

Justification of Traffic Signals at Intersection of Galston Road with Clarinda Street, Hornsby

January 2018

Hornsby Shire Council

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- Appendix 4: Traffic Accident Records*
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- Appendix 7: Amended Draft TCS Plan at Galston Road/Clarinda Street*

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Reviewer: LN

Approved by: LN

Signed:

Date: 18 January 2018

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EXECUTIVE SUMMARY

This document is an amended justification Report for the proposed TCS at the intersection of Galston Road with Clarinda Street as requested in the email from Kathryn Hawkins dated 22 August 2016. A copy of this email is presented in **Appendix 6** of the Justification Report.

The document is a site specific report outlining the following:

- existing traffic flows and crash data that was available in November 2016 when the subject report was prepared;
- projected future traffic in the study area;
- TCS warrants;
- Additional traffic management measures including medians to restrict traffic to left in/left out only at the intersections of Galston Road/Carrington Road and Peats Ferry Road/Old Berowra Rd;
- Rationale of locating the TCS at Clarinda Street instead of at Ethel Street.

Issues relating to the VMS co-location with the proposed signals at the intersection of Galston Road with Clarinda Street were addressed in a peer review report prepared by Thompson Stanbury. The peer review report was commissioned by Council to address concerns raised by the RMS regarding the proposal to co-locate the VMS with the TCS. A copy of this report is presented in **Appendix 5** of the TCS Justification Report.

The traffic management strategy for the study area was adopted by Council to manage vehicular and pedestrian access for the up-zoned Galston Road Housing Precinct. The strategy was developed in consultation with the RMS and includes:

- traffic signals at the intersection of Galston Road with Clarinda Street;
- a median in Galston Road at Carrington Road to restrict traffic to left in/left out only;
- a median in Peats Ferry Road at Old Berowra Road to restrict traffic to left in/left out only;

An extract of the RMS letter relating to the traffic management strategy for Galston Road Housing Precinct is presented in **Appendix 2** of the TCS Justification Report. In this letter, the RMS provided the following comments regarding access and traffic requirements for the area:

- 1) *Vehicular access for developments in Galston Road Precinct (which forms the principle part of the study area) should be from Clarinda Street and Old Berowra Road.*

EXECUTIVE SUMMARY

- 2) *To address road safety concerns, Council must give consideration to the closing of side streets or modification of the intersection of Galston Road/Carrington Road, and Pacific Highway/Old Berowra Road.*
- 3) *The RTA would give consideration to signals at the intersection of Galston Road with Clarinda Street subject to further investigation, analysis and traffic modelling being provided by Council.*
- 4) *In addition, Council should consider collecting Section 94 Contributions towards any future improvement works to intersections surrounding the precinct including any intersection capacity improvements and improvements to pedestrian amenities at the intersection of Pacific Highway/Galston Road and Galston Road/Clarinda Street.*

Council has addressed the issues numbered 1) to 4) above in accordance with the RMS comments and requirements by developing the traffic management strategy outlined in Section 4.3 of the TCS Justification Report.

The traffic facilities required to support the adopted access and traffic management strategy for the area are included in Hornsby Council's Development Control Plan 2013 and Section 94 Development Contributions Plan 2014 – 2024.

The proposed traffic signals at the intersection of Galston Road with Clarinda Street are scheduled for implementation as part of Councils Capital Works Program for 2018/2019 Financial Year.

As per RMS requirement, an amended TCS plan for the intersection of Galston Road with Clarinda Street, incorporating a VMS board is presented in **Appendix 7** of the TCS Justification Report. Pdf and dwg copies of the TCS Design Plan are also attached for your approval.

1.0 INTRODUCTION

Hornsby Council is seeking to install traffic signals at the intersection of Galston Road with Clarinda Street Hornsby for which a traffic signal design has been prepared.

*A report named "**Rational of Proposed Traffic Management Works in Hornsby Town Centre and Environs**" was submitted to the RMS earlier in 2016 to provide among other facilities justification of traffic signals at the intersection of Galston Road with Clarinda Street. The report indicated that funding under the S96 Contribution Plan is available for these signals. The report also noted that the traffic signals are included in Councils DCP 2013 to "improve intersection performance by minimising delay and facilitating access to/from Clarinda Street" as part of Hornsby Housing Strategy.*

The Housing Strategy supports a medium density residential zoning contained within the precinct bounded by the Pacific Highway, Galston Road, Clarinda Street and Old Berowra Road, Hornsby with the increased density requiring improved precinct accessibility.

Although Council has previously submitted an overall justification report for traffic facilities in the study area and signals at the intersections of Galston Road/Clarinda Street and Peats Ferry Road/Watson Avenue/Mildred Avenue, the RMS has requested a site specific report to support the application for the new proposed traffic signal at Clarinda Street. The report is required to address aspects such as:

- volume and crash data;*
- TCS warrant criteria;*
- why the subject location is preferred instead of Ethel Street as discussed at face to face meetings with Council officers and representatives of the RMS including during assessment of other network improvements /changes;*
- whether the introduction of traffic signals at Clarinda Street will result in alterations to other intersections (such as making Carrington Road left in and out only); and*
- the proposed traffic signal delivery time frame*

1.1 Scope of the Report

This report has been prepared by Hornsby Council to document the rationale and justification of the proposed traffic signals at the intersection of Galston Road with Clarinda Street, Hornsby. The report documents a site specific analysis of existing and future traffic conditions in the study area.

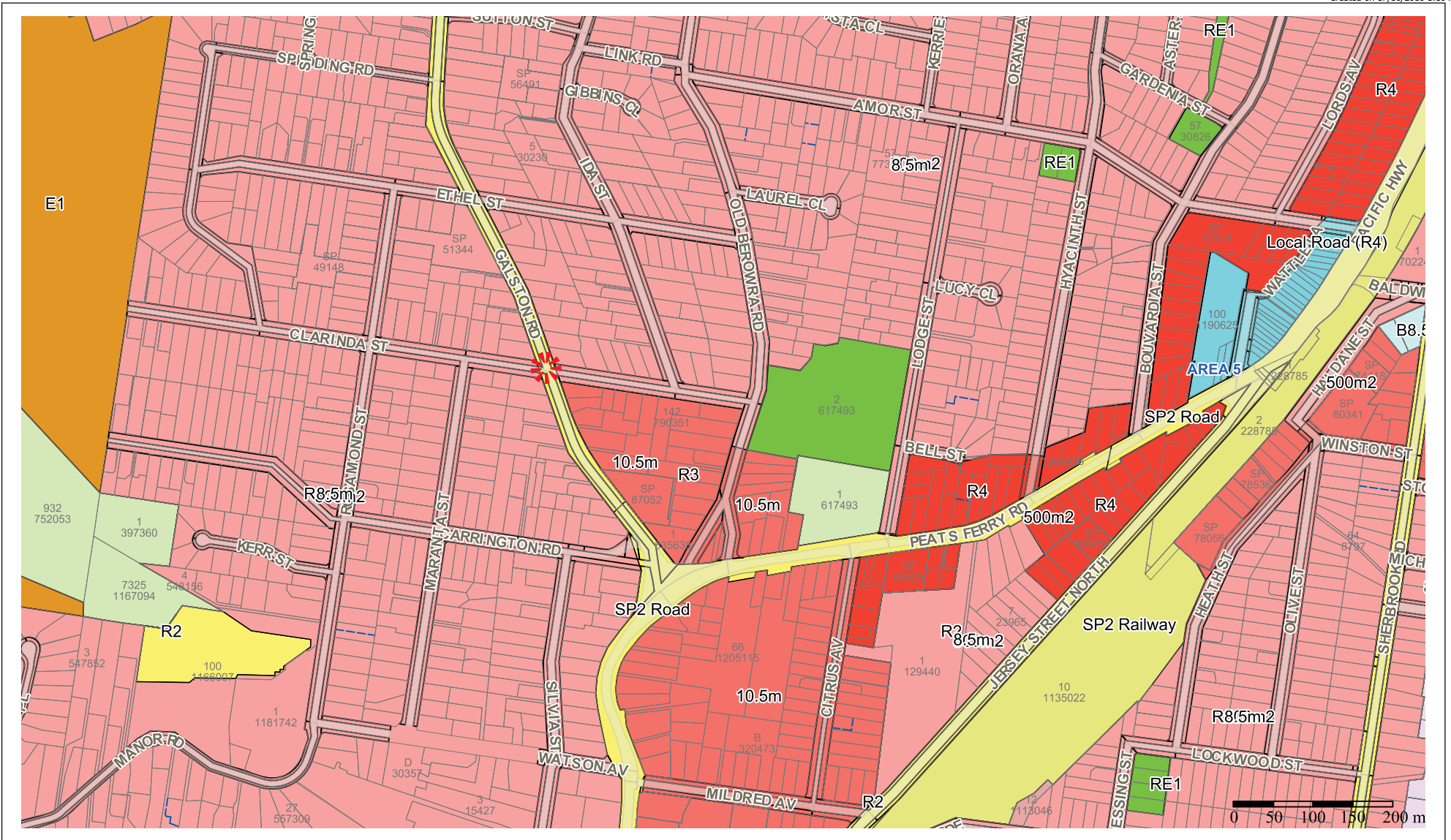
The analysis presented in this report is based on strategic PTV VISUM models and SIDRA network models and has considered the impact of future traffic on the performance of critical intersections in the study area.

1.2 Study Area

The extent of the study area relevant for this report is shown in Figure 1. This area covers part of Travel Zone¹ 1621 (Hornsby_Amor St and Kerrie Pl) and most of Travel Zone 1622 (Mt Wilga Private Hospital Precinct) and generally includes the following streets and roads:

- *Stewart Avenue/Carrington Road;*
- *Clarinda Street;*
- *Old Berowra Road;*
- *Galston Road;*
- *Ethel Street;*
- *Maranta Street;*
- *Manor Road/Rosamond Street;*
- *Alan Avenue/Ethel Street;*
- *Ida Street;*
- *Marine Crescent;*
- *Peats Ferry Road;*

¹ *A Travel Zone (TZ's) is a geographic area used for strategic transport and land use planning and modelling.*



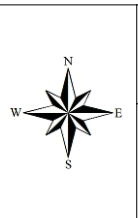


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Projection: GDA94 / MGA zone 56

Date: 17/10/2016

Figure 1 - Study Area

Map Scale: 1:6571 at A4 Landscape

2.0 EXISTING CONDITIONS

2.1 Population and Employment Characteristics

The study area is predominantly characterised by low density residential development. The area to the east of Galston Road is located in Travel Zone (TZ) 1621. In addition to detached low density residential dwellings, existing development in TZ 1621 comprises:

- *Hornsby North Public School. In 2013, there were 767 students enrolled at this school.*
- *Asquith Community Centre & netball court provided at Storey Park.*
- *Asquith Bowling & Recreation Club.*

Land on the opposite side of Old Berowra Road to the south of Clarinda Street and adjoining the southern boundary of Storey Park was recently rezoned to permit townhouse development as part of Council's Housing Strategy (2011 – 2021).

The area to the west of Galston Road is located in Travel Zone (TZ) 1622. In addition to detached low density residential dwellings, existing development in TZ 1622 includes Mt Wilga Private Hospital Precinct.

Mt Wilga Private Hospital Precinct comprises a series of one and two storey buildings, comprising the following:

1. *A total of 119 beds, comprising:*
 - *the original 80 bed facility (60 single rooms and 10 shared rooms) plus the recently approved new 39 bed facility approved via DA/224/2011;*
2. *160 car parking spaces, comprising:*
 - *105 car parking spaces in the north of the lot, accessed via Rosamond Street;*
 - *55 car parking spaces at grade in the south of the site, accessed via Manor Road;*
3. *118 Peak morning staff, comprising:*

- 106 morning staff reported as 'existing' in DA/224/2011
- 12 additional morning staff for the expansion in approved under DA/224/2011.

Employment and population data obtained from BTS for 2011 and 2016 for the two Travel Zones in the Study area is presented in Table 1 below.

Table 1
Population and Employment Data for 2011 and 2016

Travel Zone Number	Zone Description	Employment		Workforce		Population	
		2011	2016	2011	2016	2011	2016
TZ 1621	Hornsby_Amor St and Kerrie Pl	248	263	963	988	1,919	1,957
TZ 1622	Mt Wilga Private Hospital Precinct	669	736	1,623	1,907	3,035	3,523
Total		917	999	2,586	2,895	4,954	5,480

Source: BTS (TfNSW)

2.2 Traffic Generation and Existing Road Network

Journey to Work (JTW) data obtained from the TfNSW indicates that in the order of 480 origin and 1,300 destination trips per day are generated in the study area.

Vehicular access to and from the study areas is mainly obtained from Galston Road and to a lesser extent from Peats Ferry Road via Old Berowra Road, Roper Lane/Bridge Road routes, Watson Avenue and Summers Avenue.

The existing road network in the study area is shown in Figure 1. Galston Road and the section of Peats Ferry Road between Bridge Road and Galston Road (MR 161) is a state arterial route under the jurisdiction of the RMS. The section of Peats Ferry Road (SR 2103) between Galston Road and Jersey Street North is a

classified regional route. The rest of the other streets in the study area are local roads under the jurisdiction of Hornsby Shire Council.

2.3 Existing Peak Hour Traffic Volumes and Travel Pattern

Council has over the years commissioned a series of traffic surveys in the study area. The most recent traffic data for the area was obtained from turning movement counts undertaken in 2015. Summaries of the existing am and pm peak hour traffic flows for the respective count data are presented in Table 2a and Table 2b. Detailed intersection turning movement survey results for the morning and afternoon peak periods are presented in **Appendix 1**.

Data presented in Table 2a and Table 2b shows that during peak periods, Galston Road south of Clarinda Street carries in the order of 1,770 vehicles per hour (two way). The existing magnitude of peak hour traffic flows on Galston Road limits the number of vehicles that are able to enter from side streets. This is reflected by the low volume of traffic entering Galston Road from side streets (see table 2a and Table 2b).

On-site observation of the existing pattern of traffic in the study area has established that traffic going south from areas west of Galston Road finds it easier to exit via the route along Silvia Street/Roper Lane and Bridge Road through the signalised intersection with Peats Ferry Road in order to avoid delays experienced when entering Galston Road. Similarly, traffic in areas east of Galston Road finds it easier to exit via Old Berowra Road through the intersection with Peats Ferry Road. Ideally, this traffic should be encouraged to exit the study area via Galston Road to minimise the impact of through traffic in adjoining streets.

Table 2a
AM Peak Hour (07:15 – 08:15) Turning Movement Flows

Intersection	Approach/Movement											
	Galston Rd/Ethel St	Galston Road						Ethel Street				
North			South			East			West			
Left		Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
0		1,160	13	13	460	15	30	4	1	17	0	9
Galston Rd/Clarinda St	Galston Road						Clarinda Street					
	North			South			East			West		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
	12	1,235	6	13	494	9	9	0	2	7	1	6
Galston Rd/Carrington Rd	Galston Road						Carrington Road					
	North			South			East			West		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
	N/A	1,251	12	123	505	N/A	N/A	N/A	N/A	4	N/A	13
Peats Ferry Rd/Galston Rd	Galston Road						Peats Ferry Road					
	North			South			East			West		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
	170	N/A	1,090	N/A	N/A	N/A	N/A	305	215	414	163	N/A
Peats Ferry Rd/Old Berowra Rd	Old Berowra Road						Peats Ferry Road					
	North			South			East			West		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
	189	N/A	91	N/A	N/A	N/A	N/A	435	47	31	329	N/A

Table 2b
PM Peak Hour (16:45 – 17:45) Turning Movement Flows

Intersection	Approach/Movement											
	Galston Rd/Ethel St	Galston Road						Ethel Street				
North			South			East			West			
Left		Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
6		447	17	23	1,112	10	28	1	2	20	3	4
Galston Rd/Clarinda St	Galston Road						Clarinda Street					
	North			South			East			West		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
	10	455	17	34	1,256	12	10	0	2	14	1	6
Galston Rd/Carrington Rd	Galston Road						Carrington Road					
	North			South			East			West		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
	N/A	469	2	117	1,300	N/A	N/A	N/A	N/A	9	N/A	17
Peats Ferry Rd/Galston Rd	Galston Road						Peats Ferry Road					
	North			South			East			West		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
	143	N/A	336	N/A	N/A	N/A	N/A	228	353	1,054	377	N/A
Peats Ferry Rd/Old Berowra Rd	Old Berowra Road						Peats Ferry Road					
	North			South			East			West		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
	33	N/A	41	N/A	N/A	N/A	N/A	551	49	48	460	N/A

2.4 Existing Performance of Critical Intersections

Sidra intersection capacity analyses have been undertaken to determine the existing performance of key intersections in the study area. As a result of low traffic volumes entering Galston Road from side streets, the analysis established that operation of the existing road network is satisfactory. The existing intersection analysis results are summarised in Table 3a and Table 3b. Figure 2a and Figure 2b illustrates the Sidra Network Model Degree of Saturations in the study area.

Table 3a:- Site Output for Network * Existing AM Peak

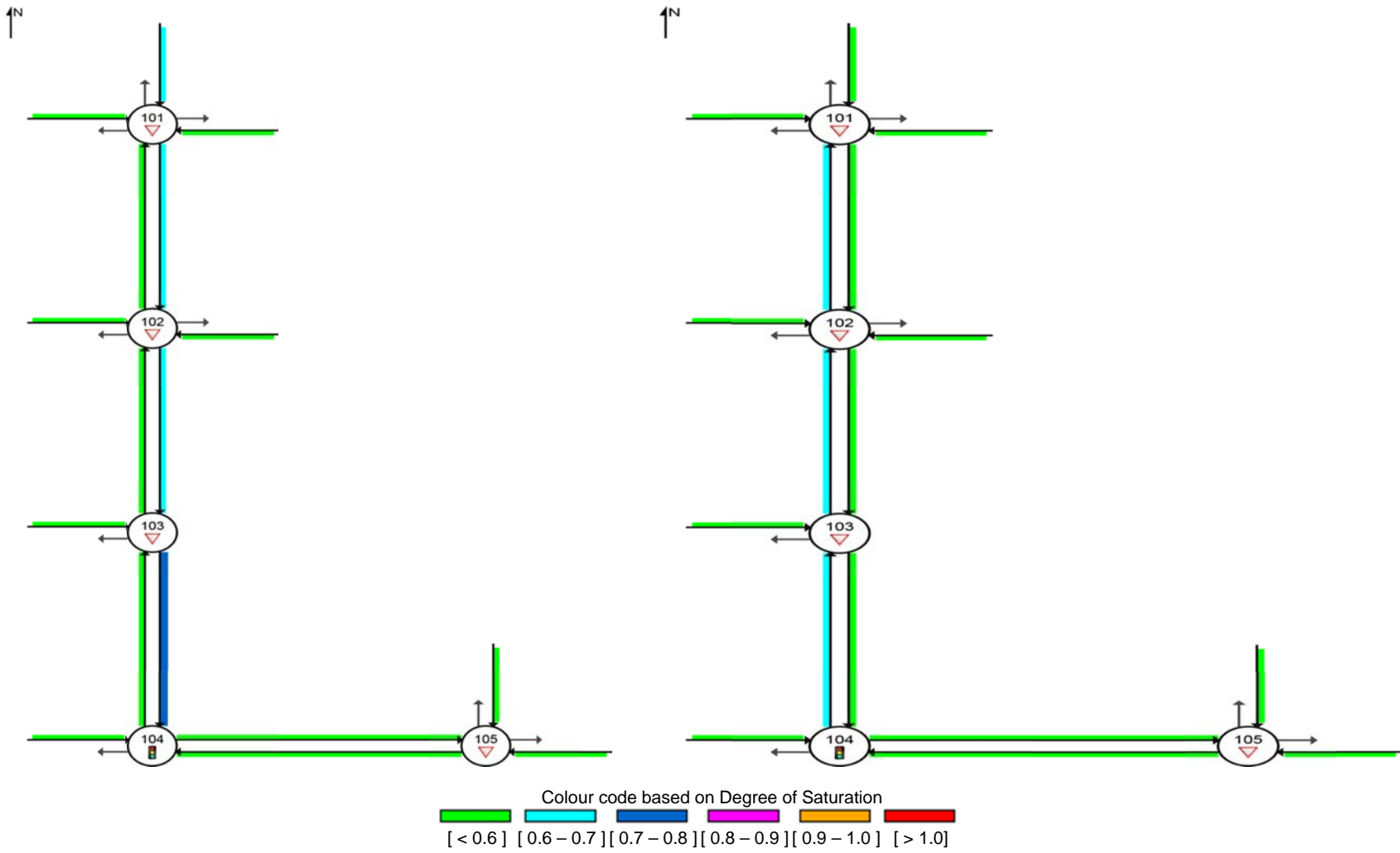
Intersection	Control Type	DOS	Delays (Sec)	LoS	Maximum Queue (m)
Galston Rd/Ethel St	Priority*	0.65	35.6	C	11
Galston Rd/Clarinda St	Priority*	0.66	42.0	C	8
Galston Rd/Carrington Rd	Priority*	0.66	40.1	C	12
Galston Rd/Peats Ferry Rd	Signals	0.76	15.7	B	73
Peats Ferry Rd/Old Berowra Rd	Priority*	0.37	9.2	A	14

Table 3b:- Site Output for Network * Existing PM Peak

Intersection	Control Type	DOS	Delays (Sec)	LoS	Maximum Queue (m)
Galston Rd/Ethel St	Priority*	0.67	33.0	C	14
Galston Rd/Clarinda St	Priority*	0.69	31.9	C	17
Galston Rd/Carrington Rd	Priority*	0.74	34.4	C	7
Galston Rd/Peats Ferry Rd	Signals	0.55	10.9	A	46
Peats Ferry Rd/Old Berowra Rd	Priority*	0.35	12.1	A	9

* For priority controlled intersections, the average performance criteria of the worst movement has been used

Existing traffic conditions along Galston Road is affected by the existing lane arrangement that only provides one travel lane per direction. In spite of high traffic volumes, on overall all intersections are noted to perform satisfactorily. The satisfactory intersection Level of Service is mainly due to the redistribution of traffic exiting the area to other routes instead of exiting via Galston Road. Sensitivity analysis has revealed that slight increases in traffic entering Galston Road can lead to exponential growth in delay and queue length.



3.0 FUTURE CONDITIONS

Future traffic conditions for the road network in the study area will be influenced by a combination of background traffic growth and traffic generated from new developments in adjoining areas and surrounding regions.

3.1 Future Population and Employment Characteristics

Future employment and population data obtained from BTS for 2016 and 2021 for the two Travel Zones in the Study area is presented in Table 4 below.

Table 4
Future Population and Employment Data for (2016 and 2021)

Travel Zone Number	Zone Description	Employment		Workforce		Population	
		2016	2021	2016	2021	2016	2021
1621	Hornsby_Amor St and Kerrie Pl	263	276	988	1036	1,957	2035
1622	Mt Wilga Private Hospital Precinct	736	792	1,907	1995	3,523	3650
Total		999	1068	2,895	3031	5,480	5685

3.2 Housing Strategy Precincts (2011 – 2021)

To help address population growth and plan for the Shire's future, Hornsby Council prepared a housing strategy that provides for new dwellings. The Strategy was prepared in response to the State Government's Metropolitan and draft North Sub regional Strategies. The Hornsby Shire Housing Strategy which came into force in September 2011 includes 117 town houses in the study area within the precinct bounded by Galston Road, Peats Ferry Road, Clarinda Street and Old Berowra Road.

In order to enhance traffic safety particularly with respect to operation and proximity of the signalised intersection of Peats Ferry Road with Galston Road, the traffic assessment that was undertaken to document the impact of the housing strategy recommended that vehicular access should be provided on the northern boundary of the precinct via Clarinda Street.

3.3 Hornsby West Side Planning Proposal

Hornsby Council has adopted revised planning controls for Hornsby West Side Precinct to facilitate development corresponding to the housing and employment targets under the NSW Government's Metropolitan Plan for Sydney 2036. It is envisaged that approximately 30,000m² of employment floor space and 1,000 new apartments will be provided within the Hornsby Town Centre West Side Precinct.

3.4 Hornsby Town Centre Redevelopments and DCP Update

Amendment of Hornsby Town Centre DCP were made in early 2004 to make allowance for new residential developments within the commercial zones of the town centre and provided for floor space ratios greater than 2 to 1 for commercial developments. These levels of development are required for Hornsby Town Centre to achieve its goal of being the focus of regional retail and commercial activities, and the key centre for the provision of office employment services within the Shire. Based on these assumptions, Council estimated that in the medium to long term, an additional 1,635 residential units and 101,330m² of commercial/recreational floor space would be provided in Hornsby Town Centre.

3.5 Redevelopment of Mount Wilga Hospital

There is a recent proposal for further future development of Mount Wilga Hospital to construct a new single storey hospital building comprising 40 patient beds, with a total floor area of 1,508m². At this stage, the increase in staff

numbers (peak AM) is yet to be confirmed, however it is understood that this would be in the order of 10 nursing staff.

3.6 Redevelopment of Storey Park (10 Old Berowra Road)

Development Consent for a child care centre accommodating 72 children was issued in December 2013 (DA/128/2012) for Storey Park (10 Old Berowra Road, Asquith). There is currently a new proposal (DA/1097/2016) for redevelopment of the existing Council owned community centre at Storey Park to incorporate a car park and public playground.

4.0 PREDICTED FUTURE TRAFFIC CONDITIONS

4.1 Area Wide Strategic Road Network Analysis

Hornsby Council owns and operates a strategic traffic model for its Local Government Area. The model's geographic coverage is the entire local government area of Hornsby Shire and includes areas and roadways that are located adjacent to the Shire Boundary.

Initial base trip matrixes for Hornsby Shire Transport Models were obtained from the Bureau of Transport Statics (BTS) and use the same travel zone numbering system. The framework behind Council's strategic transport model is underpinned by several technical studies including traffic analysis that was undertaken to test the impacts of additional development in the Shire.

The calibrated models have been used to assess the cumulative traffic impacts of the housing strategy and new planning proposals throughout Hornsby Shire.

Modelled am and pm peak hour traffic flows in the study area were extracted from the calibrated future transport models. A summary of this data is presented in Table 5a and Table 5b. Existing traffic flows are also included for comparison.

4.2 Network Performance with no Improvements

Intersection capacity analyses using SIDRA were undertaken to determine the performance of key intersections in the study area under future traffic demand if no improvements were provided. The results are presented in Table 6a and 6b. The modelled road networks Degree of Saturation (V/C Ratio) are illustrated in Figure 3b and Figure 4b.

Data presented in Tables 6a - 6b and Figures 3b and 4b shows that intersection performance and road network with no adopted improvements would deteriorate. Traffic flow on Galston Road will continue to be affected by high volumes and lane arrangement that only provides one through travel lane per direction.

Table 5a
Existing and Future AM Peak Hour (07:15 – 08:15) Turning Movement Flows

Intersection Name		South			East			North			West		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Galston Rd/Ethel St	Existing	13	460	15	30	4	1	0	1,160	13	17	0	9
	Future	16	586	2	16	9	1	11	1,202	5	32	0	0
Galston Rd/Clarinda St	Existing	13	494	9	9	0	2	12	1,235	6	7	1	6
	Future	33	528	47	188	19	17	19	1,137	62	14	11	166
Galston Rd/Carrington Rd	Existing	123	505	N/A	N/A	N/A	N/A	N/A	1,251	12	4	N/A	13
	Future	108	604	N/A	N/A	N/A	N/A	N/A	1,491	N/A	4	N/A	N/A
Galston Rd/Peats Ferry Rd	Existing	N/A	N/A	N/A	N/A	305	215	170	N/A	1,090	414	163	N/A
	Future	N/A	N/A	N/A	N/A	231	281	215	N/A	1,276	431	323	N/A
Peats Ferry Rd/Old Berowra Rd	Existing	N/A	N/A	N/A	N/A	435	47	189	N/A	91	31	329	N/A
	Future	N/A	N/A	N/A	N/A	516	N/A	76	N/A	N/A	48	490	N/A

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Table 5b
Existing and Future PM Peak Hour (16:45 – 17:45) Turning Movement Flows

Intersection Name		South			East			North			West		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Galston Rd/Ethel St	Existing	23	1,112	10	28	1	2	6	447	17	20	3	4
	Future	28	1,277	16	8	0	0	4	757	2	59	0	0
Galston Rd/Clarinda St	Existing	34	1,256	12	10	0	2	10	455	17	14	1	6
	Future	72	1,264	88	119	3	5	15	711	39	18	10	39
Galston Rd/Carrington Rd	Existing	117	1,300	N/A	N/A	N/A	N/A	N/A	469	2	9	N/A	17
	Future	79	1,356	N/A	N/A	N/A	N/A	N/A	869	N/A	68	N/A	N/A
Galston Rd/Peats Ferry Rd	Existing	N/A	N/A	N/A	N/A	228	353	143	N/A	336	1,054	377	N/A
	Future	N/A	N/A	N/A	N/A	108	571	362	N/A	507	864	506	N/A
Peats Ferry Rd/Old Berowra Rd	Existing	N/A	N/A	N/A	N/A	529	60	33	N/A	41	48	460	N/A
	Future	N/A	N/A	N/A	N/A	679	N/A	12	N/A	N/A	177	691	N/A

Table 6a
Site Output for Network* - AM Peak
Future with No Improvements

Intersection	Control Type	DOS	Delays (Sec)	LoS	Maximum Queue (m)
Galston Rd/Ethel St	Priority	0.70	112.7	F	11
Galston Rd/Clarinda St	Priority	>1.0	>70.00	F	>100
Galston Rd/Carrington Rd	Priority	>1.0	>70.0	F	>100
Galston Rd/Peats Ferry Rd	Signals	0.79	17.3	B	73
Peats Ferry Rd/Old Berowra Rd	Priority	0.39	14.6	B	13

Table 6b
Site Output for Network* - PM Peak
Future with No Improvements

Intersection	Control Type	DOS	Delays (Sec)	LoS	Maximum Queue (m)
Galston Rd/Ethel St	Priority	0.70	52.3	D	12
Galston Rd/Clarinda St	Priority	>1.0	>70	F	>100
Galston Rd/Carrington Rd	Priority	0.96	>70	F	28
Galston Rd/Peats Ferry Rd	Signals	>1.0	>70	F	>100
Peats Ferry Rd/Old Berowra Rd	Priority	0.48	21.1	B	45

* For priority controlled intersections, the average performance criteria of the worst movement has been used

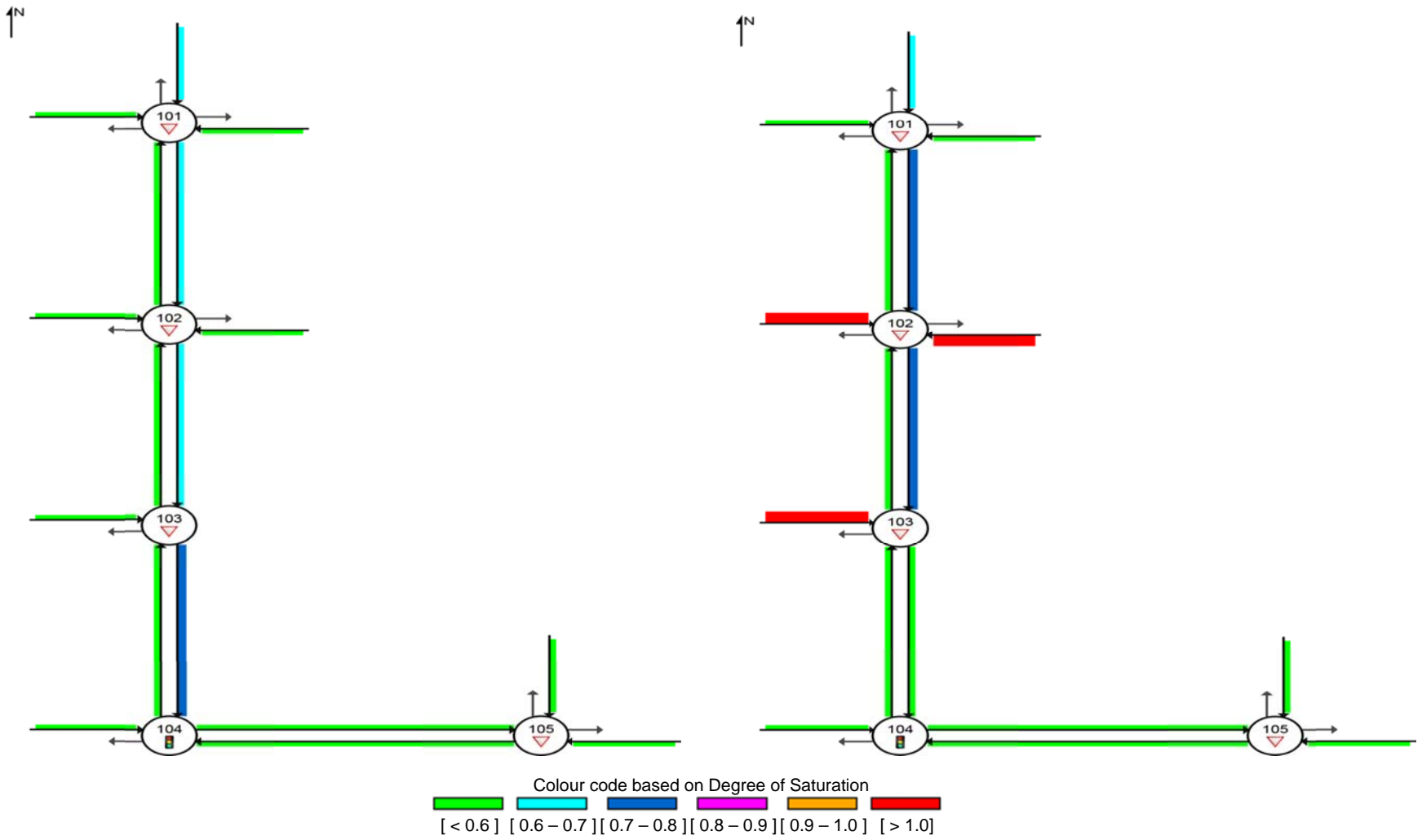


Figure 3a: - Network VC Ratio
AM Peak (Existing)

Figure 3b:- Network VC Ratio
AM Peak (Future with No Signals at Clarinda St)

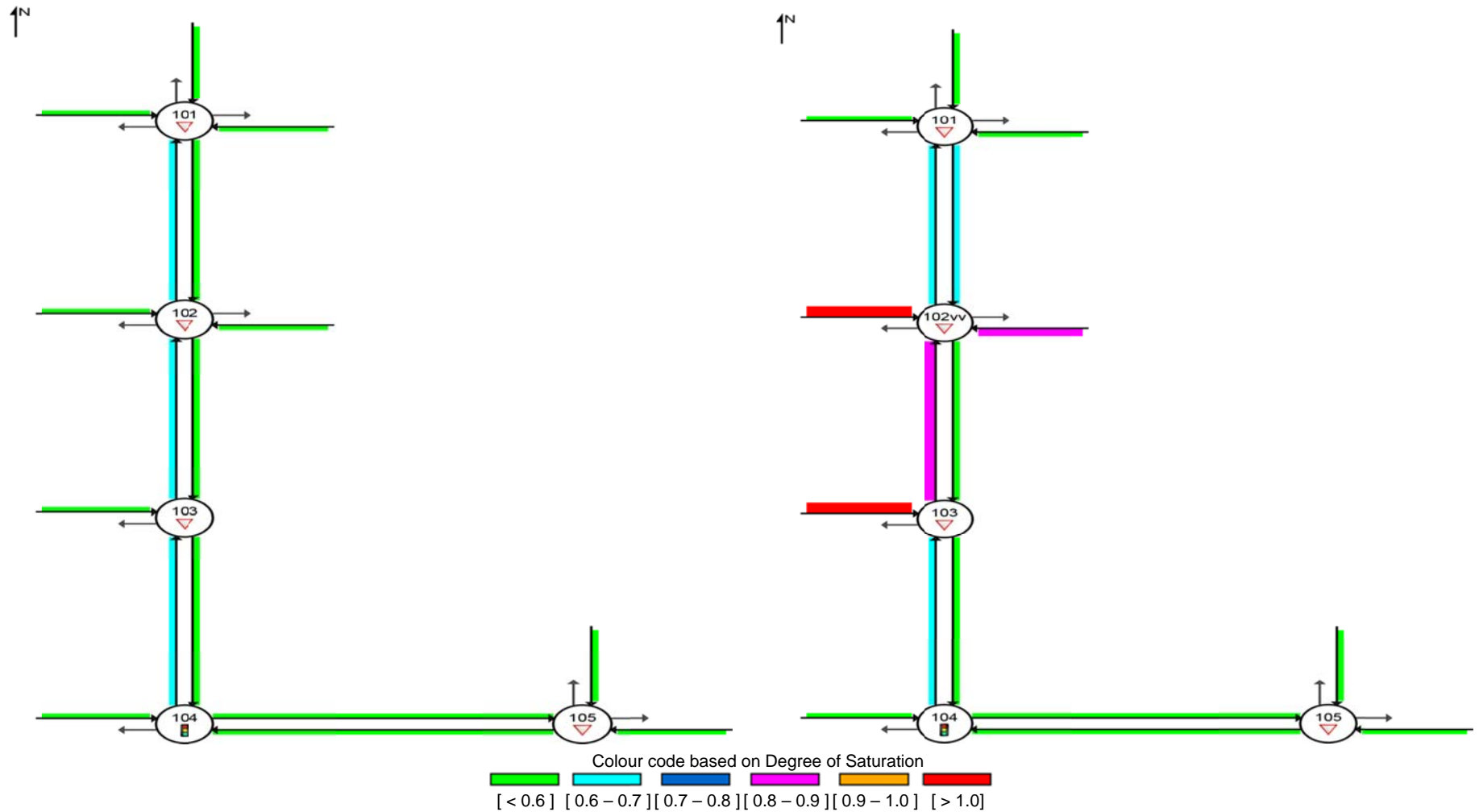


Figure 4a:- Network VC Ratio
PM Peak (Existing)

Figure 4b:- Network VC Ratio
PM Peak (Future with no Signals at Clarinda St)

4.3 Adopted Road Network Improvements in Study Area

Future growth in traffic would place additional stress on the performance of the road network in the study area. As a result, road network improvements or traffic management measures are required to provide for safe and efficient movement of vehicles. The following traffic management works were identified and adopted to mitigate the impact of future traffic growth in the study area and adjacent roads:

- *Signalisation of the intersection of Galston Road with Clarinda Street to facilitate access to areas east on the and west of Galston Road including Mount Wilga Hospital Precinct;*
- *Median Island in Peats Ferry Road at Old Berowra Road to restrict traffic movements to left in and left out only. Access for vehicles wishing to turn right out of Old Berowra Road would be available via Clarinda Street at the proposed signalised intersection with Galston Road. Vehicles wishing to turn right into Old Berowra Road from Peats Ferry Road (north approach) would be redirected to Galston Road and would access the area via Clarinda Street at the proposed new signals;*
- *Median Island in Galston Road at Carrington Road to restrict traffic movements to left in and left out only. Access for vehicles wishing to turn right out of Carrington Road would be available via Watson Avenue at the new signalised intersection with Peats Ferry Road. Vehicles wishing to turn right from Galston Road into Carrington Road would use the sheltered right turn bay that would be provided at the new signals at Clarinda Street;*
- *Signalisation of the intersection of Peats Ferry Road with Watson Avenue/Mildred Avenue.*

4.3.1 Network Performance with Improvements

Additional intersection capacity analyses were undertaken to determine the performance of key intersections in the study area under future traffic demand with the adopted improvements outlined in Section 4.3 above. The results are presented in Table 7a and 7b. The modelled road networks Degree of Saturation (V/C Ratio) are illustrated in Figure 5b and Figure 6b.

Table 7a
Intersection Performance* - AM Peak
Future with Improvements

Intersection	Control Type	DOS	Delays (Sec)	LoS	Maximum Queue (m)
Galston Rd/Ethel St	Priority	0.65	49.7	D	8
Galston Rd/Clarinda St	Priority	0.77	19.6	B	>100
Galston Rd/Carrington Rd	Priority	0.78	6.9	A	8
Galston Rd/Peats Ferry Rd	Signals	0.87	18.4	B	73
Peats Ferry Rd/Old Berowra Rd	Priority	0.27	6.5	A	8

Table 7b
Intersection Performance* - PM Peak
Future with Improvements

Intersection	Control Type	DOS	Delays (Sec)	LoS	Maximum Queue (m)
Galston Rd/Ethel St	Priority	0.70	32.5	C	8
Galston Rd/Clarinda St	Priority	0.78	14.6	B	>100
Galston Rd/Carrington Rd	Priority	0.75	26.5	B	8
Galston Rd/Peats Ferry Rd	Signals	0.70	12.0	A	41.5
Peats Ferry Rd/Old Berowra Rd	Priority	0.37	7.6.5	A	0

* For priority controlled intersections, the average performance criteria of the worst movement has been used

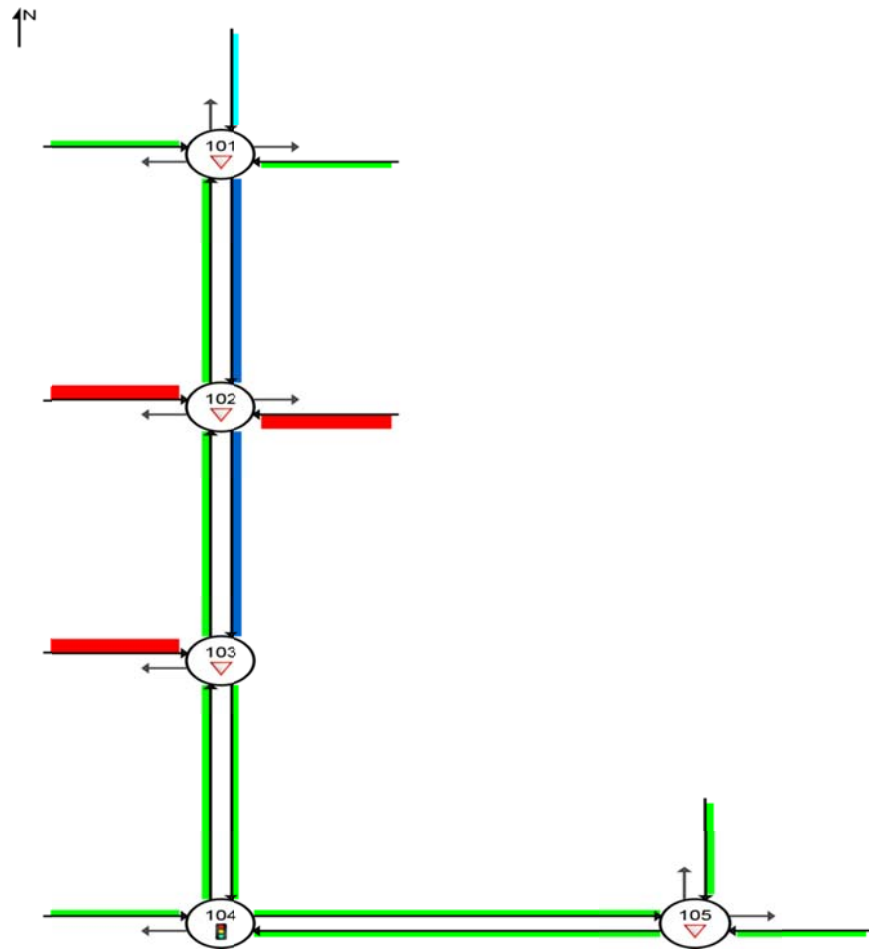


Figure 5a:- Network VC Ratio
AM Peak (Future with no Signals at Clarinda St)

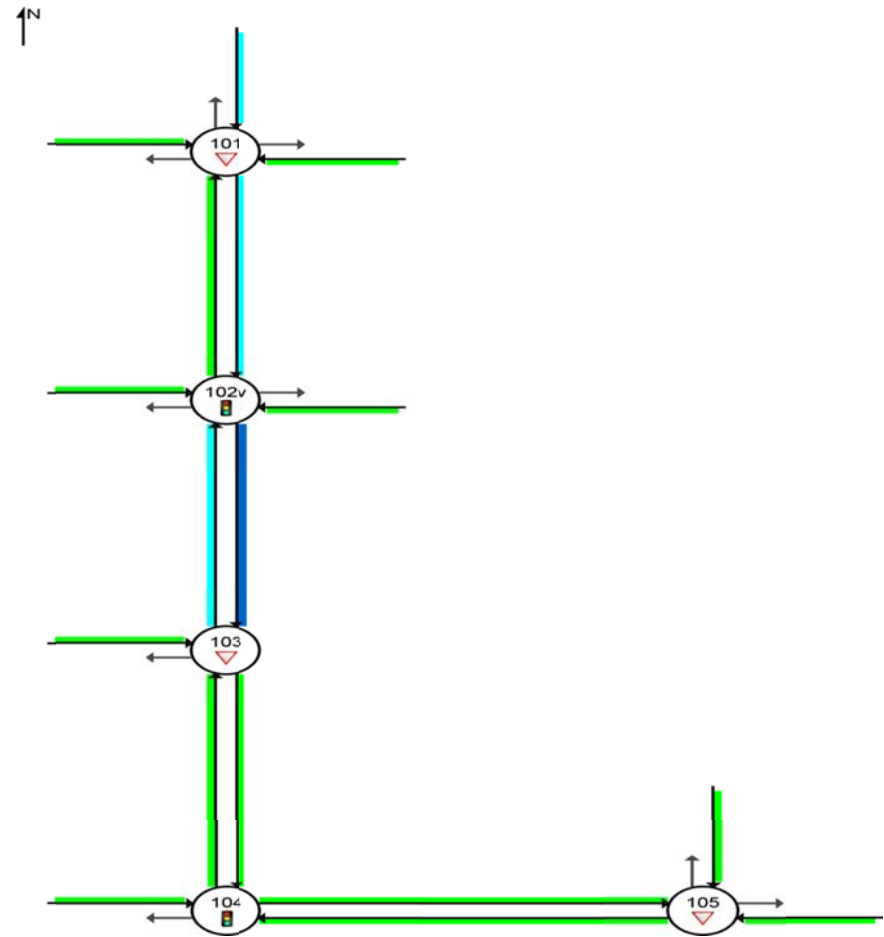
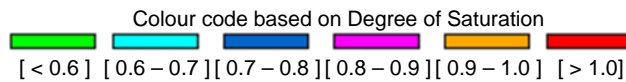


Figure 5b:- Network VC Ratio
AM Peak (Future with Signals at Clarinda St)



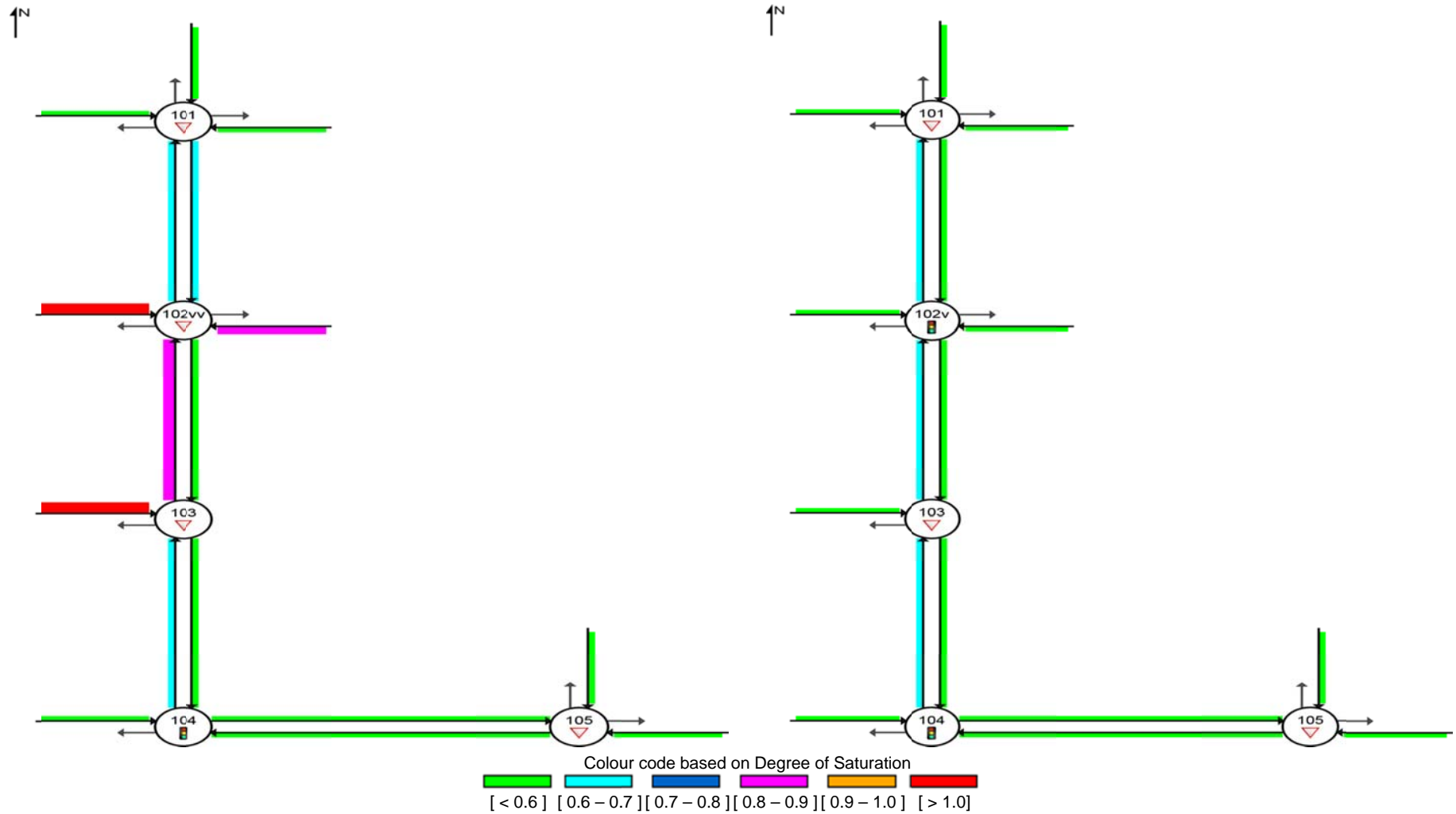


Figure 6a:- Network VC Ratio
PM Peak (Future with no Signals at Clarinda St)

Figure 6b:- Network VC Ratio
PM Peak (Future with Signals at Clarinda St)

As a result of future developments in the area, delay experienced by vehicles entering Galston Road from side streets will increase. Traffic signals will be required to maintain an acceptable Level of Service at Clarinda Street in order to facilitate access to the Galston Road Housing Precinct.

Data presented in Tables 7a - 7b and Figures 5b – 6b shows that intersection performance and road network with adopted improvements would be satisfactory. It is however noted that as a result of future traffic flows in the area, there would be a corresponding increase to delay and travel time of vehicles on Galston Road. This is mainly due to the existing lane arrangement that only provides one through travel lane per direction.

5 TCS JUSTIFICATION AT CLARINDA STREET

Safe pedestrian and vehicular access in the study area depends on the capacity of key intersections. From Figure 5a and Figure 6a, it can be seen that under the future traffic conditions, the Degree of Saturation for all 'priority controlled' intersections along Galston Road would be unsatisfactory. These intersections will require improvements to mitigate the impact from anticipated developments in the study area. The adopted traffic management works for the area which includes signalisation of the intersection of Galston Road with Clarinda Street are outlined in Section 4.3 of this report.

The traffic management strategy for the study area outlined in Section 4.3 also requires the provision of median islands in Galston Road at Carrington Street and Peats Ferry Road at Old Berowra Road to improve traffic flow along the state road network.

The results of the traffic analysis presented in Section 4.3.1 and illustrated in Figure 5b and Figure 6b justifies Council's proposal to signalise the intersection of Galston Road with Clarinda Street. Traffic signals at Clarinda Street would provide a controlled junction for pedestrians to safely cross the roads and for vehicles to enter and exit Galston Road. This would also minimise the distance vehicles travel on local streets when exiting and entering the study area.

During preparation of the Hornsby Shire Housing Strategy, The RMS were consulted (this included formal meetings) and requested to comment on access requirements and traffic implication of up-zoning the Galston Road precinct. An extract from a copy of their response is presented in **Appendix 2**. In this letter, the RMS provided the following comments regarding the access and traffic requirements for the study area:

- 1) Vehicular access for developments in Galston Road Precinct (which forms the principle part of the study area) should be from Clarinda Street and Old Berowra Road.

- 2) *To address road safety concerns, Council must give consideration to the closing of side streets or modification of the intersection of Galston Road/Carrington Road, and Pacific Highway/Old Berowra Road.*
- 3) *The RTA would give consideration to signals at the intersection of Galston Road with Clarinda Street subject to further investigation, analysis and traffic modelling being provided by Council.*
- 4) *In addition, Council should consider collecting Section 94 Contributions towards any future improvement works to intersections surrounding the precinct including any intersection capacity improvements and improvements to pedestrian amenities at the intersection of Pacific Highway/Galston Road and Galston Road/Clarinda Street.*

Council has addressed the issues numbered 1) to 4) above in accordance with the RMS comments and requirements by developing the traffic management strategy outlined in Section 4.3 above.

The traffic facilities required to support the adopted access and traffic management strategy outlined in Section 4.3 are included in Hornsby Council's Development Control Plan 2013 and Section 94 Development Contributions Plan 2014 – 2024.

With respect to issue No. 3 above regarding the requirement for further investigation, analysis and traffic modelling at the intersection of Galston Road with Clarinda Street, Council has previously addressed this concern as part of the Justification Report that was prepared to document the rationale of proposed traffic management works required to facilitate heavy vehicle access from NorthConnex construction sites to Hornsby Quarry. Additional and site specific detailed intersection modelling including existing and predicted traffic flow data that was recently requested by the RMS is provided in this report. The outcome of the traffic analysis documented in this report has established that traffic signals are required at Clarinda Street to facilitate vehicular and pedestrian traffic from areas east and west of Galston Road.

5.1 TCS Warrant Assessment

5.1.1 Numerical Traffic Flow Warrants

Analysis of future traffic conditions and existing physical characteristics of the intersection of Galston Road with Clarinda Street has been performed to determine whether installation of a traffic control signal is justified at this location.

The Analysis to establish a warrant for the traffic control signal included an analysis of factors related to the existing operation and safety at the subject location and the potential to improve these conditions.

The following applicable warrant factors contained in Section 2.3 of the RMS Traffic Signal Design warrants and Section have been used:

a) Traffic demand:

For each of four one hour periods of an average day:

- The major road flow exceeds 600 vehicles/hour in each direction; and
- The minor road flow exceeds 200 vehicles/hour in one direction

OR

b) Continuous traffic:

For each of four one hour periods of an average day:

- The major road flow exceeds 900 vehicles/hour in each direction;
- The minor road flow exceeds 100 vehicles/hour in one direction; and
- The speed of traffic on the major road or limited sight distance from the minor road causes undue delay or hazard to the minor road vehicles; and
- there is no other nearby traffic signal site easily accessible to the minor road vehicles

While the predicted future traffic flows on the minor road (Clarinda Street) are just slightly less than the recommended volumes, the flows on Galston Road which is the major road far exceeds the minimum warrant requirement (see Table 5a and Table 5b).

It should be noted that the numerical TCS warrant criteria stipulated in the RMS Traffic Signal Design Manual is only meant to be used as a guide. Other factors

such as engineering judgement and rationale have been taken into account in justifying the requirement to signalise the intersection of Galston Road with Clarinda Street; namely to provide traffic control at a site with constrained traffic capacity and to control conflicting movements with high traffic flows.

In addition to providing traffic control to manage conflicting moments to/from the side road with high traffic flows on the main road, signals are required at the subject location to facilitate access to and from local areas east and west of Galston Road including pedestrian movements as well as part of an area wide system of traffic management

A further traffic signal warrant analysis was also undertaken by Council using PTV Vistro software. The methodology used in PTV Vistro signal warrant analysis is based on the National Manual of Uniform Traffic Control Devices ("MUTCD").

The Manual on Uniform Traffic Control Devices is a document issued by the US Federal Highway Administration (FHWA) of the United States Department of Transportation to specify the standards by which traffic signs, road surface markings, and signals are designed, installed, and used. MUTCD has become influential for guidance in road markings outside the United States, particularly in the Western Hemisphere including Australia and New Zealand which use many traffic control devices and signs influenced by the MUTCD.

*Based on PTV Vistro signal warrant analysis, the projected future traffic conditions at the subject intersection met several traffic signal warrants. An extract of the output from the PTV Vistro signal warrant analysis is presented in **Appendix 3.***

5.1.2 Traffic Accident Records

As a guide, the RMS Traffic Signal Design warrants also states that signalised intersections may be considered if:

- *The intersection has been the site of an average of three or more reported tow-away or casualty traffic accidents per year over a three year period, where the traffic accidents could have been prevented by traffic signals; and*
- *The traffic flows are at least 80% of the appropriate warrants*

*The number of traffic accidents recorded in the vicinity of the intersection of Galston Road with Clarinda Street are presented in **Appendix 4** and illustrated in Figure 7. This data shows that more than five reported crashes that occurred along Galston Road between Ethel Street and Carrington Road since 2010 can be corrected by a traffic control signal.*

It is anticipated that existing right turning traffic at the intersections of Galston Road/Ethel Street, Galston Road/Carrington Road and Peats Ferry Road/Old Berowra would be redirected to Clarinda Street.

While in most cases, rear end collisions are excluded from traffic signal warrant analysis, we believe that collisions involving through traffic and vehicles waiting to turn right would also be prevented by:

- *Sheltered right turn bays that would be provided on Galston Road as part of the signalisation of the intersection with Clarinda Street;*
- *provision of median islands to restrict turning movements to left in/left out only at the intersections of Galston Road/Carrington Road and Peats Ferry Road/Old Berowra Road*

In this regard, the proposal to install traffic signals at the intersection of Galston Road and Clarinda Street is justified and should be supported to enhance pedestrian safety and provide safe access for vehicles wishing to enter and exit Galston Road.




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Projection: GDA94 / MGA zone 56

Date: 1/11/2016

Figure 7
Traffic Accidents

Map Scale: 1:4151 at A4 Landscape

5.2 TCS Siting and Location

Concerns were raised from the onset of this project regarding the siting of the traffic signals at the intersection of Galston Road with Clarinda Street due to the existing location of the Variable Message Sign (VMS). The subject VMS forms part of the system used to keep "over length" vehicles out of Galston Gorge. It is connected to a number of detectors that measure vehicle lengths and triggers a warning if the vehicle exceeds the nominal length.

Initial advice provided to Council by the TCS design consultant suggested that the proposed signals could be relocated to Ethel Street which is the next intersection to the North West of Clarinda Street. At the time, this location was considered to be a better option as it would better serve the bus services which currently travel along Ethel Street to service areas located on the eastern and western sides of Galston Road. However, due to the outcome of preliminary surveys undertaken to facilitate detailed design of the TCS, the option of relocating the proposed TCS to Ethel Street was abandoned. This decision took into account the fact that signals at Ethel Street would not actually better serve traffic wishing to access areas located on the eastern and western sides of Galston Road. The location of Clarinda Street is more central and it was considered that signals at this location would provide better access for traffic (including buses) in the area. When signals are provided at Clarinda Street, the bus company will be requested to consider re-routing the current bus service from Ethel Street.

It should also be noted that the original objective of signalising Clarinda Street was to provide a safe access for traffic that will be generated in the new Galston Road Housing Precinct. In order to enhance traffic safety particularly with respect to operation and proximity of the signalised intersection of Pacific Highway with Galston Road, a study undertaken to support the Planning Proposal for the Housing Strategy recommended that vehicular access for Galston Road Housing Precinct be provided on the northern boundary of the precinct via Clarinda Street. Locating the TCS at Ethel Street does not meet the access strategy adopted in the Housing Strategy for the new Galston Road Housing Precinct.

A further benefit of signalising this junction is that traffic flow on Galston Road will be broken up into platoons. This will assist nearby pedestrians to cross Galston Road and vehicles in adjacent side streets to cross and enter Galston Road. The proposed signals will also benefit school traffic currently using Sutton Road to access Hornsby North Public School as well as through traffic using the Link Road/Amor Street route.

5.3 Concerns Relating to Location of the TCS and VMS

Design and operational issues regarding the co-location of the TCS and VMS at the intersection of Clarinda and Galston is outside the scope of this report. Notwithstanding, it should be noted that this issue was addressed in a report by Thompson Stanbury Associates titled "Coexistence of Variable Message Sign (VMS) & Traffic Control Signals at intersection of Galston Road at Clarinda Street". A copy of this report is presented in **Appendix 5**

The Peer Review Report by Thompson Stanbury Associates was prepared to address concerns raised by the RMS regarding the current location of the VMS and the proposed TCS signal site at the intersection of Galston Road with Clarinda Street. The report notes that:-

1. The mast arm proposed in the southern approach of Galston Road:-
 - does not interfere with the VMS upon approaching the stop line of the proposed signal
 - The vertical standard forming part of the mast arm partially obscures the VMS sign at an approximate distance of 40m and beyond to the south of the proposed traffic signal stop line. However sufficient VMS sign area is available to enable the sign to be read by approaching drivers
2. The standard type 2 traffic signal posts and mounted lanterns do not interact unfavourably with the existing VMS and are not likely to impact on the visibility of the VMS messages.
3. The position of the existing VMS in relatively close proximity to the proposed signal components including marked pedestrian crossings lines as well as the associated proposed kerb ramp providing accessibility to the

crossings , are not such as to restrict or hamper pedestrian accessibility to either the push button or the actual crossing as marked.

Having regard to the above, the consultant concluded that:

- the proposed traffic signal components as shown on the draft traffic signal design plan are unlikely to interact unfavourably with the existing VMS*
- the operation of the VMS in displaying messages is not likely to interact in an unsafe way with the traffic signal displays*

*The RMS subsequently advised that if the location of the VMS board is moved and installed on the vertical-horizontal mast-arms of traffic signals, they will have no objections to this arrangement. Copy of an email confirming this advice is presented **Appendix 6**.*

5.4 Impact of TCS on Future Road Network Performance

The proposed traffic signals at Clarinda Street would result in a corresponding increase to delay and travel time of vehicles on Galston Road. The existing and predicted future road network performance for am and pm models are provided in Tables 3a and 3b for existing conditions and Tables 7a and 7b for predicted future conditions. This increase would however be outweighed by the overall benefit of network performance, traffic safety and accessibility to/from the study area.

6. PROGRAM OF IMPLEMENTATION AND SUMMARY

6.1 Traffic Signal Delivery Time Frame

The proposed traffic signals at Clarinda Street are scheduled for implementation as part of Councils Capital Works Program for 2018/2019 Financial Year.

Funding including costs associated with moving the VMS board onto the vertical-horizontal mast-arms of traffic signals has been allocated in Council's S94 Development Contribution Plan (Project R-015).

6.2 Summary and Conclusion

A site specific detailed intersection modelling and analysis has been undertaken to address the issues raised by the RMS. The outcome of this analysis has confirmed the requirement of traffic signals at Galston Road/Clarinda Street intersection to facilitate vehicular and pedestrian traffic from areas east and west of Galston Road.

The traffic management strategy for the study area also requires the provision of median islands in Galston Road at Carrington Street and Peats Ferry Road at Old Berowra Road to improve traffic flow along the state road network.

The adopted traffic management strategy for the study area which includes traffic signals at the intersection of Galston Road with Clarinda Street is included in Hornsby Council's Development Control Plan 2013. Funding to meet the cost of these works has been included in Council's Section 94 Development Contributions Plan 2014 – 2024.

The proposed traffic signals at the intersection of Galston Road with Clarinda Street are scheduled for implementation as part of Councils Capital Works Program for 2018/2019 Financial Year.

*As per RMS requirement, an amended TCS plan incorporating a VMS board is submitted with this report for approval. A Copy of the amended TCS Plan is presented in **Appendix 7**.*

APPENDICES

APPENDIX 1 Existing Traffic Flows

Intersection:	Galston Road/Clarinda Street	Survey Date:	13 May 2015
Ints ID:	01	Survey Time:	07:00 - 09:30

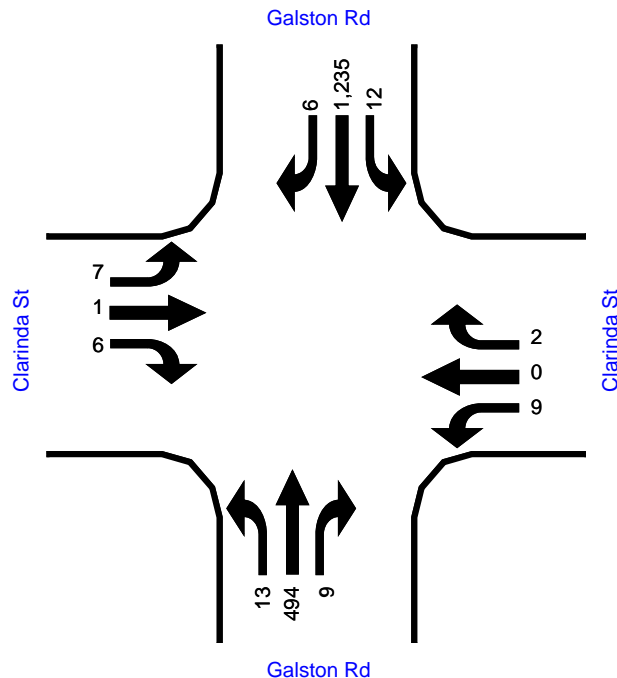
Approach	South	East	North	West
Name	Galston Rd	Clarinda St	Galston Rd	Clarinda St

Time	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 - 07:15	3	91	0	3	0	0	0	229	0	1	0	3	330
07:15 - 07:30	3	98	2	1	0	1	4	307	2	0	0	1	419
07:30 - 07:45	4	114	2	4	0	1	1	341	2	2	0	2	473
07:45 - 08:00	1	157	2	3	0	0	3	301	2	2	0	1	472
08:00 - 08:15	5	125	3	1	0	0	4	286	0	3	1	2	430
08:15 - 08:30	4	113	2	0	0	1	1	259	2	6	0	3	391
08:30 - 08:45	2	140	1	6	0	1	2	255	1	5	0	2	415
08:45 - 09:00	2	161	3	5	0	0	1	226	8	7	1	9	423
09:00 - 09:15	7	129	2	5	0	1	2	257	2	3	0	4	412
09:15 - 09:30	1	99	1	6	1	0	1	199	1	1	1	3	314

Hourly	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 - 08:00	11	460	6	11	0	2	8	1,178	6	5	0	7	1,694
07:15 - 08:15	13	494	9	9	0	2	12	1,235	6	7	1	6	1,794
07:30 - 08:30	14	509	9	8	0	2	9	1,187	6	13	1	8	1,766
07:45 - 08:45	12	535	8	10	0	2	10	1,101	5	16	1	8	1,708
08:00 - 09:00	13	539	9	12	0	2	8	1,026	11	21	2	16	1,659
08:15 - 09:15	15	543	8	16	0	3	6	997	13	21	1	18	1,641
08:30 - 09:30	12	529	7	22	1	2	6	937	12	16	2	18	1,564

Peak Hour	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:15 - 08:15	13	494	9	9	0	2	12	1,235	6	7	1	6	1,794

Peak Hour Volume By Direction	Northbound =	516	Eastbound =	22	Northbound =	503	Eastbound =	14
	Southbound =	1,250	Westbound =	11	Southbound =	1,253	Westbound =	19
	Two-Way =	1,766	Two-Way =	33	Two-Way =	1,756	Two-Way =	33



APPENDIX 1
Existing Traffic Flows

Intersection:	Galston Road/Clarinda Street	Survey Date:	13 May 2015
Ints ID:	01	Survey Time:	15:30 - 18:00

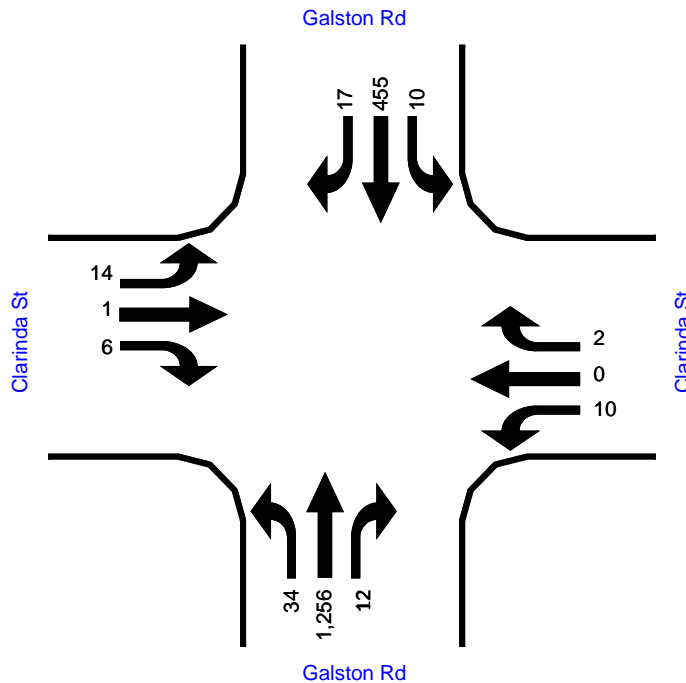
Approach	South	East	North	West
Name	Galston Rd	Clarinda St	Galston Rd	Clarinda St

Time	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
15:30 - 15:45	7	203	1	7	0	0	3	131	4	2	1	4	363
15:45 - 16:00	5	214	0	3	1	0	2	110	2	3	3	2	345
16:00 - 16:15	2	212	3	1	0	0	1	145	4	0	2	2	372
16:15 - 16:30	5	270	1	6	1	2	1	174	1	5	0	2	468
16:30 - 16:45	9	273	4	4	0	0	0	141	8	2	2	1	444
16:45 - 17:00	8	294	4	1	0	2	3	116	4	3	0	2	437
17:00 - 17:15	10	316	3	1	0	0	3	120	4	5	0	2	464
17:15 - 17:30	6	317	4	2	0	0	3	113	4	5	1	2	457
17:30 - 17:45	10	329	1	6	0	0	1	106	5	1	0	0	459
17:45 - 18:00	6	261	3	4	0	1	1	116	5	4	0	3	404

Hourly	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
15:30 - 16:30	19	899	5	17	2	2	7	560	11	10	6	10	1,548
15:45 - 16:45	21	969	8	14	2	2	4	570	15	10	7	7	1,629
16:00 - 17:00	24	1,049	12	12	1	4	5	576	17	10	4	7	1,721
16:15 - 17:15	32	1,153	12	12	1	4	7	551	17	15	2	7	1,813
16:30 - 17:30	33	1,200	15	8	0	2	9	490	20	15	3	7	1,802
16:45 - 17:45	34	1,256	12	10	0	2	10	455	17	14	1	6	1,817
17:00 - 18:00	32	1,223	11	13	0	1	8	455	18	15	1	7	1,784

Peak Hour	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
16:45 - 17:45	34	1,256	12	10	0	2	10	455	17	14	1	6	1,817

Peak Hour Volume By Direction	Northbound =	1,302	Eastbound =	23	Northbound =	1,272	Eastbound =	21
	Southbound =	471	Westbound =	12	Southbound =	482	Westbound =	51
	Two-Way =	1,773	Two-Way =	35	Two-Way =	1,754	Two-Way =	72



APPENDIX 1 Existing Traffic Flows

Intersection:	Galston Road/Ethel Street	Survey Date:	13 May 2015
Ints ID:	01	Survey Time:	07:00 - 09:30

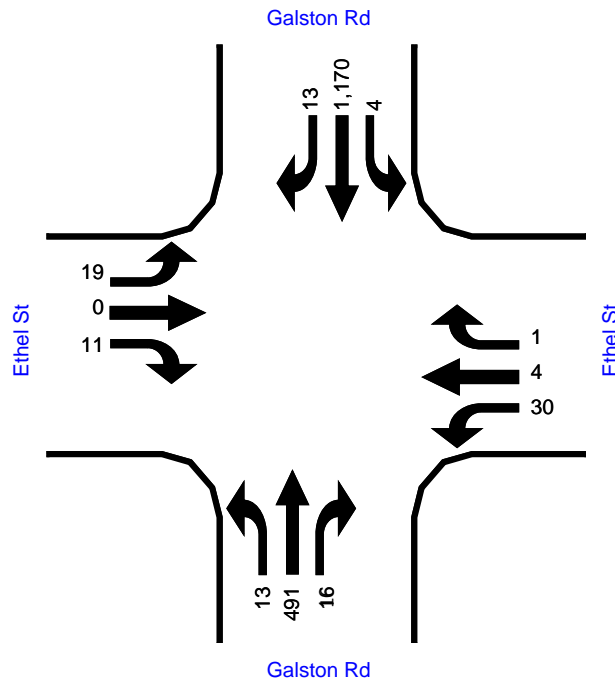
Approach	South	East	North	West
Name	Galston Rd	Ethel St	Galston Rd	Ethel St

Time	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 - 07:15	1	89	2	3	1	0	0	249	0	2	0	4	351
07:15 - 07:30	3	92	2	8	1	0	0	272	2	1	0	1	382
07:30 - 07:45	2	122	1	6	1	1	1	302	3	3	0	1	443
07:45 - 08:00	4	124	9	8	0	0	1	323	4	4	0	4	481
08:00 - 08:15	4	122	3	8	2	0	1	263	4	9	0	3	419
08:15 - 08:30	3	123	3	8	1	0	1	282	2	3	0	3	429
08:30 - 08:45	6	121	5	7	0	0	1	248	5	10	0	3	406
08:45 - 09:00	1	132	6	10	0	1	4	212	6	9	0	3	384
09:00 - 09:15	3	116	3	10	1	1	1	230	7	7	1	5	385
09:15 - 09:30	3	91	5	6	1	2	2	182	6	4	0	3	305

Hourly	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 - 08:00	10	427	14	25	3	1	2	1,146	9	10	0	10	1,657
07:15 - 08:15	13	460	15	30	4	1	3	1,160	13	17	0	9	1,725
07:30 - 08:30	13	491	16	30	4	1	4	1,170	13	19	0	11	1,772
07:45 - 08:45	17	490	20	31	3	0	4	1,116	15	26	0	13	1,735
08:00 - 09:00	14	498	17	33	3	1	7	1,005	17	31	0	12	1,638
08:15 - 09:15	13	492	17	35	2	2	7	972	20	29	1	14	1,604
08:30 - 09:30	13	460	19	33	2	4	8	872	24	30	1	14	1,480

Peak Hour	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:30 - 08:30	13	491	16	30	4	1	4	1,170	13	19	0	11	1,772

Peak Hour Volume By Direction	Northbound =	520	Eastbound =	20	Northbound =	511	Eastbound =	30
	Southbound =	1,211	Westbound =	35	Southbound =	1,187	Westbound =	30
	Two-Way =	1,731	Two-Way =	55	Two-Way =	1,698	Two-Way =	60



APPENDIX 1
Existing Traffic Flows

Intersection:	Galston Road/Ethel Street	Survey Date:	13 May 2015
Ints ID:	01	Survey Time:	15:30 - 18:00

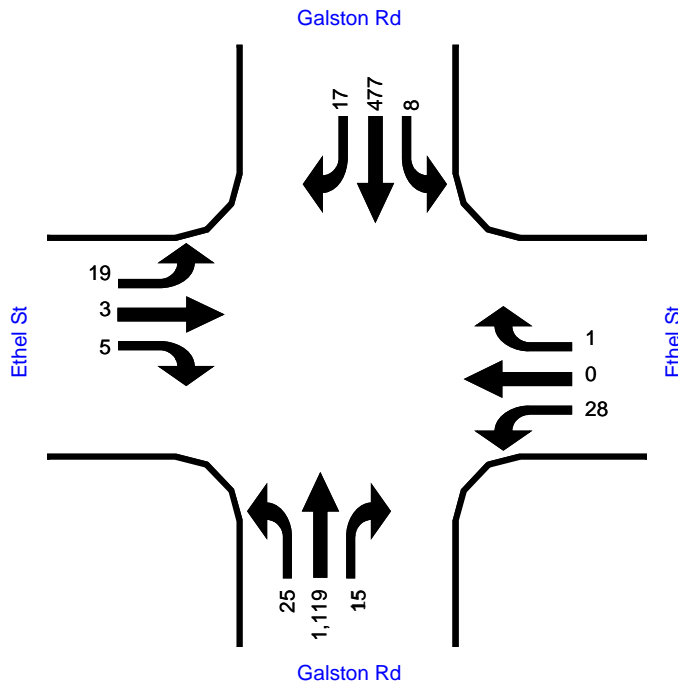
Approach	South	East	North	West
Name	Galston Rd	Ethel St	Galston Rd	Ethel St

Time	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
15:30 - 15:45	4	197	4	7	0	0	2	118	3	3	0	3	341
15:45 - 16:00	3	188	4	11	0	0	0	120	0	3	3	6	338
16:00 - 16:15	4	217	3	0	0	0	0	122	0	2	0	1	349
16:15 - 16:30	7	206	5	8	1	0	2	130	3	6	2	2	372
16:30 - 16:45	4	243	2	8	0	0	1	135	1	6	1	3	404
16:45 - 17:00	5	262	2	5	1	1	2	97	5	9	0	2	391
17:00 - 17:15	7	303	2	9	0	0	1	101	5	4	1	0	433
17:15 - 17:30	6	252	3	10	0	0	1	123	2	3	1	1	402
17:30 - 17:45	5	295	3	4	0	1	2	126	5	4	1	1	447
17:45 - 18:00	7	269	7	5	0	0	4	127	5	8	0	3	435

Hourly	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
15:30 - 16:30	18	808	16	26	1	0	4	490	6	14	5	12	1,400
15:45 - 16:45	18	854	14	27	1	0	3	507	4	17	6	12	1,463
16:00 - 17:00	20	928	12	21	2	1	5	484	9	23	3	8	1,516
16:15 - 17:15	23	1,014	11	30	2	1	6	463	14	25	4	7	1,600
16:30 - 17:30	22	1,060	9	32	1	1	5	456	13	22	3	6	1,630
16:45 - 17:45	23	1,112	10	28	1	2	6	447	17	20	3	4	1,673
17:00 - 18:00	25	1,119	15	28	0	1	8	477	17	19	3	5	1,717

Peak Hour	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
17:00 - 18:00	25	1,119	15	28	0	1	8	477	17	19	3	5	1,717

Peak Hour Volume By Direction	Northbound =	1,159	Eastbound =	26	Northbound =	1,139	Eastbound =	27
	Southbound =	510	Westbound =	29	Southbound =	502	Westbound =	42
	Two-Way =	1,669	Two-Way =	55	Two-Way =	1,641	Two-Way =	69



APPENDIX 1
Existing Traffic Flows

Intersection:	<u>Galston Road/Carrington Rd</u>	Survey Date:	<u>13 May 2015</u>
Ints ID:	<u>03</u>	Survey Time:	<u>07:00 - 09:30</u>

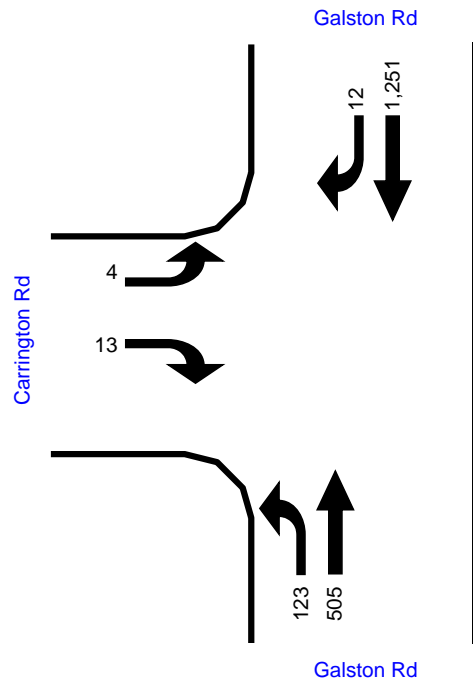
Approach	South	East	North	West
Name	<u>Galston Rd</u>	<u>N/A</u>	<u>Galston Rd</u>	<u>Carrington Rd</u>

Time	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 - 07:15	14	95						234	1	0		7	351
07:15 - 07:30	28	104						301	1	1		3	438
07:30 - 07:45	25	111						349	4	2		3	494
07:45 - 08:00	42	160						308	4	1		6	521
08:00 - 08:15	28	130						293	3	0		1	455
08:15 - 08:30	26	119						265	2	1		4	417
08:30 - 08:45	20	143						261	4	3		6	437
08:45 - 09:00	25	159						238	4	6		2	434
09:00 - 09:15	25	134						265	3	5		2	434
09:15 - 09:30	14	100						200	4	1		8	327

Hourly	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 - 08:00	109	470						1,192	10	4		19	1,804
07:15 - 08:15	123	505						1,251	12	4		13	1,908
07:30 - 08:30	121	520						1,215	13	4		14	1,887
07:45 - 08:45	116	552						1,127	13	5		17	1,830
08:00 - 09:00	99	551						1,057	13	10		13	1,743
08:15 - 09:15	96	555						1,029	13	15		14	1,722
08:30 - 09:30	84	536						964	15	15		18	1,632

Peak Hour	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:15 - 08:15	123	505						1,251	12	4		13	1,908

Peak Hour	Northbound = 628	Eastbound = 0	Northbound = 509	Eastbound = 17
Volume By	Southbound = 1,264	Westbound = 0	Southbound = 1,263	Westbound = 135
Direction	Two-Way = 1,892	Two-Way = 0	Two-Way = 1,772	Two-Way = 152



APPENDIX 1
Existing Traffic Flows

Intersection:	Galston Road/Carrington Rd	Survey Date:	13 May 2015
Ints ID:	03	Survey Time:	15:30 - 18:00

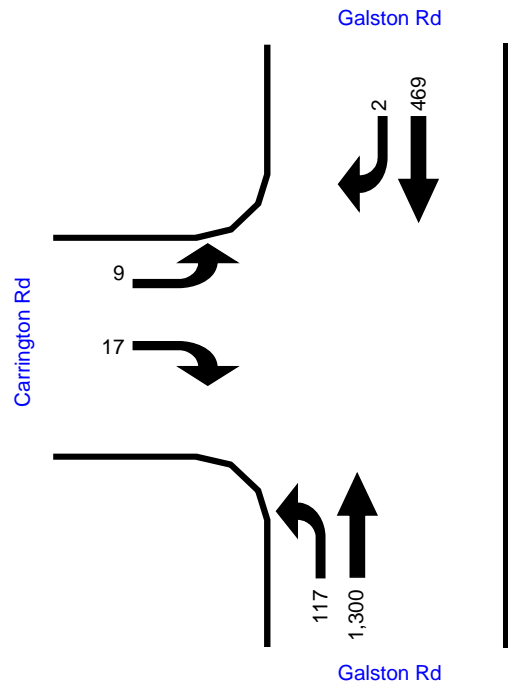
Approach	South	East	North	West
Name	Galston Rd	N/A	Galston Rd	Carrington Rd

Time	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
15:30 - 15:45	25	206						139	2	5		12	389
15:45 - 16:00	17	226						114	3	2		2	364
16:00 - 16:15	32	216						148	0	3		5	404
16:15 - 16:30	20	281						177	4	3		8	493
16:30 - 16:45	23	279						147	1	3		9	462
16:45 - 17:00	31	305						121	1	1		5	464
17:00 - 17:15	28	328						121	0	3		4	484
17:15 - 17:30	33	330						114	1	4		4	486
17:30 - 17:45	25	337						113	0	1		4	480
17:45 - 18:00	25	266						122	0	1		8	422

Hourly	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
15:30 - 16:30	94	929						578	9	13		27	1,650
15:45 - 16:45	92	1,002						586	8	11		24	1,723
16:00 - 17:00	106	1,081						593	6	10		27	1,823
16:15 - 17:15	102	1,193						566	6	10		26	1,903
16:30 - 17:30	115	1,242						503	3	11		22	1,896
16:45 - 17:45	117	1,300						469	2	9		17	1,914
17:00 - 18:00	111	1,261						470	1	9		20	1,872

Peak Hour	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
16:45 - 17:45	117	1,300						469	2	9		17	1,914

Peak Hour	Northbound = 1,417	Eastbound = 0	Northbound = 1,309	Eastbound = 26
Volume By	Southbound = 486	Westbound = 0	Southbound = 471	Westbound = 119
Direction	Two-Way = 1,903	Two-Way = 0	Two-Way = 1,780	Two-Way = 145



APPENDIX 1 Existing Traffic Flows

Intersection:	Galston Road/Peats Ferry Road	Survey Date:	13 May 2015
Ints ID:	04	Survey Time:	07:00 - 09:30

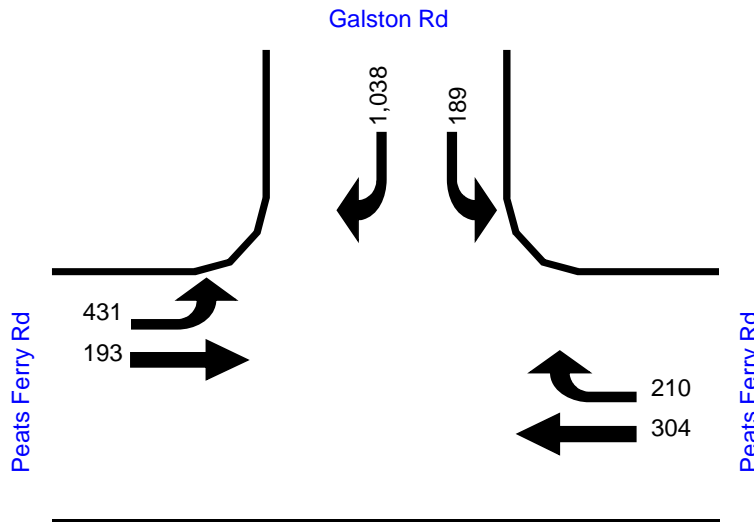
Approach	South	East	North	West
Name	N/A	Peats Ferry Rd	Galston Rd	Peats Ferry Rd

Time	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 - 07:15					71	35	30		212	75	29		452
07:15 - 07:30					69	51	39		265	82	23		529
07:30 - 07:45					90	40	37		320	98	38		623
07:45 - 08:00					84	69	53		249	132	59		646
08:00 - 08:15					62	55	41		256	102	43		559
08:15 - 08:30					68	46	58		213	99	53		537
08:30 - 08:45					75	55	37		231	110	53		561
08:45 - 09:00					89	60	35		196	125	47		552
09:00 - 09:15					87	55	45		218	104	45		554
09:15 - 09:30					68	22	42		174	93	46		445

Hourly	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 - 08:00					314	195	159		1,046	387	149		2,250
07:15 - 08:15					305	215	170		1,090	414	163		2,357
07:30 - 08:30					304	210	189		1,038	431	193		2,365
07:45 - 08:45					289	225	189		949	443	208		2,303
08:00 - 09:00					294	216	171		896	436	196		2,209
08:15 - 09:15					319	216	175		858	438	198		2,204
08:30 - 09:30					319	192	159		819	432	191		2,112

Peak Hour	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:30 - 08:30					304	210	189		1,038	431	193		2,365

Peak Hour	Northbound = 0	Eastbound = 382	Northbound = 641	Eastbound = 624
Volume By	Southbound = 0	Westbound = 514	Southbound = 1,227	Westbound = 1,342
Direction	Two-Way = 0	Two-Way = 896	Two-Way = 1,868	Two-Way = 1,966



APPENDIX 1
Existing Traffic Flows

Intersection:	Galston Road/Peats Ferry Road	Survey Date:	13 May 2015
Ints ID:	04	Survey Time:	15:30 - 18:00

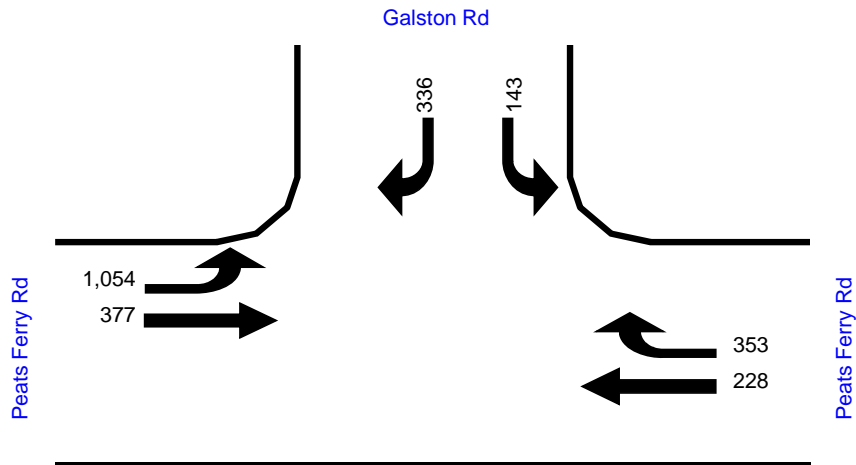
Approach	South	East	North	West
Name	N/A	Peats Ferry Rd	Galston Rd	Peats Ferry Rd

Time	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
15:30 - 15:45					56	59	31		124	177	84		531
15:45 - 16:00					55	63	29		81	179	89		496
16:00 - 16:15					64	68	36		121	181	95		565
16:15 - 16:30					48	84	60		125	217	91		625
16:30 - 16:45					53	81	63		100	220	88		605
16:45 - 17:00					63	85	39		80	237	87		591
17:00 - 17:15					48	100	42		83	267	113		653
17:15 - 17:30					47	93	32		87	266	85		610
17:30 - 17:45					70	75	30		86	284	92		637
17:45 - 18:00					54	79	31		96	213	96		569

Hourly	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
15:30 - 16:30					223	274	156		451	754	359		2,217
15:45 - 16:45					220	296	188		427	797	363		2,291
16:00 - 17:00					228	318	198		426	855	361		2,386
16:15 - 17:15					212	350	204		388	941	379		2,474
16:30 - 17:30					211	359	176		350	990	373		2,459
16:45 - 17:45					228	353	143		336	1,054	377		2,491
17:00 - 18:00					219	347	135		352	1,030	386		2,469

Peak Hour	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
16:45 - 17:45					228	353	143		336	1,054	377		2,491

Peak Hour	Northbound =	0	Eastbound =	520	Northbound =	1,407	Eastbound =	1,431
Volume By	Southbound =	0	Westbound =	581	Southbound =	479	Westbound =	564
Direction	Two-Way =	0	Two-Way =	1,101	Two-Way =	1,886	Two-Way =	1,995



APPENDIX 1
Existing Traffic Flows

Intersection:	Peats Ferry Road/Old Berowra Road	Survey Date:	13 May 2015
Ints ID:	05	Survey Time:	07:00 - 09:30

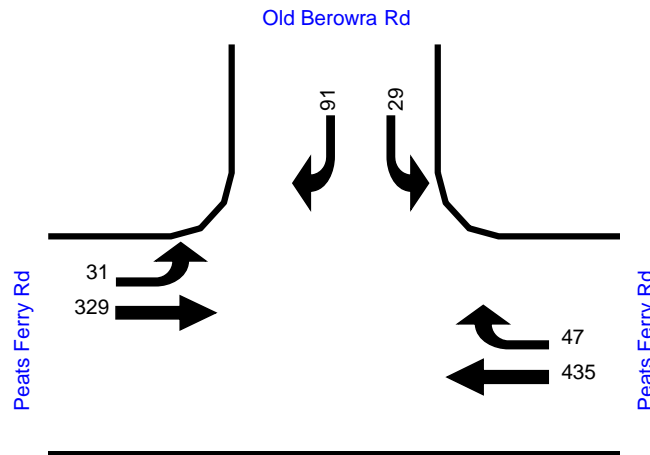
Approach	South	East	North	West
Name	N/A	Peats Ferry Rd	Old Berowra Rd	Peats Ferry Rd

Time	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 - 07:15					91	1	1		15	4	54		166
07:15 - 07:30					87	2	3		31	1	61		185
07:30 - 07:45					111	1	1		28	11	62		214
07:45 - 08:00					128	3	3		15	5	104		258
08:00 - 08:15					106	1	6		16	9	75		213
08:15 - 08:30					97	11	5		16	9	96		234
08:30 - 08:45					108	12	11		18	9	80		238
08:45 - 09:00					121	14	5		25	10	68		243
09:00 - 09:15					109	10	8		32	3	85		247
09:15 - 09:30					74	3	4		17	7	78		183

Hourly	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 - 08:00					417	7	8		89	21	281		823
07:15 - 08:15					432	7	13		90	26	302		870
07:30 - 08:30					442	16	15		75	34	337		919
07:45 - 08:45					439	27	25		65	32	355		943
08:00 - 09:00					432	38	27		75	37	319		928
08:15 - 09:15					435	47	29		91	31	329		962
08:30 - 09:30					412	39	28		92	29	311		911

Peak Hour	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
08:15 - 09:15					435	47	29		91	31	329		962

Peak Hour	Northbound = 0	Eastbound = 358	Northbound = 78	Eastbound = 360
Volume By	Southbound = 0	Westbound = 482	Southbound = 120	Westbound = 526
Direction	Two-Way = 0	Two-Way = 840	Two-Way = 198	Two-Way = 886



APPENDIX 1
Existing Traffic Flows

Intersection:	Peats Ferry Road/Old Berowra Road	Survey Date:	13 May 2015
Ints ID:	05	Survey Time:	15:30 - 18:00

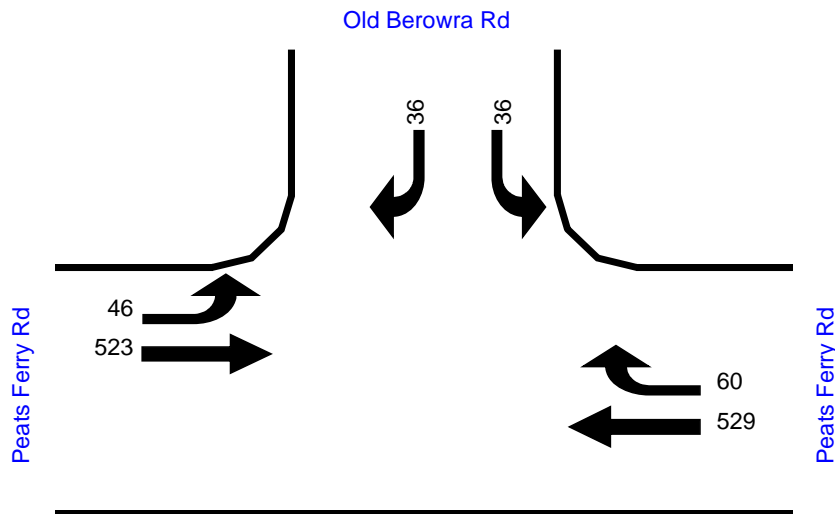
Approach	South	East	North	West
Name	N/A	Peats Ferry Rd	Old Berowra Rd	Peats Ferry Rd

Time	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
15:30 - 15:45				106	10	5			11	3	105		240
15:45 - 16:00				114	6	5			8	9	108		250
16:00 - 16:15				119	8	6			12	9	120		274
16:15 - 16:30				123	21	10			7	10	135		306
16:30 - 16:45				124	13	6			9	10	142		304
16:45 - 17:00				139	13	10			12	10	110		294
17:00 - 17:15				143	13	10			8	16	136		326
17:15 - 17:30				135	10	8			8	11	107		279
17:30 - 17:45				134	13	5			13	11	107		283
17:45 - 18:00				120	9	3			9	14	117		272

Hourly	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
15:30 - 16:30				462	45	26			38	31	468		1,070
15:45 - 16:45				480	48	27			36	38	505		1,134
16:00 - 17:00				505	55	32			40	39	507		1,178
16:15 - 17:15				529	60	36			36	46	523		1,230
16:30 - 17:30				541	49	34			37	47	495		1,203
16:45 - 17:45				551	49	33			41	48	460		1,182
17:00 - 18:00				532	45	26			38	52	467		1,160

Peak Hour	South			East			North			West			Ints Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
16:15 - 17:15				529	60	36			36	46	523		1,230

Peak Hour	Northbound =	0	Eastbound =	559	Northbound =	106	Eastbound =	569
Volume By	Southbound =	0	Westbound =	589	Southbound =	72	Westbound =	565
Direction	Two-Way =	0	Two-Way =	1,148	Two-Way =	178	Two-Way =	1,134



APPENDIX 2

Your Reference: F2004/07491-06
Our Reference: ID10M569 SYD10/00262 - 201.5314 Vol 8
Contact: Dianne Rees
Telephone: 8849 2237



The General Manager
Hornsby Shire Council
DX 9655
Hornsby

Attention: James Farrington

HORNSBY SHIRE HOUSING STRATEGY- AMENDMENTS

Dear Sir/Madam

I refer to your letter dated 15 March 2010 (Council Ref: F2004/07491-06) with regard to the abovementioned housing strategy which was referred to the Roads and Traffic Authority (RTA) for comment.

The RTA has reviewed the revised housing strategy and provides the following comments to assist Council in the preparation of the Hornsby Shire Housing Strategy:

Housing Precinct Comments

Berowra Precinct

Berowra Commercial Centre (Housing Precinct No. 61)

All vehicular access for proposed development within the Berowra Commercial Centre Precinct should be from The Gully Road. This could be achieved through the provision of an internal service road and therefore the RTA would support the proposed service road at the rear of properties fronting the Pacific Highway as depicted on the Berowra Precinct 'Draft Key Principles Diagram' (on page 9 of the strategy).

Residential parking should be segregated from parking areas provided for retail/commercial premises within the precinct.

The built form and proposed street/lane network of new development within this precinct should direct pedestrians towards pedestrian facilities by creating safe pedestrian desire lines using existing and proposed facilities.

In addition, Council should consider collecting Section 94 contributions towards addressing all vehicular and pedestrian improvement works within the precinct and at the Pacific Highway and Berowra Waters Road intersection.

The road and property boundaries along the northern side of Berowra Waters Road between Gully Road and the Pacific Highway should be adjusted as part of the precinct planning to provide a 'straight alignment' so that individual properties do not project further into the road reservation than adjacent properties.

With regard to pedestrian movements within the precinct, pedestrian desire lines should be created to direct pedestrian movements to the broad outdoor walkways, the proposed pedestrian footbridge, at grade marked signalised crossings and to minimise pedestrian movements along the Pacific Highway frontage.

The parking provision for the precinct should be located off-street and should be designed to cater for all parking needs.

Pacific Highway (Housing Precinct No. 57)

Vehicular access for proposed development within the Pacific Highway Precinct should be from the local street system. However, where this is not possible, direct vehicular access to the Pacific Highway must be kept to a minimum and consolidated where possible.

Hornsby Precincts

Galston Road

Vehicular access for proposed development within the Galston Road Precinct should be from Clarinda Street and Old Berowra Road. However, where this is not possible, direct vehicular access to Galston Road must be kept to a minimum and consolidated where possible.

To address road safety concerns, Council must give consideration to the closing of side streets or the modification of the intersections at Galston Road/Carrington Road, and Pacific Highway/Old Berowra Road.

The RTA would give consideration to signals at the intersection of Clarinda Street and Galston Road and the signalisation of the left turn slip lane from the Pacific Highway to Galston Road. The RTA will provide additional comments on this matter subject to further investigation, analysis, and traffic modelling (including pedestrian movements) being provided by Council.

In addition, Council should consider collecting Section 94 contributions towards any future improvement works to intersections surrounding the precinct, including any intersection capacity improvements and improvements to pedestrian amenities at the intersection of the Pacific Highway / Galston Road and Galston Road / Clarinda Street.

Belair Close (Housing Precinct No. 23)

Vehicular access for proposed development within the Belair Close Precinct should preferably be from Belair Close (where possible).

Linda Street

All vehicular access for proposed development within the Linda Street Precinct should be from the local street system. Improvements to facilitate access and circulation should be considered as part of the Hornsby Town Centre Traffic Management works.

The RTA would prefer that a Masterplan TMAP study of the Linda Street Precinct be prepared by Council which includes long term impacts as well as short and medium term impacts, especially in relation to pedestrian movements within and to / from the precinct. The Masterplan TMAP study should also consider improvements to access arrangements to Hornsby Railway Station, including improvements to structural deficiencies relating to the existing pedestrian footbridge. The study should also investigate the impacts of the proposed development on the Pacific Highway/Linda Street, Hunter Street/Burdett Street and Burdett Street/Sherbrook Road intersections with the completed Masterplan TMAP study being submitted to the RTA for assessment and further comment.

Any inquiries can be directed to Dianne Rees by telephone on 8849 2237, the undersigned on 8849 2180, or facsimile 8849 2918.

Yours faithfully



Andrew Popoff
A/Senior Land Use Planner
Transport Planning, Sydney Region

21 May 2010

Cc: Peter Goth – Department of Planning
Andrew King – The Hills Shire Council

APPENDIX 3

Generated with **PTV VISTRO**

Version 3.00-04

Vistro File:

Scenario: Base Scenario

Report File: H:\...\Signal Warrant Vistro.pdf

9/14/2016

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	New Intersection	Two-way stop	HCM2010	EBR	15.270	7,195.6	F

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value; for all other control types, they are taken for the whole intersection.

**Intersection Level Of Service Report
#1: New Intersection**

Control Type: Two-way stop
 Analysis Method: HCM2010
 Analysis Period: 15 minutes

Delay (sec / veh): 7,195.6
 Level Of Service: F
 Volume to Capacity (v/c): 15.270

Intersection Setup

Name	Galston Rd			Galston Rd			Clarinda St			Clarinda St		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			+			+		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.20	3.20	3.20	3.20	3.20	3.20	4.30	4.30	4.30	4.30	4.30	4.30
No. of Lanes in Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
Speed [km/h]	60.00			60.00			50.00			50.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	no			no			no			no		

Volumes

Name	Galston Rd			Galston Rd			Clarinda St			Clarinda St		
Base Volume Input [veh/h]	33	528	47	19	1234	62	14	11	166	91	19	17
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Rate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	33	528	47	19	1234	62	14	11	166	91	19	17
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	8	132	12	5	309	16	4	3	42	23	5	4
Total Analysis Volume [veh/h]	33	528	47	19	1234	62	14	11	166	91	19	17
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Priority Scheme	Free	Free	Stop	Stop
Flared Lane			no	no
Storage Area [veh]	0	0	0	0
Two-Stage Gap Acceptance			no	no
Number of Storage Spaces in Median	0	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.01	0.08	0.00	0.01	0.06	0.03	0.28	15.27	0.43	0.49	0.68
d_M, Delay for Movement [s/veh]	0.00	0.00	12.08	0.00	0.00	8.80	6871.08	6956.22	7195.55	382.22	458.05	509.71
Movement LOS	A	A	B	A	A	A	F	F	F	F	F	F
95th-Percentile Queue Length [veh]	18.75	18.75	18.75	48.31	48.31	48.31	25.19	25.19	25.19	10.49	10.49	10.49
95th-Percentile Queue Length [m]	142.91	142.91	142.91	368.11	368.11	368.11	191.92	191.92	191.92	79.93	79.93	79.93
d_A, Approach Delay [s/veh]	0.93			0.41			7157.99			410.63		
Approach LOS	F			F			F			F		
d_I, Intersection Delay [s/veh]	633.84											
Intersection LOS	F											

Vistro File:

Scenario: Base Scenario

Report File: H:\...\Signal Warrant Vistro.pdf

9/14/2016

Turning Movement Volume: Summary

ID	Intersection Name	Northbound			Southbound			Eastbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
1	New Intersection	33	528	47	19	1234	62	14	11	166	91	19	17	2241

Vistro File:

Scenario: Base Scenario

Report File: H:\...\Signal Warrant Vistro.pdf

9/14/2016

Turning Movement Volume: Detail

ID	Intersection Name	Volume Type	Northbound			Southbound			Eastbound			Westbound			Total Volume	
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		
1	New Intersection	Final Base	33	528	47	19	1234	62	14	11	166	91	19	17	2241	
		Growth Rate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-
		In Process	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Future Total	33	528	47	19	1234	62	14	11	166	91	19	17	2241	

Signal Warrants Report For Intersection #1: New Intersection

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	Yes
#2	Four Hour Vehicular Volume	Yes
#3	Peak Hour	Yes

Intersection Warrants Parameters

Major Approaches	S, N
Minor Approaches	E, W
Speed > 40mph	Yes
Population < 10,000	Yes
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets	
	S	N	E	W
1	12	26	3	4
2	12	26	3	4
3	18	39	4	6
4	18	39	4	6
5	24	53	5	8
6	61	132	13	19
7	67	145	14	21
8	122	263	25	38
9	213	460	44	67
10	219	473	46	69
11	219	473	46	69
12	237	513	50	74
13	261	565	55	82
14	274	592	57	86
15	274	592	57	86
16	292	631	61	92
17	365	789	76	115
18	383	828	80	120
19	413	894	86	130
20	462	999	97	145
21	486	1052	102	153
22	572	1236	119	180
23	584	1262	122	183
24	608	1315	127	191

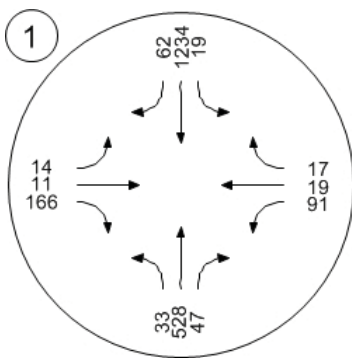
Warrant Analysis by Hour

Hour	Major Lanes		Minor Lanes		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3 Condition B
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		
1	2	38	2	7	No	No	No	No	No	No	No	No	No	No
2	2	38	2	7	No	No	No	No	No	No	No	No	No	No
3	2	57	2	10	No	No	No	No	No	No	No	No	No	No
4	2	57	2	10	No	No	No	No	No	No	No	No	No	No
5	2	77	2	13	No	No	No	No	No	No	No	No	No	No
6	2	193	2	32	No	No	No	No	No	No	No	No	No	No
7	2	212	2	35	No	No	No	No	No	No	No	No	No	No
8	2	385	2	63	No	No	No	No	No	No	No	No	No	No
9	2	673	2	111	No	No	No	No	No	No	Yes	Yes	Yes	No
10	2	692	2	115	No	No	No	No	No	No	Yes	Yes	Yes	No
11	2	692	2	115	No	No	No	No	No	No	Yes	Yes	Yes	No
12	2	750	2	124	No	No	No	No	No	Yes	Yes	Yes	Yes	No
13	2	826	2	137	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
14	2	866	2	143	No	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes
15	2	866	2	143	No	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes
16	2	923	2	153	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
17	2	1154	2	191	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
18	2	1211	2	200	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
19	2	1307	2	216	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
20	2	1461	2	242	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
21	2	1538	2	255	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
22	2	1808	2	299	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
23	2	1846	2	305	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
24	2	1923	2	318	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hours Met					4	7	8	11	9	13	16	16	16	12

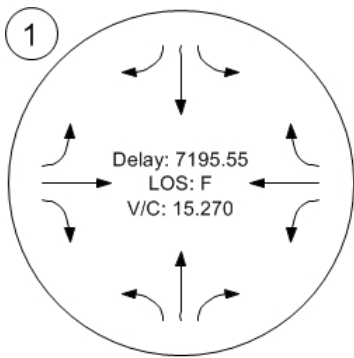
Warrant 3 Condition A

Orientation	E	W
Total Stopped Delay Per Vehicle on Minor Approach (s)	410.6	7158
Number of Lanes on Minor Street Approach	1	1
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	14:29	379:46
Delay Condition Met	Yes	Yes
Volume on Minor Street Approach During Same Hour	127	191
High Minor Volume Condition Met	Yes	Yes
Total Entering Volume on All Approaches During Same Hour	2241	2241
Number of Approaches on Intersection	4	4
Total Volume Condition Met	Yes	Yes
Warrant Met for Approach	Yes	Yes
Warrant Met for Intersection	Yes	

Traffic Volume - Base Volume



Traffic Conditions



APPENDIX 4
ACCIDENT DATA _INTERSECTION OF GALSTON RD/CLARINDA ST

TRAFFIC ACCIDENT DATA

Accident Degree	Date	Day of Week	Time	Street	Distance	Direction	Identifying Object	Crash Speed	Road User Movement	1 Direction	1 Speed	2 Direction	2 Speed
Tow Away	20080910	Wednesday	2045	GALSTON RD	0	Right on the spot	CLARINDA ST	50	10	West	10	North	55
Tow Away	20080313	Thursday	0750	GALSTON RD	5	North	CLARINDA ST	50	30	South	999	South	0
Tow Away	20080628	Saturday	1220	GALSTON RD	20	East	ETHEL ST	60	30	East	60	East	0
Injured	20071005	Friday	1115	GALSTON RD	0	Right on the spot	CLARINDA ST	60	10	East	999	North	999
Injured	20060807	Monday	1620	GALSTON RD	0	Right on the spot	ETHEL ST	60	21	North	10	South	60
Injured	20060616	Friday	1615	GALSTON RD	10	North	CLARINDA ST	60	42	South	5	South	50
Tow Away	20140131	Friday	0735	GALSTON RD	0	Right on the spot	CLARINDA ST	60	10	East	15	North	30
Tow Away	20120109	Monday	1000	GALSTON RD	100	South	ETHEL ST	60	71	South	30	South	0
Tow Away	20110831	Wednesday	0750	GALSTON RD	50	South	ETHEL ST	60	30	South	50	South	0
Injured	20101001	Friday	0858	GALSTON RD	0	Right on the spot	ETHEL ST	60	32	South	60	South	0

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75 Gindurra Ave, Castle Hill NSW 2154

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Facsimile: (02) 8850 2799
E-mail: david@thompsonstanbury.com.au
morgan@thompsonstanbury.com.au
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MOBILE PHONES:

David Thompson: 0418 262 125

Morgan Stanbury: 0410 561 848

APPENDIX 5

**THOMPSON
STANBURY
ASSOCIATES**

ABN: 79 943 737 368

General Manager
Hornsby Shire Council
PO Box 37
HORNSBY
NSW 2077

30 June 2016

Attention: Mark Nobile - Project Manager – Design

Dear Sir,

**COEXISTANCE OF VARIABLE MESSAGE SIGN (VMS)
& TRAFFIC CONTROL SIGNALS AT INTERSECTION OF
GALSTON ROAD AT CLARINDA STREET
HORNSBY**

Background

Hornsby Council is seeking to install traffic signals at the intersection of Galston Road with Clarinda Street Hornsby for which a traffic signal design has been prepared supporting by a Traffic Management report prepared for Council in July 2015.

This report named “*Rational of Proposed Traffic Management Works in Hornsby Town Centre and Environs*” recommends funding under the S96 Contribution Plan, for these signals, as included in Councils DCP 2013, to “*improve intersection performance by minimising delay and facilitating access to /from Clarinda Street*” as part of Hornsby Housing Strategy.

The Housing Strategy supports a medium density residential zoning contained within precinct bounded by the Pacific Highway, Galston Road, Clarinda Street and Old Berowra Road, Hornsby with the increased density requiring improved precinct accessibility.

The proposed traffic signal design to be submitted for the approval of the Roads & incorporates a multi-phase design layout with features: –

- Diamond turns from Galston Road
- Shared approach phasing from each approach of Clarinda Street
- Pedestrian facilities over each approach
- Traffic signal components located generally as per the RMS Traffic Signal Design standards
- Retention of an existing Variable Message Sign (VMS) on the north western corner of the intersection

This Practice has been engaged to discuss the relative merits of the retention of the VMS signage in its current location in conjunction with the proposed signal installation with commentary on the road safety aspects of the coexisting traffic management devices.

The following provides a summary of the current traffic management control employed at the subject site as well that which is proposed in the near future.

Existing Operational Features of the VMS

The following facts have been derived from records held on the operational aspect of the VMS sign located at the subject intersection or based on observation:-

- A dynamic messages facility which may include messages as determined by the Roads & Maritime Services ,from data held at the Transport Management Centre (TMC)
- Such messages may consist of advisory road condition for drivers travelling to the north and beyond including travelling within the Galston Gorge
- Will display an advisory message “*oversize vehicle*” to the driver of on any vehicle that is over length (as detected by advance loop detectors some 100m from the VMS) being the maximum vehicle size that can negotiate Galston Gorge
- Will display the message for all vehicles in excess of the prescribed length including buses along with trucks which may not have destination within the Gorge but which may terminate within the Hornsby Heights precinct
- Results in repeated displays of oversize vehicles due to regular bus timetable operating along Galston Road during parts of the day and early evening as well as well as intermittent truck traffic including Council garbage trucks
- Messages are displayed in white lettering on a black background
- During the year ending 2015 the following records have been made available from RMS :-
 - the maximum monthly activation was on average 20 in total of 240 within the 12 month period
 - these activation are not necessarily associated with illegal height vehicles proceeding to Galston Gorge as trucks and buses will activate the VMS
 - westbound traffic flows past the VMS sign was recorded as 1,003, 114 in 2015
- Give way signposting (major/minor road controls) apply to the side road Clarinda Street

Proposed Operational Features of the VMS with Traffic signals

In order to demonstrate compatibility of the existing VMS with the proposed traffic signals, photo montages have been prepared by Council staff showing the location of the proposed traffic signal components as indicated on the proposed traffic signal design with the existing VMS which are included as an **Appendix**.

These indicate the following features:-

1. The mast arm proposed in the southern approach of Galston Road:-

- does not interfere with the VMS upon approaching the stop line of the proposed signal
- the vertical standard forming part of the mast arm partially obscures the VMS sign at an approximate distance of 40m and beyond to the south of the proposed traffic signal stop line. However sufficient VMS sign area is available to enable the sign to be read by approaching drivers

2. The standard type 2 traffic signal posts and mounted lanterns do not interact unfavourably with the existing VMS and are not likely to impact on the visibility of the VMS messages.

3. The position of the existing VMS in relatively close proximity to the proposed signal components including marked pedestrian crossings lines as well as the associated proposed kerb ramp providing accessibility to the crossings , are not such as to restrict or hamper pedestrian accessibility to either the push button or the actual crossing as marked .

Conclusion

It is my opinion that:-

- the proposed traffic signal components as shown on the draft traffic signal design plan are unlikely to interact unfavourably with the existing VMS
- the operation of the VMS in displaying messages is not likely to interact in an unsafe way with the a traffic signal displays

Submitted for your consideration in conjunction with submission of the traffic signal design to RMS for review with a recommendation that the exiting VMS is in my opinion able to be maintained in its present location in conjunction the proposed traffic signal components as shown on the draft traffic signal design plan

Yours faithfully,



David Thompson

Transport Planner & RMS Accredited Lead Road Safety Auditor

APPENDIX 6

Bernard Choongo

From: HAWKINS Kathryn A <Kathryn.HAWKINS@rms.nsw.gov.au>
Sent: Monday, August 22, 2016 11:41 AM
Subject: RE: Proposed TCS at intersection of Galston Road and Clarinda Street, Hornsby

Follow Up Flag: Follow up
Flag Status: Flagged

Good morning Radek,

Sorry about the delay but I have been waiting for response from TMC, Network Operations, Compliance and Regulatory Services and the Major Project Integration staff prior to sending a thorough reply to you.

Although you attached an overall justification report for a number of traffic signal locations within Hornsby, RMS require a site specific report for the application for the new traffic signal at Galston Road and Clarinda Street. The report is to include aspects such volume data, crash data, TCS warrant criteria, why this location is preferred over installation of the signals at Ethel St as discussed at face to face meetings, assessment of other development plans (surrounding network improvements / changes), whether this introduction of traffic signals will result in alterations to other intersections (such as making Carrington Rd left in and out only), and delivery time frames. RMS will then consider the proposal in consideration alongside the RMS major project (NCX) delivery component.

In regards to the VMS, is the location of the board is moved to being installed on the vertical-horizontal mast-arms of traffic signals, there will be no objections. You can liaise with the RMS Compliance and Regulatory Services (Alexandre Dubois - 02 8837 0636) regarding the provision and relocation of cables needed for the local triggering devices.

RMS are looking forward to seeing the individual report for the provision of traffic signals at the intersection of Galston Road and Clarinda Street as mentioned above.

Regards,
Kathryn Hawkins
Network & Safety Officer
T 02 8849 2021

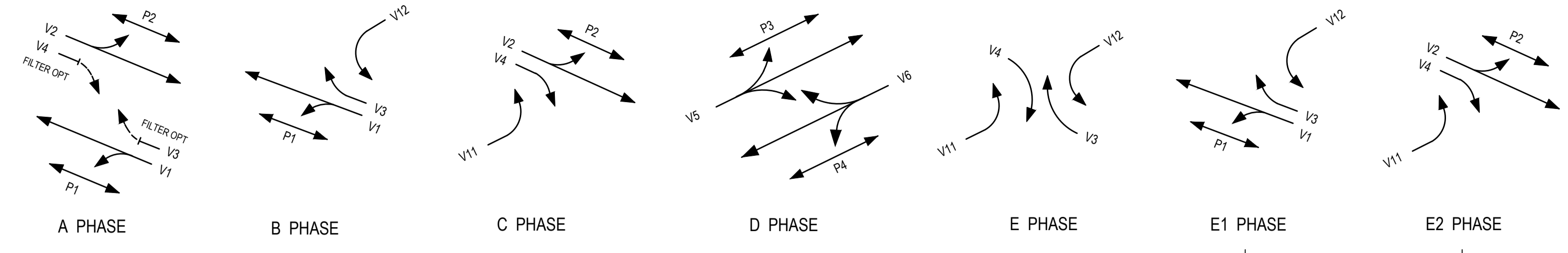


APPENDIX 7

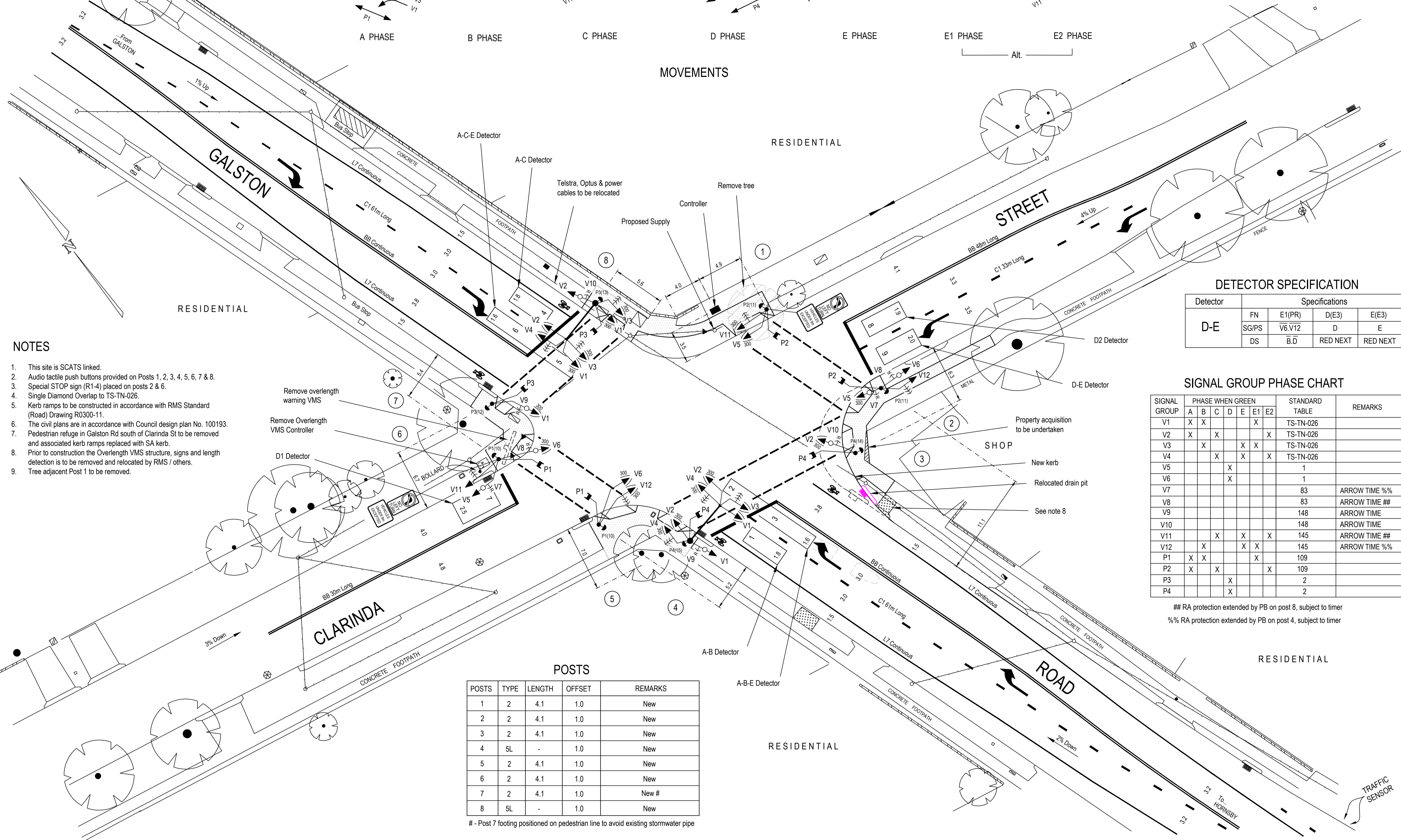
**TCS DESIGN PLAN FOR INTERSECTION OF GALSTON
ROAD WITH CLARINDA STREET, HORNSBY**

TCS 0000

DRAWN BY CADD
DO NOT AMEND MANUALLY



MOVEMENTS



NOTES

- This site is SCATS linked.
- Audio tactile push buttons provided on Posts 1, 2, 3, 4, 5, 6, 7 & 8.
- Special STOP sign (R1-4) placed on posts 2 & 6.
- Single Diamond Overlap to TS-TN-026.
- Kerb ramps to be constructed in accordance with RMS Standard (Road) Drawing R0300-11.
- The civil plans are in accordance with Council design plan No. 100193.
- Pedestrian refuge in Galston Rd south of Clarinda St to be removed and associated kerb ramps replaced with SA kerb.
- Prior to construction the Overlength VMS structure, signs and length detection is to be removed and relocated by RMS / others.
- Tree adjacent Post 1 to be removed.

DETECTOR SPECIFICATION

Detector	Specifications			
	FN	E1(PR)	D(E3)	E(E3)
D-E	SG/PS	V6.V12	D	E
	DS	B.D	RED NEXT	RED NEXT

SIGNAL GROUP PHASE CHART


SIGNAL GROUP	PHASE WHEN GREEN						STANDARD TABLE	REMARKS
	A	B	C	D	E	E2		
V1	X	X				X	TS-TN-026	
V2	X		X			X	TS-TN-026	
V3		X		X	X		TS-TN-026	
V4			X	X	X		TS-TN-026	
V5				X			1	
V6				X			1	
V7							83	ARROW TIME %%
V8							83	ARROW TIME ##
V9							148	ARROW TIME
V10							148	ARROW TIME
V11		X		X	X	X	145	ARROW TIME ##
V12	X	X			X	X	145	ARROW TIME %%
P1	X	X				X	109	
P2	X	X				X	109	
P3			X				2	
P4			X				2	

RA protection extended by PB on post 8, subject to timer
 %% RA protection extended by PB on post 4, subject to timer

POSTS

POSTS	TYPE	LENGTH	OFFSET	REMARKS
1	2	4.1	1.0	New
2	2	4.1	1.0	New
3	2	4.1	1.0	New
4	5L	-	1.0	New
5	2	4.1	1.0	New
6	2	4.1	1.0	New
7	2	4.1	1.0	New #
8	5L	-	1.0	New

- Post 7 footing positioned on pedestrian line to avoid existing stormwater pipe

A ORIGINAL ISSUE	PUBLIC UTILITY LEGEND HYDRANT □ STOP VALVE ▲ GAS VALVE # SEWER MANHOLE ⊕ COMMS PIT ○ ELECT LIGHT POLE ○ POWER POLE ○ STAY POLE ○ TELEPHONE BOX □ COMMS PILLAR ●	REFERENCE PLANS SYMBOLS/ABRVS V0003-6 STD POSN CMT V0001-5 INSTL STOP DET V0005-17 VEH GROUP OP TS-TN-019 DET LOGIC OP TS-TN-020 PED MVT OP TS-TN-021	U.B.D. Ref: Map 133 G10 I.S.G. E: 308 925 CO-ORDS N: 4 270 880 DESIGNED: J BATES CHECKED: R BATES J BATES SITE CHECKED J BATES RECOMMENDED	DESIGN APPROVAL APPROVED  NAME: _____ POSITION: MANAGER DATE: 16/01/18 DESIGN PREPARED BY B-Line Drafting	RMS RECOMMENDATION ROAD DESIGN ENGINEERING NAME: _____ POSITION: _____ DATE: _____ NETWORK OPERATIONS NAME: _____ POSITION: _____ DATE: _____	RMS ACCEPTANCE ACCEPTED NAME: _____ POSITION: _____ DATE: _____ ACCEPTED BY _____ SECTION	ROADS AND MARITIME SERVICES HORNSBY COUNCIL AREA TRAFFIC SIGNALS AT GALSTON ROAD AND CLARINDA STREET HORNSBY	EXISTING □ PROPOSED ☒ CADD FILE: VV0000_1A.dgn SCALE 5 0 (1:200) 5 10 FILE SF0000/000000 REG No. DS0000/000000 SUPERSEDES SHEET/ISSUE -/- TCS No. 0000 SHEET 1
	DESIGN LAYOUT							ISSUE A
								SHEET 1
								Revision 6 - July 2017 © COPYRIGHT ROADS AND MARITIME SERVICES

