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2 March 2020

Felix Liu
Land Use Planner
Transport for NSW
Sent via email

Re: Georges Cove Marina at 146 Newbridge Road, Moorebank - Response to RMS matters

Dear Felix,

This letter has been prepared in response to the traffic related matters that have been raised by Roads & Maritime Services (RMS) (now Transport for NSW (TfNSW)) in their letter dated 8 November 2019 in regard to construction and operation of Georges Cove Marina located at 146 Newbridge Road, Moorebank (TNSW Ref: SYD18/01728/03, Council Ref: DA-611/2018).

RMS comments and our responses are provided below.

1.1 Matter 1

RMS Comment:

The submitted traffic model needs to be updated to include 2019 traffic count data in order to consider cumulative traffic growth since the lodgement of the original traffic applications for the various land uses at 146 Newbridge Road, Moorebank.

EMM Response:

A new tube count was undertaken at Brickmakers Drive near the proposed Link Road between 30 January 2020 and 5 February 2020. In addition, the Newbridge Road/Brickmakers Drive/Governor Macquarie Drive intersection was surveyed on 30 January 2020 (refer to Appendix A for traffic count data). The SIDRA model has been updated to reflect these latest traffic counts.

1.2 Matter 2

RMS Comment:

Further clarification is requested regarding the future development traffic volumes used in the submitted traffic assessment. For instance, when will these various developments be completed and using the new road connection to Brickmakers Creek [sic, presumably 'Drive']?

EMM Response:

1.2.1 Cumulative traffic generating developments

In accordance to the respective traffic studies, the generated traffic of the following proposed developments will use the Link Road off Brickmakers Drive. The following reports cover the future development traffic to/ from the site:

- Moorebank Cove Residential Estate (EMM Consulting 2016);
- Moorebank Recycling Facility (Lyle Marshall & Associates 2012);
- Georges Cove Marina (EMM Consulting 2018);
- Georges Cove Marina residential development (EMM Consulting 2018); and
- B6 Corridor mixed-use development (Ason Group 2017).

Development applications for Moorebank Cove Residential Estate and the B6 Corridor mixed-use development are currently underway. A planning proposal application has been submitted to allow future residential development associated with the marina. The Moorebank Recycling Facility has been approved. In our understanding, that sufficient work has been completed on the facility, that it is considered to have 'physically commenced'. However, construction work has ceased and it is not known when it will recommence. Thus, cumulative traffic considers the scenario where all these developments have been constructed and in operation.

1.2.2 Traffic generation rates used in previous EMM reports

The Moorebank Cove Residential Estate will be a low-density residential development. A traffic generation rate of 0.85 per dwelling in the peak hours has been adopted, as per the RTA (now TfNSW) *Guide to Traffic Generating Developments*.

In accordance with *Guide to Traffic Generating Developments*, the following traffic generation rates have been adopted for the Georges Cove Marina development:

- 0.485 per medium-density residential dwelling;
- 0.14 per dry boat storage berth;
- 0.14 per wet berth marina; and
- 2 per 100 m^2 commercial GFA (only for the afternoon peak hour).

1.2.3 Summary of traffic generations and distributions

The traffic generation and distributions of these developments were discussed in their respective traffic reports, a summary of these traffic generations is provided in Table 1.

Table 1 Development traffic generation using the new Link Road

	Peak hour	Description	Traffic generation	Inbound	Outbound
Moorebank Cove	AM	179 dwellings	152	30	122
	PM		152	91	61
Moorebank Recycling Facility	AM		43	23	20

Table 1 Development traffic generation using the new Link Road

	Peak hour	Description	Traffic generation	Inbound	Outbound
	PM	Trucks delivering/ dispatching waste and dispatching products	29	13	16
Georges Cove Marina Commercial	AM	1,243 m² commercial gross floor area (GFA), 250 dry storage berths, 186 marina berths	61	49	12
	PM		86	43	43
George Cove Marina Residential	AM	374 dwellings	181	37	145
	PM		181	108	73
Benedict B6 Corridor Mixed-use Development	AM	-	296	145	151
	PM		386	172	214
Total	**AM**	-	**733**	**284**	**450**
	PM		**834**	**427**	**407**

The distributions of these development traffic are presented in Figure 1 to Figure 5.

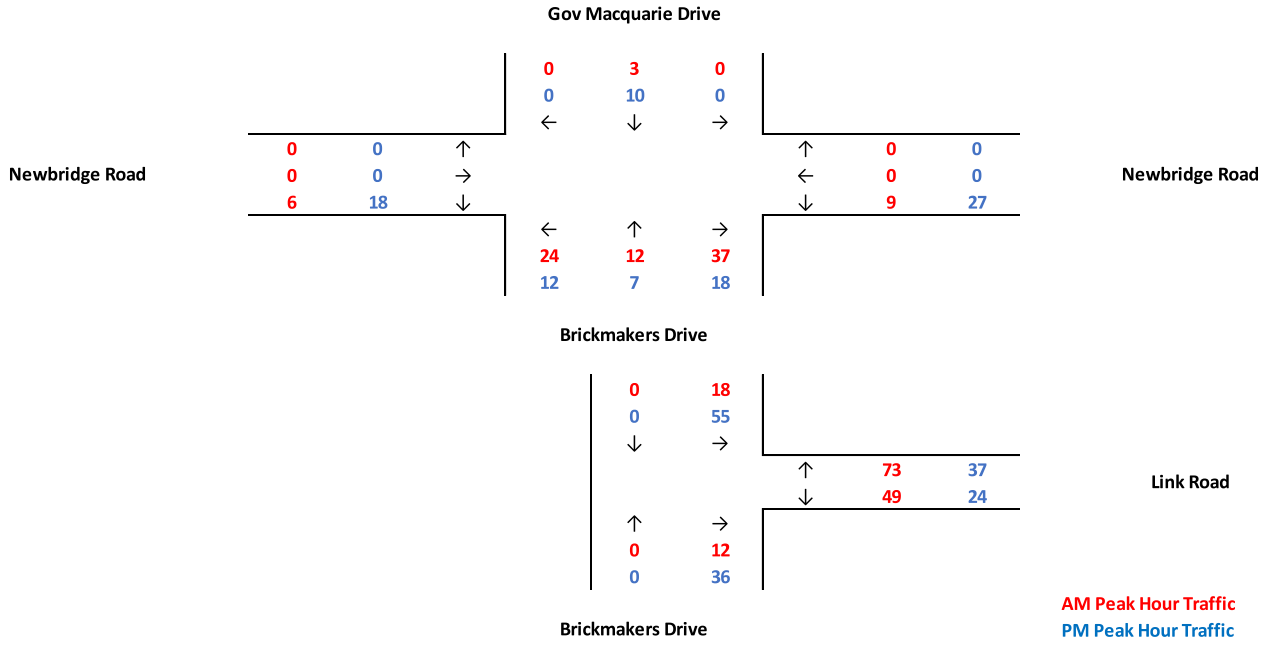


Figure 1 Traffic distribution for Moorebank Cove

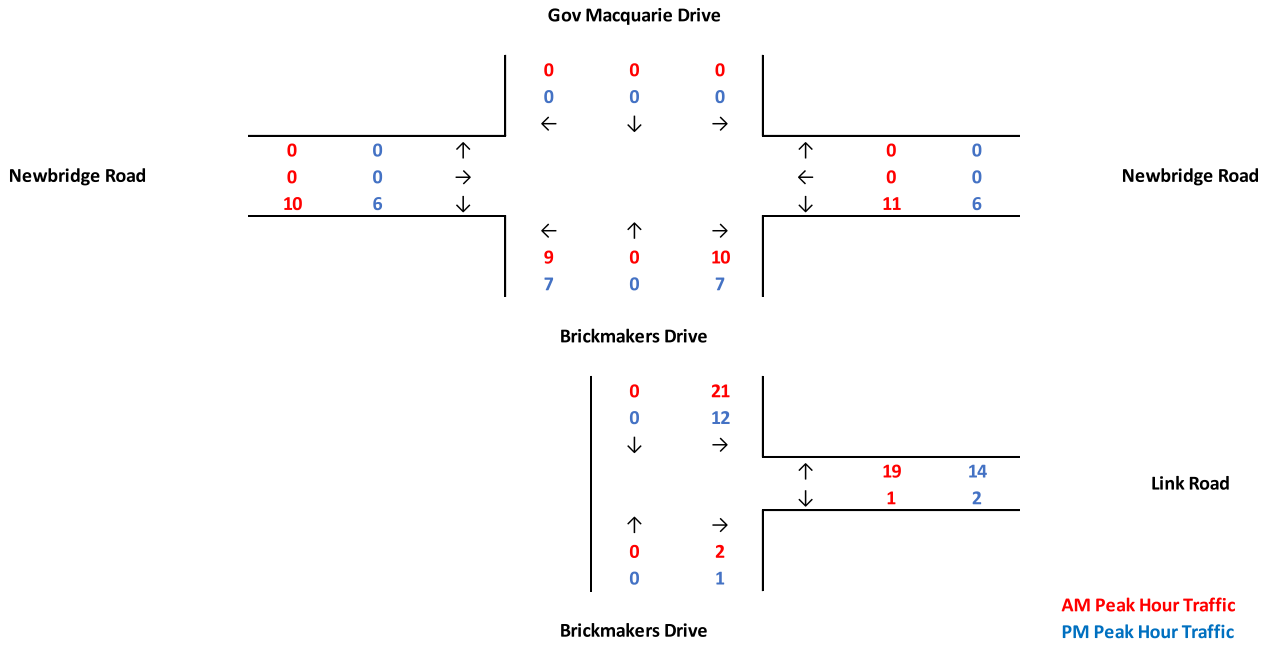


Figure 2 **Traffic distribution for Moorebank Recycling Facility**

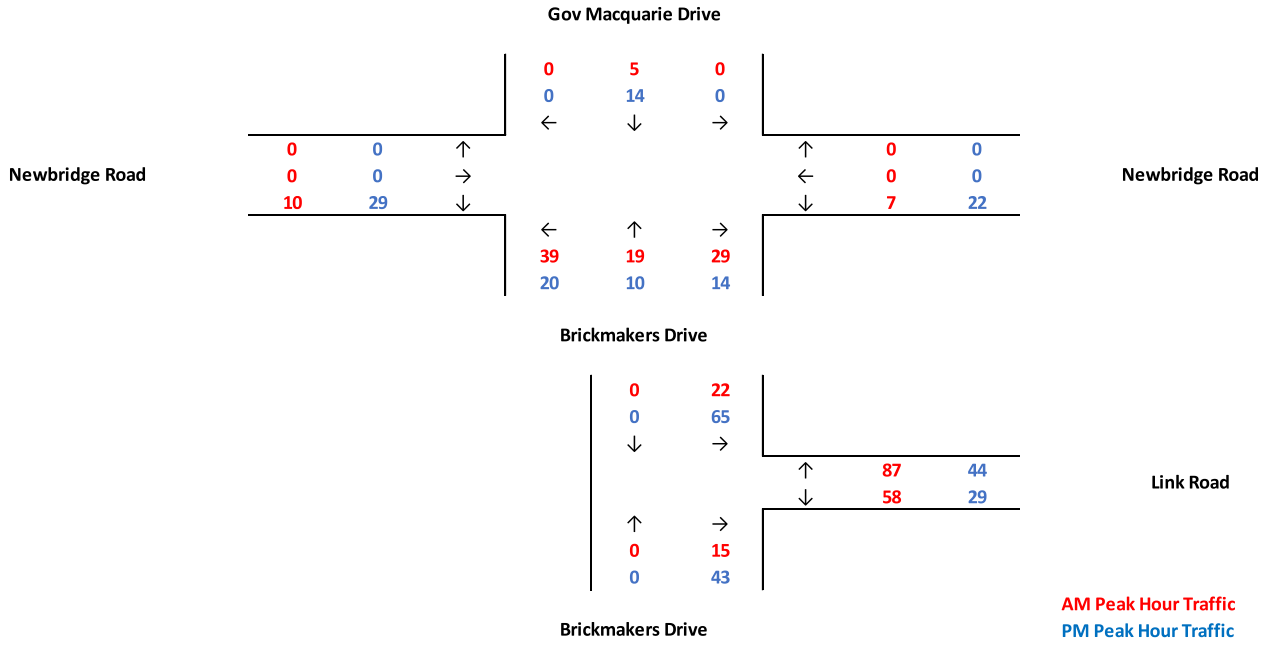


Figure 3 **Traffic distribution for Georges Cove Marina (Residential)**

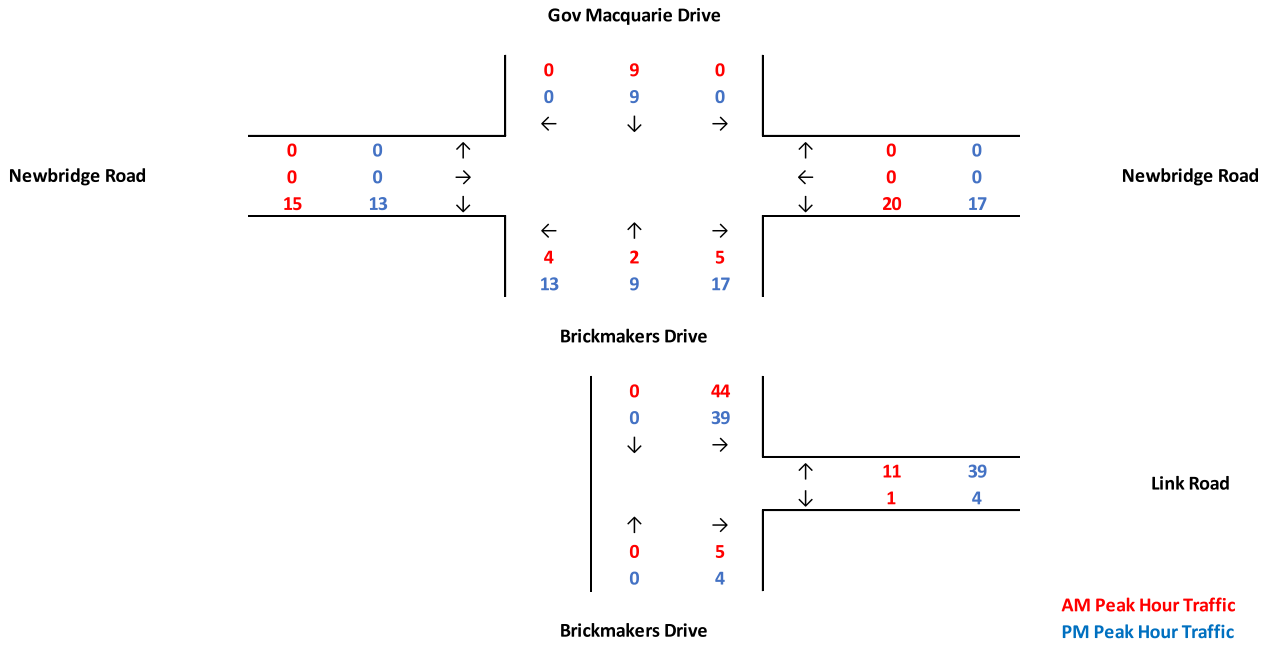


Figure 4 Traffic distribution for Georges Cove Marina (Commercial)

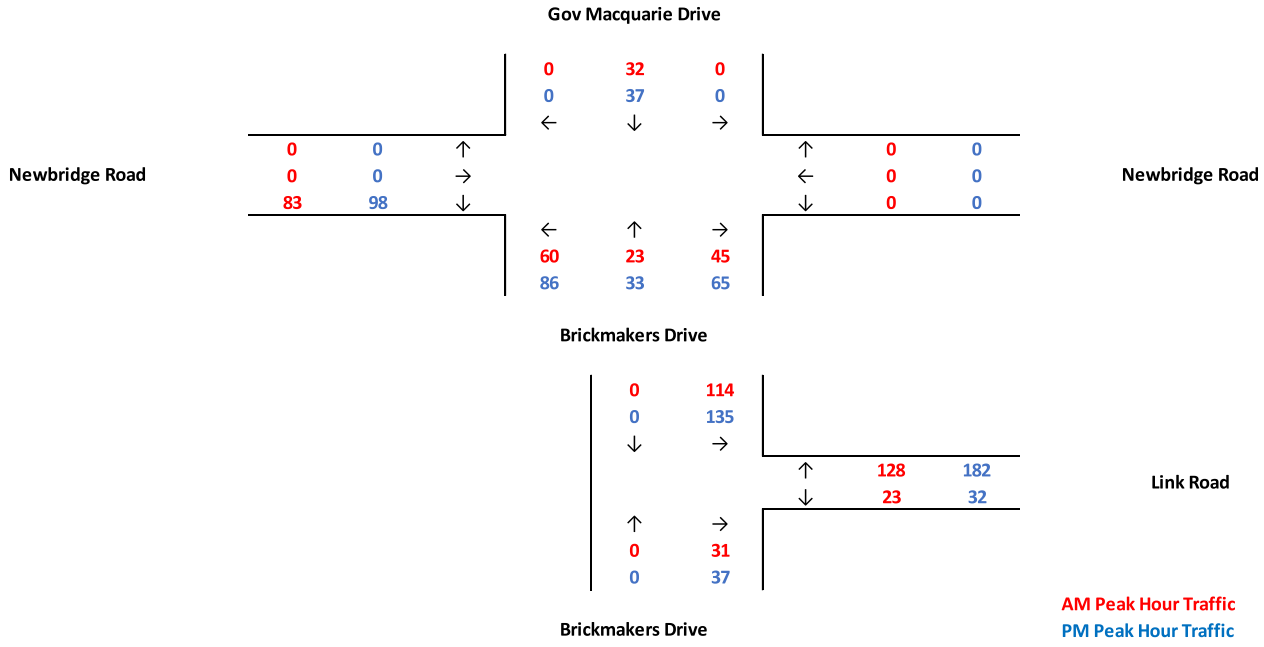


Figure 5 Traffic distribution for Benedict B6 mixed-use development

1.2.4 Overall traffic distribution

It has been assumed that all generated traffic from the Moorebank Recycling Facility are heavy vehicles while those from the rest of the developments are light vehicles. The total number of light and heavy vehicles from all developments are shown in Figure 6. The bracketed numbers represent heavy vehicle movements while the numbers unbracketed represent light vehicle movements.

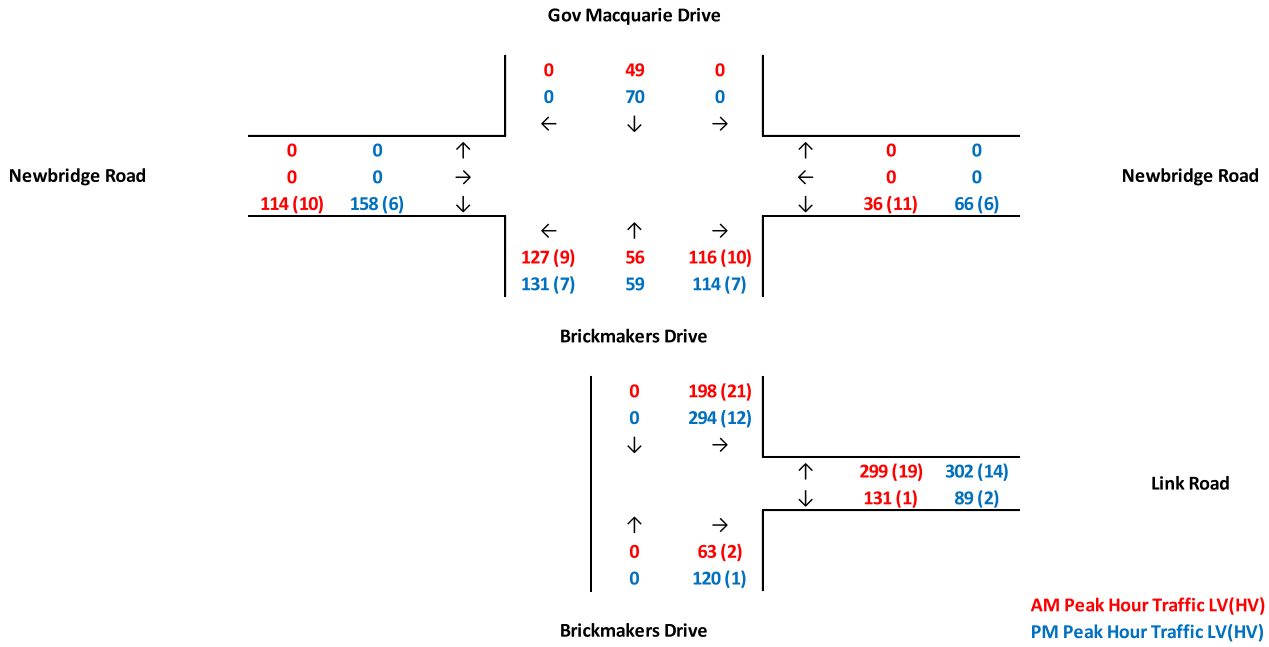


Figure 6 Traffic distribution

1.2.5 Existing and development traffic

As mentioned in Section 1.1, a new survey was conducted at the intersection of Newbridge Road with Governor Macquarie Drive and Brickmakers Drive as well as on Brickmakers Drive at the new Link Road. The existing surveyed traffic movements are presented in Figure 7.

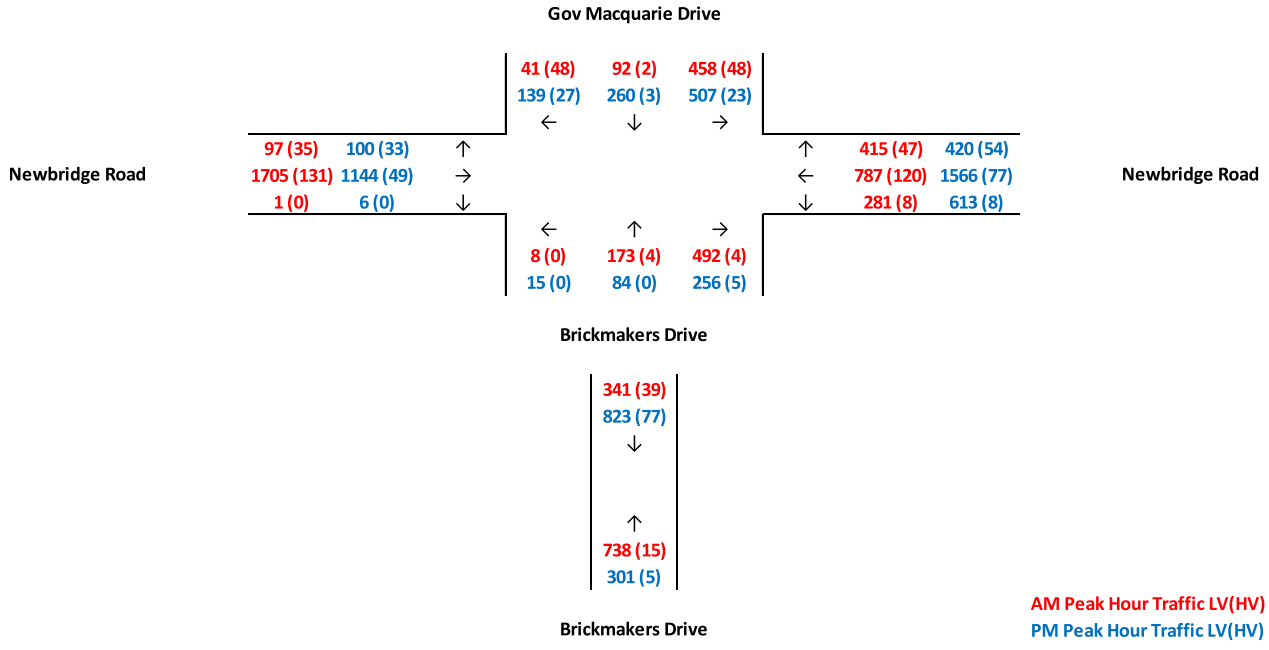


Figure 7 Existing traffic movements

The total movements from the exiting traffic movements combined with the additional traffic movements from all developments is presented in Figure 8.

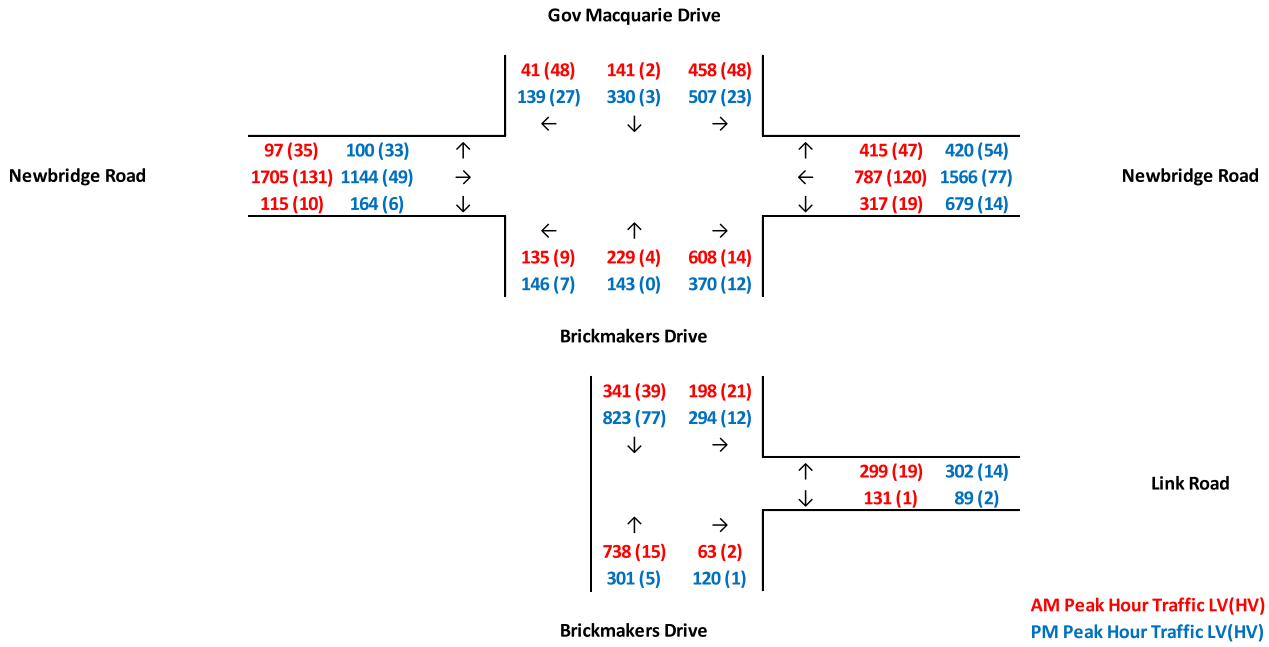


Figure 8 Total post-development traffic movements

1.3 Matter 3

RMS Comment:

The SIDRA model needs to be updated to include 140 second cycle times.

EMM Response:

The SIDRA model has been updated with 140 second cycle times. The roundabout option has also been explored in SIDRA as part of the sensitivity testing. Figure 9 and Figure 10 present the layout of the signalisation and roundabout respectively.

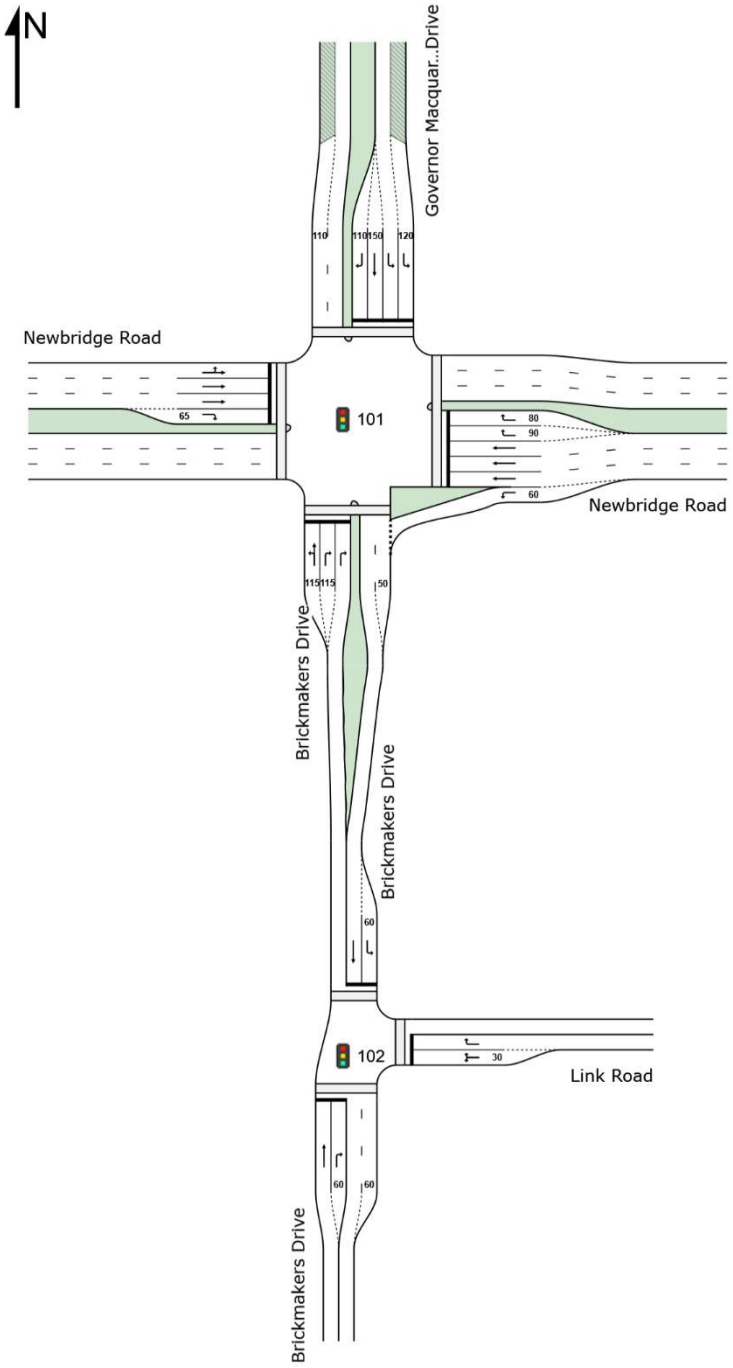


Figure 9 Signalised intersection layout

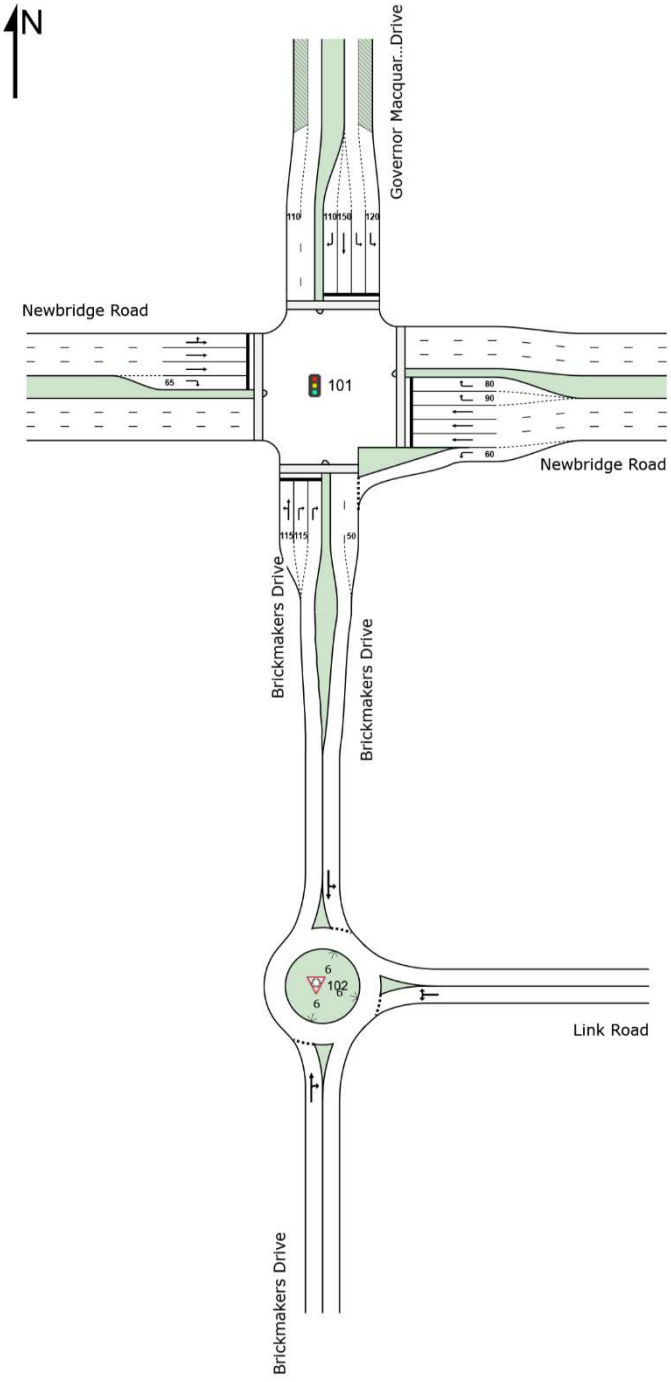


Figure 10 Roundabout intersection layout

Table 2 Summary of Brickmakers Drive/Link Road intersection performance during AM peak

Road	Signalised intersection				Roundabout			
Approach	**DOS**	**LOS**	**DEL**	**95th %ile BQL**	**DOS**	**LOS**	**DEL**	**95th %ile BQL**
South: Brickmakers Drive								
Through	0.813	B	19.6	247.5	1.237	F	230.1	876.7
Right	0.165	B	20.4	16.4	1.237	F	232.8	876.7
East: Link Road								
Left	0.177	B	22.3	36.3	0.689	A	11.6	45.1
Right	0.886	E	66.2	172.9	0.689	A	14.0	45.1
North: Brickmakers Drive								
Left	0.146	A	4.8	2.3	0.488	A	4.9	32.3
Through	0.338	A	7.5	48.4	0.488	A	4.4	32.3
All Vehicles	**0.886**	**B**	**23.8**	**247.5**	**1.237**	**F**	**105.5**	**876.7**

Note: DOS = degree of saturation, LOS = level of service, DEL = average delay by second, BQL = back of queue length
Generally for priority controlled intersections, the longest delay occurs for the right turn movement from the minor road

Table 3 Summary of Brickmakers Drive/Link Road intersection performance during PM peak

	Signalised intersection				Roundabout			
	DOS	**LOS**	**DEL**	**95th %ile BQL**	**DOS**	**LOS**	**DEL**	**95th %ile BQL**
South: Brickmakers Drive								
Through	0.239	A	9.8	57.6	0.524	A	7.1	30.9
Right	0.535	B	25.8	40.0	0.524	A	9.7	30.9
East: Link Road								
Left	0.177	C	34.2	34.7	0.829	C	34.7	107.3
Right	0.884	E	68.7	168.6	0.829	C	37.0	107.3
North: Brickmakers Drive								
Left	0.180	A	4.9	7.6	0.902	A	8.4	148.9
Through	0.610	A	5.5	93.7	0.902	A	8.1	148.9
All Vehicles	**0.884**	**B**	**20.0**	**168.6**	**0.902**	**A**	**14.3**	**148.9**

The SIDRA results show that the roundabout option would have a LOS F with a 95th percentile queue length of 876.7 m in the south approach during the AM peak, which is beyond the roundabout at Conlon Avenue and results in a significant delay for traffic accessing the Brighton Lakes residential district. This is expected as the traffic flow on the three approaches will be disproportionate and the traffic on south approach will require to constantly give way to traffic turning right from the Link Road.

Signalisation of this intersection would result in a LOS E for right turning traffic from Link Road during the AM and PM peak hours with approximately 170 m queue length. However, the queue will be able to clear in during a single green-light (140 seconds)and thus is acceptable.

If the intersection is made a priority intersection with traffic on Link Road giving way to all traffic on Brickmakers Drive:

the high northbound traffic volume in the AM, and vice versa, would make it difficult/unsafe for traffic to turn right from Link Road.

The high right turn demand would also result in an exceedingly long queue on Link Road and subsequently jam up the internal road network. Hence, a priority control operation of Brickmakers Drive/Link Road is not a viable option.

1.4 Matter 4

RMS Comment:

It is noted that Roads and Maritime has previously requested a Warrants assessment for the new traffic control signals on Brickmakers Drive. This information is still outstanding and needs to be prepared in accordance with the traffic signal warrant (TCS) template. The applicant is requested to confirm that the minor road has +200 vehicles over a four hour period because the submitted information uses traffic data over a peak hour rather than over four hours.

EMM Response:

In accordance with the *Traffic Signal Design Guidelines*, the signal warrant requires the major road with a flow exceeding 600 vehicles/hour in both directions, or with a high speed limit/significant crash history. In terms of the major road traffic flow, the Brickmakers Drive/Link Road intersection will not generally meet the signal warrant.

However, given that the marina development is a major attraction for nearby residents, the marina will attract new pedestrian trips from the Brighton Lakes residential precinct on the other side of Brickmakers Drive, it is not practical to expect the increased number of pedestrians to take the 600 m detour to Newbridge Road and back just to cross the road. Further, there is no existing footpath on the eastern side of Brickmakers Drive. Therefore, upon development of the precinct, the lack of a pedestrian crossing along Brickmakers Drive would have significant pedestrian safety issues.

While a refuge island in Brickmakers Drive on pedestrians' desire line of travel it would require significant earthwork and road realignment due to constraints in the existing road width, the current cadastral boundaries and because this section of Brickmakers Drive is on a road bridge. Signalisation of the intersection requires minimal work and will provide the maximum safety for the increased number of pedestrians crossing Brickmakers Drive.

If the signals at Brickmakers Drive with its intersections of Newbridge Road and Link Road are coordinated, the maximum traffic flow could be achieved for both arterial and local roads.

Conclusions

This response letter summarises the post-development traffic volumes at the intersection of Brickmakers Drive with Link Road based on a traffic survey conducted in 2020. Sensitivity testing has been undertaken for the Brickmakers Drive/Link Road intersection based on the traffic operation and pedestrian safety. This found:

- priority intersection:
  - the high traffic volumes would result in a long queue on Link Road and the queue would back up the internal road network;
  - pedestrian access from the other side of Brickmakers Drive to the marina would require a long detour;
  - construction of refuge island is likely to require significant earthwork and road realignment due to existing constraints;
- roundabout intersection:
  - the disproportionate heavy traffic along Brickmakers Drive (heavy northbound AM peak and heavy southbound PM peak) would result in a long queue on the south approach of Brickmakers Drive in the AM peak and block access to the Brighton Lakes residential precinct at Conlon Avenue;
  - construction of roundabout with a refuge island is likely to require significant earthwork and road realignment due to existing constraints;
- Signalised intersection:
  - good intersection performance with acceptable queue lengths on all three approaches;
  - safest pedestrian access across Brickmakers Drive to the marina;
  - requires minimal works; and
  - future potential benefits if both of the adjoining signals are coordinated.

We trust this thoroughly addresses the RMS comments. Should you require further clarification regarding this matter, please do not hesitate to contact the undersigned.

Yours sincerely

Tim Brooker
Associate Director
tbrooker@emmconsulting.com.au

References

Ason Group. (2017). *Traffic Impact Assessment, Planning Proposal, Benedict Sands; 146 Newbridge Road, Moorebank.* Benedict Industries.

EMM Consulting. (2016). *Moorebank Cove Residential Estate Traffic Assessment.* Mirvac.

EMM Consulting. (2018). *Georges Cove Marina Residential Planning Proposal.* Mirvac.

Lyle Marshall & Associates. (2012). *Traffic report for construction and operation of a materials recycling facility on Lot 6, D.P. 1065574, Newbridge Road, Moorebank.* Concrete Recyclers Group.

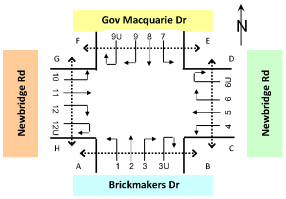
Appendix A

Intersection and tube count data

Job No. : N5560
Client : EMM
Suburb : Moorebank
Location : 1. Newbridge Rd / Gov Macquarie Dr / Brickmakers Dr

Day/Date : Thu, 30th January 2020
Weather : Fine
Description : Classified Intersection Count
: 15 mins Data

Classifications	Class 1	Class 2
	Lights	Heavies



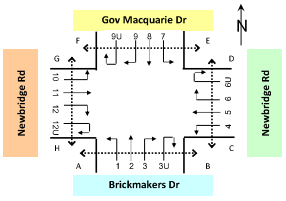
MATRIX Traffic and Transport Data

Approach	Brickmakers Dr												Newbridge Rd											
Direction	Direction 1 (Left Turn)			Direction 2 (Through)			Direction 3 (Right Turn)			Direction 3U (U Turn)			Direction 4 (Left Turn)			Direction 5 (Through)			Direction 6 (Right Turn)			Direction 6U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 7:15	1	0	**1**	33	2	**35**	134	1	**135**	0	0	**0**	70	1	**71**	200	30	**230**	101	14	**115**	0	0	**0**
7:15 to 7:30	2	0	**2**	41	1	**42**	124	0	**124**	0	0	**0**	60	1	**61**	181	39	**220**	113	16	**129**	0	0	**0**
7:30 to 7:45	4	0	**4**	42	0	**42**	88	0	**88**	0	0	**0**	63	0	**63**	194	26	**220**	60	6	**66**	0	0	**0**
7:45 to 8:00	1	0	**1**	57	1	**58**	146	3	**149**	0	0	**0**	88	6	**94**	212	25	**237**	141	11	**152**	0	0	**0**
8:00 to 8:15	3	0	**3**	72	0	**72**	161	2	**163**	0	0	**0**	65	0	**65**	164	25	**189**	125	14	**139**	0	0	**0**
8:15 to 8:30	6	0	**6**	72	1	**73**	117	1	**118**	0	0	**0**	64	1	**65**	149	23	**172**	152	12	**164**	0	0	**0**
8:30 to 8:45	2	0	**2**	64	1	**65**	108	2	**110**	0	0	**0**	58	2	**60**	159	29	**188**	118	13	**131**	0	0	**0**
8:45 to 9:00	3	0	**3**	49	1	**50**	109	1	**110**	0	0	**0**	64	1	**65**	196	32	**228**	97	15	**112**	0	0	**0**
AM Totals	**22**	**0**	**22**	**430**	**7**	**437**	**987**	**10**	**997**	**0**	**0**	**0**	**532**	**12**	**544**	**1,455**	**229**	**1,684**	**907**	**101**	**1,008**	**0**	**0**	**0**
16:00 to 16:15	4	0	**4**	25	1	**26**	102	4	**106**	0	0	**0**	165	2	**167**	411	19	**430**	121	12	**133**	0	0	**0**
16:15 to 16:30	2	1	**3**	21	0	**21**	112	0	**112**	0	0	**0**	151	1	**152**	332	19	**351**	91	15	**106**	0	0	**0**
16:30 to 16:45	2	0	**2**	24	0	**24**	73	0	**73**	0	0	**0**	146	2	**148**	306	23	**329**	92	17	**109**	0	0	**0**
16:45 to 17:00	5	0	**5**	26	0	**26**	54	1	**55**	0	0	**0**	162	1	**163**	381	24	**405**	125	11	**136**	0	0	**0**
17:00 to 17:15	4	0	**4**	16	0	**16**	77	2	**79**	0	0	**0**	166	2	**168**	411	14	**425**	89	13	**102**	0	0	**0**
17:15 to 17:30	4	0	**4**	18	0	**18**	52	2	**54**	0	0	**0**	139	3	**142**	468	16	**484**	114	13	**127**	1	0	**1**
17:30 to 17:45	1	0	**1**	18	0	**18**	55	0	**55**	0	0	**0**	145	0	**145**	398	17	**415**	109	12	**121**	0	0	**0**
17:45 to 18:00	1	0	**1**	24	0	**24**	46	0	**46**	0	0	**0**	159	0	**159**	383	17	**400**	141	15	**156**	0	0	**0**
PM Totals	**23**	**1**	**24**	**172**	**1**	**173**	**571**	**9**	**580**	**0**	**0**	**0**	**1,233**	**11**	**1,244**	**3,090**	**149**	**3,239**	**882**	**108**	**990**	**1**	**0**	**1**

Approach	Gov Macquarie Dr												Newbridge Rd												Crossing Pedestrians								
Direction	Direction 7 (Left Turn)			Direction 8 (Through)			Direction 9 (Right Turn)			Direction 9U (U Turn)			Direction 10 (Left Turn)			Direction 11 (Through)			Direction 12 (Right Turn)			Direction 12U (U Turn)										
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	B to A	A to B	D to C	C to D	F to E	E to F	H to G	G to H	Total
7:00 to 7:15	113	14	**127**	24	0	**24**	10	14	**24**	0	0	**0**	16	10	**26**	389	23	**412**	0	0	**0**	0	0	**0**	0	0	0	0	0	3	1	**4**
7:15 to 7:30	98	11	**109**	21	1	**22**	11	8	**19**	0	0	**0**	26	8	**34**	506	43	**549**	1	0	**1**	0	0	**0**	0	0	0	0	0	1	0	**1**
7:30 to 7:45	130	14	**144**	19	0	**19**	9	14	**23**	0	0	**0**	24	6	**30**	435	33	**468**	0	0	**0**	0	0	**0**	0	0	0	0	0	1	1	**2**
7:45 to 8:00	117	9	**126**	28	1	**29**	11	12	**23**	0	0	**0**	31	11	**42**	375	32	**407**	0	0	**0**	0	0	**0**	0	0	0	0	0	3	1	**4**
8:00 to 8:15	133	16	**149**	26	5	**31**	8	10	**18**	0	0	**0**	26	17	**43**	294	32	**326**	0	1	**1**	1	0	**1**	1	0	0	0	1	0	6	1	**9**
8:15 to 8:30	142	16	**158**	19	0	**19**	14	13	**27**	0	0	**0**	38	11	**49**	316	36	**352**	1	0	**1**	0	0	**0**	0	1	0	1	0	0	8	2	**12**
8:30 to 8:45	135	22	**157**	45	1	**46**	19	15	**34**	0	0	**0**	51	10	**61**	295	44	**339**	0	1	**1**	0	0	**0**	0	0	0	0	0	4	0	**4**
8:45 to 9:00	72	26	**98**	26	2	**28**	25	11	**36**	0	0	**0**	49	10	**59**	316	49	**365**	5	0	**5**	0	0	**0**	0	0	0	1	0	0	2	1	**4**
AM Totals	**940**	**128**	**1,068**	**208**	**10**	**218**	**107**	**97**	**204**	**0**	**0**	**0**	**261**	**83**	**344**	**2,926**	**292**	**3,218**	**7**	**2**	**9**	**1**	**0**	**1**	**1**	**1**	**0**	**2**	**1**	**0**	**28**	**7**	**40**
16:00 to 16:15	194	24	**218**	64	0	**64**	41	11	**52**	0	0	**0**	2	0	**2**	1	0	**1**	0	0	**0**	0	0	**0**	1	0	1	0	0	0	0	6	**8**
16:15 to 16:30	197	14	**211**	59	0	**59**	35	10	**45**	0	0	**0**	6	3	**9**	178	14	**192**	1	0	**1**	1	0	**1**	1	0	4	0	3	2	0	0	**10**
16:30 to 16:45	140	3	**143**	63	0	**63**	31	6	**37**	0	0	**0**	23	12	**35**	351	15	**366**	0	0	**0**	0	0	**0**	0	0	0	0	0	1	1	1	**3**
16:45 to 17:00	105	8	**113**	51	2	**53**	20	9	**29**	0	0	**0**	25	6	**31**	209	11	**220**	1	0	**1**	0	0	**0**	1	0	1	1	0	3	1	1	**8**
17:00 to 17:15	153	9	**162**	79	1	**80**	42	5	**47**	0	0	**0**	27	7	**34**	276	11	**287**	3	0	**3**	0	0	**0**	0	0	0	0	0	1	0	0	**1**
17:15 to 17:30	109	3	**112**	67	0	**67**	46	7	**53**	0	0	**0**	25	8	**33**	308	12	**320**	2	0	**2**	0	0	**0**	0	0	0	0	0	0	1	1	**1**
17:30 to 17:45	109	4	**113**	53	0	**53**	29	5	**34**	0	0	**0**	14	8	**22**	311	15	**326**	2	0	**2**	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:45 to 18:00	80	3	**83**	37	0	**37**	26	8	**34**	0	0	**0**	24	6	**30**	234	12	**246**	2	0	**2**	0	0	**0**	0	0	1	0	0	0	0	0	**1**
PM Totals	**1,087**	**68**	**1,155**	**473**	**3**	**476**	**270**	**61**	**331**	**0**	**0**	**0**	**146**	**50**	**196**	**1,868**	**90**	**1,958**	**11**	**0**	**11**	**1**	**0**	**1**	**3**	**0**	**7**	**1**	**3**	**7**	**2**	**9**	**32**

Job No. : N5560
Client : EMM
Suburb : Moorebank
Location : 1. Newbridge Rd / Gov Macquarie Dr / Brickmakers Dr

Day/Date : Thu, 30th January 2020
Weather : Fine
Description : Classified Intersection Count
: Hourly Summary



MATRIX Traffic and Transport Data

Approach	Brickmakers Dr												Newbridge Rd											
Direction	Direction 1 (Left Turn)			Direction 2 (Through)			Direction 3 (Right Turn)			Direction 3U (U Turn)			Direction 4 (Left Turn)			Direction 5 (Through)			Direction 6 (Right Turn)			Direction 6U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 8:00	8	0	**8**	173	4	**177**	492	4	**496**	0	0	**0**	281	8	**289**	787	120	**907**	415	47	**462**	0	0	**0**
7:15 to 8:15	10	0	**10**	212	2	**214**	519	5	**524**	0	0	**0**	276	7	**283**	751	115	**866**	439	47	**486**	0	0	**0**
7:30 to 8:30	14	0	**14**	243	2	**245**	512	6	**518**	0	0	**0**	280	7	**287**	719	99	**818**	478	43	**521**	0	0	**0**
7:45 to 8:45	12	0	**12**	265	3	**268**	532	8	**540**	0	0	**0**	275	9	**284**	684	102	**786**	536	50	**586**	0	0	**0**
8:00 to 9:00	14	0	**14**	257	3	**260**	495	6	**501**	0	0	**0**	251	4	**255**	668	109	**777**	492	54	**546**	0	0	**0**
AM Totals	**22**	**0**	**22**	**430**	**7**	**437**	**987**	**10**	**997**	**0**	**0**	**0**	**532**	**12**	**544**	**1,455**	**229**	**1,684**	**907**	**101**	**1,008**	**0**	**0**	**0**
16:00 to 17:00	13	1	**14**	96	1	**97**	341	5	**346**	0	0	**0**	624	6	**630**	1,430	85	**1,515**	429	55	**484**	0	0	**0**
16:15 to 17:15	13	1	**14**	87	0	**87**	316	3	**319**	0	0	**0**	625	6	**631**	1,430	80	**1,510**	397	56	**453**	0	0	**0**
16:30 to 17:30	15	0	**15**	84	0	**84**	256	5	**261**	0	0	**0**	613	8	**621**	1,566	77	**1,643**	420	54	**474**	1	0	**1**
16:45 to 17:45	14	0	**14**	78	0	**78**	238	5	**243**	0	0	**0**	612	6	**618**	1,658	71	**1,729**	437	49	**486**	1	0	**1**
17:00 to 18:00	10	0	**10**	76	0	**76**	230	4	**234**	0	0	**0**	609	5	**614**	1,660	64	**1,724**	453	53	**506**	1	0	**1**
PM Totals	**23**	**1**	**24**	**172**	**1**	**173**	**571**	**9**	**580**	**0**	**0**	**0**	**1,233**	**11**	**1,244**	**3,090**	**149**	**3,239**	**882**	**108**	**990**	**1**	**0**	**1**

Approach	Gov Macquarie Dr	Newbridge Rd	Crossing

Direction	Direction 7 (Left Turn)			Direction 8 (Through)			Direction 9 (Right Turn)			Direction 9U (U Turn)			Direction 10 (Left Turn)			Direction 11 (Through)			Direction 12 (Right Turn)			Direction 12U (U Turn)			Pedestrians							
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	B to A	A to B	D to C	C to D	F to E	E to F	H to G	G to H	Total
7:00 to 8:00	458	48	**506**	92	2	**94**	41	48	**89**	0	0	**0**	97	35	**132**	1,705	131	**1,836**	1	0	**1**	0	0	**0**	0	0	0	0	0	0	8	3	**11**
7:15 to 8:15	478	50	**528**	94	7	**101**	39	44	**83**	0	0	**0**	107	42	**149**	1,610	140	**1,750**	1	1	**2**	1	0	**1**	1	0	0	0	1	0	11	3	**16**
7:30 to 8:30	522	55	**577**	92	6	**98**	42	49	**91**	0	0	**0**	119	45	**164**	1,420	133	**1,553**	1	1	**2**	1	0	**1**	1	1	0	1	1	0	18	5	**27**
7:45 to 8:45	527	63	**590**	118	7	**125**	52	50	**102**	0	0	**0**	146	49	**195**	1,280	144	**1,424**	1	2	**3**	1	0	**1**	1	1	0	1	1	0	21	4	**29**
8:00 to 9:00	482	80	**562**	116	8	**124**	66	49	**115**	0	0	**0**	164	48	**212**	1,221	161	**1,382**	6	2	**8**	1	0	**1**	1	1	0	2	1	0	20	4	**29**
AM Totals	**940**	**128**	**1,068**	**208**	**10**	**218**	**107**	**97**	**204**	**0**	**0**	**0**	**261**	**83**	**344**	**2,926**	**292**	**3,218**	**7**	**2**	**9**	**1**	**0**	**1**	**1**	**1**	**0**	**2**	**1**	**0**	**28**	**7**	**40**
16:00 to 17:00	636	49	**685**	237	2	**239**	127	36	**163**	0	0	**0**	56	21	**77**	739	40	**779**	2	0	**2**	1	0	**1**	3	0	6	1	3	6	2	8	**29**
16:15 to 17:15	595	34	**629**	252	3	**255**	128	30	**158**	0	0	**0**	81	28	**109**	1,014	51	**1,065**	5	0	**5**	1	0	**1**	2	0	5	1	3	7	2	2	**22**
16:30 to 17:30	507	23	**530**	260	3	**263**	139	27	**166**	0	0	**0**	100	33	**133**	1,144	49	**1,193**	6	0	**6**	0	0	**0**	1	0	1	1	0	5	2	3	**13**
16:45 to 17:45	476	24	**500**	250	3	**253**	137	26	**163**	0	0	**0**	91	29	**120**	1,104	49	**1,153**	8	0	**8**	0	0	**0**	1	0	1	1	0	4	1	2	**10**
17:00 to 18:00	451	19	**470**	236	1	**237**	143	25	**168**	0	0	**0**	90	29	**119**	1,129	50	**1,179**	9	0	**9**	0	0	**0**	0	0	1	0	0	1	0	1	**3**
PM Totals	**1,087**	**68**	**1,155**	**473**	**3**	**476**	**270**	**61**	**331**	**0**	**0**	**0**	**146**	**50**	**196**	**1,868**	**90**	**1,958**	**11**	**0**	**11**	**1**	**0**	**1**	**3**	**0**	**7**	**1**	**3**	**7**	**2**	**9**	**32**

Job No	N5560
Client	Eric Lei
Site	Brickmakers Drive
Location	Mooorebank
Site No	1
Start Date	30-Jan-20
Description	Volume Summary
Direction	Combined

Hour Starting	Day of Week							W'Day Ave	7 Day Ave
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
	3-Feb	4-Feb	5-Feb	30-Jan	31-Jan	1-Feb	2-Feb		
AM Peak	1152	1099	1092	1122	1200	882	710		
PM Peak	1217	1228	1259	1313	1203	919	772	**14929**	**13700**
0:00	81	83	79	82	98	167	196	85	112
1:00	42	51	52	34	31	95	103	42	58
2:00	30	25	29	38	37	70	77	32	44
3:00	35	43	46	56	53	72	59	47	52
4:00	141	139	136	148	141	86	60	141	122
5:00	460	454	443	448	432	188	100	447	361
6:00	800	853	850	828	806	357	161	827	665
7:00	1030	879	1086	996	994	433	255	997	810
8:00	1152	1099	1092	1122	1200	609	343	1133	945
9:00	778	811	942	785	795	772	513	822	771
10:00	579	598	624	631	669	882	653	620	662
11:00	551	634	593	674	670	838	710	624	667
12:00	600	700	671	616	722	919	772	662	714
13:00	657	712	727	735	782	795	736	723	735
14:00	970	983	963	1076	1012	724	651	1001	911
15:00	1217	1187	1189	1306	1203	646	674	1220	1060
16:00	1162	1228	1135	1313	1179	615	691	1203	1046
17:00	1211	1197	1259	1180	1182	651	642	1206	1046
18:00	969	1024	1039	975	931	655	593	988	884
19:00	666	666	662	661	701	541	420	671	617
20:00	497	520	553	568	536	451	400	535	504
21:00	343	445	478	446	486	444	325	440	424
22:00	231	289	278	292	363	399	253	291	301
23:00	152	128	168	136	280	317	143	173	189
Total	14354	14748	15094	15146	15303	11726	9530	14929	13700

7-19	10876	11052	11320	11409	11339	8539	7233	11199	10253
6-22	13182	13536	13863	13912	13868	10332	8539	13672	12462
6-24	13565	13953	14309	14340	14511	11048	8935	14136	12952
0-24	14354	14748	15094	15146	15303	11726	9530	14929	13700

Appendix B

SIDRA results (signalisation)

MOVEMENT SUMMARY

Site: 101 [Dev Newbridge Rd/Gov Macquarie Dr/Brickmakers Dr AM]

Network: N101 [Dev AM]

Dev Four Way Intersection
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Brickmakers Drive														
1	L2	151	6.3	151	6.3	1.075	159.8	LOS F	44.5	320.5	1.00	1.43	1.85	13.8
2	T1	236	1.7	236	1.7	1.075	155.2	LOS F	44.5	320.5	1.00	1.43	1.85	14.0
3	R2	629	2.3	629	2.3	1.047	135.5	LOS F	32.5	231.9	1.00	1.24	1.69	15.7
Approach		1016	2.8	1016	2.8	1.075	143.7	LOS F	44.5	320.5	1.00	1.31	1.75	15.0
East: Newbridge Road														
4	L2	338	5.8	338	5.8	0.337	11.7	LOS A	6.0	43.9	0.43	0.71	0.43	48.9
5	T1	907	13.2	907	13.2	0.327	21.0	LOS B	11.8	92.2	0.63	0.54	0.63	50.1
6	R2	462	10.2	462	10.2	1.897	611.5	LOS F	66.4	505.4	1.00	1.65	3.53	5.1
Approach		1707	10.9	1707	10.9	1.897	178.9	LOS F	66.4	505.4	0.69	0.88	1.37	13.8
North: Governor Macquarie Drive														
7	L2	506	9.5	506	9.5	0.452	36.9	LOS C	9.0	68.4	0.84	0.86	1.02	36.9
8	T1	146	1.4	146	1.4	0.391	54.7	LOS D	8.7	61.8	0.92	0.76	0.92	22.1
9	R2	89	53.9	89	53.9	0.331	40.0	LOS C	4.0	41.0	0.91	0.76	0.91	32.1
Approach		741	13.2	741	13.2	0.452	40.7	LOS C	9.0	68.4	0.86	0.83	0.99	33.7
West: Newbridge Road														
10	L2	132	26.5	132	26.5	1.090	158.1	LOS F	76.7	587.3	1.00	1.43	1.83	16.0
11	T1	1836	7.1	1836	7.1	1.090	158.3	LOS F	84.8	630.2	1.00	1.51	1.84	16.8
12	R2	132	8.0	132	8.0	0.282	43.3	LOS D	6.6	49.2	0.78	0.78	0.78	26.8
Approach		2100	8.4	2100	8.4	1.090	151.1	LOS F	84.8	630.2	0.99	1.46	1.77	17.0
All Vehicles		5563	8.8	5563	8.8	1.897	143.6	LOS F	84.8	630.2	0.88	1.17	1.54	16.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	21	24.6	LOS C	0.0	0.0	0.59	0.59
P2	East Full Crossing	11	64.2	LOS F	0.0	0.0	0.96	0.96
P3	North Full Crossing	21	42.5	LOS E	0.1	0.1	0.78	0.78
P4	West Full Crossing	53	63.3	LOS F	0.2	0.2	0.95	0.95
All Pedestrians		105	51.5	LOS E			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [Dev Brickmakers Dr/Link Rd AM]

Network: N101 [Dev AM]

New Intersection with Traffic Signals
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Brickmakers Drive														
2	T1	753	2.0	753	2.0	0.813	19.6	LOS B	34.8	247.5	0.75	0.69	0.75	32.6
3	R2	69	3.0	69	3.0	0.165	20.4	LOS B	2.3	16.4	0.51	0.68	0.51	38.8
Approach		822	2.1	822	2.1	0.813	19.7	LOS B	34.8	247.5	0.73	0.69	0.73	33.5
East: Link Road														
4	L2	140	0.8	140	0.8	0.177	22.3	LOS B	5.1	36.3	0.58	0.70	0.58	38.0
6	R2	336	6.0	336	6.0	0.886	66.2	LOS E	23.5	172.9	0.93	0.95	1.17	17.9
Approach		476	4.4	476	4.4	0.886	53.3	LOS D	23.5	172.9	0.83	0.87	1.00	23.6
North: Brickmakers Drive														
7	L2	232	9.5	232	9.5	0.146	4.8	LOS A	0.3	2.3	0.04	0.54	0.04	45.6
8	T1	380	10.3	380	10.3	0.338	7.5	LOS A	6.4	48.4	0.27	0.24	0.27	44.3
Approach		612	10.0	612	10.0	0.338	6.5	LOS A	6.4	48.4	0.18	0.35	0.18	44.8
All Vehicles		1910	5.2	1910	5.2	0.886	23.8	LOS B	34.8	247.5	0.58	0.63	0.62	33.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	11	41.7	LOS E	0.0	0.0	0.77	0.77
P2	East Full Crossing	21	13.3	LOS B	0.0	0.0	0.44	0.44
P3	North Full Crossing	53	39.5	LOS D	0.2	0.2	0.75	0.75
All Pedestrians		84	33.2	LOS D			0.68	0.68

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Dev Newbridge Rd/Gov Macquarie Dr/Brickmakers Dr PM]

Network: N102 [Dev PM]

Dev Four Way Intersection
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Brickmakers Drive														
1	L2	160	4.6	160	4.6	1.044	134.3	LOS F	30.1	215.4	1.00	1.22	1.58	15.8
2	T1	146	0.0	146	0.0	1.044	129.7	LOS F	30.1	215.4	1.00	1.22	1.58	15.9
3	R2	388	3.2	388	3.2	0.554	60.1	LOS E	12.6	90.3	0.99	0.83	0.99	26.7
Approach		695	2.8	695	2.8	1.044	91.9	LOS F	30.1	215.4	1.00	1.00	1.25	20.5
East: Newbridge Road														
4	L2	697	2.1	697	2.1	1.304	334.7	LOS F	115.8	824.6	1.00	1.56	2.70	4.9
5	T1	1643	4.7	1643	4.7	0.692	24.5	LOS B	34.3	250.0	0.75	0.67	0.75	47.8
6	R2	474	11.4	474	11.4	1.121	121.1	LOS F	28.5	218.9	1.00	1.09	1.69	18.3
Approach		2814	5.2	2814	5.2	1.304	117.6	LOS F	115.8	824.6	0.85	0.96	1.39	18.6
North: Governor Macquarie Drive														
7	L2	530	4.3	530	4.3	0.420	31.9	LOS C	8.5	61.6	0.81	0.84	0.93	39.5
8	T1	337	0.9	337	0.9	1.105	179.0	LOS F	41.1	289.6	1.00	1.50	1.99	8.8
9	R2	166	16.3	166	16.3	0.443	39.9	LOS C	7.7	61.8	0.91	0.79	0.91	35.5
Approach		1033	5.1	1033	5.1	1.105	81.1	LOS F	41.1	289.6	0.89	1.04	1.27	22.9
West: Newbridge Road														
10	L2	133	24.8	133	24.8	0.890	68.7	LOS E	34.0	258.8	1.00	1.02	1.29	29.8
11	T1	1193	4.1	1193	4.1	0.890	62.5	LOS E	35.8	259.3	0.99	1.00	1.21	31.9
12	R2	179	3.5	179	3.5	0.710	68.4	LOS E	12.0	86.7	1.00	0.85	1.06	19.7
Approach		1505	5.9	1505	5.9	0.890	63.7	LOS E	35.8	259.3	0.99	0.98	1.20	30.5
All Vehicles		6046	5.1	6046	5.1	1.304	95.0	LOS F	115.8	824.6	0.91	0.98	1.31	21.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	21	24.0	LOS C	0.0	0.0	0.59	0.59
P2	East Full Crossing	11	64.2	LOS F	0.0	0.0	0.96	0.96
P3	North Full Crossing	21	48.9	LOS E	0.1	0.1	0.84	0.84
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		105	53.1	LOS E			0.86	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [Dev Brickmakers Dr/Link Rd PM]

Network: N102 [Dev PM]

New Intersection with Traffic Signals
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Brickmakers Drive														
2	T1	306	1.6	306	1.6	0.239	9.8	LOS A	8.1	57.6	0.43	0.37	0.43	39.5
3	R2	128	0.8	128	0.8	0.535	25.8	LOS B	5.7	40.0	0.67	0.76	0.67	36.7
Approach		434	1.4	434	1.4	0.535	14.5	LOS B	8.1	57.6	0.50	0.49	0.50	38.2
East: Link Road														
4	L2	97	2.2	97	2.2	0.177	34.2	LOS C	4.9	34.7	0.73	0.73	0.73	33.8
6	R2	334	4.4	334	4.4	0.884	68.7	LOS E	23.2	168.6	0.96	0.94	1.19	17.5
Approach		430	3.9	430	3.9	0.884	60.9	LOS E	23.2	168.6	0.91	0.90	1.09	21.2
North: Brickmakers Drive														
7	L2	323	3.9	298	3.7	0.180	4.9	LOS A	1.0	7.6	0.11	0.56	0.11	45.5
8	T1	900	8.6	741	10.1	0.610	5.5	LOS A	12.3	93.7	0.27	0.25	0.27	45.7
Approach		1223	7.3	1039[N1]	8.3	0.610	5.3	LOS A	12.3	93.7	0.22	0.34	0.22	45.7
All Vehicles		2088	5.4	1904[N1]	5.9	0.884	20.0	LOS B	23.2	168.6	0.44	0.50	0.48	36.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	11	47.3	LOS E	0.0	0.0	0.82	0.82
P2	East Full Crossing	21	10.4	LOS B	0.0	0.0	0.39	0.39
P3	North Full Crossing	53	44.9	LOS E	0.2	0.2	0.80	0.80
All Pedestrians		84	36.6	LOS D			0.70	0.70

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Appendix C

SIDRA results (roundabout)

MOVEMENT SUMMARY

Site: 101 [Dev Newbridge Rd/Gov Macquarie Dr/Brickmakers Dr AM]

Network: N101 [Dev AM roundabout]

Dev Four Way Intersection
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Brickmakers Drive														
1	L2	151	6.3	150	6.3	1.202	259.7	LOS F	52.2	376.6	1.00	1.76	2.37	9.2
2	T1	236	1.7	202	1.6	1.202	255.0	LOS F	52.2	376.6	1.00	1.76	2.37	9.3
3	R2	629	2.3	533	2.6	0.819	69.9	LOS E	18.8	134.9	1.00	0.92	1.14	24.6
Approach		1016	2.8	885 N1	3.0	1.202	144.2	LOS F	52.2	376.6	1.00	1.26	1.63	14.9
East: Newbridge Road														
4	L2	338	5.8	338	5.8	0.336	11.7	LOS A	6.0	43.8	0.43	0.71	0.43	48.9
5	T1	907	13.2	907	13.2	0.314	19.1	LOS B	11.3	88.1	0.60	0.52	0.60	51.3
6	R2	462	10.2	462	10.2	1.897	611.5	LOS F	66.0	502.0	1.00	1.65	3.53	5.1
Approach		1707	10.9	1707	10.9	1.897	177.9	LOS F	66.0	502.0	0.67	0.86	1.36	13.8
North: Governor Macquarie Drive														
7	L2	506	9.5	506	9.5	0.509	40.9	LOS C	9.4	71.5	0.89	0.88	1.08	35.5
8	T1	146	1.4	146	1.4	0.479	60.0	LOS E	9.2	65.0	0.96	0.79	0.96	20.9
9	R2	89	53.9	89	53.9	0.309	40.8	LOS C	4.1	42.3	0.89	0.76	0.89	31.8
Approach		741	13.2	741	13.2	0.509	44.6	LOS D	9.4	71.5	0.90	0.85	1.04	32.4
West: Newbridge Road														
10	L2	132	26.5	132	26.5	1.028	112.5	LOS F	65.2	499.0	1.00	1.26	1.56	20.3
11	T1	1836	7.1	1836	7.1	1.028	113.2	LOS F	73.0	542.2	1.00	1.32	1.57	21.5
12	R2	132	8.0	132	8.0	0.263	40.8	LOS C	6.3	47.5	0.75	0.77	0.75	27.8
Approach		2100	8.4	2100	8.4	1.028	108.6	LOS F	73.0	542.2	0.98	1.28	1.52	21.6
All Vehicles		5563	8.8	5433 N1	9.0	1.897	127.5	LOS F	73.0	542.2	0.88	1.09	1.42	18.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	21	22.9	LOS C	0.0	0.0	0.57	0.57
P2	East Full Crossing	11	64.2	LOS F	0.0	0.0	0.96	0.96
P3	North Full Crossing	21	40.2	LOS E	0.1	0.1	0.76	0.76
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96

All Pedestrians	105	51.2	LOS E	0.84	0.84

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [Dev Brickmakers Dr/Link Rd AM roundabout]

Network: N101 [Dev AM roundabout]

New Roundabout
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Brickmakers Drive														
2	T1	793	2.0	793	2.0	1.237	230.1	LOS F	123.1	876.7	1.00	5.37	9.52	6.9
3	R2	69	3.0	69	3.0	1.237	232.8	LOS F	123.1	876.7	1.00	5.37	9.52	12.0
Approach		862	2.1	862	2.1	1.237	230.3	LOS F	123.1	876.7	1.00	5.37	9.52	7.4
East: Link Road														
4	L2	140	0.8	140	0.8	0.689	11.6	LOS A	6.2	45.1	0.78	0.89	1.00	41.7
6	R2	336	6.0	336	6.0	0.689	14.0	LOS A	6.2	45.1	0.78	0.89	1.00	36.9
Approach		476	4.4	476	4.4	0.689	13.3	LOS A	6.2	45.1	0.78	0.89	1.00	38.9
North: Brickmakers Drive														
7	L2	232	9.5	232	9.5	0.488	4.9	LOS A	4.2	32.3	0.30	0.48	0.30	44.7
8	T1	400	10.3	400	10.3	0.488	4.4	LOS A	4.2	32.3	0.30	0.48	0.30	45.4
Approach		632	10.0	632	10.0	0.488	4.6	LOS A	4.2	32.3	0.30	0.48	0.30	45.2
All Vehicles		1969	5.2	1969	5.2	1.237	105.5	LOS F	123.1	876.7	0.72	2.72	4.51	15.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Dev Newbridge Rd/Gov Macquarie Dr/Brickmakers Dr PM]

Network: N102 [Dev PM roundabout]

Dev Four Way Intersection
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Brickmakers Drive														
1	L2	160	4.6	160	4.6	1.044	139.6	LOS F	32.3	230.7	1.00	1.32	1.76	15.4
2	T1	146	0.0	146	0.0	1.044	135.0	LOS F	32.3	230.7	1.00	1.32	1.76	15.5
3	R2	388	3.2	388	3.2	0.554	60.0	LOS E	12.1	87.0	0.96	0.81	0.96	26.7
Approach		695	2.8	695	2.8	1.044	94.1	LOS F	32.3	230.7	0.98	1.04	1.31	20.2
East: Newbridge Road														
4	L2	697	2.1	697	2.1	1.304	334.7	LOS F	115.8	824.6	1.00	1.56	2.70	4.9
5	T1	1643	4.7	1643	4.7	0.692	24.5	LOS B	34.3	250.0	0.75	0.67	0.75	47.8
6	R2	474	11.4	474	11.4	1.121	121.1	LOS F	28.5	218.9	1.00	1.09	1.69	18.3
Approach		2814	5.2	2814	5.2	1.304	117.6	LOS F	115.8	824.6	0.85	0.96	1.39	18.6
North: Governor Macquarie Drive														
7	L2	530	4.3	530	4.3	0.420	31.9	LOS C	8.5	61.6	0.81	0.84	0.93	39.5
8	T1	337	0.9	337	0.9	1.105	179.0	LOS F	41.1	289.6	1.00	1.50	1.99	8.8
9	R2	166	16.3	166	16.3	0.443	39.9	LOS C	7.7	61.8	0.91	0.79	0.91	35.5
Approach		1033	5.1	1033	5.1	1.105	81.1	LOS F	41.1	289.6	0.89	1.04	1.27	22.9
West: Newbridge Road														
10	L2	133	24.8	133	24.8	0.890	68.7	LOS E	34.0	258.8	1.00	1.02	1.29	29.8
11	T1	1193	4.1	1193	4.1	0.890	62.5	LOS E	35.8	259.3	0.99	1.00	1.21	31.9
12	R2	179	3.5	179	3.5	0.710	68.4	LOS E	12.0	86.7	1.00	0.85	1.06	19.7
Approach		1505	5.9	1505	5.9	0.890	63.7	LOS E	35.8	259.3	0.99	0.98	1.20	30.5
All Vehicles		6046	5.1	6046	5.1	1.304	95.2	LOS F	115.8	824.6	0.91	0.99	1.31	21.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	21	24.0	LOS C	0.0	0.0	0.59	0.59
P2	East Full Crossing	11	64.2	LOS F	0.0	0.0	0.96	0.96
P3	North Full Crossing	21	48.9	LOS E	0.1	0.1	0.84	0.84
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		105	53.1	LOS E			0.86	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [Dev Brickmakers Dr/Link Rd PM roundabout]

Network: N102 [Dev PM roundabout]

New Roundabout
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Brickmakers Drive														
2	T1	322	1.6	322	1.6	0.524	7.1	LOS A	4.4	30.9	0.76	0.77	0.79	41.2
3	R2	128	0.8	128	0.8	0.524	9.7	LOS A	4.4	30.9	0.76	0.77	0.79	44.6
Approach		451	1.4	451	1.4	0.524	7.8	LOS A	4.4	30.9	0.76	0.77	0.79	42.6
East: Link Road														
4	L2	97	2.2	97	2.2	0.829	34.7	LOS C	14.8	107.3	1.00	1.38	1.97	33.0
6	R2	334	4.4	334	4.4	0.829	37.0	LOS C	14.8	107.3	1.00	1.38	1.97	25.3
Approach		431	3.9	431	3.9	0.829	36.4	LOS C	14.8	107.3	1.00	1.38	1.97	27.7
North: Brickmakers Drive														
7	L2	323	3.9	298	3.7	0.902	8.4	LOS A	19.8	148.9	0.74	0.62	0.79	43.0
8	T1	947	8.6	777	10.1	0.902	8.1	LOS A	19.8	148.9	0.74	0.62	0.79	43.5
Approach		1271	7.4	1075[N1]	8.4	0.902	8.1	LOS A	19.8	148.9	0.74	0.62	0.79	43.4
All Vehicles		2152	5.4	1956[N1]	6.0	0.902	14.3	LOS A	19.8	148.9	0.80	0.82	1.05	39.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Appendix D

RMS (Now TfNSW) Traffic Signal Warrant Guidelines

2.1 INTRODUCTION

This section describes the general warrants for the installation of traffic signals. It must be emphasised that these are only a guide. If a site satisfies the warrants, it does not necessarily mean that traffic signals are the best solution. All traffic data should be analysed and alternative treatments considered to determine the optimum solution (see Section 4 of the *Road Design Guide*). Traffic signals are sometimes installed due to public pressure or an administrative directive irrespective of the general warrants.

2.2 FACTORS INFLUENCING THE PROVISION OF TRAFFIC SIGNALS

Traffic signals are usually installed at an intersection:

- to provide traffic control at a site with a traffic capacity or road safety problem
- to control conflicting movements with high traffic flows
- to facilitate access to and from local areas in a major/minor road system, including pedestrian movements
- as part of an area wide system of traffic management

A side effect of signalisation is that the traffic flow on a major road is broken up into platoons. This assists nearby pedestrians to cross the major road and vehicles in nearby side streets to cross or enter the major road.

Factors influencing the provision of traffic signals include:

- traffic flows
- traffic conflicts
- traffic accident statistics
- pedestrian requirements
- access to major roads
- cost of installation
- availability of funds
- maintenance costs
- practicality
- feasibility
- the signposted speed limit is not more than 80km/h

General warrants are given in the following sub-sections. The figures stated should only be used as a guide and each intersection should be considered in more detail before being accepted for signal design.

2.3 SIGNALISED INTERSECTIONS

As a guide, a signalised intersection may be considered if one of the following warrants is met.

(a) Traffic demand:

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

(i) the major road flow exceeds 600 vehicles/hour in each direction; and

(ii) 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:

(i) the major road flow exceeds 900 vehicles/hour in each direction; and

(ii) the minor road flow exceeds 100 vehicles/hour in one direction; and

(iii) 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

(iv) there is no other nearby traffic signal site easily accessible to the minor road vehicles.

OR

(c) Pedestrian safety:

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

(i) the pedestrian flow crossing the major road exceeds 150 persons/hour; and

(ii) the major road flow exceeds 600 vehicles/hour in each direction or, where there is a central median of at least 1.2 m wide, 1000 vehicles/hour in each direction.

OR

(d) Pedestrian safety – high speed road:

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

(i) the pedestrian flow crossing the major road exceeds 150 persons/hour; and

(ii) the major road flow exceeds 450 vehicles/hour in each direction or, where there is a central median of at least 1.2 m wide, 750 vehicles/hour in each direction; and

(iii) the 85th percentile speed on the major road exceeds 75 km/h.

OR

(e) Crashes:

(i) 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

(ii) the traffic flows are at least 80% of the appropriate flow warrants.

2.4 SIGNALISED MARKED FOOT CROSSINGS AT INTERSECTIONS

A signalised marked foot crossing must be provided on each leg of a signalised intersection (including T Junctions), in a built-up area, except in the following circumstances:

(a) There are significant road safety implications:

(i) there is insufficient sight distance (see Section 4 of the *Road Design Guide*); or

(ii) there is adverse road geometry (see Section 4 of the *Road Design Guide*).

(b) There are significant adverse transport efficiency implications

(i) there is an unacceptable increase in delay and degree of saturation which must be substantiated by intersection modelling; or