a conservative trip generation rate was adopted for the model given that majority of the C&A development might not occur for 10 to 15 years or more.

Table 5-3 Trip Generation using RTA rates

Type of Dwelling	Number of dwelling units	Percentage	RTA's Trip Generation Rate		Trip Generation (without self containment)		Trip Generation (with self containment)	
		%	PM Peak	Daily	PM Peak	Daily	PM Peak	Daily
Townhouse dwelling units	127	3.9%	0.575	5.75	73	730	55	548
Village Courtyard dwelling units	469	14.4%	0.45	4.5	211	2111	158	1583
Traditional dwelling units	1589	48.7%	0.85	9	1351	14301	1013	10726
Lifestyle dwelling units	700	21.4%	0.85	9	595	6300	446	4725
Lifestyle Heritige dwelling units	86	2.6%	0.85	9	73	774	55	581
Independent Living Units	155	4.7%	0.2	2	31	310	23	233
Minmi High Street Medium Density	41	1.3%	0.575	5.75	24	236	18	177
Minmi High Street Mixed Use/Retail	50	1.5%	0.29	3	15	150	11	113
Village Centre Mixed Use/Retail Including Community Facility	49	1.5%	0.29	3	14	147	11	110
Total	**3266**	**100.0%**			**2386**	**25059**	**1790**	**18794**

Table 5-4 Trip Generation by C&A Stages assumed for the Daily and AM peak periods (7-9 am) Model

Development Stage	Year	Total Dwellings	AM Peak (2h)	AM Peak (1h)	Daily trips (without self containment)	Daily trips (with self containment)
Stage 1	2016	580	600	330	4780	3,585
Stage 1, 2	2026	2014	1963	1080	16842	12,632
Stage 1, 2 & 3	2031	3500	3298	1814	29353	22,015

5.3 Trip Distribution

The distribution of the additional trips generated by the proposed C&A development is a key factor in determining its impact on the road network. This distribution has then been applied to the new trips to assess the full impact on surrounding roads and

intersections. The new C&A trips were distributed using LHTM (TransCAD) model which distributes the traffic via a gravity model, linking destinations such as homes and workplaces based on distance and time. The key influence on the traffic distribution from the C&A site is the proposed staging and access points which connect the C&A development with the external network. At Stage 1, the key access will be provided via Minmi Road. During Stage 2, C&A traffic will be distributed to a number of routes including Newcastle Link Road and Minmi Road. Figure 5-4 shows expected distribution of traffic from the proposed C&A development site, at each stage of the development.

Figure 5-4 shows that C&A traffic at each stage will have a different traffic pattern, due to the access connection, other traffic influences, and route choice as a result of congestion in different parts of the network. We have only shown the C&A traffic (AM peak 2 hours), using a select link/node technique. The following observations are drawn from Figure 5-4:

- Stage 1 – Minmi Road experiences the most impact from the expected traffic generation. About 40% of C&A traffic will use this route accessing Newcastle followed by Lenaghans Drive (about 29%). About 20% of C&A traffic will use Newcastle Link Road to access the Stage 1 development;
- Stage 2 – There will be a significant shift in the traffic pattern as the key access is proposed to be with the Newcastle Link Road. The proposed Frederick/Minmi Link will carry about 13% of C&A traffic via a direct connection with Glendale. Minmi Road (through Minmi/ Fletcher) and Lenaghans Drive is also expected to carry between 15% and 20% of C&A traffic; and
- Stage 3 – Similar to Stage 2, there will be a significant increase in C&A traffic on Newcastle Link Road. About 40% of C&A traffic is expected to travel via the Newcastle Link Road. Proposed Minmi Boulevard will be effective to reduce C&A traffic travelling via Minmi Road (through Minmi/Fletcher) accessing Newcastle. About 18% of C&A traffic is expected to use Lenaghans Drive – a possible destination could be at Black Hill and Beresfield.

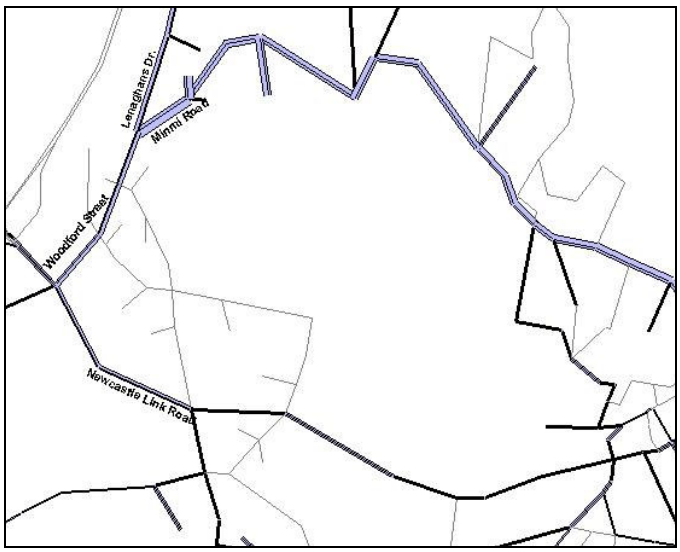


Figure 5-4 Staged C&A traffic distribution (AM Peak 2 Hrs) on key approach roads

5.4 Traffic Implications of LHRS Land Use and Proposed Infrastructure

Future traffic conditions on the Newcastle Link Road corridor will be influenced by a combination of natural background growth, additional traffic generated by the LHRS land use/developments, and long term infrastructure proposals including F32B Link and Newcastle Link Rd - Glendale Dr Link. This means that future traffic on the Newcastle Link Road will be influenced not only by the C&A Northern Land traffic, but regional and cumulative traffic impacts will play a key role on Link Road traffic performance.

In this section we have attempted to estimate each component of the above land use and infrastructure driving factors separately. We ran the 2031 LHTM models with and without C&A Northern Land traffic (including Minmi and Black Hill sites) to estimate the C&A impact alone. A separate scenario was modelled for 2031 but including full F32B Link. For natural background growth we assumed Newcastle Link Road could grow by a maximum of 2% per annum followed by 1% growth at other roads in the corridor. Table 5-5 presents corridor flows in 2031 for four cases. We measured corridor flows in terms of cordon traffic using a combination of three screenlines formed by the Newcastle Link Road (east/west), Minmi Road (north/ south), Cameron Park Dr (south) and Lenaghans Dr (north). Figure 5-5 shows the location of the cordon line.

Table 5-5 Future daily traffic flows at Corridor

Cases	2006/07	2031 No F32B but with F32R	2031 With F32B & F32R
Case 1: Existing	57,300		
Case 2: Natural background growth, network same as now		97,200	
Case 3: Cumulative traffic, without C &A Northern Lands. Future base network as per Section 4.1.		114,500	
Case 4: Cumulative traffic, with C &A Northern Lands. Future base network as per Section 4.1.		147,300	188,500
Change (% annual growth) due to background traffic, 25 yrs		39,900 (1.7%)	
Change (% annual growth) due to cumulative traffic, without C&A, 25 yrs		57,200 (2.8%)	
Change (% annual growth) due to cumulative traffic including C&A, 25 yrs		90,000 (3.8%)	
Change due to infrastructure			41,200 (28%)

Note: F32R link was assumed in 2026 base case network as per LHTM.

Key findings from Table 5-5 are:

- The model indicates that in 2031, traffic flows on the Newcastle Link Road corridor will increase from the current 57,000, to 147,200 vehicles per day including the C&A development;
- The traffic from all proposed developments is expected to grow at about 3.8% per annum, significantly higher than current growth trend of 1.7%;

- Cumulative traffic (without C&A) is expected to increase corridor traffic demand by about 57,000 vehicles per day, or about 2.8% per annum;
- In 2031, the full C& A Northern Land development will increase corridor traffic from 114,500 vehicles to 147,300 vehicles per day, an increase of 32,800 vehicles (30%); and
- The proposed F32B link will influence corridor demand significantly. The model forecasts an increase of 41,200 vehicles daily (28%). The new link (full 40km) will provide a direct connection between Maitland, Cessnock and Newcastle, and is expected to increase traffic on Newcastle Link Road significantly. However, if the F32B project is staged (terminates at John Renshaw Drive), then traffic increase on this corridor will be much lower than "with full project case".

The above modelling results confirmed the complexity of future corridor travel and the implication of the cumulative impact to corridor flows. The following section has assessed the C&A impact rigorously so that:

(a) A direct nexus between C&A traffic and required improvements at road/intersections is established; and

(b) Traffic apportionment of infrastructure cost towards the C&A development is fair and transparent.

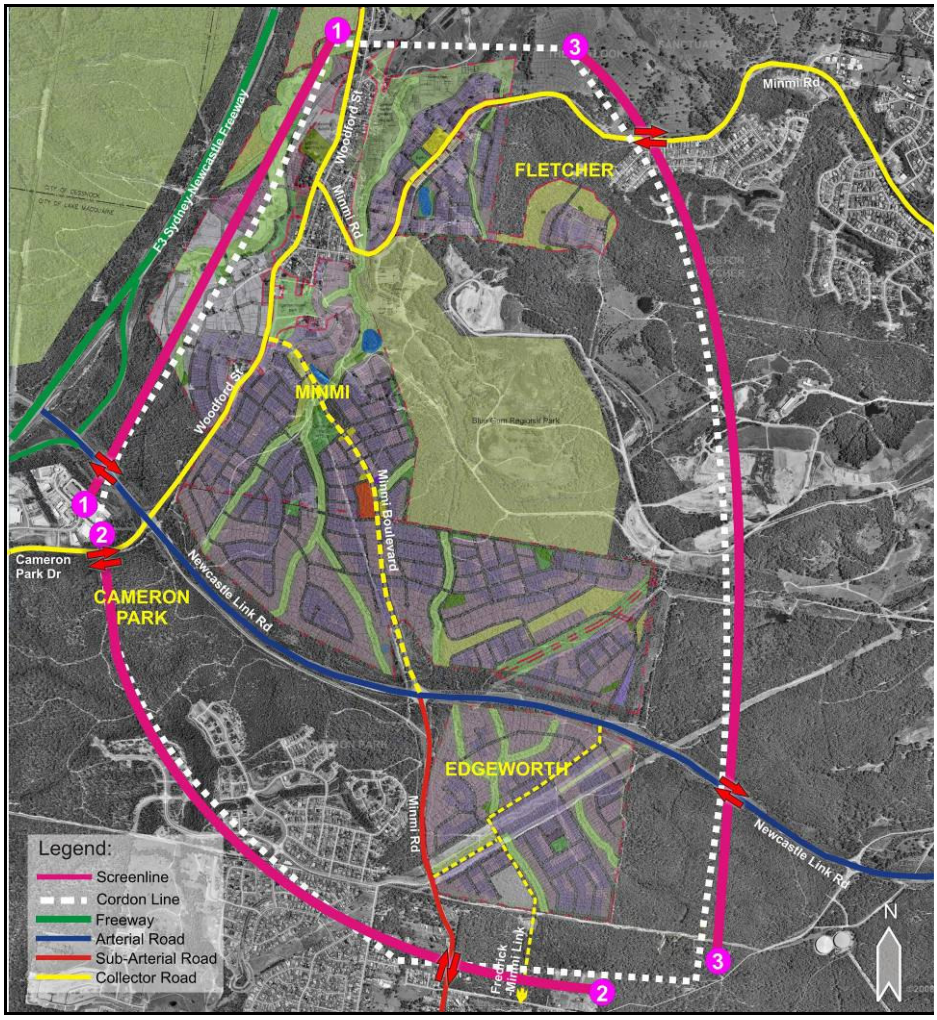


Figure 5-5 Location of Cordon Line and Screenlines

5.5 Assessment of C &A Impact

Future traffic growth will include natural background growth, and additional traffic generated by the LHRS land use/developments. To assess these impacts we have modelled three development options for the AM peak period:

1. Option R1- Nominal background growth only – This option assumes natural growth in the network irrespective of any proposed developments;
2. Option R1D-This includes R1 and C&A traffic – the difference between S1D and S1 will provide true C&A impact alone; and
3. Option R2D- Cumulative growth including C & A – This option assumes that LHRS development proceeds concurrently with C&A development as per the LHTM model assumption.

The three options were then developed into various scenarios that followed the proposed staging of the C&A development. The above options excluded F32B impact as Section 5.4 already established its impact on corridor flows. The various circumstances that could arise have been modelled using the LHTM model for the entire network and then using aaSIDRA and Paramics to model intersections. These models give an indication of how the roads and intersections in and around C&A development site will perform over the next 25 years.

In the future with planned development in the Newcastle Link Road corridor, the capacity of the network will be largely governed by the performance of individual intersections rather than midblock sections between intersections. We assessed network capacity from the intersection DoS/LoS perspective, as the intersection DoS/LoS is the most important factor in determining critical infrastructure needs as a result of future development. Table 5-6 presents modelling scenarios for the three development options.

Table 5-6 Scenarios for three development options

	Model Scenarios								
	2016			2026			2031		
Development Options	Nominal Growth	C&A Stg1	Cummulative	Nominal Growth	C&A Stg1 + Stg2	Cummulative	Nominal Growth	C&A Stg1 + Stg2 + Stg3	Cummulative
R1	☑			☑			☑		
	16S1			26S4			31S7		
R1D	☑	☑		☑	☑		☑	☑	
	16S1D			26S4D			31S7D		
R2D		☑	☑		☑	☑		☑	☑
		16S3			26S6			31S8	

5.5.1 Impact on Network Capacity

This section summarises intersection capacity results in the form of DoS, LoS, and delays (sec). We selected three key intersections which are critical for maintaining adequate LoS in the corridor and are also expected to demonstrate the impact of the C&A development. They are:

- Newcastle Link Road/ Woodford Street;
- Newcastle Link Road/Minmi Road; and
- Woodford Street/Minmi Road.

Nominal Growth (Option R1)

The future traffic conditions will be influenced by the general background traffic growth in the area. This nominal background growth is the increase in traffic that is expected to occur regardless of the C&A development taking place. Considering historical traffic growth in the area and our knowledge of land use changes, we have assumed a notional 2% growth on the Newcastle Link Road and 1% growth for other feeder roads including Woodford Street and Lenaghans Drive. Table 5-7 below summarises the predicted performance at key intersections based on the expected nominal growth only. The LoS and DoS values at key intersections from the nominal growth scenarios can be regarded as 'benchmark" and therefore be used to identify the additional impact from C & A and the cumulative growth.

Table 5-7 Intersections performance from nominal growth (Option R1)

			2016			2026			2031		
		Existing	Scenario 16S1			Scenario 26S4			Scenario 31S7		
ID	Intersections	Control	DoS	Delays	LoS	DoS	Delays	LoS	DoS	Delays	LoS
I-1	Newcastle Link Rd/ Woodford St	Roundabout	0.52	6	A	0.66	7	A	0.74	7	A
I-2	Newcastle Link Rd/Minmi Rd	Roundabout	0.63	8	A	0.81	10	A	0.92	15	B
I-3	Woodford St/Minmi Rd	Fixed Signals	0.33	15	B	0.36	15	B	0.38	15	B

Key findings from Table 5-7 are:

- Under nominal growth scenarios, the key intersections are expected to operate with a good LoS (A/B). DoS is predicted between 0.38 and 0.92 –reasonably good capacity; and
- Modelling results implied that all three intersections are expected to have a service life of 25 years or more if network continues to grow at the nominal rate. The existing roundabouts on the Newcastle Link Road at Woodford Street and Minmi Road will continue perform satisfactorily until 2031 and notional growth is unlikely to trigger upgrading works at these intersections.

C&A Staged Growth (Option R1D)

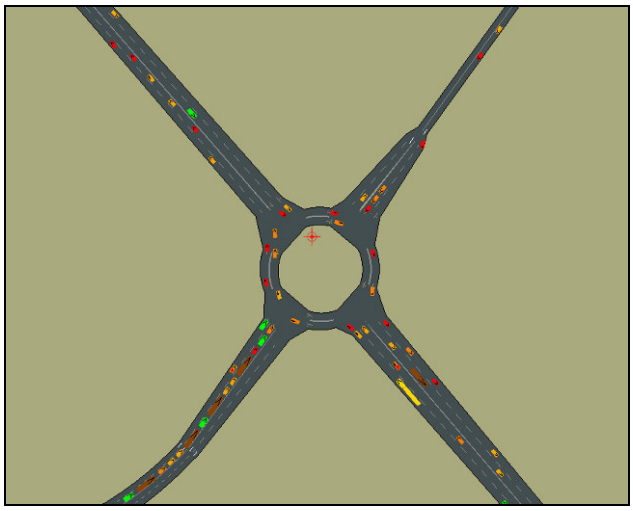
Following the proposed stages for the C&A development it is possible to show the traffic impact at each build year, based on the scenarios detailed in section 5.5. At the first stage in 2016 C&A proposes to develop about 580 dwelling units. By 2026 in the end of stage 2 about 2014 dwelling units are expected to be developed. By this stage of development there would be infrastructure changes (a proposed link 'Minmi Boulevard.') as per concept plan. The full C&A is expected to provide 3,500 dwelling units in 25 years. Table 5-8 shows the predicted LoS at key intersections with C&A staged development but keeping all three intersections with their current controls/ layout. Comparing the results in Table 5-7 and Table 5-8 indicates the C&A development impact alone at the three key intersections. Figure 5-6 shows predicted queues from the Paramics model with 100% C&A development alone in 2031.

Table 5-8 Intersections performance from C&A staged growth (Option R1D)

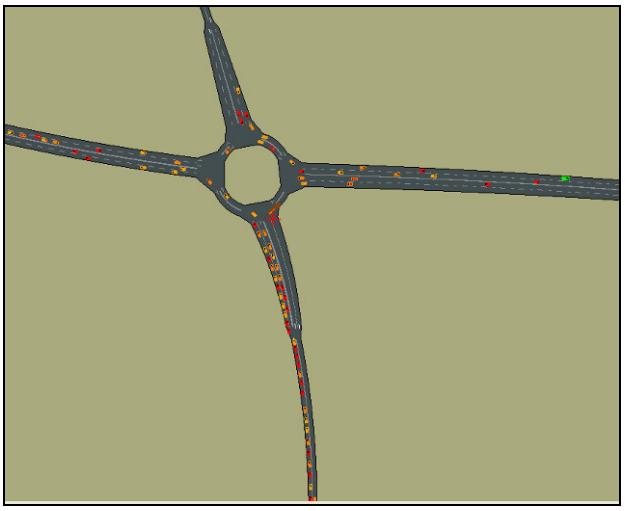
			2016			2026			2031		
		Existing	Scenario 16S1D			Scenario 26S4D			Scenario 31S7D		
ID	Intersections	Control	DoS	Delays	LoS	DoS	Delays	LoS	DoS	Delays	LoS
I-1	Newcastle Link Rd/ Woodford St	Roundabout	0.54	6	A	0.68	7	A	0.83	11	A
I-2	Newcastle Link Rd/Minmi Rd	Roundabout	0.65	8	A	0.92	21	B	1.76	>90	F
I-3	Woodford St/Minmi Rd	Fixed Signals	0.46	15	B	0.58	17	B	0.68	17	B

The modelling result from Table 5-8 indicates the following outcomes:

- C&A first stage 580 dwelling units show a minor impact on intersection capacity. All three intersections are expected to operate with LoS A/B and DoS values between 0.46 and 0.65;
- The additional 1434 dwelling units from stage 2 are expected to reduce the LoS at the Newcastle Link Road/Minmi Road roundabout. Critical movements are predicted a higher DoS values meaning some form of upgrade may be required for certain movements. This also indicates that intersection upgrading works may not be required until C&A has developed 2000 dwelling units. This lot threshold was estimated assuming minimal growth that could occur in the network. However if the assumed minimal growth is exceeded due to rapid growth from other traffic, then the C&A 2000 lot threshold would need to be reduced;
- The full C&A development is predicted to reduce LoS of the Newcastle Link Road/Minmi Road roundabout to F. The DoS value is predicted about 1.76 – implying that the intersection will operate overcapacity;
- The modelling result demonstrates that the full C&A development will be responsible for reducing LoS at the Newcastle Link Road/Minmi Road roundabout regardless of other developments; and
- The C&A impact at the other two intersections (Newcastle Link Road/Woodford St roundabout and Woodford St/Mimi Road signals) is low, as key C&A access will be maintained primarily via the Newcastle Link Road/Minmi Road intersection.



Woodford Street / Newcastle Link Road Roundabout



Minmi Road / Newcastle Link Road Roundabout

Figure 5-6 Predicted queues on existing road network from 100% C&A development only (Paramics Scenario S5, 2031)

5.6 Cumulative Impact (Option R2D)

In assessing the 'cumulative impact' of developments other than the proposed C&A development, Hyder used the expected land releases and future developments in the Lower Hunter Regional Strategy. The land use changes from LHRS are also used as a key input to RTA's LHTM model. Table 5-9 shows the predicted LoS at key intersections with the cumulative impact including C&A development but again keeping all three intersections at current controls/layout. One of the main difficulties in assessing cumulative impact is to determine the 'exact timing of all developments'. For cumulative impact assessment we have used staging assumptions for other developments as per LHTM. However other developments may or may not proceed concurrently with the C&A development. The cumulative impact results at key intersections are summarised below. Modelling results indicate that the two roundabouts are predicted have a LoS F with DoS more than 1.0. These results are consistent with previous corridor flows (Section 5.4) where the model determined significant cumulative traffic impacts at Newcastle Link Road and associated intersections. The higher congestion in 2026 at Newcastle Link Road/Minmi Road roundabout would divert more traffic via Woodford Street and then Minmi Road to access Newcastle. This showed high DoS values of about 2.15 at Newcastle Link Road/ Woodford Street roundabout, and about 0.99 at the Woodford Street/Minmi Road signals.

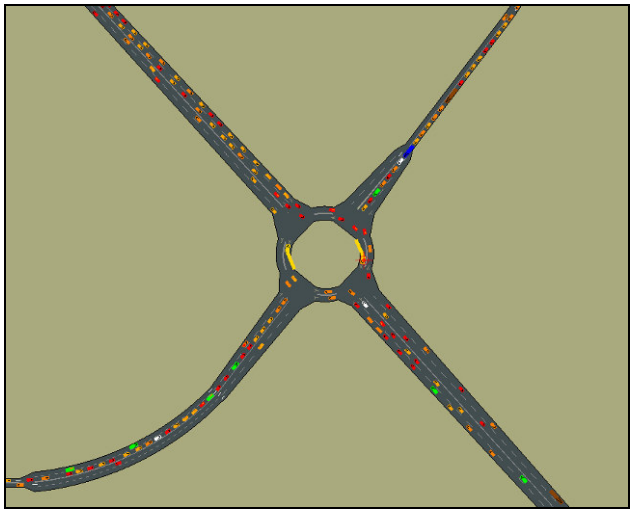
Table 5-9 Intersections performance from Cumulative impact including C&&A (Option R2D)

			2016			2026			2031		
		Existing	Scenario 16S3			Scenario 26S6			Scenario 31S8		
ID	Intersections	Control	DoS	Delays	LoS	DoS	Delays	LoS	DoS	Delays	LoS
I-1	Newcastle Link Rd/ Woodford St	Roundabout	1.09	86	F	1.55	>90	F	2.15	>90	F
I-2	Newcastle Link Rd/Minmi Rd	Roundabout	1.18	>90	F	1.64	>90	F	1.72	>90	F
I-3	Woodford St/Minmi Rd	Fixed Signals	0.50	16	B	0.84	21	B	0.99	42	C

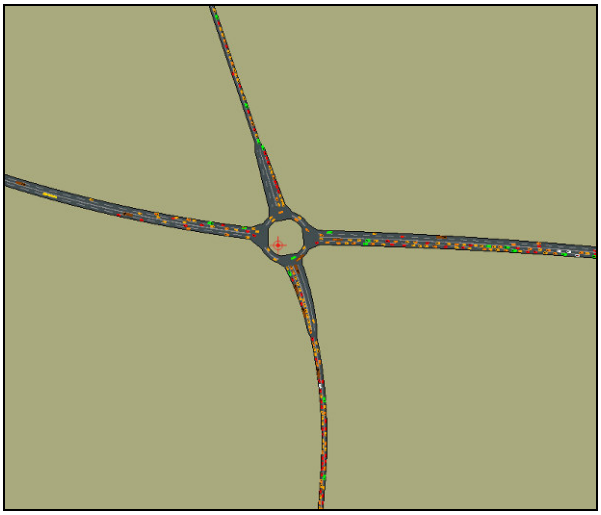
Three key issues that emerged from various scenarios were modelled and detailed as Option R1, Option R1D and Option R2D:

- Future travel demand on the Newcastle Link Road will be influenced by the combined factors of notional traffic growth, additional traffic generated by the changes in the LHRS land use/developments and proposed long term infrastructure proposals including F32B Link;
- If other development proceeds prior to the C&A staging schedule then there may be little capacity left at key Newcastle Link Road intersections particularly at Newcastle Link Road/Minmi Road and Newcastle Link Road/Woodford Street roundabouts; and
- The traffic model determined a direct nexus between the C&A development and the reduced LoS at the Newcastle Link Road/ Minmi Road roundabout.

Figure 5-7 shows predicted queues from the Paramics model with the staged C&A development and cumulative traffic in 2026.



Woodford Street / Newcastle Link Road Roundabout



Minmi Road / Newcastle Link Road Roundabout

Figure 5-7 Predicted queues on existing road network from staged C&A development and cumulative traffic (Paramics Scenario S3, 2026)

5.7 Traffic Forecasts on Midblock Section

We have prepared AM peak one hour forecasts at nine selected locations (see Figure 5-8) for the critical Option R2D (cumulative impact). Table 5-10 presents traffic forecasts without any upgrading works in the network.

Table 5-10 AM peak one hour forecasts for Option R2D (Cumulative impact)

			2006	2016	2026	2031			
			Scenarios				Percentage change		
Site ID	Road	Locations	06S0	16S3	26S6	31S8	06-16	16-26	26-31
M-1	Newcastle Link Road	West of Woodford Street	2240	4270	5450	5970	91%	28%	10%
M-2	Newcastle Link Road	East of Minmi Road	1950	3940	5260	5700	102%	34%	8%
M-3	Minmi Road	South of Newcastle Link Road	1280	1520	1580	1730	19%	4%	9%
M-4	Woodford Street	North of Newcastle Link Road	310	500	380	650	61%	-24%	71%
M-5	Minmi Road	Through Minmi/Fletcher	350	720	1050	1230	106%	46%	17%
M-6	Lenaghans Dr	Further north of Peter Street	490	730	1310	1420	49%	79%	8%
Q-2	Minmi Road	South of Northlakes Dr	1310	1470	380	430	12%	-74%	13%
Q-3	Proposed Minmi Boulevard	North of Newcastle Link Road	--	--	780	1090			40%
Q-6	Proposed Fredrick-Minmi Link	C & A South Precinct	--	--	1260	1410			12%

Key findings from Table 5-10 are:

- The model forecasts significant traffic increases on the Newcastle Link Road. By 2031, AM peak traffic will increase from 2200 vehicles to about 5800 vehicles, a greater than 100% increase;
- The proposed Newcastle Link Road to Glendale Drive link will be effective in reducing significant traffic on Minmi Road (Edgeworth, south of Newcastle Link Road). Forecast shows only a 500 vehicle increase in the AM peak hour;
- Traffic on Woodford Street is expected to double between 2006 and 2031. Expected growth in the next 10 years is predicted to be higher (about 60%). At C&A stage 2 (between 2016 and 2026), Minmi Boulevard will be effective in diverting traffic away from Woodford Street. The predicted growth on this road is about 20%. Between 2026 and 2031, cumulative traffic impact on Newcastle Link Road will be highest, and the model predicts significant traffic diversion from Newcastle Link Road to Woodford Street and Minmi Road (through Minmi, Fletcher);

- The increasing congestion on the Newcastle Link Road will divert more traffic via Minmi Road (through Minmi, Fletcher) to access Newcastle. In 2031, the model forecasts about 1200 peak hour vehicles on Minmi Road, a significant increase from the existing 300 vehicles per hour. Minmi Road has a difficult alignment and the traffic increase may have long term safety implications;
- Traffic on Minmi Boulevard is predicted between 700 and 1000 vehicles per hour in the AM peak. Daily traffic is predicted to be about 10,000 vehicles; and
- The model forecasts significant traffic reductions on Minmi Road south of Northlakes Drive. The proposed Minmi Road-Fredrick Street Link is predicted to divert most traffic from Minmi Road south thus providing a direct connection to Glendale. In 2031, the model forecasts about 1300 vehicles in the AM peak hour, and between 10,000 and 13000 vehicles per day.

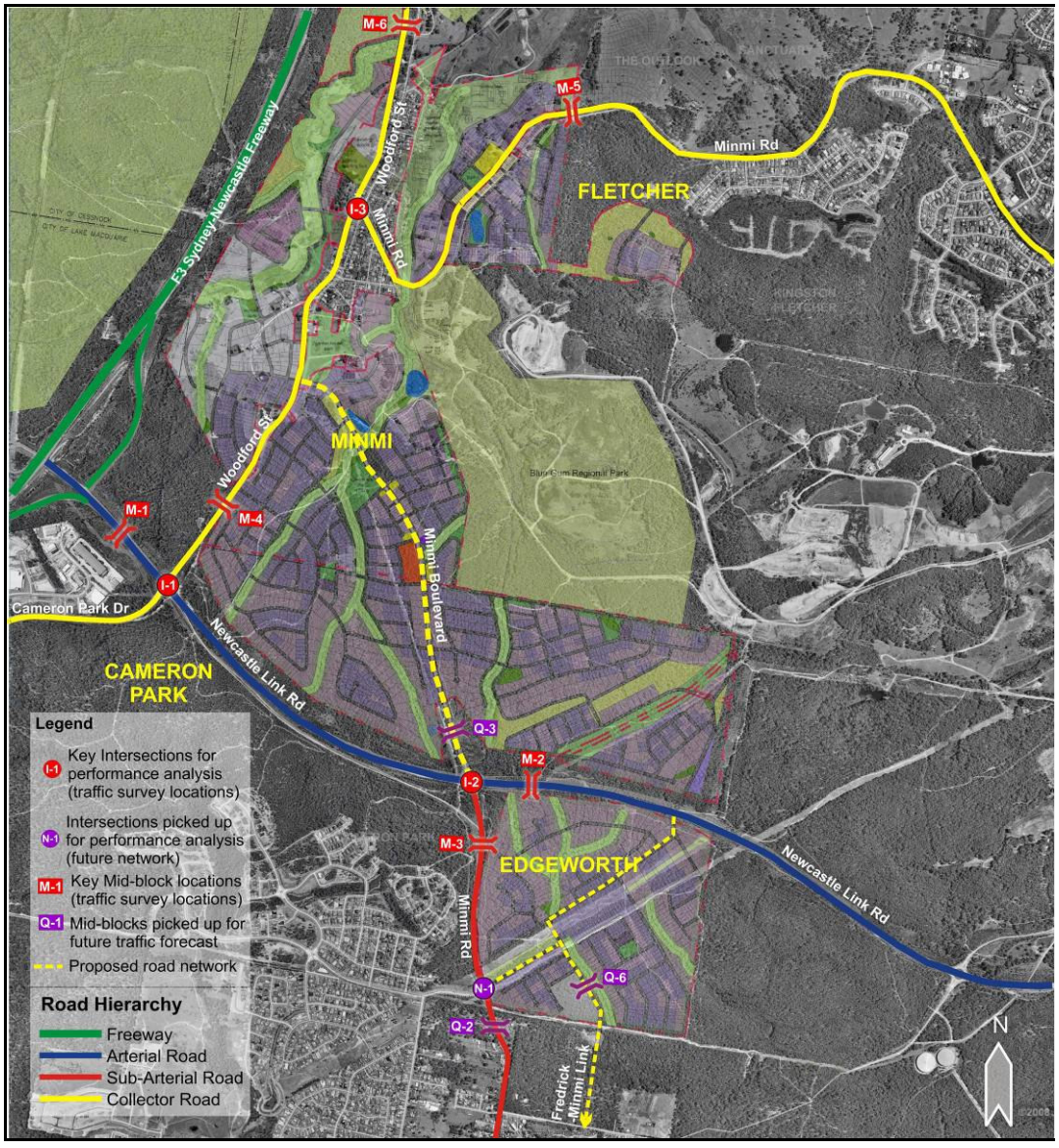


Figure 5-8 Traffic forecast locations

5.8 Internal Road Network

The internal road network and intersections for the proposed development has been designed to allow circulation and ease of movement for pedestrians, cyclists and vehicles, including public transport and service vehicles. The Environmental Assessment (EA) document included Concept Plan and road cross section of Minmi/Link Road site. Road cross-sections and intersection designs meet with the RTA guidelines for the volumes and types of traffic expected to use them. Comparing the road characteristics (contains in the Concept Plan) it appears that the proposed road geometry is generally consistent with the Council's recommended guidelines. We also checked turning paths for the internal road network using Autotrack for a standard design vehicle (12.5 metres, equivalent to a bus or garbage truck). All trafficked ways within the development will be at least 5 m wide, and conforms to NSW Rural Fires Services GTA's, that requires all roads be a minimum 5m.

The cross-sections and road reserves allow for segregated shared space for pedestrians and cyclists in most locations. These will provide attractive and safe routes for leisure trips and access to public transport. Facilities for non-car modes are detailed further in Chapter 6.

At completion, the internal layout also provides for bus penetration of the development site, and for express services to use just the main roads where applicable. This will allow for a range of bus, or other public transport, services to serve the site in future. The proposed public transport routing and facilities are detailed in Section 6.

The main site link, 'Minmi Boulevard,' has been designed with roundabouts at the majority of its intersections to cope with the expected volumes using this link. Particular attention has been given to ensuring that the internal layout has multiple accesses to each area to comply with emergency access requirements. In the event of an emergency situation the emergency services will have sufficient access to properties, even if a road has been adversely affected by the situation.

Hyder is satisfied that the layout of the internal road network will be sufficient to serve the development of dwelling units at each stage, and will interact with the existing, and future, external road network effectively.

5.9 Testing Proposed Improvements

In the future, the surrounding road network would need to cater for traffic from the full proposal and for the growth in cross-regional and cumulative traffic on the main road network. It has been assessed that the network cannot sustain such traffic increases and maintains a reasonable level of service without improvement works to intersections. Our analysis in Sections 5.5 and 5.6 suggested two critical roundabouts on the Newcastle Link Road that will require upgrading. The traffic model determined a direct nexus between C&A development and a reduced LoS at Newcastle Link Road/Minmi Road roundabout. The Newcastle Link Road and Woodford Street roundabout failed primarily from the cumulative traffic impact. We tested following four improvement options that could lead better performance on the Newcastle Link Road particularly at the two key roundabouts. All four improvement option were tested by using aaSIDRA and Paramics for year 2031 (AM peak hour) for natural background growth plus 100% C&A traffic.

- ***Improvement option A*** involves one additional access on the Link Road at the eastern end of the C&A land. Access from north is proposed for C&A and HIR waste truck. Access from south is proposed for C&A 'Link Road South'

development. Both accesses are proposed to a left in/left out operation on the Link Road. This option also assumes that C&A key access at Newcastle Link Road/Minmi Road roundabout forming a fourth leg. Newcastle Link Road/Woodford St is assumed same as current operation i.e. a roundabout;

- ***Improvement option B*** is a variation to option A. The variation includes two additional left turn slip lanes at Newcastle Link Road and Minmi Road roundabout. The first slip lane is proposed from Minmi Road south for traffic heading to the west. The second slip lane is proposed from Minmi Boulevard north for traffic heading to the east;
- ***Improvement option C*** is a further variation to option B. The variation includes a new roundabout at eastern end of the C&A land providing full access to both C&A and HIR traffic. This new roundabout replaces previous left in/left operation (from options A& B). The other variation includes one additional left turn slip lane at Newcastle Link Road and Minmi Road roundabout. The slip lane is proposed from Minmi Road south for traffic heading to the west; and
- ***Improvement option D*** is a variation to option A. The variation includes a set of new signals replacing Newcastle Link Road, Minmi Road/Minmi Boulevard roundabout. Similar to option A, left in/left out is proposed at the eastern end of the C&A land. Newcastle Link Road/Woodford St is assumed same as current operation i.e. a roundabout.

In all four options we assumed a new roundabout on the Minmi Road with North Lakes Drive. Figure 5-9 shows assumed intersection layout for four improvement options A to D.

I-1 Newcastle Link Rd/ Woodford Street	I-2 Newcastle Link Rd/ Minmi Rd	N-4 Newcastle Link Rd/ C&A and HIR waste truck access/C&A Link Rd South	
Roundabout	Roundabout	Left In/Left Out	Improvement **Option A**
Roundabout	Roundabout with two left turn slip lanes	Left In/Left Out	Improvement **Option B**
Roundabout	Roundabout with one left turn slip lane	Roundabout	Improvement **Option C**
Roundabout	Signals	Left In/Left Out	Improvement **Option D**

Figure 5-9 Intersections Improvement Options

Table 5-11 summarises result for improvement options A to D.

Table 5-11 Intersections performance for improvement Options A to D, 2031 full C& A (AM peak)

		No improvement			Option A			Option B			Option C			Option D		
		Scenario 31S7D			Scenario 31S7D-ImpA			Scenario 31S7D-ImpB			Scenario 31S7D-ImpC			Scenario 31S7D-ImpD1		
ID	Intersections	DoS	Delays	LoS	DoS	Delays	LoS	DoS	Delays	LoS	DoS	Delays	LoS	DoS	Delays	LoS
I-2	Newcastle Link Rd/Minmi Rd/ Minmi Boulevard	1.76	>90	F	1.24	>90	F	1.10	86.1	F	0.72	8.8	A	0..90	46.9	D
N-4	Newcastle Link Road/HIR and C&A accesses	-	-	-	0.55	1.0	A	0.55	1.0	A	1.1	>90	F	0.55	1.0	A

Following observations are noted from results in Table 5-11:

- Option A improvements are unlikely to provide additional capacity at Newcastle Link Road/Minmi Road roundabout. The predicted LoS is F with DoS value is 1.24;
- Option B improves capacity marginally at Newcastle Link Road/Minmi Road roundabout. The predicted LoS is F with DoS value is 1.10;
- Option C improves capacity of Newcastle Link Road/Minmi Road roundabout significantly. However, a new roundabout (at eastern end of the C&A land) shows capacity issue with predicted LoS F with DoS value more than 1.0. This indicates a “shifting” capacity problem from existing roundabout to a new roundabout. Paramics model shows, new roundabout at Link Road provide a direct through-fare for traffic accessing from Minmi south heading east to Newcastle; and
- Option D – new signals at Newcastle Link Road/Minmi Road improves the intersection capacity. The predicted LoS is D with DoS value is 0.90. We have also tested signals capacity for PM peak period traffic and model showed satisfactory LoS.

Of the four improvement options we tested, option D shows a good capacity and LoS on the Newcastle Link Road and associated key intersections.

Figure 5-10 shows predicted queue length sourced from Paramics model.

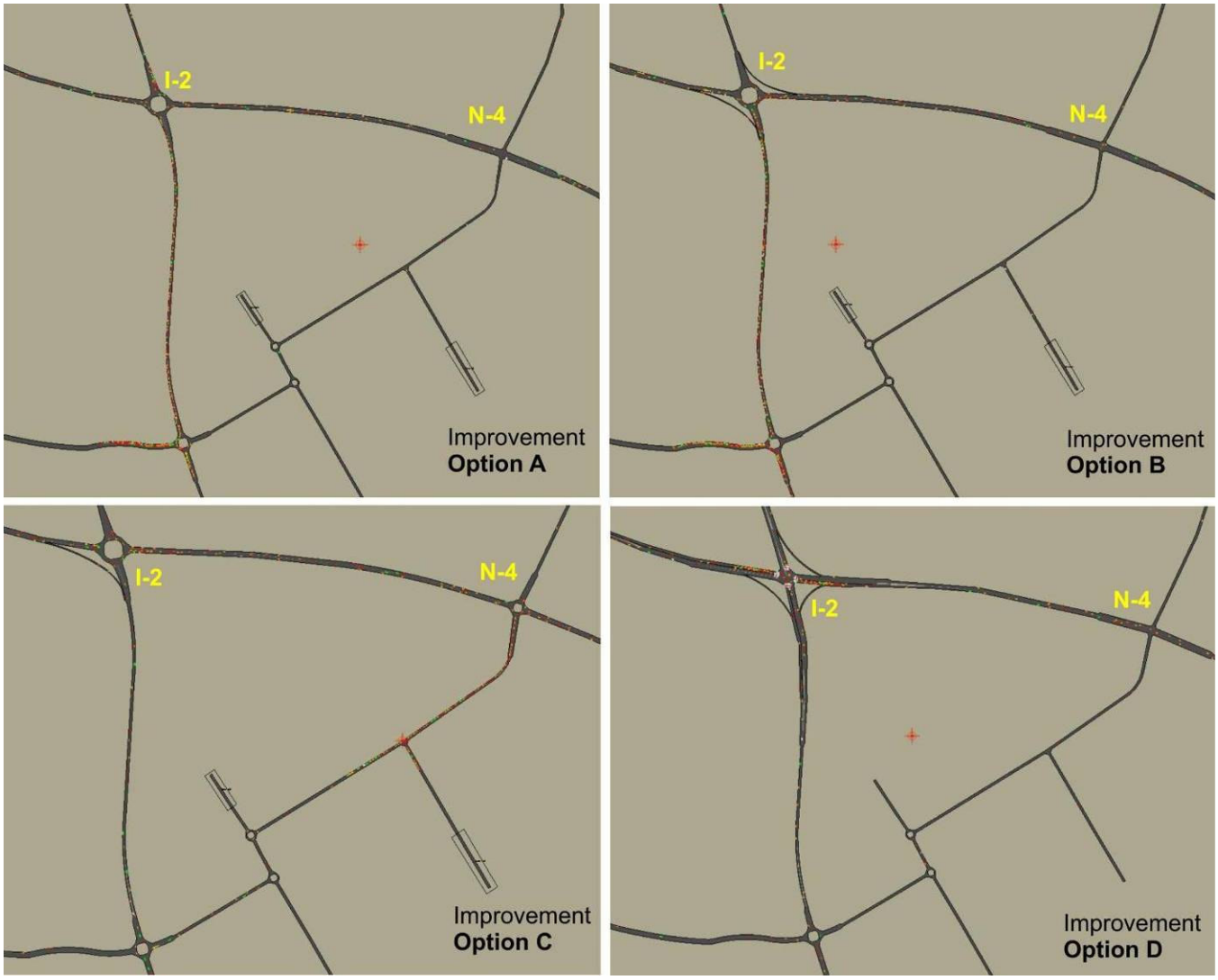


Figure 5-10 Predicted queue length for different improvement options (Paramics scenario 31S7D)

In conjunction with intersection improvement works on the Newcastle Link Road, a package of internal road and intersections are also proposed. The internal road network is proposed to be implemented gradually as C&A progress the development. An indicative package of traffic works are summarised below.

- **C&A Development Stage 1**
  - New internal roads to serve residential development, all to be two-way single carriageway, internal intersections to be 'Give-way; and
  - Six new 'Give-way' accesses onto Minmi High Street.
- **C&A Development Stage 2-site north of Newcastle Link Road**
  - New internal roads to serve residential development, all to be two-way single carriageway, internal intersections to be 'Give-way;
  - Five new 'Give-way' accesses onto Woodford Road;

- New distributor link through the site, 'Minmi Boulevard, to be one lane in each direction with parking. This is to join Newcastle Link Road at the current 3-leg NLR-Minmi Road roundabout, upgrading it to a 4-leg intersection with signals; and
- One new roundabout intersection with Woodford Road for the new 'Minmi Boulevard' link to Newcastle Link Road.

- **C&A Development Stage 2 – site south of Newcastle Link Road**
  - New internal roads to serve the residential development, all to be two-way single carriageway. One new internal roundabout intersection, all others to be 'Give-way';
  - New site access at Minmi Road – Northlakes Drive intersection;
  - Upgrade of Minmi Road – Northlakes Drive intersection from 'Give-way' to 4-leg roundabout (2 lanes); and
  - A new one lane roundabout with proposed Fredrick-Minmi Link.
- **C&A Development Stage 3**
  - New internal roads to serve residential development, all to be two-way single carriageway. All internal intersections to be 'Give-way';
  - One new 4-leg roundabout intersection with Woodford Road, to serve minor internal roads; and
  - Two new 4-leg roundabouts with Minmi Boulevard, to serve minor internal roads.

6 Non Car Modes Strategy

As set out in the Lower Hunter Integrated Transport Plan (2007), the future non-car mode share is targeted to reach 20% in 20 years time. To achieve this target, the new residential development at Minmi needs to be fully integrated to the Lower Hunter Bus Network and efficiently linked to the surrounding rail network.

Hyder is therefore suggesting a public transport strategy that would increase demand for alternative modes of transport and increase the share non-car modes will play in trips for employment, education and leisure purposes.

The strategy is set out in Section 6.1 for public transport modes and in Section 6.2 for pedestrian and cycle modes.

6.1 Public Transport strategy

As described at Section 2.5.1 part of the proposed development site is currently serviced by two bus routes, linking the area to major interchanges at Wallsend and Glendale, and also to Cardiff Railway Station. In the proposed strategy, it is recommended that links to major centres be reinforced to make public transport more attractive than private vehicles for all kind of trips. The “Journey to Work” analysis showed that the majority of trips from the study area are directed towards the City of Newcastle and the City of Lake Macquarie. In the light of the planning strategy in the Lower Hunter region, it is forecast that these travel patterns will stay similar at the 2031 horizon, when the development is proposed to be fully completed. Several new road links are proposed to take place within the development, with a major spine road, ‘Minmi Boulevard,’ linking the south and the north of the development (Newcastle Link Road to Minmi Township). Figure 6-1 shows the public transport strategy that is proposed for the new development.

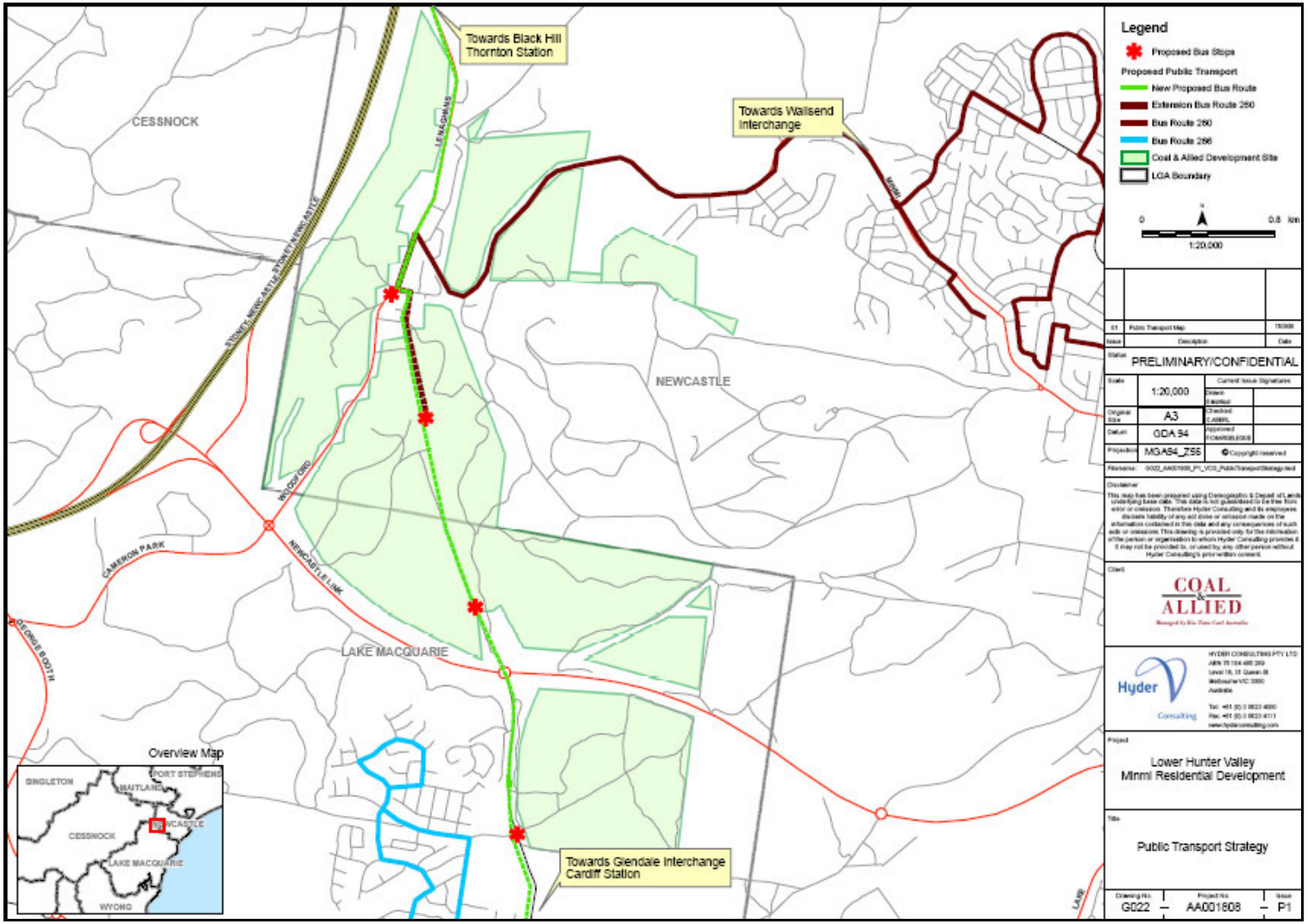


Figure 6-1 Public Transport Strategy

New Bus Route

In this context, it is suggested that new bus links be created and existing ones reinforced through the study area, in order to link the proposed development to the major attractors. Route 265/266 is a local bus route that services the local road network in Cameron Park. The route is not direct and the travel time not competitive enough to encourage people away from private vehicles.

It is therefore recommended that a new bus route be created linking Cardiff Station, Glendale Interchange, Edgeworth, the proposed residential development, Minmi Township, and Thornton Station. The new route would run along Minmi Road and the proposed spine road through the development. This new route would create connections to:

- The entire Newcastle bus network (through Glendale Interchange);
- The Sydney to Newcastle rail line at Cardiff Station; and
- The Newcastle to Maitland line at Thornton Station.

It is noted that, when the proposed Glendale Train Station (at the shopping centre) is opened, the new route could start, closer to the development, at that station instead of Cardiff Station.

This route would cater for a wide catchment along the main road network without entering local roads, and would therefore operate at a competitive and attractive travel speed, by not entering the local network. This would also allow bus priority treatments to be implemented in the future.

New bus stops would be proposed along the new bus route. Within the development it is proposed to create bus stops on:

- Minmi Road, south of Newcastle Link Road;
- The proposed Spine Road, just north of Newcastle Link Road, in the new Minmi Village Centre;
- The proposed Spine Road, in the new Minmi Village Centre; and
- Woodford Street, within the existing Minmi Township.

A map of the proposed new bus route and the bus stops is shown at Figure 6-1.

Extension of Bus Route 260

In addition to the suggested new bus route, Hyder is proposing to extend the bus route 260 from Minmi Township to the proposed new village centre.

From its existing terminus on Woodford Street, route 260 would run along the proposed 'Minmi Boulevard' to the new Village Centre where a new terminus would be created.

This initiative would create a direct access from the new development to Wallsend Interchange.

It is also proposed, in consultation with the NSW Department of Transport and the City of Newcastle, to review the route between Minmi and Wallsend to create a more direct itinerary through Fletcher and Maryland. The increase in route directness would therefore minimise travel time and make route 260 more attractive to potential passengers.

A new bus stop would be created along this route extension, at:

- The proposed Spine Road, in the new Minmi Village Centre.

A map of the proposed new bus route and the bus stops is shown at Figure 6-1.

Accessibility Analysis

A broad accessibility analysis has been undertaken for the proposed public transport strategy. A 600 metres catchment (buffer) has been applied along to the new bus route and the extended bus route 260. 600 metres walking is considered the maximum acceptable distance for potential patrons to travel to the nearest bus stop Figure 6-2 shows the extent of the 600 metres catchment.

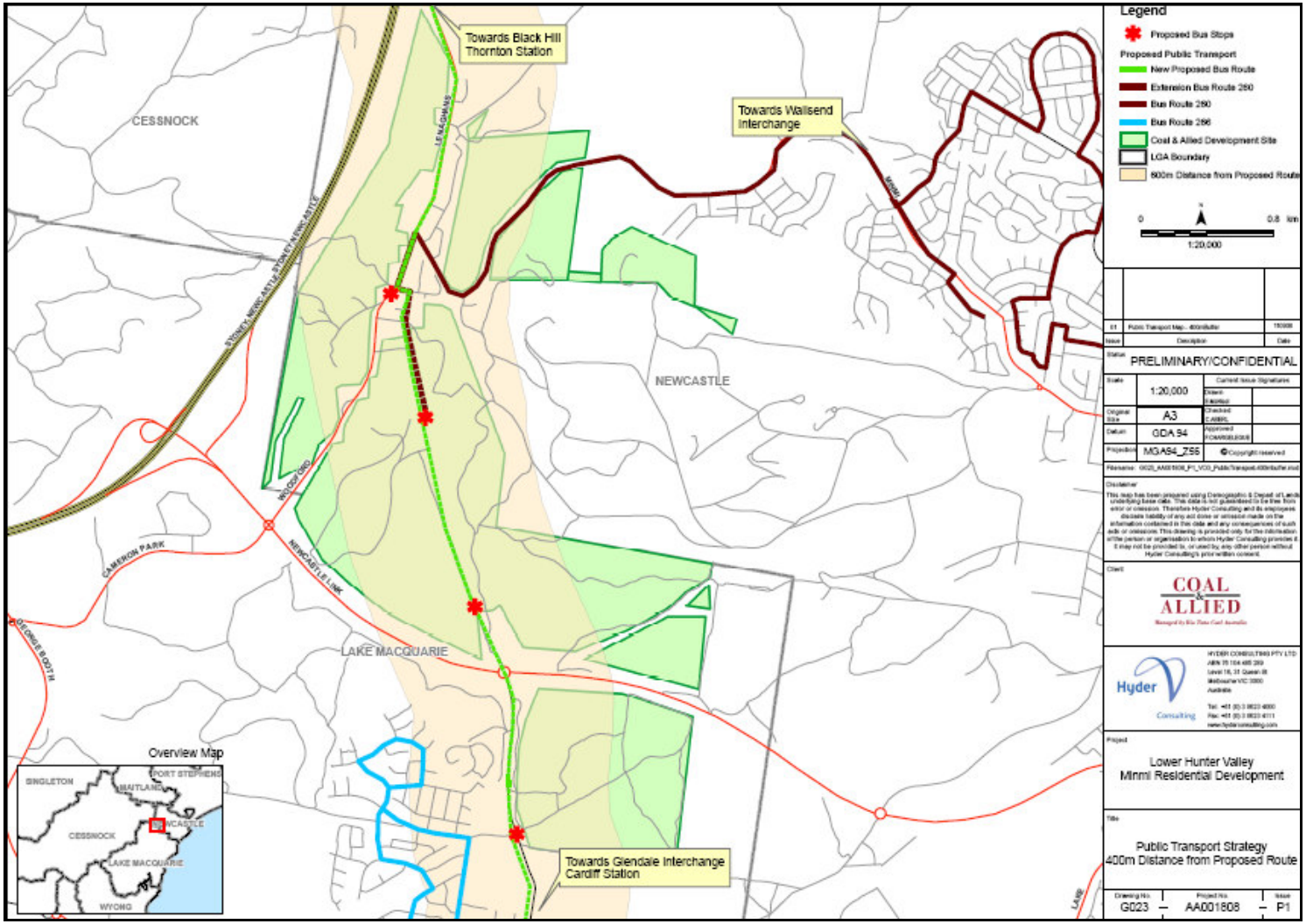


Figure 6-2 Public transport 600 metres catchment

The figure demonstrates that the proposed development would benefit from the introduction of this new bus route, as most of the dwellings would be located within 600 metres of the route. A few locations (in the east and west) would be situated outside this buffer but would be easily accessible by foot or bicycle using the local road network.

Implementation Strategy

The development at Minmi is proposed to be rolled out in three stages by 2016, 2026 and 2031. Hyder therefore suggests that the creation of the new bus route and the extension of bus route 260 would take place before completion of the Village Centre in 2026.

It is important, however, to implement the bus modifications before the residents move in. This enables the non-car modes to be sold to the new residents as part of the lifestyle they are buying into on the development. Changing travel behaviour is also more likely while people are already going through major life changes, such as moving house and possibly giving up one, or all, of the household cars. Marketing high quality bus services as early as possible will therefore give the best chance of achieving modal shift and suppressing traffic growth in the area.

6.2 Pedestrian and Cycling Strategy

Through the period to 2031, pedestrian and cycle modes should be encouraged for short trips to work, school or leisure activities.

The proposed new road network within the development can allow for the introduction of off-road cycle ways. It is therefore suggested that an off road cycle way be created along the proposed Minmi Boulevard through the development and on to Minmi Road (Edgeworth). Since the implementation of the new residential settlement in the area could generate significant car trips, the creation of cycle way would trigger a sense of security for cyclists and therefore make the cycle mode more attractive for a larger number of people.

This new cycle way would also create a direct link between the Minmi development and the activity centre at Glendale.

We also suggest that the off-road cycle path network be completed in Maryland and Fletcher towards Minmi, using the Minmi road alignment. This cycle path would create a direct link between Minmi and Wallsend activity centre. Figure 6-3 shows the off street cycle strategy throughout the new development.

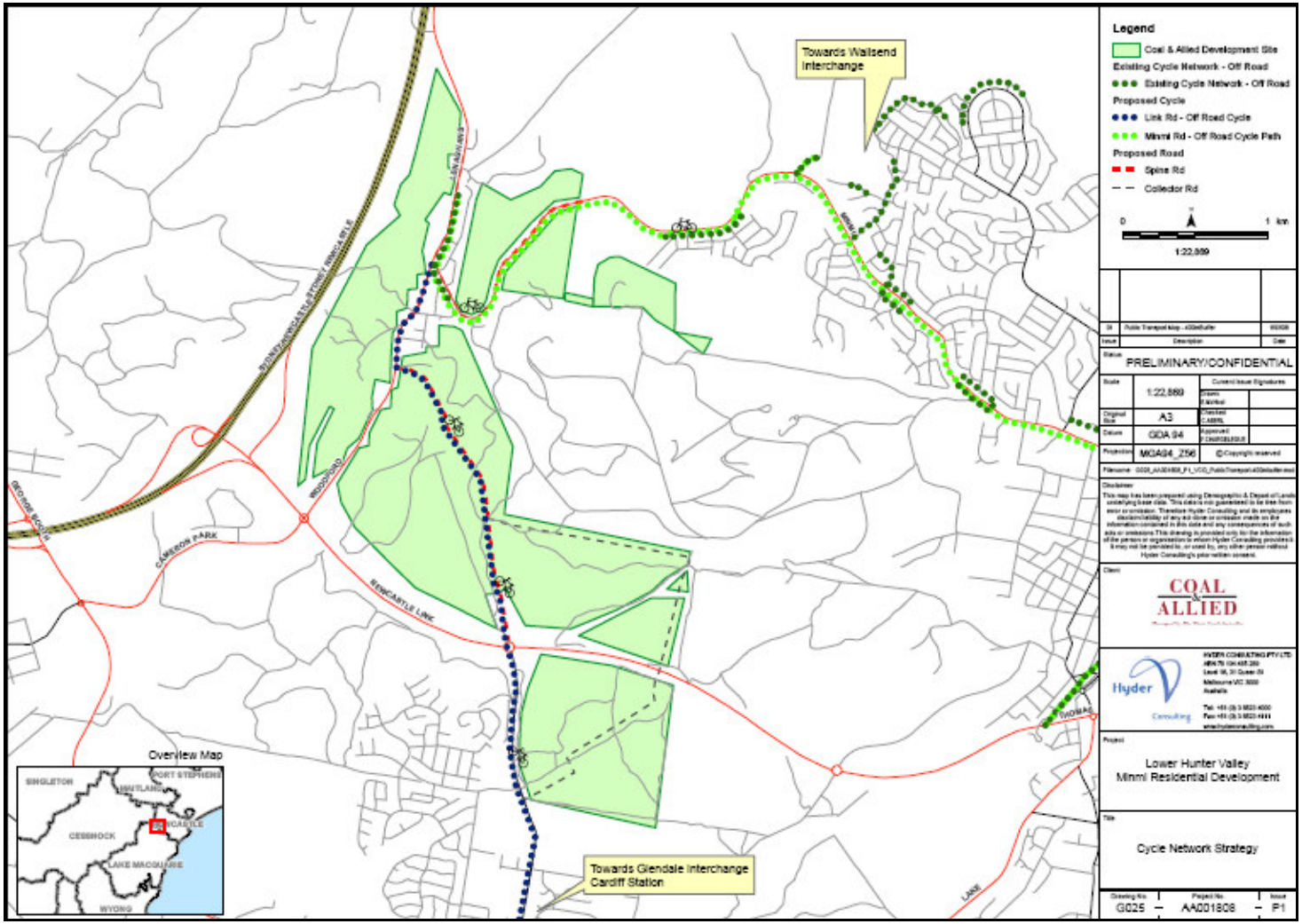


Figure 6-3 Cycle strategy

In terms of the pedestrian strategy, it is proposed to use current standards and guidelines to create secure and suitable footpaths along the new road network. The proposed cross-sections for the development allow for a segregated shared path for pedestrians and cyclists. This will take place within the development at each stage of its implementation. We also suggest giving particular attention to the surroundings of the proposed educational facilities with strong priority for cycle and pedestrian movements.

7 Summary of Findings

Coal and Allied Pty Ltd (C&A) has identified surplus landholdings in the Lower Hunter region within the boundaries of the Lower Hunter Regional Strategy (LHRS). In April 2008, the Director-General's Requirements (DGRs) for the subject land were issued. Hyder Consulting Pty Ltd (Hyder) has been commissioned to carry out the traffic study that will address the DGRs and look at the traffic and transport issues associated with the concept plan of the site.

This traffic and transport report details the impact from the residential development in the northern area comprising Minmi, Newcastle Link Road north and south. The two sites in the northern area have a combined development potential of 520 hectares (ha). These fall across the boundary of the Lake Macquarie and Newcastle local government areas (LGA). A Concept Plan for the subject site has been developed containing approximately 3,300 dwelling units and are planned for release into three stages over the next 25 years period. One access is proposed on the Newcastle Link Road from the north at Minmi Road/Minmi Boulevard intersection. Emergency accesses (left out only) are proposed from 'Link Road South' and Link Road north sites. At each stage of the C&A development, the site will have multiple accesses to comply with the emergency services requirements.

Most trips in the Minmi/Link Road area are undertaken by car. Journey to work data shows that car accounts for about 78 percent of journey to work trips with 2.5 percent using the bus. Public transport is limited. Currently, two bus services are running in the vicinity of the proposed development site.

- Route 260 Minmi – Maryland – Wallsend; and
- Route 265/266 Cameron Park – Glendale – Charlestown – Newcastle University.

The current road network in and around the C&A Minmi/Link Road site provide a number of route choices or alternative accesses. The Newcastle Link Road is the major east-west arterial road providing access to the subject site via Minmi Road and Woodford Street. Access to the site can be made via Lenaghans Drive and Minmi Road (though Minmi/Flethcher).

Newcastle Link road carries over 22,000 vehicles per day during a weekday, with weekend traffic around a third lower than on an average weekday. This implies that the Link Road carries a high proportion of commuter traffic demand to/from Newcastle. The heavy vehicles on the Link Road were recorded between 1,600 and 2,200 vehicles per day comprising between 7% and 9% of total traffic. Minmi Road (through Edgeworth), south of Newcastle Link Road carried approximately 14,000 vehicles per day during a weekday. Woodford Street, Leneghans Drive and Minmi Road (through Minmi, Fletcher) carries between 3,500 and 5,300 vehicles per day.

Results from LoS analysis indicate two key intersections on the Newcastle Link Road at Woodford Street and Minmi Road operate at LoS between A and B with satisfactory performance during both the morning and evening peak periods. Both intersections show a degree of saturation (DoS, index of measuring congestion) value between 0.30 and 0.60 which implies that some spare capacity is available for future growth.

Future traffic conditions on the regional road network in the vicinity of C&A Northern lands (including Minmi/Link Road and Black Hill sites) will be determined by the following driving factors. They are:

- Lower Hunter Regional Strategy which forecasts a population increase of about 160,000 and an additional 66,000 jobs over a 25 year planning horizon between 2006 and 2031. This land use change provided a key input to RTA's Lower Hunter Transport Model (LHTM);

- Key transport corridor involving Newcastle Link Road, F3 and John Renshaw Drive carries a significant volume of regional traffic. Future predicted population and employment growth will have a significant impact on traffic operation of these roads and associated intersections. This means that the cumulative impact will have implications on the access strategy adopted for C&A Northern lands; and
- RTA has been investigating two longer term infrastructure projects in this corridor-F3 to Branxton motorway (F32B) and F3 to Raymond Terrace Link (F32R). Both projects will have significant traffic impacts on this corridor. At present, RTA consider both schemes as long-term projects, with neither having a detailed funding plan from the Federal Government.

Due to the complexity of future travel patterns within the corridor, we have assessed C&A impact via a number of scenarios. The scenarios considered three key issues (a) impact from C&A Northern Land development alone (b) cumulative impact from other planned land developments (c) impact from F32B and F32R projects. Table 5-5 presents future growth in the next 25 years which was measured as a cordon line (Figure 5-5 shows location of cordon line). The model indicates in that 2031:

- Future demand on Newcastle Link Road corridor will increase from current 57,000 to 147,300 vehicles per day including C&A development;
- All proposed development traffic is expected to grow about 3.8% per annum, which is significantly higher than the current growth trend of 1.7%;
- Cumulative traffic (without C&A) is expected to grow corridor demand by about 57,000 vehicles per day, about 2.8% per annum; and
- In 2031 including the full C& A development, will increase corridor traffic from 114,500 vehicles to 147,300 vehicles, an increase of 32,800 vehicles per day (30%).

The proposed F32B Link will influence corridor demand significantly. The model forecasts an increase of about 41,200 vehicles daily (28%) on the corridor. The new Link (full 40km) will provide a direct connection between Maitland, Cessnock with Newcastle and is expected to increase traffic on Newcastle Link Road significantly. However, if the F32B project is staged (terminates at John Renshaw Drive), then traffic increase on this corridor will be much lower than “with the full project case”.

In considering above three key issues, we have modelled three development options for the AM peak period testing intersection performance:

- Option R1- Nominal background growth only – This option assumes natural growth in the network irrespective of any proposed developments;
- Option R1D-This includes R1 and C&A traffic – the difference between S1D and S1 will provide true C&A impact alone; and
- Option R2D- Cumulative growth including C & A – This option assumes other development proceeds concurrently with C&A as per LHTM model assumption.

These three options were then developed into various scenarios (see Table 5-6) that followed the proposed staging of the C&A development. The above options excluded F32B impact. Modelling results show:

- Under nominal growth scenarios two key roundabouts at Link Road/Woodford Street and Link Road/Minmi Road are expected to operate with a good LoS (A/B). DoS is predicted between 0.38 and 0.92 –a reasonably good capacity. Both roundabouts are expected to have a service life of 25 years or more if the network continues to grow at a nominal rate. This implies that the notional background growth is unlikely to trigger upgrading works at either intersection;

- C&A first stage (580 dwelling units) shows minor impact on intersection capacity. All key intersections on the Newcastle Link Road are expected to operate with LoS A/B and DoS values between 0.46 and 0.65;
- The additional 1,434 dwelling units from stage 2 are expected to reduce LoS at the Newcastle Link Road/Minmi Road roundabout. Critical movements are predicted to have higher DoS values meaning some form of upgrade may be required for certain movements. The full C&A development is predicted to reduce LoS of the Newcastle Link Road/Minmi Road roundabout to F. This indicates a direct nexus between C&A development and the reduced LoS at Newcastle Link Road/Minmi Road roundabout; and
- C&A impact at the other two intersections (Newcastle Link Road/Woodford St roundabout and Woodford St/Mimi Road signals) are low. The model predicts a lower LoS and higher DoS values at both intersections primarily driven by the cumulative growth.

Of the four improvement options we tested (see Figure 5-9) a combination of options is likely to provide additional capacity on the Newcastle Link Road. Improvement Option D involving new signals at the Newcastle Link Road/ Minmi Road/Minmi Boulevard provides satisfactory LoS. Model predicts a good LoS D at intersection of Newcastle Link Road/ Minmi Road/Minmi Boulevard. The recommended upgrading works at this intersection may not be required until C&A 2,000 dwelling units are completed. However if assumed background growth is exceeded due to rapid growth from cumulative/other traffic, then C&A 2,000 lot thresholds would be reduced. Section 5-9 summarises an indicative package of traffic works as C&A is progressed in stages. These recommended infrastructure works would deliver the necessary network performance for the relevant roads and intersections to cope with the proposed C&A development up to, and beyond, the 2031 full development timeframe.

7.1 Director General's Requirements

In accordance with the requirements set out in "Link Road North, Link Road South and Minmi – Director General's Requirements," 11 April 2008, this traffic study has addressed all relevant Traffic/Transport issues. Table 7-1 below summaries the DG's requirements and which sections of this report addresses each matter.

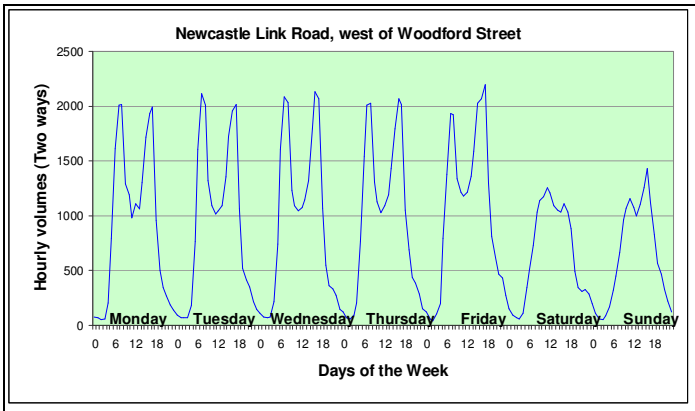
Table 7-1 Director General's Requirements

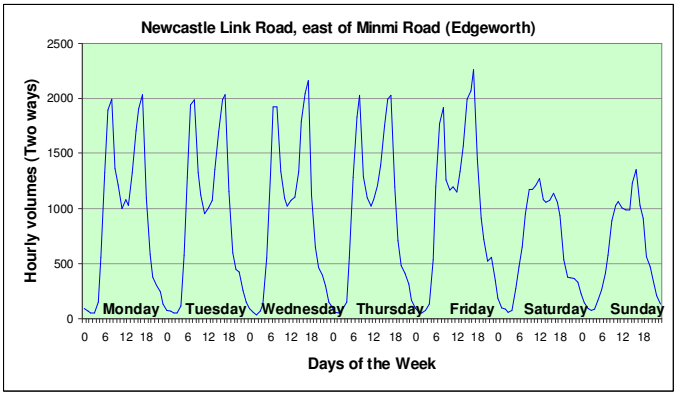
DG Requirement	Relevant Report Chapter(s)
a) Impacts on regional road networks during construction and operation;	Chap.5 Chap. 5.5 - 5.8
b) Opportunities to minimise traffic on sensitive road frontages during construction and operation;	Chap. 5.9 and Chap. 6
c) Efficiency of emergency vehicle access/egress;	Chap. 5.1
d) Proposed access from the wider road network as well as the opportunities and constraints of alternative vehicular access points;	Chap 5.1, 5.2, 5.3
e) Measures to introduce and promote public transport usage and mode share;	Chap. 6

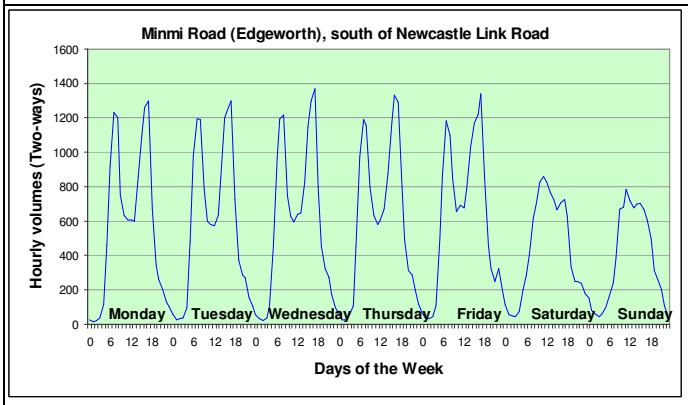
DG Requirement	Relevant Report Chapter(s)
f) Proposed pedestrian and cycle access within and to the site that connects to all relevant transport services and key off-site locations;	Chap. 6, Chap. 5.9
g) Traffic signal and intersection upgrades underpinned by an intersection analysis and micro-simulation model;	Chap 2, Chap 4, Chap. 5.5 to 5.9
h) Road design that is responsive to the proposed land use and associated urban form including proposed transport linkages between the subject land and surrounding key destination points such as existing centres, recreational areas and employment/industrial centres.	Chap. 5.9 and Chap 6

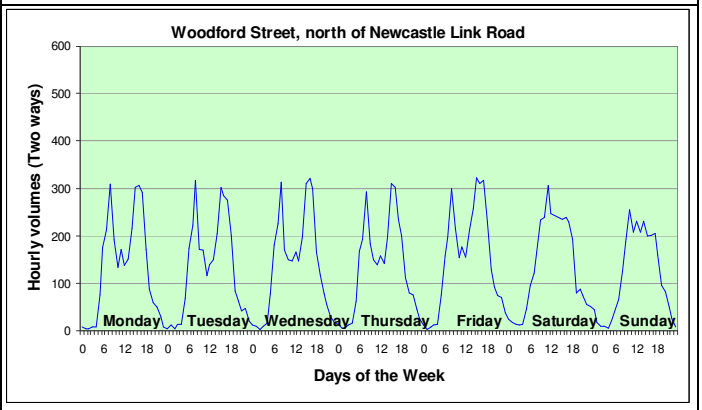
Appendix A

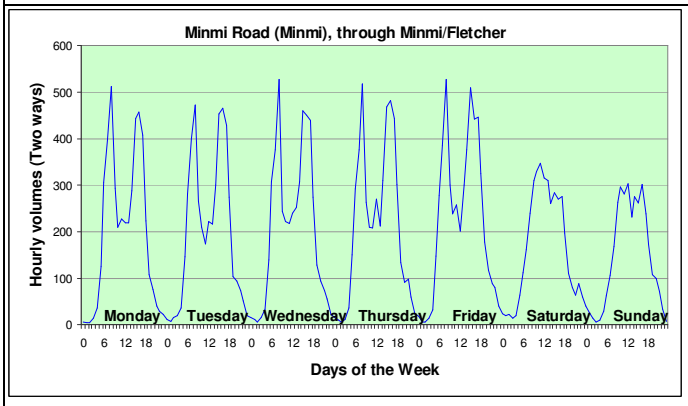
Traffic Data

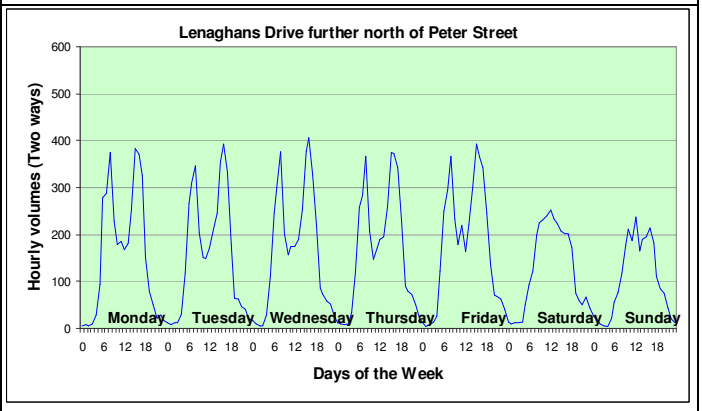




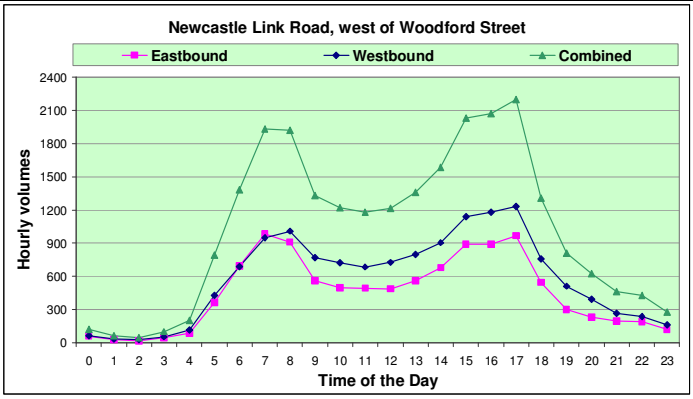


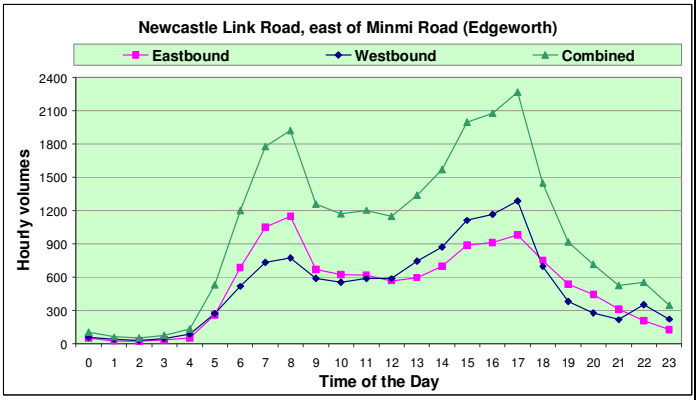


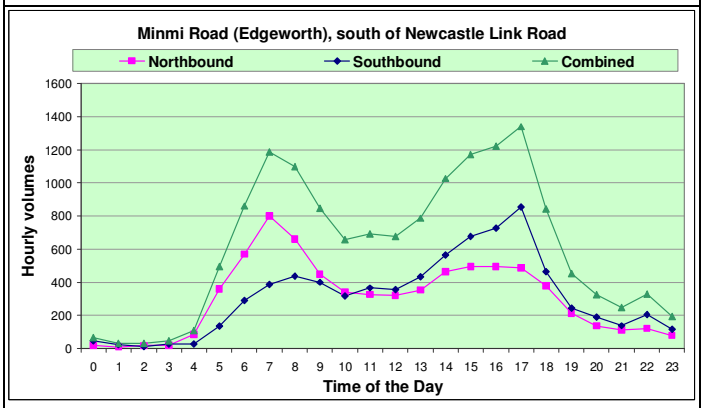


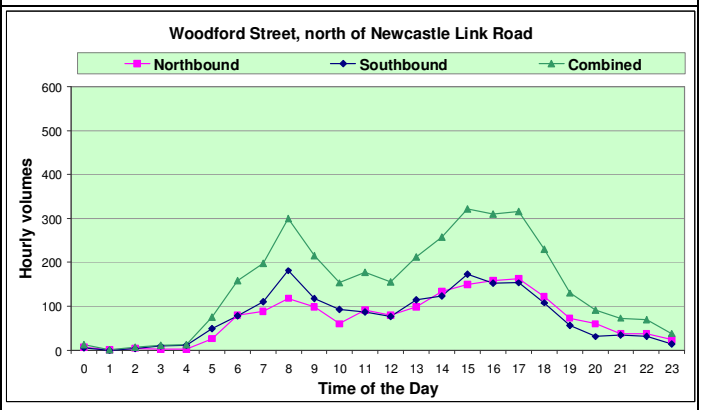


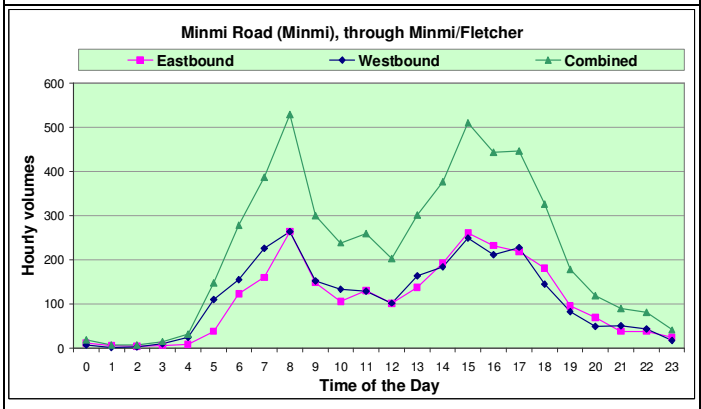
Appendix A Figure 1 Daily traffic volume on key roads in Minmi

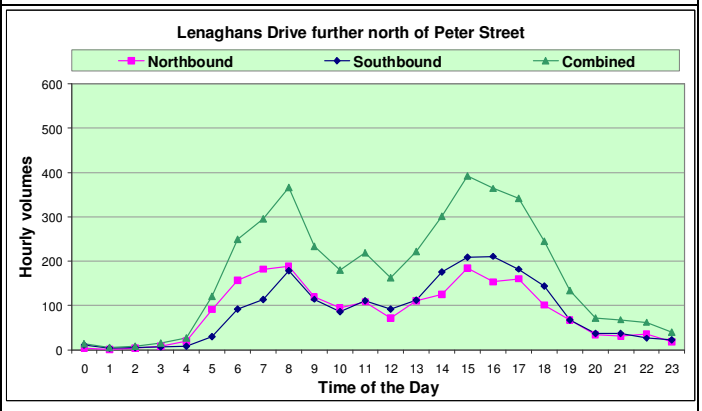












Appendix A Figure 2 Hourly traffic variation at key roads in Minmi