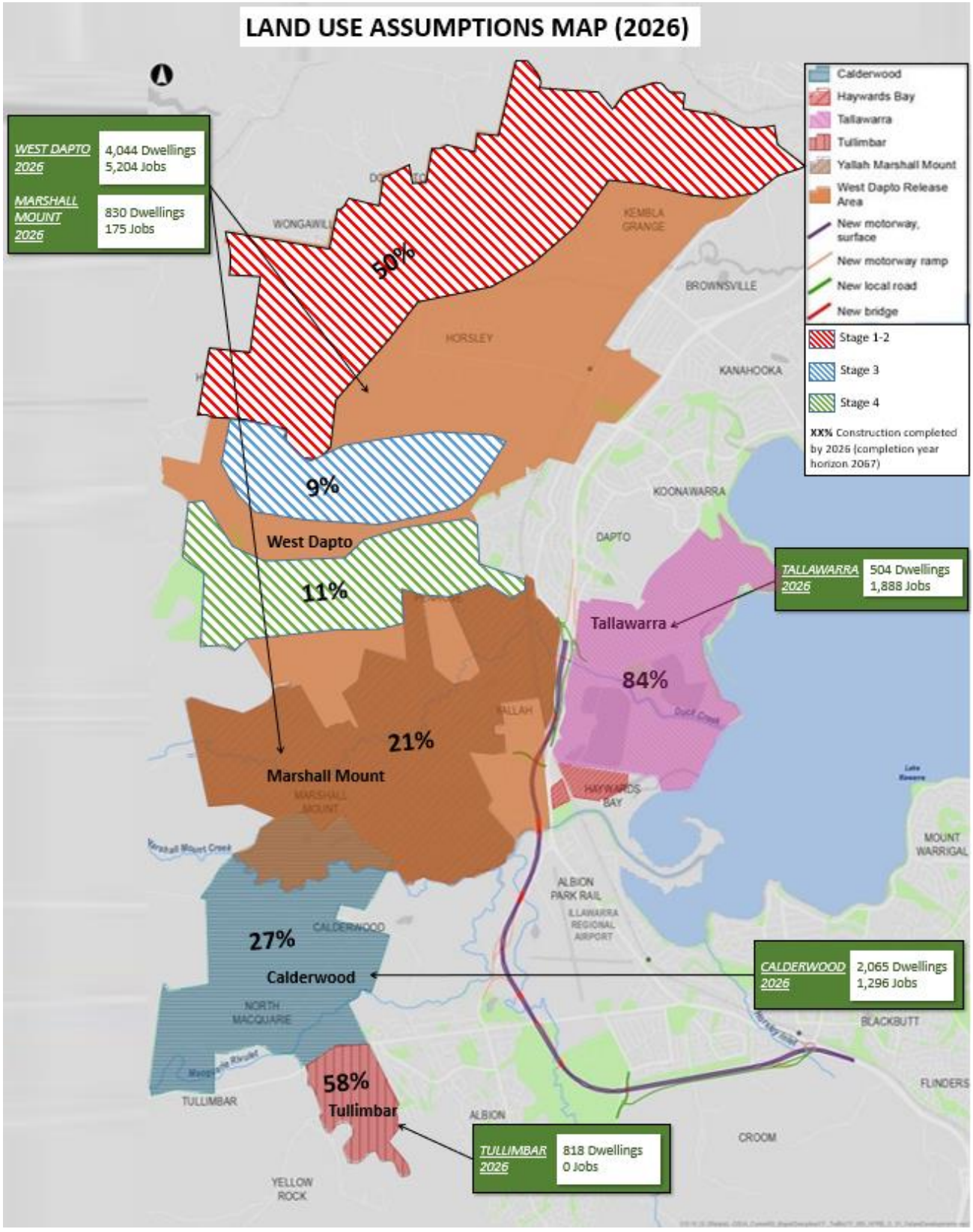


Figure 3-3 Land use assumption map (2026)

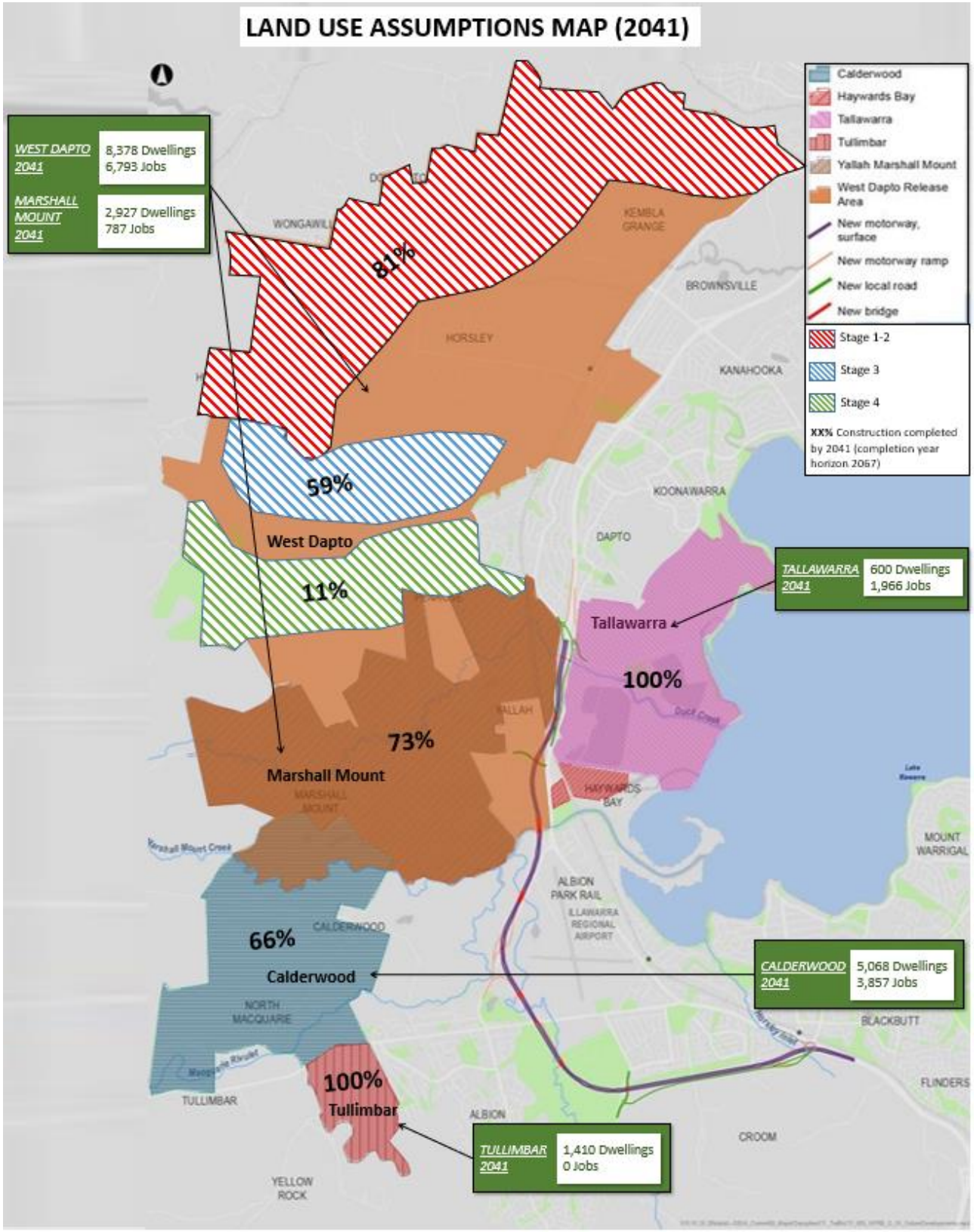


Figure 3-4 Land use assumption map (2041)

4 Operational Traffic Assessment

4.1 Core model area

The wider and core model areas that were assessed for the 2026 and 2041 design horizon years are shown in **Figure 4-1**.

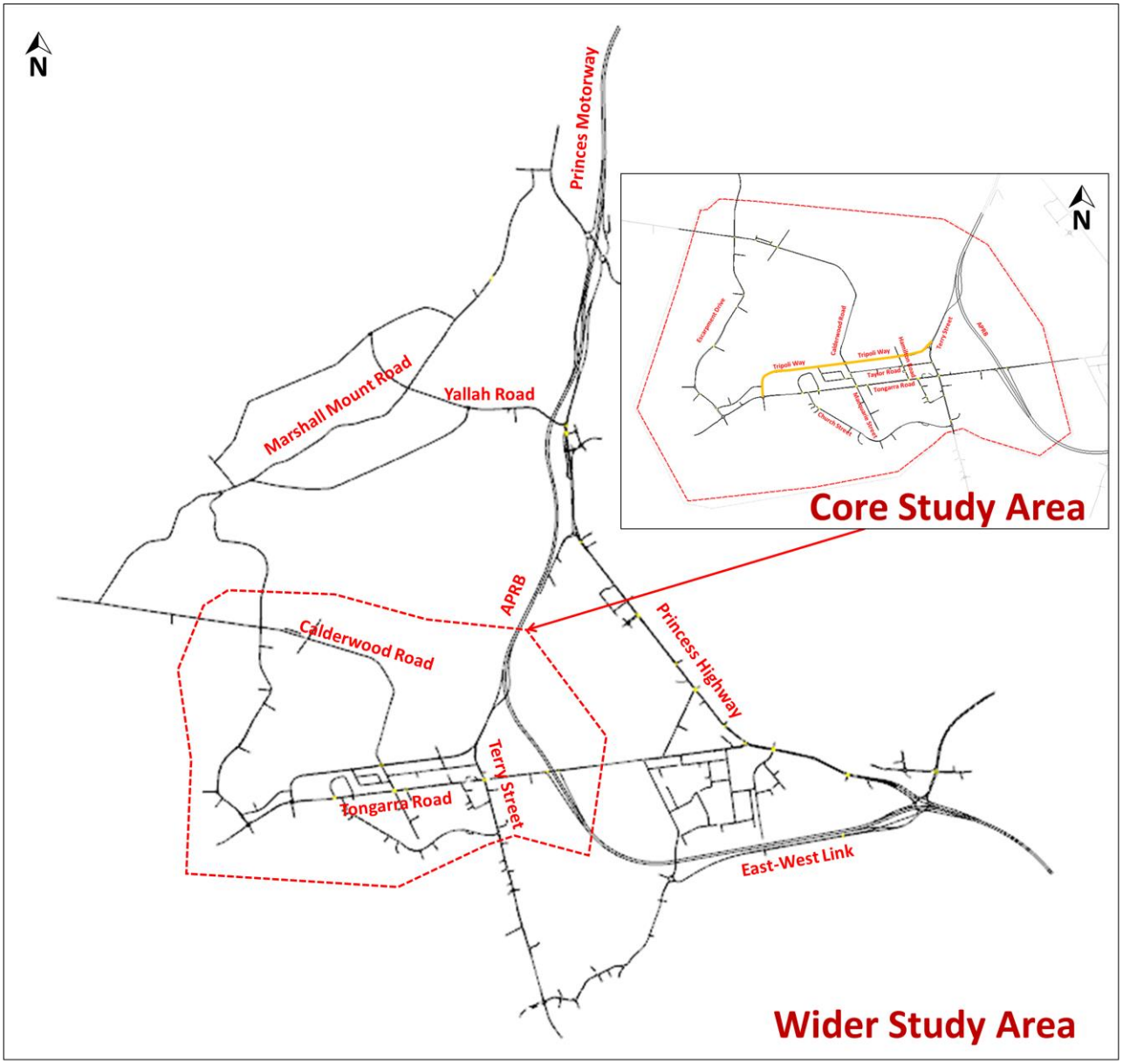


Figure 4-1 Wider and core study areas

The *2026 APRB Interim Year Stage 1* and *2041 APRB Design for Approval* AIMSUN models were used as the basis of this study. Smaller cordoned networks were extracted from wider APRB AIMSUN models that focused on the local traffic operation around the APTC. This cordoned model network included the key existing arterial roads within APTC as well as the new proposed geometry configurations along Tripoli Way and Calderwood Road shown in **Figure 4-2**.

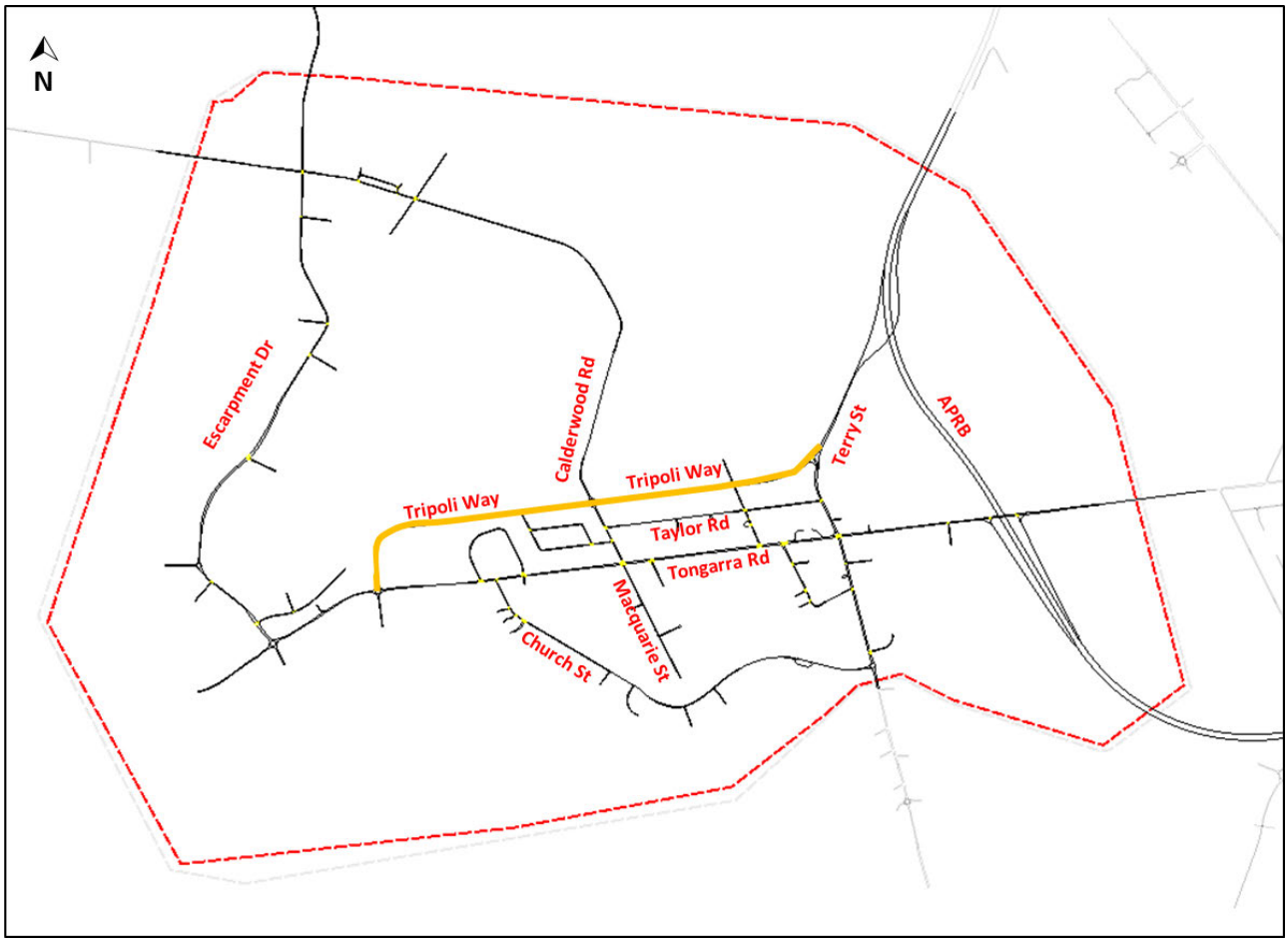


Figure 4-2 APTC core model area

The main intersections assessed within the cordoned area were the following:

- Tongarra Road / Calderwood Road / Macquarie Street
- Tongarra Road / Terry Street
- Calderwood Road / Tripoli Way
- Terry Street / Tripoli Way
- Illawarra Highway / Tongarra Road / Broughton Avenue
- Calderwood Road / Future Calderwood Valley Link / Escarpment Drive
- Tripoli Way / Hamilton Road.

Cardno extracted overall network performance statistics (including Vehicle Hours Travelled, Vehicle kilometres Travelled, Number of Stops, Average Speed & Delay and Unreleased Vehicles). Intersection operational performance including average vehicle delay, total intersection traffic volumes and Level of Service was also reported.

4.2 Modelled options

The modelling investigations were carried out for the short (2026) and long (2041) term design horizon years, which reflects the year of the Tripoli Way Extension opening and 15-year period after the proposed extension and intersection upgrades are expected to be constructed.

The time periods 8:00 – 9:00 and 17:00 – 18:00 were selected for the traffic models consistent with the modelled hours of the APRB base model (reflecting busiest 1-hour time interval). A 1-hour warm-up prior to the peak was also applied to the models.

The design years and options assessed are set out in **Table 4-1**.

Table 4-1 Summary of assessment options

Design Horizon Year	Development Option	Modelling Analysis	
		Weekday AM (8:00-9:00)	Weekday PM (17:00-18:00)
2026	Base Case / No Build	✓	✓
	Build*	✓	✓
2041	Base Case / No Build	✓	✓
	Build*	✓	✓

**Build option refers to the Tripoli Way Extension upgrade between Terry Street and Illawarra Highway / Broughton Avenue*

The Base Case/No Build options will reflect a do-minimum in regards to road network upgrades and is a standard procedure in future year modelling as it is the basis of comparison against the Build scenarios.

The following sections describe the infrastructure upgrades and alignment assumptions for the No Build and Build options.

The cordoned model network comprises 48 traffic zones. A traffic zone is a location within the network, which generates or attracts trips.

4.2.1 No Build

The No Build option assessed the APTC network performance without the Tripoli Way Extension in place as seen in **Figure 4-3**. The APRB is assumed to be fully constructed by 2026 and as such included as part of the assessment. The characteristics of the assessed intersections are summarised below:

Tongarra Road / Calderwood Road / Macquarie Street

- 4-approach traffic signal control intersection
- Single traffic lane with additional short right and left turn bays at eastern and western approaches. Single traffic lane with additional short left turn bay at northern approach.

Tongarra Road / Terry Street

- 4-approach traffic signal control intersection
- Banned right turn from west approach onto Terry Street (SB) and from east approach onto Terry Street (NB)
- Single traffic lane with additional short through turn bay at western approach along with left-turn give way slip lane. Single traffic lane with additional short left and through turn bay at eastern approach (additional 50m of parking removed by 2026 and 200m by 2041)
- Dual traffic lane at northern and southern approaches.

Illawarra Highway / Tongarra Road / Broughton Avenue

- 3-approach single lane circulatory roundabout.

Calderwood Road / Escarpment Drive

- 4-approach traffic signal control intersection with additional short through turn bay at all approaches.

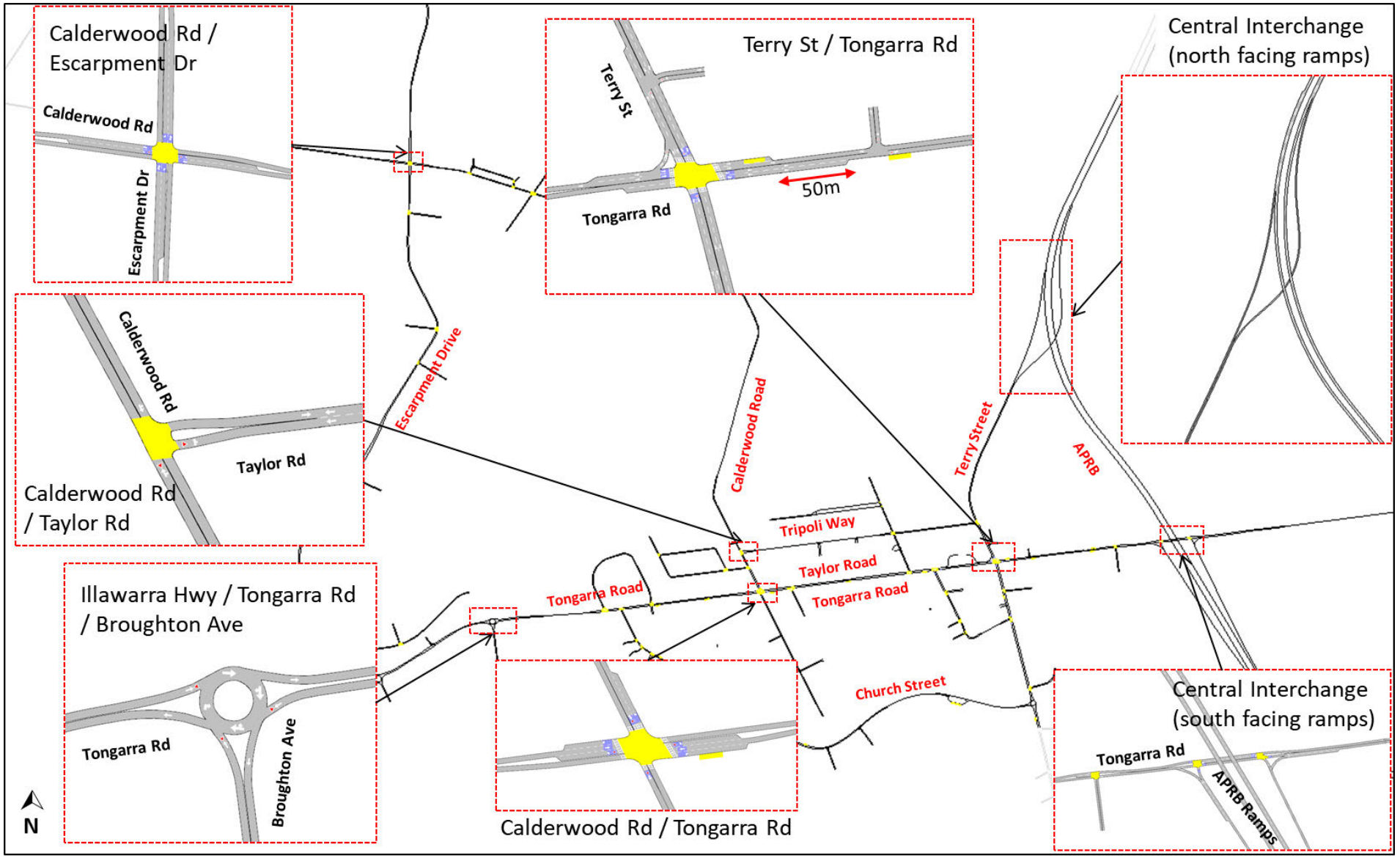


Figure 4-3 No Build model network layout

4.2.2 Build

Since the initial APRB and preliminary Tripoli Way Extension modelling assessments were completed, a 100% concept design for the Tripoli Way alignment and intersection design layouts between Illawarra Highway / Tongarra Road and Terry Street / APRB have been prepared by Cardno. The Build option adopted the proposed infrastructure recommendations as summarised in **Figure 4-4** for 2026 and **Figure 4-5** for 2041.

The build model includes the introduction of the Tripoli Way Extension and new proposed intersections at Calderwood Road, Hamilton Road and Terry Street, which are described below. All other intersection layouts within the model remain the same as described in the No Build option (**Section 4.2.1**).

Illawarra Highway / Tongarra Road / Broughton Avenue / Tripoli Way intersection

- 4-approach roundabout control intersection with single lane arrangement at all approaches in 2026.
  - Additional approach at northern side of Illawarra Highway / Tongarra Road / Broughton Avenue to connect Tripoli Way Extension.
- Upgraded to a signalised 4-approach intersection in 2041.
  - Dual traffic lanes at northern and southern approaches.
  - Single traffic lane with additional shared through & left turn short bay at the eastern and western approaches along with a dedicated short right turn bay. Single lane exit lane with additional short 100m downstream merge lane

Moles Street / Tripoli Way intersection

- Conversion of Moles Street to a left-in/left-out give-way arrangement (Moles Street giving way to Tripoli Way).

Hamilton Road / Tripoli Way intersection

- 4-approach traffic signal control intersection
- All movements are permissible. Note that the northern approach of Hamilton Road only serves eight (8) dwellings and as such will have no effect on the intersection's performance.

Calderwood Road / Tripoli Way intersection

- 4-approach traffic signal control intersection
- Single traffic lane with additional shared through & left turn short bay at western approach along with dedicated short right turn bay. Single lane exit lane with additional short 150m downstream merge lane
- Dual traffic lanes with additional short right turn bay at eastern approach. Dual lanes at eastern exit approach
- Dual traffic lanes at northern and southern approaches.

Terry Street / Tripoli Way intersection

- 3-approach traffic signal control intersection
- Dual traffic lanes at the northern approach, with an additional short lane dedicated for right turns. The middle lane is a shared through-and-right turn lane, and the outside lane allows for through movements only. Two lanes are provided for exit movements in the southbound direction.
- Dual traffic lane at southern approach. Single exit lane with additional short 150m downstream merge lane
- Dual right turn traffic lanes with two additional short left turn bays at western approach. Dual exit lanes.

A 2.5m shared user path for active transport is proposed on the northern side of the alignment for the entire length of Tripoli Way between Broughton Avenue / Tongarra Road intersection and Terry Street. In addition, a 1.5m footpath is proposed on the southern side of the alignment from Hamilton Road to Moles Street.

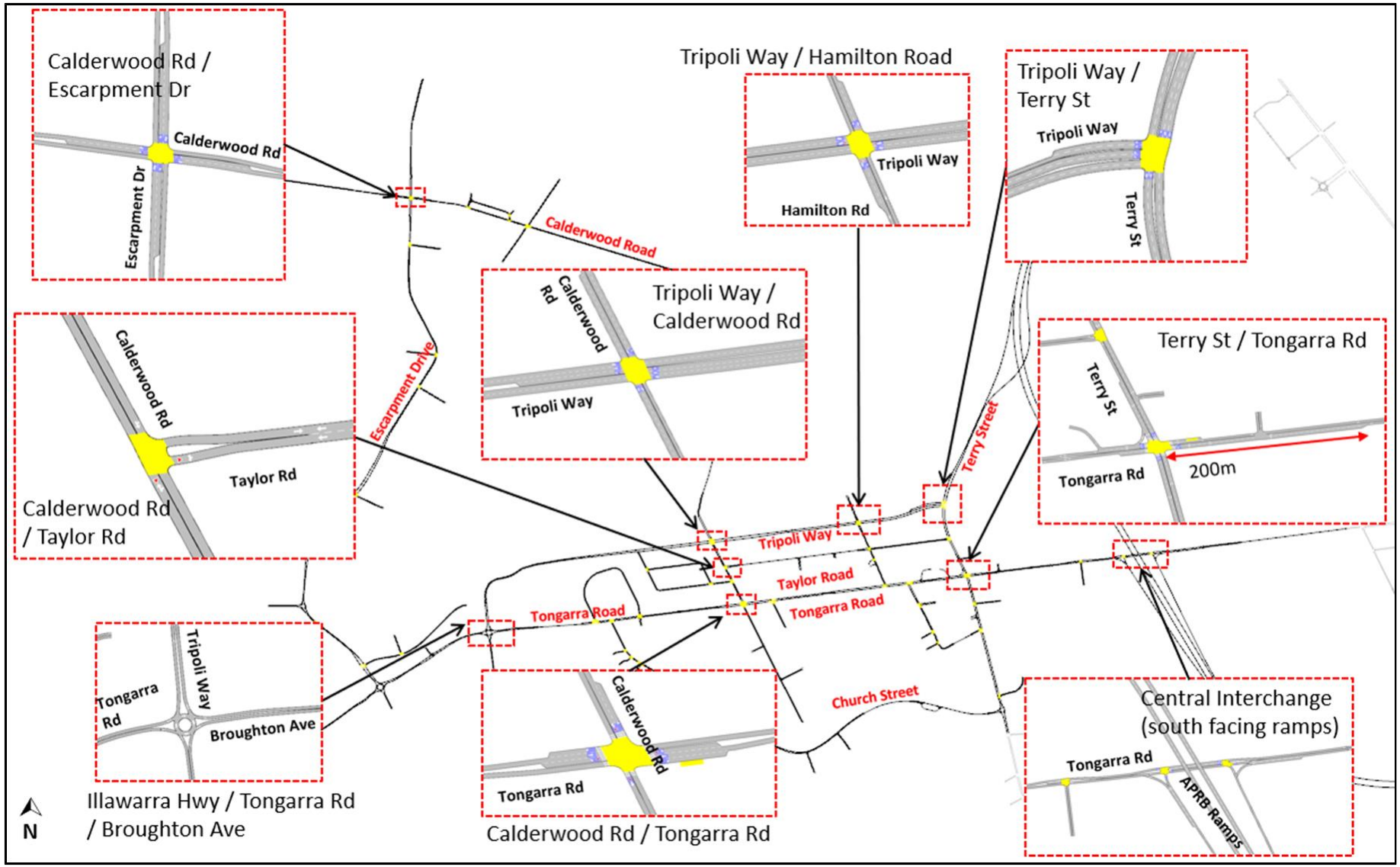


Figure 4-4 2026 Build model network layout

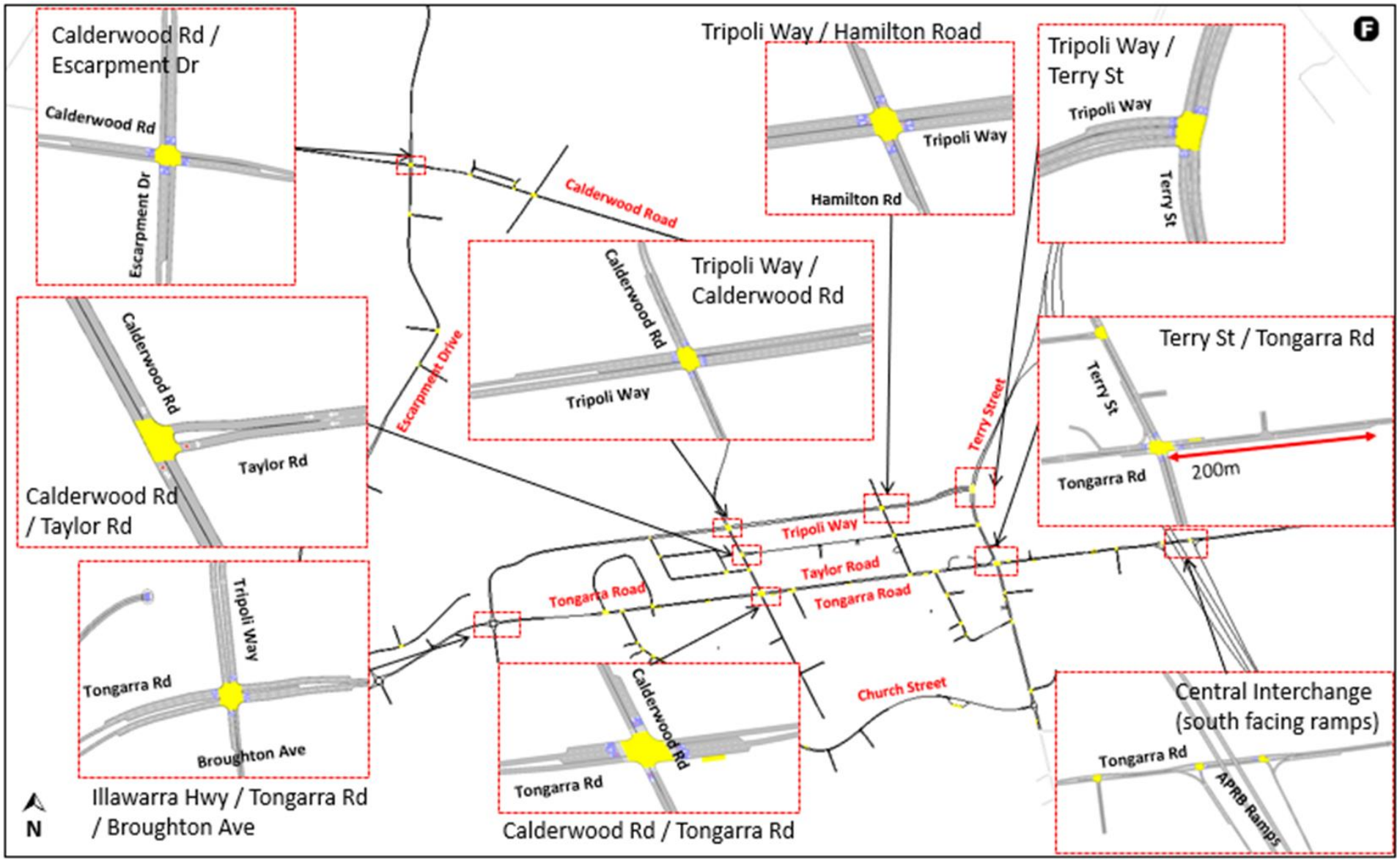


Figure 4-5 2041 Build model layout

4.3 Future year demand

Based on the land use assumptions mentioned in **Section 3.3**, the traffic demand across the core modelled network was applied for the different design years in the morning and evening weekday peak hour, shown in **Table 4-2**.

Table 4-2 Future traffic demand (core model area)

Vehicle Type	2026		2041		2041 vs 2026 absolute growth		2041 vs 2026 % growth	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Light Vehicles	8,712	9,338	11,669	12,433	2,957	3,095	33.9%	33.1%
Heavy Vehicles	516	389	927	589	411	200	79.7%	51.4%
Total Vehicles	9,228	9,727	12,596	13,022	3,368	3,295	36.5%	33.9%

Under both 2026 and 2041 design years, the PM peak period caries slightly higher traffic demand across the network compared to the AM peak. Traffic growth is expected to increase between 2026 and 2041 by 36.5% and 33.9% in the AM and PM peaks respectively.

4.4 Key Intersections Operation and Network Performance

The main reporting findings focused on the Level of Service (LoS), delay and traffic volumes for the intersections specified in **Section 4.1**. The section also summarises overall network performance statistics across the two years and options to quantify the benefit/impact of the Tripoli Way Extension.

4.4.1 Network performance statistic summary

The APRB modelling exercise (as described in section 1.3 of this report) identified, at a preliminary level, that the network requires Tripoli Way Extension to be operational with one travel lane in both directions by 2026 and two lanes in both directions by 2041. As the No Build option assesses the APTC network without Tripoli Way in place, it is expected that very high levels of congestion and queueing will occur within the network by 2041.

This is further supported through the unreleased demand statistic obtained through the models. This statistic identifies the number of vehicles that were unable to enter the modelled network in each hour, due to queues extending past the modelled area.

It is important to note that the 2041 No Build overall operation is not considered realistic. This is because the AIMSUN models were “gridlocking”, which refers to the inability of a network’s capacity to absorb the input traffic demand. Essentially, the traffic demand by 2041 is very high for the available capacity within the Albion Park Town Centre (without Tripoli Way) to be absorbed. This leads to a standstill and vehicle blockage across all the roads within the study area, which in turn does not allow the entire traffic demand to be released within the model network.

Table 4-3 summarises the network performance statistics for the four (4) assessed options.

Table 4-3 Network performance statistic summary

Statistic	2026 No Build		2026 Build		2026 Build vs No Build % growth	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Vehicle Kilometres Travelled VKT (km)	36,021	33,487	36,465	37,904	1.2%	13.2%
Vehicle Hours Travelled VHT (hrs)	966	751	641	657	-33.6%	-12.6%
Average Speed (km/hr)	50	54	60	60	17.9%	11.4%
Average Delay (secs)	68	50	23	28	-66.2%	-43.8%
Total Stops	11,114	8,774	5,778	7,125	-48.0%	-18.8%
Vehicles Completed (vehicles)	8,963	8,465	9,277	9,844	3.5%	16.3%

Vehicles in Simulation (vehicles)	1,160	1,370	612	572	-47.2%	-58.3%
Unreleased Vehicles (vehicles)	40	939	2	25	-96.0%	-97.4%
	2041 No Build		2041 Build		2041 Build vs No Build % growth	
Statistic	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
VKT (km)	23,002	22,107	48,787	51,915	112.1%	134.8%
VHT (hrs)	952	856	1,001	1,039	5.2%	21.4%
Average Speed (km/hr)	43	45	55	56	27.8%	23.6%
Average Delay (secs)	128	138	34	36	-73.3%	-73.8%
Total Stops	6,317	7,340	9,575	10,514	51.6%	43.2%
Vehicles Completed (vehicles)	5,360	5,183	12,448	13,289	132.2%	156.4%
Vehicles in Simulation (vehicles)	4,773	4,666	988	868	-79.3%	-81.4%
Unreleased Vehicles (vehicles)	5,487	7,086	86	10	-98.4%	-99.9%

**The unreleased demand of the 2041 No Build option is not representative/accurate and it provides with an unrealistic level of unreleased vehicles in the network. This is because of the significant increase in traffic demand without Tripoli Way Extension, which causes a gridlock effect within the network, therefore restricting the ability of additional vehicles to enter the network.*

The Build option shows significant improvements in all the assessed statistics compared to the No Build. This is consistent for 2026 and 2041.

Average speed increases by approximately 18% (AM peak) and 11% (PM peak) in 2026 with the average vehicle delay being reduced by approximately 66% and 44% in the respective time periods. The introduction of Tripoli Way Extension also shows improvements in 2041 average speed with increases in travel speed of approximately 28% (AM peak) and 24% (PM peak).

As it can be seen in **Table 4-3**, the amount of unreleased demand drops close to zero in the 2026 Build option compared to the 40 and 939 vehicles of the 2026 No Build in the AM and PM peaks respectively. Significant improvement is also observed in the 2041 Build option, which removes the gridlock effects experienced in the 2041 No Build and as such allows for an additional 5,400 and 7,000 vehicles to be loaded into the network in the AM and PM peaks, respectively.

Finally, the VHT results are a single figure summary used as an indication of the whole network performance by identifying whether or not the model has unrealistic “gridlocks” and/or excessive delays. VHT consists of the sum of travel time for every single vehicle across the whole network and therefore can identify congestion within a network. In AIMSUN, VHT is calculated only for the vehicles which were able to complete the respective trips from origin to destination. Any vehicles remaining in the system during the simulation period are excluded from the total system travel-time as they are unable to generate a complete travel time. VHT improves in the 2026 Build option by approximately 34% (AM peak) and 13% (PM peak). As the models were gridlocking in the 2041 No Build option, a comparison between the Build and No Build VHT is not considered realistic as the increase seen in the Build option is due to the capability of the model to accommodate more traffic.

4.4.2 Level of service

4.4.2.1 Level of service criteria threshold

In an urban area, the capacity of a road network can largely be 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

Level of Service	Average Delay per Vehicle (seconds)	Traffic Signals, Roundabout	Give Way & Stop Signs
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

**For traffic signals, the average movement delay and level of service over all movements is considered. For roundabouts and priority control intersections the level of service is based on the modelled delay for the most/worst delay movement.*

Source: Traffic Modelling Guidelines (RMS, 2013)

The Average Vehicle Delay (AVD) provides a measure of the operational performance of an intersection and determines the LoS when applying the RMS method. It should be noted that the AVD's should be taken as a guide only as longer delays could be tolerated in some locations (i.e. inner-city conditions) and on some roads (i.e. minor side street intersecting with a major arterial route). For traffic signals, the weighted average delay over all movements should be utilised. For roundabouts and priority control intersections (sign control) the critical movement for assessing LoS should be the movement with the highest average delay.

The Degree of Saturation (DoS) is another measure of the operational performance of individual intersections. For intersections controlled by traffic signals, both queue length and delay increase rapidly as DOS approaches 1.0. It is usual to attempt to keep DOS to less than 0.9. Degrees of Saturation in the order of 0.7 generally represent satisfactory intersection operation. When DOS exceed 0.9 queues can be anticipated.

4.4.2.2 APTC LoS results

Table 4-5 and **0** below summarises the LoS results for the key intersections of APTC.

Table 4-5 Intersection operational performance (LoS) - 2026

Intersection Name	2026 No Build						2026 Build					
	Volume (veh/h)	AM Peak Average Delay (secs)	LoS	Volume (veh/h)	PM Peak Average Delay (secs)	LoS	Volume (veh/h)	AM Peak Average Delay (secs)	LoS	Volume (veh/h)	PM Peak Average Delay (secs)	LoS
Broughton Ave / Illawarra Hwy	945*	5.9*	A*	985*	5.1*	A*	2,118	19.3	B*	1,903	19.0	B
Macquarie St / Tongarra Road / Calderwood Rd	2,161	100.8	F	2,080	36.3	C	1,506	26.7	B	1,469	14.5	B
Terry St / Tongarra Rd	3,880	97.4	F	3,578	61.8	E	3,17	47.3	D	3,333	43.0	D
Calderwood Rd / Escarpment Dr	594	25.9	B	713	24.5	B	599	25.1	B	714	24.6	B
Calderwood Rd / Tripoli Way	N/A			N/A			1,608	28.2	B	1,116	22.0	B
Terry St / Tripoli Way	N/A			N/A			2,325	29.6	C	2,244	28.4	B
Tripoli Way / Hamilton Rd	N/A			N/A			1,242	7.5	A	1,180	10.3	A

** Refer to text below about gridlocking*

Table 4-6 Intersection operational performance (LoS) - 2041

Intersection Name	2041 No Build						2041 Build					
	Volume (veh/h)	AM Peak Average Delay (secs)	LoS	Volume (veh/h)	PM Peak Average Delay (secs)	LoS	Volume (veh/h)	AM Peak Average Delay (secs)	LoS	Volume (veh/h)	PM Peak Average Delay (secs)	LoS
Broughton Ave / Illawarra Hwy	259*	219.9*	F*	415*	154.1	F	2,521	48.6	D*	2,486	41.4	C
Macquarie St / Tongarra Road / Calderwood Rd	534	316.2	F	1,028	149.9	F	1,812	38.9	C	1,990	36.8	C
Terry St / Tongarra Rd	842	80.8	F	938	75.3	F	4,052	30.6	C	4,251	38.7	C
Calderwood Rd / Escarpment Dr	1,191	18.0	B	1,091	66.2	E	2,225	16.9	B	2,180	13.4	A
Calderwood Rd / Tripoli Way	N/A			N/A			2,563	48.9	D	2,361	52.1	D
Terry St / Tripoli Way	N/A			N/A			3,473	49.5	D	3,323	36.6	C
Tripoli Way / Hamilton Rd	N/A			N/A			1,985	8.8	A	2,013	9.5	A

** Refer to text below about gridlocking*

Under the 2026 No Build option, the intersections of Macquarie Street / Tongarra Road / Calderwood Road and Terry Street / Tongarra Road are all operating unsatisfactorily at LoS F in the AM peak. The remaining critical intersections are operating at acceptable LoS of B or better. In the PM peak period, all intersections operate at LoS D or better with the exception of Terry Street / Tongarra Road that operates at an LoS of E. Extensive queueing along the northern approach Terry Street / Tongarra Road is observed, which spills back to the adjacent intersection of Terry Street / Taylor Road.

Modelling results suggest that the proposed intersection upgrades along with the installation of Tripoli Way Extension under the 2026 Build option will improve the operational performance for the majority of key intersections compared to the No Build. All intersections are operating at acceptable LoS D or better.

In the 2026 AM peak, Terry Street / Tongarra Road will improve to LoS D whereas Macquarie Street / Tongarra Road / Calderwood Road intersection will improve at LoS B. In the PM peak, the intersection of Terry Street / Tongarra Road will improve to LoS D. The new installed signalised intersections at Calderwood Road / Tripoli Way, Hamilton Road / Tripoli Way and Terry Street / Tripoli Way will operate at satisfactorily LoS C or better in both peak periods.

Under the 2041 No Build option, the majority of intersections are operating at LoS F with high delays. It is important to note that in the 2041 No Build option, the overall operation is not considered to be realistic. This is because the AIMSUN models were “gridlocking”, which refers to the inability of a network’s capacity to absorb the input traffic demand. Essentially, the traffic demand by 2041 is much higher than the available capacity within the Albion Park Town Centre (without the Tripoli Way Extension) to be absorbed. This leads to a standstill and vehicle blockage across all the roads within the study area. Since roadways become completely blocked, new vehicles can’t enter the road network as shown by the Unreleased Vehicles statistic in **Table 4-3**. In the 2041 No Build option, the unreleased demand exceeds 5400 vehicles in the AM Peak and 7000 vehicles in the PM peak.

The modelled traffic volumes through intersections can be very low in gridlocking scenarios as they become inaccessible to traffic, with all available routes to the intersection blocked by long queues. This can be seen in **Tables 4-5** and **4-6** at the Broughton Avenue / Illawarra Highway intersection, where the No Build options show very low traffic volumes (and consequently good LoS results) while the Build options show larger volumes and worse LoS results. Hence the comparison of the LoS results between the No Build and the Build options (in both the 2026 and 2041 years) at the Broughton Avenue / Illawarra Highway intersection provides an unrealistic point of reference; and instead, the LoS for the 2041 year should be considered independently when considering the benefits of the Project (i.e. Los B and Los D in 2026 and 2041 respectively, both of which are considered adequate levels of performance).

The introduction of Tripoli Way Extension shows significant traffic circulation improvements in the 2041 Build option as the gridlocking issues experienced in the No Build are resolved. In both the AM and PM peak periods, all intersections are operating satisfactorily (at LoS D or better) and the number of unreleased vehicles has reduced to less than 90 vehicles.

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5 Conclusion

The proposed upgrade and extension of Tripoli Way would contribute to an efficient and functional road network. The proposed Tripoli Way Extension would reduce potential congestion within the surrounding road network and assist in meeting the increased demand of road users as development occurs in the Calderwood area.

The modelling investigations were carried out for the No Build and Build options under 2026 and 2041, which reflects the year of opening and a 15-year horizon period post project opening. The Traffic and Transport Impact Assessment undertaken for the Tripoli Way Extension results in the following conclusions:

- The Tripoli Way Extension modelling exercise was based on the APRB AIMSUN models, *2026 APRB Interim Stage 1* and *2041 APRB Design for Approval* as an initial basis and were further refined
- Traffic growth is expected to increase between 2026 and 2041 by 36.5% and 33.9% in the AM and PM peaks respectively
- Intersection operational performance shows congestion and queueing issues under the 2026 and 2041 No Build option (AM and PM peaks) across APTC's key intersections. Under both peak periods of the 2041 No Build option, the models cannot cope with the increased throughput traffic demand (due to insufficient traffic capacity), which in turn causes a "gridlock" effect on the network. As such the modelling results of this option are not considered realistic and cannot be used for comparison purposes
- Under the 2026 Build option, operational performance improves for the majority of the network with all intersections operating at LoS D or better in both peak periods
- Under both peaks of the 2041 Build option, all intersections are operating at LoS D or better.

Overall modelling results suggest that the proposed intersection upgrades along with the installation of Tripoli Way Extension will significantly improve the operational performance for the majority of key intersections compared to the No Build option. This is a result of the additional traffic capacity and route selection that is introduced when Tripoli Way becomes operational.

APPENDIX A

CRASH DEFINITIONS

NSW GOVERNMENT Transport for NSW

Centre for Road Safety

Definitions and notes to support road crash data

NSW Centre for Road Safety, September 2019

September 2019

Contents

Date:	September 2019
Version:	1.0
Reference:	Statistics
Division:	Centre for Road Safety

1 Crash statistics

1.1 Guidelines

Our statistics are confined to crashes that conform to the national guidelines for reporting and classifying road vehicle crashes. The guidelines include crashes that meet all of these criteria:

- Were reported to the police
- Occurred on a road open to the public
- Involved at least one moving road vehicle
- Involved at least one person being killed or injured or at least one motor vehicle being towed away.

Reports for some crashes are not received until well into the following year and after the annual crash database has been finalised. These amount to fewer than 1 per cent of recorded crashes and are counted in the following year's statistics.

1.2 Crash reporting

Before 2000, Section 8 (3) of the Traffic Act 1909 required a road crash in NSW to be reported to the police when any person was killed or injured, or there was property damage of more than $500.

On 1 December 1999, the Traffic Act was repealed and replaced by new traffic legislation including the adoption of the Australian Road Rules. The new traffic legislation is found in the Road Transport (General) Act 1999 and the Road Transport (Safety and Traffic Management) Act 1999 and the regulations made under those Acts.

Rule 287 (3) of the Road Rules requires a crash to be reported to police when any person is killed or injured; when drivers involved in the crash do not exchange particulars; or when a vehicle involved in the crash is towed away.

2 Interactive crash statistics

2.1 Date of crash

Data presented in these displays is based on the ‘reporting year’ of the crash to police.

2.2 Road User data

In some displays the Road User values ‘Other Controller’ (e.g horse riders) and ‘Other Passenger’ (e.g train or light rail passenger) have been suppressed. However, the Grand Total will include these values.

2.3 Pedal cycle crashes

There are two means for which pedal cycle crashes are identified and included in the CRS crash database. The first is where pedal cycle crashes are reported to NSW Police. The injury severity of the pedal cyclists involved is determined by the regular linkage of these records with NSW Ministry of Health data collections. A pedal cyclist record linked to a hospital stay is classified as a ‘matched serious injury’.

Many pedal cyclists admitted to a hospital are for various reasons unable to be linked to a police report. This second process of identification results in a cohort of seriously injured pedal cyclists classified as ‘unmatched serious injuries’. Interactive crash statistic displays that only use matched serious injuries will therefore under report the extent of road trauma involving pedal cyclists.

3 Definitions and notes

Aboriginal: CRS uses an algorithm derived by the NSW Ministry of Health to report on Aboriginal and Torres Strait Islander status.

Alcohol involved in crash: Determined by whether any of the vehicle drivers or riders in the crash had an illegal level of alcohol.

Animal rider: A person sitting on or riding a horse or other animal.

Articulated truck: Any articulated tanker, semi-trailer, low loader, road train or B-double.

Bicycle rider: See Pedal cycle rider.

Bus: Includes State Transit Authority bus and long distance/tourist coach.

Car: Includes sedan, station wagon, utility (based on car design), panel van (based on car design), coupe, hatchback, sports car, passenger van and four-wheel-drive passenger vehicle.

Carriageway: That part of the road improved or designed to be ordinarily used by moving vehicles. When a road has two or more of these parts, divided by a median strip or other physical separation, each of these is a separate carriageway.

Casualty: Any person killed or injured because of a crash.

Controller: A person occupying the controlling position of a road vehicle.

Country: All local government areas except Newcastle, Lake Macquarie, Wollongong and Shellharbour, as well as those in metropolitan Sydney.

Crash: Any unplanned event involving a road vehicle on a road that results in death, injury or property damage and is reported to the police.

Crash type: The type of crash grouped according to the road user movement code recorded (see Road user movement code).

Driver: A controller of a motor vehicle other than a motorcycle

Emergency vehicle: Includes ambulance, fire brigade vehicle, police patrol car (or van) and tow truck.

Fatal crash: A crash for which there is at least one fatality.

Fatality: A person who dies within 30 days from injuries received in a road traffic crash.

Footpath: That part of the road which is ordinarily reserved for pedestrian movement as a matter of right or custom.

Heavy truck: Any heavy rigid truck or articulated truck.

Heavy rigid truck: Any rigid lorry or rigid tanker with a tare weight in excess of 4.5 tonnes.

High Threat to Life Indicator (HTTL): An alternative dimension of severity based on a person's probability of survival. This metric is based on a person's worst injury where the lowest SRR (Survival Risk Ratio) of all diagnosis codes for the first admission is used to calculate ICISS (ICD-based Injury Severity Score). ICISS values are banded into two categories and have the following survival probabilities:

Yes - at most 94.1%

No – at least 94.1%

Injury severity category: A dimension of severity based on a person's probability of survival. This metric is based on a person's worst injury where the lowest SRR (Survival Risk Ratio) of all diagnosis codes for the first admission is used to calculate ICISS (ICD-based Injury Severity Score). ICISS values are banded into four categories and have the following survival probabilities:

Maximum severity - at most 85.4%

High severity - between 85.4% and 96.5%

Moderate severity - between 96.5% and 99.2%

Minimum severity - at least 99.2%

Intersection crash: A crash where the first impact occurs at or within 10 metres of an intersection.

Killed: See Fatality.

LGA: The local government area where the crash occurred.

Light truck: Includes panel van (not based on car design), utility (not based on car design) and mobile vending vehicle.

Location of injury: Location of Injury is also derived from the Principal Diagnostic Code of the first linked Admitted Patient Data Collection (APDC) record of the patient. It provides a description of the region of the body the principal injury occurred.

Metropolitan: All local government areas in metropolitan Sydney, as well as Newcastle, Lake Macquarie, Wollongong and Shellharbour.

Minor / Other injured: A person identified as a casualty in the Police crash report data who is not matched to a hospital stay or an emergency department attendance record; or a previously defined No Injury CrashLink record matched to a SIRA CTP record with an MAIS Score of 1 (Minor).

Moderately injured: A person identified in CrashLink (casualty or driver or rider) who is matched to an emergency department attendance record on the same day or on the day after a crash but was not killed or not subsequently admitted to hospital; or a previously defined Minor/Other or No Injury CrashLink record matched to a SIRA CTP record with a MAIS score of 2 (Moderate) or higher.

Motor vehicle: Any road vehicle that is mechanically or electrically powered but not operated on rails.

Motorcycle: Any mechanically or electronically propelled two or three-wheeled machine with or without sidecar. Includes solo motorcycle, motorcycle with sidecar, motor scooter, mini-bike, three-wheeled special mobility vehicle and moped (motorised 'pedal cycle').

Motorcycle passenger: A person on but not controlling a motorcycle.

Motorcycle rider: A person occupying the controlling position of a motorcycle.

Motorcyclist: Includes motorcycle riders and motorcycle passengers.

Natural lighting conditions: The natural lighting at the time of the crash.

Nature of injury: Nature of Injury is derived from the Principal Diagnostic Code of the first linked Admitted Patient Data Collection (APDC) record of the patient. It describes the kind of injury sustained by the person.

Newcastle metropolitan area: The local government areas of Newcastle and Lake Macquarie cities.

Non-casualty crash: A crash in which at least one vehicle is towed away where there is no death and no person injured.

Passenger: Any person, other than the controller, who is in, on, boarding, entering, alighting or falling from a road vehicle at the time of the crash, provided a portion of the person is in or on the road vehicle.

Pedal cycle: Any two or three-wheeled device operated solely by pedals and propelled by human power except toy vehicles or other pedestrian conveyances. Includes bicycles with side-car, trailer or training wheels attached.

Pedal cycle passenger: A person on but not controlling a pedal cycle.

Pedal cycle rider: A person occupying the controlling position of a pedal cycle.

Pedal cyclist: Includes pedal cycle riders and pedal cycle passengers.

Pedestrian: Any person who is not in, on, boarding, entering, alighting or falling from a road vehicle at the time of the crash.

Pedestrian conveyance: Any device, ordinarily operated on the footpath, by which a pedestrian may move, or by which a pedestrian may move another pedestrian or goods. Includes non-motorised scooter, pedal car, skateboard, roller skates, in-line skates, toy tricycle, unicycle, push cart, sled, trolley, non-motorised go-cart, billycart, pram, wheelbarrow, handbarrow, non-motorised wheelchair or any other toy device used as a means of mobility.

Reporting year: The year in which the crash was recorded for reporting purposes.

RMS Region: A proxy for Road and Maritime Services (RMS) Region derived from the location of the hospital where the person was first admitted.

Road: The area devoted to public travel within a surveyed road reserve. Includes a footpath and cycle path inside the road reserve and a median strip or traffic island.

Road vehicle: Any device (except pedestrian conveyance) upon which or by which any person or property may be transported or drawn on a road.

Road surface condition: The condition of the road surface at the crash location (e.g. wet, dry).

Road user: The class of road user (e.g. driver, pedestrian).

Road user movement code: The road user movement or RUM code describing the first impact for the crash. See Appendix A.

Serious injury status: Total serious injuries comprise two categories: those persons that are matched to a police report and those persons that are not matched to a police report.

Seriously injured (matched): a person identified in the Police crash report data (casualty or traffic unit controller) matched to a hospital stay that is not an ED-only admission (unless that ended in a transfer interstate, to private hospital or other medical facility) containing an injury diagnosis on the same day or the day after a crash and did not die within 30 days of the crash; or linked to a Lifetime Care participant record.

Seriously injured (unmatched): a person not matched to a police report but has been identified as having an injury on a public road or injury on a traffic-public road for the hospital stay that is not an ED-only admission (unless that ended in a transfer interstate, to private hospital or other medical facility).

Sydney metropolitan area: The local government areas of City of Sydney, Bankstown, Blacktown, Botany Bay, Campbelltown, Canada Bay, Canterbury, Fairfield, Holroyd, Hurstville, Liverpool, Parramatta, Penrith, Randwick, Rockdale, Ryde and Willoughby cities, Ashfield, Auburn, Burwood, Camden, Hornsby, Hunters Hill, Kogarah, Ku-ring-gai, Lane Cove, Leichhardt, Manly, Marrickville, Mosman, North

Sydney, Pittwater, Strathfield, Sutherland, The Hills , Warringah, Waverley and Woollahra.

Weather: The weather conditions at the time of the crash.

Wollongong metropolitan area: The local government areas of Wollongong and Shellharbour cities.

4 Speeding and fatigue involvement

4.1 Speeding

It is not always clear from police reports if speeding (excessive speed for the prevailing conditions) was a contributing factor in a road crash.

We consider speeding to have been a contributing factor if at least one speeding motor vehicle was in a crash. We say a motor vehicle was speeding if it meets any of these conditions:

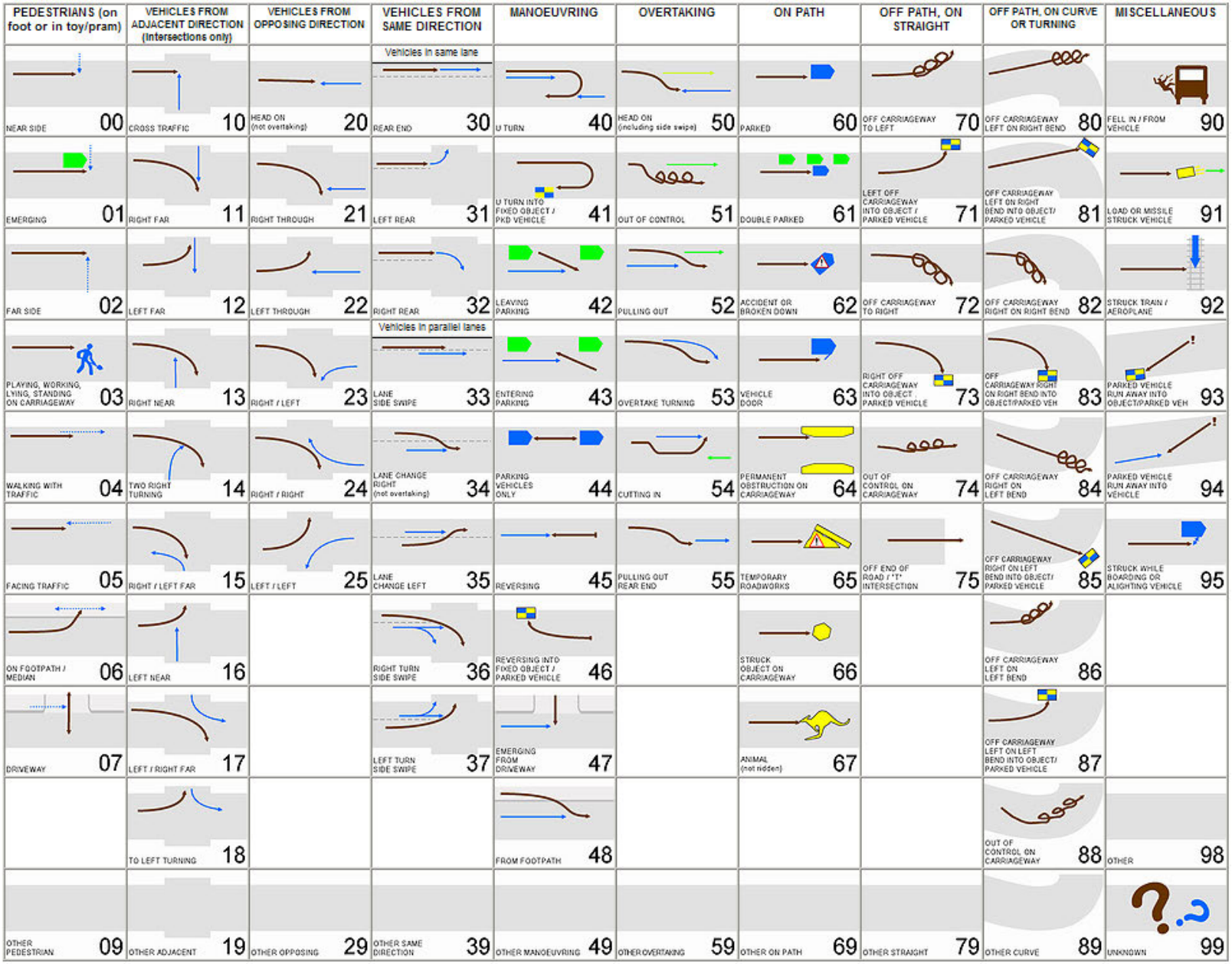
- Police said the vehicle was travelling at excessive speed
- The speed of the vehicle was faster than that allowed for the licence class of the driver or rider, or the vehicle weight (introduced 1 January 2010)
- The speed of the vehicle was higher than the speed limit
- While on a curve the vehicle jack-knifed, skidded, slid or the controller lost control
- The vehicle ran off the road on a bend or turning a corner and the driver or rider was not distracted by something, or affected by drowsiness or sudden illness, and was not swerving to avoid another vehicle, animal or object, and the vehicle did not have equipment failure

4.2 Fatigue

It is not always clear from police reports if fatigue was a contributing factor in a road crash. We consider fatigue to have been a contributing factor if at least one fatigued vehicle driver or rider was in a road crash. We define a vehicle driver or rider to be fatigued if they meet any of these conditions:

- Police said the motor vehicle driver or rider was asleep, drowsy or tired
- The vehicle travelled onto the incorrect side of a straight road and had a head-on collision (and was not overtaking another vehicle and no other relevant factor was found)
- The vehicle ran off a straight road or off the road to the outside of a curve and the vehicle was not travelling at excessive speed and there was no other relevant factor found for the crash.

5 Appendix A - Road user movement code table



APPENDIX

B

100% COMPLETE CONCEPT DESIGN DRAWINGS LIST

DOCUMENT TRANSMITTAL

To:	**Shellharbour City Council** 76 Cygnet Avenue Shellharbour City Centre NSW 2529	Project Name	**TRIPOLI WAY STAGE 1**
		Project/Transmittal Number:	**82016126-01 22**
Attn: [redacted]		Date:	14/07/2021

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Message:

Issued By: *Lachlan Broad*
Authorised by: *Ryan Adams*

We Enclose:	No	Media	Sent Via	Reason for Issue		Print Size	No
☑ Drawings	114	☐ Disc	☐ Mail	☐ Information	☐ Preliminary	☐ A0	1
☐ Reports		☐ Paper	☑ Email	☐ For Comment	☐ Tender	☑ A1	
☐ Computations		☑ PDF	☐ Courier	☐ Quotation	☐ Construction	☐ A3	
☐ Specification		☐ Electronic	☐ By Hand	☑ For Approval	☐ As Constructed	☐ B1	
☐ Other		☐ Other	☐ Other	☐ Coordination		☐ Other	

CC'd: Company	Contact	Message

Cardno Documents

Document No	Revision	Document Title
82016126-01-C2000	C	COVER SHEET
82016126-01-C2001	C	LOCALITY PLAN
82016126-01-C2002	C	DRAWING SCHEDULE
82016126-01-C2004	C	GENERAL ARRANGEMENT KEY PLAN
82016126-01-C2005	D	GENERAL ARRANGEMENT LAYOUT PLAN SHEET 1 OF 9
82016126-01-C2006	D	GENERAL ARRANGEMENT LAYOUT PLAN SHEET 2 OF 9
82016126-01-C2007	D	GENERAL ARRANGEMENT LAYOUT PLAN SHEET 3 OF 9
82016126-01-C2008	D	GENERAL ARRANGEMENT LAYOUT PLAN SHEET 4 OF 9
82016126-01-C2009	E	GENERAL ARRANGEMENT LAYOUT PLAN SHEET 5 OF 9
82016126-01-C2010	D	GENERAL ARRANGEMENT LAYOUT PLAN SHEET 6 OF 9
82016126-01-C2011	D	GENERAL ARRANGEMENT LAYOUT PLAN SHEET 7 OF 9
82016126-01-C2012	D	GENERAL ARRANGEMENT LAYOUT PLAN SHEET 8 OF 9
82016126-01-C2013	D	GENERAL ARRANGEMENT LAYOUT PLAN SHEET 9 OF 9
82016126-01-C2014	C	REF BOUNDARY LAYOUT PLAN SHEET 1 OF 2
82016126-01-C2015	C	REF BOUNDARY LAYOUT PLAN SHEET 2 OF 2
82016126-01-C2030	C	TYPICAL ROAD CROSS SECTIONS SHEET 1 OF 4
82016126-01-C2031	C	TYPICAL ROAD CROSS SECTIONS SHEET 2 OF 4
82016126-01-C2032	C	TYPICAL ROAD CROSS SECTIONS SHEET 3 OF 4
82016126-01-C2033	C	TYPICAL ROAD CROSS SECTIONS SHEET 4 OF 4
82016126-01-C2034	C	TYPICAL CIVIL DETAILS
82016126-01-C2040	C	ROAD LONG SECTIONS SHEET 1 OF 6
82016126-01-C2041	C	ROAD LONG SECTIONS SHEET 2 OF 6
82016126-01-C2042	C	ROAD LONG SECTIONS SHEET 3 OF 6
82016126-01-C2043	C	ROAD LONG SECTIONS SHEET 4 OF 6
82016126-01-C2044	D	ROAD LONG SECTIONS SHEET 5 OF 6
82016126-01-C2045	C	ROAD LONG SECTIONS SHEET 6 OF 6
82016126-01-C2050	C	ROAD CROSS SECTIONS SHEET 1 OF 19
82016126-01-C2051	C	ROAD CROSS SECTIONS SHEET 2 OF 19
82016126-01-C2052	C	ROAD CROSS SECTIONS SHEET 3 OF 19
82016126-01-C2053	C	ROAD CROSS SECTIONS SHEET 4 OF 19
82016126-01-C2054	C	ROAD CROSS SECTIONS SHEET 5 OF 19
82016126-01-C2055	C	ROAD CROSS SECTIONS SHEET 6 OF 19
82016126-01-C2056	C	ROAD CROSS SECTIONS SHEET 7 OF 19
82016126-01-C2057	C	ROAD CROSS SECTIONS SHEET 8 OF 19
82016126-01-C2058	C	ROAD CROSS SECTIONS SHEET 9 OF 19
82016126-01-C2059	C	ROAD CROSS SECTIONS SHEET 10 OF 19
82016126-01-C2060	C	ROAD CROSS SECTIONS SHEET 11 OF 19
82016126-01-C2061	C	ROAD CROSS SECTIONS SHEET 12 OF 19

Cardno Documents		
82016126-01-C2062	C	ROAD CROSS SECTIONS SHEET 13 OF 19
82016126-01-C2063	C	ROAD CROSS SECTIONS SHEET 14 OF 19
82016126-01-C2064	C	ROAD CROSS SECTIONS SHEET 15 OF 19
82016126-01-C2065	C	ROAD CROSS SECTIONS SHEET 16 OF 19
82016126-01-C2066	D	ROAD CROSS SECTIONS SHEET 17 OF 19
82016126-01-C2067	C	ROAD CROSS SECTIONS SHEET 18 OF 19
82016126-01-C2068	C	ROAD CROSS SECTIONS SHEET 19 OF 19
82016126-01-C2090	B	INTERSECTION LAYOUT PLAN SHEET 1 OF 6
82016126-01-C2091	B	INTERSECTION LAYOUT PLAN SHEET 2 OF 6
82016126-01-C2092	C	INTERSECTION LAYOUT PLAN SHEET 3 OF 6
82016126-01-C2093	B	INTERSECTION LAYOUT PLAN SHEET 4 OF 6
82016126-01-C2094	B	INTERSECTION LAYOUT PLAN SHEET 5 OF 6
82016126-01-C2095	B	INTERSECTION LAYOUT PLAN SHEET 6 OF 6
82016126-01-C2110	C	ROAD PAVEMENT LAYOUT PLAN SHEET 1 OF 9
82016126-01-C2111	C	ROAD PAVEMENT LAYOUT PLAN SHEET 2 OF 9
82016126-01-C2112	C	ROAD PAVEMENT LAYOUT PLAN SHEET 3 OF 9
82016126-01-C2113	C	ROAD PAVEMENT LAYOUT PLAN SHEET 4 OF 9
82016126-01-C2114	D	ROAD PAVEMENT LAYOUT PLAN SHEET 5 OF 9
82016126-01-C2115	C	ROAD PAVEMENT LAYOUT PLAN SHEET 6 OF 9
82016126-01-C2116	C	ROAD PAVEMENT LAYOUT PLAN SHEET 7 OF 9
82016126-01-C2117	C	ROAD PAVEMENT LAYOUT PLAN SHEET 8 OF 9
82016126-01-C2118	C	ROAD PAVEMENT LAYOUT PLAN SHEET 9 OF 9
82016126-01-C2120	B	LINE MARKING AND SIGNPOSTING LAYOUT PLAN SHEET 1 OF 9
82016126-01-C2121	B	LINE MARKING AND SIGNPOSTING LAYOUT PLAN SHEET 2 OF 9
82016126-01-C2122	B	LINE MARKING AND SIGNPOSTING LAYOUT PLAN SHEET 3 OF 9
82016126-01-C2123	B	LINE MARKING AND SIGNPOSTING LAYOUT PLAN SHEET 4 OF 9
82016126-01-C2124	B	LINE MARKING AND SIGNPOSTING LAYOUT PLAN SHEET 5 OF 9
82016126-01-C2125	B	LINE MARKING AND SIGNPOSTING LAYOUT PLAN SHEET 6 OF 9
82016126-01-C2126	B	LINE MARKING AND SIGNPOSTING LAYOUT PLAN SHEET 7 OF 9
82016126-01-C2127	B	LINE MARKING AND SIGNPOSTING LAYOUT PLAN SHEET 8 OF 9
82016126-01-C2128	B	LINE MARKING AND SIGNPOSTING LAYOUT PLAN SHEET 9 OF 9
82016126-01-C2130	E	PROPERTY ACQUISITION LAYOUT PLAN SHEET 1 OF 9
82016126-01-C2131	E	PROPERTY ACQUISITION LAYOUT PLAN SHEET 2 OF 9
82016126-01-C2132	E	PROPERTY ACQUISITION LAYOUT PLAN SHEET 3 OF 9
82016126-01-C2133	E	PROPERTY ACQUISITION LAYOUT PLAN SHEET 4 OF 9
82016126-01-C2134	F	PROPERTY ACQUISITION LAYOUT PLAN SHEET 5 OF 9
82016126-01-C2135	E	PROPERTY ACQUISITION LAYOUT PLAN SHEET 6 OF 9
82016126-01-C2136	E	PROPERTY ACQUISITION LAYOUT PLAN SHEET 7 OF 9
82016126-01-C2137	E	PROPERTY ACQUISITION LAYOUT PLAN SHEET 8 OF 9
82016126-01-C2138	E	PROPERTY ACQUISITION LAYOUT PLAN SHEET 9 OF 9
82016126-01-C2140	C	SERVICE LAYOUT PLAN SHEET 1 OF 9
82016126-01-C2141	C	SERVICE LAYOUT PLAN SHEET 2 OF 9
82016126-01-C2142	C	SERVICE LAYOUT PLAN SHEET 3 OF 9
82016126-01-C2143	C	SERVICE LAYOUT PLAN SHEET 4 OF 9
82016126-01-C2144	D	SERVICE LAYOUT PLAN SHEET 5 OF 9
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82016126-01-C2150	C	VEHICLE TURNING PATH LAYOUT PLAN SHEET 1 OF 12
82016126-01-C2151	C	VEHICLE TURNING PATH LAYOUT PLAN SHEET 2 OF 12
82016126-01-C2152	C	VEHICLE TURNING PATH LAYOUT PLAN SHEET 3 OF 12
82016126-01-C2153	C	VEHICLE TURNING PATH LAYOUT PLAN SHEET 4 OF 12
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82016126-01-C2158	C	VEHICLE TURNING PATH LAYOUT PLAN SHEET 9 OF 12
82016126-01-C2159	C	VEHICLE TURNING PATH LAYOUT PLAN SHEET 10 OF 12
82016126-01-C2160	C	VEHICLE TURNING PATH LAYOUT PLAN SHEET 11 OF 12

Cardno Documents		
82016126-01-C2161	C	VEHICLE TURNING PATH LAYOUT PLAN SHEET 12 OF 12
82016126-01-C2200	B	BRIDGE OVER HAZELTON CREEK GENERAL ARRANGEMENT LAYOUT SHEET 1 OF 2
82016126-01-C2201	B	BRIDGE OVER HAZELTON CREEK GENERAL ARRANGEMENT LAYOUT SHEET 2 OF 2
82016126-01-L1000	C	LANDSCAPE: COVER SHEET AND KEY PLAN
82016126-01-L1001	C	LANDSCAPE: STREETSCAPE PLAN SHEET 1 OF 9
82016126-01-L1002	C	LANDSCAPE: STREETSCAPE PLAN SHEET 2 OF 9
82016126-01-L1003	C	LANDSCAPE: STREETSCAPE PLAN SHEET 3 OF 9
82016126-01-L1004	C	LANDSCAPE: STREETSCAPE PLAN SHEET 4 OF 9
82016126-01-L1005	C	LANDSCAPE: STREETSCAPE PLAN SHEET 5 OF 9
82016126-01-L1006	C	LANDSCAPE: STREETSCAPE PLAN SHEET 6 OF 9
82016126-01-L1007	C	LANDSCAPE: STREETSCAPE PLAN SHEET 7 OF 9
82016126-01-L1008	C	LANDSCAPE: STREETSCAPE PLAN SHEET 8 OF 9
82016126-01-L1009	C	LANDSCAPE: STREETSCAPE PLAN SHEET 9 OF 9
82016126-01-L1020	C	LANDSCAPE: TYPICAL ROAD CROSS SECTIONS SHEET 1 OF 2
82016126-01-L1021	C	LANDSCAPE: TYPICAL ROAD CROSS SECTIONS SHEET 2 OF 2
82016126-01-L1030	C	LANDSCAPE: INDICATIVE PLANT LIST AND PLANTING PALETTE