FAIRFIELD CITY DEVELOPMENT UPLIFT
TRAFFIC MODELLING REPORT

FOR
FAIRFIELD CITY COUNCIL

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EXECUTIVE SUMMARY

Context

The Sydney Metropolitan Region has experienced significant housing growth over the last decade and this trend continues. In response to the growth targets set by the draft South West District Plan, in July 2015 Fairfield City Council (Council) resolved to exhibit a planning proposal to increase the density within the city by amending the Local Environmental Plan 2013 to rezone several areas.

Medium Density Residential precincts are proposed to be rezoned to High Density Residential (Zone R3 to R4) up to six storeys and Low-Density Residential precincts are proposed to be rezoned to Medium Density Residential (R2 to R3).

Council has initiated a planning proposal for Bonnyrigg Town Centre and adopted Urban Design Studies for Fairfield City Centre (key sites), Fairfield Heights, and Villawood Town Centres. These proposals include additional dwellings that have not previously been included in traffic modelling and road network needs assessments. This report addresses the requests made by RMS to undertake a cumulative assessment of the impacts of the proposed additional development on state-controlled roads and intersections.

Separate urban design studies for Fairfield Heights Town Centre (November 2017) and Villawood Town Centre (November 2017) have been undertaken by Council. The outcomes from these studies include identifying road network and public domain improvements in the Town Centres and their immediate surrounding area reflecting existing weaknesses as well as demand generated from future development. Council initiated planning proposals will seek to increased building heights

Summary of Proposed Changes and Dwelling Potential

The above proposals suggest additional dwellings within six major areas as shown in Table ES1 below.

Table ES1: Proposed Development and Trip Generation

Zoning Change	Estimated Dwelling Units (100% take-up)	Recommended Trip Rate	Daily Vehicle Trips	AM Vehicle Trips (2 Hrs.)	PM Vehicle Trips (2 Hrs.)
Fairfield Heights					
R2 to R3	500	Daily 5 trips/unit, AM Peak 0.5 trips/unit, PM Peak 0.5 trips/unit	2,500	500	500
Fairfield North and South					
R3 to R4	3,295	Daily 1.52 trips/unit, AM Peak 0.29 trips/unit, PM Peak 0.29 trips/unit	5,010	1,912	1,912
Fairfield East / Villawood North and South					
R2 to R3 and R3 to R4	2,975	Daily 1.52 trips/unit, AM Peak 0.29 trips/unit, PM Peak 0.29 trips/unit	4,495	1,715	1,715
Sub Total	*6,753*		*12,005*	*4,127*	*4,127*
Villawood Town Center					
R4	495	Daily 1.52 trips/unit, AM Peak 0.29 trips/unit, PM Peak 0.29 trips/unit	752	287	287
Bonnyrigg Town Centre					
R4	320	Daily 1.52 trips/unit, AM Peak 0.29 trips/unit, PM Peak 0.29 trips/unit	486	186	186
Fairfield Heights Town Centre Precinct					
R4	363	Daily 1.52 trips/unit, AM Peak 0.29 trips/unit, PM Peak 0.29 trips/unit	552	211	211
Sub Total	*1,178*		*1,791*	*683*	*683*
Total	7,931		13,795	4,810	4,810

Assessed Intersections

A total of fourteen (14) intersections were assessed to determine the additional traffic impacts on them due to the proposed additional development. These intersections were:

- The Horsley Drive / Cumberland Highway / Smithfield Road signalized intersection;
- The Horsley Drive / Polding Street signalized intersection;
- The Horsley Drive / River Avenue signalized intersection;
- The Horsley Drive / Hume Highway (North) signalized intersection;
- The Horsley Drive / Hume Highway (South) signalized intersection;
- Woodville Road / Hume Highway signalized intersection;
- Woodville Road / Fairfield Street signalized intersection;
- Smithfield Road / Edensor Road signalized intersection;
- Smithfield Road / Elizabeth Drive signalized intersection;
- Bonnyrigg Avenue / Tarlington Parade roundabout;
- Bonnyrigg Avenue / Bibbys Place (East) roundabout; and
- Bonnyrigg Avenue / Bibbys Place (West) roundabout.

Intersection Assessment Criteria

The following RMS Desired Standard of Service (DSS) Criteria have been used to identify the intersections that require upgrades:

- *Level of Service (LoS) and delays* – LoS E or average delay no more than 70 seconds;
- *Degree of Saturation (DoS)* – below operating capacity (i.e. DoS < 0.80 for priority controlled, DoS < 0.85 for roundabouts and DoS < 0.90 for signalised intersection). It is preferable to achieve DOS below practical operating capacity; however, at some intersections it was impossible to get DoS below the operating capacity, due to site constraints. At such intersections, theoretical capacity (i.e. DoS <1.0 for signalised intersections) have been adopted; and
- *Back of Queue* – 95th percentile queue lengths do not exceed turn pocket length.

EMME and SIDRA Models

The calculated development traffic was assigned in the RMS-provided Sydney Strategic Transport Model (STM) using 2016, 2026 and 2036 models to create following strategic models in EMME:

- 2016 “Base” & ‘With Development” Models (AM/PM Peak);
- 2026 “Base” & ‘With Development” Models (AM/PM Peak); and
- 2036 “Base” & “With Development” Models (AM/PM Peak).

Following the development of the EMME models, the “Base” and “With Development” link volumes from the approach to each intersection were exported for each modelled year and added to the 2018 traffic counts at each intersection. These volumes were used to create SIDRA models of each intersection for both the “Base” and the “With Development” scenarios in 2016, 2026 and 2036. The STM EMME volumes comparison between the “Base” and the “With Development” models indicate that the proposed additional development contributes a relatively minor proportion of peak traffic volumes passing through the assessed intersections. Most of the traffic through those intersections is background traffic originating from and destined to area beyond the proposed developments.

No information was available on any proposed staging of development as part of the rezoning proposals. In the absence of this information, it was conservatively assumed that realisation of the proposed rezoning changes would be by 2026.

Required Intersection Upgrades

Table ES2 and Table ES3 include the intersections that were identified for upgrades in the future year to operate satisfactorily in both "Base" and the "With Development" scenarios. The 2036 upgrades are beyond what is required for the 2026 upgrades (i.e. assuming that the 2026 upgrades are in place).

Table ES2: Recommended Intersection Upgrades – 2026

Intersection	Required Upgrades (2026 Base and "with development")	
	Due to Background Demand	Attributable to the Development
The Horsley Drive / Cumberland Highway / Smithfield Road	*The Horsley Drive Northwest approach: add a 10m long segregated left turn lane*	nil
The Horsley Drive / Polding Street	*Polding Street North-eastern Approach: extend kerbside lane to 100m*	nil
	The Horsley Drive Southern Approach: add a 100m long through lane and reduce the length of the existing left turn slip lane to 50m. Add a 60m lane on the exit lane	nil
	Polding Street Western Approach: add a 60m long right turn pocket and add a 60m long share left/through pocket	nil
	The Horsley Drive Northern Approach: Add 60m long shared left/through pocket. Add 100m long exit lane	nil
The Horsley Drive / Hume Highway (North)	*Hume Highway Western Approach: add a 200m long shared left & through lane*	nil
	The Horsley Drive Northern Approach: add a 60m long left turn lane	nil
	Hume Highway Eastern Approach: add a 100m short lane on the exit side	nil
Woodville Road / Hume Highway	*Hume Highway Eastern Approach: extend the length of the inner right turn pocket lane to 75m and outer to 100m. add a 100m short lane on the exit side*	nil
	Woodville Road Northern Approach: add 50m long right turn pocket	
	Hume Highway Western Approach: convert the shared kerbside lane to through only. Add a 100m long shared through and left turn slip lane	
Smithfield Road / Edensor Road	*Edensor Road Westbound Approach: add an additional 30m right turn lane and extend inner right turn lane to 110m*	nil
	Smithfield Road Southbound Approach: add an additional 30m right turn lane	
Elizabeth Drive / Smithfield Road	*Elizabeth Drive Eastbound Approach: add a 150m through lane. Reduce the existing kerbside lane to 100m*	nil
	Elizabeth Drive Westbound Approach: add a 60m exit lane	
Elizabeth Drive / Bonnyrigg Avenue	*Bonnyrigg Avenue Approach: extend the right turn bay to 50m*	nil

Table ES3: Recommended Intersection Upgrades – 2036

The Horsley Drive / Cumberland Highway / Smithfield Road	*The Horsley Drive Northwest approach: add a 75m long segregated left turn lane*	nil
	Smithfield Road Northeast approach: extend the kerbside lane to 170m	nil
	The Horsley Drive Southeast approach: extend the median lane to 75m	nil
The Horsley Drive / Polding Street	*Polding Street North-eastern Approach: add a 100m long westbound through lane. extend kerbside lane to 50m*	nil
	The Horsley Drive Southern Approach: add a 100m long through lane and reduce the length of the existing left turn slip lane to 50m. Add a 100m lane on the exit lane	nil
	Polding Street Western Approach: add a 75m long right turn pocket and add a 100m long share left/through pocket	nil
	The Horsley Drive Northern Approach: Add 150m long shared left/through pocket. Add 150m long exit lane.	nil
The Horsley Drive / Hume Highway (North)	*Hume Highway Western Approach: add a 200m long shared left & through lane*	nil
	The Horsley Drive Northern Approach: add a 60m long left turn lane and reconfigure the lanes to provide dual through and dual left turns	nil
	Hume Highway Eastern Approach: add a kerbside lane on the exit side	nil
Woodville Road / Hume Highway	*Hume Highway Eastern Approach: extend the length of the inner right turn pocket lane to 75m and outer to 100m. convert the shared kerbside lane to through only. add a 200m long shared through and left turn slip lane. add a 100m short lane on the exit side*	nil
	Woodville Road Northern Approach: add 50m long right turn pocket	
	Hume Highway Western Approach: Convert the shared kerbside lane to through only. Add a 100m long shared through and left turn slip lane	
Smithfield Road / Edensor Road	*Same as 2026 upgrades*	nil
Elizabeth Drive / Smithfield Road	*Same as 2026 upgrades*	nil
Elizabeth Drive / Bonnyrigg Avenue	*Same as 2026 upgrades*	nil

The modelling outputs indicate that majority of the assessed intersections that require upgrades are expected to operate over the practical capacity and theoretical capacity under “Base” scenarios and will require upgrade even without the traffic generated by the higher density development.

Costs and Apportionment

Table ES4 and Table ES5 below summarises the apportionment of upgrade costs based on the proportion of traffic using the intersections associated with the proposed precincts. The apportionment values indicate that the proposed development contribute only a minor component of the peak traffic volume passing through the assessed intersections. Most of the traffic in those intersections are background traffic originating and destined outside the proposed developments.

Table ES4: Upgrade Apportionment – 2026

2026 Upgrade Apportionment	Precinct						
	Fairfield Heights	Fairfield (North & South)	Fairfield East / Villawood	Bonnyrigg Town Centre	Fairfield Heights Town Centre	Villawood Town Centre	Other
The Horsley Drive / Polding Street	0.0%	3.8%	1.5%	0.1%	0.0%	0.2%	94.6%
Hume Highway / Woodville Road	0.0%	1.7%	3.4%	0.2%	0.0%	0.5%	94.7%
Smithfield Road / Edensor Road	0.3%	0.2%	0.0%	2.4%	0.0%	0.0%	97.1%
Smithfield Road / Elizabeth Drive	0.2%	0.2%	0.1%	2.3%	0.0%	0.0%	97.2%

Table ES5: Upgrade Apportionment – 2036

2036 Upgrade Apportionment	Precinct						
	Fairfield Heights	Fairfield (North & South)	Fairfield East / Villawood	Bonnyrigg Town Centre	Fairfield Heights Town Centre	Villawood Town Centre	Other
The Horsley Drive / Cumberland Highway	0.6%	1.7%	1.0%	0.7%	0.1%	0.1%	94.7%
The Horsley Drive / Polding Street	0.0%	3.8%	1.4%	0.1%	0.0%	0.2%	95.0%
Hume Highway / Woodville Road	0.0%	1.6%	3.2%	0.2%	0.0%	0.5%	95.0%
Woodville Road / Fairfield Street	0.0%	1.7%	2.0%	0.1%	0.0%	0.3%	96.2%
Smithfield Road / Elizabeth Drive	0.7%	0.3%	0.2%	1.7%	0.1%	0.0%	97.1%
Elizabeth Road / Bonnyrigg Avenue	0.9%	0.4%	0.2%	1.6%	0.1%	0.0%	96.9%

1. INTRODUCTION

1.1 BACKGROUND

Fairfield City is located in Western Sydney and is accessible to the Sydney CBD and Paramatta CBD by rail, transit way and via motorways. It is located within the South West District of the Sydney Metropolitan Area and is subject to short and long-term dwelling targets to accommodate Sydney's growth.

In response to the growth targets set by the draft South West District Plan, in July 2015 Fairfield City Council (Council) resolved to exhibit a planning proposal to increase the residential density within the city by amending Fairfield Local Environmental Plan 2013 to rezone several areas. Medium Density Residential precincts zones are proposed to be rezoned as High-Density Residential zones (Zone R3 to R4) and Low-Density Residential precincts are proposed to be rezoned to Medium Density Residential (Zone R2 to R3). Figure 1.1 shows the study area including the locations of the areas proposed for rezoning.

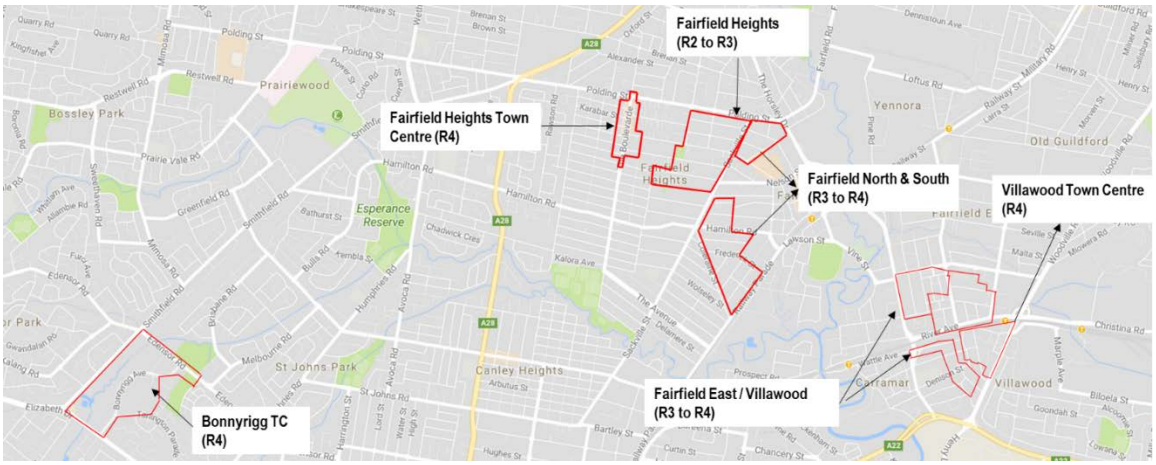


Figure 1.1: Study Area and the Proposed Rezoning Areas

The proposed rezoning is expected to generate additional traffic beyond what has previously been contemplated. The additional traffic is will influence the performance of both the local and the state-controlled road network. Roads and Maritime Service (Roads and Maritime) has requested a "cumulative" assessment of the impacts of this additional development on the state-controlled roads and intersections. In response to the request, Council has sought a strategic traffic assessment to determine the anticipated impacts and required infrastructure improvements and responsibilities

1.2 STUDY OBJECTIVES

The purpose of the study is to assess the traffic and transport impacts of the proposed rezoning on the surrounding state road network. Traffic modelling results were used to quantify the impacts on key links and intersections. This study has been based on 2026 and 2036 as the future assessment years.

The key objectives of the study included to:

- identify key intersections and access points on the state road network on which the proposed rezoning is expected to have substantial impact;
- quantify the traffic generated by the proposed rezoning consistent with Roads and Maritime's Guide to Traffic Generating Developments (2013) and in agreement with Roads and Maritimes representatives;
- undertake traffic surveys and conduct site visits to understand the existing traffic behaviour;
- develop existing condition traffic models to identify the performance of the existing road network;
- quantify future background traffic growth on the relevant state-controlled roads;
- develop future 'do minimum' traffic models;

- identify requirements for future infrastructure improvements and develop strategic cost estimates for those works;
- use traffic estimates to apportion responsibilities for the required works.

1.3 REPORT STRUCTURE

The structure of the report is as follows:

- Chapter 1 contains the project background and objectives;
- Chapter 2 discusses the study process;
- Chapter 3 includes the summary of proposed development;
- Chapter 4 provides data collection undertaken for use in the models;
- Chapter 5 discusses the existing network condition performances;
- Chapter 6 outlines the future traffic generation and distribution assumptions;
- Chapter 7 discusses the strategic modelling (STM EMME) updates and outputs;
- Chapter 8 discusses the intersection modelling (SIDRA) of the intersections;
- Chapter 9 broadly assesses development requirements related to public transport services and infrastructure as well as active transport infrastructure; and
- Chapter 10 summarises the upgrades plans, their costs and usage and possible funding responsibilities.

2. STUDY PROCESS

The approach adopted for this study is shown in Figure 2.1.

In consultation with Council and Roads and Maritime, a total of 14 intersections were identified within the study area as being relevant for assessment. The morning and afternoon peak traffic data for a typical weekday was collected for each intersection and historic SCATS traffic signal data was obtained from Roads and Maritime for the signalised intersections. Existing conditions base traffic models were developed in SIDRA. Site visits were also undertaken to understand the operations and performance of the key intersections and to calibrate and validate the existing condition models.

Roads and Maritime provided the base and future year Sydney Strategic Traffic Model (STM). The model was run to establish the base traffic volumes and to understand the future estimated growth in traffic within the study area. Then, the additional traffic generated by the rezoning areas was calculated and the Bureau of Transport Statistics (BTS) Journey to Work data used to determine the distribution of these additional development trips. The STM was then used to assign the future development traffic from each of the proposed rezoning areas to the wider road network.

The outputs from the future year STM model was analysed to establish traffic volume growth at each of the 14 key intersections. The existing conditions SIDRA models were used to assess the future 2026 and 2036 performance of these intersections by adding on the traffic growth for both the 'base case' and the 'with rezoning' scenarios. For intersections that were predicted to operate over capacity in the future year, the SIDRA models were also used to identify potential infrastructure improvements.

Concept plans showing the proposed upgrade works were prepared and a 'high level' strategic cost estimate was prepared for each of the intersection upgrade. Contribution apportionment for each development area was determined by undertaking link/zone analysis using the future year STM model.

During the course of the study a technical note was prepared to document the size and type of the proposed future developments, estimated traffic generation and the distribution from these developments. This Technical Note 1 is included in Appendix A.

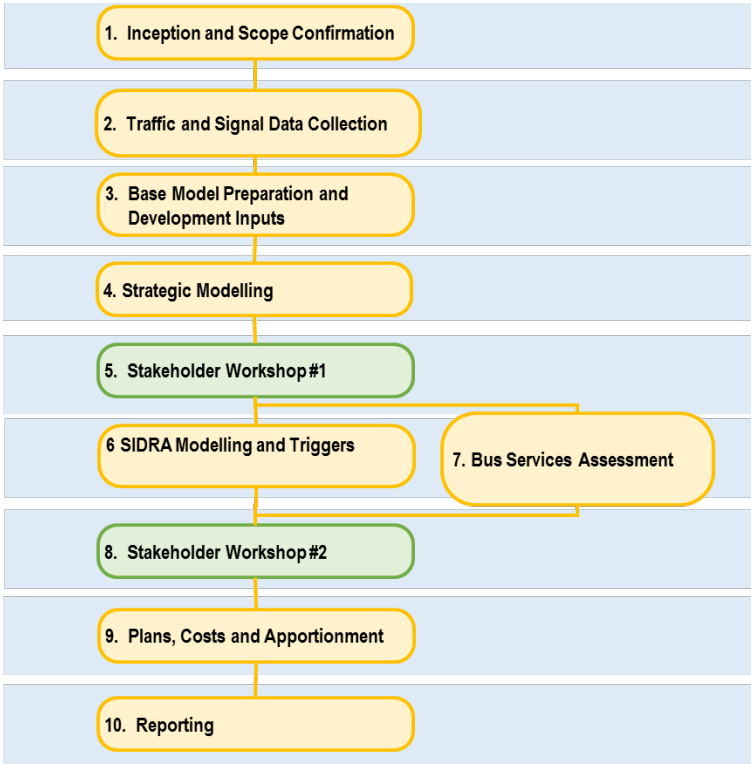


Figure 2.1: Study Process

3. PROPOSED REZONING

Council has identified rezoning areas across Fairfield, Fairfield Heights, Fairfield East, Villawood and Bonnyrigg Town Centre. The key areas in which rezoning is proposed are shown in Table 3.1.

Table 3.1: Summary of Proposed Rezoning

Existing Zoning	Proposed Zoning	Included Precincts
R2 (Low Density Residential)	R3 (Medium Density Residential)	Fairfield Heights
		Fairfield East (West) (reflecting existing development)
R3 (Medium Density Residential)	R4 (High Density Residential)	Fairfield Precincts (North & South)
		Fairfield East / Villawood (North)
		Fairfield East / Villawood (South)
		Bonnyrigg Town Centre

Figure 3.1 illustrates the proposed zoning areas and changes listed above.

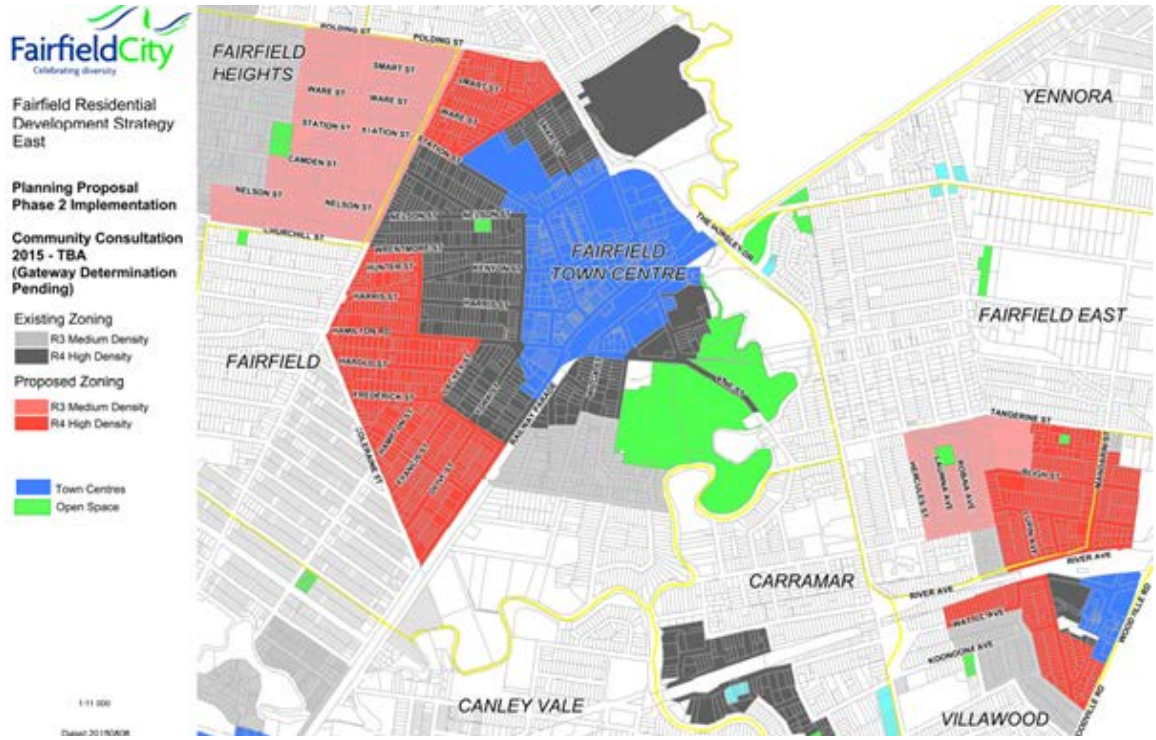


Figure 3.1: Fairfield City Council Proposed Zoning Areas and Changes

4. TRAFFIC COUNTS AND SIGNAL DATA

During the course of the study, traffic counts and traffic signal data was collected to develop the existing condition SIDRA models.

4.1 INTERSECTION TURNING COUNT DATA

Bitzios Consulting commissioned Traffic Data and Control (TDC) to undertake morning and afternoon peak traffic surveys at the following intersections.

Table 4.1: List of Intersection Turning Count Surveys

Ref.	Intersection	Control
1	The Horsley Drive / Cumberland Highway / Smithfield Road	
2	The Horsley Drive / Polding Street	
3	The Horsley Drive / River Avenue	
4	The Horsley Drive / Hume Highway (North)	
5	The Horsley Drive / Hume Highway (South)	
6	Woodville Road / Hume Highway	
7	Woodville Road / Fairfield Street	
8	Smithfield Road / Edensor Road	
9	Smithfield Road / Elizabeth Drive	
10	Bonnyrigg Avenue / Edensor Road	
11	Bonnyrigg Avenue / Elizabeth Drive	
12	Bonnyrigg Avenue / Tarlington Parade	
13	Bonnyrigg Avenue / Bibbys Place (East)	
14	Bonnyrigg Avenue / Bibbys Place (West)	

The location of these intersections is shown in Figure 4.1.

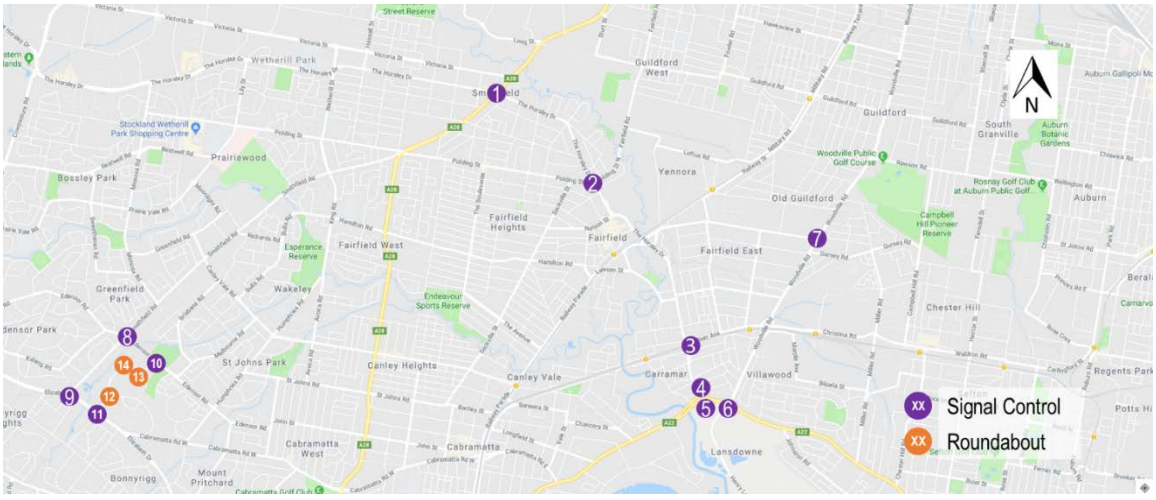


Figure 4.1: Traffic Survey Locations

The intersection surveys were undertaken during the following time periods:

- AM Peak - 7.00am to 9.00am; and
- PM Peak – 4.00pm to 6.00pm.

The intersections were split into two groups with the surveys undertaken on Thursday 9th November 2017 and Thursday 16th November 2017. The counts were undertaken using the MioVision (VCU) method with the data reported in 15 minutes interval and classified as cars, light & heavy commercial vehicles, cyclists and pedestrians.

4.2 SCATS History Data

Roads and Maritime provided SCATS history data for the 11 signal-controlled intersections of the 14 intersections assessed. The SCATS data was analysed to determine intersection cycle times, phase sequences and average phase times as well as coordination of closely located intersections.

4.3 Site Visit Observations

Bitzios Consulting conducted a site visit on Thursday 7th December 2017. During the site visit the following observations were made:

- Confirmation of the layout of each intersection;
- Operations of traffic signal;
- Queue lengths on key approaches to intersections;
- Pedestrian movements and pedestrian signal calls/locations; and
- Intersection exit blocking influences.

The site visit observations were used to calibrated and validate the existing condition SIDRA models.

5. EXISTING NETWORK PERFORMANCE

This section of the report provides a summary of the performance of the existing transport network in the vicinity of the proposed rezoning sites.

5.1 ROAD HIERARCHY AND KEY ROADS

The management of the road network in New South Wales is shared between the State Government (through Roads and Maritime) and Local Government (through local Councils).

Road management between the Roads and Maritime and councils in NSW provides for three categories of road:

- State Roads (motorways national and state significant);
- Regional Roads; and
- Local Roads.

State Roads

State Roads are major arterial links. Roads and Maritime has the responsibility for managing State Roads including funding and determining priorities and regulates the third-party activities on the road and access to adjoining land to promote road safety, traffic efficiency and protect the road asset.

Regional Roads

Within the urban areas, Regional Roads function as sub-arterial roads. Regional Roads together with State Roads provide the primary connection between smaller towns and districts. Council has the responsibility to fund, build and maintain the Regional Road network.

Local Roads

Local Roads comprise of the remaining roads which serve local circulation and access functions. Council has the responsibility to fund, build and maintain the Local Road network.

The hierarchy of the key roads within the study area is summarised in Table 5.1.

Table 5.1: Road Hierarchy and Characteristics within the Study Area

Road	Hierarchy	Responsibility	Main Characteristics
The Horsley Drive	State controlled - Secondary Road	Roads and Maritime Services	4 lanes, 60km/h posted speed limit, connects Cumberland Highway with Hume Highway.
Cumberland Highway	State Controlled - Highway	Roads and Maritime Services	4-6 lanes, 70km/h posted speed limit, provides north-south connectivity.
Smithfield Road	Council - Regional Road	Fairfield City Council	2-4 lanes, 60km/h posted speed limit, provides north-south connectivity. Connects Cumberland Highway with Elizabeth Drive.
Woodville Road	State controlled – Main Road	Roads and Maritime Services	6 lanes, 60km/h posted speed limit, provides north-south connectivity between Hume Highway and the Western Motorway.
Hume Highway	State controlled – Highway	Roads and Maritime Services	4 lanes, 100km/h posted speed limit, provides east-west connectivity.
Elizabeth Drive	State controlled – Main Road	Roads and Maritime Services	4-6 lanes, 70km/h posted speed limit, provides east-west connectivity between The Northern Road and George Street in Liverpool.
Bonnyrigg Avenue	Council – Local Road	Fairfield City Council	4 lanes, 50km/h posted speed limit, provides direct access to Bonnyrigg Plaza, provides

Road	Hierarchy	Responsibility	Main Characteristics
			north-south connectivity between Elizabeth Drive and Edensor Road.

5.2 INTERSECTION PERFORMANCE

The existing conditions AM and PM peak SIDRA models were developed for each of the 14 key intersections. The AM and PM peak performance of each intersection is summarised in Table 5.2 and Table 5.3. Currently these intersections operate between LoS A and LoS C. The Woodville Road intersection with the Hume Highway services 7,000 vehicles per hour and achieves a LoS C in both peak periods. All three roundabouts on Bonnyrigg Avenue provide LoS A in both peak periods.

Table 5.2: 2017 AM Peak Intersection Performance Summary

Ref.	Intersection	Control	Volume (veh/hr)	LoS
1	The Horsley Drive / Cumberland Highway / Smithfield Road		4,863	C
2	The Horsley Drive / Polding Street		3,801	D
3	The Horsley Drive / River Avenue		3,138	B
4	The Horsley Drive / Hume Highway (North)		4,021	D
5	The Horsley Drive / Hume Highway (South)		2,550	A
6	Woodville Road / Hume Highway		6,860	D
7	Woodville Road / Fairfield Street		3,765	B
8	Smithfield Road / Edensor Road		3,683	E
9	Smithfield Road / Elizabeth Drive		4,482	C
10	Bonnyrigg Avenue / Edensor Road		2,233	B
11	Bonnyrigg Avenue / Elizabeth Drive		3,768	B
12	Bonnyrigg Avenue / Tarlington Parade		1,490	A
13	Bonnyrigg Avenue / Bibbys Place (West)		1,261	A
14	Bonnyrigg Avenue / Bibbys Place (East)		1,477	A

Table 5.3: 2017 PM Peak Intersection Performance Summary

Ref.	Intersection	Control	Volume (veh/hr)	LoS
1	The Horsley Drive / Cumberland Highway / Smithfield Road		5,312	D
2	The Horsley Drive / Polding Street		3,907	E
3	The Horsley Drive / River Avenue		3,645	B
4	The Horsley Drive / Hume Highway (North)		3,901	E
5	The Horsley Drive / Hume Highway (South)		3,228	B
6	Woodville Road / Hume Highway		7,074	E
7	Woodville Road / Fairfield Street		4,299	B
8	Smithfield Road / Edensor Road		3,621	E
9	Smithfield Road / Elizabeth Drive		4,612	C
10	Bonnyrigg Avenue / Edensor Road		2,513	C

11	Bonnyrigg Avenue / Elizabeth Drive		3,955	B
12	Bonnyrigg Avenue / Tarlington Parade		1,652	A
13	Bonnyrigg Avenue / Bibbys Place (West)		1,476	A
14	Bonnyrigg Avenue / Bibbys Place (East)		1,862	A

6. FUTURE TRAFFIC GENERATION AND DISTRIBUTION

During the course of the study a technical note was prepared to summarise the traffic generation and traffic distribution assumptions. The assumptions in the technical note were reviewed and approved by Roads and Maritime. The technical note is included in Appendix A.

6.1 DWELLING NUMBERS

The estimated number of future dwellings in each precinct were provided by Council and are included in Attachment A of the technical note in Appendix A.

6.2 TRAFFIC GENERATION

A literature review was undertaken to compare traffic generation rates for various development types around Sydney. Following this review, the traffic generation rates that were applied to the proposed developments were based on the Roads and Maritime Services Guide to Traffic Generating Developments (2013). Table 6.1 provide a summary of the estimated traffic generation as a result of the proposed rezoning. It was estimated that a total of 13,387 daily vehicular trips would be generated with 2,977 vehicles in the AM peak two hours and 2,627 vehicles in the PM peak two hours. The locations of the proposed rezoning areas are shown in Figure 6.1 along with the locations of the key intersections which have been assessed.

Table 6.1: Traffic Generation Summary

Zoning Change	Estimated Dwelling Units (100% take-up)	Recommended Trip Rate	Daily Vehicle Trips	AM Vehicle Trips (2 Hrs.)	PM Vehicle Trips (2 Hrs.)
Fairfield Heights					
R2 to R3	500	Daily 5 trips/unit, AM Peak 0.5 trips/unit, PM Peak 0.5 trips/unit	2,500	500	500
Fairfield North and South					
R3 to R4	3,295	Daily 1.52 trips/unit, AM Peak 0.29 trips/unit, PM Peak 0.29 trips/unit	5,010	1,912	1,912
Fairfield East / Villawood North and South					
R2 to R3 and R3 to R4	2,975	Daily 1.52 trips/unit, AM Peak 0.29 trips/unit, PM Peak 0.29 trips/unit	4,495	1,715	1,715
Sub Total	*6,753*		*12,005*	*4,127*	*4,127*
Villawood Town Center					
R4	495	Daily 1.52 trips/unit, AM Peak 0.29 trips/unit, PM Peak 0.29 trips/unit	752	287	287
Bonnyrigg Town Centre					
R4	320	Daily 1.52 trips/unit, AM Peak 0.29 trips/unit, PM Peak 0.29 trips/unit	486	186	186
Fairfield Heights Town Centre Precinct					
R4	363	Daily 1.52 trips/unit, AM Peak 0.29 trips/unit, PM Peak 0.29 trips/unit	552	211	211
Sub Total	*1,178*		*1,791*	*683*	*683*
Total	7,931		13,795	4,810	4,810

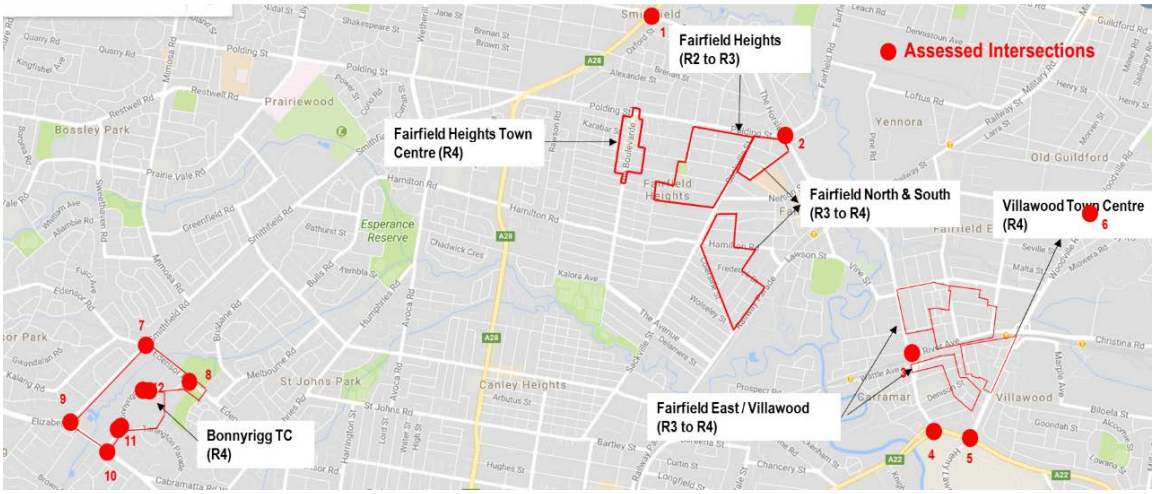


Figure 6.1: Proposed Rezoning Areas and Key Intersections

6.3 DIRECTIONAL SPLITS AND TRAFFIC DISTRIBUTION

The estimated traffic generated by the developments were distributed to the road network. The proportioning of traffic distribution splits was based on the 2011 Australian Bureau of Statistics (ABS) Journey to Work (JTW) data.

6.3.1 Directional Splits

Conventional traffic directional splits were assumed when determining the directional splits of generated traffic in each peak period. Table 6.1 shows the directional splits assumed for AM and PM peak periods.

Table 6.2: Assumed Trip Splits

	AM In	AM Out	PM In	PM Out
Split	20%	80%	70%	30%

Based on the above assumptions, the traffic generated by the proposed rezoning areas are summarised in Table 6.3.

Table 6.3: In/Out Development Traffic Generation

Precinct	Peak Trips (2 Hrs.)			
	AM Out	AM In	PM Out	PM In
Fairfield Heights	400	100	150	350
Fairfield North and South	1530	382	574	1338
Fairfield East / Villawood North and South	1372	343	515	1201
Villawood Town Center	230	57	86	201
Bonnyrigg Town Centre	149	37	56	130
Fairfield Heights Town Centre Precinct	169	42	63	148

6.3.2 Trip Distribution

The future traffic trip distribution was estimated by interrogating Bureau of Transport Statistics (BTS) Journey to Work Data for the existing travel zones within the study area as well as incorporating local knowledge of employment and activity areas. The assumed AM peak OUT traffic distribution from the developments are summarised below and also shown graphically in Figure 6.2:

- majority (31%) of the AM peak trips are contained within Fairfield City Council LGA;
- approximately 33% of the trips travel to the inner western suburbs; and
- approximately 16% travel to Sydney CBD & eastern suburbs.

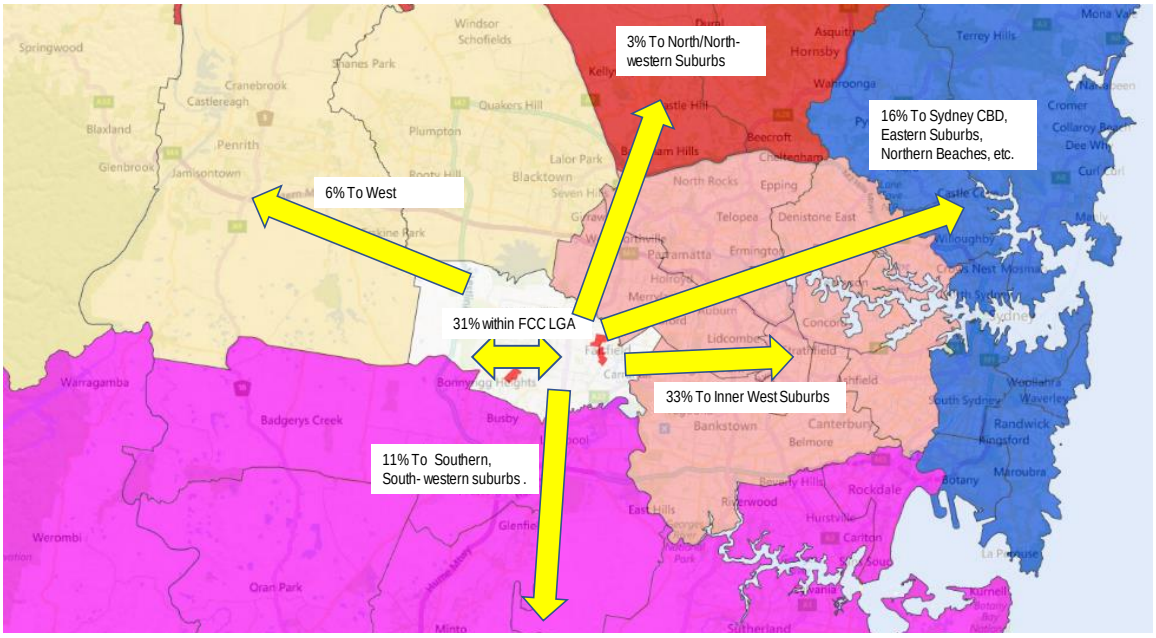


Figure 6.2: Trip Distribution from the Development – AM Peak Out

The assumed AM peak IN traffic distribution to the developments are summarised below and also shown graphically in Figure 6.3:

- majority (54%) of the AM peak trips are contained within Fairfield City Council LGA;
- approximately 21% of the trips are from the southern suburbs; and
- approximately 17% travel to/from inner-west suburbs.

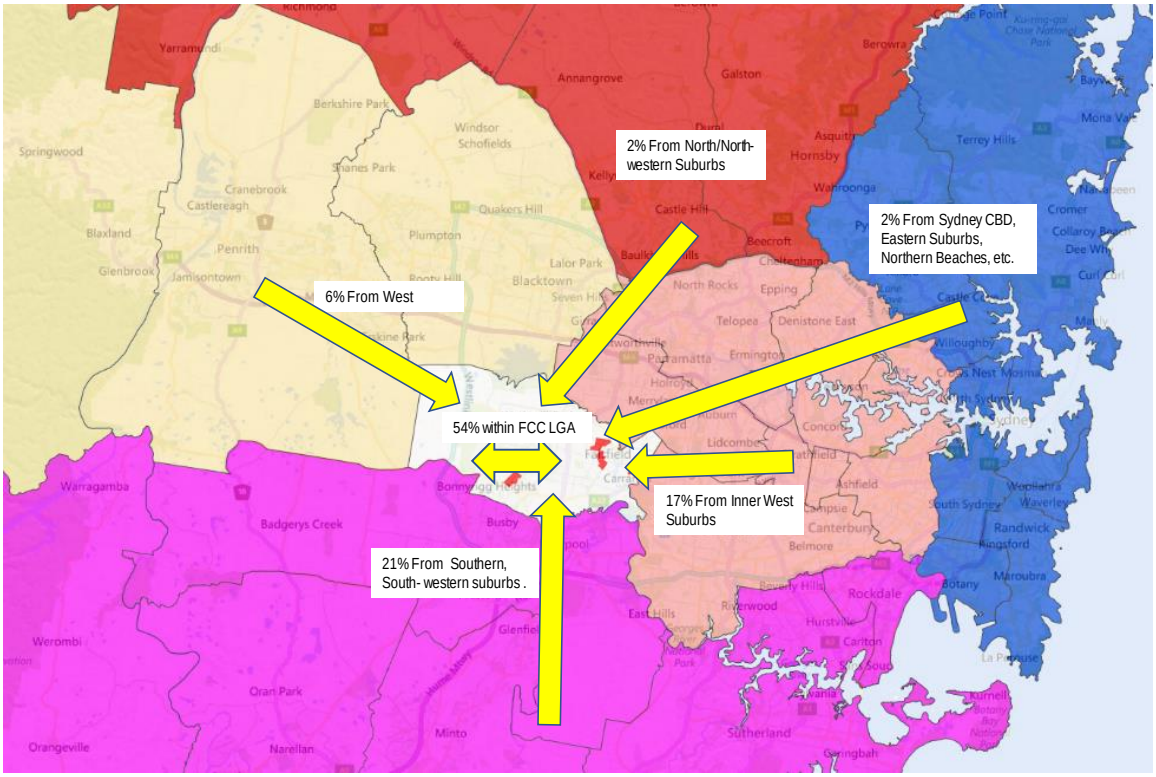


Figure 6.3: Trip Distribution from the Development – AM Peak In

The above traffic generation and traffic distribution calculations have been used as a basis to increase the traffic demand already contained in the STM for the rezoning areas. It should be noted that it has been assumed that the development 'uplift' proposed within each of the four precincts will replace 75% of the

existing development. The nett additional traffic has been distributed within the local area as well as across the wider area in the STM model.

It is important to highlight that the AM peak period calculations have simply been inverted for input into the PM peak modelling.

7. STRATEGIC TRAFFIC MODELLING

7.1 BACKGROUND

The existing 2016 and future 2026 and 2036 AM and PM peak Sydney Strategic Transport Models (STM) were provided by Roads and Maritime. It should be highlighted that the model provided was a traffic assignment model only (i.e. it did not include traffic generation, traffic distribution or mode choice and therefore did not include the capability to explicitly model modal shifts to public transport with densification.

The STM model includes all key road links within the greater Sydney Metropolitan Area. As part of this assessment, no changes were made to the existing and future STM road network. Some localised improvements were made to better reflect the zonal traffic behaviour within the core study area. The changes were limited to the core study area and only included addition or re-location of some zone connectors to simulate various traffic loading points correctly.

The impact of the proposed rezoning was assessed for two future years at 2026 and at 2036. In summary, the model scenarios used are listed in Table 7.1 .

Table 7.1: Base and 'With Development' Traffic Models

Scenario	AM	PM
Base Models		
2016 Base	√	√
2026 Base	√	√
2036 Base	√	√
'With Development' Models		
2016 Base + Development	√	√
2026 Base + Development	√	√
2036 Base + Development	√	√

The proposed rezoning includes removal of the existing low / medium density development and replacement of it with medium / high density development. The base STM models already includes trips from the low / medium density assumed in each area. In order to avoid double counting, in the "with development" models, deductions were firstly made in the base traffic demand to reflect the removal/replacement of this traffic. The estimated number of trips generated by the proposed rezoning areas was then added to the STM models.

No information was available on any proposed staging of development as part of the implementation of the planning proposals. In the absence of this information, it was conservatively assumed that the proposed rezoning would be implemented in full by 2026.

7.2 STM OUTPUTS ANALYSIS

7.2.1 STM Model Link Plots

A series of AM and PM peak STM model link plots were prepared for the base and 'with development' scenarios. The plots show assigned link traffic volumes, link volume/capacity ratios and differences in traffic volumes between the base and 'with development' scenarios. These plots are included in Appendix B.

7.2.2 Network Statistics

Network-wide statistics were prepared for the base and 'with development' scenarios. These included:

- Total Number of Trips;
- Vehicle Kilometres Travelled (VKT); and
- Vehicle Hours Travelled (VHT).

The network-wide statistics are useful in quantifying the impacts of the development traffic on the wider road network.

Matrix Totals

Table 7.2 below summarises the 2016, 2026 and 2036 AM and PM peak traffic matrices for the greater Sydney Metropolitan Area. The predicted increase in trip totals in the 'with development' scenarios is negligible as compared to the base scenario given the scale of the model area being used.

Table 7.2: Total Trips

Time Period	2016 Base	2016 "With Development"	2026 Base	2026 "With Development"	2036 Base	2036 "With Development"
AM	1,604,695	1,607,911	1,865,101	1,868,251	2,138,618	2,141,658
PM	1,741,894	1,744,390	2,032,895	2,035,320	2,327,957	2,330,272

Vehicle Kilometres Travelled

Table 7.3 below summarises the 2016, 2026 and 2036 vehicle kilometres travelled (VKT) of the entire Sydney Transport Model (STM) in AM and PM peak. The vehicle kilometres travelled are consistent with the increase/decrease of vehicle trips across various scenarios tested.

Table 7.3: Vehicle Kilometres Travelled

Time Period	2016 Base	2016 "With Development"	2026 Base	2026 "With Development"	2036 Base	2036 "With Development"
AM	20,092,410	21,396,282	22,851,388	24,364,313	25,511,634	27,236,437
PM	21,495,782	22,841,966	24,424,998	25,990,872	27,084,436	28,880,879

(1) Small reduction due to development encouraging some localisation of trip making

Vehicle Hours Travelled

Table 7.4 below summarises the vehicle hours travelled in 2021 and 2031 AM and PM peak models. There are no significant changes in vehicle hours travelled and the values are consistent with the increase/decrease in trip making across the scenarios. This indicates that there will be marginal increase in delays due to the development traffic compared to the Base conditions.

Table 7.4: Vehicle Hours Travelled

Time Period	2016 Base	2016 "With Development"	2026 Base	2026 "With Development"	2036 Base	2036 "With Development"
AM	492,781	558,031	579,873	655,639	678,109	764,152
PM	532,344	599,522	627,805	705,722	727,925	817,748

(1) Small reduction due to development encouraging some localisation of trip making

It should be highlighted that the key network statistics above are provided simply for completeness and more detailed intersection-specific assessments are necessary to understand the localised impacts of the rezoning proposals.

7.3 Estimation of Future Intersection Traffic Volumes

A two-step methodology was adopted to estimate future year traffic volumes at the 14 key intersections.

- *Step 1* - the difference in link traffic volumes between the existing 2016 base and future 2026 base (and 2036 base) provided the changes in traffic volumes at each intersection's approach roads; and
- *Step 2* – the changes in approach traffic volumes were split into turns and added to the 2017 observed turn volumes to calculate the estimated future intersection turn volumes.

The above process was repeated for the 'with development' scenario to calculate the estimated future 'with development' traffic volumes.

Appendix B contains the estimated link and turn volumes at each of the subject intersections. The estimated turns volumes were used to develop the future base and 'with development' SIDRA models.

8. INTERSECTION ASSESSMENT RESULTS

8.1 INTERSECTION LOCATIONS

The 14 intersections identified in Figure 8.1 were assessed using SIDRA and the future year traffic volumes used for the assessment are shown in Appendix E. The SIDRA models were also used to test intersection improvement measures.

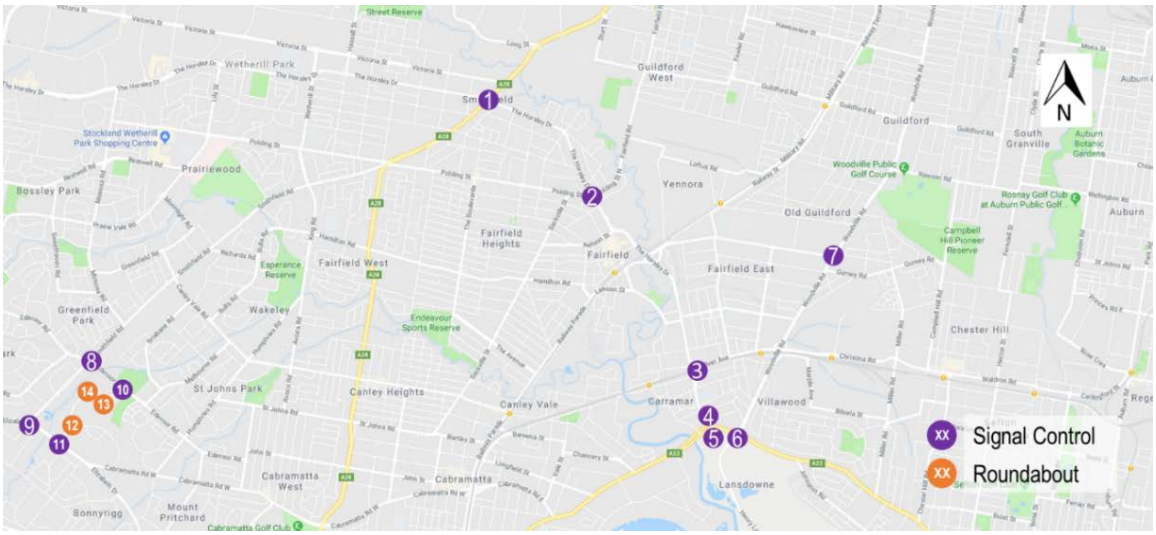


Figure 8.1: Intersection Locations

8.2 INTERSECTION ASSESSMENT CRITERIA

The following criteria was used to assess the traffic performance in each of the AM and PM peak periods:

- Level of Service (LoS) and delays;
- Degree of Saturation (DoS); and
- Queue – 95th percentile queue lengths.

8.2.1 Level of Service and Delays

Level of Service describes the operational performance at an intersection and is directly related to the delay in seconds experienced at each approach. Table 8.1 shows the standard Level of Service (LoS) criteria for intersection assessment.

Table 8.1: Level of Service Criteria *(Source: RMS Guide to Traffic Generating Development. Table 4.2)*

Level of Service	Average Delay Per Vehicle (sec/veh)	Traffic Signals, Roundabouts	Give Way and Stop Signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals, incident will cause excess delays Roundabout require other control mode	At capacity, requires other control mode

If the average vehicle delay is more than 70 seconds, the intersection is assumed to be at Level of Service F.

8.2.2 Degree of Saturation

Degree of saturation (DoS) is generally used to measure the performance on isolated intersections. As per Roads and Maritime's Guide to Traffic Generating Developments, "an upper limit of 0.9 is appropriate" at intersections controlled by traffic signals. Both queue length and delays increase rapidly as DoS approaches 1.0. Throughout the report the DoS was highlighted using the following colour scheme:

- black if the intersection operates below practical operating capacity (i.e. DoS < 0.80 for priority controlled, DoS < 0.85 for roundabouts and DoS < 0.90 for signalised intersection);
- yellow if the intersection operates above the practical operating capacity but below theoretical capacity (i.e. 1.0); and
- red if the intersection operates theoretical capacity (i.e. DoS >1.0).

It is preferable to achieve DOS below practical operating capacity (i.e. DoS < 0.80 for priority controlled, DoS < 0.85 for roundabouts and DoS < 0.90 for signalised intersection), however; at some intersections it is impossible to get DoS below the operating capacity, due to site constraints. At such intersections, theoretical capacity (i.e. DoS <1.0 for signalised intersections) has been adopted.

8.2.3 Queue Lengths

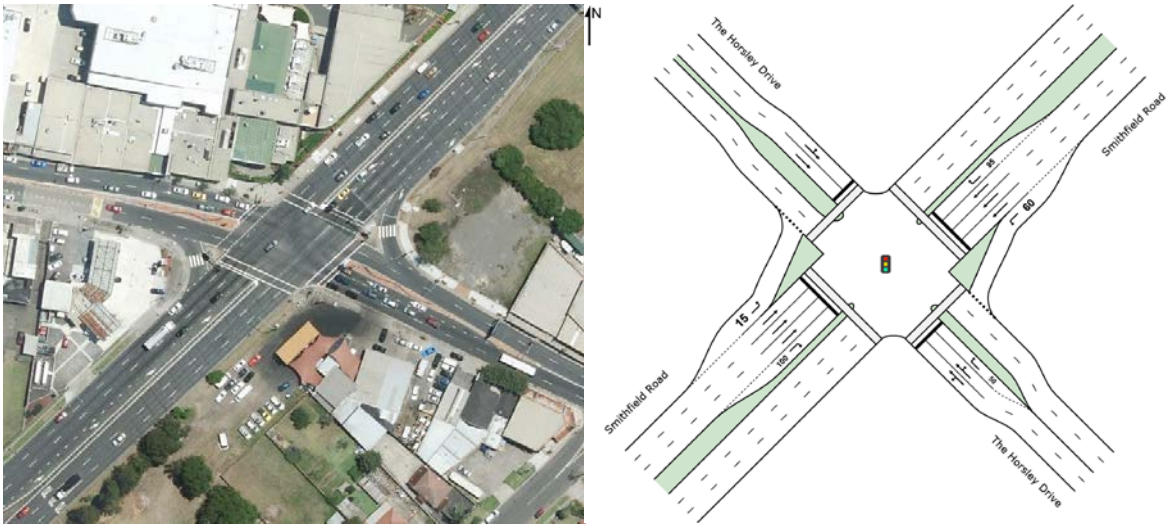
The 95th percentile queues were analysed to understand the probability of queues on intersection approaches extending back to a nearby intersection. The 95th percentile queues were also used to determine the length of turn lanes/pockets required.

Throughout the report the 95th percentile queues are highlighted in red where the queues exceed the length of the turn lanes/pockets.

8.3 THE HORSLEY DRIVE / CUMBERLAND HIGHWAY / SMITHFIELD ROAD INTERSECTION

8.3.1 Existing Conditions

Figure 8.2 shows the current configuration and the SIDRA layout of The Horsley Drive / Cumberland Highway / Smithfield Road intersection.



SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.2: The Horsley Drive / Cumberland Highway / Smithfield Road Intersection

Table 8.2 summarises the 2017, 2026 and 2036 SIDRA outputs under the base and 'with development' traffic scenarios. Detailed outputs are included in Appendix E.

Table 8.2: The Horsley Drive / Cumberland Highway / Smithfield Road Intersection Performance

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	4,863	0.83	42	C	302	5,312	0.89	48	D	404
2017 "With Development"	5,079	0.86	45	D	336	5,463	0.94	53	D	428
2026 Base	5,197	0.87	47	D	349	5,684	0.96	60	E	515
2026 "With Development"	5,465	0.93	54	D	405	5,841	0.99	68	E	541
2036 Base	5,599	0.96	55	D	423	6,051	1.04	72	F	591
2036 "With Development"	5,955	1.02	72	F	509	6,316	1.15	80	F	655

As indicated in , the intersection is predicted to operate over-capacity in the 2026 PM "with development" and 2036 AM/PM base and "with development" scenarios. The following observations were made from the SIDRA models:

2036 Base and "With Development"

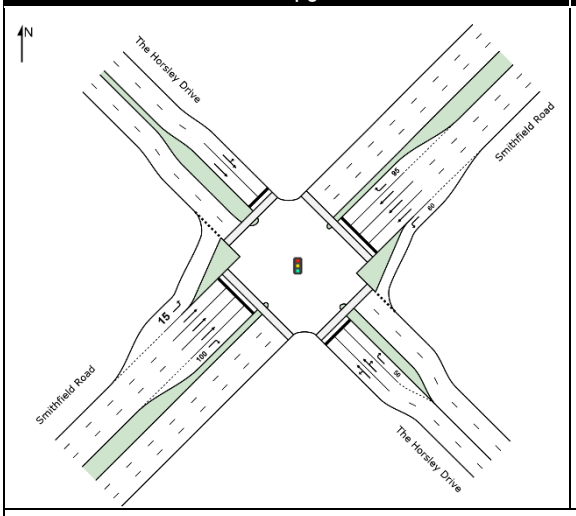
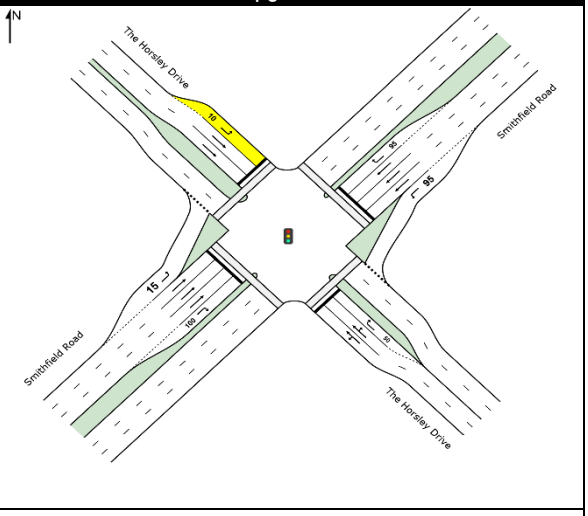
- The Horsley Drive approaches, and Smithfield Road North are predicted to operate over theoretical capacity and exhibit long queues in both the AM the PM peak periods.

In order for the intersection to operate satisfactorily in the future base and 'with development' scenarios, additional stop line capacity is needed.

8.3.2 Recommended Upgrades

Table 8.3 and Table 8.4 summarises the upgrades identified to improve the 2026 and 2036 intersection performance with the 'base' and 'with development' scenarios. The following section summarises the subsequent intersection performance under the upgraded configuration.

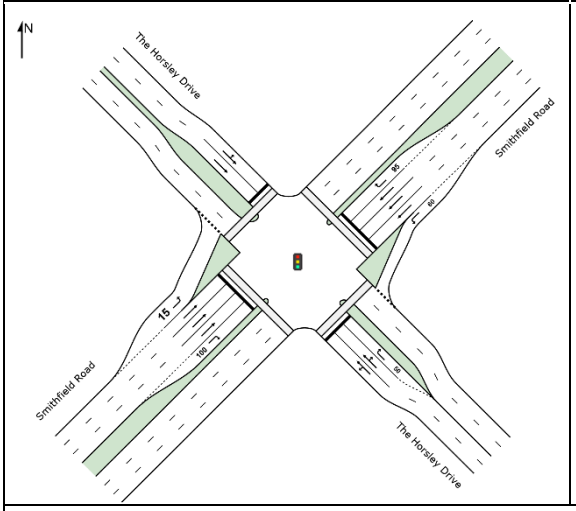
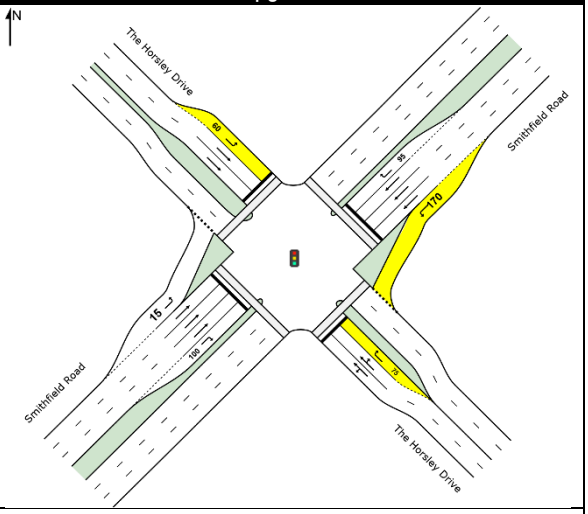
Table 8.3: The Horsley Drive Drive/Cumberland Highway/Smithfield Road Intersection – Proposed 2026 Upgrades

Before Upgrade	After Upgrade – 2036
	

Proposed Additional Upgrades:

The Horsley Drive Northwest approach: add a 10m long segregated left turn lane.

Table 8.4: The Horsley Drive Drive/Cumberland Highway/Smithfield Road Intersection – Proposed 2036 Upgrades

Before Upgrade	After Upgrade – 2036
	

Proposed Additional Upgrades:

The Horsley Drive Northwest approach: add a 75m long segregated left turn lane.

Smithfield Road Northeast approach: extend the kerbside lane to 170m.

The Horsley Drive Southeast approach: extend the median lane to 75m.

8.3.3 Performance with Upgrades

Table 8.5 below summarises the 2036 intersection performance with the proposed upgrades. The intersection is predicted to operate slightly over-capacity with DoS higher than 1.0. However, the average delay (LoS D or better) and 95th percentile queues are predicted to reduce substantially.

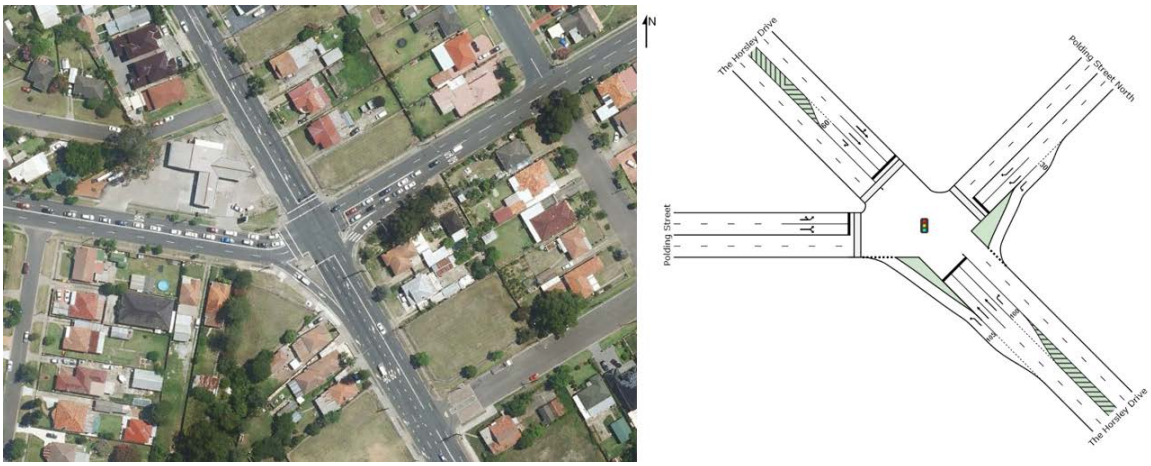
Table 8.5: The Horsley Drive / Cumberland Highway / Smithfield Road Intersection Performance – Recommended Layout

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2026 "With Development"	5,465	0.94	52	D	391	5,841	0.95	52	D	479
2036 "With Development"	5,955	0.95	56	D	442	6,316	0.98	57	D	487

8.4 THE HORSLEY DRIVE / POLDING STREET INTERSECTION

8.4.1 Existing Condition

Figure 8.3 below shows the current configuration and SIDRA layout of the existing The Horsley Drive / Polding Street intersection.



SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.3: The Horsley Drive / Polding Street Intersection

Table 8.6 below summarises the 2017, 2026 and 2036 outputs from SIDRA under the base and with development scenarios for the intersection. Detailed outputs are contained in Appendix E.

Table 8.6: The Horsley Drive / Polding Street Intersection Performance

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	3,801	0.89	48	D	256	3,907	0.98	59	E	263
2017 "With Development"	4,018	0.93	55	D	298	4,054	1.0	65	E	280
2026 Base	4,165	0.96	52	D	316	4,200	1.02	71	F	310
2026 "With Development"	4,485	1.04	67	E	389	4,405	1.06	80	F	350
2036 Base	4,537	1.05	75	F	367	4,570	1.1	89	F	379
2036 "With Development"	4,910	1.14	92	F	480	4,804	1.15	100	F	424

As indicated in the above table, the intersection is predicted to operate over capacity in both the 2026 and 2036 base case and in the 'with development' case. The following observations were made from the SIDRA models:

2026 Base and "With Development"

- both The Horsley Drive approaches and Polding Street East would operate over theoretical capacity in both peak periods.

2036 Base and "With Development"

- both The Horsley Drive approaches and both the Polding Street approaches would operate over theoretical capacity in both peak periods; and
- long queues and excessive delays (>2 minutes) are expected across all approaches in both the AM and PM peak periods.

In order for the intersection to operate satisfactorily in the 2026 and 2036 base and 'with development' scenarios, additional capacity is required in the form of additional lanes.

8.4.2 Recommended Upgrades

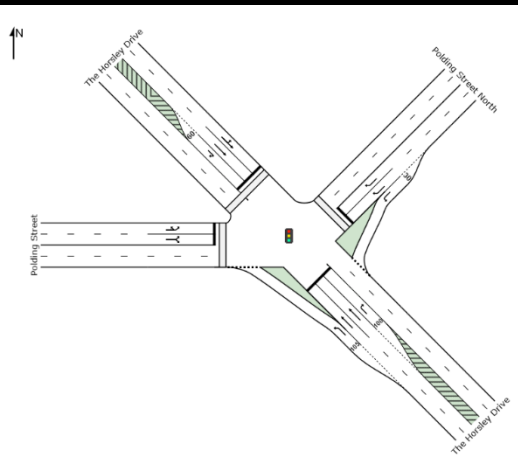
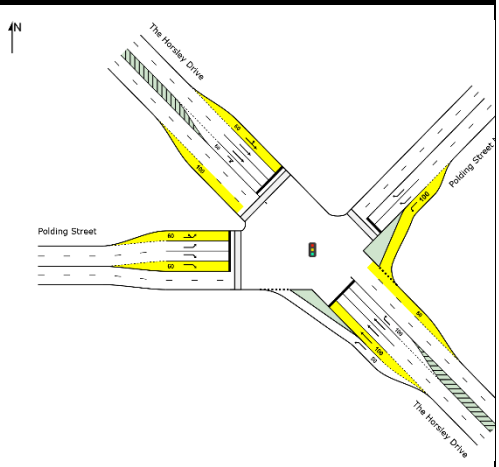
Table 8.7 and Table 8.8 shows the proposed upgrades to improve the 2026 and 2036 intersection performances under both the 'base' and 'with development' scenarios.

2026 and 2036 Base and 'With Development'

The existing demand for the right turn movements from the Polding Street the westbound approach to The Horsley Drive is very low. However, these vehicles, while waiting for a gap in the opposing traffic, significantly reduce the capacity for through traffic. It is, therefore proposed to ban the movement in the 2016 base and 'with development' cases. Additional intersection upgrades are required as identified in and .

SIDRA analysis shows that if westbound to northbound right turn is allowed the Polding Street westbound approach will experience significant delays. Currently the right turn volume is very low, therefore for the future base and options model it was assumed that this movement will be banned.

Table 8.7: The Horsley Drive / Polding Street Intersection – Proposed 2026 Upgrades

Before Upgrade	2026 Upgrade
	

Proposed Improvements:

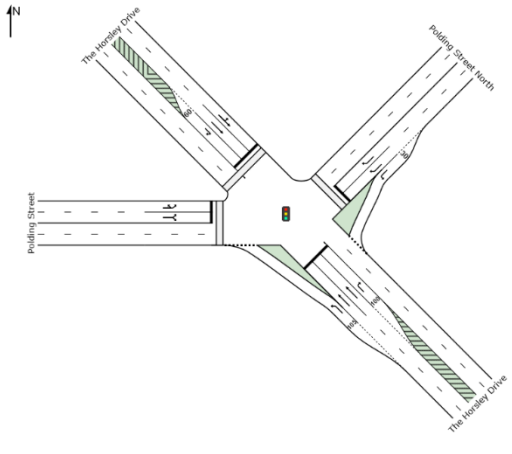
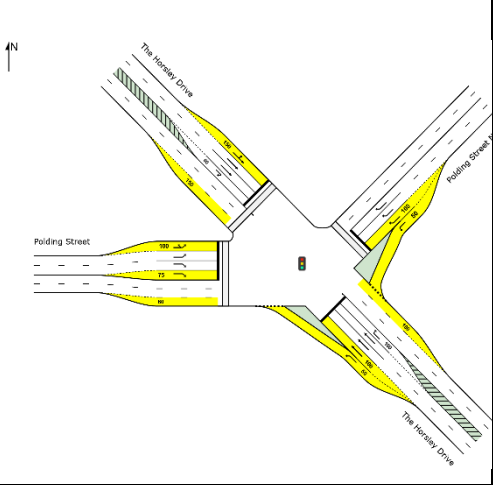
Polding Street North-eastern Approach: extend kerbside lane to 100m.

The Horsley Drive Southern Approach: add a 100m long through lane and reduce the length of the existing left turn slip lane to 50m. Add a 60m lane on the exit lane

Polding Street Western Approach: add a 60m long right turn pocket and add a 60m long share left/through pocket.

The Horsley Drive Northern Approach: Add 60m long shared left/through pocket. Add 100m long exit lane.

Table 8.8: The Horsley Drive / Polding Street Intersection – Proposed 2036 Upgrades

Before Upgrade	2036 Upgrade
	

Proposed Improvements:

Polding Street North-eastern Approach: add a 100m long westbound through lane. extend kerbside lane to 50m.

The Horsley Drive Southern Approach: add a 100m long through lane and reduce the length of the existing left turn slip lane to 50m. Add a 100m lane on the exit lane

Polding Street Western Approach: add a 75m long right turn pocket and add a 100m long share left/through pocket.

The Horsley Drive Northern Approach: Add 150m long shared left/through pocket. Add 150m long exit lane.

8.4.3 Performance with Upgrades

Table 8.9 below summarises the intersection performances with the proposed upgrades. The intersection is predicted to operate below theoretical capacity in both 2026 & 2036 base and "with development" scenarios. However, the average delay and 95th percentile queues are predicted to reduce substantially.

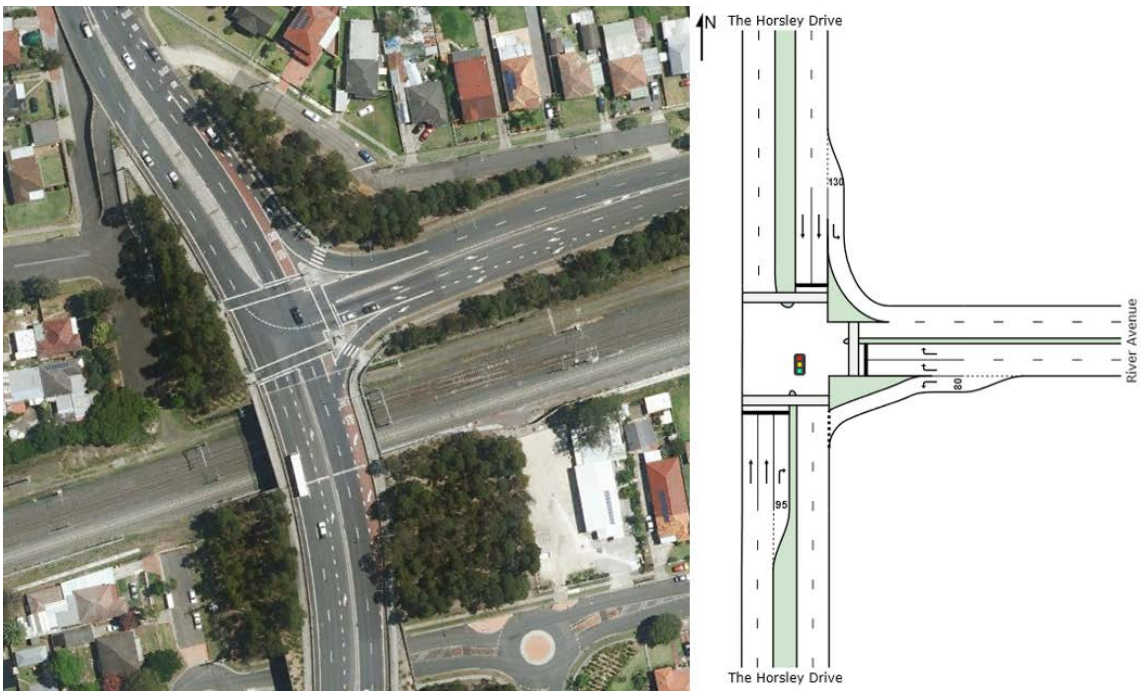
Table 8.9: The Horsley Drive / Polding Street Intersection Performance – Recommended Layout

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2026 "With Development"	4,485	0.83	43	C	196	4,392	0.86	49	D	193
2036 "With Development"	4,910	0.83	49	D	206	4,788	0.84	49	D	209

8.5 THE HORSLEY DRIVE / RIVER AVENUE INTERSECTION

8.5.1 Existing Condition

Figure 8.4 below shows the existing intersection configuration and SIDRA layout of the Horsley Drive / River Avenue intersection.



SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.4: The Horsley Drive / River Avenue Intersection

Table 8.10 below summarises the 2017, 2026 and 2036 SIDRA outputs under the base and 'with development' scenarios. Detailed outputs are contained in Appendix E.

Table 8.10: The Horsley Drive / River Avenue Intersection Performance

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	3,138	0.54	21	B	132	3,645	0.71	26	B	177
2017 "With Development"	3,264	0.56	22	B	139	3,800	0.73	26	B	188
2026 Base	3,300	0.57	21	B	141	3,782	0.69	25	B	178
2026 "With Development"	3,471	0.60	22	B	150	3,965	0.70	26	B	192
2036 Base	3,439	0.59	21	B	147	3,944	0.70	26	B	190
2036 "With Development"	3,588	0.62	21	B	152	4,170	0.74	26	B	205

As indicated in the above table, the Horsley Drive / River Avenue intersection is predicted to operate within practical capacity under all scenarios. Therefore, no intersection upgrades are required to service the future base and development traffic.

8.6 THE HORSLEY DRIVE / HUME HIGHWAY (NORTH) INTERSECTION

8.6.1 Existing Condition

Figure 8.5 below shows the existing configuration and SIDRA layout of the Horsley Drive / Hume Highway (North) intersection.

SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.5: The Horsley Drive / Hume Highway (North) Intersection

Table 8.11 below summarises the 2017, 2026 and 2036 SIDRA outputs under the base and 'with development' scenarios. Detailed outputs are provided in Appendix E.

Table 8.11: The Horsley Drive / Hume Highway (North) Intersection Performance

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	4,021	0.93	53	D	479	3,901	1.03	72	E	498
2017 "With Development"	4,197	1.04	82	F	644	4,073	1.1	53	D	523
2026 Base	4,264	1.01	72	F	614	4,141	1.14	99	F	659
2026 "With Development"	4 478	1.15	116	F	818	4,296	1.19	110	F	682
2036 Base	4,448	1.13	109	F	810	4,414	1.15	106	F	664
2036 "With Development"	4,684	1.19	127	F	860	4,571	1.19	115	F	698

As indicated in the above table, the intersection is predicted to operate over capacity in both the 2026 and 2036 base case and in the 'with development' case. The following observations were made from the SIDRA models:

- both the Hume Highway west and The Horsley Drive north approaches would operate over theoretical capacity in both the AM and PM peak periods across all model years and scenarios.

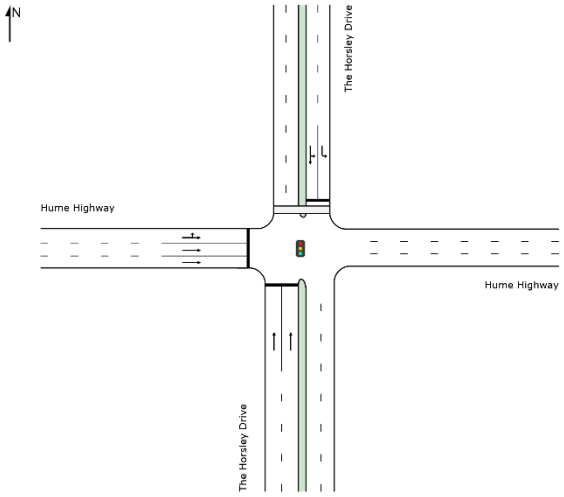
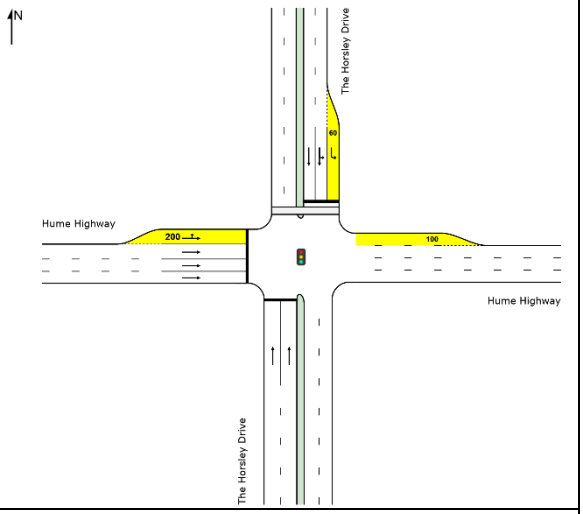
In order for the intersection to operate satisfactorily in the 2026 and 2036 base and 'with development' scenarios, additional capacity is required in the form of additional lanes.

8.6.2 Recommended Upgrades

2026 & 2036 Base and 'With Development'

Significant upgrades are required to service both the 2026 & 2036 base and 'with development' traffic. The proposed upgrades are summarised in Table 8.12 and Table 8.13.

Table 8.12: Hume Highway / The Horsley Drive – Proposed 2026 Upgrades

Before Upgrade	After Upgrade
	

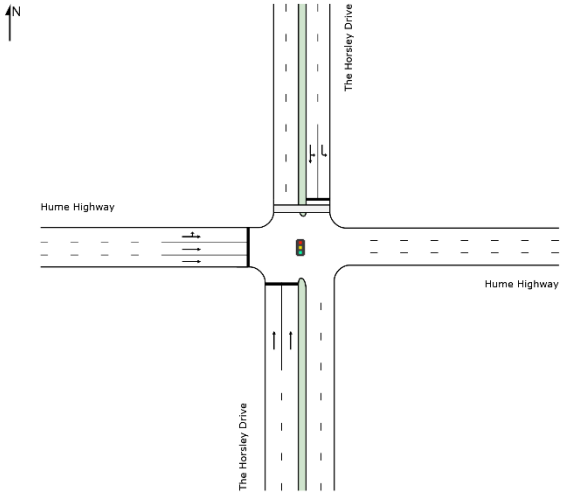
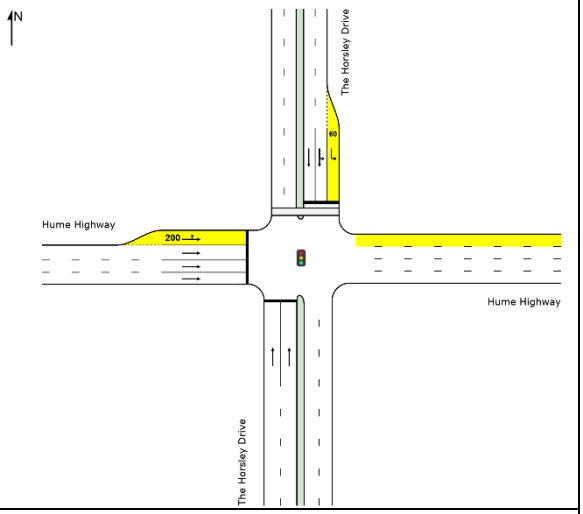
Proposed Improvements:

Hume Highway Western Approach: add a 200m long shared left & through lane.

The Horsley Drive Northern Approach: add a 60m long left turn lane.

Hume Highway Eastern Approach: add a 100m short lane on the exit side.

Table 8.13: Hume Highway / The Horsley Drive – Proposed 2036 Upgrades

Before Upgrade	After Upgrade
	

Proposed Improvements:

Hume Highway Western Approach: add a 200m long shared left & through lane.

The Horsley Drive Northern Approach: add a 60m long left turn lane and reconfigure the lanes to provide dual through and dual left turns.

Hume Highway Eastern Approach: add a kerbside lane on the exit side.

8.6.3 Performance with Upgrades

Table 8.14 below summarises the intersection performances with the proposed upgrades. The intersection is predicted to operate within practical capacity under all scenarios.

Table 8.14: The Horsley Drive / Hume Highway (North) Intersection – Recommended Layout

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2026 "With Development"	4,478	0.81	35	C	187	4,296	0.84	36	C	186
2036 "With Development"	4,684	0.79	36	C	180	4,571	0.83	39	C	178

8.7 THE HORSLEY DRIVE / HUME HIGHWAY (SOUTH) INTERSECTION

8.7.1 Existing Condition

Figure 8.6 shows the existing configuration and SIDRA layout of The Horsley Drive / Hume Highway (South) intersection.

SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.6: The Horsley Drive / Hume Highway (South) Intersection

Table 8.15 below summarises the 2017, 2026 and 2036 outputs from SIDRA model for the base and 'with development' scenarios. Detailed outputs are contained in Appendix E..

Table 8.15: The Horsley Drive / Hume Highway (South) Intersection Performance

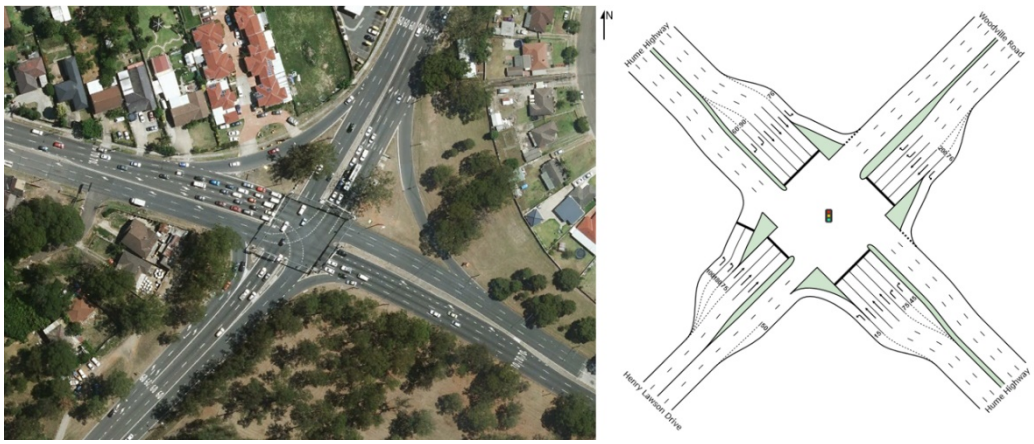
Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	2,550	0.57	10	A	80	3,228	0.74	19	B	319
2017 "With Development"	2,600	0.58	10	A	79	3,464	0.77	19	B	346
2026 Base	2,718	0.62	9	A	58	3,463	0.78	19	B	346
2026 "With Development"	2,931	0.65	10	A	92	3,629	0.79	17	B	332
2036 Base	2,949	0.66	9	A	65	3,671	0.81	20	C	364
2036 "With Development"	3,205	0.66	10	A	110	3,722	0.76	18	B	332

As indicated in the above tables, the Horsley Drive / Hume Highway (South) intersection will operate within theoretical capacity under all scenarios. Therefore, no intersection upgrades are required to service the future base and development traffic.

8.8 WOODVILLE ROAD / HUME HIGHWAY INTERSECTION

8.8.1 Existing Condition

Figure 8.7 shows the existing configuration and SIDRA layout of the Woodville Road / Hume Highway intersection.



SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.7: Woodville Road / Hume Highway Intersection

Table 8.16 below summarises the 2017, 2026 and 2036 outputs from SIDRA for the base and 'with development' scenarios. Detailed outputs are contained in Appendix E.

Table 8.16: Woodville Road / Hume Highway Intersection Performance

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	6,860	0.92	53	D	404	7,074	0.96	61	E	432
2017 "With Development"	7,168	0.92	58	E	424	7,378	1.03	68	E	491
2026 Base	7,296	0.97	61	E	413	7,579	1.03	68	E	443
2026 "With Development"	7,723	1.01	73	F	461	8,010	1.07	74	E	446
2036 Base	7,737	1.03	74	F	470	8,008	1.36	91	F	408
2036 "With Development"	8,228	1.1	85	F	511	8,444	1.43	99	F	441

As indicated in the above tables, the Woodville Road / Hume Highway intersection is predicted to operate over-capacity under both the base and 'with development' scenarios. The following observations were made from the SIDRA models:

2026 Base and "With Development"

- The Hume Highway, Woodville Road and Henry Lawson Drive approaches would operate over theoretical capacity in the PM peak periods.

2036 Base and "With Development"

- all approaches would operate over theoretical capacity in the PM peak period under the base scenario; and
- all approaches would operate over theoretical capacity in the AM and PM peak periods under "with development" scenario.

In order for the intersection to operate satisfactorily in the future years, substantial upgrades are required.

8.8.2 Recommended Upgrades

Table 8.17 and Table 8.18 summarises the proposed upgrades to improve the 2026 and 2036 intersection performances with the base and 'with development' traffic.

Table 8.17: Woodville Road / Hume Highway Intersection Performance – Proposed 2026 Upgrades

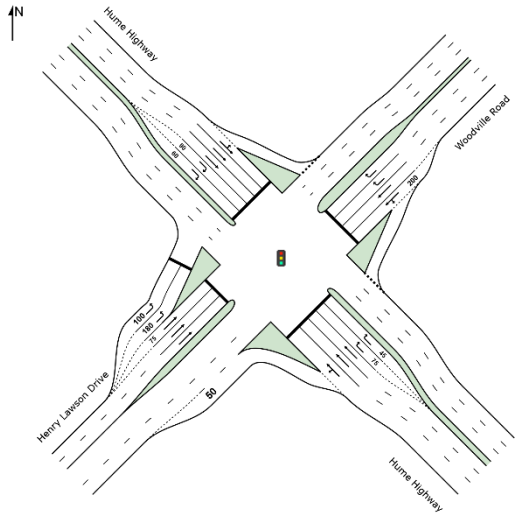
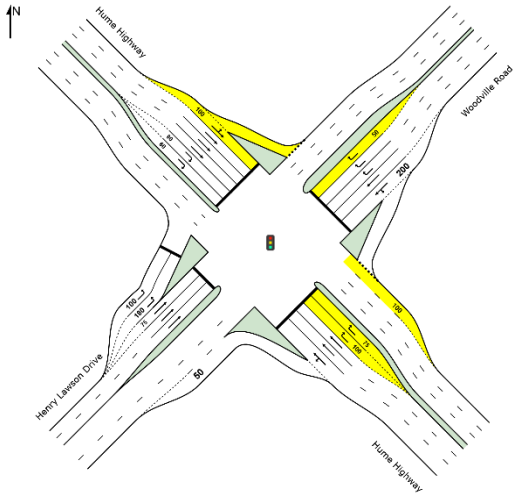
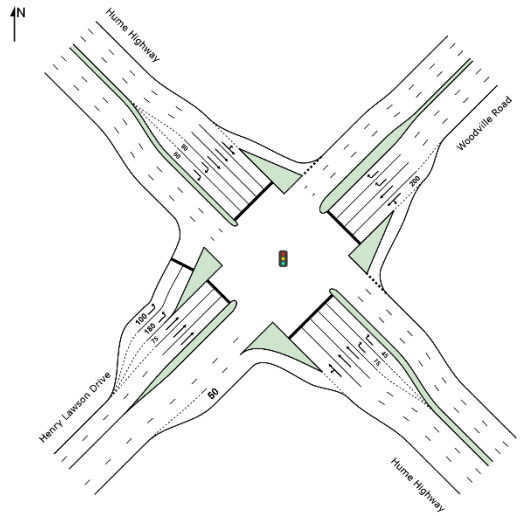
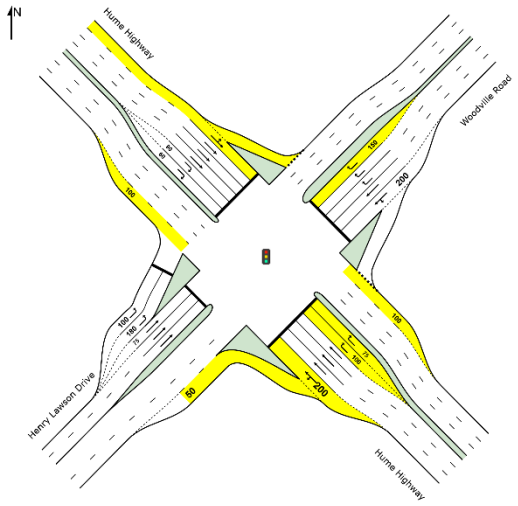
2018	2026 Upgrade
	
Proposed Improvements: *Hume Highway Eastern Approach*: extend the length of the inner right turn pocket lane to 75m and outer to 100m. add a 100m short lane on the exit side. *Woodville Road Northern Approach*: add 50m long right turn pocket. *Hume Highway Western Approach*: convert the shared kerbside lane to through only. Add a 100m long shared through and left turn slip lane.	

Table 8.18: Woodville Road / Hume Highway Intersection Performance – Proposed 2036 Upgrades

2018	2036 Upgrade
	
Proposed Improvements: *Hume Highway Eastern Approach*: extend the length of the inner right turn pocket lane to 75m and outer to 100m. convert the shared kerbside lane to through only. add a 200m long shared through and left turn slip lane. add a 100m short lane on the exit side. *Woodville Road Northern Approach*: add 50m long right turn pocket.	

Hume Highway Western Approach: Convert the shared kerbside lane to through only. Add a 100m long shared through and left turn slip lane.

8.8.3 Performance with Upgrades

Table 8.19 below summarises the intersection performance with the proposed upgrades. The intersection is predicted to operate within theoretical capacity under all scenarios and the intersection Level of Service will be D or better.

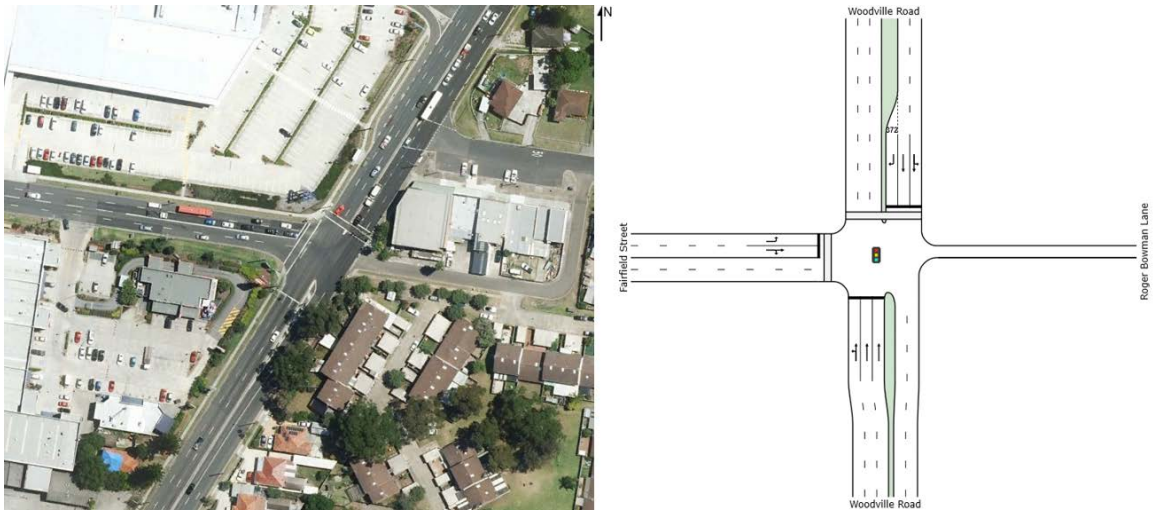
Table 8.19: Woodville Road / Hume Highway Intersection Performance – Recommended Layout

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2026 "With Development"	7,723	0.97	55	D	227	8,010	0.95	57	E	212
2036 "With Development"	8,228	0.95	55	D	224	8,444	0.95	53	D	196

8.9 WOODVILLE ROAD / FAIRFIELD STREET INTERSECTION

8.9.1 Existing Condition

Figure 8.8 below shows the existing configuration and SIDRA layout of the Woodville Road / Fairfield Street intersection.



SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.8: Woodville Road / Fairfield Street Intersection

Table 8.19 below summarises the 2017, 2026 and 2036 outputs from SIDRA under the base and 'with development' scenarios. Detailed outputs are contained in Appendix E.

Table 8.19: Woodville Road / Fairfield Street Intersection Performance

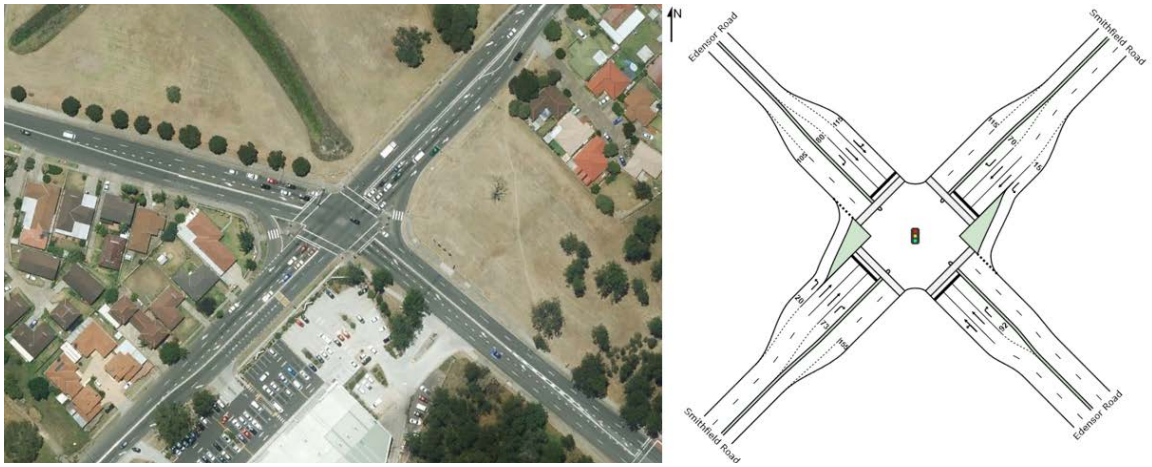
Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	3,765	0.70	27	B	244	4,299	0.77	28	B	267
2017 "With Development"	3,974	0.76	28	B	270	4,397	0.79	29	C	274
2026 Base	4,045	0.77	28	B	273	4,551	0.82	29	C	285
2026 "With Development"	4,274	0.82	30	C	313	4,713	0.85	34	C	321
2036 Base	4,468	0.84	30	C	335	4,831	0.87	33	C	328
2036 "With Development"	4,556	0.87	35	C	380	5,007	0.91	38	C	372

The intersection will operate within theoretical capacity. Therefore, no intersection upgrades are required to service the future base and development traffic.

8.10 SMITHFIELD ROAD / EDENSOR ROAD INTERSECTION

8.10.1 Existing Conditions

Figure 8.9 below shows the existing configuration and SIDRA layout of the Smithfield Road / Edensor Road intersection.



SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.9: Smithfield Road / Edensor Road Intersection

Table 8.20 below summarises the 2017, 2026 and 2036 outputs from SIDRA under the base and 'with development' scenarios. Detailed outputs are contained in Appendix E.

Table 8.20: Smithfield Road / Edensor Road Intersection Performance

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	3,683	0.86	57	E	284	3,621	1.02	70	F	371
2017 "With Development"	3,768	0.88	59	E	262	3,708	1.04	73	F	393
2026 Base	3,792	0.88	59	E	273	3,778	1.05	74	F	403
2026 "With Development"	3,923	0.91	63	E	303	3,874	1.1	80	F	420
2036 Base	4,055	0.95	65	E	326	3,999	1.11	83	F	451
2036 "With Development"	4,170	0.99	74	F	332	4,116	1.15	89	F	470

As indicated in the above tables, the Smithfield Road / Edensor Road intersection will operate above the practical capacity under most scenarios in PM peak. The following observations were made from the SIDRA models:

2026 Base and "With Development"

- the Edensor Road southeast and Smithfield Road northeast approaches would operate over theoretical capacity in the PM peak both in the base and 'with development' scenarios.

2036 Base and "With Development"

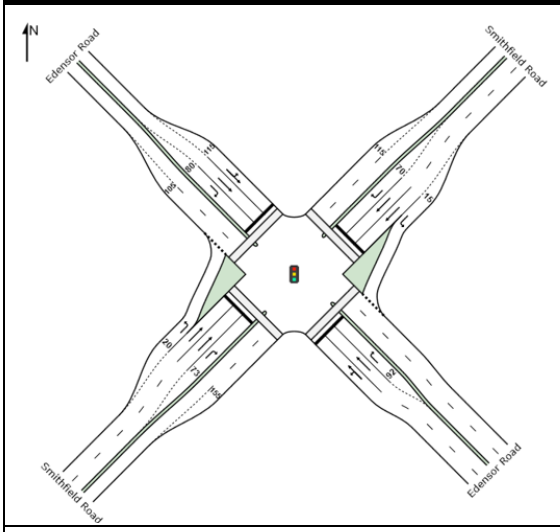
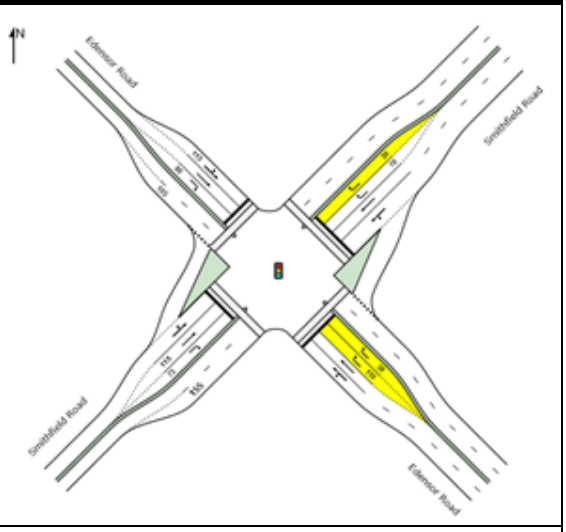
- the Edensor Road approaches would operate slightly over theoretical capacity in the AM peak under the 'with development' scenario; and
- the Edensor Road southeast and Smithfield Road northeast approaches would operate over theoretical capacity in the PM peak with and without the development.

In order for the intersection to operate satisfactorily in the future scenarios, upgrades are required. The SIDRA model was used to develop improvement measures required to service the 2026 & 2036 base and 'with development' traffic. The upgrades required are summarised in the following section.

8.10.2 Recommended Upgrades

Table 8.21 contains the proposed upgrades to improve the 2026 and 2036 intersection performances with the base and 'with development' scenarios.

Table 8.21: Smithfield Road / Edensor Road Intersection Performance – Proposed 2026 & 2036 Upgrades

Before Upgrade	After Upgrade
	
Proposed Improvements: *Edensor Road Westbound Approach*: add an additional 30m right turn lane and extend inner right turn lane to 110m. *Smithfield Road Southbound Approach*: add an additional 30m right turn lane.	

8.10.3 Performance with Upgrades

Table 8.22 below contains the modelling results for the intersection with the upgrades implemented. The intersection is predicted to operate above the theoretical capacity in 2036 AM peak "with development" scenario. However, the average delay and 95th percentile queues are predicted to reduce substantially.

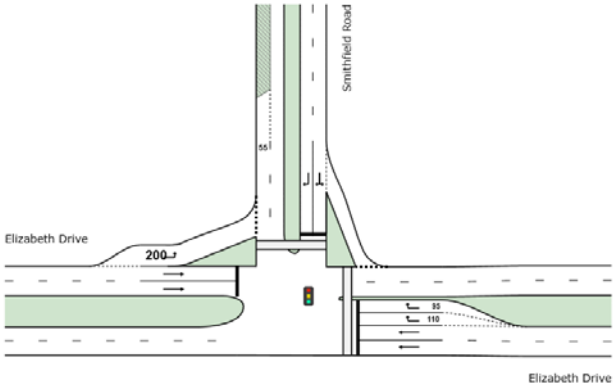
Table 8.22: Smithfield Road / Edensor Road Intersection Performance – Recommended Layout

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2026 "With Development"	3,923	0.83	54	D	261	3,874	0.87	50	D	287
2036 "With Development"	4,170	0.87	54	D	278	4,116	0.93	54	D	326

8.11 ELIZABETH DRIVE / SMITHFIELD ROAD INTERSECTION

8.11.1 Existing Condition

Figure 8.10 shows the existing configuration and SIDRA layout of the Elizabeth Drive / Smithfield Road intersection.



SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.10: Elizabeth Drive / Smithfield Road Intersection

Table 8.23 below summarises the 2017, 2026 and 2036 SIDRA outputs for the base and 'with development' scenarios. Detailed outputs are contained in Appendix E.

Table 8.23: Elizabeth Drive / Smithfield Road Intersection Performance

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	4,482	0.9	38	C	400	4,612	0.81	34	C	264
2017 "With Development"	4,573	0.92	40	C	424	4,794	0.84	35	C	291
2026 Base	4,738	1.02	53	D	591	5,007	0.87	35	C	318
2026 "With Development"	4,985	1.06	58	E	633	5,182	0.90	37	C	369
2036 Base	5,081	1.10	69	E	711	5,384	0.97	43	D	432
2036 "With Development"	5,395	1.16	78	F	779	5,552	1.07	58	E	593

Arrival type 4 has been used at the north approach of the intersection at Smithfield Road / Elizabeth Drive, as this approach is congested on a regular basis. As indicated in the above table, the Elizabeth Drive / Smithfield Road intersection is predicted to operate over practical capacity in 2026 and 2036 future assessment years under most scenarios. The following observations were made from the SIDRA models:

2026 "With Development"

- The intersection is predicted to operate slightly over theoretical capacity in the AM peak under 'with development' scenario. However, the intersection will be within acceptable limit (LoS D or better)

2036 Base and "With Development"

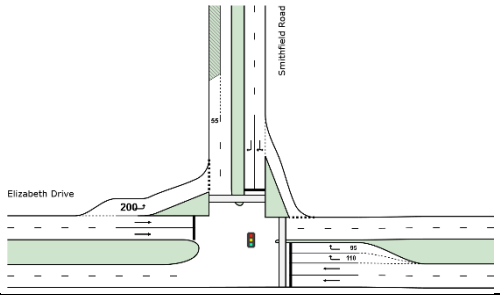
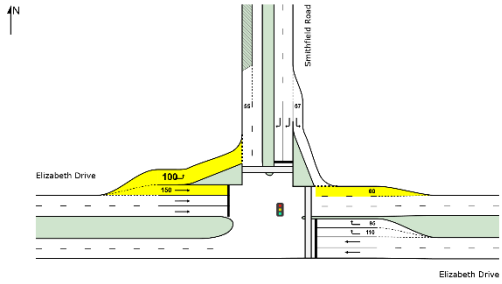
- all approaches are predicted to operate over theoretical capacity in the AM peak under the base scenario and both the AM and PM peak periods in the 'with development' scenario.

In order for the intersection to operate satisfactorily in the future scenarios, the intersection would require additional capacity. The SIDRA model was used to develop the future upgrade requirements. This is summarised in the following section.

8.11.2 Recommended Upgrades

contains the proposed upgrades required to improve the 2026 and 2036 intersection performance with the base and 'with development' scenarios.

Table 8.24: Elizabeth Drive / Smithfield Road Intersection Performance – Proposed 2026 & 2036 Upgrades

Before Upgrade	After Upgrade
	
Proposed Improvements: *Elizabeth Drive Eastbound Approach*: add a 150m through lane. Reduce the existing kerbside lane to 100m *Elizabeth Drive Westbound Approach*: add a 60m exit lane.	

8.11.3 Performance with Upgrades

Table 8.25 summarises the intersection performance with the proposed upgrades. The intersection is predicted to operate slightly over-capacity with DoS higher than 1.0 in 2036 "with development" scenario in AM peak. However, the average delay and 95th percentile queues are predicted to reduce substantially, and the intersection will operate within acceptable LoS of D or better.

Table 8.25: Elizabeth Drive / Smithfield Road Intersection Performance – Recommended layout

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2036 "With Development"	5,395	1.06	55	D	360	5,552	0.99	46	D	256

8.12 BONNYRIGG AVENUE / EDENSOR ROAD INTERSECTION

8.12.1 Existing Condition

Figure 8.11 shows the existing configuration and SIDRA layout of the Bonnyrigg Avenue / Edensor Road intersection.

SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.11: Bonnyrigg Avenue / Edensor Road Intersection

Table 8.26 below summarises the 2017, 2026 and 2036 outputs from SIDRA under the base and 'with development' scenarios. Detailed outputs are contained in Appendix E.

Table 8.26: Bonnyrigg Avenue / Edensor Road Intersection Performance

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	2,233	0.80	28	B	125	2,513	0.84	33	C	176
2017 "With Development"	2,278	0.81	29	C	127	2,580	0.87	35	C	185
2026 Base	2,289	0.81	29	C	129	2,585	0.84	36	C	201
2026 "With Development"	2,376	0.84	30	C	140	2,678	0.87	38	C	222
2036 Base	2,427	0.85	31	C	154	2,717	0.88	39	C	228
2036 "With Development"	2,529	0.90	33	C	161	2,813	0.91	41	C	249

As indicated in the above tables, the Bonnyrigg Avenue / Edensor Road intersection is predicted to operate within practical capacity except 2036 "with development". The intersection will be operating under theoretical capacity and intersection Level of Service will be D or better. Hence, no upgrades have been proposed.

8.13 ELIZABETH DRIVE / BONNYRIGG AVENUE INTERSECTION

8.13.1 Existing Condition

Figure 8.12 below shows the existing configuration and SIDRA layout of the Elizabeth Drive / Bonnyrigg Avenue intersection.

SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.12: Elizabeth Drive / Bonnyrigg Avenue Intersection

Table 8.27 below summarises the 2017, 2026 and 2036 outputs from SIDRA under the base and 'with development' scenarios. Detailed outputs are contained in Appendix E.

Table 8.27: Elizabeth Drive / Bonnyrigg Avenue Intersection Performance

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	3,786	1.06	23	B	237	3,955	0.82	27	B	265
2017 "With Development"	3,884	1.46	32	C	267	4,258	0.92	31	C	332
2026 Base	4,083	0.97	37	C	498	4,242	0.85	28	B	253
2026 "With Development"	4,228	0.99	38	C	507	4,563	0.95	35	C	416
2036 Base	4,327	1.01	39	C	508	4,484	0.95	41	C	420
2036 "With Development"	4,508	1.04	39	C	516	4,799	0.99	47	D	509

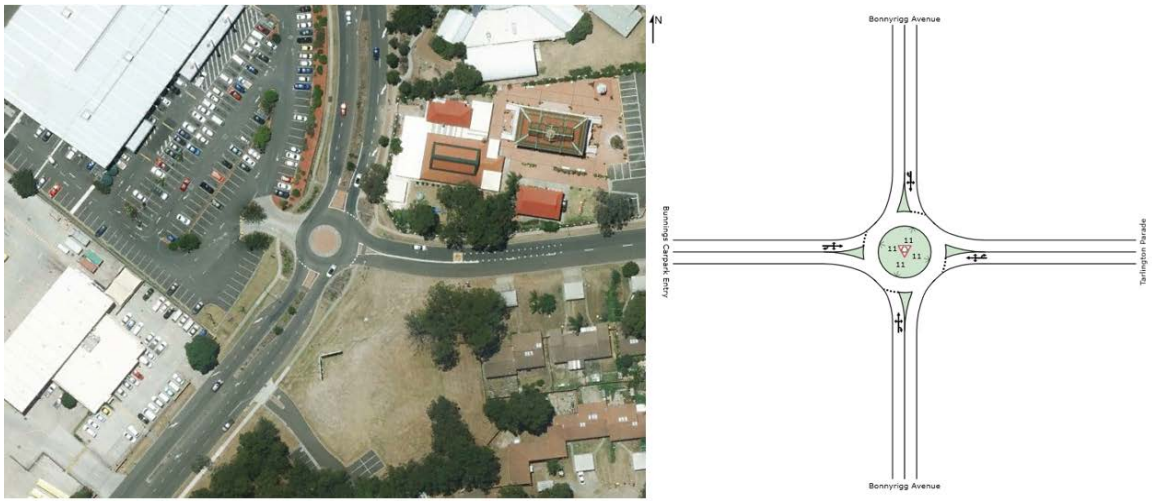
As indicated in the above table, the Elizabeth Drive / Bonnyrigg Avenue intersection would operate marginally above theoretical capacity under 2036 base and "with development". However, the average delay at the intersections will be within the acceptable limit (LoS D or better). Therefore, no intersection upgrades are required to service the future base and development traffic.

The future year models include the extension of Bonnyrigg Avenue right turn bay from 35m to 50m which was not modelled in the 2017 models. This is reflected by the increase in capacity of the intersection in the future years compared to 2017.

8.14 BONNYRIGG AVENUE / TARLINGTON PARADE INTERSECTION

8.14.1 Existing Condition

Figure 8.13 below shows the existing configuration and SIDRA layout of the Bonnyrigg Avenue / Tarlington Parade intersection.



SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.13: Bonnyrigg Avenue / Tarlington Parade Intersection

Table 8.29 summarises the 2017, 2026 and 2036 SIDRA outputs under the base and 'with development' scenarios. Detailed outputs are contained in Appendix E.

Table 8.29: Bonnyrigg Avenue / Tarlington Parade Intersection Performance

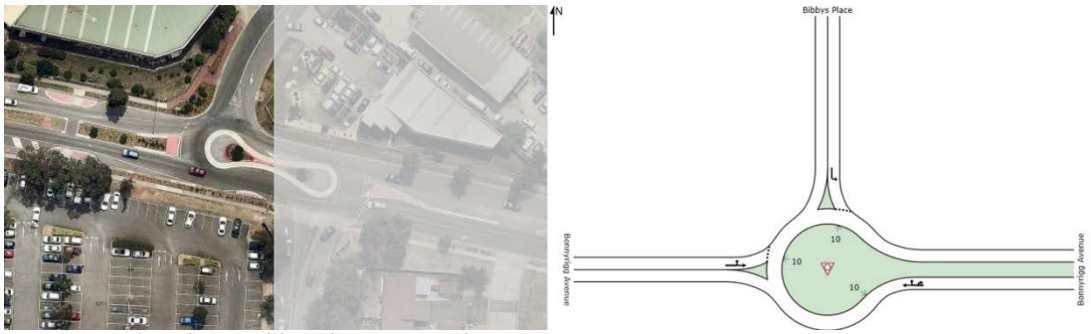
Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	1,490	0.67	6	A	44	1,652	0.66	5	A	59
2017 "With Development"	1,533	0.68	6	A	47	1,706	0.7	5	A	63
2026 Base	1,528	0.69	6	A	48	1,714	0.70	5	A	64
2026 "With Development"	1,558	0.7	6	A	50	1,745	0.7	6	A	64
2036 Base	1,567	0.71	7	A	55	1,776	0.73	6	A	70
2036 "With Development"	1,602	0.73	7	A	58	1,790	0.72	6	A	70

As indicated in the above tables, Bonnyrigg Avenue / Tarlington Parade intersection is predicted to operate within practical capacity under all scenarios.

8.15 BONNYRIGG AVENUE / BIBBYS PLACE (WEST) INTERSECTION

8.15.1 Existing Condition

Figure 8.14 below shows the existing configuration and SIDRA layout of the Bonnyrigg Avenue / Bibbys Place (West) Roundabout intersection.



SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.14: Bonnyrigg Avenue / Bibbys Place (West) Roundabout Intersection

Table 8.28 below summarises the 2017, 2026 and 2036 outputs from SIDRA under the base and 'with development' scenarios. Detailed outputs are contained in Appendix E.

Table 8.28: Bonnyrigg Avenue / Bibbys Place (West) Roundabout Intersection Performance

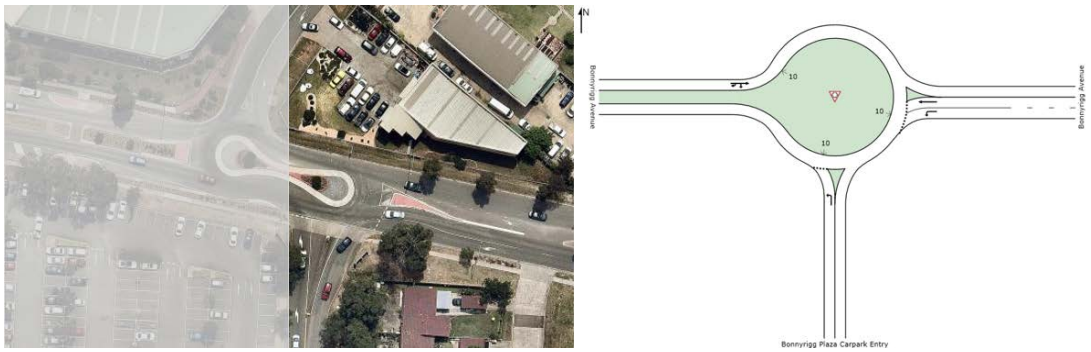
Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	1,261	0.47	3	A	24	1,476	0.56	4	A	21
2017 "With Development"	1,277	0.48	3	A	25	1,523	0.60	4	A	22
2026 Base	1,294	0.50	3	A	26	1,578	0.61	4	A	22
2026 "With Development"	1,302	0.49	3	A	26	1,539	0.59	4	A	22
2036 Base	1,415	0.55	3	A	32	1,679	0.66	4	A	24
2036 "With Development"	1,346	0.51	3	A	28	1,602	0.61	4	A	23

As indicated in the above tables, the Bonnyrigg Avenue / Bibbys Place (West) Roundabout intersection is predicted to operate within practical capacity under all scenarios. Therefore, no upgrades are required.

8.16 BONNYRIGG AVENUE / BIBBYS PLACE (EAST) ROUNDABOUT INTERSECTION

8.16.1 Existing Condition

Figure 8.15 below shows the existing configuration and SIDRA layout of the Bonnyrigg Avenue / Bibbys Place (East) Roundabout intersection.



SOURCE: Google Earth, NSW Globe and SIDRA Intersection

Figure 8.15: Bonnyrigg Avenue / Bibbys Place (East) Roundabout Intersection

below summarises the 2017, 2026 and 2036 SIDRA outputs under the base and 'with development' scenarios. Detailed outputs are contained in Appendix E.

Table 8.29: Bonnyrigg Avenue / Bibbys Place (East) Roundabout Intersection Performance

Scenario	AM					PM				
	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)	Volume (veh / h)	Degree of Saturation	Average Delay (Sec.)	LoS	95th Percentile Queue (m.)
2017 Base	1,477	0.42	3	A	12	1,862	0.43	4	A	22
2017 "With Development"	1,544	0.42	3	A	13	2,016	0.56	5	A	42
2026 Base	1,617	0.44	4	A	13	2,033	0.53	5	A	38
2026 "With Development"	1,571	0.43	3	A	13	2,056	0.60	6	A	50
2036 Base	1,980	0.55	5	A	39	2,194	0.66	7	A	66
2036 "With Development"	1,621	0.45	3	A	13	2,138	0.66	6	A	63

As indicated in the above tables, the Bonnyrigg Avenue / Bibbys Place (East) intersection is predicted to operate within practical capacity under all scenarios. Therefore, no upgrades are required.

9. ACTIVE TRANSPORT AND PUBLIC TRANSPORT ASSESSMENTS

9.1 OVERVIEW

It is important to acknowledge that the proposed rezoning areas are:

- close to the existing mixed land use neighbourhoods;
- surrounded by an existing mature urban transport network;
- well serviced by public transport facilities; and
- relatively small (i.e. approximately 3,000 dwellings proposed in Villawood and approximately 2,000 dwellings in the others).

This scale of these additional development levels are not expected to generate excessive volumes of active transport users and public transport users and these additional users would be able to take advantage of the existing established active transport and public transport infrastructure.

9.2 PUBLIC TRANSPORT

9.2.1 Trains

The precincts at Fairfield Heights, Fairfield North & South and Fairfield East / Villawood are within the walkable catchment of Fairfield Station and Villawood Station. Train services from Fairfield Station access the City, Liverpool and Parramatta and from Villawood Station access City and Liverpool. No train station or train lines lie within Bonnyrigg Town Centre area. The nearest trains station is Liverpool Station and Cabramatta Station, approximately 6km to the east; however, Bonnyrigg Town Centre is well serviced by Liverpool-Parramatta Transitway which runs high-frequency bus services between Liverpool and Parramatta.

9.2.2 Buses

The study area is serviced by Sydney Buses, with multiple routes running within the study area. Buses predominantly run along the major roads and connect with the train stations. Services are generally high in frequency across all days of the week and all peak periods, with reduced operations overnight. The designated bus routes and bus stops are shown in Figure 9.1 and Figure 9.2, and route frequencies are summarised in Table 9.1 and Table 9.2 below.

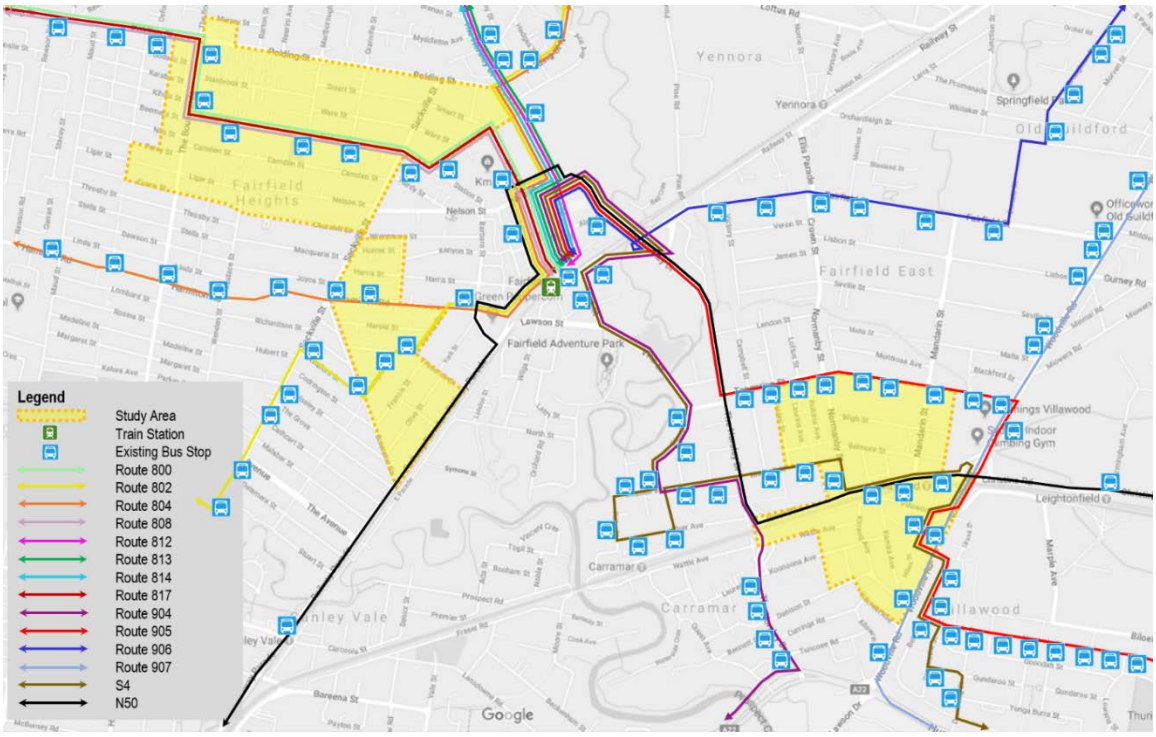


Figure 9.1: Existing Public Transport Services – Fairfield / Fairfield Heights / Villawood

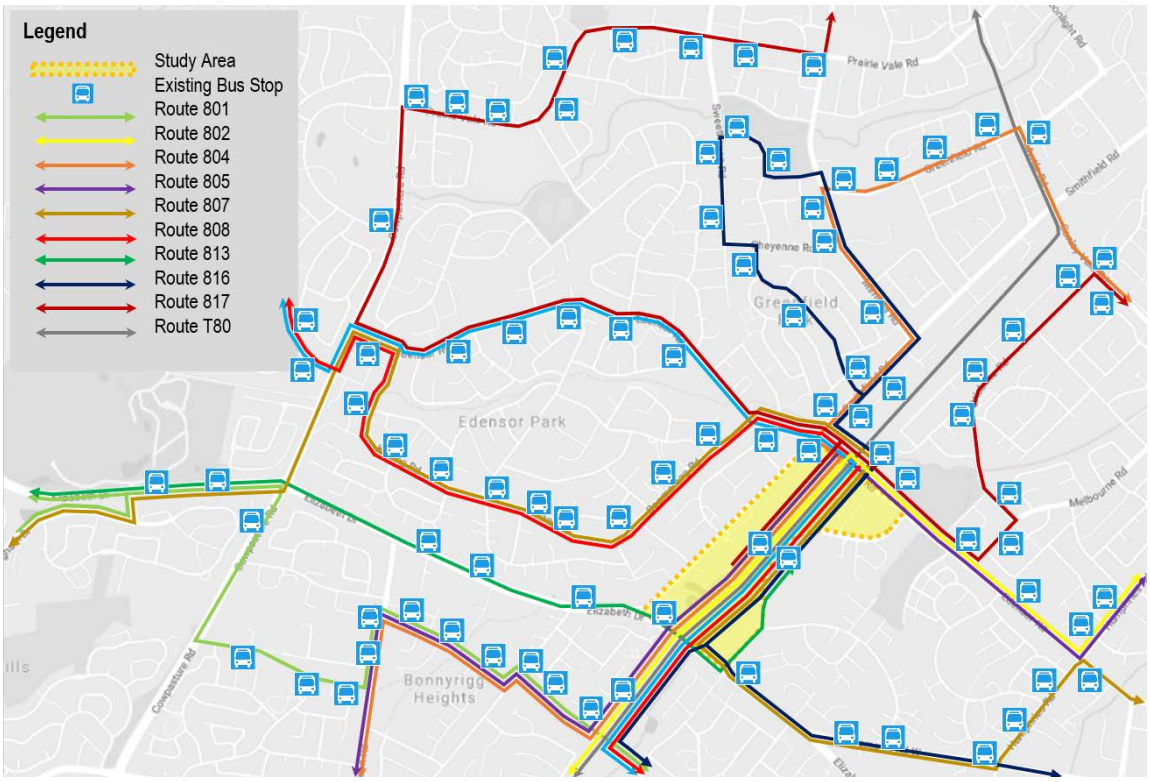


Figure 9.2: Existing Public Transport Services – Bonnyrigg Town Centre

Table 9.1: Bus Frequencies – Fairfield / Fairfield Heights / Villawood

Route No	Route direction	Specific Criterion / Restriction	Weekday AM Peak (0700-0900)	Weekday PM Peak (1600-1800)
800	Blacktown to Fairfield via Wetherill Park Fairfield to Blacktown via Wetherill Park	Operates Everyday	15min	15min
802	Liverpool to Parramatta via Green Valley Parramatta to Liverpool via Green Valley	Operates Everyday	30min	15min
804	Liverpool to Parramatta via Hinchinbrook Parramatta to Liverpool via Hinchinbrook	Operates Everyday	30min	15min
808	Liverpool to Fairfield via Abbotsbury Fairfield to Liverpool via Abbotsbury	Operates Everyday	30min	30min
812	Blacktown to Fairfield Fairfield to Blacktown	Mon - Fri	30min	30min
813	Fairfield to Bonnyrigg Bonnyrigg to Fairfield	Operates Everyday	30min	30min
814	Fairfield to Smithfield (Loop Service)	Mon - Fri	30min	60min
817	Cabramatta to Fairfield Fairfield to Cabramatta	Operates Everyday	20min	15min
904	Fairfield to Liverpool Liverpool to Fairfield	Operates Everyday	30min	30min
905	Bankstown to Fairfield Fairfield to Bankstown	Operates Everyday	15min	15min
906	Fairfield to Parramatta Parramatta to Fairfield	Mon - Sat	30min	30min
907	Bankstown to Parramatta via Bass Hill Parramatta to Bankstown via Bass Hill	Operates Everyday	30min	20min
S4	Chester Hill to Fairfield via Carramar & Villawood Fairfield to Chester Hill via Carramar & Villawood	Mon - Fri	120min	N/A
N50	Liverpool to City Town Hall City Town Hall to Liverpool			

Table 9.2: Bus Frequencies – Bonnyrigg Town Centre

Route No	Route direction	Specific Criterion / Restriction	Weekday AM Peak (0700-0900)	Weekday PM Peak (1600-1800)
801	Badgerys Creek to Liverpool Liverpool to Badgerys Creek	Mon - Fri	60min - 120min	60min - 120min
802	Liverpool to Parramatta via Green Valley Parramatta to Liverpool via Green Valley	Operates Everyday	30min	15min
804	Liverpool to Parramatta via Hinchinbrook Parramatta to Liverpool via Hinchinbrook	Operates Everyday	30min	15min
805	Liverpool to Cabramatta via Bonnyrigg Heights Cabramatta to Liverpool via Bonnyrigg Heights	Operates Everyday	30min	30min
807	Cabramatta to Cecil Hills via Bonnyrigg Cecil Hills to Cabramatta via Bonnyrigg	Operates Everyday	30min	30min
808	Liverpool to Fairfield via Abbotsbury Fairfield to Liverpool via Abbotsbury	Operates Everyday	30min	30min
813	Fairfield to Bonnyrigg Bonnyrigg to Fairfield	Operates Everyday	30min	30min
816	Cabramatta to Greenfield Park (Loop Service)	Operates Everyday	30min	30min
817	Cabramatta to Fairfield Fairfield to Cabramatta	Operates Everyday	20min	15min
T80	Liverpool to Parramatta via T-way Parramatta to Liverpool via T-way	Operates Everyday	10min	5min

9.3 ACTIVE TRANSPORT

Footpaths are provided on both sides of the road throughout the study area, along with shared path facilities, pedestrian crossings, pedestrian refuges and signalised crossing points, providing a high level of active transport connectivity and safety. The locations of pedestrian crossing points and shared paths are shown in Figure 9.3 and Figure 9.4. The study area contains separated cycleways, cycling lanes and "bicycle-friendly" roads.

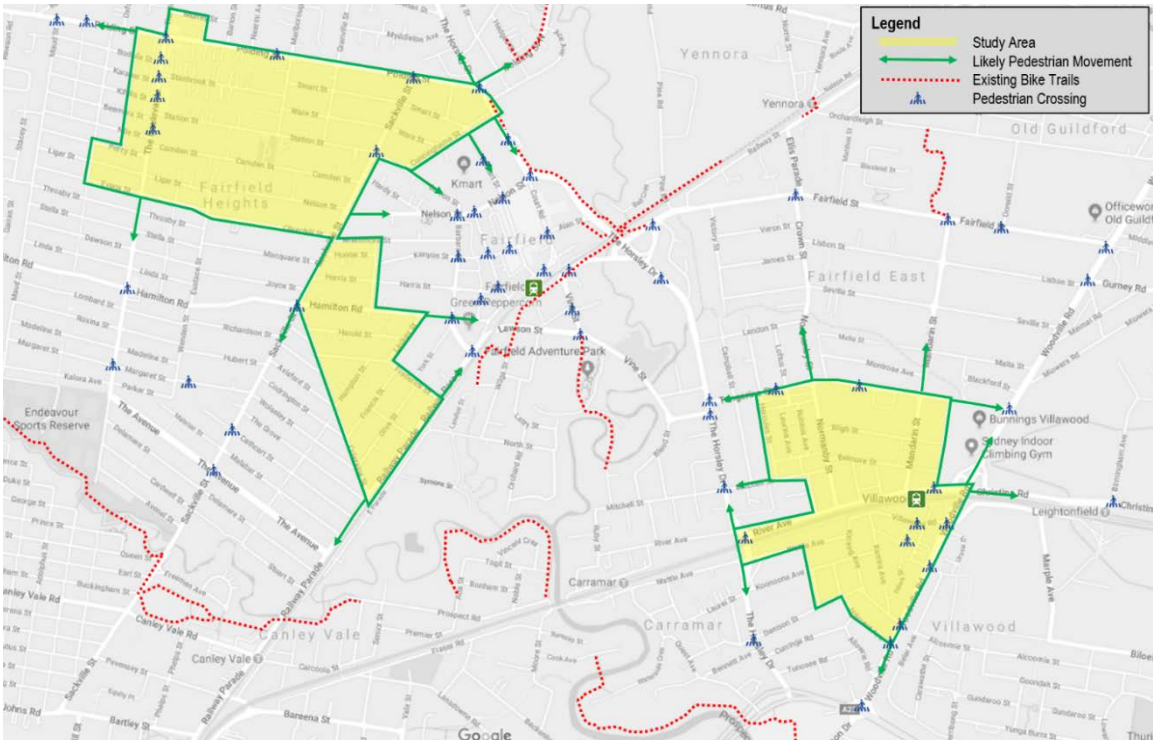


Figure 9.3: Existing Active Transport Routes – Fairfield / Fairfield Heights / Villawood

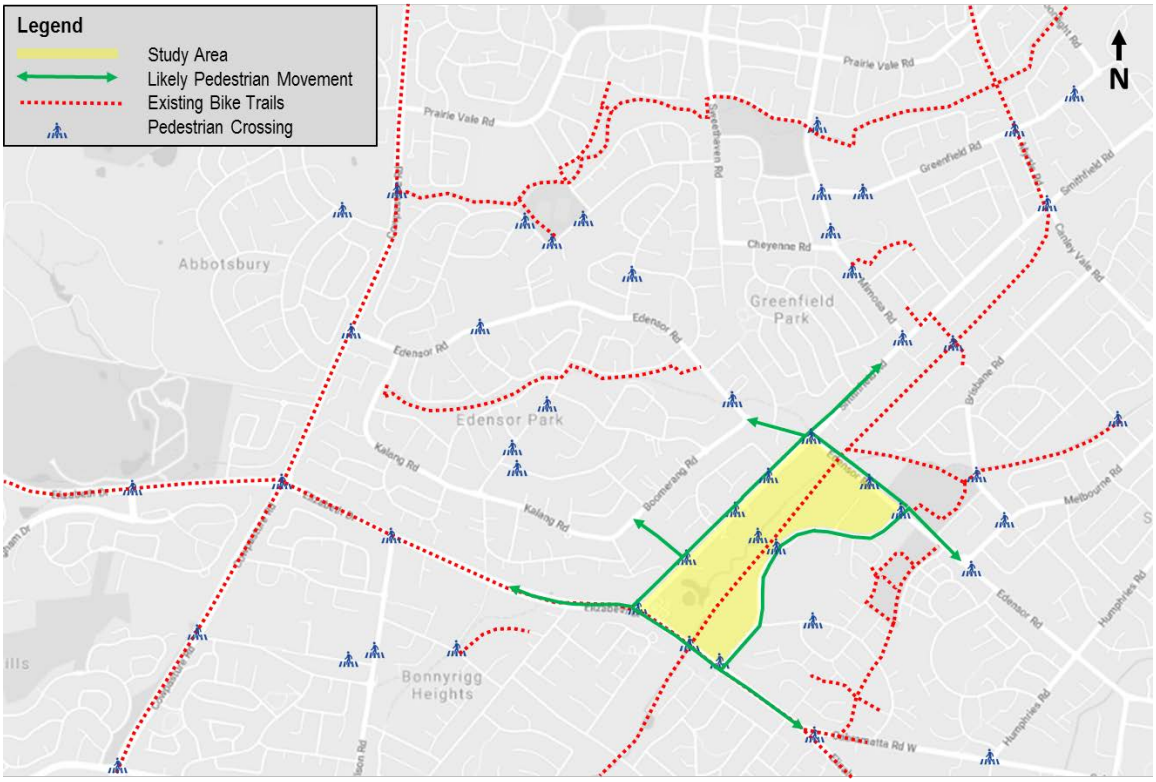


Figure 9.4: Existing Active Transport Routes – Bonnyrigg Town Centre

10. PLANS, COSTS AND APPORTIONMENT

Based on the additional traffic associated with the rezoned area and the list of upgrades discussed in Section 8 of this report, the apportionment of contributions to upgrade the affected intersections in terms of possible percentage contributions are summarised in Table 10.1 and Table 10.2 below. These apportionments are based on the volumes extracted from STM Base and "With Development" models. It should be noted that the values provided are average between AM & PM peak periods, as the percentage of development traffic through each intersection vary between time periods.

Table 10.1: Upgrade Apportionment – 2026

2026 Upgrade Apportionment	Precinct						
	Fairfield Heights	Fairfield (North & South)	Fairfield East / Villawood	Bonnyrigg Town Centre	Fairfield Heights Town Centre	Villawood Town Centre	Other
The Horsley Drive / Polding Street	0.0%	3.8%	1.5%	0.1%	0.0%	0.2%	94.6%
Hume Highway / Woodville Road	0.0%	1.7%	3.4%	0.2%	0.0%	0.5%	94.7%
Smithfield Road / Edensor Road	0.3%	0.2%	0.0%	2.4%	0.0%	0.0%	97.1%
Smithfield Road / Elizabeth Drive	0.2%	0.2%	0.1%	2.3%	0.0%	0.0%	97.2%

Table 10.2: Upgrade Apportionment – 2036

2036 Upgrade Apportionment	Precinct						
	Fairfield Heights	Fairfield (North & South)	Fairfield East / Villawood	Bonnyrigg Town Centre	Fairfield Heights Town Centre	Villawood Town Centre	Other
The Horsley Drive / Cumberland Highway	0.6%	1.7%	1.0%	0.7%	0.1%	0.1%	94.7%
The Horsley Drive / Polding Street	0.0%	3.8%	1.4%	0.1%	0.0%	0.2%	95.0%
Hume Highway / Woodville Road	0.0%	1.6%	3.2%	0.2%	0.0%	0.5%	95.0%
Woodville Road / Fairfield Street	0.0%	1.7%	2.0%	0.1%	0.0%	0.3%	96.2%
Smithfield Road / Elizabeth Drive	0.7%	0.3%	0.2%	1.7%	0.1%	0.0%	97.1%
Elizabeth Road / Bonnyrigg Avenue	0.9%	0.4%	0.2%	1.6%	0.1%	0.0%	96.9%

The apportionment values in tables above indicate that the proposed re-development contributes only a fraction of peak traffic volumes passing through the assessed intersections. Most of the traffic at the assessed intersections is background traffic originating from and destined to beyond the proposed development areas.

11. CONCLUSIONS

The traffic and transport impacts of the proposed rezoning in Fairfield Heights, Fairfield North & South, Fairfield East / Villawood and Bonnyrigg Town Centre has been assessed using Sydney Strategic Transport Model (STM) and SIDRA models of the intersections on state-controlled roads near these proposed rezoning areas.

The key findings from the assessment include:

- the proposed rezoning will generate a total of 13,795 trips daily, 4,810 in the AM peak (2 hrs.) and 4,810 in the PM peak (2 Hrs.);
- the majority of the assessed intersections operate well within their practical capacity in 2017 except for The Horsley Drive / Polding Street intersection which is over practical capacity but under theoretical capacity;
- there is substantial background traffic growth occurring in the study are between 2016 and 2026 and through to 2036 meaning that a number of major intersection upgrades are required at the assessed intersections, regardless of the rezoning proposals; and
- the proportion of the future year intersection traffic which is generated by the rezoning proposals is relatively small and in the order of 2%-5% of total intersection traffic.

Table 11.1 below summarises the intersection upgrades required in 2026 in the "Base" and "with Development" scenarios.

Table 11.1: Recommended Intersection Upgrades - 2026

Intersection	Required Upgrades (2026 Base and "with development")	
	Due to Background Demand	Attributable to the Development
The Horsley Drive / Cumberland Highway / Smithfield Road	*The Horsley Drive Northwest approach: add a 10m long segregated left turn lane*	nil
The Horsley Drive / Polding Street	*Polding Street North-eastern Approach: extend kerbside lane to 100m*	nil
	The Horsley Drive Southern Approach: add a 100m long through lane and reduce the length of the existing left turn slip lane to 50m. Add a 60m lane on the exit lane	nil
	Polding Street Western Approach: add a 60m long right turn pocket and add a 60m long share left/through pocket	nil
	The Horsley Drive Northern Approach: Add 60m long shared left/through pocket. Add 100m long exit lane	nil
The Horsley Drive / Hume Highway (North)	*Hume Highway Western Approach: add a 200m long shared left & through lane*	nil
	The Horsley Drive Northern Approach: add a 60m long left turn lane	nil
	Hume Highway Eastern Approach: add a 100m short lane on the exit side	nil
Woodville Road / Hume Highway	*Hume Highway Eastern Approach: extend the length of the inner right turn pocket lane to 75m and outer to 100m. add a 100m short lane on the exit side*	nil
	Woodville Road Northern Approach: add 50m long right turn pocket	
	Hume Highway Western Approach: convert the shared kerbside lane to through only. Add a 100m long shared through and left turn slip lane	

Smithfield Road / Edensor Road	*Edensor Road Westbound Approach: add an additional 30m right turn lane and extend inner right turn lane to 110m*	nil
	Smithfield Road Southbound Approach: add an additional 30m right turn lane	
Elizabeth Drive / Smithfield Road	*Elizabeth Drive Eastbound Approach: add a 150m through lane. Reduce the existing kerbside lane to 100m*	nil
	Elizabeth Drive Westbound Approach: add a 60m exit lane	
Elizabeth Drive / Bonnyrigg Avenue	*Bonnyrigg Avenue Approach: extend the right turn bay to 50m*	nil

Table 11.2 below summarises the intersection upgrades required in 2036 in the "Base" and "with Development" scenarios.

Table 11.2: Recommended Intersection Upgrades - 2036

The Horsley Drive / Cumberland Highway / Smithfield Road	*The Horsley Drive Northwest approach: add a 75m long segregated left turn lane*	nil
	Smithfield Road Northeast approach: extend the kerbside lane to 170m	nil
	The Horsley Drive Southeast approach: extend the median lane to 75m	nil
The Horsley Drive / Polding Street	*Polding Street North-eastern Approach: add a 100m long westbound through lane. extend kerbside lane to 50m*	nil
	The Horsley Drive Southern Approach: add a 100m long through lane and reduce the length of the existing left turn slip lane to 50m. Add a 100m lane on the exit lane	nil
	Polding Street Western Approach: add a 75m long right turn pocket and add a 100m long share left/through pocket	nil
	The Horsley Drive Northern Approach: Add 150m long shared left/through pocket. Add 150m long exit lane.	nil
The Horsley Drive / Hume Highway (North)	*Hume Highway Western Approach: add a 200m long shared left & through lane*	nil
	The Horsley Drive Northern Approach: add a 60m long left turn lane and reconfigure the lanes to provide dual through and dual left turns	nil
	Hume Highway Eastern Approach: add a kerbside lane on the exit side	nil
Woodville Road / Hume Highway	*Hume Highway Eastern Approach: extend the length of the inner right turn pocket lane to 75m and outer to 100m. convert the shared kerbside lane to through only. add a 200m long shared through and left turn slip lane. add a 100m short lane on the exit side*	nil
	Woodville Road Northern Approach: add 50m long right turn pocket	
	Hume Highway Western Approach: Convert the shared kerbside lane to through only. Add a 100m long shared through and left turn slip lane	
Smithfield Road / Edensor Road	*Same as 2026 upgrades*	nil
Elizabeth Drive / Smithfield Road	*Same as 2026 upgrades*	nil
Elizabeth Drive / Bonnyrigg Avenue	*Same as 2026 upgrades*	nil

APPENDIX A

TRIP GENERATION AND DISTRIBUTION TECHNICAL NOTE

APPENDIX B

EMME MODEL PLOTS

APPENDIX C

INTERSECTION COUNTS – BASE YEAR

APPENDIX D

INTERSECTION COUNTS – FUTURE YEAR

APPENDIX E

SIDRA OUTPUTS