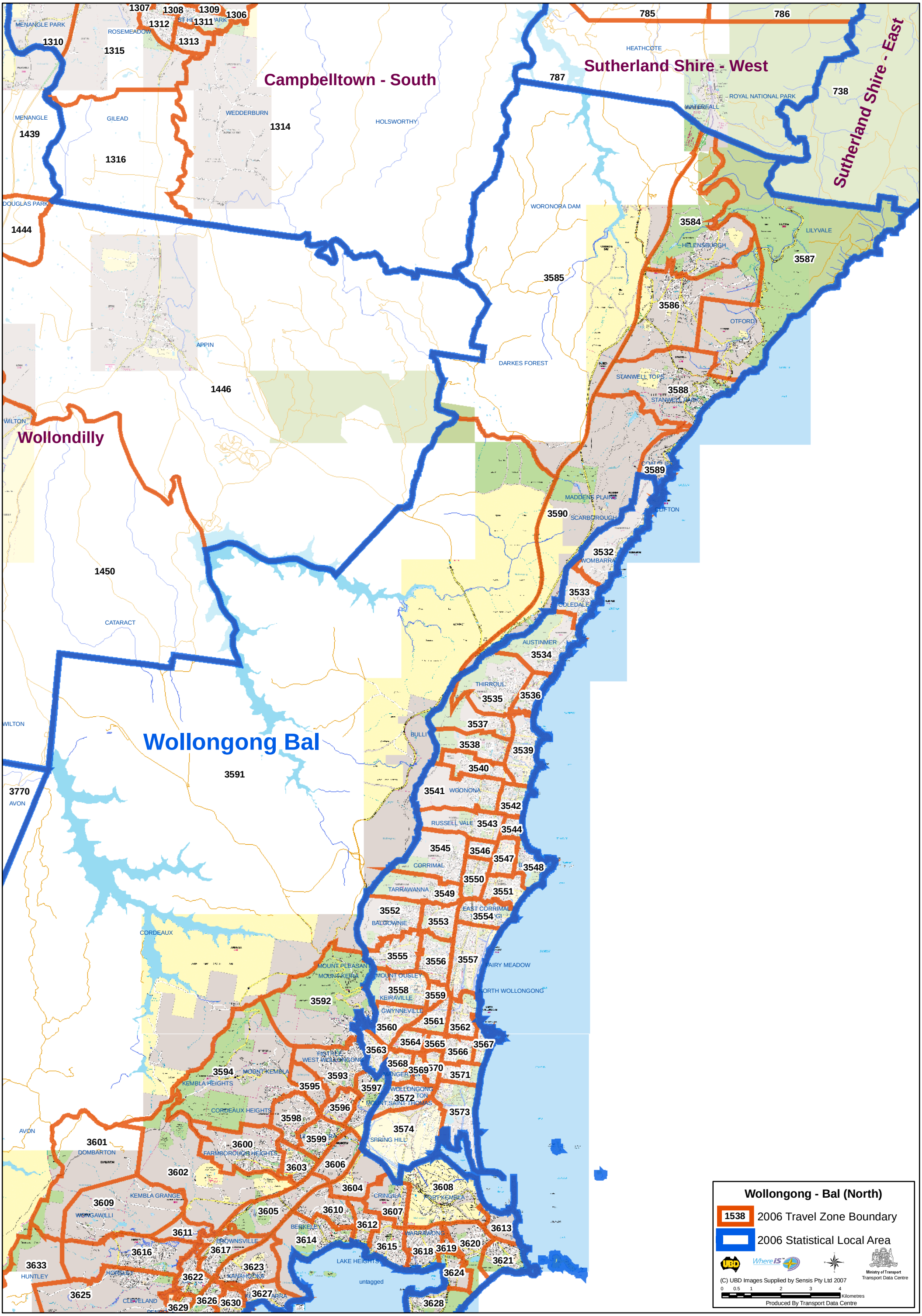
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Wollongong - Bal (North)
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2006 Travel Zone Boundary
2006 Statistical Local Area
(C) UBD Images Supplied by Sensis Pty Ltd 2007
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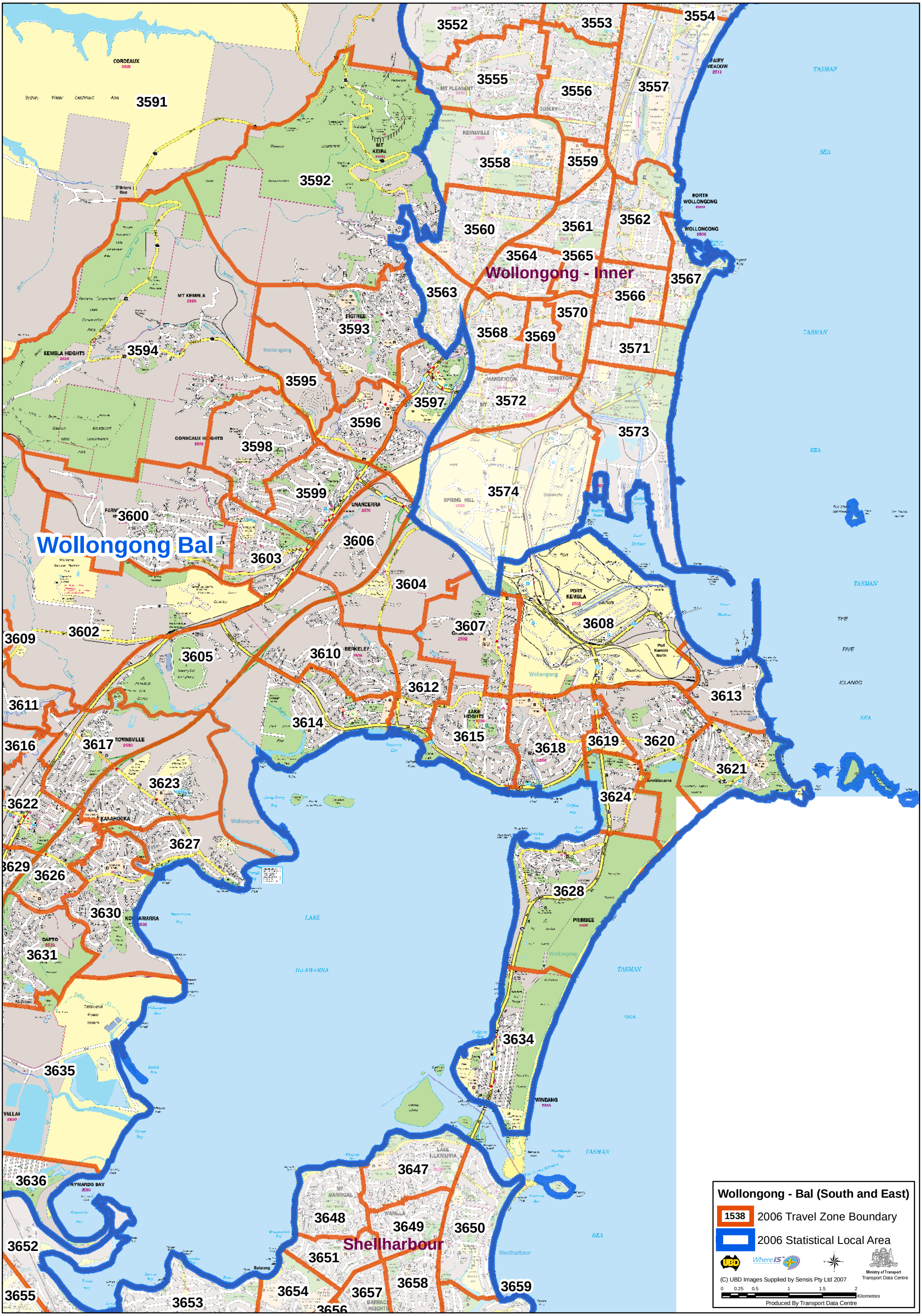
Ministry of Transport
Transport Data Centre



Wollongong - Bal (South and East)

1538 2006 Travel Zone Boundary

2006 Statistical Local Area

Wollongong - Bal (South and West)

1538 2006 Travel Zone Boundary

2006 Statistical Local Area

(C) UBD Images Supplied by Sensis Pty Ltd 2007

Ministry of Transport
Transport Data Centre

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Appendix 4N

JTW Regional Assessment

APPENDIX 4N - JTW Regional Assessment

The regional assessment covers the Wollongong and Shellharbour local government areas.

Workforce and Employment

An analysis of travel patterns of the existing Wollongong and Shellharbour local government area employment and workforce was undertaken. Trips originating within the LGA are considered to be the LGA workforce living within the LGA. Trips ending in the LGA are considered to be representing employment or jobs within the LGA. Each LGA was divided into CBD and non-CBD areas. The total workforce and jobs in the two LGA's are summarised in Table 1.

Table 1 shows that in 2006 the Shellharbour LGA had a workforce of almost 23,000 people but less than 10,000 jobs within the LGA; hence there is a deficit of jobs of almost 13,000. Wollongong LGA has a workforce of over 104,000 people with almost 83,000 jobs within the LGA; hence there is a deficit of jobs of over 21,000.

Table 1 2006 JTW: Wollongong and Shellharbour LGA Workforce & Jobs

Population	Shellharbour LGA			Wollongong LGA			TOTAL
	CBD	Non-CBD	ALL	CBD	Non-CBD	ALL	
Workforce[1]	5,157	17,723	22,880	1,388	79,781	81,259	104139
Jobs[2]	4,071	5,871	9,942	14,558	58,358	72,916	82,858
Surplus/Deficit of Jobs (compared to Workforce)	**-1,086**	**-11,852**	**-12,938**	**+13,170**	**-21,513**	**-8,343**	**-21,281**

The movement of workforce to jobs is complex and is summarised in detail in **Error! Not a valid bookmark self-reference.**. This highlights the general movement of workers to jobs in broad categories.

Table 2 2006 JTW: Wollongong and Shellharbour LGA Total Work Trips

		To Shellharbour			To Wollongong			To Wollongong/ Shellharbour	To External	TOTAL
		CBD	Other	Σ	CBD	Other	Σ			
From Shellharbour	**CBD**	771	586	**1,357**	419	2,317	**2,736**	4,093	1,064	**5,157**
	Other	1,613	3,067	**4,680**	1,835	8,290	**10,125**	14,805	2,918	**17,723**
	Σ	**2,384**	**3,653**	**6,037**	**2,254**	**10,607**	**12,861**	**18,898**	**3,982**	**22,880**
From Wollongong	**CBD**	10	20	**30**	395	608	**1,003**	1,033	355	**1,388**
	Other	1,507	1,945	**3,452**	10,778	43,801	**54,579**	58,031	21,840	**79,871**
	Σ	**1,517**	**1,965**	**3,482**	**11,173**	**44,409**	**55,582**	**59,064**	**22,195**	**81,259**
From Wollongong/ Shellharbour		3,901	5,618	**9,519**	13,427	55,016	**68,443**	77,962	26,177	**104,139**
From External		170	253	**423**	1,131	3,342	**4,473**	4,896		**4,896**
TOTAL		**4,071**	**5,871**	**9,942**	**14,558**	**58,358**	**72,916**	**82,858**	**26,177**	**109,035**

[1] Workforce is people residing in the LGA who are employed or looking for work. This workforce may or may not work within the LGA.

[2] Jobs are number of employees working within the LGA. These may be filled with LGA residents or non-residents.

In Shellharbour there are some 23,000 workers and almost 10,000 jobs. However only 6,000 workers (26%) live and work in Shellharbour, 56% work in Wollongong LGA and the remainder (17%) work outside the region.

In Wollongong there are some 81,000 workers and almost 73,000 jobs. However only 56,000 workers (68%) live and work in Wollongong, 4% work in Shellharbour LGA and the remainder (27%) work outside the region.

Mode of Travel

The assessment of mode of travel in to and out of the LGAs provides a broad overview of regional travel patterns. A summary of the results of the analysis is presented in Table 3 and Table 4.

Table 3 2006 JTW: Wollongong and Shellharbour LGA Origin Travel Patterns

	Shellharbour LGA			Wollongong LGA			
Mode of Travel	**CBD**	**Non-CBD**	**ALL**	**CBD**	**Non-CBD**	**ALL**	**TOTAL**
Train	89	323	412	69	3,865	3,934	4,346
Ferry or Tram	0	3	3	0	35	35	38
Bus	60	86	146	15	936	951	1,097
Car as Driver (incl Bus & Motorbike)	3,562	13,168	16,730	654	52,357	53,011	69,741
Car as Passenger	369	987	1,356	92	5,271	5,363	6,719
Other Modes	172	314	486	300	3,439	3,739	4,225
Sub-Total	**4,252**	**14,881**	**19,133**	**1,130**	**65,903**	**67,033**	**86,166**
Not Stated	132	322	454	21	1,511	1,532	1,986
Worked at Home/Did not go to Work	773	2,520	3,293	237	12,457	12,694	15,987
Total	**5,157**	**17,723**	**22,880**	**1,388**	**79,871**	**81,259**	**104,139**
% Car Driver/Passenger of Sub-Total	*92.5%*	*95.1%*	*94.5%*	*66.0%*	*87.4%*	*87.1%*	*88.7%*

Table 4 2006 JTW: Wollongong and Shellharbour LGA Destination Travel Patterns

	Shellharbour LGA			Wollongong LGA			
Mode of Travel	**CBD**	**Non-CBD**	**ALL**	**CBD**	**Non-CBD**	**ALL**	**TOTAL**
Train	23	47	70	367	764	1,131	1,201
Ferry or Tram	0	0	0	5	24	29	29
Bus	34	17	51	299	609	908	959
Car as Driver (incl Bus & Motorbike)	2,683	3,988	6,671	9,555	41,111	50,666	57,337
Car as Passenger	305	337	642	1,040	3,557	4,597	5,239
Other Modes	157	204	361	940	2,523	3,463	3,824
Sub-Total	**3,202**	**4,593**	**7,795**	**12,206**	**48,588**	**60,794**	**68,589**
Not Stated	79	69	148	141	724	865	1,013
Worked at Home/Did not go to Work	790	1,209	1,999	2,211	9,046	11,257	13,256
Total	**4,071**	**5,871**	**9,942**	**14,558**	**58,358**	**72,916**	**82,858**
% Car Driver/Passenger of Sub-Total	*93.3%*	*94.2%*	*93.8%*	*86.8%*	*91.9%*	*90.9%*	*91.2%*

Car is the predominant model of travel for work trips for both origin and destination trips within both LGA's.

Trips Originating in Wollongong or Shellharbour LGA (Workforce Trips)

The mode share is presented graphically in Chart 1 and Chart 2 for trips originating in Wollongong or Shellharbour LGA.

Chart 1 2006 JTW: Wollongong and Shellharbour LGA Origin Travel Patterns – All Modes

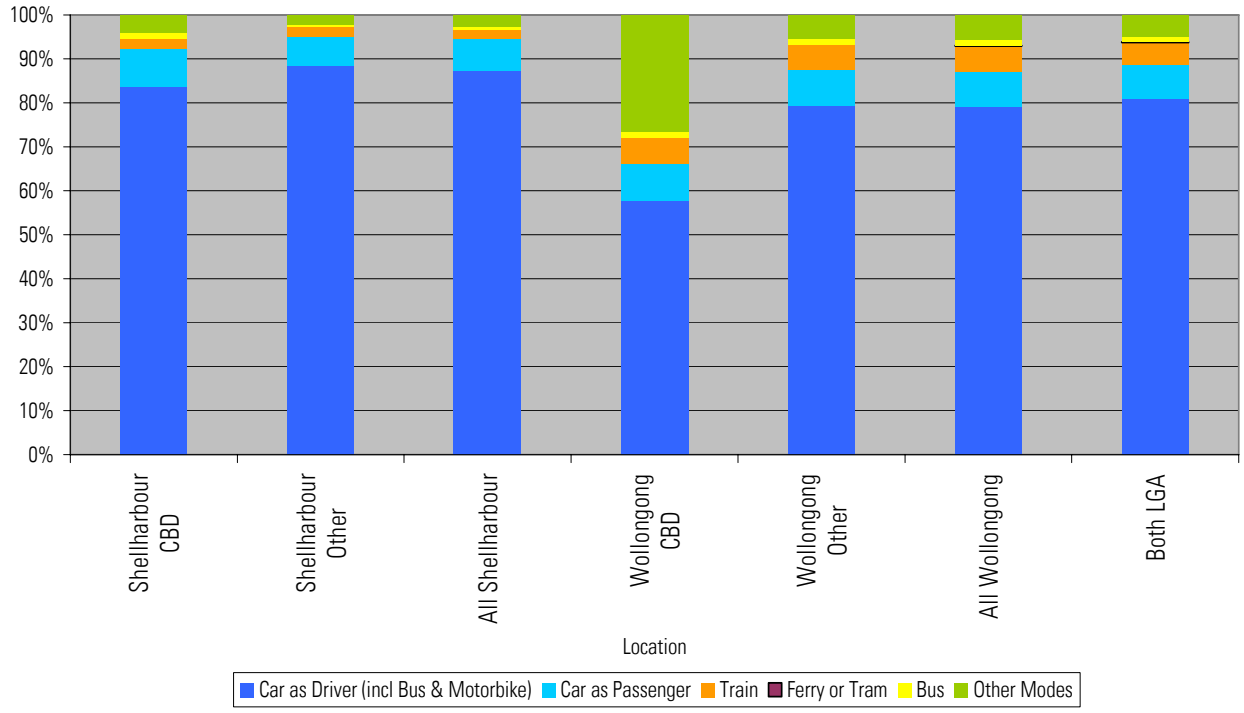
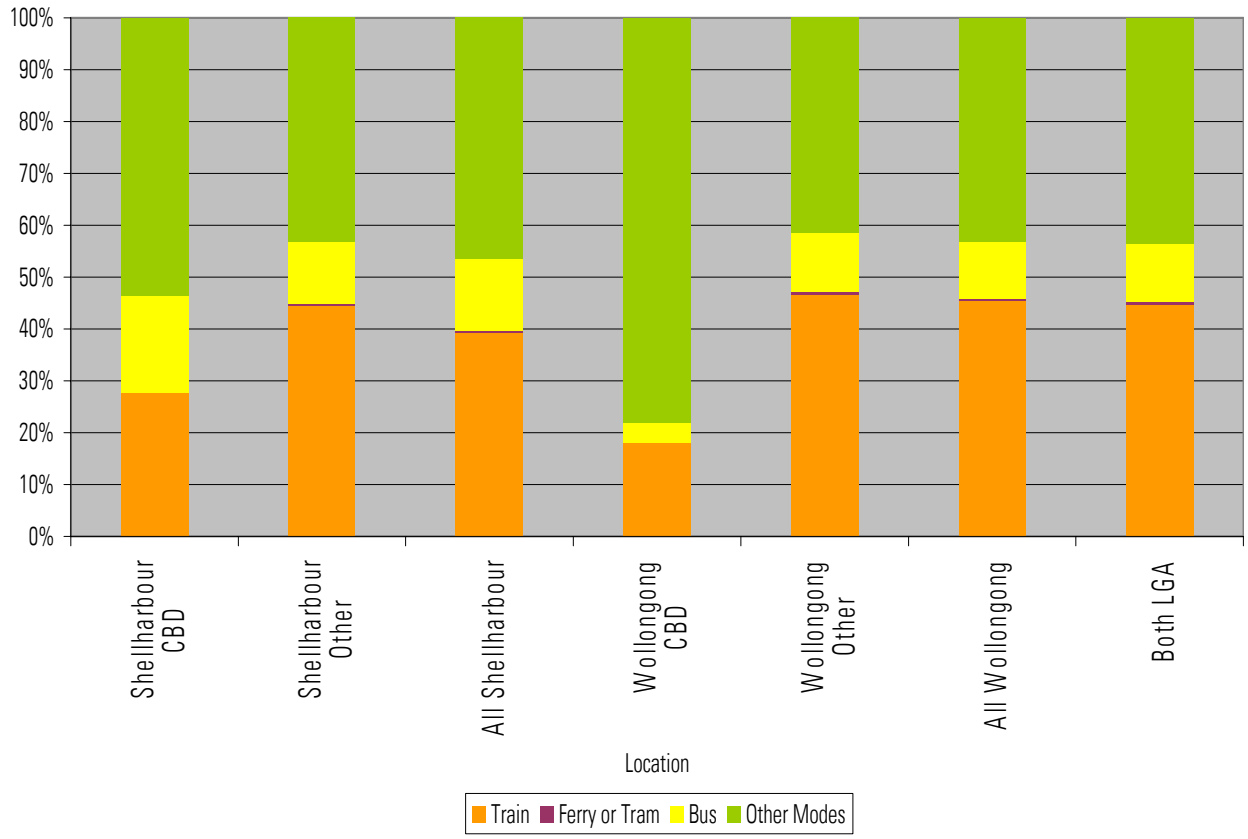


Chart 2 2006 JTW: Wollongong and Shellharbour LGA Origin Travel Patterns – Non-Car Modes



The most commonly used mode of travel among all the modes for trips originating within the region was the car. On average 89% of people who live in Wollongong and Shellharbour LGA travel by car (as either a driver or passenger). Generally Wollongong had a lower mode share, 87.1% for car use (driver and passenger) than Shellharbour with 95%. It should be noted in most cases the percentage of public transport use was similar across all the locations, ranging from 3-7%.

Wollongong CBD had a significantly lower car mode share for trips originating in the CBD, 66%. However, in the case of the Wollongong CBD the proportion of other modes increased significantly to 27%. Other modes would include active transport modes such as walking and cycling. This would lead us to believe that people living within the Wollongong CBD use other forms of transport like walking or cycling possibly as a transport mode to travel from the CBD. Over 28% of people who live in the Wollongong CBD also work in the CBD.

For Shellharbour CBD the mode of travel was consistent with the rest of the LGA, with a slightly lower car mode share and slightly higher other mode use. In the Shellharbour CBD only 15% of people who live in the Shellharbour CBD also work in the CBD.

Trips Ending in Wollongong or Shellharbour LGA (Employment Trips)

The mode share is presented graphically in Chart 3 and Chart 4 for trips ending in Wollongong or Shellharbour LGA.

Chart 3 2006 JTW: Wollongong and Shellharbour LGA Destination Travel Patterns – All Modes

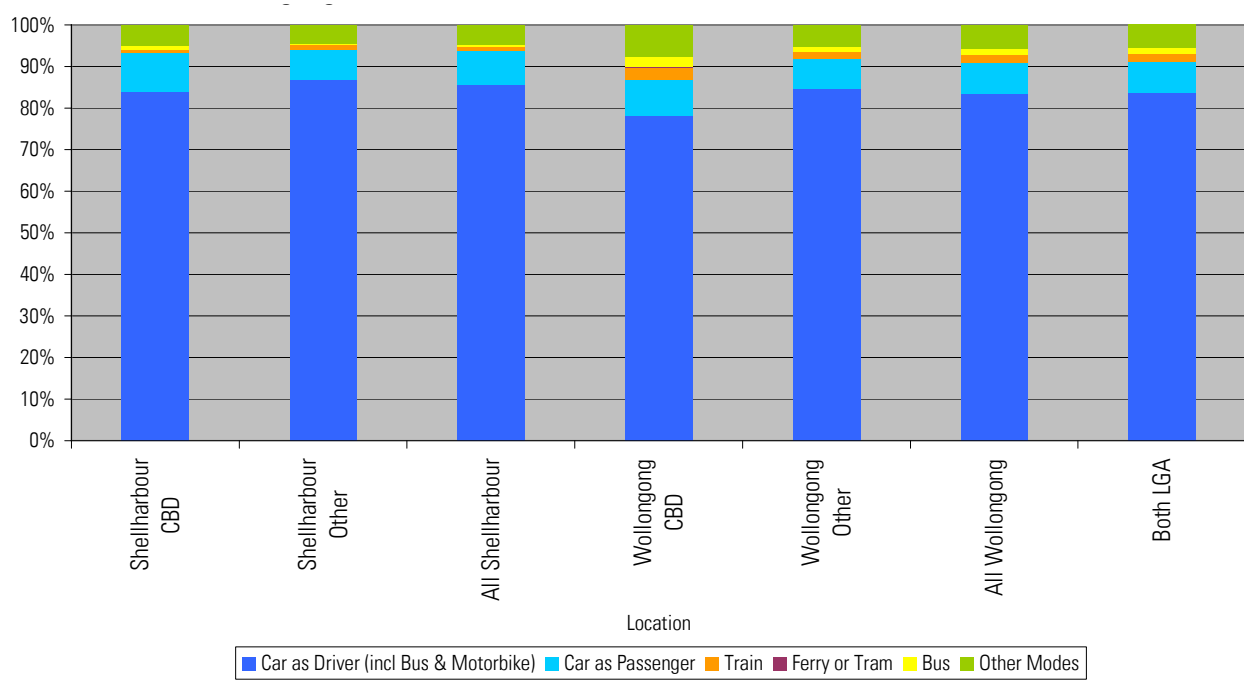
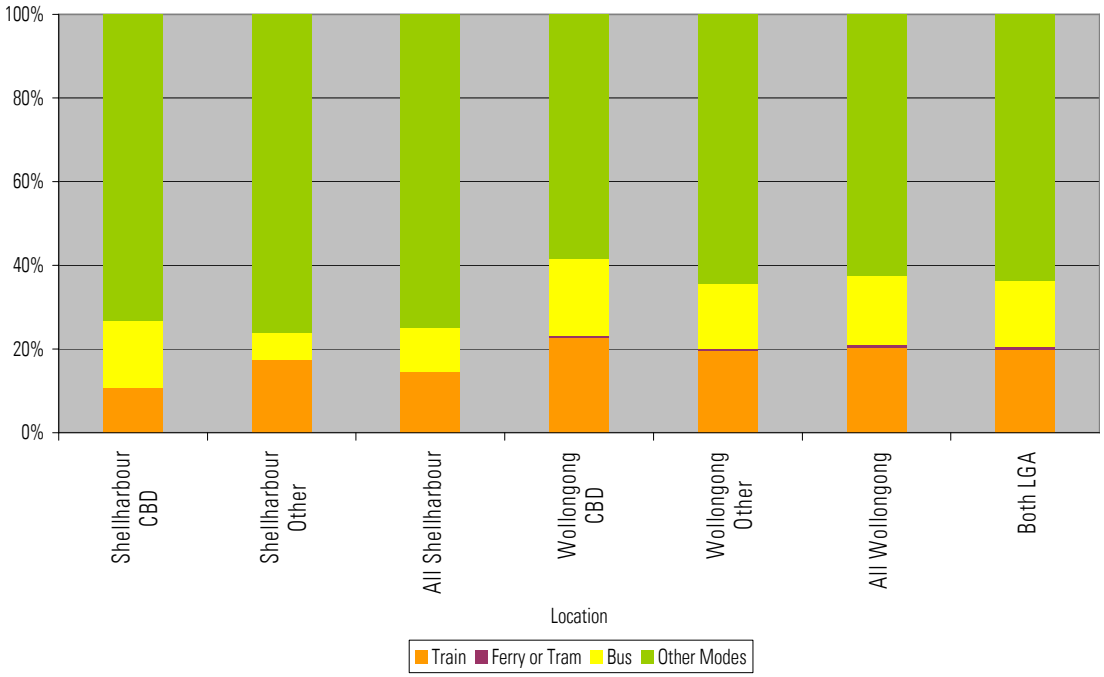


Chart 4 2006 JTW: Wollongong and Shellharbour LGA Destination Travel Patterns – Non-Car Modes



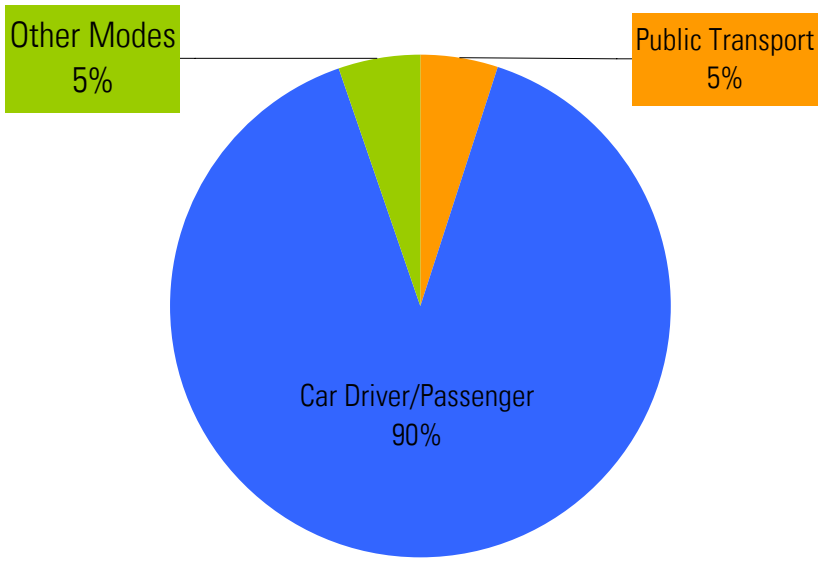
In the case of travelling to jobs within the LGA the most commonly used mode was still the car. On average 91% of people who work in Wollongong and Shellharbour LGA travel by car (as either a driver or passenger), Generally Wollongong had a lower mode share, 91% for car use (driver and passenger) than Shellharbour with 94%. It should be noted in most cases the percentage of public transport use was similar across all the locations, ranging from 1-5%.

Wollongong CBD had a notably lower car mode share for trips ending in the CBD, 78%. However, in the case of the Wollongong CBD the proportion of other modes did not increase significantly as with the origin trips.

All Trips to/from Wollongong or Shellharbour LGA

Overall when considering in the total JTW trips into and out of both LGA's the mode share is summarised in Chart 5. This shows that there is around 90% of total trips made by car (driver or passenger) with 5% of trips made by public transport. The balance of trips to other modes are assumed to be active transport trips (walking and cycling).

Chart 5 2006 JTW: Wollongong and Shellharbour LGA Mode of Travel



Appendix 4O

JTW Local Assessment

APPENDIX 40 - JTW Local Assessment

A more detailed analysis of travel patterns in the Travel Zones (TZ) surrounding the site was undertaken to establish the local travel behaviour already established in similar urban residential and employment areas. The assessment provides a broad overview of the following areas:

- Albion Park (TZ 3662, 3664, 3671).
- Albion Park Rail/Croom (TZ 3655, 3666, 3667, 3652).
- Haywards Bay (TZ 3636).

Mode of Travel

A summary of the results of the mode share analysis is presented in Table 1 and Table 2.

Based on the local travel patterns it is observed that majority of the trips within the local areas are undertaken by car. The remaining modes contain very small percentages compared to the car mode. It can be assumed that the reasoning behind this skewed proportion is due to the large car dependency from the lack of public transport facilities available in the local area and, the nature and distance of the trips.

Table 1 2006 JTW: Calderwood Local Area Origin Travel Patterns

Mode of Travel	Albion Park N (TZ 3662)	Albion Park Central (TZ 3664)	Albion Park S (TZ 3671)	Albion Park Rail NW (TZ 3655)	Albion Park Rail SW/ Croom W (TZ 3666)	Albion Park Rail SE/ Croom E (TZ 3667)	Haywards Bay/ Yallah (TZ 3636)	Albion Park Rail NE (TZ 3652)
Train	3	33	38	12	33	25	0	23
Ferry or Tram	0	0	0	0	3	0	0	0
Bus	5	9	9	0	3	6	4	0
Car as Driver (incl Bus & Motorbike)	240	1,538	1,812	170	1,371	622	212	552
Car as Passenger	13	131	131	12	124	54	14	43
Other Modes	19	54	16	4	50	18	6	21
Sub-Total	**280**	**1,765**	**2,006**	**198**	**1,584**	**725**	**236**	**639**
Not Stated	11	48	35	3	38	15	0	10
Worked at Home/Did not go to Work	53	344	323	30	280	104	48	122
Total	**344**	**2,157**	**2,364**	**231**	**1,902**	**844**	**284**	**771**
% Car Driver/Passenger of Sub-Total	*90.4%*	*94.6%*	*96.9%*	*91.9%*	*94.4%*	*93.2%*	*95.8%*	*93.1%*

Table 2 2006 JTW: Calderwood Local Area Destination Travel Patterns

Mode of Travel	Albion Park N (TZ 3662)	Albion Park Central (TZ 3664)	Albion Park S (TZ 3671)	Albion Park Rail NW (TZ 3655)	Albion Park Rail SW/ Croom W (TZ 3666)	Albion Park Rail SE/ Croom E (TZ 3667)	Haywards Bay/ Yallah (TZ 3636)	Albion Park Rail NE (TZ 3652)
Train	3	33	38	12	33	25	0	23
Ferry or Tram	0	0	0	0	3	0	0	0
Bus	5	9	9	0	3	6	4	0
Car as Driver (incl Bus & Motorbike)	240	1,538	1,812	170	1,371	622	212	552
Car as Passenger	13	131	131	12	124	54	14	43
Other Modes	19	54	16	4	50	18	6	21
Sub-Total	**280**	**1,765**	**2,006**	**198**	**1,584**	**725**	**236**	**639**
Not Stated	11	48	35	3	38	15	0	10
Worked at Home/Did not go to Work	53	344	323	30	280	104	48	122
Total	**344**	**2,157**	**2,364**	**231**	**1,902**	**844**	**284**	**771**
% Car Driver/Passenger of Sub-Total	*90.4%*	*94.6%*	*96.9%*	*91.9%*	*94.4%*	*93.2%*	*95.8%*	*93.1%*

Trips Originating in the Local Area (Workforce Trips)

The mode share is presented graphically in Chart 1 and Chart 2 for trips originating in Calderwood surrounding local areas.

Chart 1 2006 JTW: Calderwood Origin Local Area Travel Patterns – All Modes

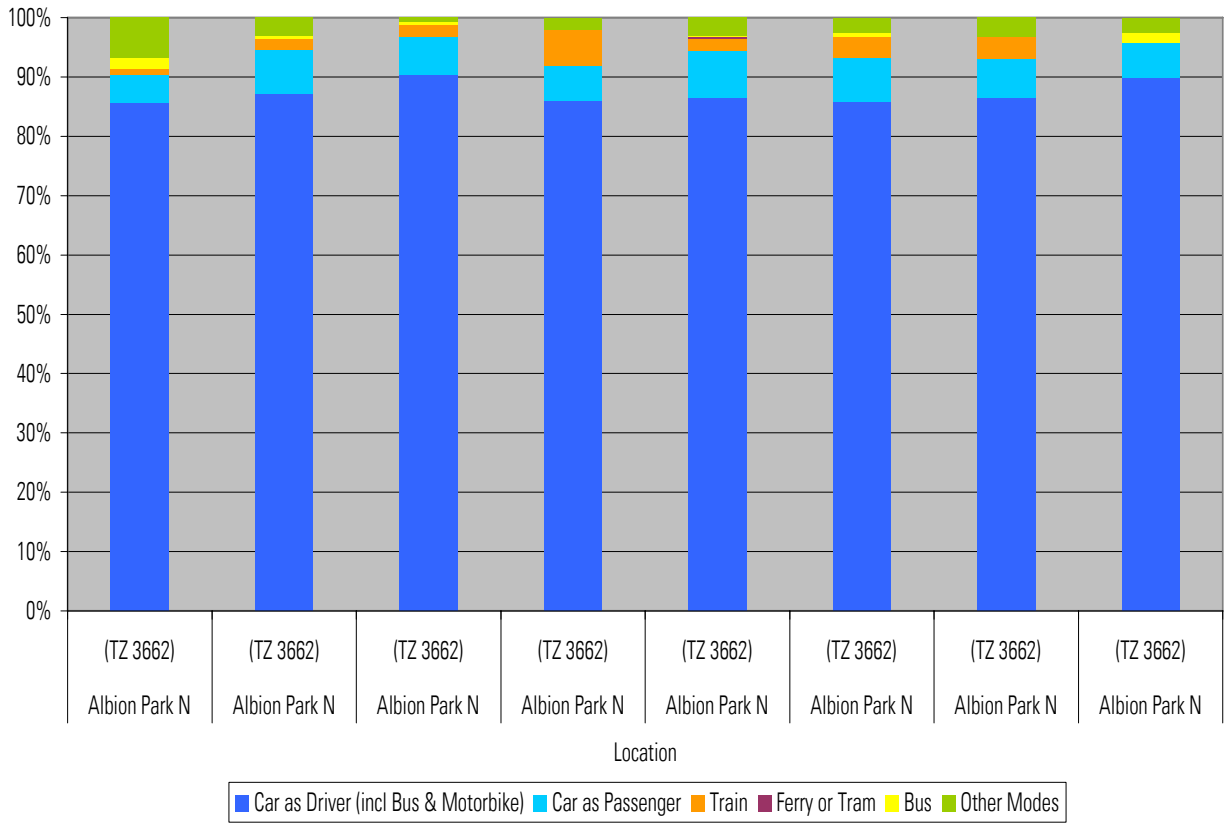
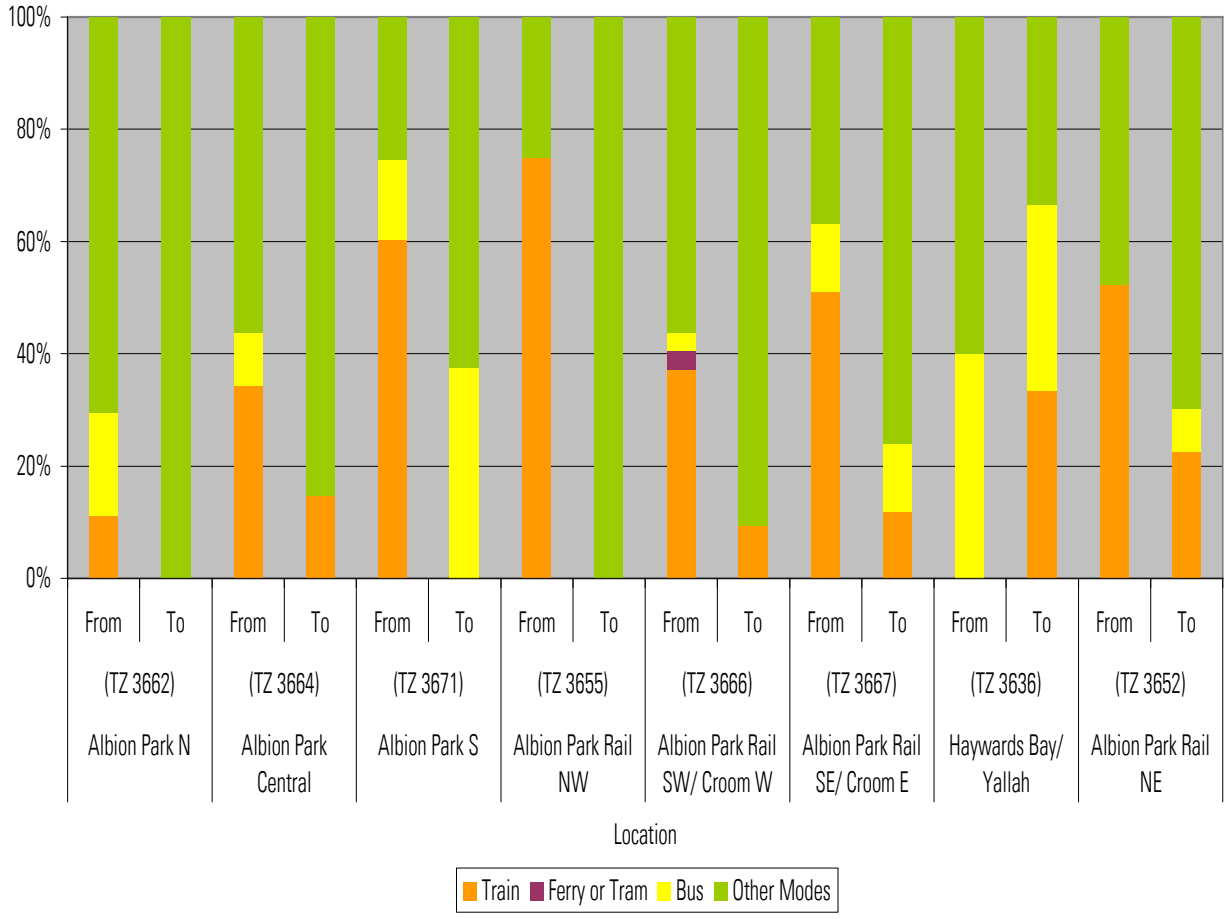


Chart 2 2006 JTW: Calderwood Origin Local Area Travel Patterns – Non-Car Modes



Trips Ending in the Local Area (Employment Trips)

The mode share is presented graphically in Chart 3 and Chart 4 for trips ending in Calderwood surrounding local areas.

Chart 3 2006 JTW: Calderwood Destination Local Area Travel Patterns – All Modes

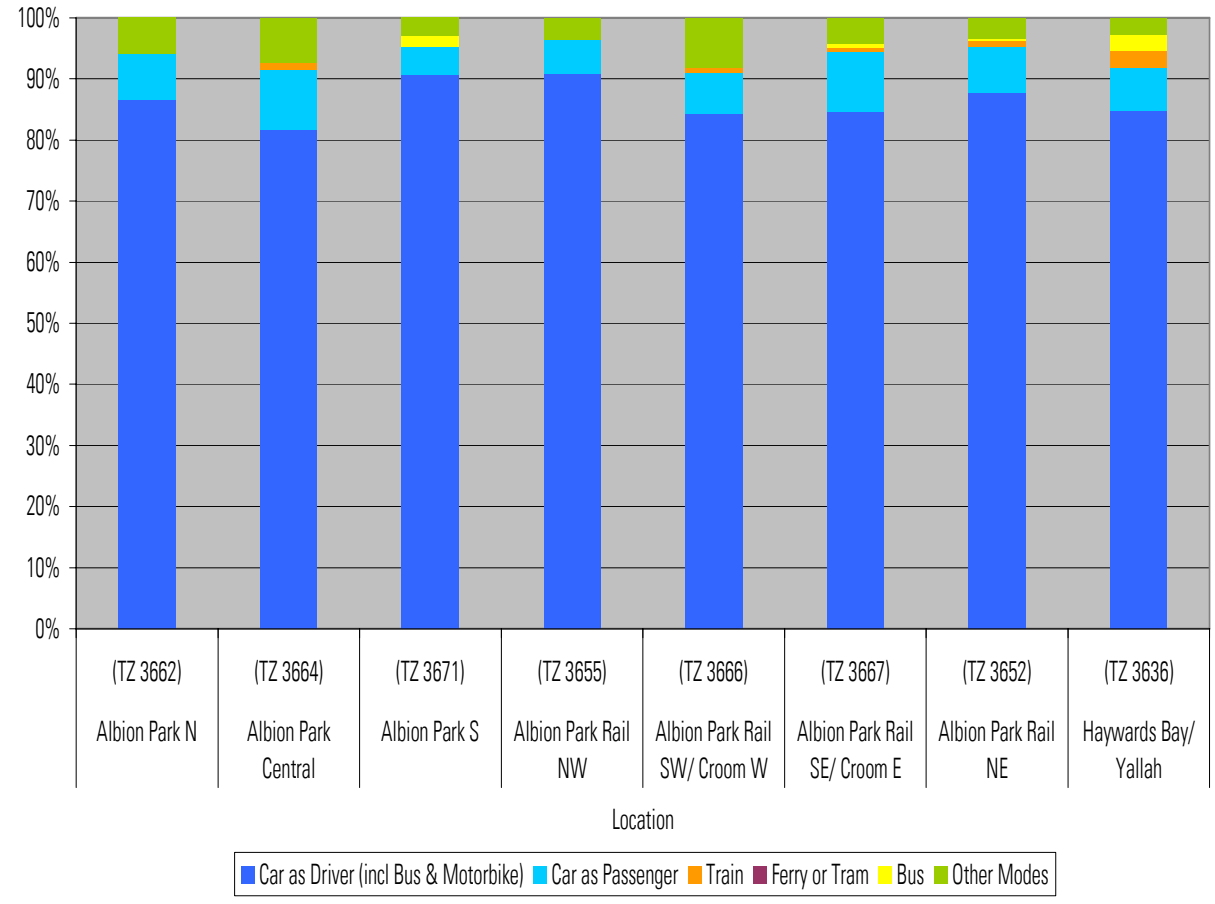
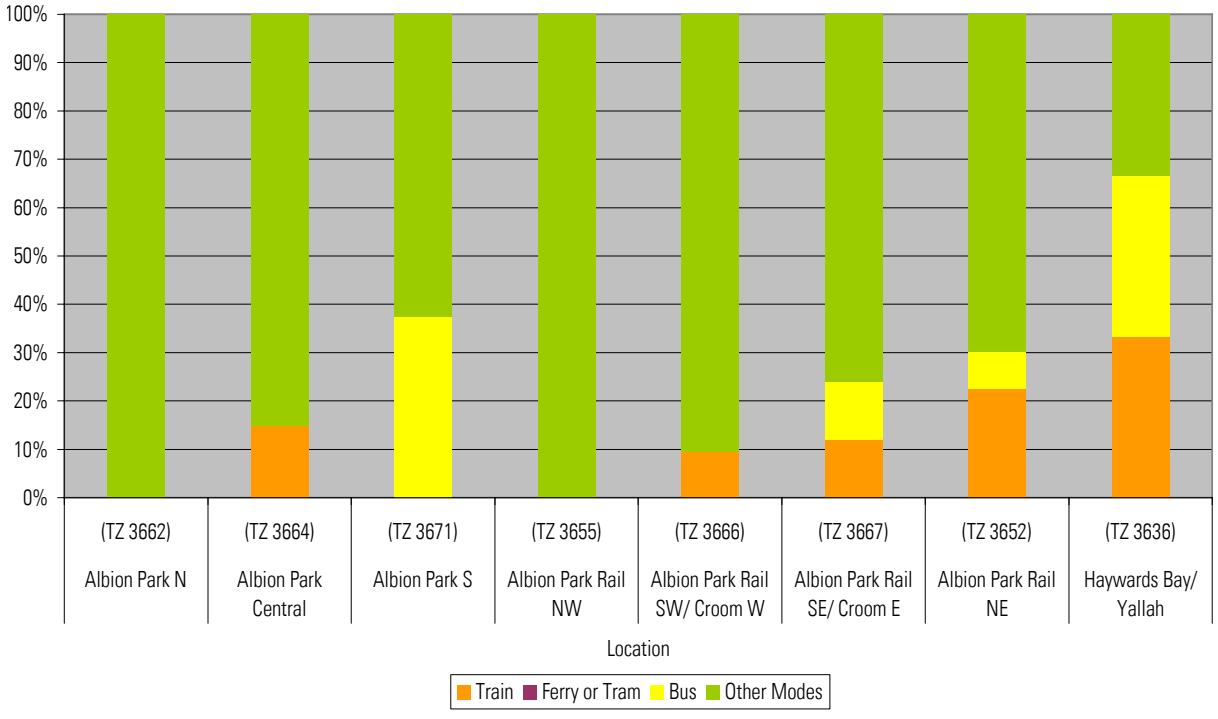


Chart 4 2006 JTW: Calderwood Destination Local Area Travel Patterns – Non-Car Modes



Appendix 5A

Cardno/DLL Review of Regional Planning Assumptions

APPENDIX 5A – CARDNO/DLL TRANSPORT PLANNING ASSUMPTIONS

Proposal	Status/authority	Scope	Timing		Transport Impact	Comment
			Proposed by Authorities	Assumed by DLL		
Approved Projects (assumed to occur prior to 2031)						
Delmo Albion Park	Declared by DoP as a State Significant Site pm 11 July 2008. Concept Approval in Jan 09.	43ha (developable) of employment land 1,650 full time positions when completed	Stage 1 – 18 lots, cut and fill, subdivision works. Stage 2 – creek rehabilitation, no lots Stage 3 – 34 lots, complete creek rehabilitation and riparian buffer Stage 4 – Building construction Stage 5 – 8 lots, creek rehabilitation.	As per proposed	Traffic generation = app 525 vehicles per hour in the AM peak and 602 vehicles per hour in the PM peak. The majority of the traffic would access the site via the Princes Highway, travelling through the Croome Road and Station Street intersections. Based on the comments from the RTA, the final approval contains the following conditions: • Upgrade of the Tongarra Rd/Station St and the Tongarra Rd/Croome Rd intersections in Stage 1 • Redesign site access to include traffic signals at the junction of Tongarra Rd and the site. This will require the proponent to obtain an option to acquire land to facilitate the construction of the intersection. Further consultation with the RTA to address and agree on the site access arrangement is required in Stage 1/Stage 2 of the development.	This Project was recently advertised for sale. The timeframe for commencement is not known. The consent conditions appear to be significant.
Tullimbar	Approved	1978 dwellings	2007/8 to 2024/2025	As per proposed	Steady production rate of 125 lots per annum.	Source: GCC report
Haywards Bay	Approved	318 dwellings	2007/8 to 2012/2013	As per proposed	Steady production rate of c75 lots per annum.	Source: GCC report
Shellharbour Town Centre	Approved	282 dwellings	2007/8 to 2012/2013	As per proposed	Steady production rate of c60 lots per annum.	Source: GCC report
Dapto Town Centre	Approved	The Dapto town centre revitalisation strategy was developed based on the following growth assumptions within Dapto and its surrounding areas: • Population increase from 26,400 in 2006 to 74,000 in 2026 • Additional 50,000m^2 of GFA of employment lands • Job projection from 4,340 in 2001 to 16,390 in 2026	2007 and staged thereafter.	Timing of growth assumptions appear to be aligned to West Dapto. The GCC timing as adopted by WCC indicates that about 23%% of the population increase is likely to occur in the period to 2026 increasing to about 40% by 2036. DLL assumed development of town centre will be proportional to population increase in WDRA. Assuming Stage 1 and 2 only occur, results in 43% of total development: • Additional 21,600m^2 of GFA of employment lands • 5200 additional jobs	The Dapto Town Centre Access and Movement Strategy commissioned by Council to identify the necessary upgrades to the existing road network and transport system suggested the following necessary changes: • Signalisation of Princes Highway/Jerrematta Street intersection • Provision of a short right turn lane on the Princes Highway (south) at the Moombara Street/Princes Highway intersection • Left in/left out at the intersection of MacCabe Street and Princes Highway • Left in/left out at Yorshire Road and Fowlers Road • New connection extending Moombara Street (at Princes Highway) through to Station Street (near Bong Bong Road) towards the west of the town centre • New north south link between Fowlers Road to Byamee Street though the Dapto Dogs site; • Signalisation of Moombara/Princes Highway intersection; • Roundabout at new road and Marshall Street; • Investigate signals Fowlers Road/Heininger Street; • Roundabout at new north south link and Byamee Street; • Bong Bong Road to be investigated as a shared zone; • Princes Highway to be implemented as a main street between Moombara Street and Baan Baan Street. • Implement Fowlers Road extension to West Dapto • Consider closure of Marshall Street as a result of the Fowlers Road extension. • Retain accessibility across Bong Bong Road for vital connections between West Dapto and the town centre.	Population growth prorated to GCC assumed stages and timing.
Shell Cove	Approved	1,135	2007/8 to 2015/16	As per proposed	Production shown at 195 per annum for 2007/08 to 2008/09 inclusive with ongoing production rate of 100 lots per annum thereafter.	Source: GCC report

Proposal	Status/authority	Scope	Timing		Transport Impact	Comment
			Proposed by Authorities	Assumed by DLL		
Proposed Projects (assumed to occur prior to 2031)						
West Dapto *Stage 1 – Kembla Grange Employment Land*	GCC Report Dec 08 recommended this Employment Land proceed; adopted by WCC 16 Dec 08	175 of employment land	2010/11	As per proposed	GCC review of the potential traffic impact based on a revised lot yield of 16,000 (previously 19,000) and covered the proposed WDRA, Yallah/Marshall Mount and Calderwood areas.	Need to clarify gross site; net developable area
West Dapto *Stage 1 - Sheaffes/ Wongawilli*	GCC report Dec 98 recommended Stage 1 proceed; adopted by WCC 16 Dec 08	3,617	2011/12 to 2026/27	As per proposed	Strategy for delivery of a package of works with 7 key upgrades totalling $78.5m for stages 1 and 2 of West Dapto endorsed by WCC on 27th October 2009 for inclusion in capital works planning process and Section 94 Contributions Plan.	
West Dapto *Stage 2 – West Horsley*	GCC report Dec 08 recommended Stage 2 proceed; adopted by WCC 16 Dec 08	2,496	2016/17 to 2036/37	As per proposed	Strategy for delivery of a package of works with 7 key upgrades totalling $78.5m for stages 1 and 2 of West Dapto endorsed by WCC on 27th October 2009 for inclusion in capital works planning process and Section 94 Contributions Plan.	
Tallawarra	The rezoning proposal was revised by WCC Jun 09 to remove part of the residential areas from 130ha in the original rezoning proposal to 80ha.	Est. 1,000	Next 5 years	As per proposed	RTA has requested the following upgrade in the future development: • North facing ramps for the Southern Freeway • Major intersection upgrades on the Princes Highway	
Illawarra International Health Precinct	Part 3A application lodged to DoP Jun 09. Applicant currently reviewing submissions.	100,000m^2 (net) floor area of medical and associated services.	8 stages 1 – c2011 to c 2022	As per proposed	No major upgrade to existing road network is proposed. The development is likely to impact on: • the intersection of Princes Highway and Huntley Road • the intersection of Princes Highway and Fowlers Road These intersections currently experience congestion regardless of the traffic generated by proposed development or other developments in the area.	
Avondale Golf Course	Rezoning application has been lodged to allow residential development on the golf course land.	21 rural res; 491 residential lots	Under consideration by Council	Not known assumed <2031	To be determined.	
Calderwood DLL	• 16/4/09 – Minister declared State Significant Site • 6/05/09 – Planning Focus Meeting • 1/06/09 – DGR issued	4,800 dwellings	2011-2028 (GCC Report)	2011-2031	**GCC Report Table 3.7.6 – Yallah/Marshall Mount and Calderwood Infrastructure Requirements identified the following list of works for the entire Calderwood Release Area and the Yallah/Marshall Mount Precinct:** YM Mount Haywards Bay Drive Bridge widening1 Calderwood Illawarra Highway widening (Broughton Road to Terry Street) Calderwood Tongarra Road widening (Terry to Princes Highway) Calderwood Upgrade Yallah Rd/F6 Freeway interchange Calderwood Albion Park station interchange upgrade	
Yallah Marshall Mount	Deferred by WCC Dec 08 based on GCC's recommendations. Subsequently decided on 26/5/09 to abandon the draft planning controls for the precinct in the draft West Dapto LEP. Revised draft planning controls will be proposed.	Estimates vary from 1,300 or 3,000	2041 (GCC Report) Indeterminate for revised proposal.	As per proposed	See comment above re GCC assessment.	
Proposed Projects Not Included as outside timeframe						
West Dapto *Stage 3 – Cleveland*	Deferred by WCC Dec 08 based on GCC's recommendations.	3,926	2027/28 to 2051/51	Post 2031	Not known.	
West Dapto *Stage 4 – Avondale*	Deferred by WCC Dec 08 based on GCC's recommendations.	4,162	2034/35 to 2051/52 and beyond	Post 2031		
Balance of Calderwood	Identified MDP, IRS as future urban area	3,000	2029 – 2040/41	Post 2031	See comment above re GCC assessment.	

Appendix 5B

DoP/RTA DLL Review of Regional Planning Assumptions

APPENDIX 5B – DOP/RTA LAND USE INPUTS

Release Area/Project	2011	2021	2036
West Dapto	160 lots Assumes: - Stage 1 = 100 lots + - Stage 2 = 60lots	3410 lots (160 + 3250) Assumes: - ramp up to 250 lots p/a in Stage 1 + - 60 lots p/a in Stage 2 + - 50 lots p/a in Marshall Mount from 2013	8890 lots (3410 + 5480) Assumes: - Ramping down in Stage 1 + - Ramping up in Stage 2 + - Commencing of Stage 3 (late in timeframe) + - 50 lots p/a in Marshall Mount
Calderwood	-	2300 lots Assumes: - Ramping up from 100/200 lots in 2011/2012 to 250 lots p/a	6050 lots (2300 + 3750) Assumes: - 250 lots p/a (from p8 of Delfin's justification report)
Tallawarra	-	700 lots Assumes: - 70 lots p/a from 2011	
Huntley Heritage	-	Golf course, tourist facility + 400 lots Assumes: - 50 lots p/a from 2013 until finished	
Illawarra Health Precinct (refer to Environmental Assessment for details)	Specialists centre and pathology/radiology units	24 hr medical centre, obstetrics unit, hospital, retail centre, nurses accommodation, education facility, aged and disability centres, seniors accommodation.	
Illawarra Employment and teaching Centre (refer to project application for details)	-	Teaching/conference facilities, accommodation, workshops (total floor spaces of 320,00m^2)	
Increased residential densities around Dapto town centre	-	Gradual increase in densities up to 6 storeys and up to 1.5:1 FSR	

Appendix 5C

Cardno/DLL vs DoP/RTA Review of Regional Planning Assumptions

APPENDIX 5C – CARDNO/DLL – DOP/RTA PLANNING ASSUMPTION COMPARISON

Proposal	Development by 2031			Comment
	Cardno/DLL	DoP/RTA	Assumed for Modelling	
Approved Projects (assumed to occur prior to 2031)				
Delmo Albion Park	1650 jobs	-	1650 jobs	As per DGR's
Tullimbar	1978 jobs	-	1978 jobs	As per GCC report
Haywards Bay	318 dwellings	-	318 dwellings	As per GCC report
Shellharbour Town Centre	282 dwellings	-	282 dwellings	As per GCC report
Dapto Town Centre	5200 jobs + 21,600 sqm employment	Gradual increase in densities up to 6 storeys and up to 1.5:1 FSR	5200 jobs + 21,600 sqm employment	Refer to note below
Shell Cove	1135 dwellings	-	1135 dwellings	As per GCC report
Proposed Projects (assumed to occur prior to 2031)				
West Dapto *Stage 1 – Kembla Grange Employment Land*	175 Ha employment land	-	175 Ha employment land	As per GCC report
West Dapto *Stage 1 - Sheaffes/ Wongawilli*	3617 dwellings	3667 dwellings	3667 dwellings	RTA/DOP figure used
West Dapto *Stage 2 – West Horsley*	2496 dwellings	2496 dwellings	2496 dwellings	RTA/DOP figure used
Tallawarra	1000 dwellings	700 dwellings	700 dwellings	RTA/DOP figure used
Illawarra International Health Precinct	100,000sqm as per EA	Non-specific (refer to EA)	100,000sqm as per EA	EA figure used
Avondale Golf Course/ Huntley Heritage	21 rural residential lots + 491 dwellings	Golf course, tourist facility + 400 lots	Golf course, tourist facility + 400 lots	RTA/DOP figure used
Calderwood DLL	4,800 dwellings	4,800 dwellings	4,800 dwellings	Agree
Yallah Marshall Mount	1300-3000 dwellings	900 dwellings	900 dwellings	RTA/DOP figure used

Note:
Dapto Town Centre development assumed to develop in proportion with WDRA development proportion.
In 2031 assume Stage 1 and 2 have developed i.e. 6113 of potential 14,165 lots – hence 43%.
At full development DTC assumed to have additional 50,000sqm employment land plus 12,050 jobs.
Hence by 2031 - 21,600sqm employment land plus 5,200 jobs.

Appendix 5D

Description of Base Future Road Network Upgrade Works

APPENDIX 5D - Description of Base Future Road Network Upgrade Works

F6 FREEWAY EXTENSION

This project involves the extension of the F6 Freeway from its present terminus at Tallawarra interchange (Princes Highway) to the Oak Flats interchange, bypassing the section of Princes Highway through Yallah and Albion Park Rail.

The following assumptions have been made regarding the layout of this project in the absence of official advice from the RTA:

- Two-lanes in each direction on a dual, grade-separated carriageways.
- A north-facing connection to the existing Princes Highway/Southern Freeway interchange with access available to/from Princes Highway (north) and the Southern Freeway.
- No access at Yallah Road or Illawarra Highway.
- Extension of Tripoli Way from Illawarra Highway to Tongarra Road as a four-lane, divided carriageway.
- An elevated roundabout interchange at the extension of Tripoli Way.
- No access at Tongarra Road.
- East-facing ramps at Croome Road.
- Absorption of the present East West Route into the freeway.
- No access at Woollybutt Drive or Colden Drive/quarry access.
- The existing approaches from East West Route to the Oak Flats interchange become on and off ramps from the freeway.
- A direct connection from the freeway to Princes Highway (east), beneath the roundabout.
- Removal of the existing direct connection between Princes Highway (east) and Princes Highway (west) and re-routing of all traffic to/from Princes Highway (west) through the roundabout.

The F6 freeway extension would accommodate a significant proportion of strategic through trips travelling between origins and destinations to the north and south of the new road infrastructure. Traffic demands for the extension would compose the following trip types:

- Generated traffic (consists of diverted trips shifted in time, route and destination).
- Induced traffic (shifts from other modes, longer trips and new vehicle trips). These trips are accounted for in modelling assessments by the inclusion of strategic through traffic growth and new trips from the increasing intensification over time of land use developments in the surrounding area. It is recognised that the effects of induced traffic are limited due to existing road network constraints at the terminal ends of the freeway extension.

In order to gain the maximum benefit of the freeway on the existing roads which its bypasses complimentary measure would need to be installed to prevent induced traffic using up the resultant spare capacity created by trips that have diverted to the new freeway. Such measure would typically include roadspace reallocation (conversion of through traffic lanes to bus/parking lanes etc) to reduce through traffic capacity, installation of local area traffic management measures and reductions of road speed limits to control vehicle speeds thereby enabling the installation of improved pedestrian/cyclist facilities and the retiming/re-phasing of traffic signals to reduce through journey times.

For modelling purposes it has been assumed that the Princes Highway between the northern and southern extents of the F6 freeway extension will be treated with complimentary measures to restrict through traffic movements and to encourage traffic to transfer to the strategic road network.

TRIPOLI WAY

Tripoli Way, also known as the Albion Park Bypass, is expected to be constructed by 2020 as per the Albion Park Traffic Study.

This project involves the provision of a two-lane undivided carriageway along the Tripoli Way alignment between Illawarra Highway/Broughton Avenue intersection and the Illawarra Highway north of Taylor Road. The intersections with Illawarra Highway/Broughton Avenue, Calderwood Road and Hamilton Avenue are assumed to be one-lane roundabouts. The intersection with Illawarra Highway (east) is assumed to be signalised. As part of the F6 Extension project, Tripoli Way would be extended east from Illawarra Highway to Tongarra Road as a four-lane divided carriageway.

As identified above in section 0 for modelling purposes it has been assumed that complimentary measures will be installed along the section of the Tongarra Road / Illawara Highway which will be bypassed by the upgraded Tripoli Way.

TALLAWARRA INTERCHANGE NORTH-FACING RAMPS

This project involves the provision of north-facing ramps at the existing Princes Highway/Southern Freeway interchange at Tallawarra. Due to the steep grade immediately north of the interchange, it has been assumed that the new ramps will be provided in a folded diamond arrangement – i.e. a northbound on-ramp running parallel to the existing northbound off-ramp before entering a hairpin bend to turn northwards; and a southbound off-ramp forming a new western leg at the intersection of Princes Highway and Yallah Bay Road.

MARSHALL MOUNT ROAD AND YALLAH ROAD

As discussed in Section 5.3.2, the emergent urbanisation of the land uses surrounding both Marshall Mount Road and Yallah Road will intensify traffic movements along both of these roads. Sub regional planning undertaken to date and structure planning has also identified the need to upgrade the inadequacies of the existing road infrastructure (narrow two way road widths providing no delineation, minimal road signage and shoulders) to provide access for the planned land use changes.

It is considered that fundamentally for the development of the Yallah Marshall Mount Environmental Precinct an upgrade of these roads to provide adequately sized and delineated traffic lanes with appropriate edge treatments and road side hazard protective measures would need to be implemented.

Traffic from the CUDP whilst not fundamentally requiring use of these roads (subject to the provision of additional road capacity through the F6 Freeway extension and Tripoli Way upgrades) could also potentially make use of the upgraded road network as a local access route between the CUDP and both Dapto and northbound connection to the F6 Freeway Extension.

Appendix 5E

Future CUDP Road Network

APPENDIX 5E - Future CUDP Road Network

Key assumptions/description of CUDP internal road network:

- A north-south sub-arterial road providing two lane two way traffic operation (ie one traffic lane in each direction) through the precinct forming the main precinct spine road. The sub-arterial road would accommodate bus movements and be designed for an 80 km/h design speed but carry a posted 60 kph speed limit. Due to the sub-arterial function it would be desirable to limit direct access from it and also limit the number of intersection along its length to permit the free flow of traffic. Carriageway edge friction (from parking movements) along its length should be minimised except in the town centre area where a concentration of on-street parking opportunities may be desirable.
- Major collector Roads would form the links between the sub arterial road and minor collector roads. These roads would be two lane two-way (ie one traffic lane in each direction) and would also carry bus movements and provide a lower speed environment (50kph or lower would be desirable). The lower speed environment would also be reinforced through design features in the horizontal and geometric design, and the use of roundabouts at four way intersections.
- Minor collector Roads would form the lowest level of road within the hierarchy and would provide direct access opportunities to individual dwellings. Roads would ideally be subject to 40kph speed limits reinforced through appropriate horizontal and vertical design and intersection control strategy.

The road network and its internal intersections would be designed to accommodate the largest anticipated vehicle types required to serve the retail, commercial and industrial uses within the precinct.

External connections between the CUDP internal road network and the existing/planned road network are as follows:

- A connection from the north-south sub arterial road to the existing Marshall Mount Road at its northernmost section is proposed. Such an intersection form would provide an appropriate gateway feature for entry/exit movements to the precinct. A three arm roundabout is assessed such that the major collector road forming the CUDP north-western boundary can tie into the north-south sub arterial/Marshall Mount Road.
- The southern end of the north-south sub arterial road would connect to the external road network via a four arm roundabout at the location of the existing Illawarra Highway /Yellow Rock Road priority controlled intersection. A roundabout is considered an appropriate form of intersection control at this location due to consistency of intersection types along the Illawarra Highway, its ability to act as a speed control device for through traffic and to provide adequate capacity and safety performance.
- A minor collector road would connect to the Illawarra Highway at the eastern end of the southern CUDP frontage as a fourth (northern arm) to the existing Illawarra Highway / Broughton Avenue roundabout.
- At the western edge of the CUDP southern frontage two priority controlled intersections would be provided to connect the minor and major collector roads to the Illawarra Highway. The major collector road would connect where North Macquarie Road currently connects. These intersection types would provide appropriate capacity to serve the lower traffic volumes on both the CUDP internal road network and the Illawarra Highway at this location.
- Calderwood Road provides an existing east-west route through the CUDP. It is proposed to upgrade and re-align the extent of the road within the internal CUDP internal road network to a major/minor collector road. Its outward eastward connection to the external road network will therefore similarly need to be upgraded from its current rural narrow non-delineated state to one appropriate to its functional role within the road hierarchy. To the west of the site Calderwood Road will be retained in it s current form.
- Access to North Marshall Mount Road will remain off Marshall Mount Road.

Based upon the CUDP internal road network hierarchy and for modelling purposes a series of assumptions were made as to the intersection control strategy to be adopted within the precinct as follows:

- Town centre sub arterial road – major collector road intersections – due to the concentration of activities within the town centre housing, retail, commercial) and the consequent focus of traffic, pedestrian and bus movements it is considered that traffic signal controlled four way intersections would be appropriate intersection controls.
- Intersections of sub-arterial road and major collector roads - where four arm intersections are proposed as part of the road hierarchy plan these should be controlled by roundabout for speed reduction and operational reasons.
- Intersections of sub-arterial road and minor collector roads - where four arm intersections are proposed as part of the road hierarchy plan these should be controlled by roundabout for speed reduction and operational reasons and three arm intersections priority control considered adequate on capacity grounds.
- Intersections of major collector roads and minor collector roads - where four arm intersections are proposed as part of the road hierarchy plan these should be controlled by roundabout for three arm intersections priority control considered adequate on capacity grounds.

Appendix 6A

Modelling Methodology

APPENDIX 6A - Modelling Methodology

MODELLING METHODOLOGY OVERVIEW

To accord with Director General's requirements for land use/road infrastructure assessment the WOLSH TRACKS strategic traffic model was made available for study purposes by the RTA and Wollongong Council.

The TRACKS model provides a representation of the regional, state and local road network and provides forecast traffic demands over the combined LGA areas. The use of the TRACKS traffic model is Council and the RTA's preferred assessment tool to undertake assessments of infrastructure requirements necessary to support land use changes.

Different combinations of land use and road network assumptions are used as input to the 2031 TRACKS model to generate, distribute and assign traffic movements within the model area and provide outputs resolved to intersection turning movement level. These intersection turning movements can then be more accurately modelled in the SIDRA intersection modelling software which enables assessment of isolated intersections performance using NSW RTA level of service criteria under a given set of traffic demands.

Subsequent modelling iterations allow the formulation of appropriate intersection configurations/controls to achieve the desired level of intersection performance. Comparisons of 'with' and 'without' CUDP transport demands for comparable road network options allow the impact upon operational performance of road links and intersections to be made for cost allocation purposes.

AREA OF INFLUENCE

For modelling purposes, it has been agreed with the RTA the extent of the road network over which the transport demands associated with the CUDP should be assessed. Described as the 'area of influence' the extent of road network is detailed in Section **Error! Reference source not found.**. This area is considered to represent all the road sections and key intersections over which development related transport impacts need to be assessed.

MODEL DEVELOPMENT

2009 BASE MODEL DEVELOPMENT AND CALIBRATION

The 2006 TRACKS model supplied by Wollongong Council contains a 550 zone network and land use data set. To reflect current traffic conditions and provide the model extents within the area of influence, the model was recalibrated using current (2009) traffic counts within the area of influence. The resultant appropriately calibrated model provides a satisfactory base for future assessments. Details relating to the model calibration process and results are provided below.

The 2009 model was developed by comparing 2009 traffic count data with the 2006 base year model to ensure that the base case model is adequately replicating current observed traffic flows on the network in the agreed area of influence. Iterative changes were made to the 2006 model until a good level of calibration was achieved. These changes included modifying intersection characteristics to correspond with actual network conditions, as well as changing link types to more accurately model road characteristics and corresponding traffic volumes. A summary table of the comparison of observed versus modelled flows is provided in Table 1 and Table 2 for the AM and PM peak periods respectively.

Table 1 AM Peak Observed versus Modelled Flow Comparison

Intersection	Approach	Movement	2009 TRACKS (Modelled)	2009 Count (Observed)	GEH
Princes Highway / Tongarra Road	Princes Highway (S)	Left	388	279	6.0
		Through	1227	1256	0.8
	Princes Highway (N)	Through	1138	1217	2.3
		Right	74	77	0.3
	Tongarra Road (W)	Left	122	11	4.5
		Right	404	368	1.8
Princes Highway / Illawarra Highway	Princes Highway (S)	Left	0	50	10.0
		Through	1712	1659	1.3
	Princes Highway (N)	Through	1428	1622	5.0
		Right	504	377	6.1
	Illawarra Highway (W)	Left	957	915	1.4
		Right	27	45	3.0
Princes Highway / Yallah Road Off-ramp	Princes Highway (S)	Left	69	84	1.7
		Through	2602	2555	0.9
	Princes Highway (N)	Through	1894	2006	2.5
Yallah Road / Princes Highway On-ramp	Yallah Road (S)	Left	38	32	1.0
		Through	27	77	6.9
	Yallah Road (W)	Left	8	30	5.0
		Right	21	31	2.0
Princes Highway / Huntley Road	Princes Highway (S)	Left	111	34	9.0
		Through	681	457	9.4
	Princes Highway (N)	Through	401	507	5.0
		Right	68	59	1.1
	Huntley Road (W)	Left	73	83	1.1
		Right	100	64	4.0
Tongarra Road / Station Road	Tongarra Road (E)	Through	338	301	2.1
		Right	15	69	8.3
	Tongarra Road (W)	Left	163	135	2.3
		Through	322	365	2.3
	Station Road (N)	Left	28	59	4.7
		Right	118	95	2.2
Tongarra Road / Illawarra Highway / Terry Street	Tongarra Road (E)	Left	184	108	6.3
		Through	214	345	7.8
	Illawarra Highway (W)	Left	77	258	1.1
		Through	232	314	5.0
	Illawarra Highway (N)	Left	10	40	6.0
		Through	302	163	9.1
		Right	86	162	6.8
	Terry Street (S)	Left	77	40	4.8
		Through	674	612	2.4
		Right	152	194	3.2

Intersection	Approach	Movement	2009 TRACKS (Modelled)	2009 Count (Observed)	GEH
Illawarra Highway / Calderwood Road	Illawarra Highway (E)	Left	0	49	9.9
		Through	245	295	3.0
		Right	55	84	3.5
	Illawarra Highway (W)	Left	13	52	6.8
		Through	286	415	6.9
		Right	0	15	5.5
	Calderwood Road (N)	Left	32	76	6.0
		Through	1	16	5.1
		Right	10	41	6.1
	Calderwood Road (S)	Left	1	15	4.9
		Through	1	6	2.7
		Right	0	35	8.4
Illawarra Highway / Broughton Ave	Illawarra Highway (E)	Left	30	70	5.7
		Through	85	135	4.8
	Illawarra Highway (W)	Through	75	171	8.7
		Right	0	2	2.0
	Broughton Avenue (S)	Left	1	1	0.0
		Right	46	58	1.7
Illawarra Highway / Yellow Rock Road	Illawarra Highway (E)	Left	0	18	6.0
		Through	86	118	3.2
	Illawarra Highway (W)	Through	75	131	5.5
		Right	0	0	-
	Yellow Rock Road (S)	Left	0	5	3.2
		Right	0	42	9.2
Illawarra Highway / North Macquarie Road	Illawarra Highway (E)	Through	86	112	2.6
		Right	0	3	2.4
	Illawarra Highway (W)	Left	4	6	0.9
		Through	75	120	4.6
	North Macquarie Road (N)	Left	0	8	4.0
		Right	1	1	0.0
Calderwood Road / North Macquarie Road	Calderwood Road (E)	Left	0	2	2.0
		Through	73	97	2.6
	Calderwood Road (W)	Through	47	65	2.4
		Right	1	4	1.9
	North Macquarie Road (S)	Left	4	11	2.6
		Right	0	4	2.8
Calderwood Road / Marshall Mount Road	Calderwood Road (E)	Through	43	5	7.8
		Right	38	29	1.6
	Calderwood Road (W)	Left	30	7	5.3
		Through	26	20	1.3
	North Macquarie Road (N)	Left	23	24	0.2
		Right	30	12	3.9
Huntley Road / Marshall Mount Road	Huntley Road (E)	Left	67	48	2.5
		Through	112	47	7.3
	Huntley Road (W)	Through	109	120	1.0
		Right	6	3	1.4
	Marshall Mount Road (S)	Left	4	4	0.0
		Right	64	26	5.7

Table 2 PM Peak Observed versus Modelled Flow Comparison

Intersection	Approach	Movement	2009 TRACKS (Modelled)	2009 Count (Observed)	GEH
Princes Highway / Tongarra Road	Princes Highway (S)	Left	463	324	7.0
		Through	858	1141	9.0
	Princes Highway (N)	Through	1492	1496	0.1
		Right	135	142	0.6
	Tongarra Road (W)	Left	77	71	0.7
		Right	424	337	4.5
Princes Highway / Illawarra Highway	Princes Highway (S)	Left	0	40	8.9
		Through	1231	1261	0.8
	Princes Highway (N)	Through	1921	1980	1.3
		Right	1006	803	6.7
	Illawarra Highway (W)	Left	548	421	5.8
		Right	20	38	3.3
Princes Highway / Yallah Road Off-ramp	Princes Highway (S)	Left	46	49	0.4
		Through	1733	1694	0.9
	Princes Highway (N)	Through	2847	2687	3.0
Yallah Road / Princes Highway On-ramp	Yallah Road (S)	Left	24	33	1.7
		Through	33	41	1.3
	Yallah Road (W)	Left	18	14	1.0
		Right	39	20	3.5
Princes Highway / Huntley Road	Princes Highway (S)	Left	116	36	9.2
		Through	597	159	6.0
	Princes Highway (N)	Through	613	525	3.7
		Right	80	24	7.8
	Huntley Road (W)	Left	70	48	2.9
		Right	129	32	10.8
Tongarra Road / Station Road	Tongarra Road (E)	Through	392	415	1.1
		Right	9	31	4.9
	Tongarra Road (W)	Left	101	86	1.6
		Through	365	315	2.7
	Station Road (N)	Left	47	75	3.6
		Right	208	96	9.1
Tongarra Road / Illawarra Highway / Terry Street	Tongarra Road (E)	Left	181	155	2.0
		Through	311	339	1.6
	Illawarra Highway (W)	Left	188	157	2.4
		Through	302	283	1.1
	Illawarra Highway (N)	Left	13	25	2.8
		Through	599	530	2.9
		Right	279	315	2.1
	Terry Street (S)	Left	42	50	1.2
		Through	315	252	3.7
		Right	132	238	7.8

Intersection	Approach	Movement	2009 TRACKS (Modelled)	2009 Count (Observed)	GEH
Illawarra Highway / Calderwood Road	Illawarra Highway (E)	Left	0	30	7.7
		Through	357	332	1.3
		Right	38	56	2.6
	Illawarra Highway (W)	Left	11	11	0.0
		Through	303	297	0.3
		Right	0	3	2.4
	Calderwood Road (N)	Left	55	55	0.0
		Through	1	5	2.3
		Right	14	41	5.1
	Calderwood Road (S)	Left	1	17	5.3
		Through	0	4	2.8
		Right	0	31	7.9
Illawarra Highway / Broughton Ave	Illawarra Highway (E)	Left	55	6	8.9
		Through	115	139	2.1
	Illawarra Highway (W)	Through	122	171	4.0
		Right	2	1	0.8
	Broughton Avenue (S)	Left	1	1	0.0
		Right	34	4	6.9
Illawarra Highway / Yellow Rock Road	Illawarra Highway (E)	Left	0	9	4.2
		Through	115	131	1.4
	Illawarra Highway (W)	Through	123	169	3.8
		Right	0	4	2.8
	Yellow Rock Road (S)	Left	0	0	-
		Right	0	10	4.5
Illawarra Highway / North Macquarie Road	Illawarra Highway (E)	Through	115	101	1.3
		Right	0	6	3.5
	Illawarra Highway (W)	Left	1	5	2.3
		Through	123	159	3.0
	North Macquarie Road (N)	Left	5	3	2.4
		Right	0	3	1.0
Calderwood Road / North Macquarie Road	Calderwood Road (E)	Left	0	12	4.9
		Through	55	21	5.5
	Calderwood Road (W)	Through	77	38	5.1
		Right	5	1	2.3
	North Macquarie Road (S)	Left	1	2	0.8
		Right	0	12	4.9
Calderwood Road / Marshall Mount Road	Calderwood Road (E)	Through	29	13	3.5
		Right	24	15	2.0
	Calderwood Road (W)	Left	33	4	6.7
		Through	49	14	6.2
	North Macquarie Road (N)	Left	34	12	5.6
		Right	41	4	6.9
Huntley Road / Marshall Mount Road	Huntley Road (E)	Left	79	17	8.9
		Through	117	58	6.3
	Huntley Road (W)	Through	139	56	8.4
		Right	5	11	2.1
	Marshall Mount Road (S)	Left	6	5	0.4
		Right	60	26	5.8

The **GEH Statistic** is a formula used in traffic engineering, traffic forecasting, and traffic modelling to compare two sets of traffic volumes. It is an empirical formula that has proven useful for a variety of traffic analysis purposes.

The formula for the "GEH Statistic" is:

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

Where M is the hourly traffic volume from the traffic model (or new count) and C is the real-world hourly traffic count (or the old count).

The use of GEH as an acceptance criterion for travel demand forecasting models is recognised in the UK Highways Agency's *Design Manual for Roads and Bridges* (DMRB), Volume 12, Section 2, and in other references.

For traffic modelling work in the "baseline" scenario, a GEH of less than 5.0 is considered a good match between the modelled and observed hourly volumes (flows of longer or shorter durations should be converted to hourly equivalents to use these thresholds). According to DMRB, 85% of the volumes in a traffic model should have a GEH less than 5.0. GEHs in the range of 5.0 to 10.0 may warrant investigation. If the GEH is greater than 10.0, there is a high probability that there is a problem with either the travel demand model or the data (this could be something as simple as a data entry error, or as complicated as a serious model calibration problem).

Table 1 and Table 2 show that there is a good correlation between the observed traffic flows and the 2009 base case model and the model is therefore suitable for further testing of the proposed development. It should be noted that the correlation did not achieve a GEH of less than 5.0 for 85% of the volumes; however the model is primarily strategic in nature, covering the whole of the Wollongong and Shellharbour. It therefore uses generation rates and distribution parameters that are averages for the entire region. It is therefore unlikely that traffic flows and patterns in a specific area will be replicated precisely. Additionally, the strategic nature of the model means that traffic is generated and loaded on to the network from traffic zones at the CCD level. This can mean 100-200 households can be loaded on to the network at one or two points. Furthermore, strategic models are generally calibrated to mid-block daily counts and at times to peak hour counts. To have 98% of turning movements calibrated to a GEH of 10 or less and 62% of turning movements calibrated to a GEH of 5 or less and 98% of turning movements calibrated to a GEH of 10 or less and 69% of turning movements calibrated to a GEH of 5 or less for the AM peak and PM peak, respectively, is a good result for the calibration of a strategic model

2031 BASE MODEL

The 2031 design year represents a 20 year construction period for the CUDP. The 2031 CUDP model was developed to reflect likely transport conditions at the development completion time. The 2031 Base model was developed to assess background traffic without the CUDP.

Two models were initially provided by the Council's as follows:

- A 550 zone 2006 model
- A 470 zone 2026 model

The two above models were developed separately over time. The traffic demands from the 2026 470 zone model were used in conjunction with the 2006 550 zone traffic model structure (modelled road network and land use patterns). This provided a 2026 550 zone model.

Traffic growth factors calculated from the difference between the 2006 and 2026 models were incorporated into the 2026 model to derive the 2031 model for assessment purposes. Additionally, the agreed regional developments growth, infill growth and external background growth (described in section 5.2 above) were incorporated into the 2031 base model.

Appendix 6B

Modelling Scenario Inputs

APPENDIX 6B - Modelling Scenario Inputs

ROAD NETWORK OPTIONS

The road network options that were developed to determine the base case (without CUDP) as follows:

- 2009 existing road network.
- 2031 'do nothing' road network, as per the 2009 existing road network.
- 2031 'do minimum' road network which is the 'do nothing' road network and including:
  - F6 extension and associated ramps.
  - Tallawarra F6 North Facing Ramps.
  - All 3 stages of the Albion Park Bypass (Tripoli Way).
- 2031 'do absolute minimum' road network which is the:
  - 'do minimum' road network excluding Tallawarra F6 North Facing Ramps.
  - Upgrade of Marshall Mount and Yallah Road.
- 2031 'do base upgrades' road network which is the 2031 'do absolute minimum' road network and including additional infrastructure identified through the modelling process to overcome any network deficiencies.

To examine the impact of the CUDP on the base road network operation, development road network options were developed as follows:

- 2031 'do nothing' road network with CUDP road network.
- 2031 'do minimum' road network with CUDP road network.
- 2031 'do absolute minimum' road network with CUDP road network.
- 2031 'do base upgrades' road network with CUDP road network[1].

TRAVEL DEMAND OPTIONS

As described above in Section 5 there are a number of potential land use changes that can lead to resulting changes in travel demand over the assessment timeframe period. These potential sources of travel demand increases are considered to comprise the following:

- 2009 development – assumes all development is as per the existing situation with no growth.
- 2031 Regional release area growth – includes approved and proposed sites (as detailed in Section 5.2.1):
  - Approved sites which have the benefit of development/project application approval which remain to be implemented and as such are not accounted for in the use of the 2009 traffic data.
  - Sites which are allocated for redevelopment within the Illawarra Regional Strategy and the draft West Dapto Release Area (WDRA) planning documents and are expected to be progressively developed through the assessment timeframe period.
- Regional infill growth - Sites which are progressively re-developed over time and development relating to natural population expansion (as detailed in Section 5.2.2).
- External growth – this is natural traffic growth which occurs outside of the traffic model area of influence but may have origins or destinations which involve travel through the area of influence (through trips) (as detailed in Section 5.2.3).
- CUDP - The DLL landholdings, with development potential for about 4,800 accommodates about 12,500 people or about 60% of the future Calderwood Release Area population.

[1] Additional upgrade works required as a result of future growth to 2031 excluding Calderwood (these are discussed in detail in Sections **Error! Reference source not found.**)

The following combinations of potential travel demand increases were used in the assessments:

- 2009 Base – with 2009 development only.
- 2031 Base scenarios include:
  - Regional release area growth excluding CUDP.
  - Regional Infill growth.
  - External growth
- 2031 with CUDP scenarios include:
  - Regional release area growth including CUDP.
  - Regional Infill growth.
  - External growth.

MODE SHARE OPTIONS

Current modals splits within the LGA areas reflect a lack of public transport and active transport opportunities with only 10% of travel undertaken by non-car modes across both the Wollongong and Shellharbour LGA's. This is described as the 'business as usual' (BAU) case.

As described in Section 3 the concept plan for the CUDP contains a number of key principles relating to transport and travel demand management.

Such measures on other similarly master planned community developments undertaken by DLL have achieved positive modal shift results away from car based transport. Accordingly, at least a 10% modal shift from car based to non car based modes of transport is expected and is incorporated into the modelling of the transport demands relating to the CUDP.

However, in transport demand assessment terms an unknown variable is the extent by which the other agreed planned developments can contribute to positive modal shift to non car based modes. Scenario testing will account for the following range of potential outcomes:

- CUDP and other planned regional developments BAU (no change from current mode splits).
- CUDP 10% modal transfer to non car modes and other planned regional developments BAU (no change from current mode splits).
- CUDP 10% modal transfer to non car modes and other planned developments appropriately designed and constructed to also achieve a 10% modal transfer to non car modes.

Appendix 6B - Modelling Scenario Testing Summary Matrix

		Year	09		31		31		31				31		31		31		31		31		31	
		Scenario Name	2009 Base (bau)		2031 Base 'do nothing' (bau)		2031 Base 'do minimum' (bau)		2031 Base 'do minimum' (mode shift)		2031 Base 'do absolute minimum' (bau)		2031 Base 'base upgrades' (bau)		2031 CUDP 'do nothing' (bau)		2031 CUDP 'do nothing' (mode shift)		2031 CUDP 'do minimum' (mode shift)		2031 CUDP 'do absolute minimum' (mode shift)		2031 CUDP 'base upgrades' (mode shift)		2031 CUDP 'full upgrades' (mode shift)	
		Scenario Ref	B00		B01		B02		B03		B04		B05		D01		D02		D04		D08		D11		D12	
		Peak	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P
		Filename	09_B00A	09_B00P	31_B01A	31_B01P	31_B02A	31_B02P	31_B03A	31_B03P	_B04A	_B04P	_B05A	_B05P	31_D01A	31_D01P	31_D02A	31_D02P	31_D04A	31_D04P	31_D08A	31_D08P	31_D11A	31_D11P	31_D12A	31_D12P
Road Network	Base Road Network	2009	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	'Do Minimum'/'Do Absolute Minimum' Upgrades	F6 Extension and ramps	n	n	n	n	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y	y	y	y	y
		Tallawarra F6 North Facing Ramps	n	n	n	n	y	y	y	y	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n
		Albion Park Bypass (Tripoli Way)	n	n	n	n	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y	y	y	y	y
	Calderwood Road Network	2031	n	n	n	n	n	n	n	n	n	n	n	n	y	y	y	y	y	y	y	y	y	y	y	y
	Strategic Road Network Improvements*	Marshall Mount Rd upgrade	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Yallah Road Rd upgrade	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Traffic Calming Tongarra Rd (Tripoli)	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Duplicate Princes Highway between F6 & Mt Brown Rd	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Signalise Princes Hwy/Huntley Rd	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Signalise Princes Hwy/Cormack Ave	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Signalise Princes Hwy/Tallawarra Off-ramp	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		F6 southbound on ramp additional lane	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		F6 northbound off ramp additional lane	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Signalise Marshall Mount Rd/Yallah Rd Tongarra Rd/Station Rd	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
		Signalise Tongarra Rd/Station Rd	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
		Roundabout at Yallah Rd/Haywards Bay Dr	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	y	y
Land Use Planning Assumptions	Growth	2009 Development	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
		2031 Regional Infill Growth	n	n	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
		2031 External Growth	n	n	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
		2031 Regional New Development	n	n	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
		2031 CUDP	n	n	n	n	n	n	n	n	n	n	n	n	y	y	y	y	y	y	y	y	y	y	y	y
		2031 Other Calderwood	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	Mode Share	2009 Development	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau
		2031 Regional Infill Growth	n	n	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau
		2031 External Growth	n	n	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau
		2031 Regional New Development	n	n	bau	bau	bau	bau	-10%	-10%	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau
		2031 CUDP	n	n	n	n	n	n	n	n	n	n	n	n	bau	bau	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
		2031 Other Calderwood	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Mode Share:
bau = business as usual
-x% = x% shift to non-car based transport modes

Peak:
A = AM
P = PM

Other:
CUDP = Calderwood Urban Development Project

Appendix 6C

Modelling Scenarios

APPENDIX 6C - Modelling Scenarios

Base Assessment Scenarios - No CUDP

The following scenarios (during both weekday AM and PM peak hours) were examined to establish the road network performance without the CUDP:

- 2009 Base BAU scenario {B00}:
  - 2009 road network.
  - No growth.
  - BAU modal splits.
- 2031 Base 'do nothing' BAU scenario {B01} including:
  - 2009 road network.
  - Regional infill growth, external growth and regional new development growth with no CUDP.
  - BAU modal splits.
- 2031 Base 'do minimum' BAU scenario {B02} including:
  - 2009 road network with 'do minimum' upgrades.
  - Regional infill growth, external growth and regional new development growth with no CUDP.
  - BAU modal splits.
- 2031 Base 'do minimum' mode shift scenario {B03} including:
  - 2009 road network with 'do minimum' upgrades.
  - Regional infill growth and external growth with BAU modal splits.
  - Regional new development growth (with no CUDP) including a 10% modal shift.
- 2031 Base 'do absolute minimum' BAU scenario {B04} including:
  - 2009 road network with 'do absolute minimum' upgrades i.e. 'do minimum' excluding the Tallawarra Freeway ramps.
  - Regional infill growth, external growth and regional new development growth with no CUDP.
  - BAU modal splits.
- 2031 Base 'do base upgrades' BAU scenario {B05} including:
  - 2009 road network with 'do absolute minimum' upgrades i.e. 'do minimum' excluding the Tallawarra Freeway ramps plus the following upgrades identified to be required to address future base road network deficiencies (without Calderwood)[1]:
    - Upgrade Marshall Mount Road from the CUDP boundary to Huntley Road to an appropriate minimum 2 lane two-way carriageway with sealed shoulders.
    - Upgrade Yallah Road between Marshall Mount Road and Haywards Bay Drive to an appropriate minimum 2 lane two-way carriageway with sealed shoulders.
    - Duplication of the Princes Highway between Mount Brown Road and Cormack Avenue (both directions).
    - Duplication of Princes Highway southbound between Cormack Avenue and Yallah Bay Road
    - Duplication of the F6 Freeway southbound on-ramp south of Yallah Bay Road and associated freeway widening to accommodate improved merge area .
    - Duplication of the F6 Freeway northbound off-ramp at Tallawarra Interchange and associated F6 widening to accommodate ramp upgrade.
    - Provide traffic signals at the intersection of Princes Highway and Huntley Road.
    - Provide traffic signals at the intersection of Princes Highway and F6 northbound off-ramp at Tallawarra Interchange.
    - Provide traffic signals at the intersection of Princes Highway and Cormack Avenue.
  - Regional infill growth, external growth and regional new development growth with no CUDP.
  - BAU modal splits.

[1] Additional upgrade works required as a result of future growth to 2031 excluding Calderwood (these are discussed in detail in Sections **Error! Reference source not found.**)

With Development (CUDP) Assessment Scenarios

A significant range of scenarios were tested to assess the road network performance with full 2031 future development including the Calderwood project. Many scenarios were required to be run in an iterative process to determine an appropriate package of measures. Some scenarios were tested and discarded others formed part of the ultimate package of measures. Only key scenarios have been reported on that demonstrate the impacts of the future development with the CUDP and the optimum package of measures. Furthermore selected scenarios were run to test the model sensitivity for assumptions and to demonstrate the robust process.

The following key scenarios (during both weekday AM and PM peak hours) were examined to establish the road network performance with the CUDP:

- 2031 With CUDP 'do nothing' BAU scenario {D01} including:
  - 2009 road network plus Calderwood internal road network.
  - Regional infill growth, external growth and regional new development growth.
  - CUDP growth.
  - BAU modal splits.
- 2031 With CUDP 'do nothing' mode shift scenario {D02} including:
  - 2009 road network plus Calderwood internal road network.
  - Regional infill growth, external growth and regional new development growth with BAU modal splits.
  - CUDP growth including a 10% modal shift.
- 2031 With CUDP 'do minimum' mode shift scenario {D04} including:
  - 2009 road network with 'do minimum' upgrades plus Calderwood internal road network.
  - Regional infill growth, external growth and regional new development growth with BAU modal splits.
  - CUDP growth including a 10% modal shift.
- 2031 With CUDP 'do absolute minimum' mode shift scenario {D08} including:
  - 2009 road network with 'do absolute minimum' upgrades plus Calderwood internal road network.
  - Regional infill growth, external growth and regional new development growth with BAU modal splits.
  - CUDP growth including a 10% modal shift.
- 2031 With CUDP 'do base upgrades' with mode shift scenario {D11} including:
  - 2009 road network with 'do absolute minimum' upgrades plus Calderwood internal road network plus the following upgrades identified to be required to address future base road network deficiencies (without Calderwood):
    - Upgrade Marshall Mount Road from the CUDP boundary to Huntley Road to an appropriate minimum 2 lane two-way carriageway with sealed shoulders.
    - Upgrade Yallah Road between Marshall Mount Road and Haywards Bay Drive to an appropriate minimum 2 lane two-way carriageway with sealed shoulders.
    - Duplication of the Princes Highway between Mount Brown Road and Cormack Avenue (both directions).
    - Duplication of the F6 Freeway southbound on-ramp south of Yallah Bay Road.
    - Duplication of the F6 Freeway northbound off-ramp at Tallawarra Interchange and associated F6 widening to accommodate ramp upgrade.
    - Provide traffic signals at the intersection of Princes Highway and Huntley Road.
    - Provide traffic signals at the intersection of Princes Highway and F6 northbound off-ramp at Tallawarra Interchange.
    - Provide traffic signals at the intersection of Princes Highway and Cormack Avenue.
  - Regional infill growth, external growth and regional new development growth with BAU modal splits.
  - CUDP growth including a 10% modal shift.

It should be noted that the 'do base upgrade' road network would need to consider the road linkages between the Princes Highway, Southern Freeway and F6 extension holistically as part of a design process based upon a range of factors including safety, capacity, cost etc. Therefore assessments of the road links between the F5 extension and Princes Highway / Southern Freeway have been undertaken on the basis of its existing two lane section.

A range of additional scenarios were run iteratively to test a variety of network options and potential mitigation measures. Furthermore, scenarios were run to test the sensitivity of measures under different assumptions.

Appendix 7A

Network Performance Characteristics - 2031 Base ‘Do Nothing’ BAU Model {31_B01}

Appendix 7A - Network Performance Characteristics - 2031 Base 'Do Nothing' BAU Model
Mid-block Carriageway Performance - AM Peak {31_B01A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	282	308	590	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	265	275	540	B	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	265	275	540	B	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	266	275	541	B	B
Illawarra Highway	Broughton Avenue	Church Street	952	670	1,622	C	A
Illawarra Highway	Church Street	Calderwood Road	1,110	628	1,738	D	A
Illawarra Highway	Calderwood Road	Russell Street	1,114	636	1,750	A	A
Illawarra Highway	Russell Street	Terry Street	1,351	701	2,052	B	A
Illawarra Highway	Terry Street	Croome Lane	1,532	817	2,349	F	B
Illawarra Highway	Croome Lane	Princes Highway	1,593	923	2,516	F	C
Yallah Road	Marshall Mount Road	Princes Highway	261	163	424	B	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	116	69	185	B	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	94	44	138	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	224	271	495	B	B
Marshall Mount Road	Yallah TAFE	Huntley Road	344	215	559	C	B
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	17	31	48	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	63	124	187	A	B
Calderwood Road	Illawarra Christian School	North Macquarie Road	69	110	179	A	B
Calderwood Road	CUDP	Mansons Bridge	62	67	129	A	A
Calderwood Road	Mansons Bridge	Illawarra Highway	60	58	118	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	43	7	50	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	43	7	50	A	A
Huntley Road	Marshall Mount Road	Princes Highway	361	306	667	A	A
Tongarra Road	Terry Street	Stapleton Avenue	780	580	1,360	B	A
Tongarra Road	Stapleton Avenue	Croome Road	660	861	1,521	A	B
Tongarra Road	Croome Road	Station Road	903	703	1,606	C	A
Tongarra Road	Station Road	Ti-Tree Avenue	654	528	1,182	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	635	480	1,115	A	A
Tongarra Road	Ash Avenue	Princes Highway	893	627	1,520	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,361	2,037	4,398	D	C
Princes Highway	Tongarra Road	Station Road	2,000	1,410	3,410	C	A
Princes Highway	Station Road	Airport Road	2,285	1,621	3,906	D	B
Princes Highway	Airport Road	Illawarra Highway	2,281	1,685	3,966	D	B
Princes Highway	Illawarra Highway	Yallah Road	3,858	2,592	6,450	F	E
Princes Highway	Yallah Road	Southern Freeway	3,821	2,405	6,226	F	E
Princes Highway	Southern Freeway	Huntley Road	1,550	667	2,217	F	A
Princes Highway	Huntley Road	Mount Brown Road	1,659	721	2,380	F	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	1,229	1,229		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,667	-	1,667	E	
Southern Freeway	Princes Highway	Fowlers Road	2,154	1,332	3,486	C	B

Appendix 7A - Network Performance Characteristics - 2031 Base 'Do Nothing' BAU Model
Mid-block Carriageway Performance - PM Peak {31_B01P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	274	395	669	C	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	380	176	556	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	380	176	556	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	380	176	556	C	B
Illawarra Highway	Broughton Avenue	Church Street	869	1,234	2,103	B	E
Illawarra Highway	Church Street	Calderwood Road	743	1,272	2,015	A	F
Illawarra Highway	Calderwood Road	Russell Street	729	1,224	1,953	A	A
Illawarra Highway	Russell Street	Terry Street	910	1,385	2,295	A	B
Illawarra Highway	Terry Street	Croome Lane	757	1,561	2,318	A	F
Illawarra Highway	Croome Lane	Princes Highway	824	1,705	2,529	B	F
Yallah Road	Marshall Mount Road	Princes Highway	692	335	1,027	D	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	59	238	297	A	B
Marshall Mount Road	North Marshall Mount Road	Yallah Road	42	201	243	A	B
Marshall Mount Road	Yallah Road	Yallah TAFE	328	843	1,171	B	D
Marshall Mount Road	Yallah TAFE	Huntley Road	139	892	1,031	B	E
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	29	17	46	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	249	58	307	B	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	230	67	297	B	A
Calderwood Road	CUDP	Mansons Bridge	132	52	184	B	A
Calderwood Road	Mansons Bridge	Illawarra Highway	47	122	169	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	15	98	113	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	15	98	113	A	B
Huntley Road	Marshall Mount Road	Princes Highway	238	559	797	A	A
Tongarra Road	Terry Street	Stapleton Avenue	766	1,108	1,874	B	D
Tongarra Road	Stapleton Avenue	Croome Road	1,138	920	2,058	E	C
Tongarra Road	Croome Road	Station Road	895	1,281	2,176	C	F
Tongarra Road	Station Road	Ti-Tree Avenue	756	964	1,720	A	C
Tongarra Road	Ti-Tree Avenue	Ash Avenue	737	918	1,655	A	C
Tongarra Road	Ash Avenue	Princes Highway	868	1,160	2,028	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,162	3,074	5,236	D	F
Princes Highway	Tongarra Road	Station Road	1,297	2,501	3,798	A	E
Princes Highway	Station Road	Airport Road	1,469	2,791	4,260	A	F
Princes Highway	Airport Road	Illawarra Highway	1,571	2,855	4,426	A	F
Princes Highway	Illawarra Highway	Yallah Road	2,371	4,535	6,906	D	F
Princes Highway	Yallah Road	Southern Freeway	2,192	4,117	6,309	D	F
Princes Highway	Southern Freeway	Huntley Road	1,303	1,728	3,031	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,193	1,939	3,132	E	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,284	2,284		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,429	-	1,429	D	
Southern Freeway	Princes Highway	Fowlers Road	763	2,082	2,845	A	C

Appendix 7A - Network Performance Characteristics - 2031 Base 'Do Nothing' BAU Model
Intersection Performance {31_B01}

		Scenario 31_B01 AM Peak			Scenario 31_B01 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.154	15.3	B	0.095	16.2	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Tongarra Rd	Signals	0.886	33.0	C	0.898	31.9	C
Calderwood Road/Nth Macquarie Road	Priority	0.044	13.5	A	0.010	14.1	A
Calderwood Road/Marshall Mount Road	Priority	0.039	11.2	A	0.134	11.2	A
Marshall Mount Road/Yallah Road	Priority	0.177	12.7	A	0.674	25.4	B
Huntley Rd/Marshall Mount Rd	Priority	0.423	12.9	A	0.378	20.7	B
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.704	8.2	A	0.849	11.5	A
Illawarra Hwy/Broughton Ave	Roundabout	0.636	14.3	A	0.508	16.9	B
Tongarra Rd/Station Rd	Priority	0.855	50.8	D	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.099	10.4	A	0.709	14.3	A
Yallah Rd/Haywards Bay Dr	Priority	0.126	10.4	A	0.498	15.2	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.010	19.6	B	0.009	19.2	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.120	12.8	A	0.469	19.1	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F

APPENDIX 7A - Network Performance Characteristics - 2031 Base 'Do Nothing' BAU Model {31_B01}

SCENARIO FINDINGS

The traffic volumes in this scenario have increased considerably over the 2009 model, but the network capacity has remained the same. This increase in traffic has resulted in the following key changes in network performance:

- Traffic volumes on the Illawara Highway between Broughton Avenue and the Princes Highway have increased significantly, with an increase in traffic of around 1,400 vehicles in the AM Peak and 2,100 vehicles in the PM peak. This pushes the LoS from an A to an E/F.
- Traffic on Tongarra Road between Terry Street and the Princes Highway roughly doubles in the AM Peak, with a resulting increase in LoS from A to a maximum of F between Terry Street and Station Road. A similar increase in volumes also occurs in the PM Peak with a resulting increase of LoS up to F.
- The intersection of Illawara Highway, Tongarra Road and Terry Street operates with a LoS of C in the 2009 base scenario. This increases to an F in both the AM and PM peaks in this scenario.
- The intersection of Illawara Highway and the Princes Highway worsens in the PM peak from a LoS B to F.
- The intersection of Princes Highway and Tongarra Road increases from a B to F in the AM Peak.
- Traffic on the Princes Highway increases by around 2,000 vehicles overall during the AM Peak, representing a 30% increase in traffic. The mid-block LoS along Princes Highway shifts from a LoS E to F between the Illawara Highway and Yallah Road.
- Traffic on the Princes Highway increases by a maximum of around 2,500 vehicles during the PM Peak, with a resulting increase in LoS to F along almost the whole stretch between Wollybutt Drive and Mount Brown Road.
- The intersection of the Princes Highway with Huntley Road has to accommodate a significantly greater volume of traffic, and as such experiences an increase in LoS from a D to F in the AM Peak and C to F in the PM Peak.
- The intersection of Tongarra Road and Station Road experiences a worsened LoS during both peaks, from B to F.
- The intersection of the Princes Highway with Cormack Avenue and the Southern Freeway operate at a LoS of F during both the AM and PM Peaks.

Appendix 7B

Network Performance Characteristics - 2031 Base ‘Do Minimum’ BAU Model {31_B02}

Appendix 7B - Network Performance Characteristics - 2031 Base 'Do Minimum' BAU Model
Mid-block Carriageway Performance - AM Peak {31_B02A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	285	308	593	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	284	280	564	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	284	279	563	B	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	244	173	417	B	B
Illawarra Highway	Broughton Avenue	Church Street	410	233	643	A	A
Illawarra Highway	Church Street	Calderwood Road	1,001	387	1,388	D	A
Illawarra Highway	Calderwood Road	Russell Street	993	400	1,393	A	A
Illawarra Highway	Russell Street	Terry Street	1,273	433	1,706	B	A
Illawarra Highway	Terry Street	Tripoli Way	1,618	190	1,808	A	A
Illawarra Highway	Tripoli Way	Princes Highway	816	446	1,262	B	A
Yallah Road	Marshall Mount Road	Princes Highway	209	212	421	B	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	89	54	143	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	84	55	139	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	267	235	502	B	B
Marshall Mount Road	Yallah TAFE	Huntley Road	421	204	625	C	B
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	17	30	47	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	52	100	152	A	B
Calderwood Road	Illawarra Christian School	North Macquarie Road	54	79	133	A	A
Calderwood Road	CUDP	Mansons Bridge	49	55	104	A	A
Calderwood Road	Mansons Bridge	Illawarra Highway	49	25	74	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	24	5	29	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	24	5	29	A	A
Huntley Road	Marshall Mount Road	Princes Highway	367	317	684	A	A
Tongarra Road	Terry Street	Stapleton Avenue	741	940	1,681	A	C
Tongarra Road	Stapleton Avenue	Croome Road	634	884	1,518	A	C
Tongarra Road	Croome Road	Station Road	817	564	1,381	B	A
Tongarra Road	Station Road	Ti-Tree Avenue	647	443	1,090	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	618	379	997	A	A
Tongarra Road	Ash Avenue	Princes Highway	835	465	1,300	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	659	1,123	1,782	A	A
Princes Highway	Tongarra Road	Station Road	348	442	790	A	A
Princes Highway	Station Road	Airport Road	558	628	1,186	A	A
Princes Highway	Airport Road	Illawarra Highway	749	712	1,461	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,528	1,121	2,649	A	A
Princes Highway	Yallah Road	Southern Freeway	1,424	903	2,327	A	A
Princes Highway	Southern Freeway	Huntley Road	1,648	568	2,216	F	A
Princes Highway	Huntley Road	Mount Brown Road	1,739	609	2,348	F	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	775	775		B
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,112	-	2,112	F	
Southern Freeway Ext	Princes Highway	Croome Road	1,850	544	2,394	B	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,419	429	1,848	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,486	1,073	3,559	C	B
Southern Freeway	F6 Extension	Princes Highway	3,910	1,073	4,983	F	B
Southern Freeway	Princes Highway	Fowlers Road	2,023	1,446	3,469	C	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	136	277	413	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	166	289	455	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,016	135	1,151	A	A
Tripoli Way	Southern Freeway	Tongarra Road	144	601	745	A	A

Appendix 7B - Network Performance Characteristics - 2031 Base 'Do Minimum' BAU Model
Mid-block Carriageway Performance - PM Peak {31_B02P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	275	395	670	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	378	225	603	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	378	225	603	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	254	73	327	B	A
Illawarra Highway	Broughton Avenue	Church Street	322	168	490	A	A
Illawarra Highway	Church Street	Calderwood Road	659	707	1,366	A	A
Illawarra Highway	Calderwood Road	Russell Street	622	721	1,343	A	A
Illawarra Highway	Russell Street	Terry Street	786	987	1,773	A	A
Illawarra Highway	Terry Street	Tripoli Way	746	646	1,392	A	A
Illawarra Highway	Tripoli Way	Princes Highway	259	1,081	1,340	A	D
Yallah Road	Marshall Mount Road	Princes Highway	689	287	976	D	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	59	129	188	A	B
Marshall Mount Road	North Marshall Mount Road	Yallah Road	62	124	186	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	309	774	1,083	B	D
Marshall Mount Road	Yallah TAFE	Huntley Road	164	856	1,020	B	D
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	30	17	47	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	141	58	199	B	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	125	70	195	B	A
Calderwood Road	CUDP	Mansons Bridge	75	53	128	B	A
Calderwood Road	Mansons Bridge	Illawarra Highway	37	17	54	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	17	50	67	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	17	50	67	A	A
Huntley Road	Marshall Mount Road	Princes Highway	235	512	747	A	A
Tongarra Road	Terry Street	Stapleton Avenue	614	1,385	1,999	A	F
Tongarra Road	Stapleton Avenue	Croome Road	936	983	1,919	C	C
Tongarra Road	Croome Road	Station Road	684	886	1,570	A	C
Tongarra Road	Station Road	Ti-Tree Avenue	572	643	1,215	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	523	567	1,090	A	A
Tongarra Road	Ash Avenue	Princes Highway	614	700	1,314	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	795	1,725	2,520	A	B
Princes Highway	Tongarra Road	Station Road	225	1,241	1,466	A	A
Princes Highway	Station Road	Airport Road	426	1,510	1,936	A	A
Princes Highway	Airport Road	Illawarra Highway	652	1,540	2,192	A	A
Princes Highway	Illawarra Highway	Yallah Road	886	2,596	3,482	A	E
Princes Highway	Yallah Road	Southern Freeway	694	1,965	2,659	A	C
Princes Highway	Southern Freeway	Huntley Road	1,341	1,669	3,010	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,234	2,117	3,351	E	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	405			A
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,475	-	1,475	D	
Southern Freeway Ext	Princes Highway	Croome Road	1,771	1,035	2,806	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	916	1,080	1,996	A	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,485	2,659	4,144	B	C
Southern Freeway	F6 Extension	Princes Highway	2,179	2,035	4,214	C	C
Southern Freeway	Princes Highway	Fowlers Road	910	2,453	3,363	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	86	598	684	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	120	589	709	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	634	318	952	A	A
Tripoli Way	Southern Freeway	Tongarra Road	145	847	992	A	A

Appendix 7B - Network Performance Characteristics - 2031 Base 'Do Minimum' BAU Model

Intersection Performance {31_B02}

		Scenario 31_B02 AM Peak			Scenario 31_B02 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.016	15.7	B	0.125	16.3	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	1.000	38.7	C	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	0.439	14.4	A	0.399	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.636	16.8	B	0.593	15.3	B
Calderwood Road/Nth Macquarie Road	Priority	0.027	13.5	A	0.021	13.7	A
Calderwood Road/Marshall Mount Road	Priority	0.030	11.2	A	0.073	11.2	A
Marshall Mount Road/Yallah Road	Priority	0.109	12.6	A	0.539	18.5	B
Huntley Rd/Marshall Mount Rd	Priority	0.494	13.1	A	0.398	19.5	B
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.642	6.9	A	0.667	7.9	A
Illawarra Hwy/Broughton Ave	Roundabout	0.200	12.0	A	0.158	11.3	A
Tongarra Rd/Station Rd	Priority	0.494	24.9	B	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.111	11.2	A	0.709	13.9	A
Yallah Rd/Haywards Bay Dr	Priority	0.423	11.0	A	0.421	13.5	A
Illawarra Hwy/Yellow Rock Rd	Priority	0.010	19.9	B	0.022	16.9	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.030	12.6	A	0.185	16.9	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	0.167	53.2	D	>1.000	>120	F
Tripoli Way and Calderwood Road.	Roundabout	0.053	12.6	A	0.056	14.9	B
Illawarra Highway and Tripoli Way.	Signals	>1.000	>120	F	>1.000	97.4	F
Tripoli Way and F6 Extension ramps.	Roundabout	0.031	12.4	A	0.124	12.5	A
Tongarra Road and Tripoli Way.	Signals	0.816	28.7	C	0.883	35.3	C

APPENDIX 7B - Network Performance Characteristics - 2031 Base 'Do Minimum' BAU Model {31_B02}

SCENARIO FINDINGS

The 2031 'Do Nothing' scenario highlighted some of the deficiencies in the existing network, especially around Albion Park and the connections onto the Princes Highway. With the implementation of the 'Do Minimum' upgrades the key network performance changes can be summarized as:

- The mid-block LoS on the Illawara Highway drops to below C on all sections except for between Terry Street and Croome Lane eastbound during the AM Peak, with a LoS of F.
- The peak volume on the Illawara Highway between Russell Street and Terry Street drops by 40% during the AM Peak and 60% during the PM Peak.
- The mid-block LoS on all of Tongarra Road drops to below C in both peaks except for between Terry Street and Stapleton Avenue.
- The peak volume on Tongarra Road between Croome Road and Station Road drops by 42% during the AM Peak and 44% during the PM Peak
- With the introduction of the F6 extension the traffic on the Princes Highway south of Haywards Bay drops by up to 70% during the AM Peak and 60% during the PM Peak
- Traffic on the Princes Highway between the Illawara Highway and Yallah Road drops by 50% in the AM Peak and 75% during the PM Peak
- Traffic volumes southbound on the Princes Highway between Yallah Road and Mount Brown Road actually increase during the PM Peak by 12%.
- With the introduction of the 'Do Minimum' measures the intersection of the Princes Highway and Huntley Road still remains at LoS F.
- The intersection of the Princes Highway and Southern Freeway remains at LoS F in this scenario.
- The intersection of Illawara Highway and Tripoli Way operates at a LoS of F in the AM Peak.
- The modelling indicated there would be minimal traffic demand (less than 20 peak hour movements) for the north facing ramps at the Tallawarra Freeway ramps.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7C

Network Performance Characteristics - 2031 Base ‘Do Minimum’ Mode Shift Model {31_B03}

Appendix 7C - Network Performance Characteristics - 2031 Base 'Do Minimum' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_B03A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	283	308	591	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	289	279	568	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	289	279	568	B	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	249	173	422	B	B
Illawarra Highway	Broughton Avenue	Church Street	423	241	664	A	A
Illawarra Highway	Church Street	Calderwood Road	974	381	1,355	C	A
Illawarra Highway	Calderwood Road	Russell Street	966	394	1,360	A	A
Illawarra Highway	Russell Street	Terry Street	1,243	426	1,669	A	A
Illawarra Highway	Terry Street	Tripoli Way	1,618	184	1,802	A	A
Illawarra Highway	Tripoli Way	Princes Highway	811	430	1,241	B	A
Yallah Road	Marshall Mount Road	Princes Highway	178	172	350	B	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	84	54	138	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	78	54	132	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	229	211	440	B	B
Marshall Mount Road	Yallah TAFE	Huntley Road	384	199	583	C	B
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	17	30	47	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	52	95	147	A	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	52	74	126	A	A
Calderwood Road	CUDP	Mansons Bridge	48	55	103	A	A
Calderwood Road	Mansons Bridge	Illawarra Highway	49	25	74	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	19	4	23	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	19	4	23	A	A
Huntley Road	Marshall Mount Road	Princes Highway	352	318	670	A	A
Tongarra Road	Terry Street	Stapleton Avenue	718	934	1,652	A	C
Tongarra Road	Stapleton Avenue	Croome Road	626	860	1,486	A	B
Tongarra Road	Croome Road	Station Road	793	556	1,349	B	A
Tongarra Road	Station Road	Ti-Tree Avenue	624	435	1,059	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	595	371	966	A	A
Tongarra Road	Ash Avenue	Princes Highway	814	458	1,272	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	650	1,094	1,744	A	A
Princes Highway	Tongarra Road	Station Road	346	434	780	A	A
Princes Highway	Station Road	Airport Road	555	619	1,174	A	A
Princes Highway	Airport Road	Illawarra Highway	750	698	1,448	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,523	1,091	2,614	A	A
Princes Highway	Yallah Road	Southern Freeway	1,430	884	2,314	A	A
Princes Highway	Southern Freeway	Huntley Road	1,608	584	2,192	F	A
Princes Highway	Huntley Road	Mount Brown Road	1,674	616	2,290	F	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	770	770		B
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,025	-	2,025	F	
Southern Freeway Ext	Princes Highway	Croome Road	1,819	549	2,368	B	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,390	432	1,822	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,459	1,077	3,536	C	B
Southern Freeway	F6 Extension	Princes Highway	3,889	1,077	4,966	F	B
Southern Freeway	Princes Highway	Fowlers Road	2,080	1,432	3,512	C	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	129	267	396	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	159	280	439	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,016	133	1,149	A	A
Tripoli Way	Southern Freeway	Tongarra Road	144	602	746	A	A

Appendix 7C - Network Performance Characteristics - 2031 Base 'Do Minimum' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_B03P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	276	394	670	C	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	379	224	603	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	379	224	603	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	262	74	336	B	A
Illawarra Highway	Broughton Avenue	Church Street	326	166	492	A	A
Illawarra Highway	Church Street	Calderwood Road	636	676	1,312	A	A
Illawarra Highway	Calderwood Road	Russell Street	601	689	1,290	A	A
Illawarra Highway	Russell Street	Terry Street	765	956	1,721	A	A
Illawarra Highway	Terry Street	Tripoli Way	732	645	1,377	A	A
Illawarra Highway	Tripoli Way	Princes Highway	263	1,048	1,311	A	D
Yallah Road	Marshall Mount Road	Princes Highway	711	272	983	D	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	57	128	185	A	B
Marshall Mount Road	North Marshall Mount Road	Yallah Road	60	123	183	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	288	790	1,078	B	D
Marshall Mount Road	Yallah TAFE	Huntley Road	144	853	997	B	E
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	30	17	47	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	140	56	196	B	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	125	68	193	B	A
Calderwood Road	CUDP	Mansons Bridge	73	53	126	B	A
Calderwood Road	Mansons Bridge	Illawarra Highway	35	17	52	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	15	52	67	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	15	52	67	A	A
Huntley Road	Marshall Mount Road	Princes Highway	222	485	707	A	A
Tongarra Road	Terry Street	Stapleton Avenue	607	1,356	1,963	A	F
Tongarra Road	Stapleton Avenue	Croome Road	914	967	1,881	C	C
Tongarra Road	Croome Road	Station Road	680	865	1,545	A	B
Tongarra Road	Station Road	Ti-Tree Avenue	563	625	1,188	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	519	550	1,069	A	A
Tongarra Road	Ash Avenue	Princes Highway	610	685	1,295	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	776	1,738	2,514	A	B
Princes Highway	Tongarra Road	Station Road	224	1,261	1,485	A	A
Princes Highway	Station Road	Airport Road	423	1,516	1,939	A	A
Princes Highway	Airport Road	Illawarra Highway	622	1,557	2,179	A	A
Princes Highway	Illawarra Highway	Yallah Road	860	2,580	3,440	A	E
Princes Highway	Yallah Road	Southern Freeway	692	1,941	2,633	A	C
Princes Highway	Southern Freeway	Huntley Road	1,296	1,647	2,943	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,235	1,849	3,084	E	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,133	2,133		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,454	-	1,454	D	
Southern Freeway Ext	Princes Highway	Croome Road	1,767	1,071	2,838	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	906	1,079	1,985	A	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,468	2,024	3,492	B	C
Southern Freeway	F6 Extension	Princes Highway	2,160	2,023	4,183	C	C
Southern Freeway	Princes Highway	Fowlers Road	893	2,354	3,247	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	83	554	637	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	116	549	665	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	631	312	943	A	A
Tripoli Way	Southern Freeway	Tongarra Road	142	842	984	A	A

Appendix 7C - Network Performance Characteristics - 2031 Base 'Do Minimum' Mode Shift Model
Intersection Performance {31_B03}

		Scenario 31_B03 AM Peak			Scenario 31_B03 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.111	16.3	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	1.000	33.0	C	0.770	26.6	B
Illawarra Hwy/Princes Hwy	Roundabout	0.548	15.9	B	0.253	13.5	A
Princes Hwy/Tongarra Rd	Signals	0.590	15.9	B	0.583	14.0	A
Calderwood Road/Nth Macquarie Road	Priority	0.042	13.6	A	0.010	13.8	A
Calderwood Road/Marshall Mount Road	Priority	0.053	11.2	A	0.102	11.2	A
Marshall Mount Road/Yallah Road	Priority	0.074	12.5	A	0.358	11.9	A
Huntley Rd/Marshall Mount Rd	Priority	0.212	10.9	A	0.075	14.3	A
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.616	7.3	A	0.619	9.3	A
Illawarra Hwy/Broughton Ave	Roundabout	0.128	11.9	A	0.036	11.3	A
Tongarra Rd/Station Rd	Priority	0.426	22.7	B	0.603	21.2	B
Yallah Rd/Princes Hwy on-ramp	Priority	0.016	12.6	A	0.016	9.9	A
Yallah Rd/Haywards Bay Dr	Priority	0.526	11.0	A	0.158	10.6	A
Illawarra Hwy/Yellow Rock Rd	Priority	0.010	19.6	B	0.025	16.4	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.019	12.5	A	0.182	16.9	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F
Tripoli Way and Calderwood Road.	Roundabout	0.062	12.6	A	0.067	14.4	A
Illawarra Highway and Tripoli Way.	Signals	>1.000	>120	F	0.933	38.0	C
Tripoli Way and F6 Extension ramps.	Roundabout	0.006	12.6	A	0.119	13.0	A
Tongarra Road and Tripoli Way.	Signals	0.837	30.8	C	0.652	17.2	B

APPENDIX 7C - Network Performance Characteristics - 2031 Base 'Do Minimum' Mode Shift Model {31_B03}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- The reduction in traffic resulting from the 10% mode shift applied to the developmental growth is negligible in most areas when compared to the total traffic volumes in the network.
- During the PM Peak the model indicates that 257 vehicles more will travel southbound between Croome Lane and the Princes Highway on the Illawara Highway.
- Similarly, 118 vehicles more will travel westbound on Tongarra Road between Terry Street and Stapleton Avenue.
- On the Princes Highway, between Yallah Road and the Illawara Highway 253 vehicles more travel in the westbound direction during the PM Peak.
- 268 vehicles less travel south on the Southern Freeway between Tripoli Way and the Princes Highway
- 214 vehicles less travel westbound on Tripoli Way between Illawara Highway and the Southern Freeway during the PM Peak.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7D

Network Performance Characteristics - 2031 Base ‘Do Absolute Minimum’ BAU Model {31_B04}

Appendix 7D - Network Performance Characteristics - 2031 Base 'Do Absolute Minimum' BAU Model
Mid-block Carriageway Performance - AM Peak {31_B04A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	281	309	590	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	293	271	564	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	293	270	563	B	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	221	118	339	B	B
Illawarra Highway	Broughton Avenue	Church Street	283	142	425	A	A
Illawarra Highway	Church Street	Calderwood Road	917	313	1,230	C	A
Illawarra Highway	Calderwood Road	Russell Street	925	287	1,212	A	A
Illawarra Highway	Russell Street	Terry Street	1,219	329	1,548	A	A
Illawarra Highway	Terry Street	Tripoli Way	1,586	200	1,786	A	A
Illawarra Highway	Tripoli Way	Princes Highway	1,082	555	1,637	D	A
Yallah Road	Marshall Mount Road	Princes Highway	372	296	668	C	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	65	66	131	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	63	65	128	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	275	354	629	B	B
Marshall Mount Road	Yallah TAFE	Huntley Road	91	45	136	B	A
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	17	30	47	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	58	70	128	A	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	67	59	126	A	A
Calderwood Road	CUDP	Mansons Bridge	57	43	100	A	A
Calderwood Road	Mansons Bridge	Illawarra Highway	47	71	118	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	16	10	26	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	16	10	26	A	A
Huntley Road	Marshall Mount Road	Princes Highway	201	181	382	A	A
Tongarra Road	Terry Street	Stapleton Avenue	716	963	1,679	A	C
Tongarra Road	Stapleton Avenue	Croome Road	600	894	1,494	A	C
Tongarra Road	Croome Road	Station Road	782	529	1,311	B	A
Tongarra Road	Station Road	Ti-Tree Avenue	592	405	997	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	568	355	923	A	A
Tongarra Road	Ash Avenue	Princes Highway	742	433	1,175	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	617	1,365	1,982	A	A
Princes Highway	Tongarra Road	Station Road	331	770	1,101	A	A
Princes Highway	Station Road	Airport Road	575	1,000	1,575	A	A
Princes Highway	Airport Road	Illawarra Highway	1,003	1,355	2,358	A	A
Princes Highway	Illawarra Highway	Yallah Road	2,061	1,886	3,947	C	C
Princes Highway	Yallah Road	Southern Freeway	2,094	1,699	3,793	C	B
Princes Highway	Southern Freeway	Huntley Road	1,728	1,069	2,797	F	D
Princes Highway	Huntley Road	Mount Brown Road	1,640	961	2,601	F	C
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	1,737	1,737		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,132	-	2,132	F	
Southern Freeway Ext	Princes Highway	Croome Road	2,245	857	3,102	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,830	693	2,523	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,672	1,447	4,119	C	B
Southern Freeway	F6 Extension	Princes Highway	4,766	1,447	6,213	F	B
Southern Freeway	Princes Highway	Fowlers Road	2,634	1,636	4,270	C	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	182	331	513	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	234	394	628	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	803	164	967	A	A
Tripoli Way	Southern Freeway	Tongarra Road	156	706	862	A	A

Appendix 7D - Network Performance Characteristics - 2031 Base 'Do Absolute Minimum' BAU Model
Mid-block Carriageway Performance - PM Peak {31_B04P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	274	395	669	C	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	376	240	616	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	376	240	616	C	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	246	44	290	B	A
Illawarra Highway	Broughton Avenue	Church Street	287	79	366	A	A
Illawarra Highway	Church Street	Calderwood Road	615	583	1,198	A	A
Illawarra Highway	Calderwood Road	Russell Street	590	574	1,164	A	A
Illawarra Highway	Russell Street	Terry Street	717	820	1,537	A	A
Illawarra Highway	Terry Street	Tripoli Way	645	457	1,102	A	A
Illawarra Highway	Tripoli Way	Princes Highway	222	859	1,081	A	B
Yallah Road	Marshall Mount Road	Princes Highway	585	404	989	D	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	59	100	159	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	61	92	153	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	394	605	999	C	C
Marshall Mount Road	Yallah TAFE	Huntley Road	1	405	406	A	C
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	29	17	46	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	113	60	173	B	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	100	74	174	B	A
Calderwood Road	CUDP	Mansons Bridge	66	55	121	A	A
Calderwood Road	Mansons Bridge	Illawarra Highway	50	32	82	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	19	34	53	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	19	34	53	A	A
Huntley Road	Marshall Mount Road	Princes Highway	184	323	507	A	A
Tongarra Road	Terry Street	Stapleton Avenue	626	1,367	1,993	A	F
Tongarra Road	Stapleton Avenue	Croome Road	826	939	1,765	B	C
Tongarra Road	Croome Road	Station Road	625	780	1,405	A	B
Tongarra Road	Station Road	Ti-Tree Avenue	512	542	1,054	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	467	467	934	A	A
Tongarra Road	Ash Avenue	Princes Highway	545	590	1,135	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	729	1,626	2,355	A	B
Princes Highway	Tongarra Road	Station Road	265	1,207	1,472	A	A
Princes Highway	Station Road	Airport Road	462	1,470	1,932	A	A
Princes Highway	Airport Road	Illawarra Highway	577	1,483	2,060	A	A
Princes Highway	Illawarra Highway	Yallah Road	774	2,316	3,090	A	D
Princes Highway	Yallah Road	Southern Freeway	633	1,960	2,593	A	C
Princes Highway	Southern Freeway	Huntley Road	1,350	1,843	3,193	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,148	1,780	2,928	E	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,460			F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,507	-	1,507	D	
Southern Freeway Ext	Princes Highway	Croome Road	1,712	1,047	2,759	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	954	1,068	2,022	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,508	2,220	3,728	B	C
Southern Freeway	F6 Extension	Princes Highway	2,141	2,219	4,360	C	C
Southern Freeway	Princes Highway	Fowlers Road	634	2,115	2,749	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	103	701	804	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	155	724	879	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	600	484	1,084	A	A
Tripoli Way	Southern Freeway	Tongarra Road	210	924	1,134	A	A

Appendix 7D - Network Performance Characteristics - 2031 Base 'Do Absolute Minimum' BAU Model

Intersection Performance {31_B04}

		Scenario 31_B04 AM Peak			Scenario 31_B04 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.133	16.4	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	1.000	32.7	C	>1.000	47.6	D
Illawarra Hwy/Princes Hwy	Roundabout	0.667	17.8	B	0.320	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.566	15.8	B	0.580	15.1	B
Calderwood Road/Nth Macquarie Road	Priority	0.020	13.5	A	0.023	13.6	A
Calderwood Road/Marshall Mount Road	Priority	0.037	11.2	A	0.057	11.2	A
Marshall Mount Road/Yallah Road	Priority	0.218	14.4	A	0.418	19.2	B
Huntley Rd/Marshall Mount Rd	Priority	0.098	10.8	A	0.013	17.5	B
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.571	10.7	A	0.778	11.7	A
Illawarra Hwy/Broughton Ave	Roundabout	0.060	11.7	A	0.182	11.4	A
Tongarra Rd/Station Rd	Priority	0.438	22.4	B	0.813	35.6	C
Yallah Rd/Princes Hwy on-ramp	Priority	0.367	14.3	A	0.552	12.5	A
Yallah Rd/Haywards Bay Dr	Priority	0.669	16.3	B	0.470	14.6	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.010	19.9	B	0.023	16.9	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.142	12.8	A	0.286	15.5	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F
Tripoli Way and Calderwood Road.	Roundabout	0.051	12.9	A	0.075	15.8	B
Illawarra Highway and Tripoli Way.	Signals	>1.000	>120	F	>1.000	>120	F
Tripoli Way and F6 Extension ramps.	Roundabout	0.006	12.6	A	0.119	13.0	A
Tongarra Road and Tripoli Way.	Signals	0.866	29.7	C	0.902	37.2	C

APPENDIX 7D - Network Performance Characteristics - 2031 Base 'Do Absolute Minimum' BAU Model {31_B04}

SCENARIO FINDINGS

After review of the implementation of the 'do absolute minimum' upgrades the key network performance changes can be summarized by describing the results of the mid-block assessments as follows:

- Tongarra Road between Terry Street and Stapleton Avenue in the westbound direction operates at LoS F during the PM peak carrying about 1,350 vehicles. It was determined during this model run of the appropriateness of complimentary measures implemented along Illawarra Highway to ensure maximum utilisation of Tripoli Way (Albion Park Bypass) by through traffic to provide relief to the bypassed section of Tongarra Road/Illawarra Highway.
- Princes Highway between Southern Freeway and Mount Brown Road is Los F in the northbound direction during the AM peak and LoS E/F during the PM peak. The southbound direction is LoS F in the PM peak.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in either direction for the purposes of this assessment.
- All other road sections indicate satisfactory mid-block performance during the modelled peak hour periods.

Appendix 7E

Network Performance Characteristics - 2031 Base ‘Do Base Upgrades’ BAU Model {31_B05}

Appendix 7E - Network Performance Characteristics - 2031 Base 'Do Base Upgrades' BAU Model
Mid-block Carriageway Performance - AM Peak {31_B05A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	285	309	594	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	305	281	586	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	304	281	585	B	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	87	157	244	A	B
Illawarra Highway	Broughton Avenue	Church Street	125	180	305	A	A
Illawarra Highway	Church Street	Calderwood Road	366	291	657	A	A
Illawarra Highway	Calderwood Road	Russell Street	483	195	678	A	A
Illawarra Highway	Russell Street	Terry Street	728	243	971	A	A
Illawarra Highway	Terry Street	Tripoli Way	1,139	170	1,309	A	A
Illawarra Highway	Tripoli Way	Princes Highway	848	368	1,216	B	A
Yallah Road	Marshall Mount Road	Princes Highway	183	162	345	B	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	65	73	138	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	50	41	91	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	175	187	362	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	341	181	522	A	A
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	17	29	46	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	73	77	150	A	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	74	59	133	A	A
Calderwood Road	CUDP	Mansons Bridge	70	55	125	B	A
Calderwood Road	Mansons Bridge	Illawarra Highway	51	119	170	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	4	4	8	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	4	4	8	A	A
Huntley Road	Marshall Mount Road	Princes Highway	341	333	674	A	A
Tongarra Road	Terry Street	Stapleton Avenue	719	789	1,508	A	B
Tongarra Road	Stapleton Avenue	Croome Road	513	864	1,377	A	B
Tongarra Road	Croome Road	Station Road	795	463	1,258	B	A
Tongarra Road	Station Road	Ti-Tree Avenue	626	333	959	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	599	278	877	A	A
Tongarra Road	Ash Avenue	Princes Highway	836	373	1,209	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	572	1,093	1,665	A	A
Princes Highway	Tongarra Road	Station Road	346	404	750	A	A
Princes Highway	Station Road	Airport Road	547	590	1,137	A	A
Princes Highway	Airport Road	Illawarra Highway	732	658	1,390	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,547	994	2,541	A	A
Princes Highway	Yallah Road	Southern Freeway	1,494	813	2,307	A	A
Princes Highway	Southern Freeway	Huntley Road	1,912	264	2,176	C	A
Princes Highway	Huntley Road	Mount Brown Road	1,993	337	2,330	C	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	742	742		A
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,212	-	2,212	C	
Southern Freeway Ext	Princes Highway	Croome Road	2,001	537	2,538	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,532	452	1,984	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,448	1,047	3,495	C	B
Southern Freeway	F6 Extension	Princes Highway	3,943	1,047	4,990	F	B
Southern Freeway	Princes Highway	Fowlers Road	1,731	1,290	3,021	B	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	619	302	921	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	665	392	1,057	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,010	217	1,227	A	A
Tripoli Way	Southern Freeway	Tongarra Road	126	597	723	A	A

Appendix 7E - Network Performance Characteristics - 2031 Base 'Do Base Upgrades' BAU Model
Mid-block Carriageway Performance - PM Peak {31_B05P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	273	392	665	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	369	201	570	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	370	201	571	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	170	40	210	B	A
Illawarra Highway	Broughton Avenue	Church Street	193	67	260	A	A
Illawarra Highway	Church Street	Calderwood Road	348	403	751	A	A
Illawarra Highway	Calderwood Road	Russell Street	326	382	708	A	A
Illawarra Highway	Russell Street	Terry Street	458	545	1,003	A	A
Illawarra Highway	Terry Street	Tripoli Way	384	916	1,300	A	A
Illawarra Highway	Tripoli Way	Princes Highway	225	224	449	A	A
Yallah Road	Marshall Mount Road	Princes Highway	331	212	543	C	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	77	173	250	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	36	131	167	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	210	424	634	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	162	598	760	A	A
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	29	17	46	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	186	78	264	B	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	174	90	264	B	A
Calderwood Road	CUDP	Mansons Bridge	102	67	169	B	B
Calderwood Road	Mansons Bridge	Illawarra Highway	47	50	97	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	23	72	95	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	23	72	95	A	A
Huntley Road	Marshall Mount Road	Princes Highway	237	474	711	A	A
Tongarra Road	Terry Street	Stapleton Avenue	577	650	1,227	A	A
Tongarra Road	Stapleton Avenue	Croome Road	664	861	1,525	A	B
Tongarra Road	Croome Road	Station Road	615	631	1,246	A	A
Tongarra Road	Station Road	Ti-Tree Avenue	511	381	892	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	459	316	775	A	A
Tongarra Road	Ash Avenue	Princes Highway	549	453	1,002	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	587	1,626	2,213	A	B
Princes Highway	Tongarra Road	Station Road	256	1,199	1,455	A	A
Princes Highway	Station Road	Airport Road	441	1,482	1,923	A	A
Princes Highway	Airport Road	Illawarra Highway	575	1,621	2,196	A	B
Princes Highway	Illawarra Highway	Yallah Road	776	1,822	2,598	A	B
Princes Highway	Yallah Road	Southern Freeway	571	1,489	2,060	A	A
Princes Highway	Southern Freeway	Huntley Road	828	1,640	2,468	A	B
Princes Highway	Huntley Road	Mount Brown Road	765	1,814	2,579	A	B
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,398	2,398		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,336	-	1,336	B	
Southern Freeway Ext	Princes Highway	Croome Road	1,915	997	2,912	C	B
Southern Freeway Ext	Croome Road	Tripoli Way	1,078	981	2,059	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,381	2,556	3,937	B	C
Southern Freeway	F6 Extension	Princes Highway	1,952	2,556	4,508	C	C
Southern Freeway	Princes Highway	Fowlers Road	616	1,996	2,612	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	302	770	1,072	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	337	774	1,111	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	570	1,729	2,299	A	B
Tripoli Way	Southern Freeway	Tongarra Road	189	303	492	A	A

Appendix 7E - Network Performance Characteristics - 2031 Base 'Do Base Upgrades' BAU Model
Intersection Performance {31_B05}

		Scenario 31_B05 AM Peak			Scenario 31_B05 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.015	16.0	B	0.111	16.2	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	0.851	31.3	C	0.909	34.3	C
Illawarra Hwy/Princes Hwy	Roundabout	0.452	14.5	A	0.089	13.5	A
Princes Hwy/Tongarra Rd	Signals	0.642	17.5	B	0.635	15.3	B
Calderwood Road/Nth Macquarie Road	Priority	0.011	13.8	A	0.028	13.8	A
Calderwood Road/Marshall Mount Road	Priority	0.041	11.2	A	0.097	11.2	A
Marshall Mount Road/Yallah Road	Priority	0.122	12.5	A	0.041	12.4	A
Huntley Rd/Marshall Mount Rd	Priority	0.423	13.0	A	0.285	14.9	B
Princes Hwy/Huntley Rd	Signals	1.000	22.1	B	1.000	13.7	A
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.517	13.6	A	0.310	8.8	A
Illawarra Hwy/Broughton Ave	Roundabout	0.400	14.3	A	0.125	16.8	B
Tongarra Rd/Station Rd	Priority	0.442	21.2	B	0.694	24.1	B
Yallah Rd/Princes Hwy on-ramp	Priority	0.114	11.3	A	0.046	10.2	A
Yallah Rd/Haywards Bay Dr	Priority	0.403	10.9	A	0.315	10.4	A
Illawarra Hwy/Yellow Rock Rd	Priority	0.005	20.3	B	0.019	18.7	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.046	12.5	A	0.102	13.7	A
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Signals	0.674	14.4	A	0.851	27.7	B
Princes Hwy/Cormack Ave	Signals	0.532	22.9	B	0.881	44.8	D
Tripoli Way and Calderwood Road.	Roundabout	0.096	15.1	B	0.076	16.5	B
Illawarra Highway and Tripoli Way.	Signals	1.000	36.7	C	0.606	21.3	B
Tripoli Way and F6 Extension ramps.	Roundabout	0.072	12.4	A	0.183	15.0	B
Tongarra Road and Tripoli Way.	Signals	0.823	28.0	B	0.555	15.7	B

APPENDIX 7E - Network Performance Characteristics - 2031 Base 'Do Base Upgrades' BAU Model {31_B05}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- During the morning and evening peak hour the road links which comprise the study area all operate at satisfactory LoS (C or better).
- However as identified above the section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7F

Network Performance Characteristics – 2031 CUDP ‘Do Nothing’ BAU Model {31_D01}

Appendix 7F - Network Performance Characteristics – 2031 CUDP 'Do Nothing' BAU Model
Mid-block Carriageway Performance - AM Peak {31_D01A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	309	282	591	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	261	569	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	435	272	707	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	636	546	1,182	C	C
Illawarra Highway	Broughton Avenue	Church Street	947	728	1,675	C	A
Illawarra Highway	Church Street	Calderwood Road	1,222	752	1,974	E	A
Illawarra Highway	Calderwood Road	Russell Street	1,488	1,059	2,547	C	A
Illawarra Highway	Russell Street	Terry Street	1,702	1,050	2,752	D	A
Illawarra Highway	Terry Street	Croome Lane	1,534	994	2,528	F	C
Illawarra Highway	Croome Lane	Princes Highway	1,598	1,252	2,850	F	E
Yallah Road	Marshall Mount Road	Princes Highway	757	713	1,470	D	D
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	869	574	1,443	D	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	783	471	1,254	D	C
Marshall Mount Road	Yallah Road	Yallah TAFE	634	366	1,000	C	B
Marshall Mount Road	Yallah TAFE	Huntley Road	499	131	630	C	B
Calderwood Road	CUDP	Mansons Bridge	584	466	1,050	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	402	403	805	A	A
Huntley Road	Marshall Mount Road	Princes Highway	223	162	385	A	A
Tongarra Road	Terry Street	Stapleton Avenue	1,200	710	1,910	E	A
Tongarra Road	Stapleton Avenue	Croome Road	1,200	710	1,910	E	A
Tongarra Road	Croome Road	Station Road	1,219	846	2,065	E	B
Tongarra Road	Station Road	Ti-Tree Avenue	1,012	626	1,638	D	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	1,000	577	1,577	D	A
Tongarra Road	Ash Avenue	Princes Highway	1,303	765	2,068	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,892	2,799	5,691	F	F
Princes Highway	Tongarra Road	Station Road	2,604	1,973	4,577	E	C
Princes Highway	Station Road	Airport Road	2,854	2,265	5,119	F	D
Princes Highway	Airport Road	Illawarra Highway	3,103	2,526	5,629	F	E
Princes Highway	Illawarra Highway	Yallah Road	4,693	3,769	8,462	F	F
Princes Highway	Yallah Road	Southern Freeway	5,029	4,002	9,031	F	F
Princes Highway	Southern Freeway	Huntley Road	1,759	1,426	3,185	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,737	1,343	3,080	F	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,130	2,130		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,167	-	2,167	F	
Southern Freeway	Princes Highway	Fowlers Road	2,861	2,020	4,881	D	C
North South Arterial	Section 1		572	655	1,227	A	A
North South Arterial	Section 2		482	494	976	A	A
North South Arterial	Section 3		482	494	976	A	A
North South Arterial	Section 4		433	338	771	A	A
North South Arterial	Section 5		459	303	762	A	A
North South Arterial	Section 6		372	161	533	A	A
North South Arterial	Section 7		492	199	691	A	A
North South Arterial	Section 8		524	273	797	A	A
North South Arterial	Section 9		567	295	862	A	A
North South Arterial	Section 10		656	499	1,155	A	A
North South Arterial	Section 11		646	445	1,091	A	A
North South Arterial	Section 12		634	411	1,045	A	A

Appendix 7F - Network Performance Characteristics – 2031 CUDP 'Do Nothing' BAU Model
Mid-block Carriageway Performance - PM Peak {31_D01P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	396	274	670	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	366	267	633	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	450	283	733	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	546	617	1,163	C	C
Illawarra Highway	Broughton Avenue	Church Street	725	996	1,721	A	C
Illawarra Highway	Church Street	Calderwood Road	710	1,270	1,980	A	F
Illawarra Highway	Calderwood Road	Russell Street	944	1,500	2,444	A	C
Illawarra Highway	Russell Street	Terry Street	946	1,544	2,490	A	C
Illawarra Highway	Terry Street	Croome Lane	620	1,405	2,025	A	F
Illawarra Highway	Croome Lane	Princes Highway	707	1,676	2,383	A	F
Yallah Road	Marshall Mount Road	Princes Highway	568	669	1,237	C	D
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	383	768	1,151	C	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	283	658	941	B	C
Marshall Mount Road	Yallah Road	Yallah TAFE	323	598	921	B	C
Marshall Mount Road	Yallah TAFE	Huntley Road	12	474	486	A	D
Calderwood Road	CUDP	Mansons Bridge	593	561	1,154	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	411	527	938	A	A
Huntley Road	Marshall Mount Road	Princes Highway	179	439	618	A	A
Tongarra Road	Terry Street	Stapleton Avenue	855	1,297	2,152	B	F
Tongarra Road	Stapleton Avenue	Croome Road	855	1,297	2,152	B	F
Tongarra Road	Croome Road	Station Road	997	1,427	2,424	C	F
Tongarra Road	Station Road	Ti-Tree Avenue	850	1,182	2,032	B	E
Tongarra Road	Ti-Tree Avenue	Ash Avenue	827	1,122	1,949	B	D
Tongarra Road	Ash Avenue	Princes Highway	962	1,369	2,331	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,129	3,031	5,160	C	F
Princes Highway	Tongarra Road	Station Road	1,103	2,412	3,515	A	E
Princes Highway	Station Road	Airport Road	1,279	2,606	3,885	A	E
Princes Highway	Airport Road	Illawarra Highway	1,319	2,514	3,833	A	E
Princes Highway	Illawarra Highway	Yallah Road	1,988	4,152	6,140	C	F
Princes Highway	Yallah Road	Southern Freeway	2,087	4,453	6,540	C	F
Princes Highway	Southern Freeway	Huntley Road	1,168	1,763	2,931	E	F
Princes Highway	Huntley Road	Mount Brown Road	972	1,827	2,799	C	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,372	2,372		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,319	-	1,319	D	
Southern Freeway	Princes Highway	Fowlers Road	769	2,326	3,095	A	C
North South Arterial	Section 1		771	768	1,539	A	A
North South Arterial	Section 2		551	653	1,204	A	A
North South Arterial	Section 3		551	653	1,204	A	A
North South Arterial	Section 4		380	522	902	A	A
North South Arterial	Section 5		334	520	854	A	A
North South Arterial	Section 6		183	315	498	A	A
North South Arterial	Section 7		242	322	564	A	A
North South Arterial	Section 8		281	388	669	A	A
North South Arterial	Section 9		304	429	733	A	A
North South Arterial	Section 10		349	509	858	A	A
North South Arterial	Section 11		289	495	784	A	A
North South Arterial	Section 12		254	480	734	A	A

Appendix 7F - Network Performance Characteristics - 2031 CUDP 'Do Nothing' BAU Model

Intersection Performance {31_D01}

		Scenario 31_D01 AM Peak			Scenario 31_D01 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.143	16.5	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Tongarra Rd	Signals	>1.000	>120	F	0.927	35.0	C
Marshall Mount Road/Yallah Road	Priority	>1.000	>120	F	0.978	63.3	E
Huntley Rd/Marshall Mount Rd	Priority	0.498	11.3	A	0.026	13.6	A
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	>1.000	28.2	B	1.000	27.7	B
Illawarra Hwy/Broughton Ave	Roundabout	0.129	18.4	B	0.258	15.7	B
Tongarra Rd/Station Rd	Priority	>1.000	>120	F	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.889	34.3	C	0.674	16.3	B
Yallah Rd/Haywards Bay Dr	Priority	>1.000	>120	F	0.637	22.5	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.118	22.0	B	>1.000	>120	F
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.483	13.3	A	0.664	16.6	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F

APPENDIX 7F - Network Performance Characteristics - 2031 CUDP 'DO NOTHING' BAU SCENARIO {31_D01}

SCENARIO FINDINGS

A review of the model results highlighted the following road sections to be overcapacity (LoS E or worse):

- Illawarra Highway sections between Church Street and Calderwood Road and Terry Street and Princes Highway.
- Yallah Road between Marshall Mount Road and Princes Highway.
- Tongarra Road between Terry Street and Station Road.
- Princes Highway between Woollybutt Drive and Southern Freeway and Southern Freeway to Mount Brown Road.
- Southern Freeway northbound off-ramp to Princes Highway
- Southern Freeway southbound on-ramp from Princes Highway
- Southern Freeway between Princes Highway and Fowlers Road.

Appendix 7G

Network Performance Characteristics – 2031 CUDP ‘Do Nothing’ Mode Shift Model {31_D02}

Appendix 7G - Network Performance Characteristics – 2031 CUDP 'Do Nothing' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_D02A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	308	281	589	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	261	569	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	434	272	706	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	598	532	1,130	C	C
Illawarra Highway	Broughton Avenue	Church Street	908	713	1,621	C	A
Illawarra Highway	Church Street	Calderwood Road	1,193	749	1,942	E	A
Illawarra Highway	Calderwood Road	Russell Street	1,452	1,049	2,501	B	A
Illawarra Highway	Russell Street	Terry Street	1,642	1,047	2,689	C	A
Illawarra Highway	Terry Street	Croome Lane	1,527	1,001	2,528	F	D
Illawarra Highway	Croome Lane	Princes Highway	1,598	1,259	2,857	F	E
Yallah Road	Marshall Mount Road	Princes Highway	722	705	1,427	D	D
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	813	562	1,375	D	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	731	460	1,191	C	C
Marshall Mount Road	Yallah Road	Yallah TAFE	620	366	986	C	B
Marshall Mount Road	Yallah TAFE	Huntley Road	482	130	612	C	B
Calderwood Road	CUDP	Mansons Bridge	573	444	1,017	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	394	392	786	A	A
Huntley Road	Marshall Mount Road	Princes Highway	216	161	377	A	A
Tongarra Road	Terry Street	Stapleton Avenue	1,177	704	1,881	E	A
Tongarra Road	Stapleton Avenue	Croome Road	1,177	704	1,881	E	A
Tongarra Road	Croome Road	Station Road	1,188	842	2,030	E	B
Tongarra Road	Station Road	Ti-Tree Avenue	983	622	1,605	C	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	970	573	1,543	C	A
Tongarra Road	Ash Avenue	Princes Highway	1,277	756	2,033	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,902	2,772	5,674	F	F
Princes Highway	Tongarra Road	Station Road	2,617	1,966	4,583	E	C
Princes Highway	Station Road	Airport Road	2,866	2,261	5,127	F	D
Princes Highway	Airport Road	Illawarra Highway	3,118	2,528	5,646	F	E
Princes Highway	Illawarra Highway	Yallah Road	4,707	3,779	8,486	F	F
Princes Highway	Yallah Road	Southern Freeway	5,013	4,007	9,020	F	F
Princes Highway	Southern Freeway	Huntley Road	1,755	1,428	3,183	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,727	1,345	3,072	F	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,133	2,133		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,156	-	2,156	F	
Southern Freeway	Princes Highway	Fowlers Road	2,857	2,022	4,879	D	C
North South Arterial	Section 1		552	608	1,160	A	A
North South Arterial	Section 2		461	457	918	A	A
North South Arterial	Section 3		461	457	918	A	A
North South Arterial	Section 4		415	313	728	A	A
North South Arterial	Section 5		437	284	721	A	A
North South Arterial	Section 6		349	149	498	A	A
North South Arterial	Section 7		456	187	643	A	A
North South Arterial	Section 8		491	256	747	A	A
North South Arterial	Section 9		525	276	801	A	A
North South Arterial	Section 10		618	487	1,105	A	A
North South Arterial	Section 11		609	439	1,048	A	A
North South Arterial	Section 12		598	407	1,005	A	A

Appendix 7G - Network Performance Characteristics – 2031 CUDP 'Do Nothing' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_D02P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	396	274	670	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	366	267	633	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	450	283	733	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	546	617	1,163	C	C
Illawarra Highway	Broughton Avenue	Church Street	725	996	1,721	A	C
Illawarra Highway	Church Street	Calderwood Road	710	1,270	1,980	A	F
Illawarra Highway	Calderwood Road	Russell Street	944	1,500	2,444	A	C
Illawarra Highway	Russell Street	Terry Street	946	1,544	2,490	A	C
Illawarra Highway	Terry Street	Croome Lane	620	1,405	2,025	A	F
Illawarra Highway	Croome Lane	Princes Highway	707	1,676	2,383	A	F
Yallah Road	Marshall Mount Road	Princes Highway	568	669	1,237	C	D
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	383	768	1,151	C	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	283	658	941	B	C
Marshall Mount Road	Yallah Road	Yallah TAFE	323	598	921	B	C
Marshall Mount Road	Yallah TAFE	Huntley Road	12	474	486	A	D
Calderwood Road	CUDP	Mansons Bridge	593	561	1,154	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	411	527	938	A	A
Huntley Road	Marshall Mount Road	Princes Highway	179	439	618	A	A
Tongarra Road	Terry Street	Stapleton Avenue	855	1,297	2,152	B	F
Tongarra Road	Stapleton Avenue	Croome Road	855	1,297	2,152	B	F
Tongarra Road	Croome Road	Station Road	997	1,427	2,424	C	F
Tongarra Road	Station Road	Ti-Tree Avenue	850	1,182	2,032	B	E
Tongarra Road	Ti-Tree Avenue	Ash Avenue	827	1,122	1,949	B	D
Tongarra Road	Ash Avenue	Princes Highway	962	1,369	2,331	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,129	3,031	5,160	C	F
Princes Highway	Tongarra Road	Station Road	1,103	2,412	3,515	A	E
Princes Highway	Station Road	Airport Road	1,279	2,606	3,885	A	E
Princes Highway	Airport Road	Illawarra Highway	1,319	2,514	3,833	A	E
Princes Highway	Illawarra Highway	Yallah Road	1,988	4,152	6,140	C	F
Princes Highway	Yallah Road	Southern Freeway	2,087	4,453	6,540	C	F
Princes Highway	Southern Freeway	Huntley Road	1,168	1,763	2,931	E	F
Princes Highway	Huntley Road	Mount Brown Road	972	1,827	2,799	C	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,372	2,372		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,319	-	1,319	D	
Southern Freeway	Princes Highway	Fowlers Road	769	2,326	3,095	A	C
North South Arterial	Section 1		771	768	1,539	A	A
North South Arterial	Section 2		551	653	1,204	A	A
North South Arterial	Section 3		551	653	1,204	A	A
North South Arterial	Section 4		380	522	902	A	A
North South Arterial	Section 5		334	520	854	A	A
North South Arterial	Section 6		183	315	498	A	A
North South Arterial	Section 7		242	322	564	A	A
North South Arterial	Section 8		281	388	669	A	A
North South Arterial	Section 9		304	429	733	A	A
North South Arterial	Section 10		349	509	858	A	A
North South Arterial	Section 11		289	495	784	A	A
North South Arterial	Section 12		254	480	734	A	A

Appendix 7G - Network Performance Characteristics - 2031 CUDP 'Do Nothing' Mode Shift Model
Intersection Performance {31_D02}

		Scenario 31_D02 AM Peak			Scenario 31_D02 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.021	16.4	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Tongarra Rd	Signals	>1.000	>120	F	0.927	35.0	C
Marshall Mount Road/Yallah Road	Priority	>1.000	>120	F	0.978	63.3	E
Huntley Rd/Marshall Mount Rd	Priority	0.479	11.2	A	0.026	13.6	A
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	>1.000	26.0	B	1.000	27.7	B
Illawarra Hwy/Broughton Ave	Roundabout	0.108	17.8	B	0.258	15.7	B
Tongarra Rd/Station Rd	Priority	>1.000	>120	F	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.822	27.9	B	0.674	16.3	B
Yallah Rd/Haywards Bay Dr	Priority	>1.000	>120	F	0.637	22.5	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.118	21.8	B	0.597	26.4	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.475	13.3	A	0.664	16.6	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F

APPENDIX 7G - Network Performance Characteristics - 2031 CUDP 'DO NOTHING' MODE SHIFT SCENARIO {31_D02}

SCENARIO FINDINGS

A review of the model results highlighted the following road sections to be overcapacity (LoS E or worse):

- Illawarra Highway sections between Church Street and Calderwood Road, Russell Street and Princes Highway.
- Marshall Mount Road between Calderwood Road and Yallah Road.
- Tongarra Road between Terry Street and Ti-Tree Avenue.
- Princes Highway between Woollybutt Drive and Southern Freeway and Southern Freeway to Mount Brown Road.
- Southern Freeway northbound off-ramp to Princes Highway.
- Southern Freeway southbound on-ramp from Princes Highway.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7H

Network Performance Characteristics – 2031 CUDP ‘Do Minimum’ Mode Shift Model {31_D04}

Appendix 7H - Network Performance Characteristics – 2031 CUDP 'Do Minimum' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_D04A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	308	281	589	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	262	570	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	391	272	663	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	682	456	1,138	C	C
Illawarra Highway	Broughton Avenue	Church Street	838	423	1,261	B	A
Illawarra Highway	Church Street	Calderwood Road	1,214	446	1,660	E	A
Illawarra Highway	Calderwood Road	Russell Street	1,322	722	2,044	B	A
Illawarra Highway	Russell Street	Terry Street	1,620	715	2,335	C	A
Illawarra Highway	Terry Street	Tripoli Way	1,642	273	1,915	C	A
Illawarra Highway	Croome Lane	Princes Highway	831	645	1,476	B	A
Yallah Road	Marshall Mount Road	Princes Highway	635	444	1,079	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	540	474	1,014	C	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	534	468	1,002	C	B
Marshall Mount Road	Yallah Road	Yallah TAFE	355	479	834	B	C
Marshall Mount Road	Yallah TAFE	Huntley Road	157	155	312	B	B
Calderwood Road	CUDP	Mansons Bridge	652	550	1,202	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	360	224	584	A	A
Huntley Road	Marshall Mount Road	Princes Highway	208	240	448	A	A
Tongarra Road	Terry Street	Stapleton Avenue	1,017	1,144	2,161	D	E
Tongarra Road	Stapleton Avenue	Croome Road	1,017	1,144	2,161	D	E
Tongarra Road	Croome Road	Station Road	990	677	1,667	C	A
Tongarra Road	Station Road	Ti-Tree Avenue	765	537	1,302	B	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	739	475	1,214	A	A
Tongarra Road	Ash Avenue	Princes Highway	862	524	1,386	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	804	1,395	2,199	A	A
Princes Highway	Tongarra Road	Station Road	417	670	1,087	A	A
Princes Highway	Station Road	Airport Road	687	899	1,586	A	A
Princes Highway	Airport Road	Illawarra Highway	925	1,219	2,144	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,721	1,828	3,549	B	B
Princes Highway	Yallah Road	Southern Freeway	2,075	1,856	3,931	C	B
Princes Highway	Southern Freeway	Huntley Road	1,595	1,015	2,610	F	D
Princes Highway	Huntley Road	Mount Brown Road	1,546	998	2,544	F	C
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,190	2,190		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,139	-	2,139	F	
Southern Freeway Ext	Princes Highway	Croome Road	2,254	878	3,132	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,864	878	2,742	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,961	1,516	4,477	D	B
Southern Freeway	F6 Extension	Princes Highway	5,037	3,455	8,492	F	E
Southern Freeway	Princes Highway	Fowlers Road	3,028	1,870	4,898	D	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	226	663	889	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	479	597	1,076	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,163	214	1,377	A	A
Tripoli Way	Southern Freeway	Tongarra Road	186	675	861	A	A
North South Arterial	Section 1		365	640	1,005	A	A
North South Arterial	Section 2		315	452	767	A	A
North South Arterial	Section 3		315	452	767	A	A
North South Arterial	Section 4		269	295	564	A	A
North South Arterial	Section 5		281	265	546	A	A
North South Arterial	Section 6		160	127	287	A	A
North South Arterial	Section 7		207	154	361	A	A
North South Arterial	Section 8		238	211	449	A	A
North South Arterial	Section 9		264	218	482	A	A
North South Arterial	Section 10		361	409	770	A	A
North South Arterial	Section 11		351	358	709	A	A
North South Arterial	Section 12		340	323	663	A	A

Appendix 7H - Network Performance Characteristics – 2031 CUDP 'Do Minimum' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_D04P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	395	274	669	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	369	268	637	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	443	284	727	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	542	518	1,060	C	C
Illawarra Highway	Broughton Avenue	Church Street	568	474	1,042	A	A
Illawarra Highway	Church Street	Calderwood Road	677	801	1,478	A	B
Illawarra Highway	Calderwood Road	Russell Street	771	1,056	1,827	A	A
Illawarra Highway	Russell Street	Terry Street	845	1,172	2,017	A	A
Illawarra Highway	Terry Street	Tripoli Way	727	690	1,417	A	A
Illawarra Highway	Croome Lane	Princes Highway	298	998	1,296	A	C
Yallah Road	Marshall Mount Road	Princes Highway	580	579	1,159	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	366	591	957	C	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	362	581	943	B	C
Marshall Mount Road	Yallah Road	Yallah TAFE	436	655	1,091	C	C
Marshall Mount Road	Yallah TAFE	Huntley Road	33	441	474	A	C
Calderwood Road	CUDP	Mansons Bridge	691	600	1,291	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	331	239	570	A	A
Huntley Road	Marshall Mount Road	Princes Highway	179	379	558	A	A
Tongarra Road	Terry Street	Stapleton Avenue	656	1,456	2,112	A	F
Tongarra Road	Stapleton Avenue	Croome Road	656	1,456	2,112	A	F
Tongarra Road	Croome Road	Station Road	549	1,037	1,586	A	D
Tongarra Road	Station Road	Ti-Tree Avenue	401	754	1,155	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	362	667	1,029	A	A
Tongarra Road	Ash Avenue	Princes Highway	399	784	1,183	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	931	1,371	2,302	A	A
Princes Highway	Tongarra Road	Station Road	324	1,149	1,473	A	A
Princes Highway	Station Road	Airport Road	530	1,429	1,959	A	A
Princes Highway	Airport Road	Illawarra Highway	667	1,465	2,132	A	A
Princes Highway	Illawarra Highway	Yallah Road	926	2,425	3,351	A	E
Princes Highway	Yallah Road	Southern Freeway	981	2,445	3,426	A	E
Princes Highway	Southern Freeway	Huntley Road	1,228	1,775	3,003	E	F
Princes Highway	Huntley Road	Mount Brown Road	1,055	1,802	2,857	D	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	1,724	1,724		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,464	-	1,464	D	
Southern Freeway Ext	Princes Highway	Croome Road	1,794	1,275	3,069	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	988	1,275	2,263	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,224	1,969	3,193	B	C
Southern Freeway	F6 Extension	Princes Highway	2,204	4,578	6,782	C	F
Southern Freeway	Princes Highway	Fowlers Road	767	2,451	3,218	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	116	1,115	1,231	A	B
Tripoli Way	Calderwood Road	Illawarra Highway (East)	439	957	1,396	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	730	678	1,408	A	A
Tripoli Way	Southern Freeway	Tongarra Road	172	682	854	A	A
North South Arterial	Section 1		628	710	1,338	A	A
North South Arterial	Section 2		498	573	1,071	A	A
North South Arterial	Section 3		498	573	1,071	A	A
North South Arterial	Section 4		348	452	800	A	A
North South Arterial	Section 5		309	442	751	A	A
North South Arterial	Section 6		170	241	411	A	A
North South Arterial	Section 7		224	241	465	A	A
North South Arterial	Section 8		280	278	558	A	A
North South Arterial	Section 9		277	292	569	A	A
North South Arterial	Section 10		335	359	694	A	A
North South Arterial	Section 11		280	345	625	A	A
North South Arterial	Section 12		244	332	576	A	A

Appendix 7H - Network Performance Characteristics - 2031 CUDP 'Do Minimum' Mode Shift Model
Intersection Performance {31_D04}

		Scenario 31_D04 AM Peak			Scenario 31_D04 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.019	16.6	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	68.8	E	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	0.507	15.7	B	0.370	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.464	18.8	B	0.581	14.1	A
Marshall Mount Road/Yallah Road	Priority	0.589	23.5	B	0.967	63.2	E
Huntley Rd/Marshall Mount Rd	Priority	0.175	11.1	A	0.047	12.0	A
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	>1.000	17.5	B	0.868	15.9	B
Illawarra Hwy/Broughton Ave	Roundabout	0.479	19.7	B	0.686	20.3	B
Tongarra Rd/Station Rd	Priority	0.789	49.3	D	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.619	20.5	B	0.584	14.3	A
Yallah Rd/Haywards Bay Dr	Priority	>1.000	>120	F	0.172	18.6	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.030	21.2	B	0.420	21.8	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.300	12.9	A	0.449	14.5	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F
Tripoli Way/Major Collector Street	Roundabout	0.038	11.8	A	0.030	11.4	A
Tripoli Way and Calderwood Road.	Roundabout	0.500	17.0	B	1.000	50.3	D
Illawarra Highway and Tripoli Way.	Signals	>1.000	>120	F	>1.000	116.0	F
Tripoli Way and F6 Extension ramps.	Roundabout	0.007	13.2	A	0.111	14.6	B
Tongarra Road and Tripoli Way.	Signals	0.911	42.3	C	0.903	37.8	C

APPENDIX 7H - Network Performance Characteristics - 2031 CUDP 'DO MINIMUM' MODE SHIFT SCENARIO {31_D04}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- The 'do minimum' upgrades provide a greater level of satisfactory modelled peak hour operation compared with the previous scenario (31_D02) although the following road sections would be continue to overcapacity:
  - Illawarra Highway between Church Street and Calderwood Road.
  - Tongarra Road between Terry Street and Terry Street and Croome Road.
  - Princes Highway between Southern Freeway and Mount Brown Road.
  - Southern Freeway northbound off ramp to Princes Highway.
  - Southern Freeway southbound on ramp from Princes Highway.
- As with the base scenarios the section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7I

Network Performance Characteristics – 2031 CUDP 'Do Absolute Minimum' Mode Shift Model {31_D08}

Appendix 7I - Network Performance Characteristics – 2031 CUDP 'Do Absolute Minimum' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_D08A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	308	281	589	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	262	570	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	392	272	664	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	681	456	1,137	C	C
Illawarra Highway	Broughton Avenue	Church Street	840	425	1,265	B	A
Illawarra Highway	Church Street	Calderwood Road	1,215	449	1,664	E	A
Illawarra Highway	Calderwood Road	Russell Street	1,323	725	2,048	B	A
Illawarra Highway	Russell Street	Terry Street	1,622	719	2,341	C	A
Illawarra Highway	Terry Street	Tripoli Way	1,644	274	1,918	C	A
Illawarra Highway	Croome Lane	Princes Highway	832	643	1,475	B	A
Yallah Road	Marshall Mount Road	Princes Highway	633	472	1,105	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	538	473	1,011	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	533	468	1,001	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	374	469	843	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	181	144	325	A	A
Calderwood Road	CUDP	Mansons Bridge	652	549	1,201	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	360	224	584	A	A
Huntley Road	Marshall Mount Road	Princes Highway	218	217	435	A	A
Tongarra Road	Terry Street	Stapleton Avenue	1,017	1,147	2,164	D	E
Tongarra Road	Stapleton Avenue	Croome Road	1,017	1,147	2,164	D	E
Tongarra Road	Croome Road	Station Road	990	678	1,668	C	A
Tongarra Road	Station Road	Ti-Tree Avenue	765	538	1,303	B	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	740	475	1,215	A	A
Tongarra Road	Ash Avenue	Princes Highway	863	525	1,388	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	804	1,396	2,200	A	A
Princes Highway	Tongarra Road	Station Road	416	670	1,086	A	A
Princes Highway	Station Road	Airport Road	687	899	1,586	A	A
Princes Highway	Airport Road	Illawarra Highway	934	1,219	2,153	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,730	1,826	3,556	B	B
Princes Highway	Yallah Road	Southern Freeway	2,066	1,864	3,930	C	C
Princes Highway	Southern Freeway	Huntley Road	1,688	1,031	2,719	F	D
Princes Highway	Huntley Road	Mount Brown Road	1,656	998	2,654	F	C
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	1,753	1,753		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,139	-	2,139	F	
Southern Freeway Ext	Princes Highway	Croome Road	2,248	878	3,126	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,858	878	2,736	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,957	1,520	4,477	D	B
Southern Freeway	F6 Extension	Princes Highway	5,023	3,465	8,488	F	E
Southern Freeway	Princes Highway	Fowlers Road	2,911	1,852	4,763	D	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	226	660	886	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	478	594	1,072	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,163	214	1,377	A	A
Tripoli Way	Southern Freeway	Tongarra Road	186	678	864	A	A
North South Arterial	Section 1		363	640	1,003	A	A
North South Arterial	Section 2		313	452	765	A	A
North South Arterial	Section 3		313	452	765	A	A
North South Arterial	Section 4		267	296	563	A	A
North South Arterial	Section 5		279	265	544	A	A
North South Arterial	Section 6		158	127	285	A	A
North South Arterial	Section 7		195	156	351	A	A
North South Arterial	Section 8		230	213	443	A	A
North South Arterial	Section 9		262	219	481	A	A
North South Arterial	Section 10		359	411	770	A	A
North South Arterial	Section 11		349	359	708	A	A
North South Arterial	Section 12		338	324	662	A	A

Appendix 7I - Network Performance Characteristics – 2031 CUDP 'Do Absolute Minimum' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_D08P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	395	274	669	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	369	268	637	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	443	284	727	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	545	516	1,061	C	C
Illawarra Highway	Broughton Avenue	Church Street	570	473	1,043	A	A
Illawarra Highway	Church Street	Calderwood Road	679	799	1,478	A	B
Illawarra Highway	Calderwood Road	Russell Street	773	1,054	1,827	A	A
Illawarra Highway	Russell Street	Terry Street	850	1,171	2,021	A	A
Illawarra Highway	Terry Street	Tripoli Way	730	688	1,418	A	A
Illawarra Highway	Croome Lane	Princes Highway	298	994	1,292	A	C
Yallah Road	Marshall Mount Road	Princes Highway	578	577	1,155	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	363	598	961	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	360	589	949	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	436	666	1,102	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	32	453	485	A	A
Calderwood Road	CUDP	Mansons Bridge	686	600	1,286	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	331	239	570	A	A
Huntley Road	Marshall Mount Road	Princes Highway	181	383	564	A	A
Tongarra Road	Terry Street	Stapleton Avenue	658	1,456	2,114	A	F
Tongarra Road	Stapleton Avenue	Croome Road	658	1,456	2,114	A	F
Tongarra Road	Croome Road	Station Road	549	1,042	1,591	A	D
Tongarra Road	Station Road	Ti-Tree Avenue	400	759	1,159	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	363	672	1,035	A	A
Tongarra Road	Ash Avenue	Princes Highway	399	789	1,188	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	934	1,371	2,305	A	A
Princes Highway	Tongarra Road	Station Road	324	1,151	1,475	A	A
Princes Highway	Station Road	Airport Road	530	1,430	1,960	A	A
Princes Highway	Airport Road	Illawarra Highway	668	1,468	2,136	A	A
Princes Highway	Illawarra Highway	Yallah Road	926	2,422	3,348	A	E
Princes Highway	Yallah Road	Southern Freeway	976	2,437	3,413	A	E
Princes Highway	Southern Freeway	Huntley Road	1,318	1,804	3,122	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,146	1,834	2,980	E	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,436	2,436		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,139	-	2,139	F	
Southern Freeway Ext	Princes Highway	Croome Road	1,791	1,271	3,062	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	982	1,271	2,253	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,226	1,963	3,189	B	C
Southern Freeway	F6 Extension	Princes Highway	2,203	4,565	6,768	C	F
Southern Freeway	Princes Highway	Fowlers Road	740	2,354	3,094	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	116	1,110	1,226	A	B
Tripoli Way	Calderwood Road	Illawarra Highway (East)	439	952	1,391	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	732	675	1,407	A	A
Tripoli Way	Southern Freeway	Tongarra Road	172	676	848	A	A
North South Arterial	Section 1		628	714	1,342	A	A
North South Arterial	Section 2		497	577	1,074	A	A
North South Arterial	Section 3		497	577	1,074	A	A
North South Arterial	Section 4		348	454	802	A	A
North South Arterial	Section 5		307	446	753	A	A
North South Arterial	Section 6		168	248	416	A	A
North South Arterial	Section 7		222	248	470	A	A
North South Arterial	Section 8		277	284	561	A	A
North South Arterial	Section 9		275	299	574	A	A
North South Arterial	Section 10		332	366	698	A	A
North South Arterial	Section 11		277	352	629	A	A
North South Arterial	Section 12		241	338	579	A	A

Appendix 7I - Network Performance Characteristics - 2031 CUDP 'Do Absolute Minimum' Mode Shift Model
Intersection Performance {31_D08}

		Scenario 31_D08 AM Peak			Scenario 31_D08 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.019	16.6	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	68.9	E	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	0.515	15.8	B	0.369	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.464	18.8	B	0.469	14.3	A
Marshall Mount Road/Yallah Road	Priority	0.589	24.5	B	0.977	71.3	F
Huntley Rd/Marshall Mount Rd	Priority	0.198	11.0	A	0.046	12.1	A
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	1.000	17.5	B	0.888	18.0	B
Illawarra Hwy/Broughton Ave	Roundabout	0.477	19.7	B	0.686	20.3	B
Tongarra Rd/Station Rd	Priority	0.789	49.5	D	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.643	21.3	B	0.573	14.3	A
Yallah Rd/Haywards Bay Dr	Priority	>1.000	>120	F	0.174	18.6	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.027	21.3	B	0.493	22.4	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.310	12.9	A	0.447	14.5	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F
Tripoli Way/Major Collector Street	Roundabout	0.038	11.8	A	0.030	11.4	A
Tripoli Way and Calderwood Road.	Roundabout	0.500	16.9	B	1.000	47.8	D
Illawarra Highway and Tripoli Way.	Signals	>1.000	>120	F	>1.000	113.5	F
Tripoli Way and F6 Extension ramps.	Roundabout	0.007	13.2	A	0.111	14.6	B
Tongarra Road and Tripoli Way.	Signals	0.913	43.1	D	0.917	38.0	C

APPENDIX 7I - Network Performance Characteristics - 2031 CUDP 'DO ABSOLUTE MINIMUM' MODE SHIFT SCENARIO {31_D08}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- The 'do absolute minimum' upgrades provide a greater level of satisfactory modelled peak hour operation compared with the previous scenario (31_D04)although the following road sections would be continue to overcapacity:
  - Illawarra Highway between Church Street and Calderwood Road.
  - Tongarra Road between Terry Street and Croome Road.
  - Princes Highway between Southern Freeway and Mount Brown Road.
  - Southern Freeway northbound off ramp to Princes Highway.
  - Southern Freeway southbound on ramp from Princes Highway.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7J

Network Performance Characteristics – 2031 CUDP ‘Do Base Upgrades’ Mode Shift Model {31_D11}

Appendix 7J - Network Performance Characteristics – 2031 CUDP 'Do Base Upgrades' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_D11A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	308	284	592	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	265	573	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	375	275	650	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	595	479	1,074	C	C
Illawarra Highway	Broughton Avenue	Church Street	602	382	984	A	A
Illawarra Highway	Church Street	Calderwood Road	1,036	363	1,399	D	A
Illawarra Highway	Calderwood Road	Russell Street	1,110	445	1,555	A	A
Illawarra Highway	Russell Street	Terry Street	1,370	408	1,778	B	A
Illawarra Highway	Terry Street	Tripoli Way	1,583	265	1,848	C	A
Illawarra Highway	Croome Lane	Princes Highway	683	562	1,245	A	A
Yallah Road	Marshall Mount Road	Princes Highway	481	361	842	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	770	517	1,287	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	698	431	1,129	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	581	434	1,015	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	658	345	1,003	A	A
Calderwood Road	CUDP	Mansons Bridge	690	454	1,144	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	236	217	453	A	A
Huntley Road	Marshall Mount Road	Princes Highway	410	349	759	A	A
Tongarra Road	Terry Street	Stapleton Avenue	904	804	1,708	C	B
Tongarra Road	Stapleton Avenue	Croome Road	904	804	1,708	C	B
Tongarra Road	Croome Road	Station Road	945	624	1,569	C	A
Tongarra Road	Station Road	Ti-Tree Avenue	765	482	1,247	B	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	729	402	1,131	A	A
Tongarra Road	Ash Avenue	Princes Highway	876	474	1,350	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	800	1,140	1,940	A	A
Princes Highway	Tongarra Road	Station Road	448	386	834	A	A
Princes Highway	Station Road	Airport Road	639	572	1,211	A	A
Princes Highway	Airport Road	Illawarra Highway	783	632	1,415	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,417	1,145	2,562	A	A
Princes Highway	Yallah Road	Southern Freeway	1,641	1,147	2,788	B	A
Princes Highway	Southern Freeway	Huntley Road	1,818	111	1,929	C	A
Princes Highway	Huntley Road	Mount Brown Road	2,018	250	2,268	D	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	687	687		A
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,112	-	2,112	C	
Southern Freeway Ext	Princes Highway	Croome Road	1,909	523	2,432	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,454	523	1,977	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,354	871	3,225	C	A
Southern Freeway	F6 Extension	Princes Highway	3,995	2,066	6,061	F	C
Southern Freeway	Princes Highway	Fowlers Road	1,883	1,497	3,380	B	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	441	932	1,373	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	536	838	1,374	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,156	296	1,452	A	A
Tripoli Way	Southern Freeway	Tongarra Road	154	461	615	A	A
North South Arterial	Section 1		341	526	867	A	A
North South Arterial	Section 2		310	394	704	A	A
North South Arterial	Section 3		310	394	704	A	A
North South Arterial	Section 4		282	289	571	A	A
North South Arterial	Section 5		323	275	598	A	A
North South Arterial	Section 6		224	159	383	A	A
North South Arterial	Section 7		310	196	506	A	A
North South Arterial	Section 8		346	247	593	A	A
North South Arterial	Section 9		385	267	652	A	A
North South Arterial	Section 10		480	412	892	A	A
North South Arterial	Section 11		484	379	863	A	A
North South Arterial	Section 12		481	356	837	A	A

Appendix 7J - Network Performance Characteristics – 2031 CUDP 'Do Base Upgrades' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_D11P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	395	274	669	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	367	268	635	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	448	283	731	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	461	370	831	C	B
Illawarra Highway	Broughton Avenue	Church Street	450	318	768	A	A
Illawarra Highway	Church Street	Calderwood Road	546	603	1,149	A	A
Illawarra Highway	Calderwood Road	Russell Street	558	725	1,283	A	A
Illawarra Highway	Russell Street	Terry Street	687	853	1,540	A	A
Illawarra Highway	Terry Street	Tripoli Way	653	690	1,343	A	A
Illawarra Highway	Croome Lane	Princes Highway	253	936	1,189	A	C
Yallah Road	Marshall Mount Road	Princes Highway	453	476	929	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	440	885	1,325	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	336	785	1,121	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	476	903	1,379	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	315	956	1,271	A	A
Calderwood Road	CUDP	Mansons Bridge	605	580	1,185	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	238	154	392	A	A
Huntley Road	Marshall Mount Road	Princes Highway	265	514	779	A	A
Tongarra Road	Terry Street	Stapleton Avenue	557	1,128	1,685	A	D
Tongarra Road	Stapleton Avenue	Croome Road	557	1,128	1,685	A	D
Tongarra Road	Croome Road	Station Road	556	885	1,441	A	C
Tongarra Road	Station Road	Ti-Tree Avenue	436	607	1,043	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	377	523	900	A	A
Tongarra Road	Ash Avenue	Princes Highway	421	621	1,042	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	829	1,314	2,143	A	A
Princes Highway	Tongarra Road	Station Road	322	1,007	1,329	A	A
Princes Highway	Station Road	Airport Road	519	1,323	1,842	A	A
Princes Highway	Airport Road	Illawarra Highway	665	1,498	2,163	A	A
Princes Highway	Illawarra Highway	Yallah Road	882	2,399	3,281	A	D
Princes Highway	Yallah Road	Southern Freeway	796	2,302	3,098	A	D
Princes Highway	Southern Freeway	Huntley Road	848	1,349	2,197	A	A
Princes Highway	Huntley Road	Mount Brown Road	858	1,608	2,466	A	B
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,204	2,204		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,195	-	1,195	A	
Southern Freeway Ext	Princes Highway	Croome Road	1,857	1,260	3,117	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	1,027	1,260	2,287	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,120	1,686	2,806	B	B
Southern Freeway	F6 Extension	Princes Highway	1,916	4,151	6,067	C	F
Southern Freeway	Princes Highway	Fowlers Road	721	2,178	2,899	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	388	1,164	1,552	A	B
Tripoli Way	Calderwood Road	Illawarra Highway (East)	582	948	1,530	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	820	740	1,560	A	A
Tripoli Way	Southern Freeway	Tongarra Road	144	555	699	A	A
North South Arterial	Section 1		580	791	1,371	A	A
North South Arterial	Section 2		486	715	1,201	A	A
North South Arterial	Section 3		486	715	1,201	A	A
North South Arterial	Section 4		369	622	991	A	A
North South Arterial	Section 5		338	615	953	A	A
North South Arterial	Section 6		206	429	635	A	A
North South Arterial	Section 7		325	444	769	A	A
North South Arterial	Section 8		335	527	862	A	A
North South Arterial	Section 9		366	553	919	A	A
North South Arterial	Section 10		399	631	1,030	A	A
North South Arterial	Section 11		346	620	966	A	A
North South Arterial	Section 12		313	607	920	A	A

Appendix 7J - Network Performance Characteristics - 2031 CUDP 'Do Base Upgrades' Mode Shift Model
Intersection Performance {31_D11}

		Scenario 31_D11 AM Peak			Scenario 31_D11 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.019	16.6	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	1.000	53.5	D	0.950	37.3	C
Illawarra Hwy/Princes Hwy	Roundabout	0.379	14.1	A	0.135	13.2	A
Princes Hwy/Tongarra Rd	Signals	0.473	18.9	B	0.431	13.9	A
Marshall Mount Road/Yallah Road	Priority	0.899	26.7	B	>1.000	>120	F
Huntley Rd/Marshall Mount Rd	Priority	0.840	21.3	B	0.708	24.9	B
Princes Hwy/Huntley Rd	Signals	>1.000	28.8	C	>1.000	14.9	B
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.682	17.5	B	0.507	12.6	A
Illawarra Hwy/Broughton Ave	Roundabout	0.366	15.4	B	0.561	16.2	B
Tongarra Rd/Station Rd	Priority	0.589	26.7	B	0.798	27.4	B
Yallah Rd/Princes Hwy on-ramp	Priority	0.643	14.4	A	0.379	11.5	A
Yallah Rd/Haywards Bay Dr	Priority	0.091	14.1	A	0.182	15.5	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.027	21.2	B	0.222	21.2	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.230	12.8	A	0.347	14.3	A
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Signals	0.529	16.6	B	0.842	18.2	B
Princes Hwy/Cormack Ave	Signals	0.532	23.0	B	0.866	33.9	C
Tripoli Way/Major Collector Street	Roundabout	0.067	12.0	A	0.047	11.6	A
Tripoli Way and Calderwood Road.	Roundabout	0.007	21.2	B	0.448	21.6	B
Illawarra Highway and Tripoli Way.	Signals	1.000	45.7	D	1.000	38.7	C
Tripoli Way and F6 Extension ramps.	Roundabout	0.150	12.7	A	0.111	14.3	A
Tongarra Road and Tripoli Way.	Signals	0.817	24.8	B	0.795	19.5	B

APPENDIX 7J - Network Performance Characteristics - 2031 CUDP 'DO BASE UPGRADES' MODE SHIFT SCENARIO {31_D11}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- Significant improvements to overall network operation with all road section providing a mid-block LoS of D or better.
- Intersection modelling as part of this option also indicated the need for the intersection of Marshall Mount Road and Yallah Road to be upgraded from its current priority to roundabout ccontrol to ensure acceptable peak hour operation. All other intersection layouts assessed provide an overall LoS of D or better.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7K

Network Performance Characteristics – 2031 CUDP ‘Do Full Development Upgrades’ Mode Shift Model {31_D12}

Appendix 7K - Network Performance Characteristics – 2031 CUDP 'Do Full Development Upgrades' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_D12A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	308	284	592	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	265	573	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	374	275	649	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	595	478	1,073	C	C
Illawarra Highway	Broughton Avenue	Church Street	603	382	985	A	A
Illawarra Highway	Church Street	Calderwood Road	1,037	363	1,400	D	A
Illawarra Highway	Calderwood Road	Russell Street	1,116	444	1,560	A	A
Illawarra Highway	Russell Street	Terry Street	1,380	408	1,788	B	A
Illawarra Highway	Terry Street	Tripoli Way	1,585	266	1,851	C	A
Illawarra Highway	Croome Lane	Princes Highway	683	560	1,243	A	A
Yallah Road	Marshall Mount Road	Princes Highway	482	367	849	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	768	520	1,288	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	695	435	1,130	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	578	433	1,011	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	654	342	996	A	A
Calderwood Road	CUDP	Mansons Bridge	687	455	1,142	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	235	222	457	A	A
Huntley Road	Marshall Mount Road	Princes Highway	409	349	758	A	A
Tongarra Road	Terry Street	Stapleton Avenue	912	804	1,716	C	B
Tongarra Road	Stapleton Avenue	Croome Road	912	804	1,716	C	B
Tongarra Road	Croome Road	Station Road	952	624	1,576	C	A
Tongarra Road	Station Road	Ti-Tree Avenue	773	482	1,255	B	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	736	402	1,138	A	A
Tongarra Road	Ash Avenue	Princes Highway	884	473	1,357	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	801	1,148	1,949	A	A
Princes Highway	Tongarra Road	Station Road	449	385	834	A	A
Princes Highway	Station Road	Airport Road	639	573	1,212	A	A
Princes Highway	Airport Road	Illawarra Highway	784	633	1,417	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,418	1,143	2,561	A	A
Princes Highway	Yallah Road	Southern Freeway	1,642	1,151	2,793	B	A
Princes Highway	Southern Freeway	Huntley Road	1,819	111	1,930	C	A
Princes Highway	Huntley Road	Mount Brown Road	2,017	249	2,266	D	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	691	691		A
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,115	-	2,115	C	
Southern Freeway Ext	Princes Highway	Croome Road	1,909	516	2,425	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,454	516	1,970	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,356	870	3,226	C	A
Southern Freeway	F6 Extension	Princes Highway	3,998	2,069	6,067	F	C
Southern Freeway	Princes Highway	Fowlers Road	1,883	1,497	3,380	B	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	432	929	1,361	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	532	835	1,367	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,124	296	1,420	A	A
Tripoli Way	Southern Freeway	Tongarra Road	153	461	614	A	A
North South Arterial	Section 1		339	524	863	A	A
North South Arterial	Section 2		308	392	700	A	A
North South Arterial	Section 3		308	392	700	A	A
North South Arterial	Section 4		279	288	567	A	A
North South Arterial	Section 5		320	274	594	A	A
North South Arterial	Section 6		221	158	379	A	A
North South Arterial	Section 7		307	195	502	A	A
North South Arterial	Section 8		344	249	593	A	A
North South Arterial	Section 9		383	270	653	A	A
North South Arterial	Section 10		478	414	892	A	A
North South Arterial	Section 11		481	381	862	A	A
North South Arterial	Section 12		478	358	836	A	A

Appendix 7K - Network Performance Characteristics – 2031 CUDP 'Do Full Development Upgrades' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_D12P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	395	274	669	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	367	268	635	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	448	283	731	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	461	370	831	C	B
Illawarra Highway	Broughton Avenue	Church Street	450	318	768	A	A
Illawarra Highway	Church Street	Calderwood Road	547	599	1,146	A	A
Illawarra Highway	Calderwood Road	Russell Street	564	722	1,286	A	A
Illawarra Highway	Russell Street	Terry Street	687	850	1,537	A	A
Illawarra Highway	Terry Street	Tripoli Way	653	688	1,341	A	A
Illawarra Highway	Croome Lane	Princes Highway	253	940	1,193	A	C
Yallah Road	Marshall Mount Road	Princes Highway	456	478	934	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	439	878	1,317	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	335	778	1,113	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	475	895	1,370	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	315	948	1,263	A	A
Calderwood Road	CUDP	Mansons Bridge	605	579	1,184	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	238	158	396	A	A
Huntley Road	Marshall Mount Road	Princes Highway	264	505	769	A	A
Tongarra Road	Terry Street	Stapleton Avenue	557	1,127	1,684	A	D
Tongarra Road	Stapleton Avenue	Croome Road	557	1,127	1,684	A	D
Tongarra Road	Croome Road	Station Road	556	885	1,441	A	C
Tongarra Road	Station Road	Ti-Tree Avenue	437	607	1,044	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	377	522	899	A	A
Tongarra Road	Ash Avenue	Princes Highway	421	620	1,041	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	828	1,314	2,142	A	A
Princes Highway	Tongarra Road	Station Road	322	1,007	1,329	A	A
Princes Highway	Station Road	Airport Road	520	1,324	1,844	A	A
Princes Highway	Airport Road	Illawarra Highway	665	1,499	2,164	A	A
Princes Highway	Illawarra Highway	Yallah Road	883	2,403	3,286	A	E
Princes Highway	Yallah Road	Southern Freeway	797	2,308	3,105	A	D
Princes Highway	Southern Freeway	Huntley Road	843	1,365	2,208	A	A
Princes Highway	Huntley Road	Mount Brown Road	853	1,616	2,469	A	B
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,212	2,212		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,196	-	1,196	A	
Southern Freeway Ext	Princes Highway	Croome Road	1,859	1,260	3,119	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	1,028	1,260	2,288	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,120	1,688	2,808	B	B
Southern Freeway	F6 Extension	Princes Highway	1,917	4,158	6,075	C	F
Southern Freeway	Princes Highway	Fowlers Road	721	2,178	2,899	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	389	1,175	1,564	A	C
Tripoli Way	Calderwood Road	Illawarra Highway (East)	576	958	1,534	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	821	745	1,566	A	A
Tripoli Way	Southern Freeway	Tongarra Road	143	554	697	A	A
North South Arterial	Section 1		580	784	1,364	A	A
North South Arterial	Section 2		486	709	1,195	A	A
North South Arterial	Section 3		486	709	1,195	A	A
North South Arterial	Section 4		369	615	984	A	A
North South Arterial	Section 5		338	608	946	A	A
North South Arterial	Section 6		206	422	628	A	A
North South Arterial	Section 7		324	438	762	A	A
North South Arterial	Section 8		335	519	854	A	A
North South Arterial	Section 9		365	545	910	A	A
North South Arterial	Section 10		398	623	1,021	A	A
North South Arterial	Section 11		346	612	958	A	A
North South Arterial	Section 12		312	599	911	A	A

Appendix 7K - Network Performance Characteristics - 2031 CUDP 'Do Full Development Upgrades' Mode Shift Model

Intersection Performance {31_D12}

		Scenario 31_D12 AM Peak			Scenario 31_D12 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.019	16.6	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	1.000	55.1	D	0.950	37.3	C
Illawarra Hwy/Princes Hwy	Roundabout	0.379	14.1	A	0.350	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.596	18.0	B	0.489	13.7	A
Marshall Mount Road/Yallah Road	Roundabout	0.300	16.9	B	0.547	21.3	B
Huntley Rd/Marshall Mount Rd	Priority	0.697	16.4	B	0.704	24.6	B
Princes Hwy/Huntley Rd	Signals	>1.000	27.0	B	1.000	14.1	A
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.717	15.9	B	0.498	12.0	A
Illawarra Hwy/Broughton Ave	Roundabout	0.366	15.4	B	0.408	14.8	B
Tongarra Rd/Station Rd	Priority	0.598	27.1	B	0.800	27.5	B
Yallah Rd/Princes Hwy on-ramp	Priority	0.644	14.4	A	0.382	11.5	A
Yallah Rd/Haywards Bay Dr	Priority	0.092	14.3	A	0.183	15.5	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.027	21.2	B	0.500	16.2	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.236	12.8	A	0.350	14.3	A
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Signals	0.638	14.6	B	0.748	17.0	B
Princes Hwy/Cormack Ave	Signals	0.748	22.4	B	0.877	34.8	C
Tripoli Way/Major Collector Street	Roundabout	0.067	12.0	A	0.047	11.6	A
Tripoli Way and Calderwood Road.	Roundabout	0.007	21.2	B	0.464	22.0	B
Illawarra Highway and Tripoli Way.	Signals	1.000	45.8	D	1.000	34.7	C
Tripoli Way and F6 Extension ramps.	Roundabout	0.140	12.7	A	0.111	14.3	A
Tongarra Road and Tripoli Way.	Signals	0.817	25.0	B	0.795	19.5	B

APPENDIX 7K - Network Performance Characteristics - 2031 CUDP 'DO FULL DEVELOPMENT UPGRADES' MODE SHIFT SCENARIO {31_D12}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- The introduction of a roundabout at the Marshall Mount Road and Yallah Road leads to a removal of intersection delay which in turn promotes an additional 5 vehicles to use Princes Highway between Illawara Highway and Yallah Road. This small rise in vehicles is sufficient to change the mid-block LoS from a D to an E. However, given the future uncertainties in terms of final road network and land use releases and in terms of sustainable transport aims it is proposed to retain the existing layout rather than produce an additional traffic lane along the affected section.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7L

2031 CUDP Full Development Sensitivity Testing

APPENDIX 7L – 2031 CUDP Full Development Sensitivity Testing

In order to test the sensitivity of the future road network (2031) to potential increased yields within CUDP, two model scenarios were run as follows:

- Additional 10% CUDP dwellings.
- Additional 15% CUDP dwellings.

Both of the above models were run for the AM and PM peaks with the following assumptions:

- The 2009 road network with the internal CUDP road network plus the full 2031 full development road network upgrades.
- Regional infill growth, external growth, regional new development growth with BAU modal splits
- CUDP growth + 10% or 15% additional dwellings with 10% mode shift.

For each scenario the mid-block and turning traffic volumes were extracted from the relevant 2031 AM and PM TRACKS models.

In order to assess the network performance the following steps were undertaken:

1. Run the model for the current scenario with additional dwellings and mode share.
2. Review mid-block and turning traffic volumes to identify any significant changes or anomalies.
3. Mid-block traffic volumes were used to assess mid-block carriageway capacity and performance.
4. Turning traffic volumes were used to assess intersection performance.

The mid-block and turning traffic volumes were used to then assess mid-block carriageway capacity and intersection performance. This sensitivity tests identified that the modelled road network (on a mid-block capacity basis) provided a road network generally capable of satisfactorily accommodating the 2031 future demand with the additional 10% or 15% yield in dwellings in CUDP.

Detailed results (mid-block volumes and carriageway LoS and intersection Los) for the worst case scenario of +15% additional CUDP dwellings are provided in the tables on following pages.

A summary of the key findings of the analysis of +15% CUDP additional dwellings scenario follows:

- There will be no change in mid-block LoS during the AM peak when compared to the full development CUDP scenario, with the exception of:
  - Tongarra Road southbound between Ti-Tree Avenue and Ash Avenue will change from LoS A to LoS B.
- There will be minor changes in mid-block LoS during the PM peak when compared to the full development CUDP scenario at the following locations (all sections will still operate at LoS C or better):
  - Illawarra Highway westbound between Yellow Rock Road and Broughton.
  - Marshall Mount Road southbound south of North Marshall Mount Road and south of Huntley.
  - Southern Freeway off-ramp between the Southern Freeway and Princes.
  - Southern Freeway extension northbound between Princes Highway and Croome Road.
- The layout of the section of the Princes Highway southbound between the south-facing ramps at the Tallawarra Interchange and the F6 extension will need to be considered as part of the design process for the F6 extension based upon the forecast traffic volumes. As a result of the 15% increase in CUDP yields traffic volumes along this section of road will increase by approximately 4% (in the section south of Yallah Road) during the PM Peak. This will result in a change in LoS from D to E for this section.

- The following intersections will experience a change in overall LoS (but will still operate at LoS C or better) as a result of the 15% increase in yield in CUDP:
  - Princes Highway/Huntley Road.
  - Tongarra Road/Station Road.
  - Yallah Road/Princes Highway On-ramp.
  - Haywards Bay Drive/Princes Highway southbound ramps.
  - Tripoli Way/Calderwood Road.
- Intersection analysis showed that the intersection of Illawarra Highway with Tongarra Road and Terry Street will perform at a LoS F in the PM peak period (Los D in the AM Peak). It is difficult to provide additional capacity through the addition of traffic lanes due to frontage development on all sides of the intersection. It is likely that if constructed the Tripoli Way Extension will create a significant redistribution of traffic. It is recommended that should additional development beyond the yields contemplated by the Concept Plan eventuate that further detailed investigation be undertaken with Council/RTA on potential improvements at this intersection. This would also be better understood based upon a re-survey of traffic volumes and subsequent analysis once the Tripoli Way Extension is completed.

Appendix L - Network Performance Characteristics

2031 CUDP 'Do Full Development Upgrades' Mode Shift Model - +15% CUDP Sensitivity Test

		Sensitivity Scenario 15% (5520 Dwellings)					
		Scenario 31_S15 AM Peak			Scenario 31_S15 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.019	16.6	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	71.3	F	>1.000	49.6	D
Illawarra Hwy/Princes Hwy	Roundabout	0.376	14.1	A	0.353	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.512	19.2	B	0.433	13.9	A
Marshall Mount Road/Yallah Road	Roundabout	0.305	17.0	B	0.706	27.3	B
Huntley Rd/Marshall Mount Rd	Priority	0.896	25.6	B	0.721	26.4	B
Princes Hwy/Huntley Rd	Signals	>1.000	25.7	B	1.000	17.1	B
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.735	18.1	B	0.596	14.5	A
Illawarra Hwy/Broughton Ave	Roundabout	0.389	15.7	B	0.596	17.1	B
Tongarra Rd/Station Rd	Priority	0.638	29.6	C	0.878	36.4	C
Yallah Rd/Princes Hwy on-ramp	Priority	0.664	14.8	B	0.408	12.1	A
Yallah Rd/Haywards Bay Dr	Priority	0.094	14.3	A	0.186	17.7	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.028	21.4	B	0.545	23.6	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.235	12.9	A	0.423	14.6	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Signals	0.549	17.1	B	0.744	15.2	B
Princes Hwy/Cormack Ave	Signals	0.561	23.0	B	0.909	38.8	C
Tripoli Way and Calderwood Road.	Roundabout	0.007	21.3	B	0.600	30.3	C
Illawarra Highway and Tripoli Way.	Signals	>1.000	50.0	D	1.000	38.8	C
Tongarra Road and Tripoli Way.	Signals	0.972	52.0	D	0.776	18.7	B

Appendix 7L - Network Performance Characteristics
Mid-block Carriageway Performance - 2031 CUDP 'Additional 15%' Mode Shift Model

Location			AM Peak					PM Peak				
			Peak Flow (Veh/hr)			LoS		Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	309	285	594	B	B	397	274	671	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	264	572	B	B	365	267	632	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	379	275	654	C	B	473	287	760	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	636	486	1,122	C	C	488	443	931	C	C
Illawarra Highway	Broughton Avenue	Church Street	638	393	1,031	A	A	478	387	865	A	A
Illawarra Highway	Church Street	Calderwood Road	1,059	376	1,435	D	A	569	658	1,227	A	A
Illawarra Highway	Calderwood Road	Russell Street	1,148	472	1,620	A	A	588	812	1,400	A	A
Illawarra Highway	Russell Street	Terry Street	1,425	419	1,844	B	A	698	917	1,615	A	A
Illawarra Highway	Terry Street	Tripoli Way	1,571	270	1,841	C	A	644	763	1,407	A	A
Illawarra Highway	Croome Lane	Princes Highway	682	570	1,252	A	A	279	949	1,228	A	C
Yallah Road	Marshall Mount Road	Princes Highway	497	365	862	C	C	488	535	1,023	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	857	570	1,427	A	A	495	1,064	1,559	A	B
Marshall Mount Road	North Marshall Mount Road	Yallah Road	770	467	1,237	A	A	371	941	1,312	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	622	451	1,073	A	A	482	1,005	1,487	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	703	368	1,071	A	A	308	1,044	1,352	A	B
Calderwood Road	CUDP	Mansons Bridge	692	495	1,187	C	C	707	624	1,331	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	237	225	462	A	A	273	192	465	A	A
Huntley Road	Marshall Mount Road	Princes Highway	381	349	730	A	A	217	500	717	A	A
Tongarra Road	Terry Street	Stapleton Avenue	984	813	1,797	C	B	568	1,112	1,680	A	D
Tongarra Road	Stapleton Avenue	Croome Road	984	813	1,797	C	B	568	1,112	1,680	A	D
Tongarra Road	Croome Road	Station Road	993	627	1,620	C	A	565	950	1,515	A	C
Tongarra Road	Station Road	Ti-Tree Avenue	810	484	1,294	B	A	442	666	1,108	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	777	411	1,188	B	A	382	578	960	A	A
Tongarra Road	Ash Avenue	Princes Highway	940	475	1,415	A	A	420	673	1,093	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	794	1,222	2,016	A	A	871	1,316	2,187	A	A
Princes Highway	Tongarra Road	Station Road	442	405	847	A	A	321	1,019	1,340	A	A
Princes Highway	Station Road	Airport Road	643	593	1,236	A	A	520	1,339	1,859	A	A
Princes Highway	Airport Road	Illawarra Highway	775	663	1,438	A	A	678	1,520	2,198	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,404	1,181	2,585	A	A	919	2,431	3,350	A	E
Princes Highway	Yallah Road	Southern Freeway	1,639	1,182	2,821	B	A	874	2,402	3,276	A	E
Princes Highway	Southern Freeway	Huntley Road	1,882	134	2,016	C	A	940	1,106	2,046	A	A
Princes Highway	Huntley Road	Mount Brown Road	2,052	272	2,324	D	A	904	1,353	2,257	A	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	720	720		A	-	2,216	2,216		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,208	-	2,208	C		1,272	-	1,272	B	
Southern Freeway Ext	Princes Highway	Croome Road	1,982	544	2,526	C	A	1,910	1,283	3,193	C	B
Southern Freeway Ext	Croome Road	Tripoli Way	1,531	544	2,075	B	A	1,065	1,283	2,348	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	2,434	870	3,304	C	A	1,138	1,731	2,869	B	B
Southern Freeway	F6 Extension	Princes Highway	4,073	2,102	6,175	F	C	2,012	4,294	6,306	C	F
Southern Freeway	Princes Highway	Fowlers Road	1,864	1,494	3,358	B	B	740	2,311	3,051	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	473	937	1,410	A	A	425	1,259	1,684	A	C
Tripoli Way	Calderwood Road	Illawarra Highway (East)	578	838	1,416	A	A	610	1,051	1,661	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,164	298	1,462	A	A	830	869	1,699	A	A
Tripoli Way	Southern Freeway	Tongarra Road	172	461	633	A	A	144	480	624	A	A
North South Arterial	Section 1		359	580	939	A	A	677	840	1,517	A	A
North South Arterial	Section 2		331	435	766	A	A	566	778	1,344	A	A
North South Arterial	Section 3		331	435	766	A	A	566	778	1,344	A	A
North South Arterial	Section 4		300	317	617	A	A	419	694	1,113	A	A
North South Arterial	Section 5		349	302	651	A	A	386	665	1,051	A	A
North South Arterial	Section 6		263	181	444	A	A	248	483	731	A	A
North South Arterial	Section 7		361	222	583	A	A	426	503	929	A	A
North South Arterial	Section 8		388	284	672	A	A	385	611	996	A	A
North South Arterial	Section 9		439	308	747	A	A	434	652	1,086	A	A
North South Arterial	Section 10		532	452	984	A	A	448	742	1,190	A	A
North South Arterial	Section 11		536	415	951	A	A	384	730	1,114	A	A
North South Arterial	Section 12		533	389	922	A	A	344	714	1,058	A	A

Appendix 9A

Background Review – Sustainability Measures

APPENDIX 9A – Background Review - Sustainability Measures

URBAN DESIGN

Good urban design is not just about making places visually attractive, good urban design:

- Delivers value for money. Design costs are a small percentage of construction costs, but it is through the design process that the greatest impact can be made on the quality, efficiency and overall sustainability of buildings and travel patterns.
- Encourages local community identity creating places that respond to people's needs and aspirations. This in turn can help influence peoples travel patterns by for example shopping locally.
- Improves the longer-term "liveability", management and maintenance of the built environment, including public places such as streets and parks, to ensure spaces can stay clean, safe and green and achieve a vitality that may further support local leisure employment and retailing patterns.
- Contributes to the achievement of sustainable development by respecting historic or local context (where appropriate) and making best use of resources, whilst being able to respond to change.

ACTIVE TRANSPORT MEASURES

Provision of infrastructure for walk/cycle modes can encourage travel by these sustainable modes which is beneficial to overall environmental objectives and the participant's health.

The provision of an adequate footpath network (adequate widths for intended usage, suitable grades, street lit for security, provision of safe pedestrian crossing points, available for mobility impaired users etc) can help encourage local trips to be undertaken by foot to reduce the number of vehicle trips and promote healthier travel and also provide good pedestrian access to public transport nodes to promote efficient integration. It is recognised that pedestrians have a propensity to minimize trips lengths although research suggest that regular walk trips in the range 400m-800m are commonplace and even up to 1 km are not inappropriate.

Bicycle trips provide an ideal transport mode to undertake medium length trips (up to 5km) and bicycle usage can be promoted if good dedicated cycle infrastructure is provided along main corridors of movements and to key local destinations such as town centre uses, recreational and educational uses and key transport nodes.

WAYFINDING SIGNAGE

As part of a good footpath network providing wayfinding information can encourage residents and visitors to walk to local centres and key destinations. Effective wayfinding signage could include comprehensive maps, showing destinations, distances, landmarks and safety contacts. Lighting is also an important element of the footpath network of the wayfinding strategy. An example of an effective cycle wayfinding signage is shown in **Error! Reference source not found.**.

Photograph Error! No text of specified style in document.**.1** **Example of effective cycle wayfinding signage**

EARLY PROVISION OF BUS SERVICES

Early provision of bus services is essential to ensure that sustainable travel behavior is encouraged from the commencement of development. The provision of bus services from the outset potentially allows residents to establish their patterns of travel when moving into a new home. This may result in avoiding the need to purchase a second or third vehicle for their family without compromising access to employment and services. These services should be of an appropriate standard to ensure they are seen as a realistic alternative to the private vehicle and to develop positive perceptions of public transport.

TELE-WORKING/TELE-COMMUTING

National Broadband Network

The Australian Government announced on 7 April 2009 it would establish a new company to invest up to $43 billion over eight years delivering superfast broadband to Australian homes and workplaces. As part of this program, the Government announced on 7 April 2009 that greenfield estates across Australia should have fibre optic infrastructure to prepare them for the future. The CUDP will be developed with fibre to the premises technology.

The National Broadband Network (NBN) will dramatically increase the speed and capacity of telecommunications facilities in Australia. The greatest potential impact that the NBN will have on transport will be a reduced need to travel through the greater use of telecommuting and video conference technologies.

Telecommuting is still in its relative infancy, although trials have been occurring in Australia for at least ten years. Research has shown that the effectiveness of telecommuting programs is variable, with factors affecting the success of such programs including the availability of high-speed broadband, commuting distance, job compatibility and business enthusiasm/reluctance. Research by the Fibre to the Home Council in the USA has shown that telecommuters with access to fibre to the home technology are likely to work from home for an additional two days per month than telecommuters utilising regular broadband internet connections.

Research in Australia has identified that a reduction in travel demand of 6-12% is potentially achievable; however this is yet to be tested through large-scale trials.

Towards a High-Bandwidth, Low Carbon Future (2009)

This report provides an analysis of the opportunities for Australia to achieve nationally significant reductions in greenhouse gas emissions through the greater utilisation of telecommunications networks.

The report cites tele-working and decentralised workplaces as examples of how telecommunications networks can be used to reduce travel demand. Tele-working would allow employees to work from home, for all or part of the working week, eliminating the need for commuting. The decentralised workplace involves allowing employees to work remotely from a ‘tele-work centre’ or a regional centre located closer to their home than the normal workplace. As well as reducing commuting distance and travel time, the decentralised workplace can allow employees to live and work from a regional centre, shifting travel demand from the congested areas of Sydney to less congested areas within New South Wales. The report cites that the average commute time in Sydney is 4.9 hours per week, whilst the average commute time for the rest of the New South Wales is only 2.7 hours per week.

The report also cites the greater use of real-time data transfers to provide improved public transport services. This may involve the use of mobile phones to order taxis or for service operators to respond quickly to spikes in demand. The integration of demand data can assist in improving the viability of the transport network.

RTA West Gosford Tele-centre Project (1998/99)

This report summarises the results of a tele-centre experiment conducted by the RTA in 1998/99. A tele-centre was established at West Gosford at an existing RTA depot to obviate the need for local employees to commute to RTA offices in Sydney or Newcastle. Most participants in the experiment tele-worked for less than the full working week.

Travel time, distance and cost savings were significant for tele-workers who would otherwise have travelled long distances to their regular workplace. Some participants experienced no reduction in travel costs due to the continued use of periodical rail tickets for the days which they travelled to their regular workplace. 53% of participants tended to use some of the travel time savings to work longer hours at the tele-centre.

Appendix 10A

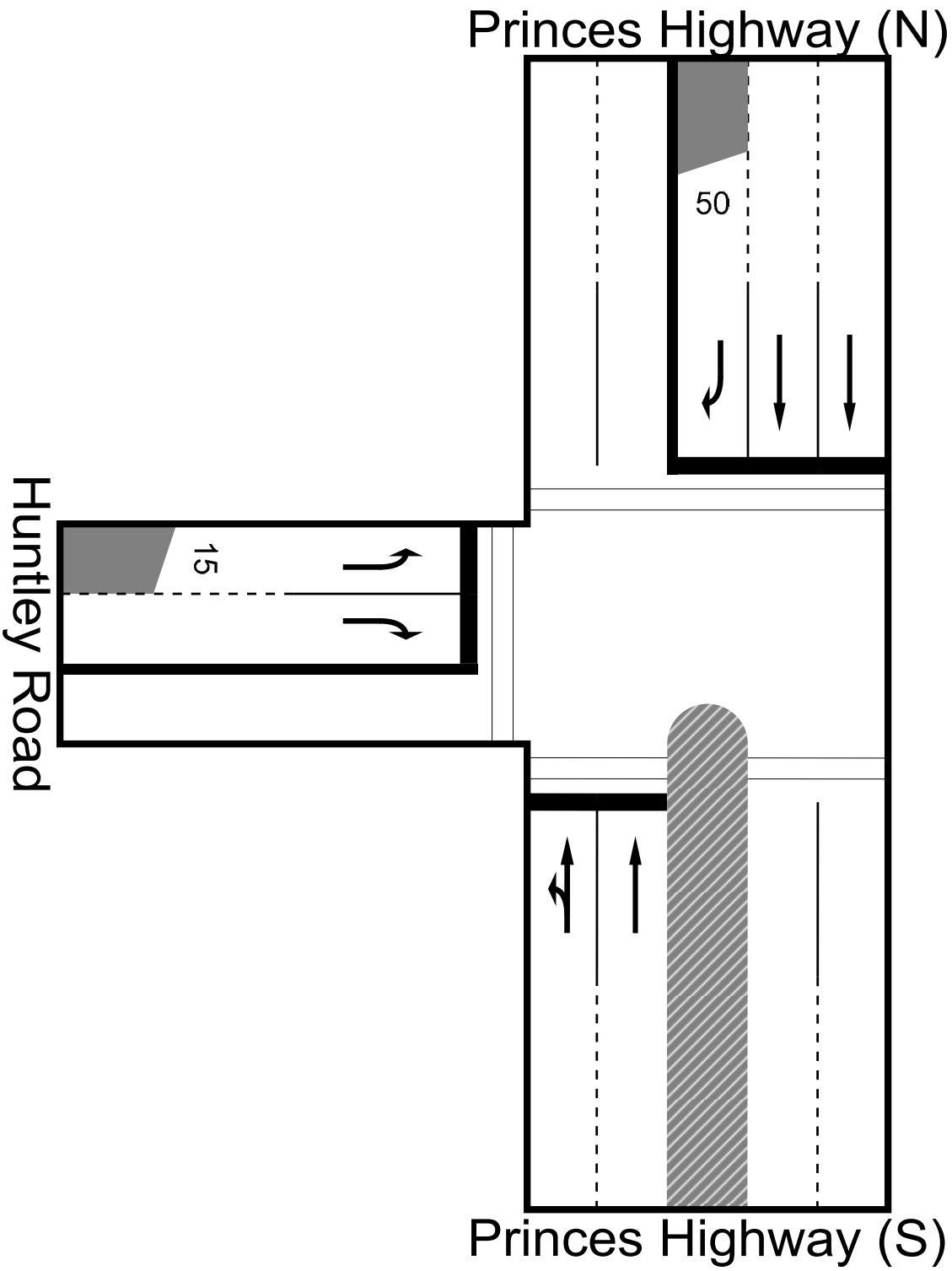
Concept Intersection Layouts – Future Base Upgrades

APPENDIX 10A – Concept Intersection Layouts - Future Base Upgrades

Princes Highway and Huntley Road

Signalise existing priority controlled intersection plus provide an additional right turn bay (50m) on the northern approach. Refer to Figure 10A-1.

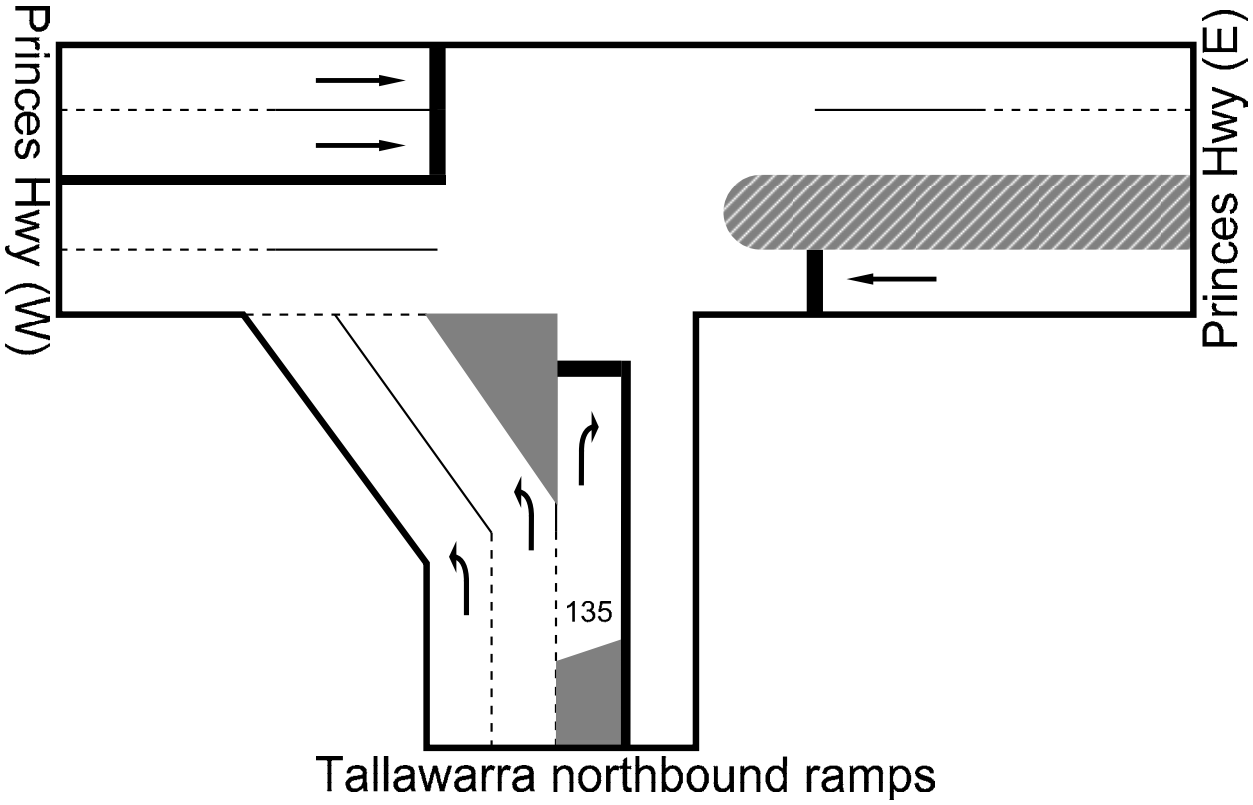
Figure 10A-1 Proposed Conceptual Layout of Princes Hwy/Huntley Rd



Princes Highway and F6 Southbound Off-Ramp

Signalise existing priority controlled intersection with left turn on off-ramp converted to left slip lane, as well as additional through lane on Princes Highway as per carriageway upgrade. Refer to Figure 10A-2.

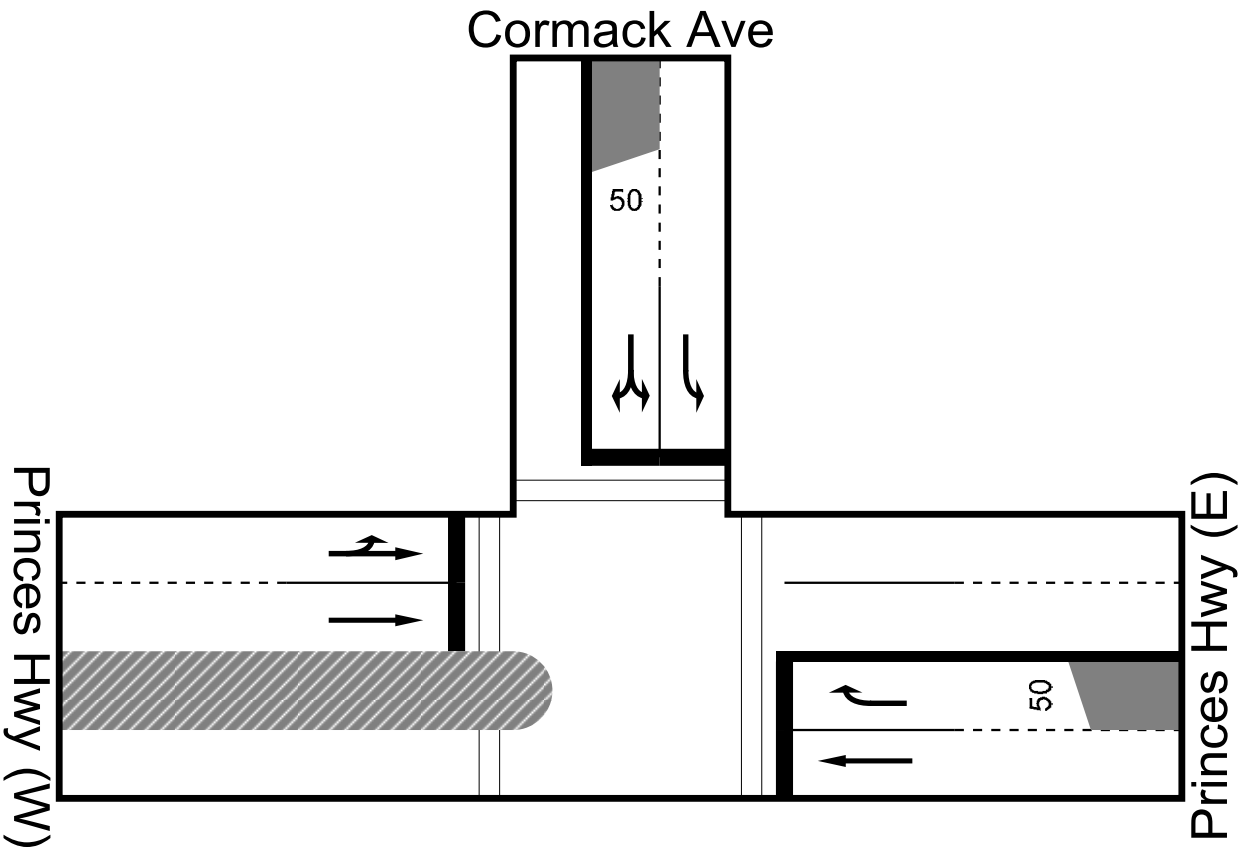
Figure 10A-2 Proposed Conceptual Layout of Princes Hwy/ F6 Southbound Off-Ramp



Princes Highway and Cormack Avenue

Signalise existing priority controlled intersection plus provide an additional right turn bay (50m) on south/eastern approach, additional through lane south\eastbound as per carriageway upgrade, as well as mark approach lanes on northern approach to provide left turn lane and right turn bay (50m). Refer to Figure 10A-3.

Figure 10A-3 Proposed Conceptual Layout of Princes Hwy/ Cormack Ave



Tripoli Way Junctions

In conjunction with the provision of the Tripoli Way connection (Albion Park By-pass) upgrades to intersection controls will be required at the following locations:

- Illawarra Highway and Broughton Avenue - provide a fourth leg to the roundabout (northern approach) for connecting in one of the Calderwood collector roads. Refer to Figure 10A-4.
- Calderwood Road upgrade to Roundabout. Refer to Figure 10A-5.
- Illawarra Highway upgrade to Traffic signals. Refer to Figure 10A-6.
- Tongarra Road upgrade to Traffic signals Roundabout. Refer to Figure 10A-7.

Figure 10A-4 Proposed Conceptual Layout of Illawarra Hwy/ Broughton Ave

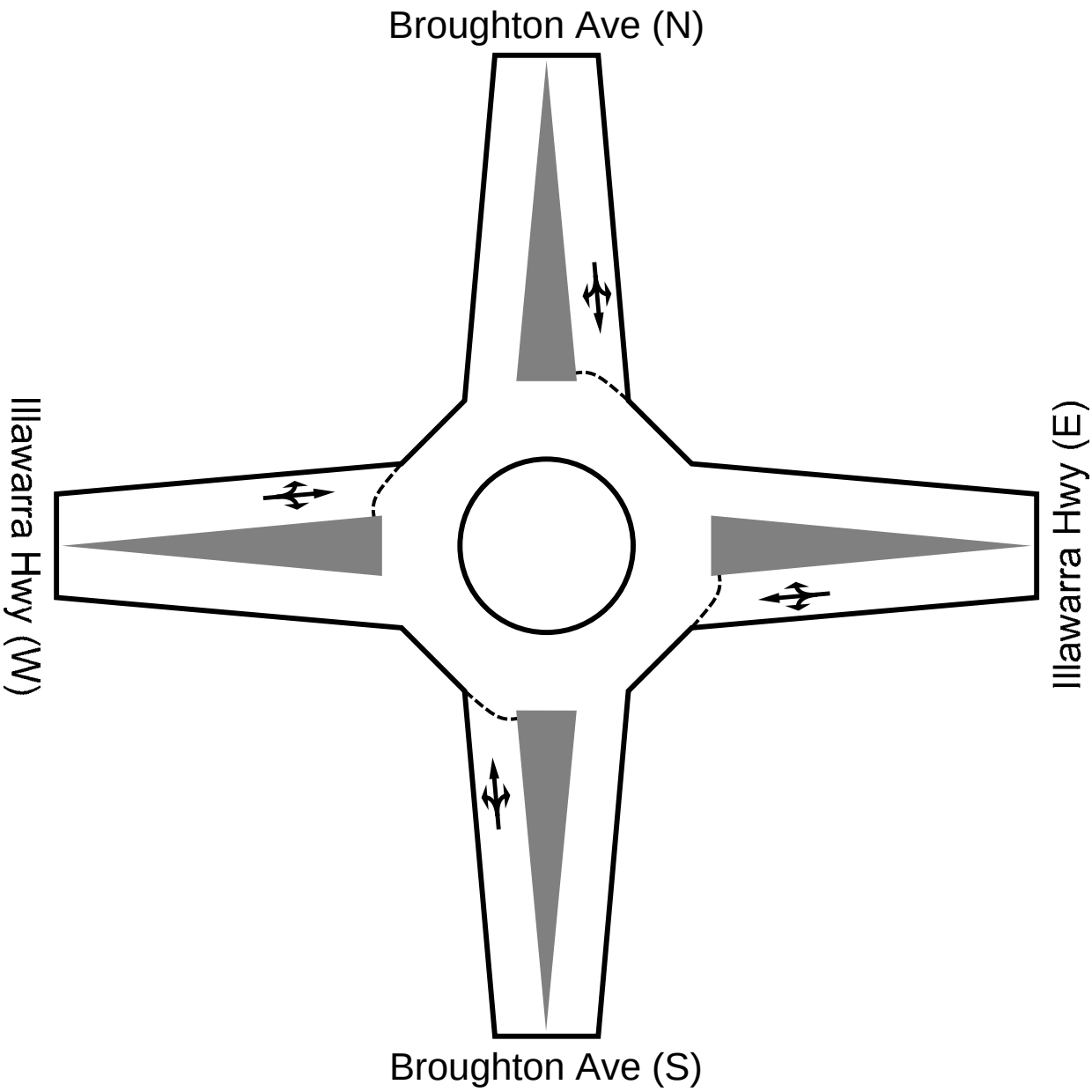


Figure 10A-5 Proposed Conceptual Layout of Tripoli Way/ Calderwood Rd

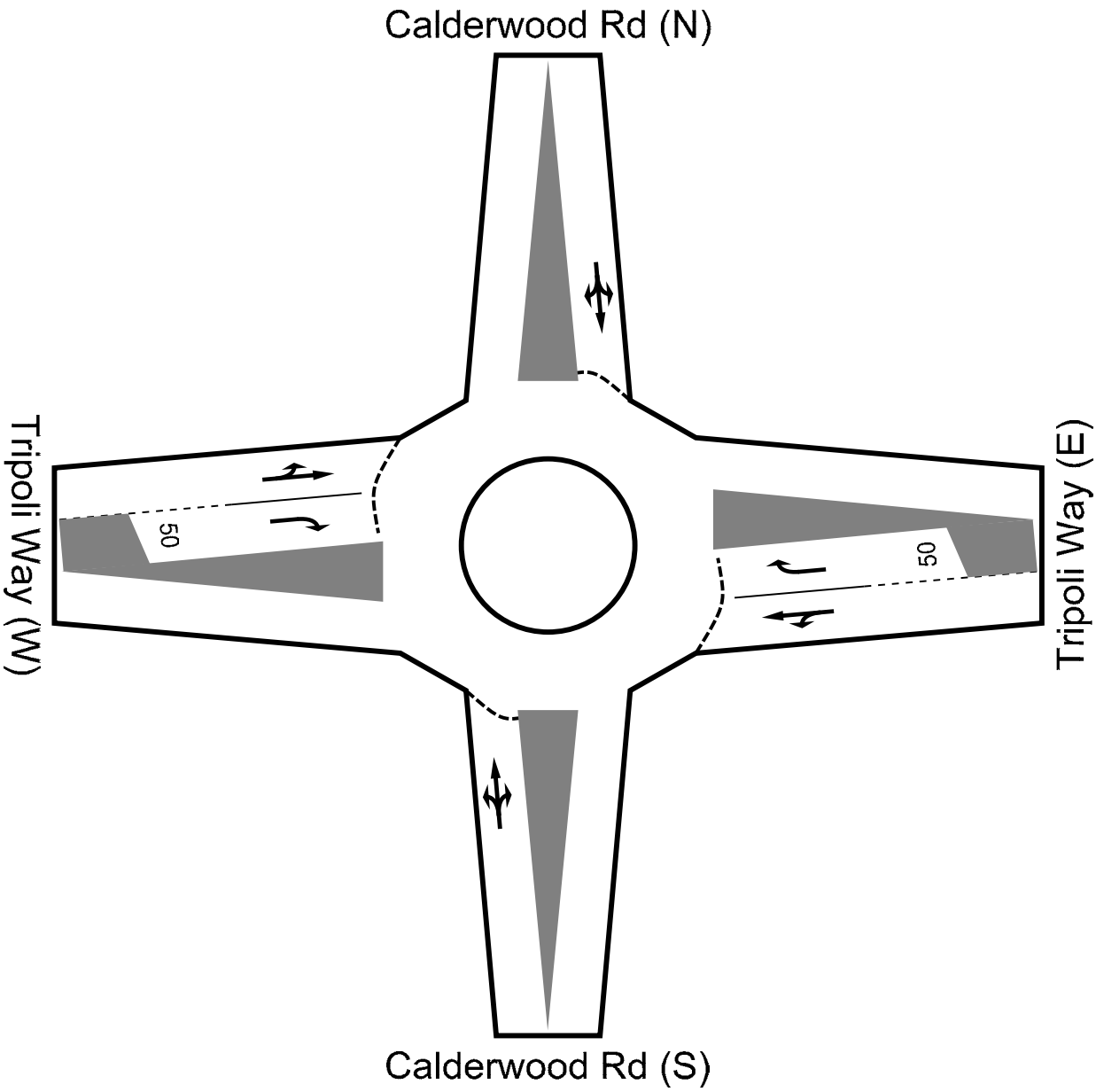


Figure 10A-6 **Proposed Conceptual Layout of Tripoli Way/ Illawarra Hwy**

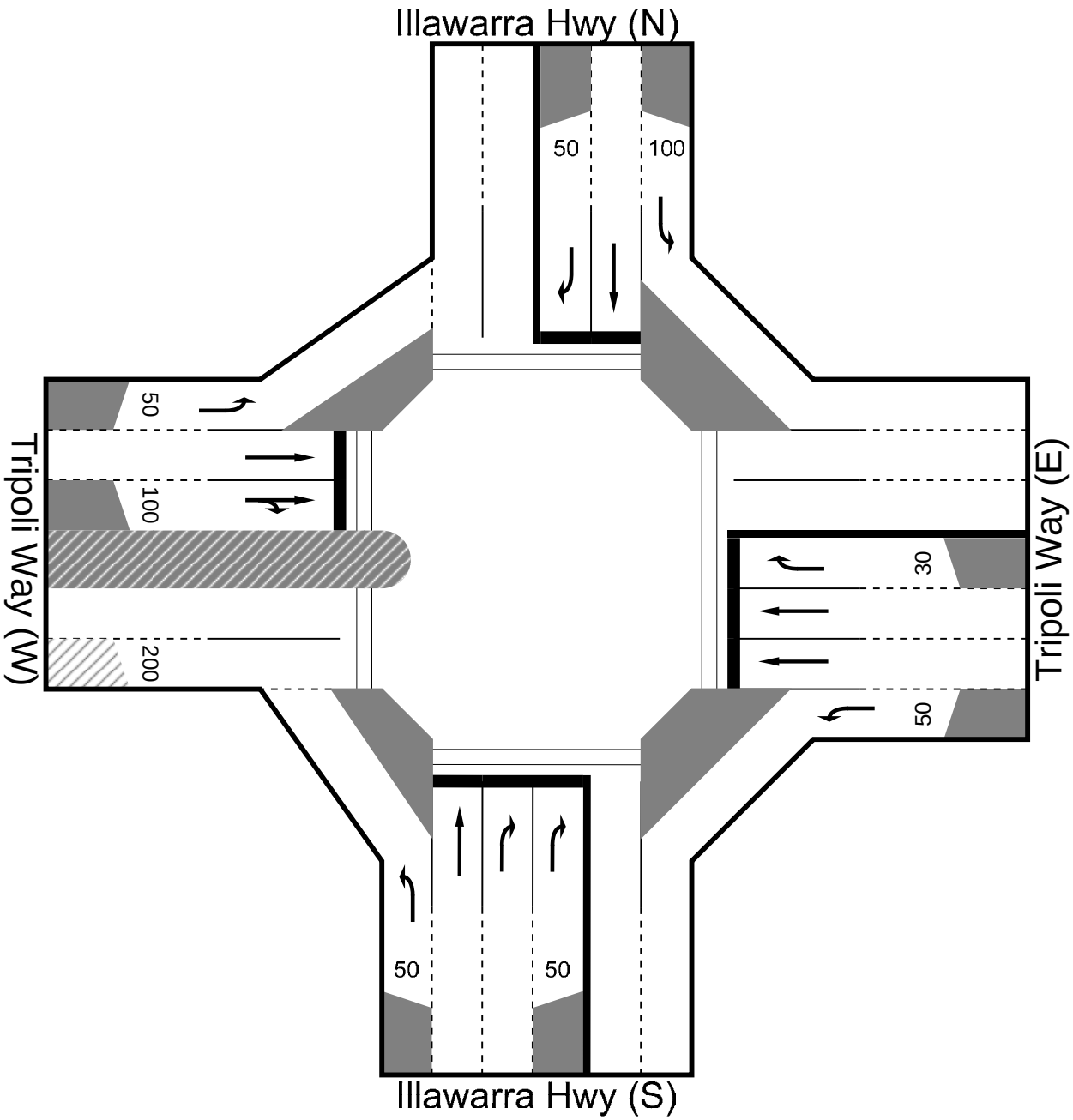
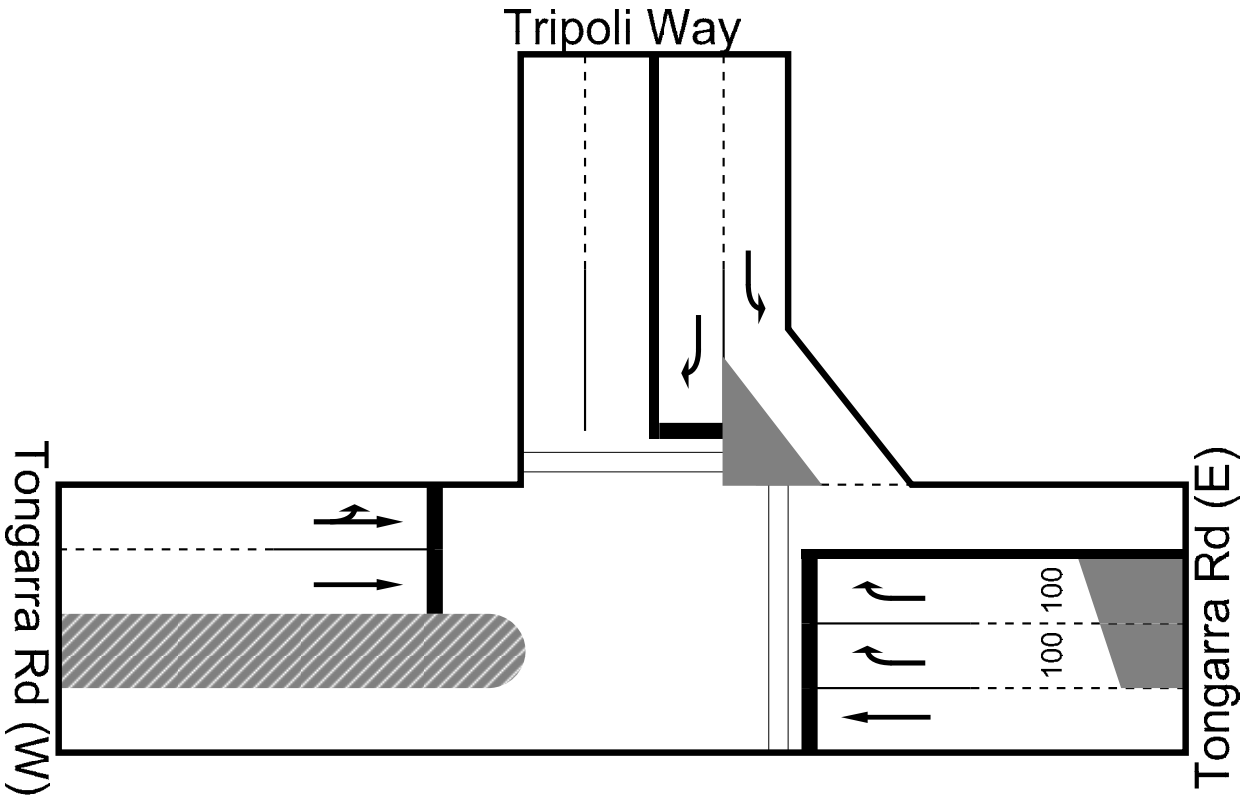


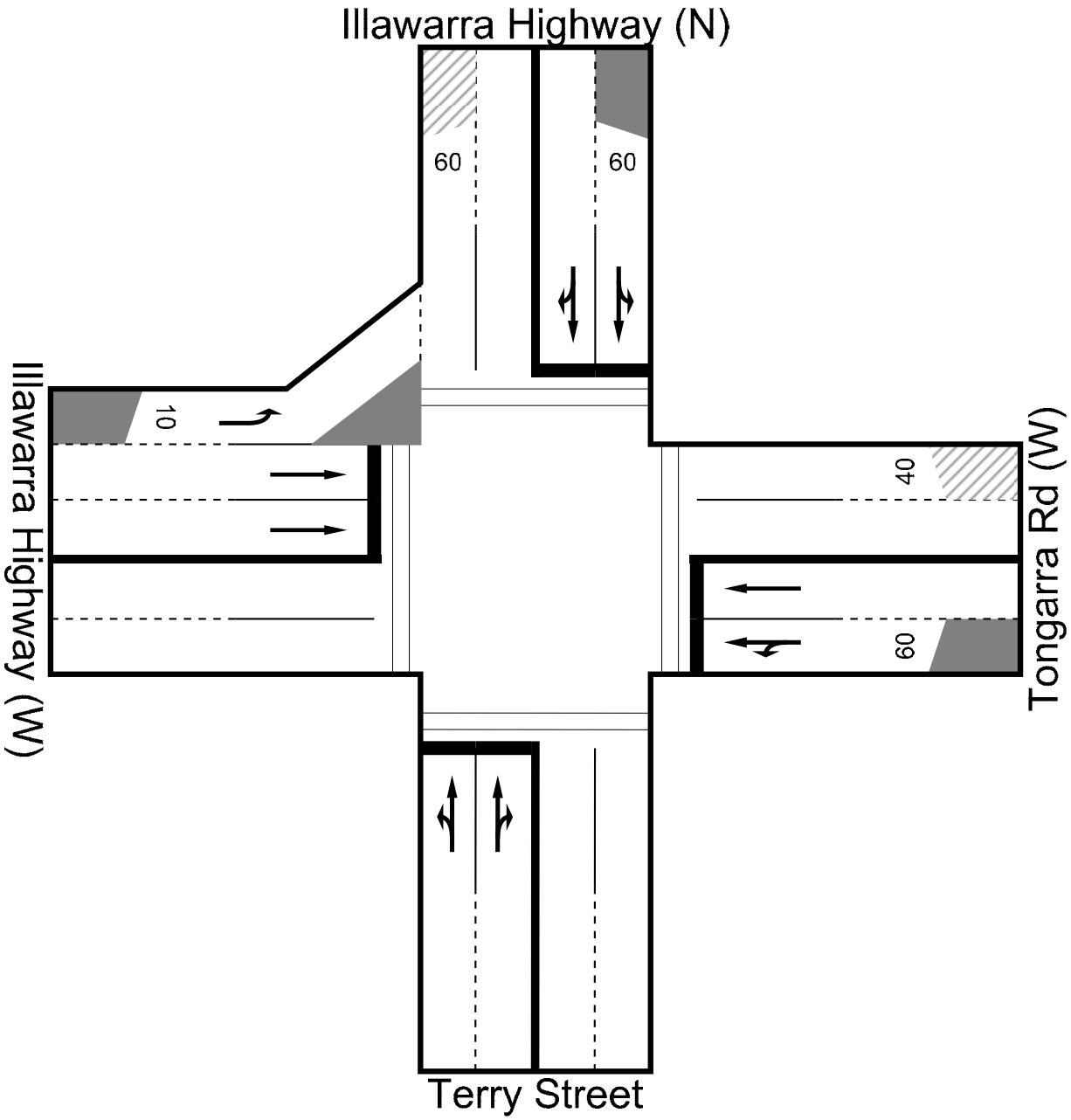
Figure 10A-7 Proposed Conceptual Layout of Tripoli Way/ Tongarra Rd



Illawarra Highway and Tongarra Road/Terry Street

Minor signal alterations - adjustments to timings and install through and right arrow in right turn lane on southern approach. Refer to Figure 10A-8.

Figure 10A-8 Proposed Conceptual Layout of Illawarra Hwy/ Terry St



Appendix 10B

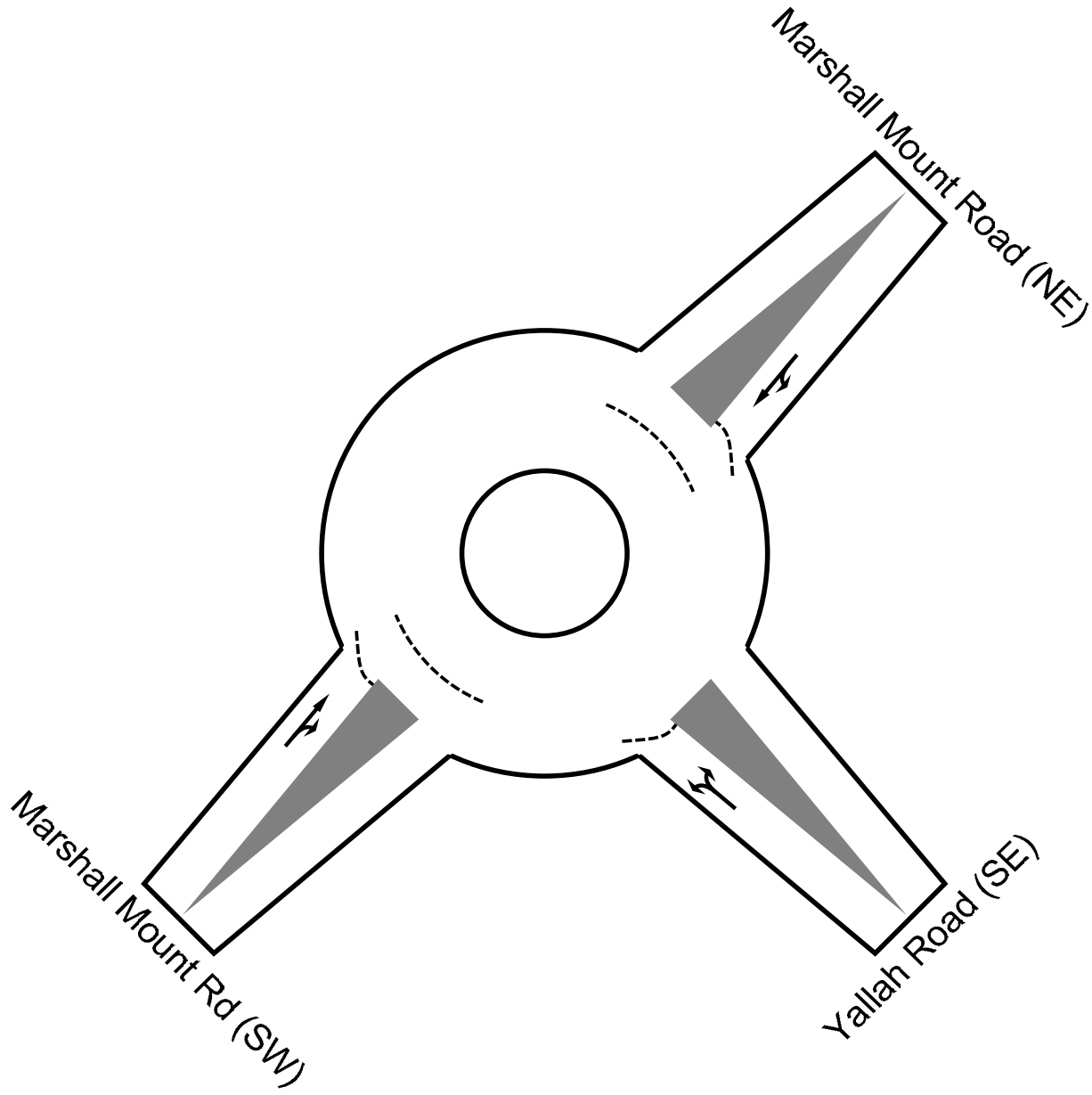
Concept Intersection Layouts – Future Full CUDP Development Upgrades

APPENDIX 10B – Concept Intersection Layouts - Future Full CUDP Development Upgrades

Marshall Mount Road and Yallah Road

Upgrade existing T-intersection to 30 metre ICD single lane roundabout. Refer to Figure 10B-1.

Figure 10B-1 Proposed Conceptual Layout of Marshall Mount Road/ Yallah Road



Illawarra Highway and Yellow Rock Road

Convert existing priority control intersection to 4 arm roundabout with additional northern leg for Calderwood North-South Route. Refer to Figure 10B-2.

Figure 10B-2 Proposed Conceptual Layout of Illawarra Hwy/ Yellow Rock Road