

APPENDIX 4

WSP Parsons Brinkerhoff Traffic Assessment

Memo

Date 18 November 2015
To West Appin Project Team
From David Bohm
Ref 2189717B-ITP-MEM-001 Rev5
Subject West Appin Strategic Traffic Analysis

1. Purpose

This memo documents the Strategic Traffic Analysis that Parsons Brinckerhoff undertook during October-November 2015 in relation to the planned and proposed developments at Mount Gilead and West Appin.

Appendix A of this memo also provides a summary of the findings of a review of the *Greater Macarthur Land Release Investigation Strategic Transport Plan* (AECOM, 21 October 2015).

2. Methodology

The first-principles traffic analysis has been undertaken using:

1. Spreadsheet modelling of forecast future strategic traffic volumes
2. Volume/capacity analysis to identify upgrade requirements.

The analysis undertaken extends for a 25 year period to 2040.

2.1 Study area

The analysis has been undertaken considering the key elements of the road network immediately surrounding West Appin and Mount Gilead, illustrated in Figure 2.1. This road network comprises:

- Existing roads:
 - ▶ Appin Road: a north-south connection between Appin Village and Campbelltown
 - ▶ Appin-Bulli Road: a northwest-southeast connection between Appin Village and the M1 motorway / Wollongong
 - ▶ Wilton Road: a northeast-southwest connection between Appin Village and Picton Road / Wilton Village.

- Future roads:
 - ▶ Appin bypass: an alternative route to Appin Road / Appin-Bulli Road to the west / south of Appin Village
 - ▶ Spring Farm Parkway: a northwest-southeast connection between Appin Road and the Hume Motorway and beyond
 - ▶ Northern Arterial: a north-south connection parallel and to the west of Appin Road
 - ▶ Appin / Hume M9 Extension: a northwest-southeast connection between Appin-Bulli Road and the Hume Motorway and beyond. This connection could form part of the alignment of the proposed M9 Outer Sydney Orbital Motorway.

Figure 2.1 also illustrates:

- The locations and estimated timeframes of traffic generating development starting to occur in development precincts
- The locations of screenlines which have been used during the traffic forecasting and volume-capacity analysis processes.

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Figure 2.1 Study area overview

2.2 Inputs and assumptions

The following key inputs and assumptions are presented in the following tables:

- Table 2.1: Surveyed traffic volumes
- Table 2.2: Forecast background traffic growth rates
- Table 2.3: Development yield and timing estimates
- Table 2.4: Development traffic generation rates
- Table 2.5: Development traffic distribution assumptions
- Table 2.6: Development traffic assignment assumptions
- Table 2.7: Road capacity assumptions

Table 2.1 Surveyed traffic volumes (2013)

Location		Road type	Direction	Volume (PCUs) ¹	
				AM peak hour	PM peak hour
Appin Rd: Screenlines 1-4	N of Appin Village	2L2W	Northbound	860	485
			Southbound	445	760
			2-way	1,305	1,245
Appin-Bulli Rd	E of Appin Village	2L2W	Northbound	775	370
			Southbound	490	635
			2-way	1,265	1,005
Wilton Road	S of Appin Village	2L2W	Northbound	105	105
			Southbound	115	115
			2-way	220	220

Source: *West Appin – Preliminary traffic and transport assessment* (Parsons Brinckerhoff, 2015)

1. Assumes a heavy vehicle PCU factor of 3.0

Table 2.2 Forecast background traffic growth rates

Location		Direction	Forecast background growth (2011-2036 average, p/a)	
			AM peak hour	PM peak hour
Appin Rd	N of Appin Village	Northbound	1.3%	2.3%
		Southbound	2.4%	1.6%
Appin-Bulli Rd	E of Appin Village	Northbound	1.1%	2.2%
		Southbound	2.1%	1.4%
Wilton Road	S of Appin Village	Northbound	0.6%	1.3%
		Southbound	1.5%	0.8%

Source: Sydney Strategic Transport Model (STM) outputs (Transport for NSW, 2015)

Table 2.3 Development yield and timing estimates

Location	Land use	Yield	First dwellings occupied	Rate of development (p/a)	Development by year		
					2022	2030	2040
West Appin Precinct 1	Residential	2,500 dwellings	2020	150 dwellings	300	1,500	2,500
	Employment	935 jobs		Lags residential development by 10%	20	470	935
	Retail	7,650 m ² GFA			155	3,825	7,650
West Appin Precinct 2	Residential	4,000 dwellings	2018	150 dwellings	600	1,800	3,300
	Employment	2,260 jobs		Lags residential development by 10%	115	790	1,640
	Retail	7,650 m ² GFA			385	2,680	5,545
Mount Gilead Precinct 1	Residential	4,400 dwellings	2018	150 dwellings	750	1,950	3,450
	Employment	115 jobs		Lags residential development by 10%	10	40	80
	Retail	940 m ² GFA			65	325	645
Mount Gilead Precinct 2	Residential	7,000 dwellings	2022	150 dwellings	50	1,250	2,750
	Employment	2,580 jobs		Lags residential development by 10%	0	205	755
	Retail	17,150 m ² GFA			0	1,350	5,025
Wilton Junction	Residential	11,900 dwellings	2013	Varies ¹	2,380	6,545	10,590
	Employment	935 jobs		Lags residential development by 10%	1,100	4,950	8,690
	Retail	65,000 m ² GFA			6,500	29,250	51,350

Source: (Walker Corporation, 2015)

1. Rate of development consistent with the Wilton Junction TMAP (Parsons Brinckerhoff, 2014), assuming a 1-year lag when compared to the yields presented in the TMAP.

Table 2.4 Development traffic generation rates

Land use	Measure	Time period	
		AM peak hour	PM peak hour
Residential	Vehicles / dwelling	0.78	0.84
Employment	Vehicles / employee	0.48	0.41
Retail	Vehicles / 100m ² GFA	12.3 ¹	12.5 ¹

Source: *West Appin – Preliminary traffic and transport assessment* (Parsons Brinckerhoff, 2015)

1. Wilton Junction TMAP assumes rates of 7.6 / 6.2 for AM / PM peak hour retail traffic generation which have been applied to development in Wilton Junction.

Table 2.5 Development traffic distribution assumptions

Land use	Direction	Proportion of traffic		Internal containment
		AM peak hour	PM peak hour	
Residential	Inbound	30%	70%	25%
	Outbound	70%	30%	
Employment	Inbound	85%	15%	
	Outbound	15%	85%	
Retail	Inbound	50% ¹	50%	
	Outbound	50% ¹	50%	

Source: *West Appin – Preliminary traffic and transport assessment* (Parsons Brinckerhoff, 2015)

1. Wilton Junction TMAP assumes a split of 60% / 40% for inbound / outbound movements during AM peak hours for retail traffic distribution which have been applied to traffic generated by Wilton Junction.

Table 2.6 Development traffic assignment assumptions

Direction	Proportion of traffic
To/from north (Appin Road)	75%
To/from southeast (Appin-Bulli Road)	15%
To/from southwest (Wilton Road)	10%

Source: *West Appin – Preliminary traffic and transport assessment* (Parsons Brinckerhoff, 2015)

Table 2.7 Road capacity assumptions

Level of Service (LoS)	Road type and capacity (Passenger Car Units (PCUs) per hour)	
	2-lane, 2-way (2L2W) roads (Combined, 2-way capacity)	Multi-lane arterial (Capacity per lane)
A	490	560
B	780	880
C	1,190	1,280
D	1,830	1,705
E	3,200	2,000
F	>3,200	>2,000

Source: *Guide to Traffic Management (Austroads, 2013)*

The volume/capacity analysis has adopted the capacity limits for LoS D as the threshold for acceptable performance. As an example, a forecast traffic volume of 1,830 PCUs per hour on a two-lane, 2-way road would result in a V/C ratio of 1.0, indicating the maximum possible traffic volume before performance deteriorates to LoS E.

3. Analysis

The following sections provide a summary of the results of the following scenarios:

- Existing conditions (2015)
- Future conditions:
 - Background traffic growth **plus** traffic generated by Mount Gilead and Wilton Junction
 - Background traffic growth **plus** traffic generated by West Appin, Mount Gilead, and Wilton Junction.

3.1 Existing conditions

Table 3.1 provides a summary of existing (2015) conditions, based on:

- 2013 surveyed traffic volumes
- background traffic growth consistent with the rates shown in Table 2.2.

Table 3.1 Forecast traffic volumes and volume/capacity analysis (2015 conditions)

Location		Road type	Direction	AM peak hour		PM peak hour	
				Volume (PCUs)	Volume/capacity	Volume (PCUs)	Volume/capacity
Appin Rd: Screenlines 1-4	N of Appin Village	2L2W	Northbound	-	-	-	-
			Southbound	-	-	-	-
			2-way	1,350	0.75	1,290	0.70
Appin-Bulli Rd	E of Appin Village	2L2W	Northbound	-	-	-	-
			Southbound	-	-	-	-
			2-way	1,300	0.70	1,035	0.55
Wilton Road	S of Appin Village	2L2W ¹	Northbound	-	-	-	-
			Southbound	-	-	-	-
			2-way	225	>1.0 ¹	225	>1.0 ¹

1. The Wilton Junction TMAP (2014) and West Appin Preliminary traffic and transport assessment (2015) both estimate that Wilton Road is currently operating at LoS E with severely restricted capacity due to its existing alignment and the single-lane river crossing.

The results of this analysis indicate that:

- Appin Road has capacity for less than 500 additional PCUs before performance would be unacceptable
- Appin-Bulli Road has capacity for 500 additional PCUs before performance would be unacceptable
- Performance on Wilton Road is currently unacceptable.

The following upgrades are recommended based on this analysis:

- Upgrade Wilton Road at Broughton Pass to achieve a 'standard' 2-lane, 2-way configuration.

3.2 Future conditions – 2022: Mount Gilead and Wilton Junction only

Table 3.2 provides a summary of future conditions in 2022. This is the point where future traffic growth would result in the existing capacity of Appin Road being exceeded, based on:

- background traffic growth consistent with the rates shown in Table 2.2
- traffic generated by the occupation of (see assumptions in Table 2.3):
 - ▶ 800 dwellings in Mount Gilead
 - ▶ 2,380 dwellings in Wilton Junction.

**Table 3.2 Forecast traffic volumes and volume/capacity analysis
(2022: Mount Gilead and Wilton Junction only)**

Location		Road type	Direction	AM peak hour		PM peak hour	
				Volume (PCUs)	Volume/capacity	Volume (PCUs)	Volume/capacity
Appin Rd: Screenlines 1&2	N of Mount Gilead	2L2W	Northbound	-	-	-	-
			Southbound	-	-	-	-
			2-way	1,990	>1.0	2,200	>1.0
Appin Rd: Screenline 4	S of Mount Gilead	2L2W	Northbound	-	-	-	-
			Southbound	-	-	-	-
			2-way	1,760	0.95	1,850	>1.0
Appin-Bulli Rd	E of Appin Village	2L2W	Northbound	-	-	-	-
			Southbound	-	-	-	-
			2-way	1,510	0.85	1,280	0.70
Wilton Road	S of Appin Village	2L2W ¹	Northbound	-	-	-	-
			Southbound	-	-	-	-
			2-way	430	0.25	510	0.30

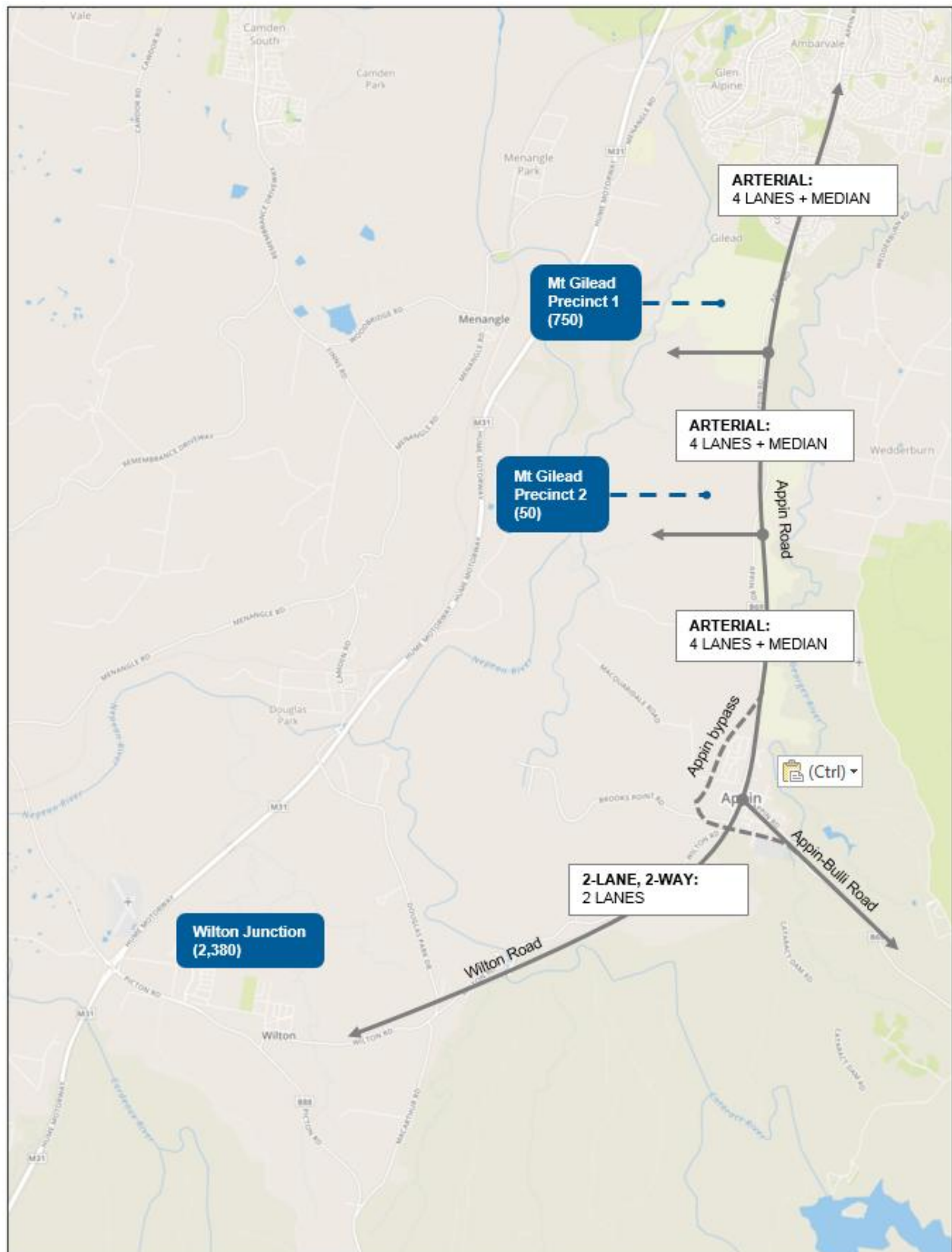
1. Wilton Road upgraded prior to 2022 to achieve a standard 2L2W configuration – see section 3.1.

The results of this analysis indicate that:

- Performance on all sections of Appin Road would be unacceptable
- Appin-Bulli Road has capacity for just over 300 additional PCUs before performance would be unacceptable
- The assumed upgrade to Wilton Road would result in acceptable performance.

The following upgrades are recommended by 2022 based on this analysis, illustrated in Figure 3.1:

- Upgrade Appin Road to achieve a minimum 2-lane per direction arterial standard between Appin and Campbelltown, potentially including the construction of a bypass route around Appin Village.



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Figure 3.1 Recommended future network upgrades (2022: Mount Gilead and Wilton Junction only)
(3,180 dwellings: 800 in Mount Gilead; 2,380 in Wilton Junction)

3.3 Future conditions – 2030: Mount Gilead, Wilton Junction, and West Appin

The development of West Appin, in addition to Mount Gilead and Wilton Junction, would not change the fundamental need to initially upgrade Appin Road and Wilton Road in the immediate future. Consequently these initial upgrades are included in the analysis of this scenario.

Table 3.3 provides a summary of future conditions in 2030. This is the point where future traffic growth would result in the future upgraded capacity of Appin Road adjacent to Mount Gilead being exceeded, based on:

- background traffic growth consistent with the rates shown in Table 2.2
- traffic generated by the occupation of (see assumptions in Table 2.3):
 - ▶ 3,200 dwellings in Mount Gilead
 - ▶ 6,550 dwellings in Wilton Junction
 - ▶ 3,300 dwellings in West Appin.

**Table 3.3 Forecast traffic volumes and volume/capacity analysis
(2030: Mount Gilead, Wilton Junction, and West Appin)**

Location		Road type	Direction	AM peak hour		PM peak hour	
				Volume (PCUs)	Volume/capacity	Volume (PCUs)	Volume/capacity
Appin Rd: Screenlines 1&2	N of Mount Gilead Precinct 1	Arterial: 4 lanes	Northbound	3,750	>1.0	2,230	0.65
			Southbound	2,220	0.65	3,850	>1.0
			2-way	5,970	-	6,080	-
Appin Rd: Screenline 3	N of Mount Gilead Precinct 2	Arterial: 4 lanes	Northbound	3,350	1.0	2,170	0.65
			Southbound	2,150	0.65	3,430	>1.0
			2-way	5,500	-	5,600	-
Appin Rd: Screenline 4	S of Mount Gilead	Arterial: 4 lanes	Northbound	2,760	0.80	2,180	0.65
			Southbound	2,150	0.65	2,790	0.80
			2-way	4,910	-	4,970	-
Appin-Bulli Rd	E of Appin Village	2L2W	Northbound	-	-	-	-
			Southbound	-	-	-	-
			2-way	2,340	>1.0	2,090	>1.0
Wilton Road	S of Appin Village	2L2W	Northbound	-	-	-	-
			Southbound	-	-	-	-
			2-way	1,240	0.70	1,240	0.70

The results of this analysis indicate that:

- Performance on Appin Road north of Mount Gilead Precinct 2 would be unacceptable
- Performance on Appin-Bulli Road would be unacceptable.

The following upgrades are recommended by 2030 based on this analysis, illustrated in Figure 3.2:

- Construction of Spring Farm Parkway, assumed as a 2-lane per direction arterial standard road when fully constructed
- Construction of the northern sections of the Northern Arterial adjacent to the Mount Gilead Precincts, assumed as a 2-lane per direction arterial standard road when fully constructed
- Construction of the Appin bypass, assumed as a 2-lane per direction arterial standard road when fully constructed
- Upgrade Appin-Bulli Road to achieve a minimum 2-lane per direction arterial standard.

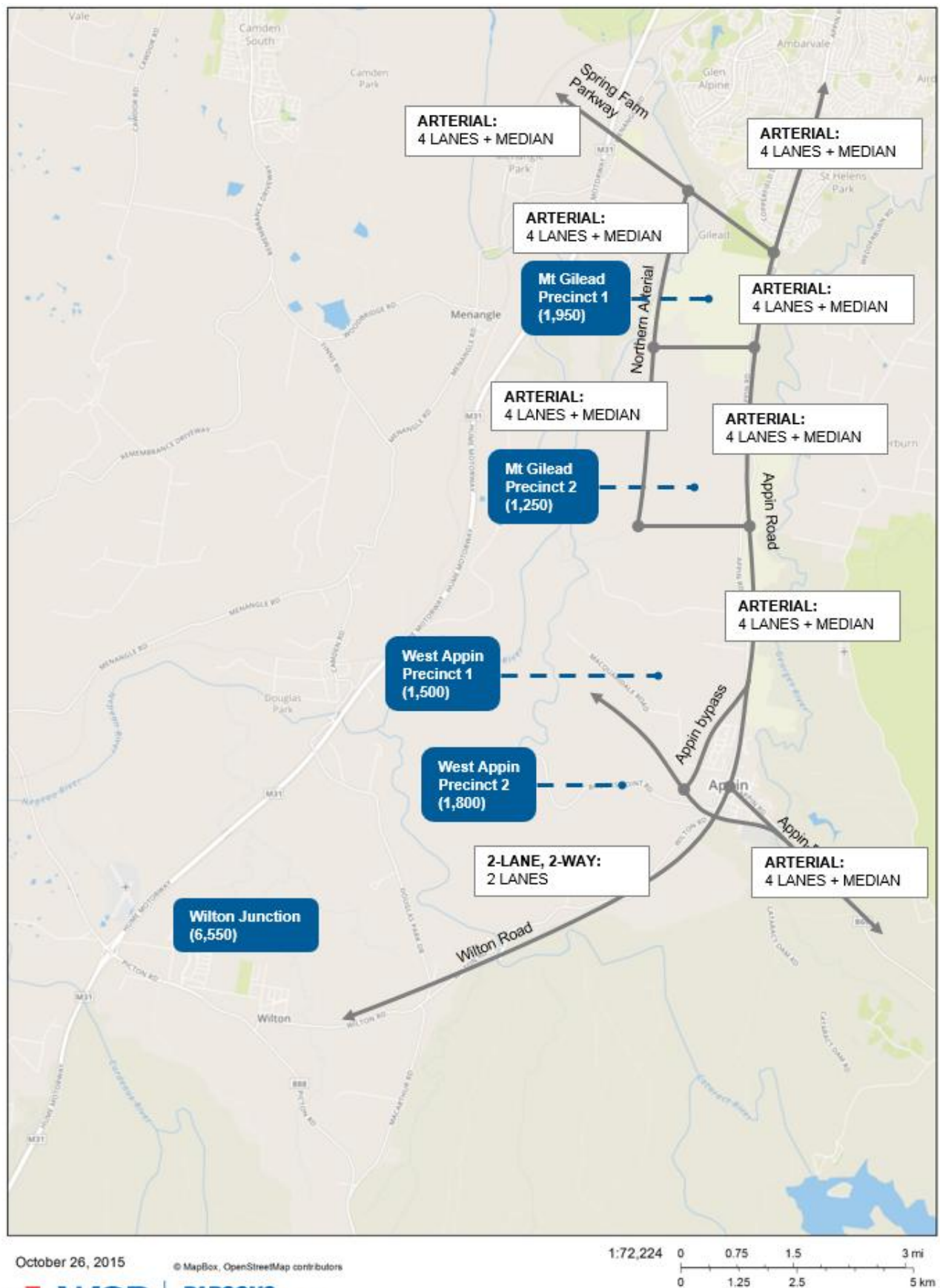


Figure 3.2 Recommended future network upgrades (2030: Mt Gilead, Wilton Junction, and West Appin)
(13,050 dwellings: 3,200 in Mount Gilead; 6,550 in Wilton Junction; 3,300 in West Appin)

3.4 Future conditions – 2040: Mount Gilead, Wilton Junction, and West Appin

By 2040 it is assumed that the Northern Arterial road would need to be fully constructed between the Spring Farm Parkway and West Appin, as illustrated in Figure 3.3.

Table 3.4 provides a summary of future conditions in 2040 based on this network and traffic forecasts including:

- background traffic growth consistent with the rates shown in Table 2.2
- traffic generated by the occupation of (see assumptions in Table 2.3):
 - ▶ 6,200 dwellings in Mount Gilead
 - ▶ 10,590 dwellings in Wilton Junction
 - ▶ 5,800 dwellings in West Appin.

**Table 3.4 Forecast traffic volumes and volume/capacity analysis
(2040: Mount Gilead, Wilton Junction, and West Appin)**

Location		Road type	Direction	AM peak hour		PM peak hour	
				Volume (PCUs)	Volume/capacity	Volume (PCUs)	Volume/capacity
Appin Road & Spring Farm Parkway: Screenline 1	N of Mount Gilead Precinct 1	(2x) Arterial: 4 lanes	Northbound	6,230	0.90	3,910	0.55
			Southbound	3,950	0.60	6,510	0.95
			2-way	10,180	-	10,420	-
Appin Road & Northern Arterial: Screenline 2	N of Mount Gilead Precinct 1	(2x) Arterial: 4 lanes	Northbound	6,230	0.90	3,910	0.55
			Southbound	3,950	0.60	6,510	0.95
			2-way	10,180	-	10,420	-
Appin Road & Northern Arterial: Screenline 3	N of Mount Gilead Precinct 2	(2x) Arterial: 4 lanes	Northbound	5,350	0.80	3,660	0.55
			Southbound	3,660	0.55	5,540	0.80
			2-way	9,010	-	9,200	-
Appin Road & Northern Arterial: Screenline 4	S of Mount Gilead	(2x) Arterial: 4 lanes	Northbound	4,290	0.65	3,660	0.55
			Southbound	3,660	0.55	4,410	0.65
			2-way	7,950	-	8,070	-
Appin-Bulli Rd	E of Appin Village	Arterial: 4 lanes	Northbound	1,550	0.45	1,590	0.45
			Southbound	1,720	0.50	1,430	0.40
			2-way	3,270	-	3,020	-
Wilton Road	S of Appin Village	2L2W	Northbound	-	-	-	-
			Southbound	-	-	-	-
			2-way	2,080	>1.0	2,080	>1.0

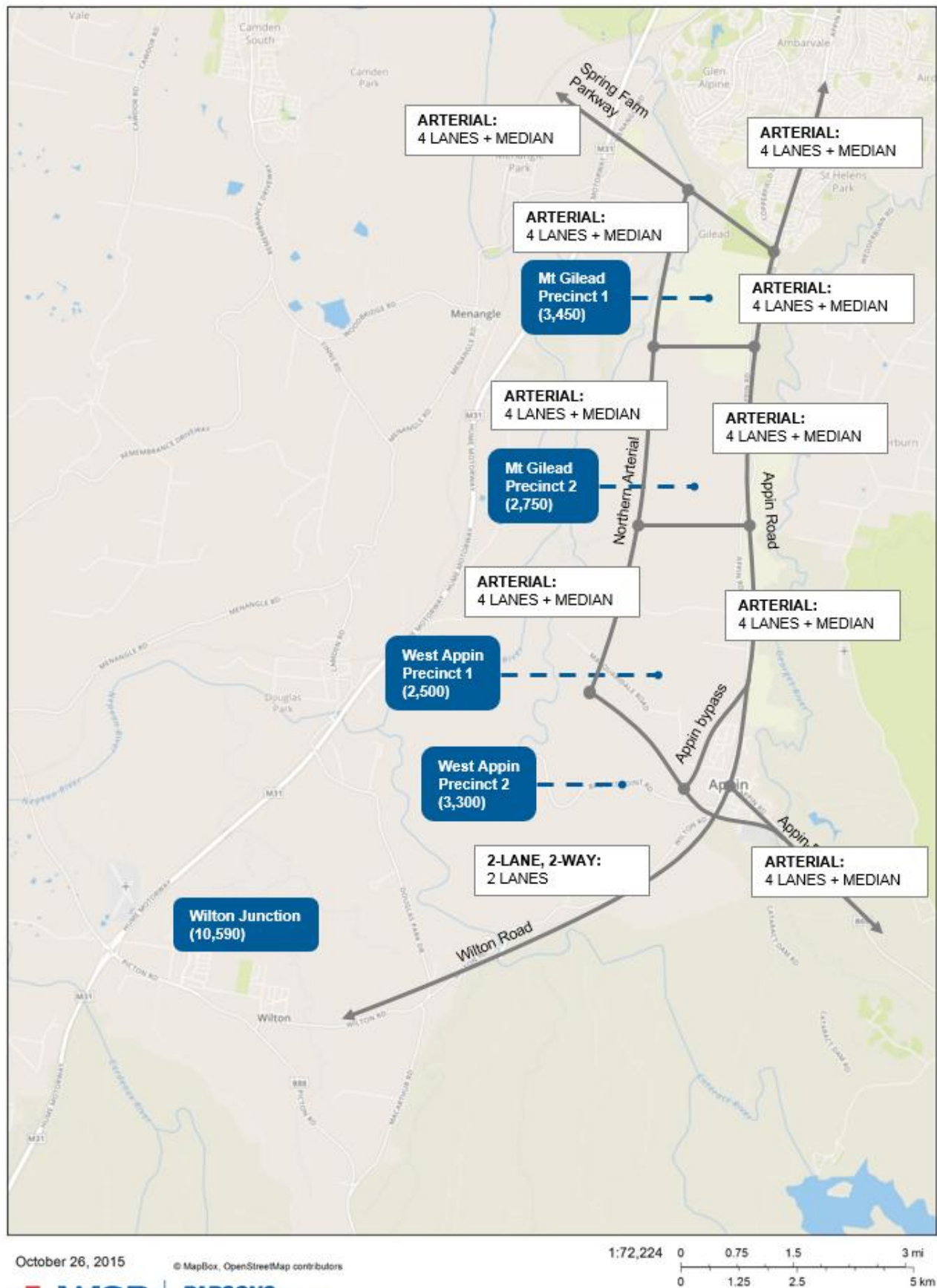


Figure 3.3 Assumed future network upgrades (2040: Mount Gilead, Wilton Junction, and West Appin) (22,590 dwellings: 6,200 in Mount Gilead; 10,590 in Wilton Junction; 5,800 in West Appin)

The results of this analysis indicate that by 2040, including the development of 6,200 dwellings in Mount Gilead and 5,800 dwellings in West Appin, based on the road network assumed in Figure 3.3:

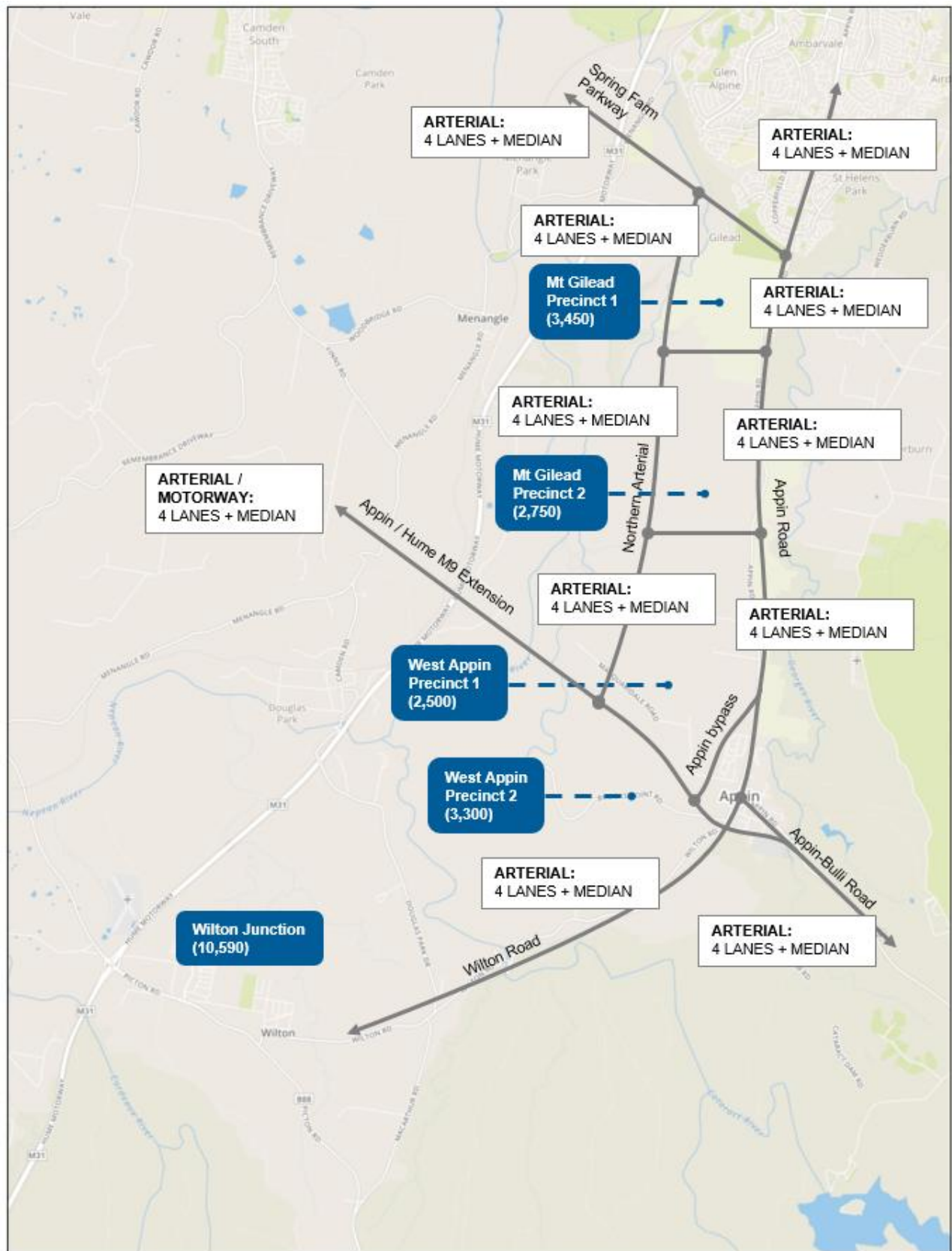
- Performance on Appin Road, Spring Farm Parkway, and the Northern Arterial would be acceptable with spare capacity
- Performance on Appin-Bulli Road would be acceptable with significant spare capacity
- Performance on Wilton Road would be unacceptable, with additional capacity upgrades required.

3.5 Future conditions – Beyond 2040: Mount Gilead, Wilton Junction, and West Appin

As development continues beyond 2040, the analysis indicates that further upgrades would be required. Further traffic growth would trigger the need to construct the Appin / Hume M9 Extension, which would provide a new connection between Appin-Bulli Road and the Hume Motorway and beyond. This new connection would:

- Provide an alternative route for traffic travelling to and from the north of West Appin, significantly reducing traffic on Appin Road, the Northern Arterial, and Spring Farm Parkway.
- Provide an alternative route for traffic through the area which would otherwise use a combination of Appin Road and Appin-Bulli Road, further reducing traffic on Appin Road and Spring Farm Parkway.
- Provide an alternative route for traffic travelling to and from the southwest of West Appin, reducing traffic on Wilton Road.

The future road network including the Appin / Hume M9 Extension is illustrated in Figure 3.4.



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Figure 3.4 Assumed future network upgrades (Beyond 2040: Mt Gilead, Wilton Junction, and W Appin)
(Development exceeding 22,590 dwellings)

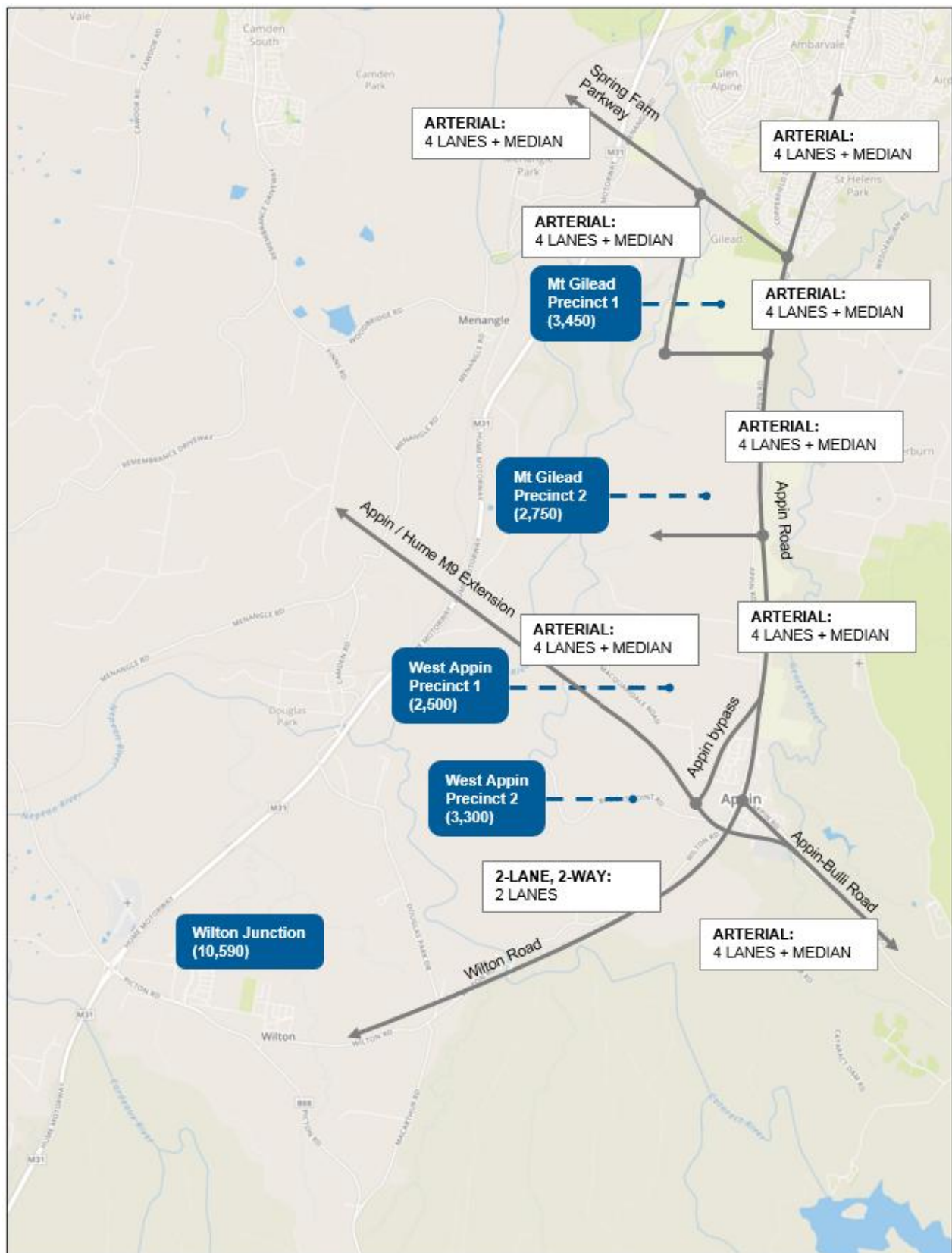
3.6 Alternate network development strategy

As the Appin / Hume M9 Extension would provide a major new route to and from the area, it also enables alternate network development options. The construction of the Appin / Hume M9 Extension would provide an alternative route to, and consequently reduce traffic on:

- Appin Road
- Wilton Road
- Appin bypass (west of Appin Village)
- Spring Farm Parkway
- The Northern Arterial.

As a result, the earlier construction of the Appin / Hume M9 Extension could delay, reduce, or negate the need for upgrades to these routes.

As an example, if the Northern Arterial to the north of West Appin were delayed or not constructed, the Appin / Hume M9 Extension could be constructed as an alternative. Preliminary analysis indicates that the alternate network illustrated in Figure 3.5 could accommodate the same development yield by 2040 (22,590 dwellings) as the recommended network described in section 3.4 and illustrated in Figure 3.3.



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Figure 3.5 Alternate future network option (2040: Mount Gilead, Wilton Junction, and West Appin)
(22,590 dwellings: Alternate network utilising Appin / Hume M9 Extension)

4. Summary

The analysis presented in section 3 illustrates that:

- The development of Mount Gilead and Wilton Junction will create a need to upgrade Appin Road and Wilton Road in the short-term (by 2022). The development of West Appin will not change this fundamental requirement. Around this time it is recommended that:
 - ▶ Appin Road would be upgraded to a 4-lane arterial standard
 - ▶ Wilton Road would be upgraded at Broughton Pass.
- When including the development of Mount Gilead, Wilton Junction, and West Appin, the development of a combined 13,000 dwellings (estimated around 2030) would result in the capacity of the upgraded road network being exceeded. Around this time it is recommended that:
 - ▶ Spring Farm Parkway would be constructed (to a 4-lane arterial standard when completed)
 - ▶ The Northern Arterial adjacent to Mount Gilead would be constructed (to a 4-lane arterial standard when completed)
 - ▶ Appin bypass would be constructed (to a 4-lane arterial standard when completed)
 - ▶ Appin-Bulli Road would be upgraded to a 4-lane arterial standard.
- Beyond this time, the development of a combined 22,500 dwellings (estimated around 2040) would result in the capacity of the upgraded road network being exceeded again. Around this time it is assumed that the Northern Arterial would be completed, providing a continuous 4-lane arterial route between Spring Farm Parkway and West Appin
- Development of more than 22,500 dwellings (beyond 2040) would trigger the need to construct the Appin / Hume M9 Extension, which would provide a new primary route to and from the study area
- Preliminary analysis also indicates that an alternate network development strategy incorporating the Appin / Hume M9 Extension at an earlier stage could delay, reduce, or negate the need for upgrades to other routes including the Northern Arterial.

Appendix A: Greater Macarthur Land Release Investigation Strategic Transport Plan Review

Executive summary

This memo appendix provides a summary of the key findings of Parson Brinckerhoff's review of the *Greater Macarthur Land Release Investigation (GMLRI) Strategic Transport Plan* (AECOM, 21 October 2015).

This review focuses on aspects most relevant to the Strategic Traffic Analysis presented in the main body of this memo, in relation to the planned and proposed developments at Mount Gilead and West Appin. The review finds that based on the magnitude and location of the development proposed in the Greater Macarthur Investigation Area (GMIA):

- The traffic forecasts presented in the *GMLRI Strategic Transport Plan* - which indicate little/no traffic growth on routes between the GMIA and Illawarra region - appear unrealistic.
- The resulting absence of road upgrade recommendations for these routes - which are based on these forecasts - is therefore also unrealistic.

In support of this view:

- 37% of existing workers in the GMIA reside in, and travel to and from Wollongong (19%), Kiama-Shellharbour (10%), or Dapto-Port Kembla (8%) (2011 Journey to Work Data, Bureau of Transport Statistics, TfNSW).
- Various previous transport assessments, including the Wilton Junction TMAP (2014) and West Appin Preliminary traffic and transport assessment (2015), which were developed using the Sydney Strategic Transport Model (STM) in collaboration with TfNSW (BTS), estimated that around 15% of total traffic generated by developments in the GMIA would travel to and from the Illawarra region.
- In addition, Appin and Wilton Development Modelling (2010) undertaken using Roads and Maritime's Illawarra Transport Model also estimated that 20% of traffic generated by developments in the GMIA would travel to and from the east.

Therefore, in contrast to the *GMLRI Strategic Transport Plan*, it is believed that upgrades to routes between the GMIA and Illawarra region will be necessary to accommodate the traffic growth created by the significant level of development in the area. This would include upgrades to Appin Road south of Mount Gilead and Appin-Bulli Road, and a new Appin bypass.

GMLRI Strategic Transport Plan Inputs and assumptions

The Western Sydney Strategic Model (WSSM) was adopted as a tool to assess land use and transport network proposals for the Greater Macarthur Investigation Area (GMIA). The following key inputs and assumptions are incorporated by the *GMLRI Strategic Transport Plan*, which ultimately provides recommendations for the Strategic Transport Network requirements:

- **Existing road network:**
 - ▶ "Appin Road and Appin-Bulli Road are identified as Class 4U roads... "General features of the route include... generally one lane in each direction along the route with overtaking lanes provided in sections and localised widening at intersections" ¹

¹ Class 4U roads are important State Roads... They are typified by moderately high traffic volumes including freight, public transport and commercial vehicle travel. They provide a good standard of travel and serve strategic inter-regional and intra-regional functions with direct access to abutting land controlled. Typically they have undivided carriageways with four or more lanes. **Source:** Network and Corridor Planning Practice Notes (NSW Roads and Maritime Services, November 2008)

- ▶ *“Picton Road is identified as a Class 5U road to the south of the M31 Hume Motorway. Picton Road forms a majority of the B88 route that links Wollongong to Wilton...General features of the road include...Four lanes between its interchange with the Hume Motorway and Pembroke Parade otherwise generally one lane in each direction with overtaking lanes provided in sections and localised widening at intersections.”²*
- **Background traffic growth:**
 - ▶ Not stated.
- **Future development yields (2036):**
 - ▶ 18,100 homes in Menangle Park and Mount Gilead, and 16,600 new homes in Wilton Junction.
 - ▶ 90,000 new residents in these precincts.
 - ▶ 20,000 new jobs in these precincts.
- **Traffic generation:**
 - ▶ Existing and future public transport mode share estimated as 10% or less.
 - ▶ Residential development is estimated to generate around 30,000 trips per AM peak hour.
 - ▶ No traffic generation allowance appears to have been made for external non-residential trips which would travel to and from the GMIA (e.g. workers travelling to and from the GMIA for employment).
 - ▶ *“This is a significant increase in travel demand in the area in the context of the existing transport network, and will generate the need for a large investment in supporting transport infrastructure.”*
- **Traffic distribution:**
 - ▶ Existing conditions:
 - Approximately 35-40% of existing workers in the GMIA travel to and from Wollongong, Kiama-Shellharbour, or Dapto-Port Kembla.
 - *“Overall the data suggests the predominant movements for people accessing employment outside of the GMIA are from the southeast and northeast.”*
 - ▶ Future conditions:
 - *“Two key demand corridors have been defined...(this includes an) Eastern demand corridor - the need to connect potential centres to the east of the M31 Hume Motorway between Gilead and Wilton Junction lends itself to a north-south demand corridor. This would connect the potential centres of Gilead, Appin, South Appin, Wilton and other centres in between.”*
 - *“A low to moderate proportion of this demand will be self-contained within the GMIA, partially accounting for the trips generated by... GMIA workers.”*
 - *“The remainder of inbound worker trips will likely come from the Wollongong area as well as the existing residential areas to the north / northeast.”*
 - *“A relatively small portion of home-based work trips will be to the Illawarra area via Bulli-Appin Road or Picton Road.”*

² Class 5U roads are significant State Roads...They are typified by high traffic volumes including freight, public transport and commercial vehicle travel. In areas without motorways, they provide the major traffic function. They serve interstate, strategic inter-regional and regional functions with direct access to abutting land controlled. Typically they are undivided carriageways with four or more lanes. **Source:** *Network and Corridor Planning Practice Notes* (NSW Roads and Maritime Services, November 2008)

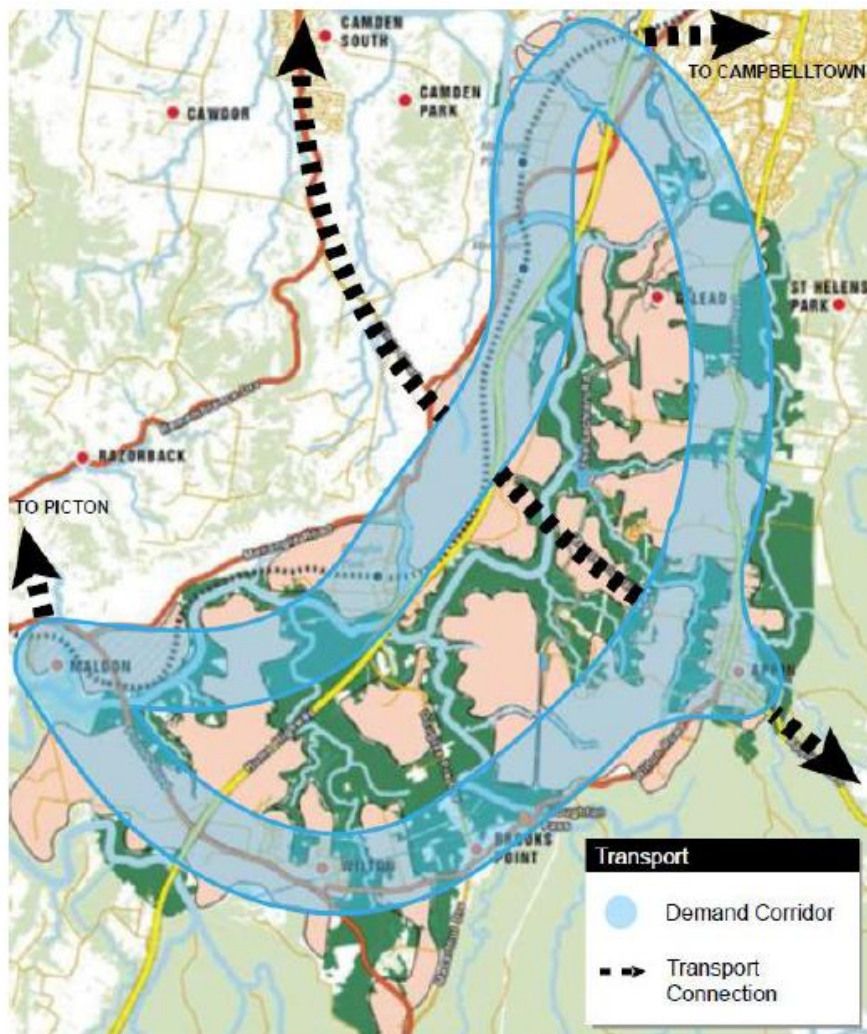


Figure A.1 Transport demand corridors (AECOM, 2015)

■ **Traffic volumes:**

- ▶ Appin Road (Rosemeadow to Gilead):
 - Existing: 1,200 PCU/hr (AM peak); 1,150 PCU/hr (PM peak)
 - Future: 3,600 vehicles/hour (V/C ratio: 0.6-0.8)
- ▶ Appin Road (South of Gilead):
 - Existing: 1,200 PCU/hr (AM peak); 1,150 PCU/hr (PM peak)
 - Future: 1,250 vehicles/hour (V/C ratio: 0.6-0.8)
- ▶ Appin-Bulli Road:
 - Existing: 900 PCU/hr (AM peak); 1,050 PCU/hr (PM peak)
 - Future: 800 vehicles/hour (V/C ratio: 0.4-0.6)
- ▶ Picton Road (East of Almond St):
 - Existing: 1,550 PCU/hr (AM peak); 1,350 PCU/hr (PM peak)
 - Future: 1,550 vehicles/hour (V/C ratio: 0.4-0.6)
- ▶ A heavy vehicle PCU factor of 2.0 was assumed.

GMLRI Strategic Transport Plan road network recommendations

Based on the above inputs, assumptions, and future traffic volume forecasts, the following key road network upgrades (see Figure A.2) in proximity of West Appin are recommended by the *GMLRI Strategic Transport Plan*:

- **M31 Hume Motorway Upgrade:**

- ▶ 2036:
 - Widening of the M31 Hume Motorway to six lanes from Spring Farm Link Road and Narellan Road.
- ▶ Ultimate:
 - Widening of the motorway to eight lanes between Spring Farm Link Road and Raby Road interchanges.
 - Upgrade of the motorway to six lanes between Picton Road and Spring Farm Link Road interchanges.

- **Spring Farm Link Road:**

- ▶ 2036 (Ultimate): Construction of the 4-lane arterial Spring Farm Link Road, including a new interchange with the M31 Hume Motorway.

- **Appin Road:**

- ▶ 2036: Widening of Appin Road to four lane arterial from Kellerman Drive to the southern extent of the Menangle Park and Mount Gilead Priority Precinct.
- ▶ Ultimate: Upgrade to 4-lane arterial (to and from Appin Village).

- **Appin bypass:**

- ▶ 2036: No upgrade.
- ▶ Ultimate: Construct two-lane free flow bypass of Appin village.

- **Appin-Bulli Road:**

- ▶ 2036:
 - No upgrade.
- ▶ Ultimate:
 - Allowance for improvements such as additional over-taking lanes.

- **Macquariedale Road Upgrade:**

- ▶ 2036: No upgrade.
- ▶ Ultimate: New four lane arterial road in place of existing local road. Includes connection from Appin to Menangle Road, including full interchange with the M31 Hume Motorway and connection with Moreton Park Road.

- **North-south arterial / sub-arterial:**

- ▶ 2036: A new arterial / sub-arterial road through the Menangle Park and Mount Gilead Priority Precinct.
- ▶ Ultimate: A new arterial / sub-arterial road between Campbelltown and Wilton.

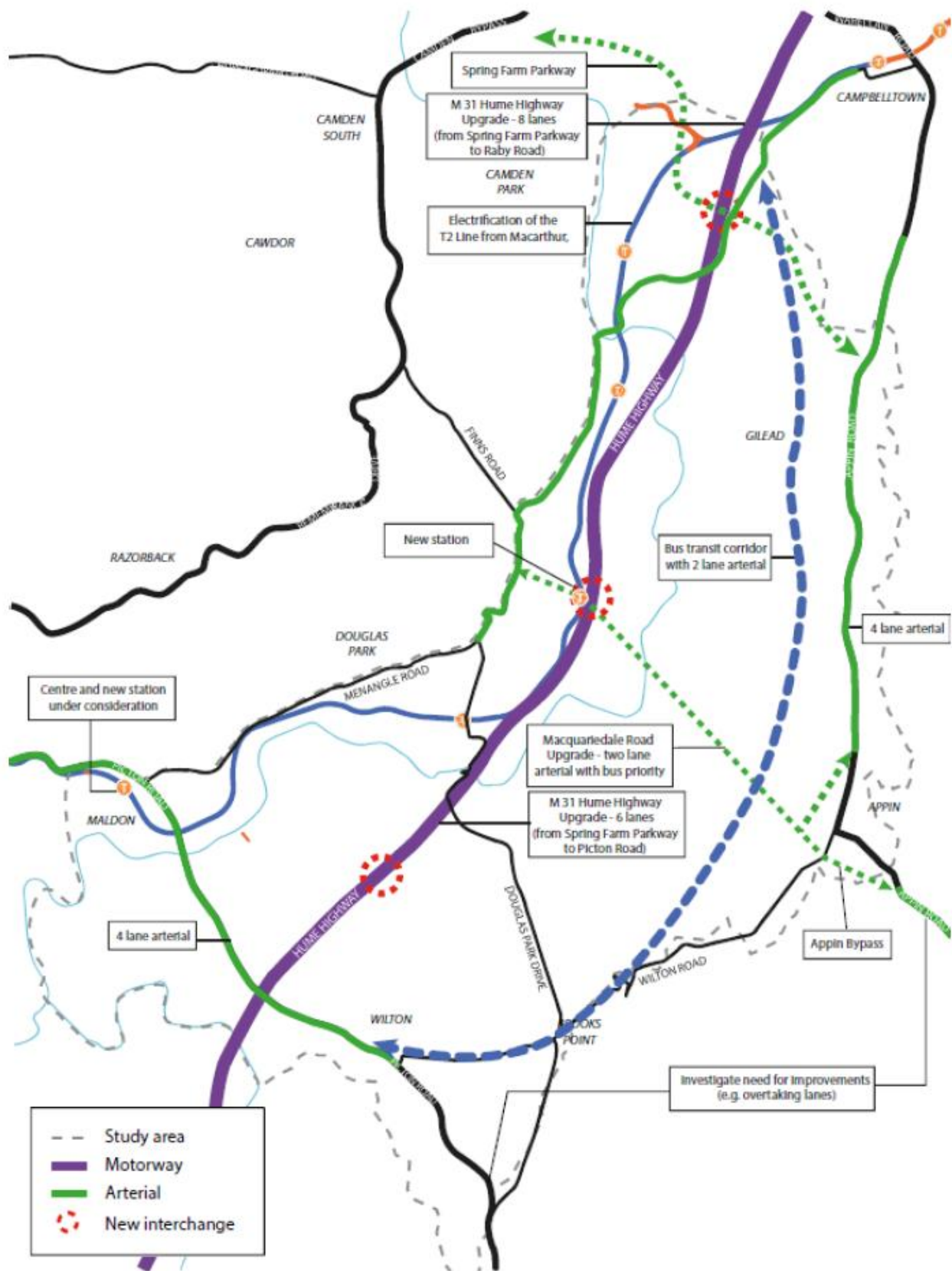


Figure A.2 Concept transport network (AECOM, 2015)

Parsons Brinckerhoff review comments/analysis

The following points are noted a result of the review of the *GMLRI Strategic Transport Plan*:

- The 2036 road network proposed by the *GMLRI Strategic Transport Plan* would:
 - ▶ Develop capacity and connectivity between the GMIA and areas north of the GMIA.
 - ▶ Effectively exclude any major upgrades to links between the GMIA and the Illawarra region:
 - No upgrades are proposed to Appin Road south of Mount Gilead.
 - Construction of the Appin bypass is not included.
 - No upgrades are proposed on Appin-Bulli Road
 - No upgrades are proposed to Picton Road east of Wilton Junction.
 - It is noted that all of these routes are Class 4U and 5U roads. These roads are typically “undivided carriageways with four or more lanes”.³
- The traffic volumes presented in the *GMLRI Strategic Transport Plan* have been used as the basis for these recommendations. Critically, the traffic forecasts presented appear to indicate very little/no growth on routes between the GMIA and the Illawarra region between 2013 and 2036:
 - ▶ Traffic volumes on Appin-Bulli Road would remain relatively unchanged at around 900-1,000 PCU/hr.
 - ▶ Traffic volumes on Picton Road would grow from 1,550 PCU/hr to around 1,780 PCU/hr (0.6% P/A).⁴
- Conflicting with these forecasts, the *GMLRI Strategic Transport Plan* indicates that over 30,000 new dwellings and 20,000 new jobs would have been created in the GMIA over this period. Consequently, it is suggested that the very low volume of forecast traffic growth between the GMIA and Wollongong is highly unlikely, considering:
 - ▶ The estimated volume of overall traffic (30,000 trips per AM peak hour) generated by the GMIA.
 - ▶ That 35-40% of existing workers in the GMIA travel to and from Wollongong, Kiama-Shellharbour, or Dapto-Port Kembla, and that a high proportion of future worker trips are expected to continue to travel to and from the Illawarra region.
 - ▶ As an example, assuming a trip generation rate of 0.4 vehicle trips/employee/peak hour, and that 25% of workers would travel to and from the Illawarra region, would result in 2,000 additional vehicles ($20,000 * 0.4 * 25\%$) combined on Appin-Bulli Road and Picton Road.
 - ▶ Various previous transport assessments, including the Wilton Junction TMAP (2014) and West Appin Preliminary traffic and transport assessment (2015), which were developed using the Sydney Strategic Transport Model (STM) in collaboration with TfNSW (BTS), estimated that around 15% of total traffic generated by developments in the GMIA would travel to and from the Illawarra region. Based on an estimated 30,000 trips per hour, this would result in around 4,500 trips combined on Appin-Bulli Road and Picton Road.
- Compounding the traffic forecasting anomaly, it also seems likely that the overall quantum of traffic generated by the proposed developments has been understated:
 - ▶ 30,000 trips per AM peak hour would equate to around 0.86 trips per dwelling, based on the assumed 34,700 combined dwellings in the GMIA. This is a reasonable estimate based on the type of residential development proposed.

³ Network and Corridor Planning Practice Notes (NSW Roads and Maritime Services, November 2008)

⁴ Using the GMLRI forecast of 1,550 vehicles/hour, and assuming 15% heavy vehicles and a PCU factor of 2.0.

- ▶ However, no additional traffic generation allowance appears to have been made for external non-residential trips which would travel to and from the GMIA (e.g. workers travelling to and from the GMIA for employment, but who do not reside in the GMIA).
- ▶ As an example, an assumption of 20,000 workers and 0.4 vehicle trips/employee/peak hour would generate 8,000 additional vehicle trips per hour. Assuming 50% of these trips to be self-contained (and accounted for within the residential traffic generation component) would result in an additional 4,000 external trips travelling beyond the boundaries of the GMIA.
- It is also noted that in the context of the *GMLRI Strategic Transport Plan*, self-containment has also been defined to include trips within the GMIA between Wilton Junction and the Menangle Park/Mount Gilead precincts:
 - ▶ 2,000 self-contained trips per hour are estimated to travel between Wilton Junction and Menangle Park/Mount Gilead precincts.
 - ▶ Previous advice provided by TfNSW noted that the Spring Farm Link Road interchange with the Hume Motorway would comprise north-facing ramps only. Consequently it is likely that a significant proportion of these 2,000 trips travelling between Wilton Junction and the Menangle Park/Mount Gilead precincts would travel along the Appin Road-Wilton Road route. This is illustrated as the “Eastern demand corridor” by the *GMLRI Strategic Transport Plan*.

Parsons Brinckerhoff review summary

It is acknowledged that traffic forecasting outputs can vary significantly based on inputs, assumptions, and methodologies. However, based on the magnitude and location of the development proposed in the GMIA:

- The traffic forecasts presented in the *GMLRI Strategic Transport Plan* - which indicate little/no traffic growth on routes between the GMIA and Illawarra region - appear unrealistic.
- The resulting road upgrade recommendations presented in the *GMLRI Strategic Transport Plan* are based on these traffic forecasts, and are therefore also debatable.

In contrast to the *GMLRI Strategic Transport Plan*, and as noted in the assessment presented in the main body of this memo, it is proposed that upgrades to routes between the GMIA and Illawarra region will be necessary to maintain performance, including:

- Appin Road south of Mount Gilead (including an Appin bypass)
- Appin-Bulli Road

These roads are defined as Class 4U roads by the *GMLRI Strategic Transport Plan*. These routes:

- Are important State Roads
- Serve strategic inter-regional and intra-regional functions
- Typically have four or more lanes.⁵

Consequently, it is noted that these roads (and Picton Road, which is a Class 5U road) require upgrading to achieve a ‘typical’ four lane configuration. This will become increasingly critical in the future to maintain the strategic function of these routes as traffic increases.

⁵ *Network and Corridor Planning Practice Notes* (NSW Roads and Maritime Services, November 2008)

APPENDIX 5

BG&E Roads Infrastructure Table and Costings

APPENDIX 6

West Appin Landowners SW Sydney Lot Projections

TABLE 2: DWELLING PROJECTIONS FOR SW SYDNEY

CAMDEN DWELLINGS										
Locality (growth commences)	2011	2016	2021	2026	2031	2036	2041	2046	Assumptions	
Camden	3069	3105	3292	3418	3478	3553	3600	3600	1.	
Catherine Fields North Precinct (2021)	991	1001	1000	1500	2000	3500	4000	4500	2. 100 dwellings pa	
Catherine Fields Precinct (2016)	22	22	500	1000	1500	2000	2500	3000	2. 100 dwellings pa	
Currans Hill	1723	1897	2142	2153	2168	2183	2200	2200	1.	
Elderslie	1609	2021	2466	2511	2529	2549	2600	2600	1.	
Grasmere, Ellis Lane, Cawdor, Bickley Vale, Cobbitty Hills	1323	1402	1630	1666	1686	1706	1700	1700	1.	
Harrington Park & Kirkham	2565	3516	4126	4211	4221	4231	4300	4300	1.	
Leppington Precincts (2016)	480	480	1000	1500	2000	2500	3000	3500	2. 100 dwellings pa	
Lowes Creek Precinct (2016)	149	149	1150	2200	3200	4000	4000	4000	3. 200 dwellings pa	
Marylands Precinct (2026)	9	9	9	9	500	1000	1500	2000	2. 100 dwellings pa	
Mount Annan	3327	3701	3813	3828	3843	3858	3900	3900	1.	
Narellan & Smeaton Grange	1318	1359	1443	1494	1529	1569	1600	1600	1.	
Narellan Vale	2338	2363	2378	2389	2399	2409	2400	2400	1.	
Oran Park Precinct	56	1594	4994	7444	7660	7700	7700	7700	1.	
Spring Farm	553	1759	3106	3793	3893	3900	3900	3900	1.	
Turner Road Precinct & Central Hills	56	1975	3705	4648	4716	4700	4700	4700	1.	
TOTAL DWELLINGS	19588	26353	36754	43764	47322	51358	53600	55600		

1. Camden Council projections (<http://forecast.id.com.au/camden>) - rounding applied post 2036
2. West Appin Landowner Group projections – slow rates of growth caused by fragmented landholdings
3. West Appin Landowner Group projections - progress of PAP application, infrastructure announcements and market conditions

Greenfield lots 2016-36 - 23,600

CAMPBELLTOWN DWELLINGS									
Locality (growth commences)	2011	2016	2021	2026	2031	2036 ²	2041 ²	2046 ²	Assumptions
Airds	1242	1247	1442	1597	1612	1600	1600	1600	1.
Ambarvale & Englorie Park	2592	2612	2632	2652	2672	2700	2700	2700	1.
Blair Athol	809	814	819	824	829	800	800	800	1.
Bradbury	3287	3345	3565	3615	3665	3700	3700	3700	1.
Campbelltown (2016)	4416	5352	5852	6352	6852	7352	7852	8352	100 dwellings pa
Claymore	969	974	989	1019	1049	1050	1050	1050	1.
Eagle Vale	1834	1854	1994	2042	2062	2100	2100	2100	1.
East Leppington (2016)	-	300	1800	3000	3000	3000	3000	3000	300 dwellings pa
Eschol Park	917	922	927	932	937	950	950	950	1.
Glen Alpine	1420	1435	1450	1465	1480	1500	1500	1500	1.
Glenfield	2704	3454	3706	3761	3816	3800	3800	3800	1.
Ingleburn (2016)	5333	5593	6093	6593	7093	7593	7600	7600	100 dwellings pa (incl. Ed Park)
Kearns	899	909	919	929	939	900	900	900	1.
Leumeah	3794	3834	3899	3964	4029	4000	4000	4000	1.
Macquarie Fields & Links	5149	5257	5312	5367	5422	5400	5400	5400	1.
Menangle Park	-	-	750	1500	2250	3000	3400	3400	3.
Minto	3467	3891	4181	4226	4251	4300	4300	4300	1.
Mt Gilead	-	-	750	1500	1500	1500	1500	1500	3.
Raby	1992	1997	2002	2007	2012	2000	2000	2000	1.
Rosemeadow	2525	2530	2535	2540	2545	2550	2550	2550	1.
Rural Residential	902	1032	1100	1100	1100	1100	1100	1100	No growth after 2016
Ruse	2029	2039	2047	2052	2057	2060	2060	2060	1.
South Campbelltown	-	-	1000	2000	3000	4000	5000	6000	3.
St Andrews & Bow Bowing	2424	2429	2434	2439	2444	2450	2450	2450	1.
St Helens Park	2116	2146	2171	2201	2231	2250	2250	2250	1.
Woodbine & Blairmont	1049	1099	1699	2199	2400	2400	2400	2400	4.
TOTAL DWELLINGS	51869	55065	62068	67876	71247	74055	75962	77462	

1. Campbelltown Council projections (<http://forecast.id.com.au/campbelltown>) with rounding applied post 2031 accept were noted otherwise in assumptions column
2. West Appin Landowner Group projections assume minimal change post 2031 and with rounding applied post 2031
3. West Appin Landowner Group projections (Ref: West Appin and adjoining areas yield and growth forecasts, July 2014)
4. Assume 1300 additional dwellings at 100dwellings pa commencing 2016

Greenfield lots 2016-36 - 7,000

LIVERPOOL DWELLINGS									
Locality (growth commences)	2011	2016	2021	2026	2031	2036	2041	2046	Assumptions ^{1.}
Austral (2016)			500	1000	1500	2000	2500	3000	100 dwellings pa
Edmondson Park (2013)		600	1600	2600	3600	4600	5600	6700	200 dwellings pa
Kemps Creek (2021)				250	500	750	1000	1250	50 dwellings pa
Leppington East (2016)			500	1000	1500	1500	1500	1500	100 dwellings pa
Leppington North (2016)			250	500	750	1000	1250	1500	50 dwellings pa
North Rossmore (2026)					250	500	750	1000	50 dwellings pa
Bringelly (2026)					250	500	750	1000	50 dwellings pa
Liverpool (non- growth centre)		2500	5000	7500	10000	12500	15000	17500	500 dwellings pa
TOTAL DWELLINGS	62600	65700	70450	75450	80950	85950	90950	96050	

1. West Appin Landowner Group projections for Liverpool were used commencing 2016 (no other projections available). Slow rates of growth were projected for fragmented release areas as indicated in assumptions column.

Greenfield lots 2016-36 - 10,250

BANKSTOWN DWELLINGS									
	2011	2016	2021	2026	2031	2036 ^{2.}	2041	2046	
TOTAL DWELLINGS^{1.}	63508	66605	69928	73256	75425	78000	79600	82300	

1. Council projections (<http://forecast.id.com.au/bankstown>) for 2011-2031 (October 2012)

2. Post 2031 projections assume annual growth continues at same rate (0.67% and occ. rate 2.93p / dw). Rounding applied post 2031

FAIRFIELD DWELLINGS									
	2011	2016	2021	2026	2031 ^{2.}	2036	2041	2046	
TOTAL DWELLINGS^{1.}	61195	63967	67263	69945	71948	73700	75400	77300	

1. Council projections (<http://forecast.id.com.au/fairfield>) for 2011-2031 (September 2012)

2. Post 2031 projections assume annual growth continues at same rate (0.48% and occ. rate 3.09p / dw). Rounding applied post 2031

WOLLONDILLY DWELLINGS & POPULATION										
Locality	2011	2016	2021	2026	2031	2036	2041	2046	Assumptions	
Bargo				300	600	900	1650	2200	1.	
Douglas Park						25	60	100	1.	
Menangle Rd			350	350	350	350	350	350	1.	
Oakdale				220	260	300	350	400	1.	
Picton				600	850	1100	1200	1300	1.	
Silverdale & Warragamba				800	1050	1300	1500	1700	1.	
Tahmoor & Thirlmere				600	1200	1800	2250	2700	1.	
The Oaks				200	250	300	375	450	1.	
Bingarra Gorge		800	1600	1800	1800	1800	1800	1800	2. 160 dwellings pa	
Wilton Junction			1350	3665	5980	8040	10100	10100	2. WJ Master Plan excl. Bingarra Gorge	
Other Infill		50	150	250	350	450	550	650	1.	
West Appin			500	5000	9250	13600	16000	17500	2.	
TOTAL DWELLINGS³	15609	16459	19559	29394	37549	45574	51794	54859		
TOTAL POPULATION⁴	44382	48389	57503	86418	110394	133988	152274	161285		

1. Council estimated growth rate

2. Landowner estimate based on high level master plan, a deduction of 20% for roads and open space and development fronts producing an average of 150 lots / year

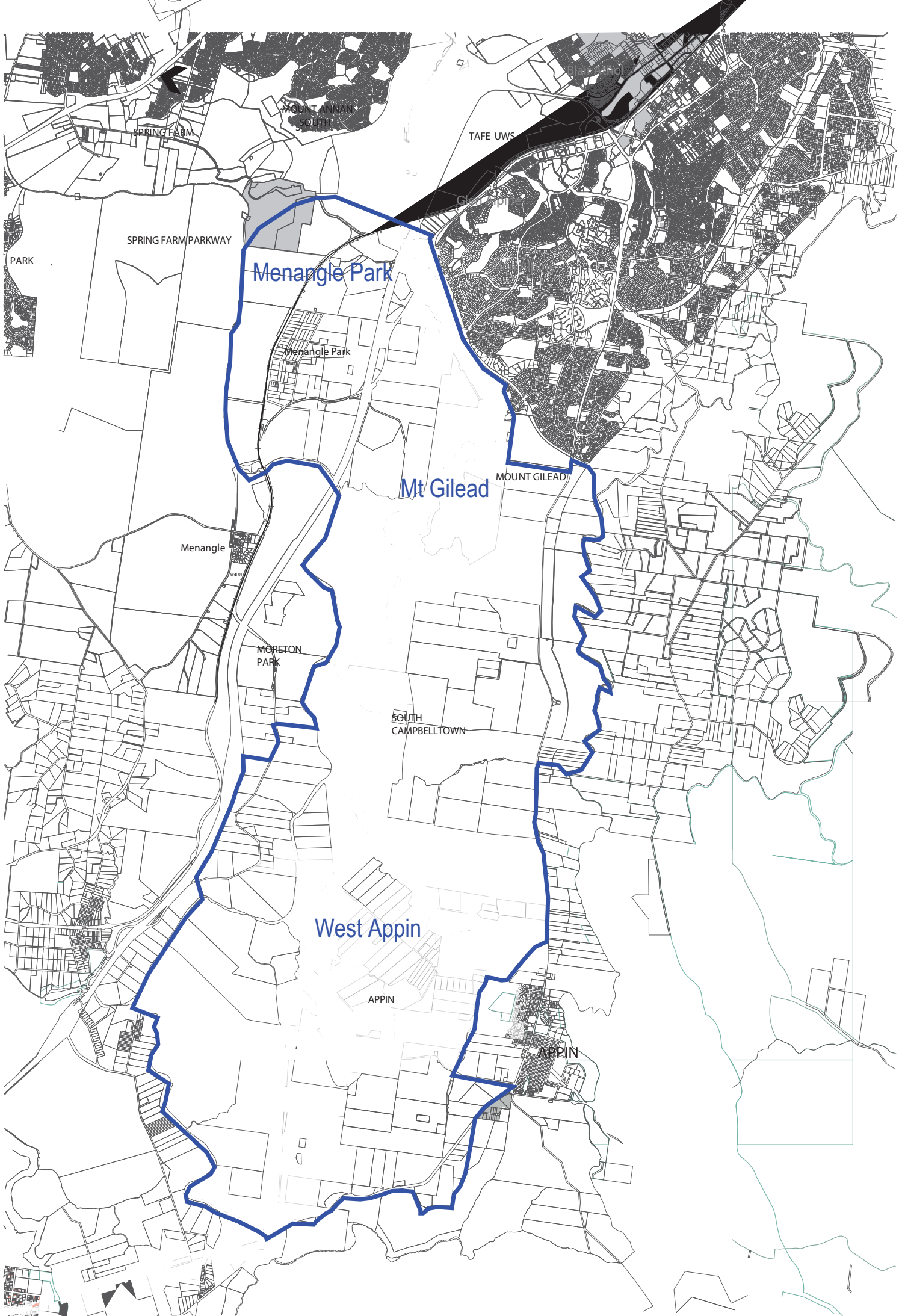
3. 2011 dwellings and population based on (<http://forecast.id.com.au/wollondilly>)

4. Assumed occupancy rate of 2.94 persons / dwelling and rounding applied after 2011

Greenfield lots 2016-36 - 7,100 (excluding Wilton Junction and West Appin)

APPENDIX 7

Amended Map for the Growth Centre SEPP



APPENDIX 8

Plan Showing Delivery of Upgraded Appin Road

POTENTIAL STAGING OF DEVELOPMENT
TO DELIVER INFRASTRUCTURE

