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Transport Planning, Traffic Impact Assessments, Road Safety Audits, Expert Witness

30th March 2017

Reference: 17215.01FB

Platform Project Services Pty Ltd
Level 3, 95 Pitt Street
Sydney NSW
Attention: Callum Sked

UPDATED TRAFFIC & PARKING IMPACT ASSESSMENT FOR THE MODIFICATION APPLICATION FOR APPROVED RESIDENTIAL DEVELOPMENT AT ARTARMON ROAD, WILLOUGHBY

Dear Callum,

Reference is made to your request to provide a traffic and parking impact assessment for the new proposed Modification Application to the approved concept plan for the redevelopment of the Channel 9 site on Artarmon Road, Willoughby.

As part of this updated traffic and parking impact assessment, the following has been taking into consideration:

- 1) Traffic Impact Assessment (**GTA TIA**) prepared by GTA Consultants, dated 18th July 2016 prepared for the Modification Application.
- 2) Traffic Impact Assessment Review (**Arup TIAR**) prepared by Arup on behalf of Willoughby Council, dated 15th September 2016
- 3) Willoughby Council Submission (file dated 26th September 2016)
- 4) GTA electronic SIDRA file provided 9th November 2016
- 5) Arup electronic SIDRA file provided 7th November 2016
- 6) Traffic Impact Assessment (**Aecom TIA**) prepared by Aecom dated 19th August 2013 for the Part 3A application
- 7) Traffic Impact Assessment Review (**Arup TIAR 2013**) prepared by Arup on behalf of the Department of Planning and Infrastructure dated 15th July 2013
- 8) Department of Planning letter dated 30th September 2016.

Modification Application No.01 previously detailed 510 dwellings and the realignment of the existing Scott Street to suit the proposed development layout. The traffic and parking impact has been considered within the **GTA TIA**. This letter is provided to update the GTA TIA report where necessary for the amended CHROFI Master Plan and Modification No.2, as well as addressing issues raised during the assessment Modification No.1, within the Arup TIAR, Willoughby Council September 2016 Submission and the Department of Planning September 2016 letter in relation to the previous s75W application lodged in 2016.

1 Proposed Modification Application

The proposed development scale is as follows:

- 495 residential units
- Retention of the existing Scott Street alignment, with the intersection of Artarmon Road / Scott Street upgraded to a roundabout as Scott Street is now excluded from the developed land
- Provision of 66 at-grade car parking spaces within the internal road for general visitor parking

Two (2) driveways are proposed from the internal roadway, within the envelope of Buildings G & D respectively. The north-south alignment of the internal road retains the existing Scott Street alignment, whilst the east-west alignment of the internal road is consistent with that assessed under the **GTA TIA** assessment, connecting to Richmond Avenue.

In regard to the intersection of Willoughby Road / Artarmon Road, there are no proposed works as part of this application, rather the application offers a contribution of \$500,000 under a Voluntary Planning Agreement (VPA) to future works at this intersection if the RMS / Council / TfNSW decide to undertake works.

The proposed site layout is provided in **Annexure A**.

2 Proposed Internal Road

The proposed internal road retains the existing Scott Street alignment (north-south) whilst connecting to Richmond Avenue via its east-west alignment. Two (2) driveways servicing basement car parking and loading area are proposed to access the internal road, with the driveway to Building G providing car and service vehicle access whilst the driveway adjacent to Building D services car access only.

Parking is provided within the internal road to supplement lost on-street public car parking spaces with a total of 66 general visitor car parking spaces provided along the internal road.

It is important to note that whilst the internal road arrangement differs to the approved Concept Plan, the provision of parking within the internal road is a consistent provision. Furthermore, the level of parking lost (or gained) under the approved Concept Plan compared to the proposed Modification Application and further to the existing site conditions are summarised in **Table 1** below. Parking plans are provided in **Annexure B** which forms the basis of the car parking assumption.

TABLE 1: PUBLIC PARKING

Scenario	On-Street ⁽¹⁾	Scott Street / Internal Road (public parking)	Total
Existing	69	9	78
Approved Concept Plan	69	51	120
Modification Application	52	66	118

Notes:

- 1) Parking within Richmond Avenue and Artarmon Road that would be affected as a result of the redevelopment.

The public car parking within Richmond Avenue, Artarmon Road and Scott Street that would be impacted by the redevelopment is 78 car parking spaces. Under the Concept Plan, an estimated total of 69 spaces within Richmond Avenue and Artarmon Road were retained (albeit with slight modifications to car parking locations) whilst the Modification Application will likely result in and estimated 52 car parking spaces in these two streets, a reduction of 17 spaces.

Consistent with the **Aecom TIA**, which states that “opportunities also exist...to count the on-street parking spaces created along the internal road network as part of the requirements for visitor parking space.”

As shown, the total amount of public parking provided under the Modification Application is short 2 car parking spaces when compared to the Concept Plan; however, provides 30 car spaces more than the existing provisions. It is important to also highlight the parking conditions of the existing Channel 9 site whereby it has been observed that employees / staff of the existing site utilise on-street parking external to Scott Street. This is consistent with the **Aecom TIA** (original assessment for the approved Concept Plan). Accordingly, as a consequence of the proposed development, removing the overspill car parking that currently occurs is highly likely to result in an improvement to kerbside car parking conditions with a potential increase in car parking availability surrounding the site. Therefore, in these circumstances the minor difference of 2 car parking spaces is negligible, and still an improved outcome to the existing parking conditions.

The internal road and driveway access has been designed to accommodate Willoughby Council’s 9.9m waste vehicle which is consistent with the Concept Plan. It is important to note that the **Arup TIAR** suggest a 12.5m Heavy Rigid Vehicle (HRV) should be adopted as the design vehicle.

To review the above comment, it is relevant to refer to Clause C.4.5 of Part C.4 of Willoughby Council DCP 2006 (WDCP2006) which states the following:

B. Off-Street Loading & Unloading Facilities Loading Bay Provision - Off-street loading and unloading facilities must be provided for all businesses, commercial, office and retail as required by Council. The size and number of loading bays provided will be determined by Council having regard to the: - Frequency of deliveries; - Size and bulk of goods; - Size of trucks; - Availability of on-street loading zones; and - Intended use of the premises. - In this regard full details of the anticipated volume and frequency of deliveries must be submitted to Council with each development application. - Provision must be made for removalist vans to park, load and unload onsite for all residential developments in excess of 12 units. Loading Bay Dimensions - Loading bay dimensions must conform with the current appropriate Australian Standard 2890 for Off Street Parking. - In major industrial developments, warehouses and multi-storey buildings or where garbage compactor units are to be used internally, depending on the type of waste collection vehicle expected to be used, a dock headroom clearance up to 6.6m may be required. - Adequate building splay facilities must be provided to each loading bay to minimise the danger of damage to the building and the vehicle during manoeuvres as well as to provide adequate sight distance for pedestrians. C. Internal Manoeuvring Areas - On site turning facilities must be provided to permit the turning of vehicles likely to frequent the premises. The swept path design templates shown in the current Australian Standard 2890 must be used to determine the layout of service areas. - Council may consider swept path templates from approved computer programs provided the appropriate class of vehicles are used and documentary evidence produced from vehicle manufacturers to support design parameters. Each submission will be treated on its own merits.

WDCP2006 does not specify the dimensional requirements for removalist vans, rather the DCP only requires that provision be made for removalist vans for development in excess of 12 units. WDCP2006 does not specify HRV requirements for removalist vans however does specify loading requirements for waste collection. Future residents will be fully aware of the loading facilities provided on-site and the provision of a loading area for vehicles generally 10m in length will provide acceptable

delivery options for residents. Therefore it is concluded that a loading vehicle length of 10m (not 12.5m) is suitable for the future residential development.

In regard to the design of the driveway and internal roadway, The **Arup TIAR** critique of the **GTA TIA** states that *"the internal road allows for two standard cars to pass one another at any one time, vehicle swept path analysis indicates a 9.8m long garbage vehicle crosses the road centre line when manoeuvring within the site. This is illustrated in Figure 3, and would mean a standard car could not pass this vehicle type when driving within the site, creating safety issues"* (p5).

To review the above comment, it is instructive and relevant to refer to Clauses 3.2.2 and 3.2.4 of AS2890.2:2002 which states the following:

3.2.2 Occasional service

Requirements and recommendations for providing for occasional service are as follows:

- (a) The vehicle shall be able to stand wholly within the site.
- (b) Reverse manoeuvres at the property boundary, if permitted by the relevant authority, shall be limited to one only, either on entering or departing, and shall be subject to consideration of both safety and obstruction to other on-street traffic.
- (c) The swept path plus clearances shall be accommodated within the access driveway or circulation roadway.
- (d) The full width of the access driveway may be used for both entering and leaving the site.

3.2.4 Regular service—Minor road

Requirements and recommendations for providing for regular service from a minor road are as follows:

- (a) Manoeuvring on-street, if permitted by the relevant authority, shall be strictly limited to one reverse movement either onto or off the street, and furthermore, shall be subject to consideration of both safety and obstruction to other on-street traffic.
- (b) The swept path of the maximum size design vehicle using the facility may be allowed to occupy the entire width (less specified clearances) of a two-way access driveway when the vehicle is entering or leaving the minor road.

The highlighted parts of AS2890.2:2002 shown boxed are relevant to the circumstances. In accordance with the referenced clauses of AS2890.2:2002, the occasional or regular service vehicle is permitted to use the full width of the access driveway for both entry and exit manoeuvres onto the minor road.

It is therefore considered that the swept path manoeuvring provided within the **GTA TIA** is in accordance with AS2890.2:2002 whereby the findings of the **Arup TIAR** are incorrect with reference to AS2890.2:2002.

The relevant swept paths for the 9.9m waste vehicle, prepared by *McLaren Traffic Engineering*, is provided in **Annexure C** for reference.

3 External Traffic Impact

3.1 Development Scale

As previously discussed, the Modification Application has been amended for a proposed 495 dwellings. The GTA TIA & Arup TIAR were based upon the previous modifications' scale of 510 dwellings.

The proposed 496 dwellings is an increase of 96 dwellings above the approved Concept Plan.

Whilst the application is for 495 dwellings, 15 dwellings below what was considered under the **GTA TIA & Arup TIAR**, the intersection modelling provided in the following sub-sections is based upon the same 510 dwellings to be consistent with these two preceding assessments to respond to concerns raised in the previous modification. As the current modification is for fewer movements, the conclusions of the report remain valid.

3.2 Intersection Performance

Updated intersection modelling has been undertaken by McLaren Traffic Engineering using SIDRA 7 (most recent version). The traffic flows for the existing scenario, approved 400 dwellings and proposed 510 dwellings have been extracted from the **GTA TIA** and supplied SIDRA files. The **Arup TIAR** additional development traffic generation has been extracted from their supplied SIDRA analysis.

A review of both the **GTA TIA** and **Arup TIAR** intersection modelling was undertaken as part of this assessment, with findings provided in **Annexure D** for reference.

Whilst the additional development discussed within the **Arup TIAR** has been provided in this updated assessment, the inclusion of an additional 350 units within identified within the Arup TIAR is not transparent, with only 145 units actually identified as "known development" (leaving 205 units unaccounted for) of which only three (3) of the nine (9) development sites being approved at the time of this assessment. The development of a further 205 units may not eventuate and are subject to their own D.A assessment in any case. Moreover, each of these developments are expected to mitigate their own immediate traffic impacts and contribute financially toward broader local traffic improvements via Section 94 development contributions levied by Willoughby City Council.

The intersection performance is largely summarised by the reported Level of Service (LoS), which is categorised by the RMS as per **Figure 1**. The LoS for the intersection can be best described as a weighted average of all movements, such that minor traffic volumes associated with particular movements that incur long delays do not skew the overall intersection performance.

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	< 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode

FIGURE 1: RMS LEVEL OF SERVICE

The results of the SIDRA 7 intersection modelling are provided in **Annexure E** and summarised in **Table 2, Table 3 & Table 4**.

TABLE 2: MCLAREN SUMMARY OF LEVEL OF SERVICE – THURSDAY AM

	Thursday Existing	Thursday Approved 400 dwellings	Thursday Future 510 dwellings	Thursday Future 510 dwellings with Additional Development
Willoughby Rd (North)	B	B	B	N/A
Artarmon Rd	D	D	D	
Willoughby Rd (South)	B	B	B	
Small St	D	D	D	
Overall	B	B	B	N/A

Notes: Model is based upon 510 dwellings however the current application is for 495 dwellings.

Based upon the Thursday AM analysis, the intersection performance overall will operate at **LoS “B”** under future conditions.

TABLE 3: MCLAREN SUMMARY OF LEVEL OF SERVICE – THURSDAY PM

	Thursday Existing			Thursday Approved 400 dwellings			Thursday Future 510 dwellings			Thursday Future 510 dwellings with Additional Development		
Movement ⁽²⁾	LT	T	RT	LT	T	RT	LT	T	RT	LT	T	RT
Willoughby Rd (North)	B	B	B	B	B	B	C	C	D	D	D	E
Artarmon Rd	E	D	E	E	D	E	F	E	F	F	E	F
Willoughby Rd (South)	B	B	N/A	B	B	N/A	B	B	N/A	B	B	N/A
Small St	E	E	E	D	D	E	E	E	F	E	F	F
Overall	B			B			C			C		

Notes:

- (1) Model is based upon 510 dwellings however the current application is for 495 dwellings.
- (2) LT denotes Left Turn Movements, T denotes Through Movements, RT denotes Right Turn Movements.

Based upon the Thursday PM analysis, the intersection performance overall will operate at **LoS “C”** under future conditions and maintain operation at **LoS “C”** under Arup’s assumptions of additional hypothetical development as instructed by Willoughby Council.

TABLE 4: MCLAREN SUMMARY OF LEVEL OF SERVICE – SATURDAY

	Thursday Existing			Thursday Approved 400 dwellings			Thursday Future 510 dwellings			Thursday Future 510 dwellings with Additional Development		
Movement ⁽²⁾	LT	T	RT	LT	T	RT	LT	T	RT	LT	T	RT
Willoughby Rd (North)	B	B	B	B	B	B	B	B	C	B	B	C
Artarmon Rd	E	D	E	D	D	D	F	E	F	F	E	F
Willoughby Rd (South)	C	C	D	B	C	C	D	D	E	E	E	F
Small St	D	E	E	D	E	E	D	E	E	D	E	E
Overall	C			C			C			D		

Notes:

- (1) Model is based upon 510 dwellings however the current application is for 495 dwellings.
- (2) LT denotes Left Turn Movements, T denotes Through Movements, RT denotes Right Turn Movements.

Based upon the Saturday analysis, the intersection performance overall will operate at LoS “C” under future conditions whilst with the inclusion of Arup’s additional traffic (as instructed by Willoughby Council), the LoS shifts to Los “D”.

Under the additional traffic loading associated with the **Arup TIAR** assumptions, the Degree of Saturation is reported as 0.97 which is still within acceptable levels. Willoughby Road is a Classified State road (No. 641), as such the RMS, through their letter dated 5th September 2016, have reviewed the modification application and stated no objection. RMS are satisfied with the intersection performance of Willoughby Road / Artarmon Road and have not requested any further details or required any further modifications to the assumptions / modelling undertaken.

Under Arup's additional traffic volume scenario, the MTE model shows a queue of 105m and 116m on Artarmon Road during the Thursday PM and Saturday midday peak respectively. This queue length does not extend to the existing Scott Street intersection.

The intersection upgrade works will improve the operation of the Willoughby Road / Artarmon Road intersection however based upon the assessment of 510 dwellings only, the full intersection upgrade is not necessarily required, with the overall intersection performance LoS "C" outcome being satisfactory under the RMS Guide. The proposed scale of 495 dwellings will have some form of improvement on the intersection analysis, however the assessment of 510 dwellings is undertaken for comparison to the **GTA TIA & Arup TIAR** submission.

Based upon the existing pedestrian facilities providing safe access to the north and south of Artarmon Road / Small Street, in conjunction with the RMS Traffic Signal Warrants, the inclusion of a pedestrian crossing on the south approach of Willoughby Road will result in adverse transport efficiency implications based upon **Arup's TIAR** assessment and accordingly should be rejected.

Willoughby Road is a Classified State road (No. 641), as such the RMS, through their letter dated 5th September 2016, have reviewed the modification application and made no objection. RMS are satisfied with the intersection performance Willoughby Road / Artarmon Road and have not requested the provision of an additional pedestrian crossing on Willoughby Road. Further information in regards to this crossing facility is provided in the **Annexure D** review.

It is important to acknowledge the previous assessments and determinations for the Concept Approval. Notably, the following statements / extracts should be taken into consideration for the Modification Application:

- Department of Planning & Infrastructure's (DoPI) Major Project Assessment based on a proposed 450 dwellings dated January 2014 the following was stated:
 - *"Based on the revised analysis, the substantial intersection upgrade recommended by Council (and also previously recommended by Arup) is not supported by Arup. However, Arup also recommended that revised traffic modelling should be carried out as part of a future development application (prior to the occupation of 200 dwellings), to enable the issue to be revisited should the circumstances of the intersection change by the time the development goes ahead."*
 - *"In relation to the Artarmon Road / Willoughby Road intersection, the department agrees with the analysis by Arup that the extent of the traffic impacts arising from the development as revised by the PPR would not warrant the extensive intersection upgrade sought by Council. The impacts on the intersection are considered to be minor, and are limited to a short period of time on Saturdays....Further, the department notes that the application was referred to RMS, as Willoughby Road is a State controlled Arterial Road, and the RMS did not raise any concern with the intersection."*

Further, the DoPI assessment report (informed by as provided by Arup's assessment for 450 dwellings), identified the intersection performance of Artarmon Road / Willoughby Road as LoS "B" for the weekday AM and PM peak and LoS "E" for the Saturday. It is further highlighted that the **Arup TIAR 2013** (which is based upon 585 dwellings), identified the future weekday PM (without upgrade) operating at LoS "C" (satisfactory) for the intersection of Artarmon Road / Willoughby Road.

Based upon the Modification Application for 496 dwellings, (although the intersection modelling undertaken to date for the Modification Application is based upon 510 dwellings to be consistent with the **GTA TIA** and **Arup TIAR**) the intersection performance of Artarmon Road / Willoughby Road operates at LoS “B” & “C”, which is an acceptable level of performance. It is considered that the Modification Application is consistent with the findings and conclusions contained within the DoPI 2014 assessment report.

4 Conclusion

As shown, the total amount of public parking provided under Modification Application No.2 is short 2 car parking spaces when compared to the Concept Plan. However, it is important to highlighted the parking conditions of the existing Channel 9 site whereby it has been observed that employees / staff of the existing site utilise on-street parking external to Scott Street. This is consistent with the **Aecom TIA** (original assessment for the approved Concept Plan). Accordingly, as a consequence of the proposed development, removing the overspill car parking that currently occurs is highly likely to result in an improvement to kerbside car parking conditions with a potential increase in car parking availability surrounding the site. Therefore, in these circumstances the minor difference of 2 car parking spaces is negligible, and still a substantially improved outcome in comparison to existing conditions.

In accordance with the referenced clauses of AS2890.2:2002, the occasional or regular service vehicle is permitted to use the full width of the access driveway for both entry and exit manoeuvres onto the minor road. It is therefore considered that the swept path manoeuvring provided within the **GTA TIA** is in accordance with AS2890.2:2002 whereby the findings of the **Arup TIAR** are incorrect with reference to AS2890.2:2002. The relevant swept paths for the 9.9m waste vehicle, prepared by *McLaren Traffic Engineering*, is provided in **Annexure C** for reference.

Willoughby Road is a Classified State road (No. 641), as such the RMS, through their letter dated 5th September 2016, have reviewed the previous Modification No.1 (510 dwellings) and stated no objection. RMS are satisfied with the intersection performance of Willoughby Road / Artarmon Road and have not requested any further details or required any further modifications to the assumptions / modelling undertaken.

Under Arup’s additional traffic volume scenario, the *MTE* model shows a queue of 105m and 116m on Artarmon Road during the Thursday PM and Saturday midday peak respectively. This queue length does not extend to the existing Scott Street intersection.

The intersection upgrade works will improve the operation of the Willoughby Road / Artarmon Road intersection however based upon the modelling of 510 dwellings only, the full intersection upgrade is not necessarily required, with the overall intersection performance LoS “C” outcome being satisfactory under the RMS Guide. The proposed scale of 496 dwellings will have some form of improvement on the intersection analysis, however the assessment of 510 dwellings is undertaken for comparison to the **GTA TIA & Arup TIAR** submission.

Based upon the existing pedestrian facilities providing safe access to the north and south of Artarmon Road / Small Street, in conjunction with the RMS Traffic Signal Warrants, the inclusion of a pedestrian crossing on the south approach of Willoughby Road will result in adverse transport efficiency implications based upon **Arup’s TIAR** assessment and accordingly should be rejected.

Based upon the new Modification Application for 495 dwellings, (although the intersection modelling undertaken to date for the Modification Application is based upon 510 dwellings to be consistent with the **GTA TIA** and **Arup TIAR**) the intersection performance of Artarmon Road / Willoughby Road operates at LoS "B" & "C", which is an acceptable level of performance.

It is also considered that the Modification Application for 496 dwellings is also consistent with the relevant findings and conclusions contained within the DoPI 2014 assessment report and Arup's previous assessments of 585 and 450 dwellings.

Please contact the undersigned on 8355 2440 should you require further information or assistance.

Yours faithfully,

McLaren Traffic Engineering



Craig McLaren
Director

BE Civil. Graduate Diploma (Transport Eng) MAITPM MITE [1985]

RMS Accredited Level 3 Road Safety Auditor

RMS Accredited Traffic Control Planner, Auditor & Certifier (Orange Card)

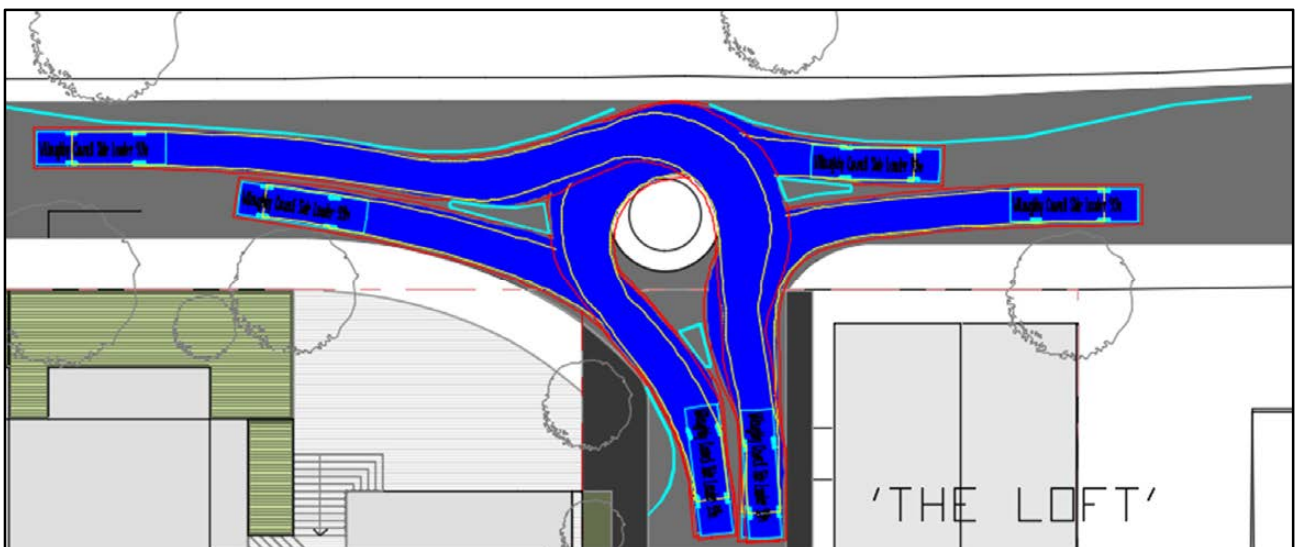
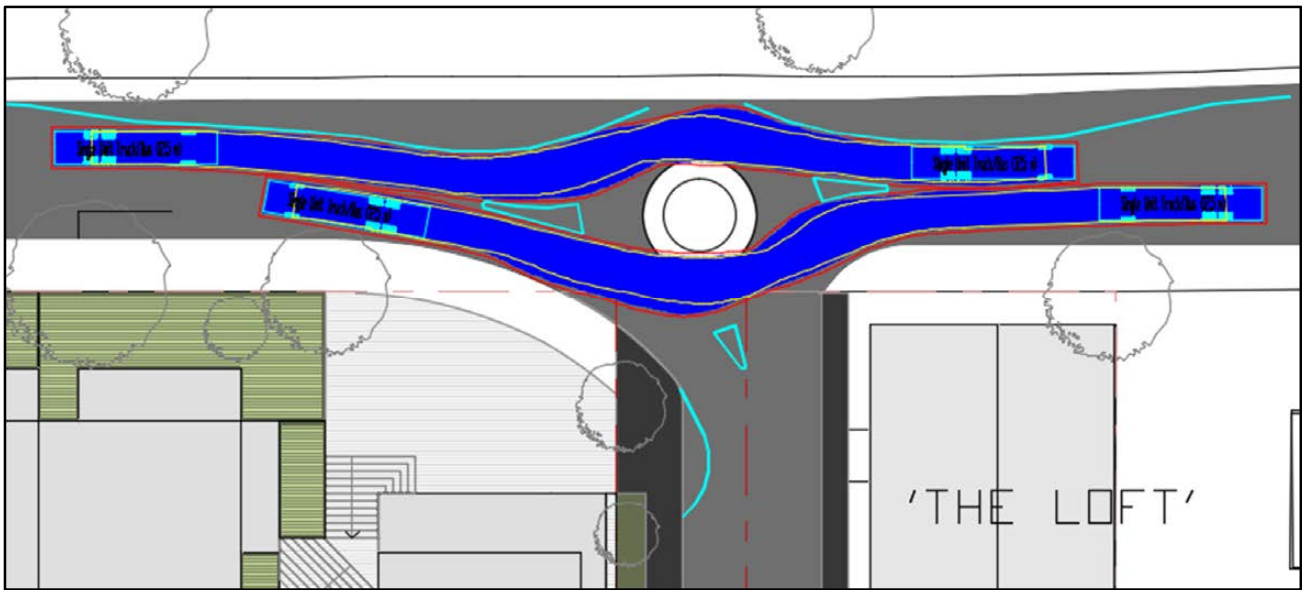
ANNEXURE B: PUBLIC CAR PARKING CONDITIONS
(Sheet 1 of 3)



ANNEXURE B: PUBLIC CAR PARKING CONDITIONS
(Sheet 3 of 3)



ANNEXURE C: SWEEP PATH
(Sheet 1 of 2)

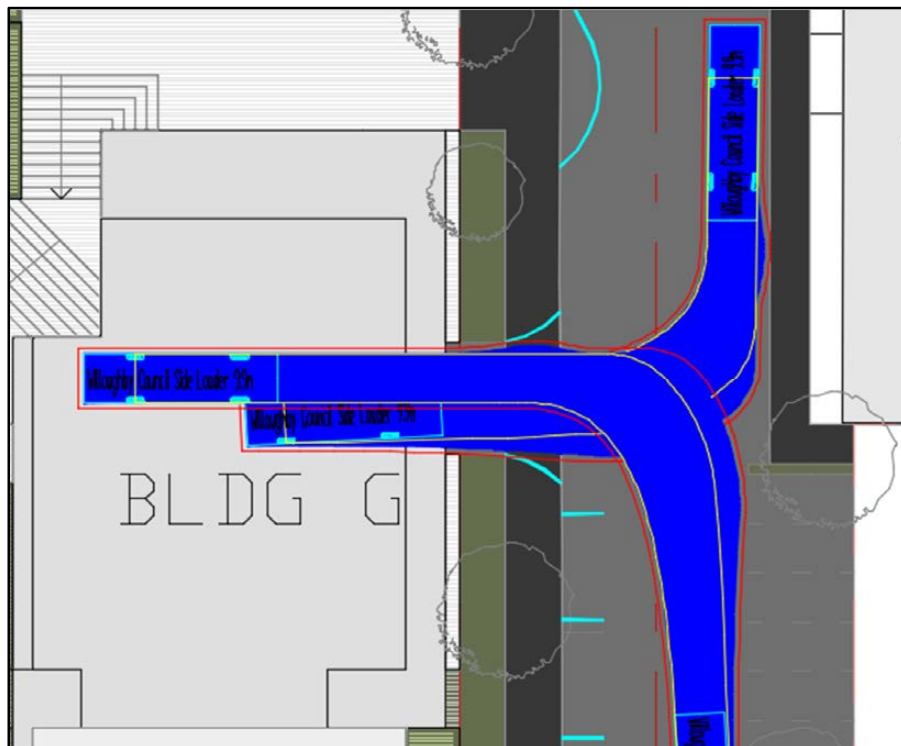
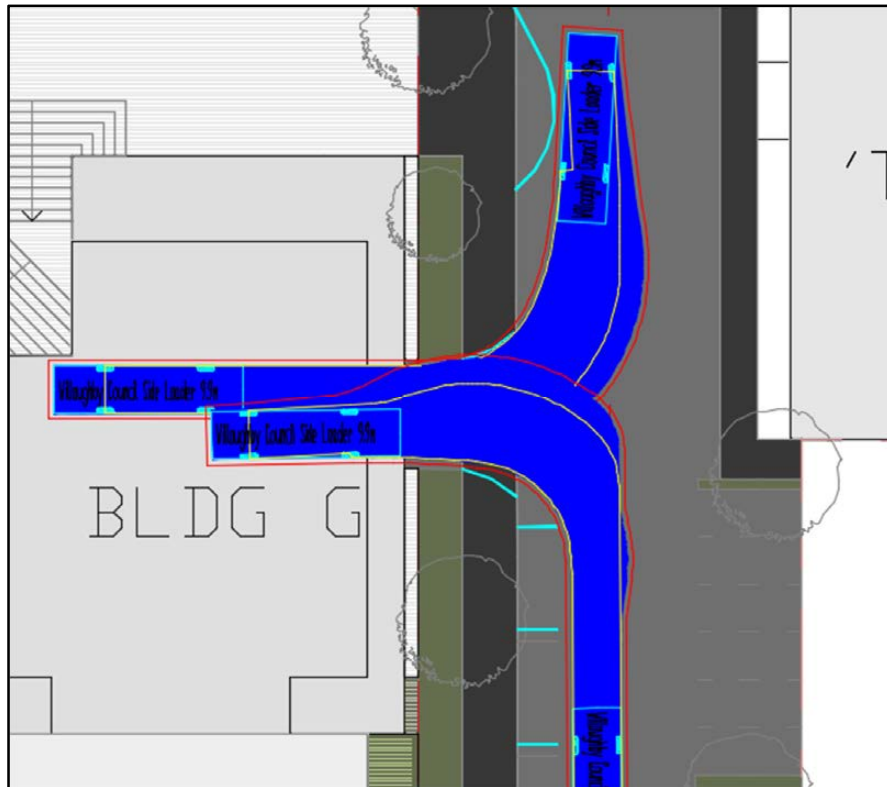


12.5m HRV Through Movement
9.9m Waste Vehicle Turning Movement
10km/h
Successful

Blue- Vehicle Body
Red- 300mm Clearance

Mountable 1.6m outer radius of roundabout.
Non-mountable 5.5m diameter of roundabout

ANNEXURE C: SWEEP PATH
(Sheet 2 of 2)



9.9m Waste Vehicle

10km/h road; 5km/h internal

Successful

ANNEXURE D: REVIEW OF GTA & ARUP SUBMISSIONS

(Sheet 1 of 6)

1 External Traffic Impact

1.1.1 Development Traffic Generation

The GTA TIA adopt the Arup 2013 TIAR for the proposed development traffic generation. The Arup TIAR concurs with the use of these rates.

The use of 0.32 trips per unit in the morning and evening weekday peak hour and 0.25 trips per unit during the Saturday peak hour is consistent with the original application, which also based the adopted trip generation rate on surveys of similar sites.

1.1.2 Development Traffic Assignment

The GTA TIA adopt the Arup 2013 TIAR for the proposed development traffic assignment. The Arup TIAR concurs with the use of this distribution. This is consistent with the original application.

1.1.3 Modelling Assumptions

The modelling undertaken by GTA's TIA essentially adopts three scenarios, being:

- 1) Intersection performance based upon the approved 400 dwellings under the original Part 3A approval
- 2) Intersection performance based upon the proposed 510 dwellings under the Modification Application
- 3) Intersection performance based upon the proposed 510 dwellings under the Modification Application inclusive of upgraded / modified intersection treatments.

The modelling undertaken by Arup's TIAR differs, in that it assessed the following:

- 1) Intersection performance based upon the approved 400 dwellings under the original Part 3A approval
- 2) Intersection performance based upon the proposed 510 dwellings under the Modification Application inclusive of upgraded / modified intersection treatments.
- 3) Intersection performance based upon the proposed 510 dwellings under the Modification Application inclusive of upgraded / modified intersection treatments and with adjacent development

Section 2.4.3 of the Arup TIA (p9) lists five (5) known developments totalling 147 units, a 225 place child care and identifies a further three (3) sites that will provide an additional 350 units.

Further clarification has been sought from Willoughby Council in regard to the known developments assessed in the Arup TIAR. Willoughby Council have kindly provided the information as per **Table 5**.

ANNEXURE D: REVIEW OF GTA & ARUP SUBMISSIONS
(Sheet 2 of 6)

TABLE 5: ADDITIONAL DEVELOPMENTS PROVIDED BY COUNCIL

Item	Address*	Development Scale	Council Assessment	Application Traffic Report**
1	5-9 Walter St	29 residential units	DA lodged	9 ⁽¹⁾
2	1-11A and 13 Walter Street	24 residential units	DA lodged	5 vehicle trips ⁽²⁾
3	1 & 1A Walter Street & 452 & 460 Willoughby Road Willoughby	225 place child care centre	DA lodged	174 morning and 152 evening net traffic generation ⁽³⁾
4	462 Willoughby Rd	20 residential units	DA Lodged	8-10 peak hour trips ⁽⁴⁾
5	34-42 Penshurst St	74 residential units	DA approved	21 vehicle trips ⁽⁵⁾
6	150 Mowbray Rd	commercial and 104 residential units	DA approved	33 ⁽¹⁾
7	3 Nathan lane	23 bedroom student accommodation / boarding house	DA lodged	3 ⁽⁶⁾
8	562-564 Willoughby R	2 commercial offices, 18 residential units	DA lodged	Increase of 9.7 vehicle trips ⁽⁷⁾
9	Willoughby Public and Willoughby Girls School	Addition of 8 demountable class rooms	DA approved	Department of Education shows 994 current enrolments in the public school and 968 in the high school. Proposal identified an increase at 2020 the population will have grown less than 5% from 2015, year on year ⁽⁸⁾ .

Notes

- (1) Traffic report not found however based on an assumption of 0.32 trips per unit for traffic generation
- (2) Traffic Report prepared by *The Transport Planning Partnership* dated 11th August 2016
- (3) Traffic Report prepared by *Traffix* dated 15th July 2016
- (4) Traffic Report prepared by *GTA* dated 3rd February 2016. It should be noted that Willoughby Council DA tracker states that on the 3rd May 2016 the application was withdrawn.
- (5) Statement of Environmental Effects prepared by *Metroplan* dated July 2015
- (6) Traffic Report prepared by *GTA* dated 18th October 2016
- (7) Statement of Environmental Affects dated September 2016 prepared by Ingham Planning, referring to Varga Traffic report dated September 2016
- (8) Statement made by NSW Department of Education dated 12th August 2016.

* 145 units relates to Item's 6, 7 & 8

** Worst case as existing site generation levels are not discounted

ANNEXURE D: REVIEW OF GTA & ARUP SUBMISSIONS

(Sheet 3 of 6)

Clarifying the known developments identified by Council, it appears that the additional development considered by the **Arup TIAR** takes into account the 147 units listed by address in the **Arup TIAR** whilst of the extra 350 units identified by Arup, only 145 units (plus commercial space) and upgrades of the Willoughby Public/Girls school have been identified as known development. The remaining 205 units have not been accounted for, rather they appear to have been generally grouped together as further potential development, notwithstanding no design and constraint analysis being available on any of the identified land

For the purpose of assessing the impact of the Modification Application, only those developments that are approved should be considered. The inclusion of an additional 205 (350 stated in **Arup TIAR** less the 145 shown in **Table 5** that was not previously listed in the **Arup TIAR**) unaccounted units is not transparent as the development of a further 205 units may not eventuate and are subject to their own D.A assessment in any case.

The reported Level of Service performance for the intersection of Artarmon Road / Willoughby Road are summarised in **Table 6**.

TABLE 6: COMPARISON OF GTA & ARUP LEVEL OF SERVICE

Day	Scenario	GTA		Arup	
		Existing Geometry	Upgraded Geometry	Upgraded Geometry without Pedestrian Crossing)	Upgraded Geometry with Pedestrian Crossing
Thursday AM	Existing	B	n.a	n.a	n.a
	400 Dwellings	B	n.a		
	510 Dwellings	C	B		
Thursday PM	Existing	B	n.a	n.a	n.a
	400 Dwellings	B	n.a	B	B
	510 Dwellings	C	B	B	C
Saturday	Existing	C	n.a	n.a	n.a
	400 Dwellings	C	n.a	B	C
	510 Dwellings	C	C	C	D

The **GTA TIA** finds that based upon the proposed 510 dwellings, the intersection of Artarmon Road / Willoughby Road will shift in LoS from B to C in the Thursday AM, B to C in the Thursday PM and maintain LoS C on Saturday.

ANNEXURE D: REVIEW OF GTA & ARUP SUBMISSIONS (Sheet 4 of 6)

The **Arup TIAR** focuses on the Thursday PM and Saturday midday as the peak period. The **Arup TIAR** finds that the LoS will be maintained at Los B in the Thursday PM and shift from B to C on Saturday (based upon the reported results without the inclusion of additional development in the area). Including the additional development detailed in the **Arup TIAR**, the intersection LoS is reported as B and C on Thursday PM and Saturday without the additional pedestrian crossing, reducing to LoS D during both peaks with the inclusion of the pedestrian crossing.

The **Arup TIAR** states a queue length of 112m on Artarmon Road (refer to Table 3, p11) under the upgraded intersection layout, increasing to 167m when modelled with the additional pedestrian crossing (refer to Table 4, p12).

Willoughby Road is a Classified State road (No. 641), as such the RMS, through their letter dated 5th September 2016, have reviewed the modification application and stated no objection. RMS are satisfied with the intersection performance of Willoughby Road / Artarmon Road and have not requested any further details or required any further modifications to the assumptions / modelling undertaken.

Whilst the inclusion of additional development accords with sound traffic and transport planning practice, the inclusion of unknown development is inappropriate at this point in time, as such applications may never eventuate and are subject to their own assessment. The implication of unknown developments requires strategic regional modelling and should be prepared by Council for its own Local Environmental Plan (LEP) in determining appropriate zoning and development requirements.

Furthermore, the impacts of the pedestrian crossing included within **Arup's TIAR** (see **Section 1.1.4**) has not been requested by the RMS as the efficiency of the intersection would be compromised, as indicated by the **Arup TIAR** assessment.

1.1.4 Pedestrian Crossing at Willoughby Road

The **GTA TIA** and **Arup TIAR** differ in the inclusion of a pedestrian crossing across the southern leg of its Willoughby Road signalised intersection with Artarmon Road. The **Arup TIAR** states that *"current RMS policy is that for any new or upgraded signalised intersection, pedestrian crossings must be provided on all approaches unless it can be demonstrated that it is impractical to do so. The presence of an additional pedestrian crossing on the southern leg of the intersection is preferable given the pedestrian demand generated by the development – particularly between the site and active open space on the eastern side of Willoughby Road. This includes the Willoughby squash centre, Willoughby leisure centre and Bicentennial reserve."*

In order to review the above comment, reference is made to the RMS "Traffic Signal Design Manual", 2008 particularly Section 2 – Warrants which states the following:

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:

ANNEXURE D: REVIEW OF GTA & ARUP SUBMISSIONS
(Sheet 5 of 6)

- a) *There are significant road safety implications:*
 - i. *There is insufficient sight distance*
 - ii. *There is adverse road geometry*
- 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*
- c) *There are parallel grade separated pedestrian facilities provided; or*
- d) *There is an un-signalised approach (eg slip lane) where a pedestrian crossing may be used*
- e) *The crossing would terminate in an area that is not possible for pedestrians to access (eg a wall or cliff face); or*
- f) *The crossing is associated with a raised pavement or threshold*

Based upon **Arup's TIAR** modelling, the inclusion of a fourth pedestrian crossing at the signalised intersection would result in *"adverse transport efficiency"* as the intersection performance would result in an *"unacceptable increase in delay and degree of saturation"* substantiated by Arup's analysis.

In regard to pedestrian desire lines, it is important to note that the northbound and southbound bus routes utilise the existing bus stops north of Artarmon Road. Further, local shops are situated to the north of Artarmon Road. These existing facilities and retail premises result in pedestrian demand to / from the north of Artarmon Road which does not require crossing Willoughby Road, south approach, due to the existing pedestrian crossings available.

The **Arup TIAR** identifies the Willoughby squash club as a pedestrian generator, however this facility is to the north of Artarmon Road / Small Street. Willoughby Leisure Centre has an existing pedestrian crossing near Pendey Street facilitating pedestrian movements across Small Street. Bicentennial Reserve Oval can be accessed via the existing pedestrian facilities at the signalised intersection.

Based upon the existing pedestrian facilities providing safe access to the north and south of Artarmon Road / Small Street, in conjunction with the RMS Traffic Signal Warrants, the inclusion of a pedestrian crossing on the south approach of Willoughby Road and will result in adverse transport efficiency implications based upon **Arup's TIAR** assessment and accordingly should be rejected.

Willoughby Road is a Classified State road (No. 641), as such the RMS, through their letter dated 5th September 2016, have reviewed the modification application and made no objection. RMS are satisfied with the intersection performance Willoughby Road / Artarmon Road and have not requested the provision of an additional pedestrian crossing on Willoughby Road.

ANNEXURE D: REVIEW OF GTA & ARUP SUBMISSIONS (Sheet 6 of 6)

2 Review of Willoughby Council Submission

The Willoughby Council submission relies upon the findings of the **Arup TIAR** to establish its view on traffic and parking implications in regards to the modification application.

Council states (p12) that *“there is concern that the loss of 29 on-street car spaces and their relocation within the redevelopment site will deter their use by the local community, and result in these car spaces being used solely by occupants of the site. Council’s preferred position is that the loss of any on-street parking as a direct result from the Modification be kept to a minimum.”* As part of the internal road design, there is opportunity to create angled 90 degree car parking spaces instead of parallel parking bays. This could result in a net gain of on-street parking for public use. It is also relevant to note that the **Aecom TIA** identified *“some of the existing Nine Network employees were observed to park their vehicles on Artarmon Road and Richmond Avenue. With the relocation of the Nine Network operations, it is anticipated that the on-street parking spaces that are currently occupied by existing employees would become available.”* During the site inspection undertaken on 15th November 2016, this same behaviour was observed. It is therefore highly likely that as a result of the redevelopment, removing the overspill of parking that currently occurs, there may be an improvement to kerbside car parking conditions with a potential increase in car parking availability surrounding the site.

Council concludes (p29) that *“the additional number of dwellings resulting in a more intense use of the site will have significant adverse impacts on the local infrastructure including the local road network.”* With respect to the intersection of Willoughby Road / Artarmon Road, it is considered that the additional traffic generated under the modification application can be accommodated by the existing intersection geometry. The Arup TIAR states however that *“the traffic modelling indicates the increase in dwellings on the Channel 9 site will have a relatively minor impact on the operation of the (upgraded) Willoughby Road / Artarmon Road intersection.”* Furthermore, the operation under existing geometry without the additional traffic associated with other development operates at an acceptable LoS. Under the additional traffic load of other development, the intersection performance is reported as LoS “D” on Saturday. LoS “D” is still an acceptable performance, which is inferred by the RMS raising no objection to the proposal. The intersection impact under the “With Pedestrian Crossing” design outcome for Willoughby Road is not considered reflective of the developments impact due to the unlikely implementation of the pedestrian facility. The upgraded intersection geometry would benefit the forecast additional developments identified by Willoughby Council, and not solely the proposed modification application.

In regard to the Voluntary Planning Agreement (VPA), of which it is understood the terms of this agreement are not yet finalised, Council’s submission states (p5), with regard to the nominated monetary contribution towards the upgrade of Willoughby Rd/Artarmon Road/Small Street intersection, that *“this is considered inadmissible for inclusion in a VPA as it relates to intersection upgrade works required for the development to proceed at all. These junction upgrades should be the subject of conditions of approval.”* The upgrades at the aforementioned intersection was originally proposed as part of the Willoughby Leisure Centre upgrade and not the subject proposal. As per MTE modelling, the intersection upgrade in its entirety is not necessarily required, particularly if the Willoughby Leisure Centre does not proceed.

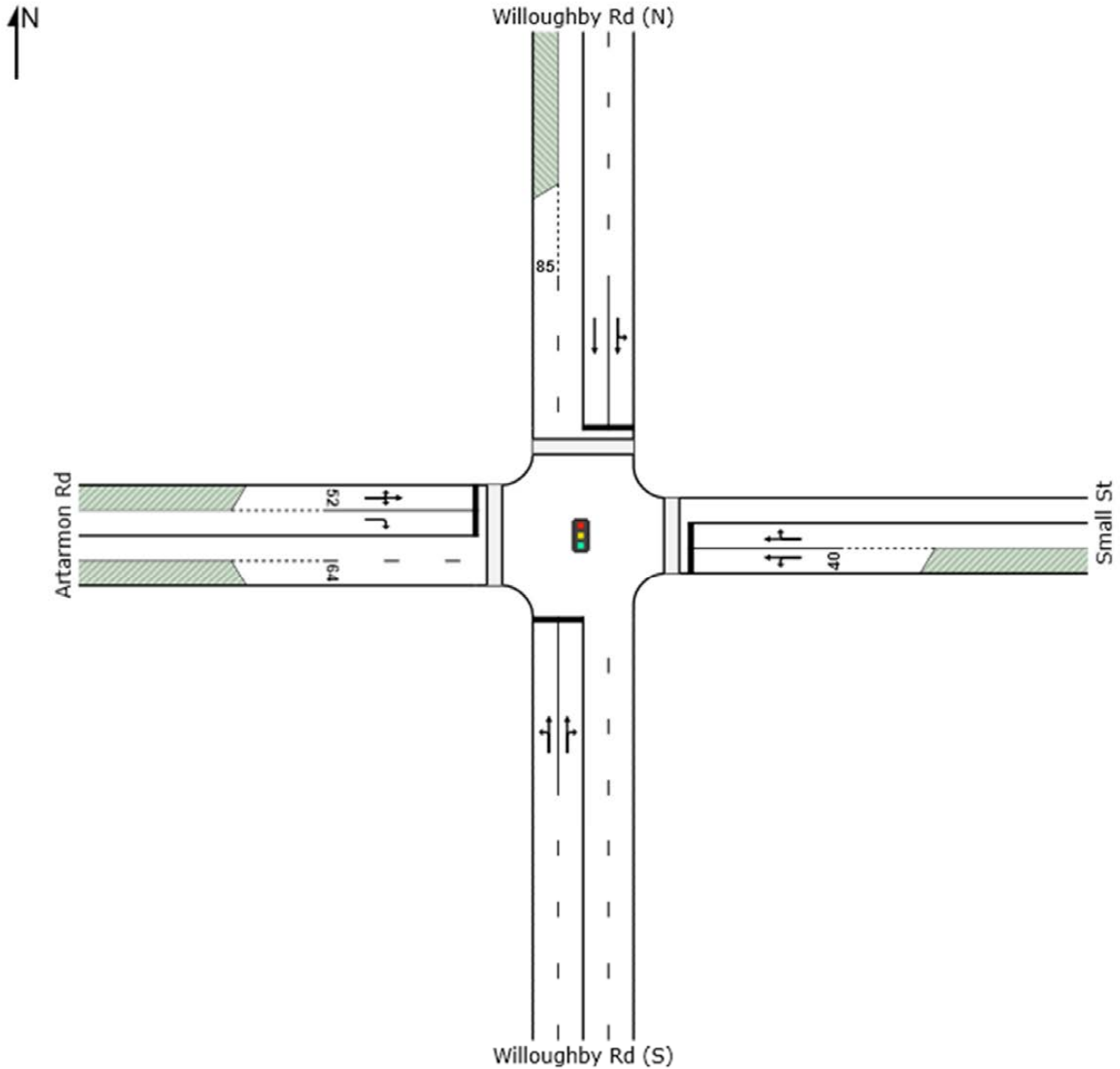
ANNEXURE E: SIDRA SUMMARY

(Sheet 1 of 11)

SITE LAYOUT

 **Site: 101 [Existing Geometry- Existing Thursday AM]**

New Site
Signals - Fixed Time Isolated



ANNEXURE E: SIDRA SUMMARY (Sheet 2 of 11)

MOVEMENT SUMMARY

Site: 101 [Existing Geometry- Existing Thursday AM]

New Site

Signals - Fixed Time Isolated Cycle Time = 90 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand 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 per veh	Average Speed km/h
South: Willoughby Rd (S)											
1	L2	246	2.0	0.394	17.5	LOS B	10.0	71.1	0.80	0.87	48.8
2	T1	882	2.0	0.816	21.7	LOS B	29.6	210.4	0.85	0.84	43.9
3	R2	18	0.0	0.816	29.4	LOS C	29.6	210.4	0.91	0.88	42.2
Approach		1146	2.0	0.816	20.9	LOS B	29.6	210.4	0.80	0.80	44.5
East: Small St											
4	L2	82	1.0	0.668	54.3	LOS D	3.9	27.4	1.00	0.82	31.3
5	T1	78	1.0	0.783	50.7	LOS D	4.9	34.3	1.00	0.89	32.4
6	R2	22	1.0	0.783	56.2	LOS D	4.9	34.3	1.00	0.89	31.8
Approach		182	1.0	0.783	53.0	LOS D	4.9	34.3	1.00	0.88	31.8
North: Willoughby Rd (N)											
7	L2	24	2.0	0.758	21.4	LOS B	26.9	191.5	0.82	0.75	46.4
8	T1	1597	2.0	0.758	16.2	LOS B	27.2	193.6	0.83	0.76	47.4
Approach		1621	2.0	0.758	16.2	LOS B	27.2	193.6	0.83	0.76	47.4
West: Artarmon Rd											
10	L2	28	1.0	0.787	48.3	LOS D	12.0	84.6	1.00	0.91	33.2
11	T1	36	1.0	0.787	42.8	LOS D	12.0	84.6	1.00	0.91	33.7
12	R2	454	1.0	0.787	48.3	LOS D	12.0	84.6	1.00	0.91	33.0
Approach		518	1.0	0.787	48.0	LOS D	12.0	84.6	1.00	0.91	33.1
All Vehicles		3467	1.8	0.816	24.4	LOS B	29.6	210.4	0.85	0.80	42.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site 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 (Akapik 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 per ped	
P2	East Full Crossing	53	6.4	LOS A	0.1	0.1	0.38	0.38	
P3	North Full Crossing	53	38.4	LOS D	0.1	0.1	0.92	0.92	
P4	West Full Crossing	53	13.4	LOS B	0.1	0.1	0.55	0.55	
All Pedestrians		158	19.4	LOS B			0.62	0.62	

MOVEMENT SUMMARY

Site: 101 [Existing Geometry- Existing Thursday AM 400]

New Site

Signals - Fixed Time Isolated Cycle Time = 90 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand 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 per veh	Average Speed km/h
South: Willoughby Rd (S)											
1	L2	166	2.0	0.377	18.0	LOS B	9.5	67.9	0.91	0.83	47.2
2	T1	882	2.0	0.780	19.6	LOS B	25.7	182.6	0.82	0.78	45.0
3	R2	18	0.0	0.780	27.5	LOS B	25.7	182.6	0.89	0.83	43.1
Approach		1066	2.0	0.780	19.6	LOS B	25.7	182.6	0.79	0.76	45.3
East: Small St											
4	L2	78	1.0	0.634	53.9	LOS D	3.6	25.8	1.00	0.80	31.4
5	T1	53	1.0	0.587	47.7	LOS D	3.5	24.4	1.00	0.78	33.2
6	R2	22	1.0	0.587	53.2	LOS D	3.5	24.4	1.00	0.78	32.5
Approach		153	1.0	0.634	51.6	LOS D	3.6	25.8	1.00	0.79	32.1
North: Willoughby Rd (S)											
7	L2	23	2.0	0.773	22.4	LOS B	27.7	197.4	0.84	0.78	45.8
8	T1	1597	2.0	0.773	17.2	LOS B	28.0	199.4	0.85	0.78	46.8
Approach		1620	2.0	0.773	17.2	LOS B	28.0	199.4	0.85	0.78	46.8
West: Artarmon Rd											
10	L2	32	1.0	0.810	48.8	LOS D	13.3	93.9	1.00	0.93	33.0
11	T1	38	1.0	0.810	43.2	LOS D	13.3	93.9	1.00	0.93	33.6
12	R2	497	1.0	0.810	48.8	LOS D	13.3	93.9	1.00	0.93	32.9
Approach		566	1.0	0.810	48.4	LOS D	13.3	93.9	1.00	0.93	32.9
All Vehicles		3405	1.8	0.810	24.7	LOS B	28.0	199.4	0.86	0.80	42.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site 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 (Akapik 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 per ped	
P2	East Full Crossing	53	6.8	LOS A	0.1	0.1	0.39	0.39	
P3	North Full Crossing	53	37.4	LOS D	0.1	0.1	0.91	0.91	
P4	West Full Crossing	53	13.9	LOS B	0.1	0.1	0.56	0.56	
All Pedestrians		158	19.4	LOS B			0.62	0.62	

ANNEXURE E: SIDRA SUMMARY

(Sheet 3 of 11)

MOVEMENT SUMMARY

Site: 101 [Existing Geometry- Future Thursday AM -510]

New Site
Signals - Fixed Time Isolated Cycle Time = 85 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn vic	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Willoughby Rd (S)											
1	L2	178	2.0	0.400	18.8	LOS B	9.7	68.8	0.64	0.66	46.6
2	T1	882	2.0	0.827	23.3	LOS B	27.8	198.2	0.87	0.86	43.0
3	R2	18	0.0	0.827	32.1	LOS C	27.8	198.2	0.94	0.93	40.9
Approach		1078	2.0	0.827	22.7	LOS B	27.8	198.2	0.83	0.83	43.5
East: Small St											
4	L2	82	1.0	0.631	51.0	LOS D	3.6	25.6	1.00	0.81	32.2
5	T1	57	1.0	0.585	44.8	LOS D	3.5	24.4	1.00	0.79	34.1
6	R2	22	1.0	0.585	50.3	LOS D	3.5	24.4	1.00	0.79	33.4
Approach		161	1.0	0.631	48.7	LOS D	3.6	25.6	1.00	0.80	33.0
North: Willoughby Rd (S)											
7	L2	24	2.0	0.813	26.3	LOS B	29.9	212.8	0.89	0.86	43.7
8	T1	1597	2.0	0.813	21.0	LOS B	30.1	214.1	0.90	0.86	44.6
Approach		1621	2.0	0.813	21.1	LOS B	30.1	214.1	0.90	0.86	44.6
West: Artarmon Rd											
10	L2	35	1.0	0.844	48.3	LOS D	14.4	101.5	1.00	0.97	33.2
11	T1	42	1.0	0.844	42.8	LOS D	14.4	101.5	1.00	0.97	33.7
12	R2	547	1.0	0.844	48.3	LOS D	14.4	101.5	1.00	0.96	33.0
Approach		624	1.0	0.844	48.0	LOS D	14.4	101.5	1.00	0.96	33.1
All Vehicles		3484	1.8	0.844	27.7	LOS B	30.1	214.1	0.90	0.87	41.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site 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 per ped	
P2	East Full Crossing	53	7.2	LOS A	0.1	0.1	0.41	0.41	
P3	North Full Crossing	53	35.0	LOS D	0.1	0.1	0.91	0.91	
P4	West Full Crossing	53	14.7	LOS B	0.1	0.1	0.59	0.59	

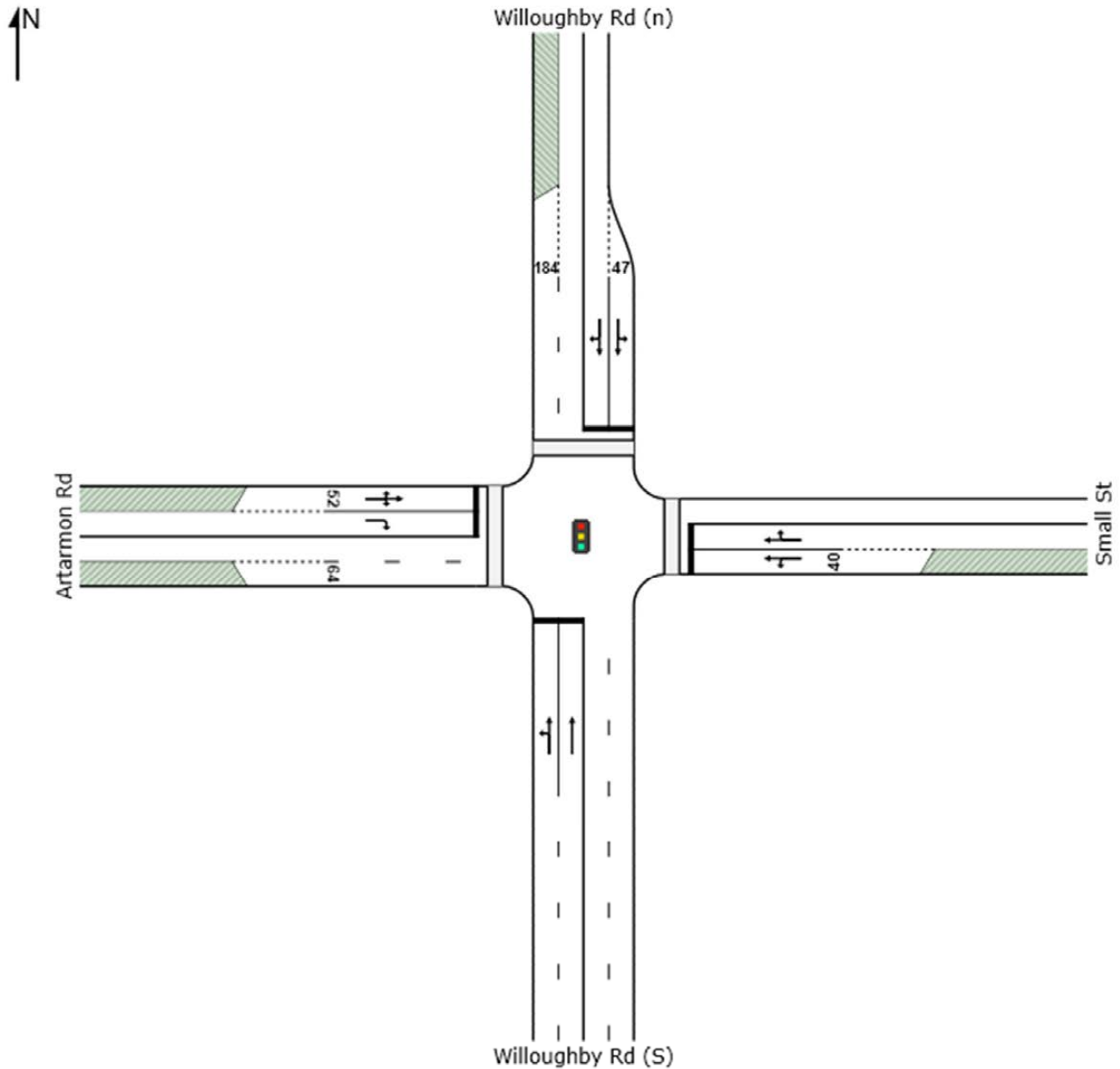
ANNEXURE E: SIDRA SUMMARY

(Sheet 4 of 11)

SITE LAYOUT

 **Site: 101 [Existing Geometry- Existing Thursday PM - 400]**

New Site
Signals - Fixed Time Isolated



ANNEXURE E: SIDRA SUMMARY

(Sheet 5 of 11)

MOVEMENT SUMMARY

Site: 101 [Existing Geometry- Existing Thursday PM]

New Site
Signals - Fixed Time Isolated Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand 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 per veh	Average Speed km/h
South: Willoughby Rd (S)											
1	L2	384	2.0	0.842	27.3	LOS B	39.7	282.4	0.86	0.86	42.1
2	T1	1479	2.0	0.842	21.9	LOS B	41.5	295.8	0.88	0.85	43.7
Approach		1863	2.0	0.842	23.0	LOS B	41.5	295.8	0.88	0.85	43.4
East: Small St											
4	L2	113	1.0	0.641	58.0	LOS E	5.9	41.8	1.00	0.81	30.3
5	T1	101	1.0	0.823	57.3	LOS E	8.4	59.2	1.00	0.93	30.5
6	R2	48	1.0	0.823	62.8	LOS E	8.4	59.2	1.00	0.93	30.0
Approach		262	1.0	0.823	58.6	LOS E	8.4	59.2	1.00	0.88	30.3
North: Willoughby Rd (N)											
7	L2	45	2.0	0.764	20.0	LOS B	18.4	130.9	0.64	0.60	47.1
8	T1	1038	2.0	0.764	16.5	LOS B	18.4	130.9	0.66	0.62	47.1
9	R2	6	2.0	0.764	24.3	LOS B	17.0	120.8	0.69	0.64	44.9
Approach		1089	2.0	0.764	16.7	LOS B	18.4	130.9	0.66	0.62	47.1
West: Artarmon Rd											
10	L2	49	1.0	0.839	59.6	LOS E	13.4	94.6	1.00	0.97	30.4
11	T1	85	1.0	0.839	54.1	LOS D	13.4	94.6	1.00	0.97	30.8
12	R2	341	1.0	0.839	59.7	LOS E	13.4	94.6	1.00	0.94	30.0
Approach		476	1.0	0.839	58.7	LOS E	13.4	94.6	1.00	0.95	30.2
All Vehicles		3691	1.8	0.842	28.3	LOS B	41.5	295.8	0.84	0.80	40.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site 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 per ped	
P2	East Full Crossing	53	5.5	LOS A	0.1	0.1	0.32	0.32	
P3	North Full Crossing	53	45.8	LOS E	0.1	0.1	0.94	0.94	
P4	West Full Crossing	53	13.4	LOS B	0.1	0.1	0.51	0.51	
All Pedestrians		158	21.6	LOS C			0.59	0.59	

ANNEXURE E: SIDRA SUMMARY

(Sheet 6 of 11)

MOVEMENT SUMMARY

Site: 101 [Existing Geometry- Existing Thursday PM - 400]

New Site
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flow 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 per veh	Average Speed km/h
South: Willoughby Rd (S)											
1	L2	403	2.0	0.819	24.6	LOS B	34.9	248.4	0.84	0.83	43.4
2	T1	1405	2.0	0.819	19.3	LOS B	36.6	260.7	0.86	0.82	45.1
Approach		1808	2.0	0.819	20.5	LOS B	36.6	260.7	0.85	0.82	44.7
East: Small St											
4	L2	107	1.0	0.582	54.4	LOS D	5.3	37.3	1.00	0.79	31.2
5	T1	107	1.0	0.805	53.6	LOS D	8.1	57.5	1.00	0.92	31.5
6	R2	46	1.0	0.805	59.1	LOS E	8.1	57.5	1.00	0.92	30.9
Approach		261	1.0	0.805	54.9	LOS D	8.1	57.5	1.00	0.87	31.3
North: Willoughby Rd (n)											
7	L2	43	2.0	0.754	19.2	LOS B	17.6	125.7	0.65	0.60	47.6
8	T1	986	2.0	0.754	16.7	LOS B	17.6	125.7	0.68	0.63	46.9
9	R2	13	2.0	0.754	26.3	LOS B	15.5	110.4	0.73	0.68	43.7
Approach		1042	2.0	0.754	17.0	LOS B	17.6	125.7	0.68	0.63	46.9
West: Artarmon Rd											
10	L2	45	1.0	0.823	57.1	LOS E	11.4	80.6	1.00	0.95	31.0
11	T1	75	1.0	0.823	51.6	LOS D	11.4	80.6	1.00	0.95	31.5
12	R2	308	1.0	0.823	57.2	LOS E	11.4	80.6	1.00	0.93	30.6
Approach		428	1.0	0.823	56.2	LOS D	11.4	80.6	1.00	0.94	30.8
All Vehicles		3540	1.8	0.823	26.3	LOS B	36.6	260.7	0.83	0.79	41.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site 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 per ped	
P2	East Full Crossing	53	5.1	LOS A	0.0	0.0	0.32	0.32	
P3	North Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94	
P4	West Full Crossing	53	13.0	LOS B	0.1	0.1	0.51	0.51	

ANNEXURE E: SIDRA SUMMARY

(Sheet 7 of 11)

MOVEMENT SUMMARY

Site: 101 [Existing Geometry- Future Thursday PM -510]

New Site

Signals - Fixed Time Isolated Cycle Time = 115 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand 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 per veh	Average Speed km/h
South: Willoughby Rd (S)											
1	L2	445	2.0	0.831	24.5	LOS B	40.8	290.2	0.83	0.82	43.4
2	T1	1479	2.0	0.831	19.2	LOS B	43.0	306.2	0.85	0.81	45.1
Approach		1924	2.0	0.831	20.4	LOS B	43.0	306.2	0.85	0.81	44.7
East: Small St											
4	L2	113	1.0	0.639	62.5	LOS E	6.4	45.4	1.00	0.81	29.2
5	T1	118	1.0	0.911	70.0	LOS E	10.9	77.2	1.00	1.04	27.6
6	R2	48	1.0	0.911	75.5	LOS F	10.9	77.2	1.00	1.04	27.2
Approach		279	1.0	0.911	68.0	LOS E	10.9	77.2	1.00	0.94	28.1
North: Willoughby Rd (S)											
7	L2	45	2.0	0.895	36.1	LOS C	34.3	244.0	0.68	0.75	39.0
8	T1	1038	2.0	0.895	36.1	LOS C	34.3	244.0	0.70	0.79	37.6
9	R2	16	2.0	0.895	52.5	LOS D	20.2	144.1	0.75	0.87	33.3
Approach		1099	2.0	0.895	36.3	LOS C	34.3	244.0	0.70	0.79	37.6
West: Artarmon Rd											
10	L2	48	1.0	0.895	70.9	LOS F	15.1	106.4	1.00	1.03	27.8
11	T1	83	1.0	0.895	65.3	LOS E	15.1	106.4	1.00	1.03	28.2
12	R2	332	1.0	0.895	71.0	LOS F	15.1	106.4	1.00	0.99	27.5
Approach		463	1.0	0.895	70.0	LOS E	15.1	106.4	1.00	1.00	27.6
All Vehicles		3765	1.0	0.911	34.7	LOS C	43.0	306.2	0.83	0.84	38.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site 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 per ped	
P2	East Full Crossing	53	5.0	LOS A	0.1	0.1	0.30	0.30	
P3	North Full Crossing	53	50.8	LOS E	0.2	0.2	0.94	0.94	
P4	West Full Crossing	53	12.7	LOS B	0.1	0.1	0.47	0.47	

ANNEXURE E: SIDRA SUMMARY

(Sheet 8 of 11)

MOVEMENT SUMMARY

Site: 101 [Existing Geometry- Future Thursday PM + ARUP Developments]

New Site

Signals - Fixed Time Isolated Cycle Time = 110 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Willoughby Rd (S)											
1	L2	445	2.0	0.850	26.4	LOS B	42.9	305.3	0.85	0.85	42.5
2	T1	1525	2.0	0.850	21.1	LOS B	45.2	321.8	0.87	0.85	44.1
Approach		1971	2.0	0.850	22.3	LOS B	45.2	321.8	0.87	0.85	43.7
East: Small St											
4	L2	113	1.0	0.672	61.3	LOS E	6.2	44.1	1.00	0.82	29.5
5	T1	118	1.0	0.958	77.8	LOS F	11.4	80.4	1.00	1.11	26.1
6	R2	48	1.0	0.958	83.3	LOS F	11.4	80.4	1.00	1.11	25.7
Approach		279	1.0	0.958	72.1	LOS F	11.4	80.4	1.00	1.00	27.3
North: Willoughby Rd (S)											
7	L2	45	2.0	0.949	53.6	LOS D	44.3	315.4	0.70	0.91	32.9
8	T1	1123	2.0	0.949	53.2	LOS D	44.3	315.4	0.72	0.94	32.0
9	R2	16	2.0	0.949	68.7	LOS E	25.3	180.2	0.76	1.00	29.0
Approach		1184	2.0	0.949	53.5	LOS D	44.3	315.4	0.72	0.94	31.9
West: Artarmon Rd											
10	L2	48	1.0	0.913	71.5	LOS F	14.9	105.1	1.00	1.07	27.7
11	T1	83	1.0	0.913	65.9	LOS E	14.9	105.1	1.00	1.07	28.0
12	R2	332	1.0	0.913	71.6	LOS F	14.9	105.1	1.00	1.02	27.3
Approach		463	1.0	0.913	70.6	LOS F	14.9	105.1	1.00	1.04	27.5
All Vehicles		3897	1.8	0.958	41.1	LOS C	45.2	321.8	0.85	0.91	35.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site 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 per ped	
P2	East Full Crossing	53	5.0	LOS A	0.0	0.0	0.30	0.30	
P3	North Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95	
P4	West Full Crossing	53	12.3	LOS B	0.1	0.1	0.47	0.47	

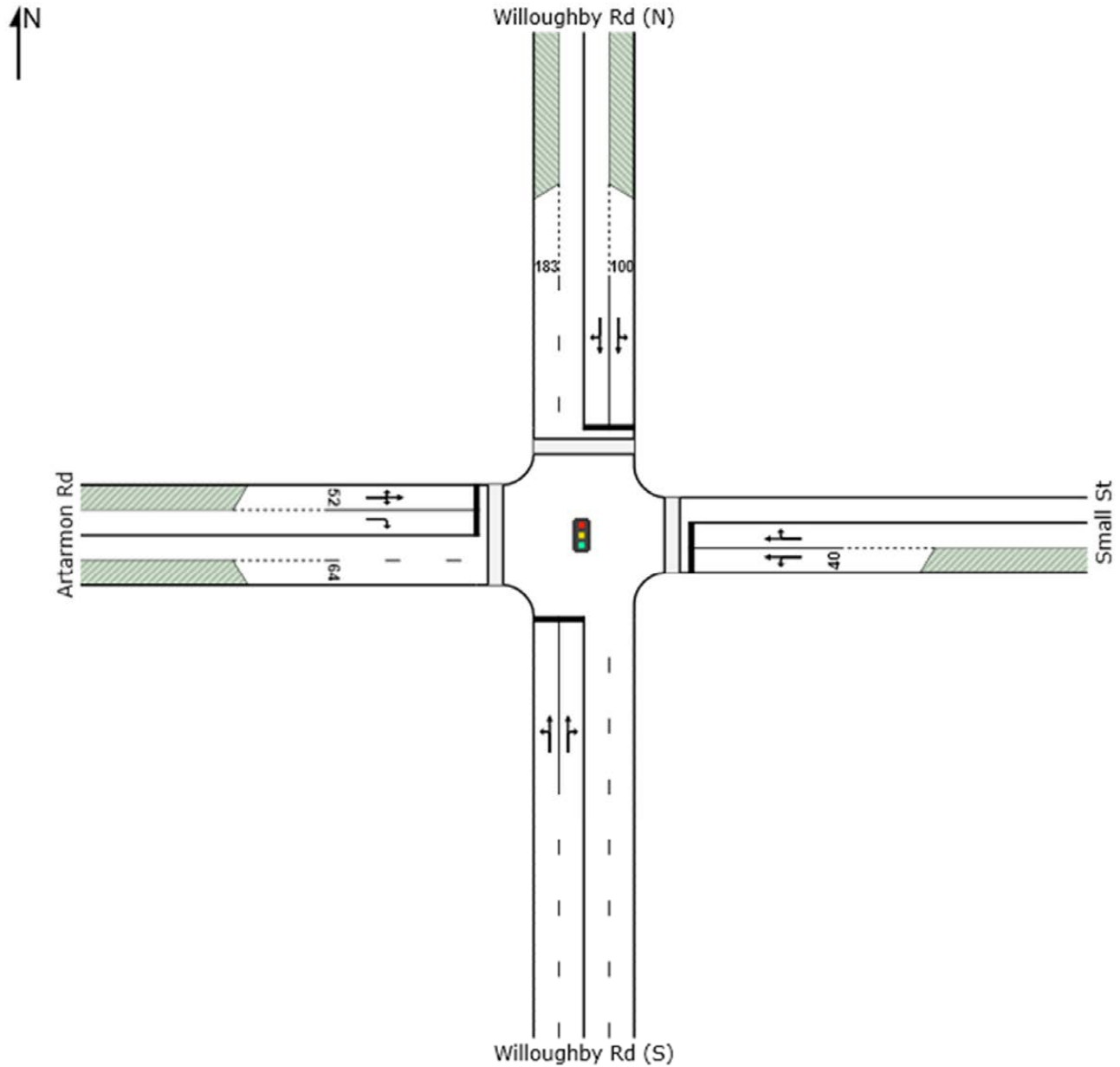
ANNEXURE E: SIDRA SUMMARY

(Sheet 9 of 11)

SITE LAYOUT

 **Site: 101 [Existing Geometry- Existing Saturday Mid]**

New Site
Signals - Fixed Time Isolated



ANNEXURE E: SIDRA SUMMARY (Sheet 10 of 11)

MOVEMENT SUMMARY

Site: 101 [Existing Geometry- Existing Saturday Mid]

New Site

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Willoughby Rd (S)											
1	L2	335	2.0	0.896	36.0	LOS C	48.2	343.0	0.92	0.96	38.4
2	T1	1049	2.0	0.896	37.7	LOS C	48.2	343.0	0.95	1.02	38.5
3	R2	87	2.0	0.896	54.1	LOS D	28.4	202.4	1.00	1.10	32.6
Approach		1452	2.0	0.896	38.1	LOS C	48.2	343.0	0.95	1.01	38.8
East: Small St											
4	L2	128	1.0	0.896	56.2	LOS D	6.5	46.0	1.00	0.84	30.8
5	T1	104	1.0	0.899	57.5	LOS E	9.2	64.7	1.00	0.99	30.4
6	R2	61	1.0	0.899	63.0	LOS E	9.2	64.7	1.00	0.99	29.8
Approach		294	1.0	0.899	58.0	LOS E	9.2	64.7	1.00	0.92	30.4
North: Willoughby Rd (N)											
7	L2	91	2.0	0.639	20.5	LOS B	22.6	160.9	0.72	0.68	46.6
8	T1	1131	2.0	0.639	18.3	LOS B	22.6	160.9	0.77	0.70	45.9
9	R2	16	2.0	0.639	27.7	LOS B	20.0	142.2	0.82	0.74	43.0
Approach		1237	2.0	0.639	18.6	LOS B	22.6	160.9	0.77	0.70	45.9
West: Artarmon Rd											
10	L2	36	1.0	0.883	61.5	LOS E	14.0	99.1	1.00	1.03	30.1
11	T1	129	1.0	0.883	56.0	LOS D	14.0	99.1	1.00	1.03	30.6
12	R2	329	1.0	0.883	61.7	LOS E	14.0	99.1	1.00	0.99	29.6
Approach		495	1.0	0.883	60.2	LOS E	14.0	99.1	1.00	1.01	29.9
All Vehicles		3477	1.8	0.898	36.0	LOS C	48.2	343.0	0.90	0.89	37.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site 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 (Akapik 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 per ped	
P2	East Full Crossing	53	5.5	LOS A	0.0	0.0	0.33	0.33	
P3	North Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94	
P4	West Full Crossing	53	13.5	LOS B	0.1	0.1	0.52	0.52	
All Pedestrians		158	21.1	LOS C			0.60	0.60	

MOVEMENT SUMMARY

Site: 101 [Existing Geometry- Existing Saturday Mid - 400]

New Site

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Willoughby Rd (S)											
1	L2	336	2.0	0.838	28.0	LOS B	37.3	265.5	0.87	0.87	41.9
2	T1	997	2.0	0.840	28.9	LOS C	37.3	265.5	0.92	0.92	40.1
3	R2	64	2.0	0.840	42.5	LOS C	26.1	185.9	0.98	0.99	36.4
Approach		1397	2.0	0.840	29.3	LOS C	37.3	265.5	0.91	0.91	40.3
East: Small St											
4	L2	122	1.0	0.662	55.5	LOS D	6.1	43.3	1.00	0.83	30.9
5	T1	105	1.0	0.857	56.5	LOS E	9.0	63.2	1.00	0.98	30.6
6	R2	58	1.0	0.857	62.1	LOS E	9.0	63.2	1.00	0.98	30.1
Approach		285	1.0	0.857	57.2	LOS E	9.0	63.2	1.00	0.91	30.6
North: Willoughby Rd (S)											
7	L2	86	2.0	0.604	20.6	LOS B	20.6	146.7	0.71	0.66	46.6
8	T1	1074	2.0	0.604	17.6	LOS B	20.6	146.7	0.75	0.68	46.3
9	R2	15	2.0	0.604	26.0	LOS B	18.7	132.9	0.79	0.70	43.9
Approach		1175	2.0	0.604	17.9	LOS B	20.6	146.7	0.74	0.68	46.3
West: Artarmon Rd											
10	L2	36	1.0	0.821	55.5	LOS D	13.0	91.8	1.00	0.96	31.7
11	T1	128	1.0	0.821	50.0	LOS D	13.0	91.8	1.00	0.96	32.2
12	R2	326	1.0	0.821	55.6	LOS D	13.0	91.8	1.00	0.93	31.1
Approach		491	1.0	0.821	54.2	LOS D	13.0	91.8	1.00	0.94	31.4
All Vehicles		3247	1.8	0.857	31.3	LOS C	37.3	265.5	0.87	0.83	39.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site 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 (Akapik 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 per ped	
P2	East Full Crossing	53	5.8	LOS A	0.1	0.1	0.34	0.34	
P3	North Full Crossing	53	43.3	LOS E	0.1	0.1	0.93	0.93	
P4	West Full Crossing	53	14.1	LOS B	0.1	0.1	0.53	0.53	
All Pedestrians		158	21.1	LOS C			0.60	0.60	

ANNEXURE E: SIDRA SUMMARY (Sheet 11 of 11)

MOVEMENT SUMMARY

Site: 101 [Existing Geometry- Future Saturday Mid -510]

New Site

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flow veh/h	HV %	Seg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Willoughby Rd (S)											
1	L2	360	2.0	0.925	43.6	LOS D	55.6	395.6	0.96	1.03	35.6
2	T1	1046	2.0	0.925	45.3	LOS D	55.6	395.6	0.97	1.08	33.9
3	R2	67	2.0	0.925	62.1	LOS E	30.2	215.0	1.00	1.16	30.5
Approach		1477	2.0	0.925	45.7	LOS D	55.6	395.6	0.97	1.07	34.1
East: Small St											
4	L2	128	1.0	0.906	56.2	LOS D	6.5	46.0	1.00	0.84	30.8
5	T1	113	1.0	0.912	62.3	LOS E	10.1	71.4	1.00	1.05	29.2
6	R2	61	1.0	0.912	67.9	LOS E	10.1	71.4	1.00	1.05	28.7
Approach		302	1.0	0.912	60.8	LOS E	10.1	71.4	1.00	0.96	29.7
North: Willoughby Rd (S)											
7	L2	91	2.0	0.652	29.7	LOS B	23.3	165.7	0.73	0.68	46.5
8	T1	1131	2.0	0.652	18.9	LOS B	23.3	165.7	0.78	0.71	45.5
9	R2	17	2.0	0.652	29.2	LOS C	20.0	142.7	0.84	0.75	42.2
Approach		1238	2.0	0.652	19.2	LOS B	23.3	165.7	0.78	0.71	45.5
West: Artarmon Rd											
10	L2	39	1.0	0.939	71.5	LOS F	16.5	116.2	1.00	1.13	27.9
11	T1	138	1.0	0.939	65.9	LOS E	16.5	116.2	1.00	1.13	28.2
12	R2	349	1.0	0.939	71.7	LOS F	16.5	116.2	1.00	1.08	27.4
Approach		526	1.0	0.939	70.2	LOS E	16.5	116.2	1.00	1.09	27.6
All Vehicles		3543	1.8	0.939	41.3	LOS C	55.6	395.6	0.91	0.94	35.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site 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 (Akpolik 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 per ped	
P2	East Full Crossing	53	5.5	LOS A	0.0	0.0	0.33	0.33	
P3	North Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94	
P4	West Full Crossing	53	13.5	LOS B	0.1	0.1	0.52	0.52	
All Pedestrians		158	21.1	LOS C			0.60	0.60	

MOVEMENT SUMMARY

Site: 101 [Existing Geometry- Future Saturday Mid + ARUP Developments]

New Site

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flow veh/h	HV %	Seg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Willoughby Rd (S)											
1	L2	360	2.0	0.972	62.4	LOS E	70.9	505.1	1.00	1.16	30.1
2	T1	1068	2.0	0.972	63.7	LOS E	70.9	505.1	1.00	1.22	29.0
3	R2	67	2.0	0.972	61.5	LOS F	32.3	230.0	1.00	1.26	29.2
Approach		1496	2.0	0.972	64.2	LOS E	70.9	505.1	1.00	1.21	29.1
East: Small St											
4	L2	128	1.0	0.906	56.2	LOS D	6.5	46.0	1.00	0.84	30.8
5	T1	113	1.0	0.912	62.3	LOS E	10.1	71.4	1.00	1.05	29.2
6	R2	61	1.0	0.912	67.9	LOS E	10.1	71.4	1.00	1.05	28.7
Approach		302	1.0	0.912	60.8	LOS E	10.1	71.4	1.00	0.96	29.7
North: Willoughby Rd (S)											
7	L2	91	2.0	0.678	21.0	LOS B	24.6	175.3	0.75	0.70	46.4
8	T1	1149	2.0	0.678	20.0	LOS B	24.6	175.3	0.80	0.73	44.9
9	R2	17	2.0	0.678	31.5	LOS C	20.7	147.1	0.88	0.78	41.1
Approach		1257	2.0	0.678	20.2	LOS B	24.6	175.3	0.80	0.73	45.0
West: Artarmon Rd											
10	L2	39	1.0	0.939	71.5	LOS F	16.5	116.2	1.00	1.13	27.9
11	T1	138	1.0	0.939	65.9	LOS E	16.5	116.2	1.00	1.13	28.2
12	R2	349	1.0	0.939	71.7	LOS F	16.5	116.2	1.00	1.08	27.4
Approach		526	1.0	0.939	70.2	LOS E	16.5	116.2	1.00	1.09	27.6
All Vehicles		3581	1.8	0.972	49.4	LOS D	70.9	505.1	0.93	1.01	33.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

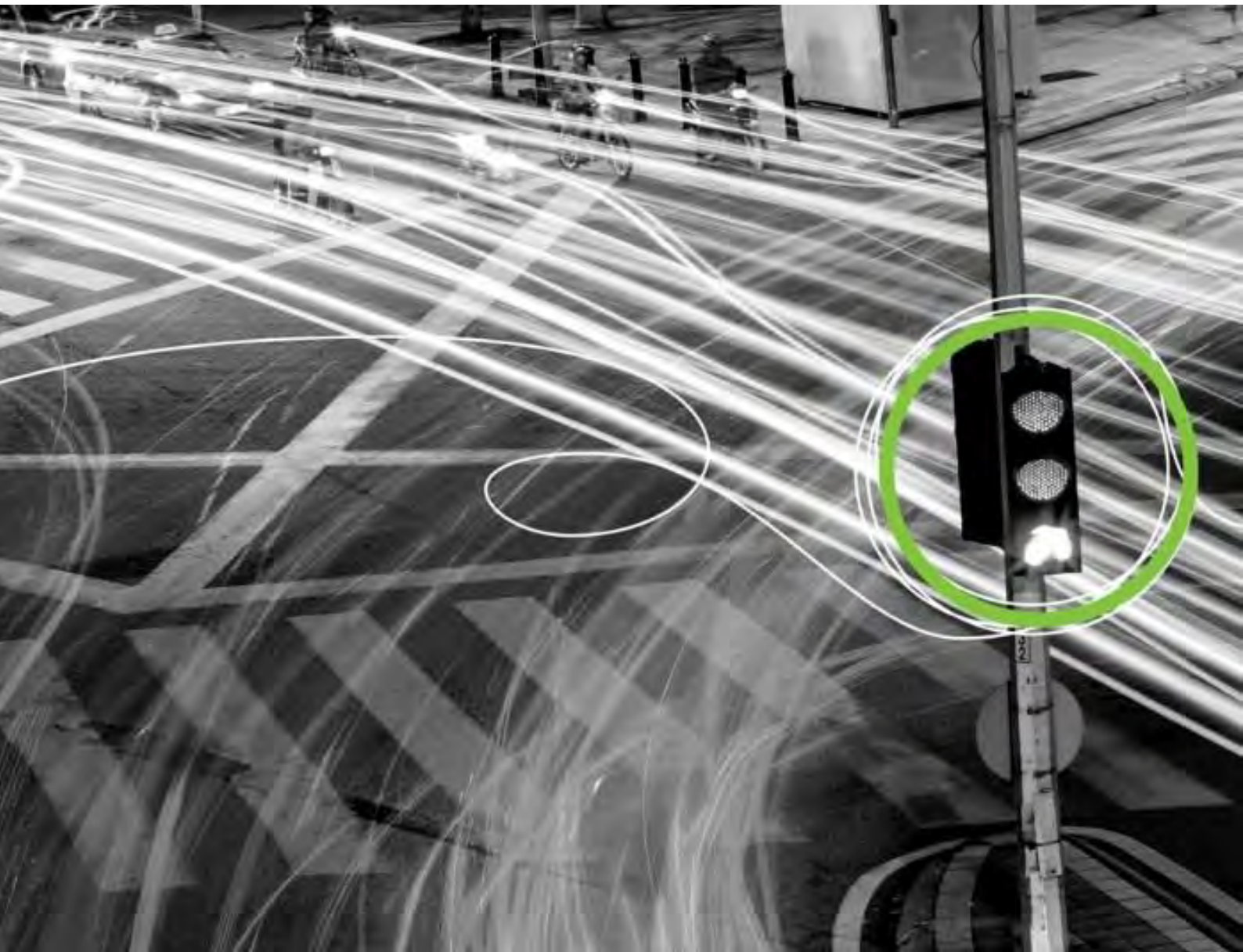
Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akpolik 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 per ped	
P2	East Full Crossing	53	5.5	LOS A	0.0	0.0	0.33	0.33	
P3	North Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94	
P4	West Full Crossing	53	13.5	LOS B	0.1	0.1	0.52	0.52	
All Pedestrians		158	21.1	LOS C			0.60	0.60	



Nine Network Site Redevelopment Willoughby Transport Impact Assessment

Client //	LEPC9
Office //	NSW
Reference //	16S1405100
Date //	18/07/16

Nine Network Site Redevelopment

Willoughby

Transport Impact Assessment

Issue: B 18/07/16

Client: LEPC9

Reference: 16S1405100

GTA Consultants Office: NSW

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
A	28/06/16	Final	Dean Rance	Nicole Vukic	Nicole Vukic	Nicole Vukic
B	18/07/16	Final – revised	Dean Rance	Nicole Vukic	Nicole Vukic	N. Vukic

Table of Contents

1. Introduction	1
1.1 Background	1
1.2 Purpose of this Report	2
1.3 References	2
2. Existing Conditions	3
2.1 Road Network	5
2.2 Traffic Volumes	5
2.3 Intersection Operation	8
2.4 Car Parking	9
2.5 Public Transport	9
2.6 Pedestrian and Cycle Infrastructure	10
2.7 Local Car Sharing Initiatives	11
3. Development Proposal	13
3.1 Approved Development	13
3.2 Land Uses	13
3.3 Vehicle Access	13
3.4 Car Parking	14
3.5 Pedestrian Facilities	15
3.6 Bicycle Facilities	15
3.7 Loading and Waste Collection Areas	15
4. Car Parking	16
4.1 Car Parking Requirements	16
4.2 Adequacy of On-street Parking Supply	16
4.3 Car Park and Site Access Design Review	17
5. Traffic Impact Assessment	18
5.1 Traffic Generation	18
5.2 Distribution and Assignment	19
5.3 Traffic Impact	19
5.4 Mitigating Measures and Intersection Works	21
5.5 Future Transport Infrastructure	24
5.6 Safety	24
6. Conclusion	25
6.1 Secretary's Environmental Assessment Requirements (SEARs)	25
6.2 Conclusion	25

Appendices

- A: Existing and Forecast Traffic Volumes
- B: SIDRA INTERSECTION Results
- C: Swept Path Analysis
- D: Survey Results

Figures

Figure 2.1:	Subject site and its environs	3
Figure 2.2:	Current land zoning map	4
Figure 2.3:	Existing land use – Nine Network Australia Studio	4
Figure 2.4:	Artarmon Road looking west	5
Figure 2.5:	Artarmon Road at Willoughby Road	5
Figure 2.6:	Two-way traffic flow on Artarmon Road	6
Figure 2.7:	Roads and Maritime Services count data	7
Figure 2.8:	Sydney Buses map	9
Figure 2.9:	Cycle infrastructure	11
Figure 2.10:	High quality cycling infrastructure adjacent to Lane Cove Road west of site	11
Figure 2.11:	GoGet vehicle map	12
Figure 3.1:	Site access	14
Figure 5.1:	Willoughby Road/ Artarmon Road/ Small Street GTA concept layout	22

Tables

Table 2.1:	SIDRA INTERSECTION level of service criteria	8
Table 2.2:	Existing operating conditions (2016)	8
Table 2.3:	Public transport provision	10
Table 4.1:	Statutory car parking requirements for 510 dwellings	16
Table 4.2:	On-street public parking provision	17
Table 5.1:	Traffic generation estimates	18
Table 5.2:	Operating conditions with development	20
Table 5.3:	Willoughby Road-Small Street/ Artarmon Road intersection level of service and average delay (seconds)	23
Table 5.4:	Artarmon Road queue length (metres)	23
Table 5.5:	Richmond Avenue south leg movements (delay in seconds)	23
Table 6.1:	Addressing SEARS comments	25

1. Introduction

1.1 Background

The redevelopment of the Nine Network Australia Studio site was declared to be a project to which Part 3A of the *Environmental Planning and Assessment Act 1979* applies on 19 November 2010. Nine Network Australia submitted a concept plan application (MP 10_0198) to the NSW Department of Planning and Environment in November 2012.

In December 2014, following a lengthy planning assessment and community engagement process, the NSW Planning Assessment Commission Planning Assessment Commission (PAC), Willoughby City Council (Council) and Nine Network mediated an agreed planning approval before the NSW Land and Environment Court. The mediated outcome was formalised by the PAC in its final determination on 23 December 2014 to approve the concept plan application for:

The use of the site for a residential development with small-scale non-residential uses, incorporating:

- *Building envelopes for five residential flat buildings above basement level parking and two rows of terrace houses incorporating:*
 - *Up to 400 dwellings*
 - *Up to 500 square metres floor space of non-residential uses to support the development*
- *Retention and adaptive reuse of No 6 Artarmon Road for retail/ commercial purposes*
- *New internal roadways and other infrastructure works to support the development*
- *Publicly accessible open space and through Site link*
- *Temporary exhibition homes and/or exhibition villages*
- *Superlot subdivision.*

The Concept Plan Approval establishes maximum building footprints and heights, open space areas, road infrastructure and other development parameters, and sets out the future environmental assessment requirements for detailed development applications that are required to be submitted to Council in the future.

Euro Properties and Lotus Property Fund No.8 (LEPC9) agreed to purchase the site from Nine Network Australia in late August 2015. Recognising the opportunity to deliver an improved urban design, planning, development and community outcome, LEPC9 engaged five of Australia's leading urban design firms to participate in a design competition to identify the most appropriate residential master plan for the site. This voluntary design excellence process led to the selection of the CHROFI master plan by a panel of industry experts and, along with a substantial public benefit offer above the requirements of the current approval, has the potential to deliver a substantial improvement to the current approval for all project stakeholders.

GTA Consultants was commissioned by Platform Project Services in April, 2016 to undertake a transport impact assessment for the proposed modification development.

1.2 Purpose of this Report

This report sets out an assessment of the anticipated transport implications of the proposed development, providing a comparison of the approved and revised development schemes, including consideration of the following:

- i Existing traffic and parking conditions surrounding the site
- ii Suitability of the proposed parking in terms of supply (quantum) and layout
- iii Service vehicle requirements
- iv Pedestrian and bicycle requirements
- v Traffic generating characteristics of the proposed development
- vi Suitability of the proposed access arrangements for the site
- vii Transport impact of the development proposal on the surrounding road network
- viii Traffic and transport impact of increasing the number of dwellings from 400 to 510.

1.3 References

In preparing this report, reference has been made to the following:

- o An inspection of the site and its surrounds on 18 and 25 May 2016
- o Willoughby City Council Development Control Plan (DCP)
- o Australian Standard/ New Zealand Standard, Parking Facilities, Part 1: Off-Street Car Parking AS/NZS 2890.1:2004
- o Australian Standard, Parking Facilities, Part 2: Off-Street Commercial Vehicle Facilities AS 2890.2:2002
- o Australian Standard / New Zealand Standard, Parking Facilities, Part 6: Off-Street Parking for People with Disabilities AS/NZS 2890.6:2009
- o Traffic and car parking surveys undertaken by Austraffic as referenced in the context of this report
- o *Nine Network Site, Artarmon Road, Willoughby, Transport and Access Review* (GTA Consultants' due-diligence report for the Nine Network site, 8 March 2016)
- o *Nine Network Australia – Willoughby Site Redevelopment Independent Transport Assessment* (Arup, 15 July 2013)
- o *Nine Network Australia (NNA) Willoughby site redevelopment Transport and Accessibility Impact Assessment* (AECOM, 19 March 2013)
- o Master plan for the proposed development prepared by CHROFI, drawing number A-SK-002, revision A, dated 26 April 2016
- o Other documents and data as referenced in this report.

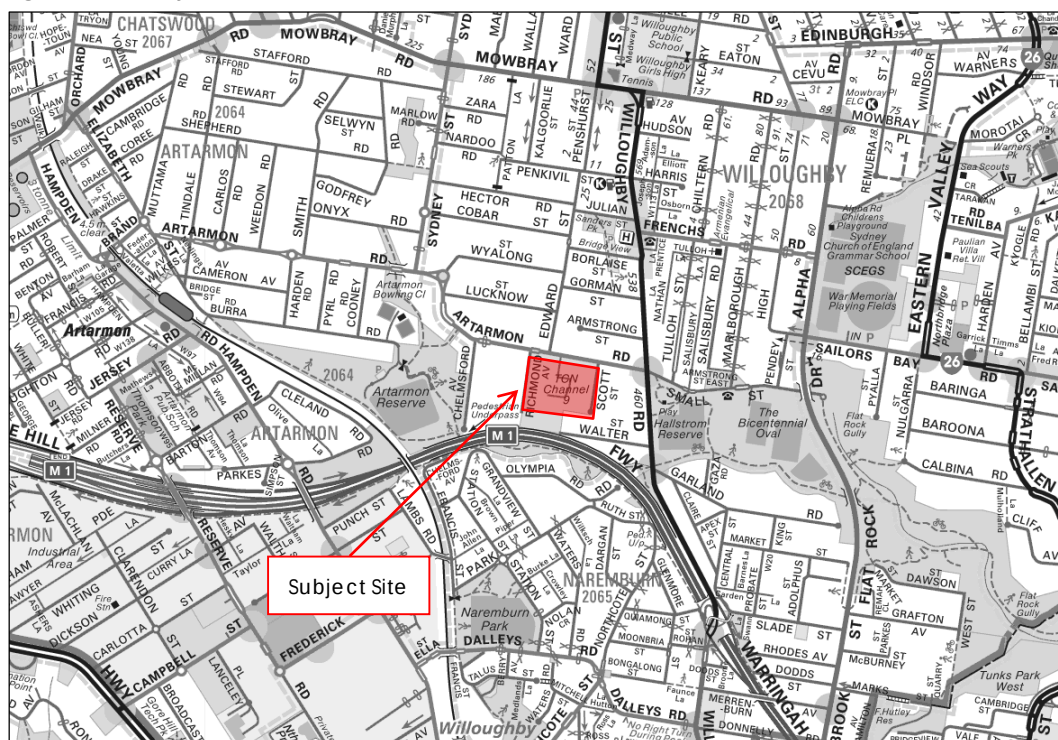
2. Existing Conditions

The existing Nine Network Australia Studio site is located on Artarmon Road in Willoughby, which is approximately 200 metres west of the Willoughby Road/ Small Street/ Artarmon Road intersection.

The site has a frontage of 200 metres to Artarmon Road along its northern boundary and is bounded by Gore Hill Freeway to the south, Richmond Avenue to the west and Scott Street to the east. The site has a total area of 30,644 square metres and is predominantly surrounded by low and medium density residential land uses. There are also a number of commercial developments in the immediate vicinity, particularly to the east, including a child care facility along Artarmon Road, a car dealership on Willoughby Road and the Willoughby Leisure Centre further east on Small Street.

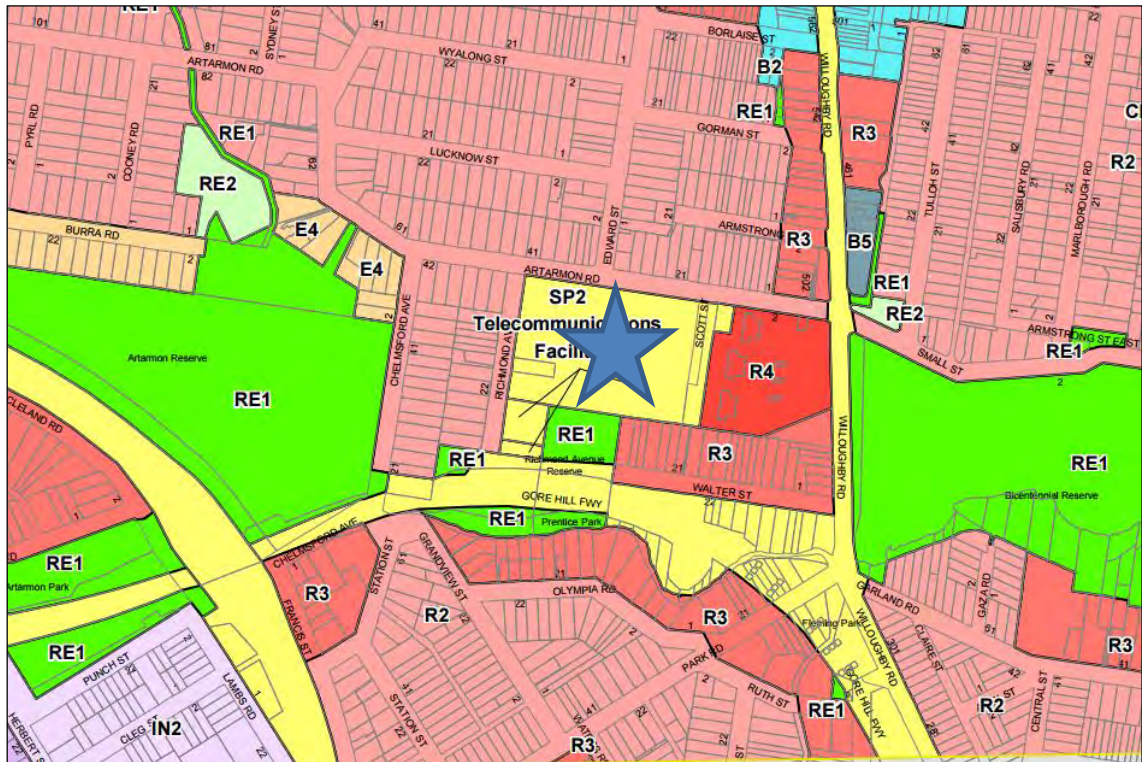
The location of the subject site and its surrounding environs is shown in Figure 2.1 and the current land zoning map is shown in Figure 2.2. The current site access from Artarmon Street is shown in Figure 2.3.

Figure 2.1: Subject site and its environs



Source: Reproduced with permission from Sydway Publishing Pty Ltd

Figure 2.2: Current land zoning map



Source: http://www.legislation.nsw.gov.au/maps/db17cf11-5f70-c22f-acf0-db33d5d22296/8250_COM_LZN_004_010_20121112.pdf, accessed 26 April 2016

Figure 2.3: Existing land use – Nine Network Australia Studio



2.1 Road Network

The following roads are the key collector and arterial roads surrounding the site.

2.1.1 Adjoining Roads

Artarmon Road

Artarmon Road functions as a collector road and in the vicinity of the site is aligned in an east-west direction. It is a two-way road with unrestricted parking permitted on both sides.

Artarmon Road is shown in Figure 2.4 and Figure 2.5.

Figure 2.4: Artarmon Road looking west



Figure 2.5: Artarmon Road at Willoughby Road



Willoughby Road

Willoughby Road is a classified State road (MR 641), which is aligned in a north-south direction. It is a two-way, undivided four-lane road with a carriageway width of approximately 12.9 metres carriageway, set within a road reserve of about 20.6 metres.

Kerbside parking is not permitted at any time on Willoughby Road in the vicinity of the site, with clearway periods during peak times. North of Armstrong Street, there is unrestricted parking (with the exception of Saturday 8am to 4pm) and clearways remain in place during peak periods.

2.1.2 Surrounding Intersections

The following intersections currently exist in the vicinity of the site:

- Artarmon Road, Willoughby Road and Small Street (traffic signals)
- Artarmon Road and Scott Street (priority control)
- Artarmon Road and Edward Street (priority control)
- Artarmon Road and Richmond Avenue (priority control).

2.2 Traffic Volumes

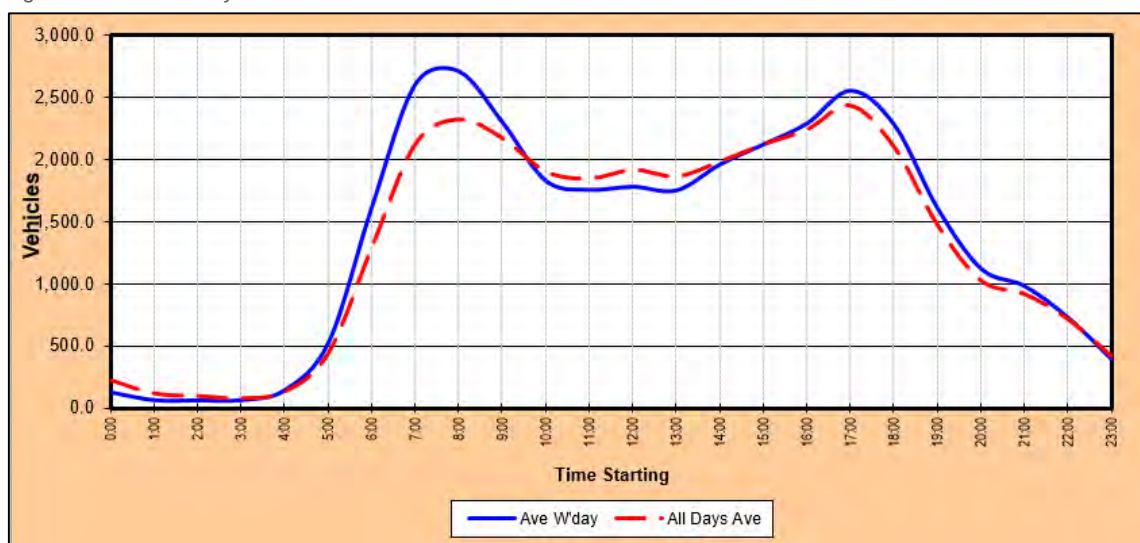
GTA Consultants commissioned traffic turning movement counts on key intersections in the vicinity of the site being Willoughby Road and Artarmon Road/Small Street, Artarmon Road and Richmond Avenue, as well as the intersection of Artarmon Road and Wyalong Street, on a Thursday (12 May 2016) and Saturday (14 May 2016) during the following peak periods:

- 7am to 9am (Thursday)
- 4pm to 6pm (Thursday)
- 9am and 1pm (Saturday)

The AM and PM peak hour traffic volumes are summarised in Appendix A.

In addition to the peak time turning counts, a mid-block tube count was commissioned for a period of seven days on Willoughby Road between its intersection with Artarmon Road and Small Street and Walter Street. The data output illustrated in Figure 2.7 is largely consistent with Roads and Maritime Services (Roads and Maritime) data. Average traffic vehicle movements were 15,365 per day (northbound) and 16,667 per day (southbound). One of the key congestion periods is the weekend during the day, which is reflected in the data with weekends having higher traffic volumes than weekdays between 10am and 2pm. This peak period impacts the operation of the Willoughby Road/ Artarmon Road/ Small Street intersection during weekends, noting that during this period the right turn bans from Willoughby Road into Small Street are not in place.

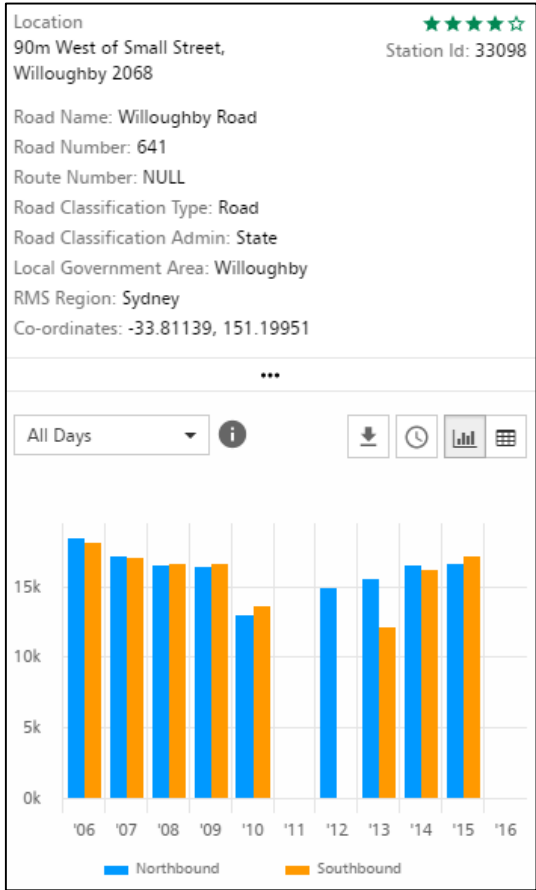
Figure 2.6: Two-way traffic flow on Artarmon Road



Source: Austraffic, data received 25 May 2016

Long term Roads and Maritime counts are publicly available for Willoughby Road between Artarmon Road/ Small Street and Walter Street. The data records establish approximately 16,000 vehicle movements per day (each way) with a moderate degree of variability across the years and a slight upward trend since 2010 (where data is provided), however, volumes remain lower than recorded in 2006.

Figure 2.7: Roads and Maritime Services count data



Source: [RMS Traffic Volume Viewer](#), accessed 26 April 2016

Note: The location description above incorrectly states 'west' of Small Street instead of 'south' if coordinates are utilised

2.3 Intersection Operation

The operation of the key intersections within the study area have been assessed using SIDRA INTERSECTION¹, version 6.1, a computer based modelling package, which calculates intersection performance.

The commonly used measure of intersection performance, as defined by Roads and Maritime, is vehicle delay. SIDRA INTERSECTION determines the average delay that vehicles encounter and provides a measure of the level of service.

Table 2.1 shows the criteria that SIDRA INTERSECTION adopts in assessing the level of service.

Table 2.1: SIDRA INTERSECTION level of service criteria

Level of service	Average delay per vehicle (secs/veh)	Traffic signals, roundabout	Give way and stop sign
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

Table 2.2 presents a summary of the existing operation of the intersection, with full results presented in Appendix B.

Table 2.2: Existing operating conditions (2016)

Intersection	Peak	Degree of saturation (v/c)	Average delay (sec)	95th percentile queue (m)	Level of service ²
Willoughby Road/ Artarmon Road/ Small Street	Thursday AM	0.73	27	222	B
	Thursday PM	0.78	28	278	B
	Saturday	0.82	33	296	C
Artarmon Road/ Edward Street**	Thursday AM	0.25	7	4	A
	Thursday PM	0.24	6	2	A
	Saturday	0.22	6	2	A
Artarmon Road/ Richmond Avenue	Thursday AM	0.25	7	1	A
	Thursday PM	0.22	7	1	A
	Saturday	0.20	7	1	A
Artarmon Road/ Wyalong Street	Thursday AM	0.33	6	15	A
	Thursday PM	0.32	5	15	A
	Saturday	0.28	5	13	A

** Data for Edward Street was extrapolated as the difference in the traffic between Scott Street and Richmond Avenue

On the basis of the above assessment, it is evident that the local road network in vicinity of the site is operating at an acceptable level of service of C or better for the peak periods assessed.

¹ Program used under license from Akcelik & Associates Pty Ltd.

² For intersections without traffic signals, the level of service is reported for the worst movement at the intersection.

2.4 Car Parking

2.4.1 Supply

GTA Consultants undertook a site visit and estimated the current provision and proposed future provision of on-street parking. It is estimated that along the length of Richmond Avenue, Scott Street and Artarmon Road west of Richmond Avenue, there is currently the provision of approximately 107 on-street parking spaces.

Utilising aerial photography of the site, it is estimated that the current Nine Network Australia site has approximately 261 off-street parking spaces, with approximately a further 47 privately allocated spaces on Scott Street.

2.4.2 Demand

An anecdotal review of publicly available car parking in the vicinity of the site indicates that demand for on-street parking is moderate to high, this is consistent with a shortfall of parking associated with the existing Nine Network Australia site due to a high number of car parking with secure access. Artarmon Road has high demand for untimed parking with limited capacity for further parking. Anecdotal observations also indicated a tendency for people to park their vehicles on Artarmon Road and walk to the bus stop on Willoughby Road. This high demand for parking was also observed to spill over onto surrounding local streets such as Edward Street and Richmond Avenue.

2.5 Public Transport

A review of the public transport available in the vicinity of the site is illustrated in Figure 2.8 and summarised in Table 2.3.

Figure 2.8: Sydney Buses map



Source: http://www.sydneybuses.info/routes/Region_guide_North-2015.pdf, accessed 26 April 2016

Table 2.3: Public transport provision

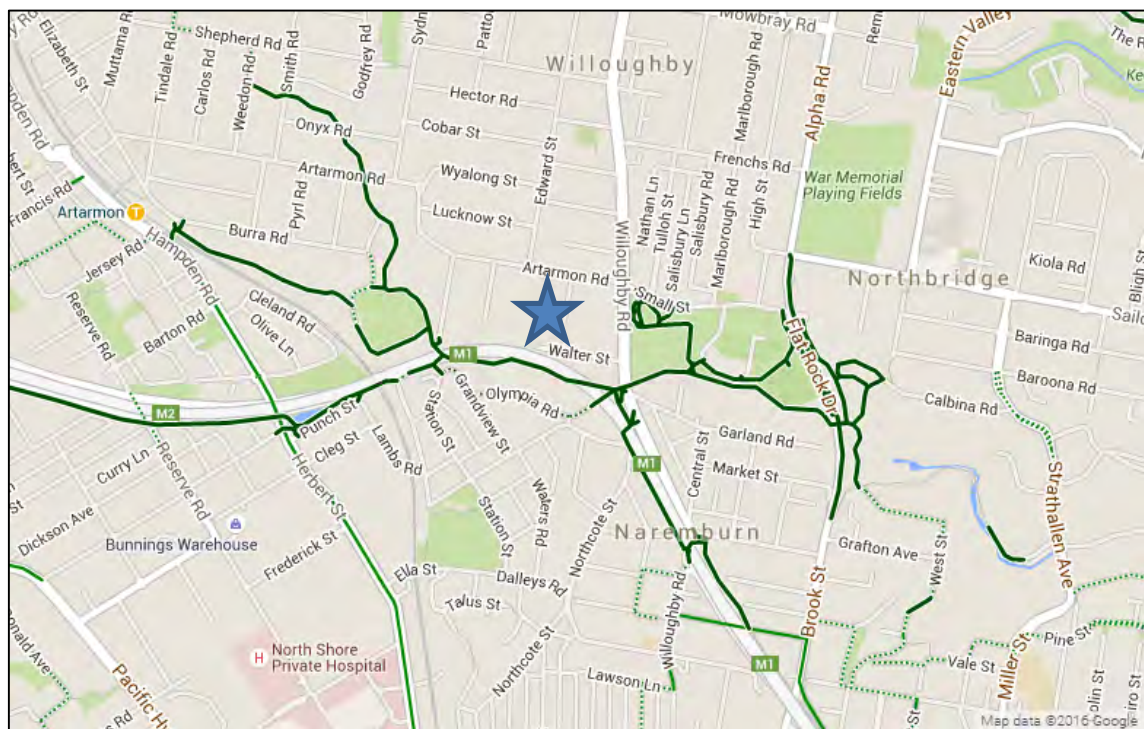
Service	Route number	Route description	Location of stop	Distance to nearest stop	Frequency on/off peak
Bus	272	North Willoughby to Sydney CBD (Wynyard)	Willoughby Road near Artarmon/Small Street	250 m	10 mins/30 mins
Bus	257	Balmoral Beach to Chatswood			20 mins/ 30 mins
Bus	343	Kingsford to Chatswood via Sydney CBD			10 mins/20 mins
Bus	M40	Bondi Junction to Chatswood via Sydney CBD			10 mins/20 mins
Train	T1 North Shore	Hornsby/Epping to Richmond/Penrith via Sydney CBD	Artarmon	1,300 m	3 mins/8 mins

2.6 Pedestrian and Cycle Infrastructure

A well-developed network of footpaths exists in the vicinity of the site with most streets having standard width paths on both sides of the road.

High quality cycling infrastructure exists in close proximity to the site, with the Naremburn cycleway a few hundred metres away to the east or west. This cycleway is arguably one of Sydney's primary cycling corridors and provides largely off-road links to and between various centres such as Chatswood, North Sydney, Macquarie Park, Lane Cove and the Sydney CBD. Linking the development with pedestrian and cyclist facilities to either Artarmon Reserve or Bicentennial Oval would enhance the environment for all community members.

Figure 2.9: Cycle infrastructure



— Separate dedicated cycleways — Dedicated cycling lanes Bicycle-friendly roads

Source: <http://www.sydneycycleways.net/map/>, accessed 26 April 2016

Figure 2.10: High quality cycling infrastructure adjacent to Lane Cove Road west of site

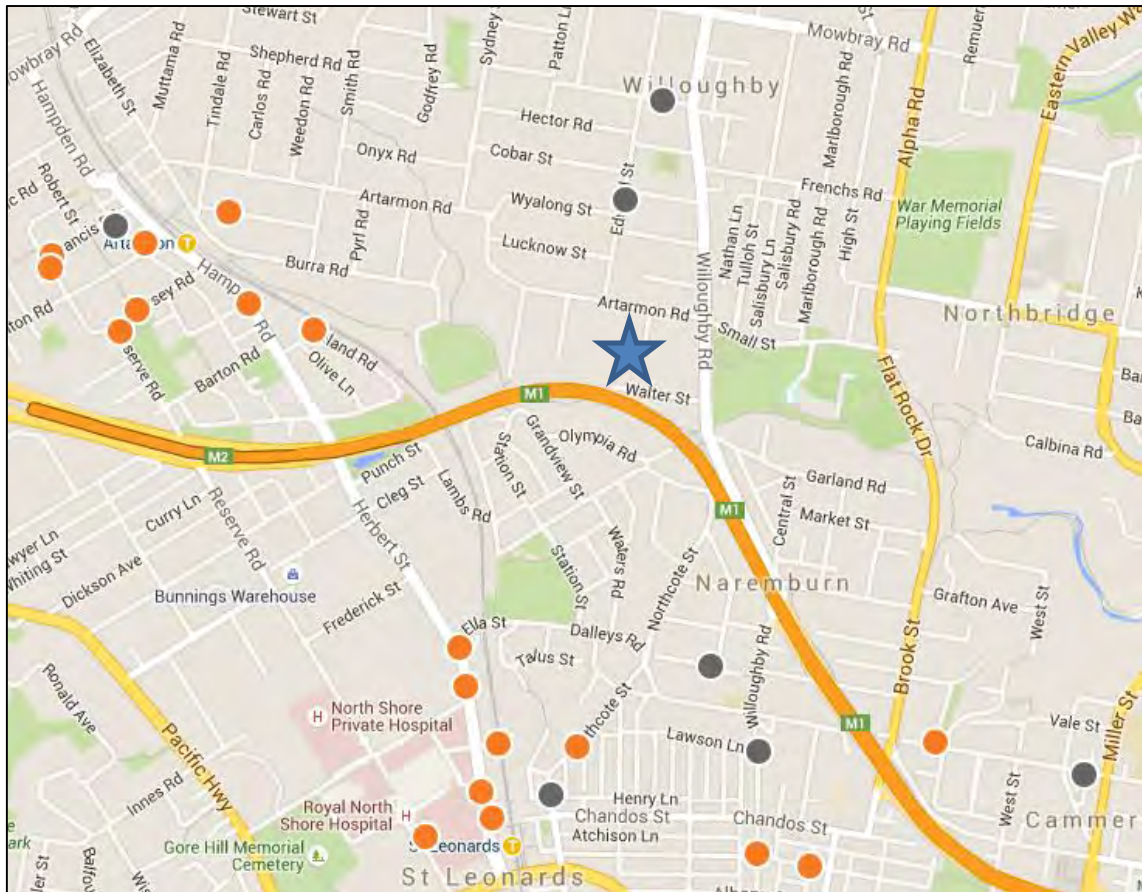


2.7 Local Car Sharing Initiatives

GoGet car sharing service operates a number of share vehicles in the vicinity of the site. Currently, two vehicles are located north of the site on or close to Edward Street. The nearest

being 300 metres away, with higher concentrations of vehicles in close proximity to railway stations (St Leonards and Artarmon).

Figure 2.11: GoGet vehicle map



Source: <https://www.goget.com.au/find-cars/>, accessed 26 April 2016

Note: The differences in the markers show the available (orange) and non-available (grey) vehicles at the time of viewing the map, 26 April 2016 at 1:30pm

3. Development Proposal

3.1 Approved Development

A Concept Plan Approval for a development scheme for 400 apartments has been granted by the Planning and Assessment Commission (PAC) under Part 3A of the EP&A Act. This report details the gross impacts of an application to modify the Concept Plan Approval, which will comprise development of 510 apartments over forecast traffic conditions and provides a comparison between the impacts of the approved concept plan with the modified concept plan proposal.

3.2 Land Uses

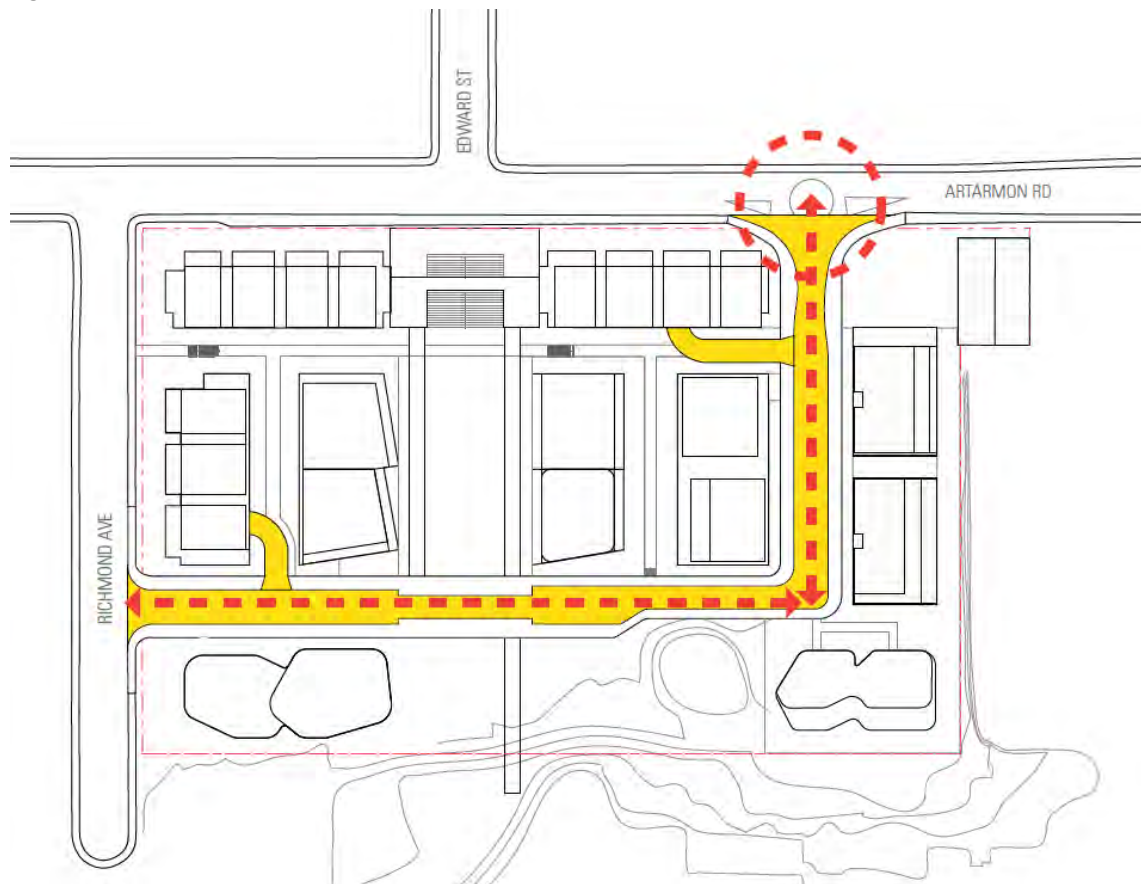
The modified concept plan proposes to include the construction of a residential development with ancillary retail floor space, car parking and open space with a mix of building heights of up to 12 storeys. A total of 510 apartments are proposed, with a preliminary mix of one-bedroom, two-bedroom and three-bedroom units accounting for about 33 per cent, 63 per cent and 5 per cent of the total number of units, respectively.

In addition, 1,322 square metres of commercial floor space is proposed within the development and an additional 415 square metres of retail floor space has been allocated.

3.3 Vehicle Access

Vehicular access to the site is to be achieved by creating an internal road within the site. This road has access points from Artarmon Road and Richmond Avenue as shown in Figure 3.1. This will assist in distributing the traffic generation of the site. The road highlighted yellow (realignment and extension of Scott Street) is to be a local road with driveways to a number of underground carparks for the proposed development.

Figure 3.1: Site access



To facilitate safe access to the site and reduce the speed environment on Artarmon Road a roundabout will be implemented at the new Artarmon Road / Scott Street intersection. This roundabout design will be developed as the design progresses for the site and will take into consideration existing geometry of the corridor and access to adjacent properties, minimising impacts to the existing residential properties on Artarmon Road.

3.4 Car Parking

It has been tentatively identified that car parking will be provided according to the following schedule, which is consistent with Council's DCP, the current concept plan approval (Condition 29) and in line with requirements for developments within major transport corridors and railway precincts:

- 1 bedroom apartments – 1 per dwelling
- 2 bedroom apartments – 1 per dwelling
- 3 bedroom apartments – 1.25 per dwelling
- Visitor parking – 1 per 4 dwellings

Provision of disabled and adaptable parking requirements will be provided in accordance with Council's DCP (pages C4 to 5, Willoughby DCP).

Parking for the proposed commercial and retail use will be provided in accordance with Council's DCP requirements for one space per 110 square metres for office and business space within major transport corridors and railway precincts for one space per 25 square metres for retail.

At this stage, residential community infrastructure such as pools, gyms and childcare facilities are yet to be confirmed.

The provision of motorcycle parking will be confirmed as the design progresses for the proposed development.

The car parking provision, its suitability for the development and layout is discussed in Section 4 of this report.

3.5 Pedestrian Facilities

A pedestrian refuge will be provided on Artarmon Road, west of Edward Street. Condition 17 of the concept approval requires this to be upgraded to a pedestrian crossing if warrants are met.

The provision of additional pedestrian facilities within and immediately surrounding the site is yet to be confirmed, however, all new roads shall have footpaths and where possible, additional internal links shall be provided to facilitate pedestrian access within and surrounding the site. All facilities will comply with Austroads Guide to Road Design: 6A – Providing for cyclists and pedestrians and Council's requirements.

The suitability of the proposed pedestrian facilities is discussed in Section 5.2 of this report.

3.6 Bicycle Facilities

The provision of bicycle facilities is yet to be confirmed. Notwithstanding, sufficient bicycle parking shall be provided as part of the development consistent with Council's DCP.

The suitability of the bicycle provisions is discussed in Section 5.3 of this report.

3.7 Loading and Waste Collection Areas

Bulk waste disposal will be preferred due to the size of the development. Twice-weekly general garbage collection is proposed, along with weekly recycling collection. This will be confirmed as development applications for buildings are submitted to Council in the future.

Council's DCP requires that the design for waste collection on private property has a minimum unobstructed height clearance of 3.8 metres over all areas traversed by Council's refuse collection (pages 8 to 3, Willoughby DCP).

4. Car Parking

4.1 Car Parking Requirements

The car parking provision requirements for different development types are set out in Council's DCP – Part C and the rates approved for the approved concept plan (Condition 29). A review of the car parking requirement rates and the floor area schedule results in a statutory parking requirement for the proposed development and is summarised in Table 4.1.

Table 4.1: Statutory car parking requirements for 510 dwellings

Use	Size/ number (% of dwellings)	Statutory parking rate	Statutory parking requirement
Residential (510)	1 bedroom (33%)	1/dwelling (166)	166
	2 bedrooms (63%)	1/dwelling (320)	320
	3 bedrooms (5%)	1.25/dwelling (24)	30
	Visitor	1 / 4 dwellings	128
<i>Residential Sub-Total</i>			<i>644</i>
Commercial	1,322 m ²	1/110m ²	13
Retail	415 m ²	1/25m ²	17
<i>Mixed Sub-Total</i>			<i>30</i>
Total		674 spaces	

Based on the above, the proposed development is required to provide 674 car parking spaces. The proposed development will meet these statutory parking provisions providing sufficient parking on site for the proposed land uses.

4.2 Adequacy of On-street Parking Supply

Future works associated with the proposed roundabout is likely to result in some loss of on-street parking on Artarmon Road. This on-street parking loss will be offset by the increase of on-street public parking on Scott Street. It is estimated that the provision of on-street parking bounded by the same area as above, with the inclusion of new parking on Scott Street will be up to approximately 107 spaces. This is in addition to the proposed off-street parking provision specified in Section 4.1. Table 4.2 summarises the existing and proposed on-street parking provision.

Table 4.2: On-street public parking provision

Location	Current estimate	Revised development estimate (change from existing)
Richmond Avenue (west side)	17	17 (0)
Richmond Avenue (east side)	26	19 (-7)
Artarmon Road (north side) (between Richmond Avenue and Edward Street)	4	4 (0)
Artarmon Road (north side) (between Edward Street and Willoughby Road)	28	12 (-16)
Artarmon Road (south side) (between Willoughby Road and Richmond Avenue)	23	17 (-6)
Scott Street	9	38 (+29)
Total	107	107 (0)

On the basis of the empirical assessment of the expected demand, the on-site car parking provision is expected to be capable of accommodating the car parking demands associated with the proposed development with minimal overflow onto the existing local road network.

The approved concept plan comprises two roundabouts to be constructed on Artarmon Road. The construction of the second roundabout would result in an overall reduction of on-street parking on Artarmon Road. Therefore, the revised concept plan has less impact on on-street parking provision compared with the approved concept plan.

As part of the development, it is understood the Department of Planning and Environment and Council support a reduced rate of parking supply requirement given the proximity of the site to existing transport facilities including buses on Willoughby Road.

4.3 Car Park and Site Access Design Review

The roundabout to be located on Artarmon Road at Scott Street has been designed such that full access will be able to be accommodated for an 8.8 metre medium rigid vehicle (Austroads service vehicle). In addition, it has been designed such that 12.5-metre heavy rigid vehicles will be able to be accommodated for through movements along Artarmon Road.

The car park accesses have been assessed and all nominated access points have been designed to accommodate two 99 percentile vehicles (cars) passing each other. The swept path analysis for the proposed car park accesses is provided in Appendix C.

As the design for the proposed development progresses, the car park layout will be designed in accordance with the requirements of the Australian Standard for off street car parking (AS/NZS2890.1:2004 and AS/NZS2890.6:2009).

5. Traffic Impact Assessment

5.1 Traffic Generation

5.1.1 Design Rates

Traffic generation estimates for the proposed development are based on the *Guide to Traffic Generating Developments* (Roads and Maritime, October 2002) and *Technical Direction (TDT 2013/04a) Guide to Traffic Generating Developments Updated traffic surveys* (Roads and Maritime, August 2013). For the purposes of this report, a peak hour traffic generation rate of 0.32 vehicle trips per dwelling was adopted for weekdays and 0.25 vehicle trips per dwelling on Saturdays. These rates are also consistent with the Arup report, which was commissioned by the former NSW Department of Planning and Infrastructure to provide an independent assessment of the proposed development.

Estimates of peak hour and daily traffic volumes resulting from the proposal for 510 dwellings are summarised in Table 5.1.

Table 5.1: Traffic generation estimates

Period	Traffic generation rate	Vehicle movements	Increase in number of vehicle movements from approved 400 dwellings
	Movements/ dwelling	Total	Total
AM Peak	0.32/peak hr	164/hr	36/hr
PM Peak	0.32/peak hr	164/hr	36/hr
Saturday Peak	0.25/peak hr	128/hr	28/hr
Daily	1.52/day	776/day	167/day

Table 5.1 indicates that the site could potentially generate up to 164 vehicle movements in any peak hour, which equates to an additional 36 vehicle movements per peak hour from the approved concept plan of 400 dwellings. The site would generate around 776 vehicle movements over the entire day, which is an additional 167 vehicle movements per day from approved development of 400 dwellings. It is to be noted that this estimate is based on traffic for the residential component of the development. The additional traffic likely generated by the retail and commercial spaces is expected to be around six to seven trips in the peak hours, which is considered negligible relative to the residential aspect of the development. These traffic volumes have been considered in this assessment. The type of commercial and retail uses proposed for the development is uncertain and will be determined as the design progresses and tenants are confirmed.

For the purpose of this assessment, it is assumed that the following inbound and outbound vehicle trips would be associated with the proposed development, based on similar developments in comparable study areas:

- AM peak hour: 85 per cent outbound / 15 per cent inbound
- PM peak hour: 30 per cent outbound / 70 per cent inbound
- Saturday peak hour: 50 per cent outbound / 50 per cent inbound.

The Arup report indicates that the existing Nine Network Australia Studio site generates up to 198 and 176 movements in AM and PM peak hours, respectively. There is a net reduction of 28 and six movements, respectively that can be expected in the weekday AM and PM peak periods,

respectively (based on the development of 510 dwellings). The Arup report outlines the Nine Network Australia site generates about 24 movements on a Saturday peak hour and the site is forecast to generate a net increase of 104 movements in a peak hour (based on the development of 510 dwellings).

It is noted that the current traffic generated by the Nine Network Australia Studio site has the majority of traffic travelling inbound during the AM peak and outbound during the PM peak, which is the reverse for the traffic generated by the proposed development. This directional split has been considered in the assessment of the impacts and the modelling presented in Section 5.3.

5.2 Distribution and Assignment

The directional distribution and assignment of traffic generated by the proposed development will be influenced by a number of factors, including the:

- i Configuration of the arterial road network in the immediate vicinity of the site
- ii Existing operation of intersections providing access between the local and arterial road network
- iii Surrounding employment centres, retail centres and schools in relation to the site
- iv Configuration of access points to the site.

Having considered the above, for the purposes of estimating vehicle movements, the following directional distributions have been assumed and are consistent with the Arup report:

- o Willoughby Road northbound 29%
- o Willoughby Road southbound 43%
- o Artarmon Road westbound 28%.

Appendix A contains the post development traffic count forecasts.

5.3 Traffic Impact

The traffic impact was assessed for key intersections surrounding the site using SIDRA INTERSECTION. The assessment excludes traffic generated by the existing Nine Network Australia land use and includes the traffic generation estimates for the proposed residential development.

Table 5.2 presents the findings from the intersection analysis with the proposed development traffic for 510 dwellings, compared with the approved development of 400 dwellings.

Table 5.2: Operating conditions with development

Intersection	Peak	Current level of service ³	Approved 400 dwellings				510 Dwellings <i>without intersection</i> upgrade			
			Degree of saturation (v/c)	Average delay (sec)	95th percentile queue (m)	Forecast level of service	Degree of saturation (v/c)	Average delay (sec)	95th percentile queue (m)	Forecast level of service
Willoughby Road/ Artarmon Road/ Small Street	Thursday AM	B	0.73	28	232	B	0.77	30	246	C
	Thursday PM	B	0.80	28	284	B	0.81	29	296	C
	Saturday	C	0.85	34	309	C	0.86	35	323	C
Artarmon Road/ Scott Street	Thursday AM	Not calculated	0.37	5	18	A	0.38	5	19	A
	Thursday PM	Not calculated	0.31	4	14	A	0.33	4	15	A
	Saturday	Not calculated	0.27	4	12	A	0.28	4	12	A
Artarmon Road/ Edward Street	Thursday AM	A	0.23	6	4	A	0.23	6	4	A
	Thursday PM	A	0.23	6	2	A	0.23	8	2	A
	Saturday	A	0.22	6	2	A	0.22	6	2	A
Artarmon Road/ Richmond Avenue	Thursday AM	A	0.24	6	1	A	0.24	6	1	A
	Thursday PM	A	0.22	7	2	A	0.22	7	2	A
	Saturday	A	0.21	6	1	A	0.21	6	1	A
Artarmon Road/ Wyalong Street	Thursday AM	A	0.32	6	14	A	0.32	6	14	A
	Thursday PM	A	0.30	5	14	A	0.31	5	15	A
	Saturday	A	0.28	5	13	A	0.29	5	13	A

³ For intersections without traffic signals, the level of service is reported for the worst movement at the intersection.

The traffic forecasts for the site were added to existing 2016 traffic counts, subtracting Nine Network Australia site generation. It is noted:

- One intersection will operate at an acceptable level of service of C, under forecast traffic volumes with the proposed development of 510 dwellings
- Four intersections will operate at a level of service of A, under forecast traffic volumes with the proposed development of 510 dwellings
- Compared with the approved development of 400 dwellings, the levels of service marginally decrease from B to C on weekdays, however, intersections still operate at an acceptable level of service
- The weekday AM peak queue along Artarmon Road may approach the proposed roundabout. The SIDRA analysis shows a forecast 95th percentile queue length of 118 metres. Compared with the approved development of 400 dwellings, which has a forecast 95th percentile queue length of 111 metres, the modified development results in additional seven metres or the length of one queued car.

In summary, future traffic volume estimates in the vicinity of the site and the additional traffic generated by the proposed development are not forecast to compromise the safety or function of the surrounding road network, with the exception of potential queuing to the proposed roundabout during the AM peak period (refer to Section 5.4). The movements are to add to the existing capacity constraints of the Willoughby Road/ Artarmon Road/ Small Street intersection, and proposed upgrade works are outlined in Section 5.4.

5.4 Mitigating Measures and Intersection Works

As a consequence of previous developments in the surrounding area, existing network constraints and this development, two changes to the road network are proposed.

5.4.1 Roundabout construction

It is anticipated that there will be a requirement for the construction of a roundabout at the intersection of the access road (realigned Scott Street) and Artarmon Road (the current approval proposes two roundabouts to be constructed on Artarmon Road). This is partially a consequence of the traffic generation of the site, but the implementation of this would have positive traffic calming impacts to Artarmon Road in slowing traffic where sightlines can be considered inadequate. The roundabout will be designed in accordance with Austroads and Council requirements and would consider road geometry, existing residential accesses and minimise impacts to existing residential properties along Artarmon Road.

5.4.2 Intersection upgrade

To improve the level of service of the intersection of Willoughby Road/ Artarmon Road/ Small Street and reduce queuing on Artarmon Road on the approach to this intersection, the developer has committed to contributing a \$3 million Voluntary Planning Agreement (VPA) contribution for Council's planned upgrade of the intersection. This will be subject to negotiation with Council. This proposed upgrade will provide a 100 metre right turn bay for northbound vehicles on Willoughby Road and provide a slip left turn lane out of Small Street into Willoughby Road.

Figure 5.1 provides a preliminary sketch of the proposed intersection layout for the upgrade of Willoughby Road/ Artarmon Road/ Small Street. The design of this proposed upgrade will need to

refine what was prepared for Council as part of the Willoughby Leisure Centre upgrade study and would be subject to a more detailed assessment of constraints prior to implementation.

Figure 5.1: Willoughby Road/ Artarmon Road/ Small Street GTA concept layout



Source: Willoughby Leisure Centre Expansion – Traffic and Parking Study (GTA Consultants, May 2012)

Table 5.3 to Table 5.5 demonstrate the existing conditions, the impact of the approved 400 dwellings, as well as the impact of 510 dwellings with and without the upgrade of Willoughby Road/ Artarmon Road/ Small Street intersection. It is to be noted that the phasing of the proposed intersection upgrade is based on existing phase times and queue lengths could be further improved through a review of phase times. This would be coordinated with Roads and Maritime as the design is progressed.

Table 5.3: Willoughby Road-Small Street/ Artarmon Road intersection level of service and average delay (seconds)

Time period	Existing	400 dwellings	510 dwelling without upgrade	510 dwellings with upgrade
Thursday AM	B (27)	B (28)	C (30)	B (26)
Thursday PM	B (28)	B (28)	C (29)	B (25)
Saturday	C (33)	C (34)	C (35)	C (35)

Table 5.4: Artarmon Road queue length (metres)

Time period	Existing	400 dwellings	510 dwelling without upgrade	510 dwellings with upgrade
Thursday AM	99	111	118	115
Thursday PM	96	91	95	92
Saturday	101	108	111	104

Table 5.5: Richmond Avenue south leg movements (delay in seconds)

Time period	Existing	400 dwellings	510 dwellings
Thursday AM	7	6	6
Thursday PM	7	7	7
Saturday	7	6	6

A SIDRA analysis of the proposed intersection layout indicates that the intersection will operate at an acceptable level of service of C or better during AM, PM and Saturday peak periods. With the increase in the number of dwellings from 400 to 510, the level of service reduces from B to C, which is attributed to minor increase in average delay of one to two seconds per vehicle. This level of increase and the forecast level of service is not considered to trigger the requirement for the upgrade of the intersection as a result of the revised concept plan.

Queuing on Artarmon Road is a key issue raised by the community. The queue lengths shown in Table 5.4 indicate 95th percentile queue lengths for the western approach to Willoughby Road. The impact of 510 dwellings with the intersection upgrade represents minor increases compared with current conditions. This increase represents an additional two to three vehicles queued, which is considered insignificant. The existing queues on Artarmon Road extend beyond the Castle Vale access. Therefore, the proposed development is unlikely to further impact access to the Castle Vale site. It is noted that the upgrade scenario assessed does not propose any phase timing changes. It is estimated that with a shorter overall phase sequence for the intersection would reduce traffic queues on Artarmon Road and further reduce the potential for impacts to the Castle Vale site and the proposed roundabout.

The Concept Plan Approval for the 400 dwellings included the implementation of roundabout control of the Artarmon Road/ Richmond Avenue intersection. Based on the analysis conducted for this assessment, the existing intersection control is satisfactory for accommodating the forecast traffic movements for the proposed development of 510 dwellings and a roundabout is not required.

Under the proposed road network for the site, the loop road from Artarmon Road to Richmond Avenue, via a new access road (formed by the realignment of Scott Street) is proposed as a two-way local road. The estimated volume of traffic on the east-west aligned section of the loop road is minimal, with the majority of traffic accessing the site via the proposed roundabout at the Artarmon Road/ Scott Street intersection. Should the access to Richmond Avenue be restricted to one-way into the proposed development, the impacts are likely to be negligible.

Sufficient resident and visitor parking is proposed to be provided within the development site. However, to mitigate the potential impact of vehicles parking within the existing residential streets as a result of the proposed development, it is recommended that the developer consults with Council to implement a resident parking scheme for the local roads. It is common practice to implement resident parking schemes adjacent to high density residential developments to minimise the impacts of on-street parking within the local road network.

Further exploration of car sharing vehicle opportunities should be examined as part of the development to further reduce the demand for parking. An SGS Economics and Planning report⁴ highlighted that the benefit cost ratio (BCR) of car sharing is approximately 20:1. Evidence from this report demonstrates on average 22 community members utilising one shared vehicle.

It is understood that Willoughby Road has been tentatively identified as a strategic bus corridor, which will likely result in new routes and higher frequency of buses in the future. Further, it might be appropriate that an east-west bus link route can be provided that links the site with Artarmon railway station.

5.5 Future Transport Infrastructure

The existing bus services along Willoughby Road are often at capacity during peak periods with buses travelling towards the CBD in the AM peak observed to bypass the nearest bus stop to the development on Willoughby Road. With the introduction of the Sydney Metro and the CBD light rail extension, it is anticipated that the regional public transport services will be reviewed to provide increased capacity and improved efficiency in bus services in the study area.

The Sydney Metro will develop new stations through the north shore area. As outlined in the Environmental Impact Statement for the project, a station has tentatively been identified at the Pacific Highway and Oxley Street. This represents a distance of 2.5 kilometres from the proposed development to gain access to modern, high quality transport infrastructure. Bus services linking the community to the metro station should be a key future consideration.

5.6 Safety

The proposed roundabout intersection of the access road to the development and Artarmon Road has some geometry constraints associated with being located on a grade. These constraints will be addressed to provide a safe roundabout design that meets the sight distance requirements in accordance with Austroads. The introduction of a roundabout on Artarmon Road is likely to reduce the speed environment along Artarmon Road during off-peak periods, which would improve safety for all road users.

A pedestrian refuge may be provided on Artarmon Road, west of Edward Street, which will provide improved safety for pedestrians crossing at this location and facilitate pedestrian access to the proposed development site.

Swept path analyses have been carried out to assess the proposed vehicular access to the site and the proposed off-street parking areas. These swept path analyses confirm that vehicles likely to access the proposed development would be able to perform the required manoeuvres without encroaching oncoming traffic lanes or leaving the carriageway.

⁴ http://www.cityofsydney.nsw.gov.au/_data/assets/pdf_file/0012/122502/CarShareEconomicAppraisalFINALREPORT.pdf, accessed 20 May 2016

6. Conclusion

6.1 Secretary's Environmental Assessment Requirements (SEARs)

Table 6.1 summarises the responses to the SEARs issued for the proposed development on 16 May 2016.

Table 6.1: Addressing SEARs comments

SEARs comment	GTA response
Daily and peak traffic movements likely to be generated by the development including the impact on surrounding intersections and the need for upgrades/improvements, specifically addressing Willoughby Road/Artarmon Road-Small Street	Up to 776 and 164 traffic movements can be expected to be generated by the development daily and in a peak hour respectively by the residential component. This equates to an additional 167 daily and 36 peak hour traffic movements compared with the Concept Plan Approval for 400 dwellings. The impact of this generation has been modelled on a number of surrounding intersections, including the Willoughby Road/Artarmon Road-Small Street intersection and with proposed upgrade works. The intersections are forecast to operate at an acceptable level of service of C or better for all peak periods after the development of 510 dwellings is complete. Notwithstanding the acceptable intersection performance with the traffic generated by the proposed development, the developer proposes to contribute \$3 million by way of a VPA to upgrade the intersection of Willoughby Road/ Artarmon Road-Small Street.
Details of proposed accesses and the parking provision associated with the development	An access street adjacent to the existing Scott Street will be constructed and will be connected to Richmond Avenue. This street will accommodate all off street parking access associated with the development. Detailed design has not been undertaken of the car parking facilities, but in due course, these will be designed consistent with Australian Standards.
Proposed number of car parking spaces and compliance with the appropriate parking codes	The development will require the removal of some on-street parking on Artarmon Road which will be offset by new parking on Scott Street. A parking rate has been agreed to with Council (consistent with the DCP) and the Department of Planning and Environment. The development will be required to provide 674 parking spaces based on the proposed land uses proposed.
Details of service vehicle movements	Service vehicle movements have not been confirmed, but access has been considered with the roundabout on Artarmon Road able to accommodate a medium rigid vehicle turning into Scott Street. Bulk waste disposal will be preferred due to the size of the development. The development will be required to be in the basement with a minimum height clearance of 3.8 metres consistent with access requirements.

6.2 Conclusion

Based on the analysis and discussions presented within this report, the following conclusions are made:

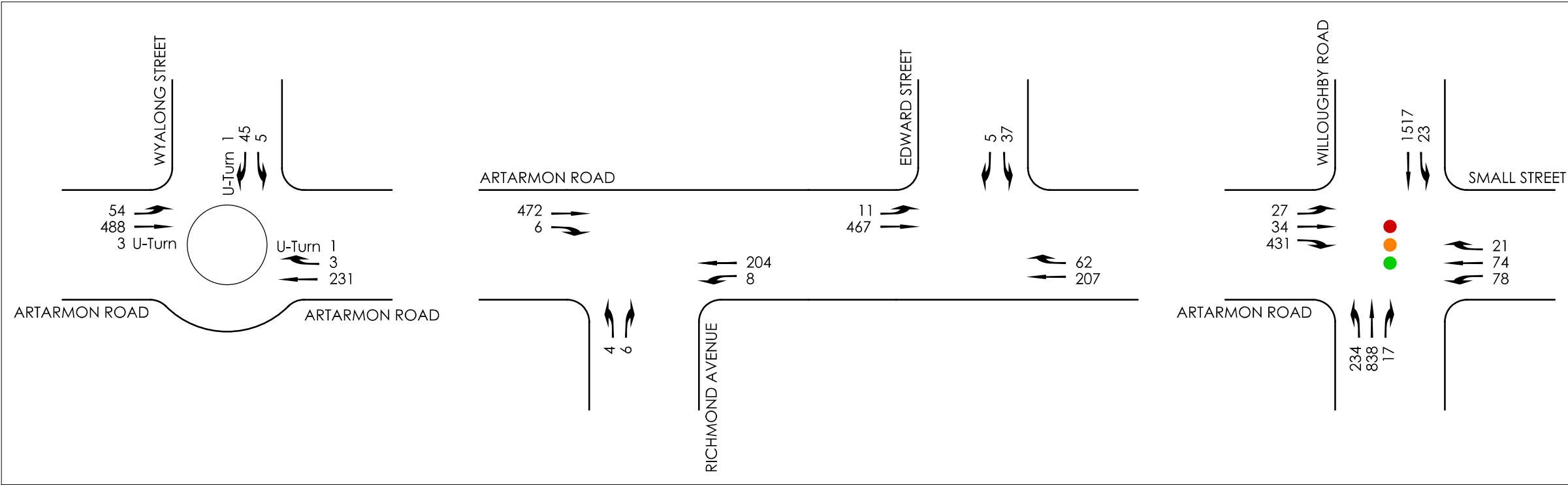
- i A redevelopment of the existing Nine Network Australia site on Artarmon Road in Willoughby is proposed with 510 apartments and ancillary retail space. This is an additional 110 dwellings compared with the approved development of 400 dwellings.
- ii The proposed development generates a statutory parking requirement of 674 spaces, for the presently nominated land uses proposed.
- iii The proposed parking supply is consistent with the rates which have been previously agreed.

- iv The proposed parking layout is to be consistent with the dimensional requirements as set out in Council's Planning Scheme and Australian/New Zealand Standard for Off Street Car Parking (AS/NZS2890.1:2004 and AS/NZS2890.6:2009).
- v The provision of loading facilities is to be more carefully considered as part of the future development application process.
- vi The residential aspect of the site is expected to generate up to 164 and 776 vehicle movements in any peak hour and daily respectively. This equates to an additional 36 peak hour and 167 daily traffic movements compared with the Concept Plan Approval for 400 dwellings.
- vii There is adequate capacity in the surrounding road network to cater for the traffic generated by the proposed development when the appropriate mitigation measures are adopted. The analysis considers the impacts of reversing the directional split of traffic during peak periods when comparing the existing Nine Network Australia with the proposed development.
- viii A \$3 million contribution as part of VPA will be allocated to Council's planned upgrade of the Willoughby Road/Artarmon Road-Small Street intersection. Additionally, a new roundabout is proposed for the access road to the development and Artarmon Road intersection near Scott Street.
- ix Any potential adverse effects from land use development proposals on road safety and operational efficiency are identified and, where necessary, mitigating road improvement works as part of the development costs are recommended to minimise these effects and retain, within practical limitations, the level of safety and operational efficiency that would have existed without the development.
- x A construction management plan should be prepared for the development prior to commencement of work.

Appendix A

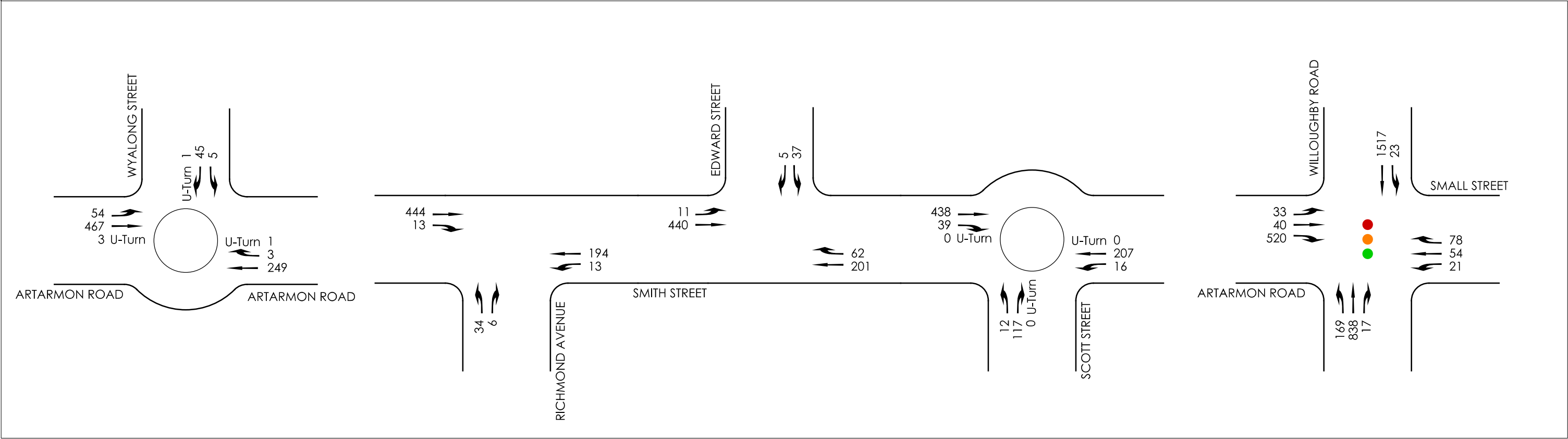
Existing and Forecast Traffic Volumes

THURSDAY AM PEAK HOUR



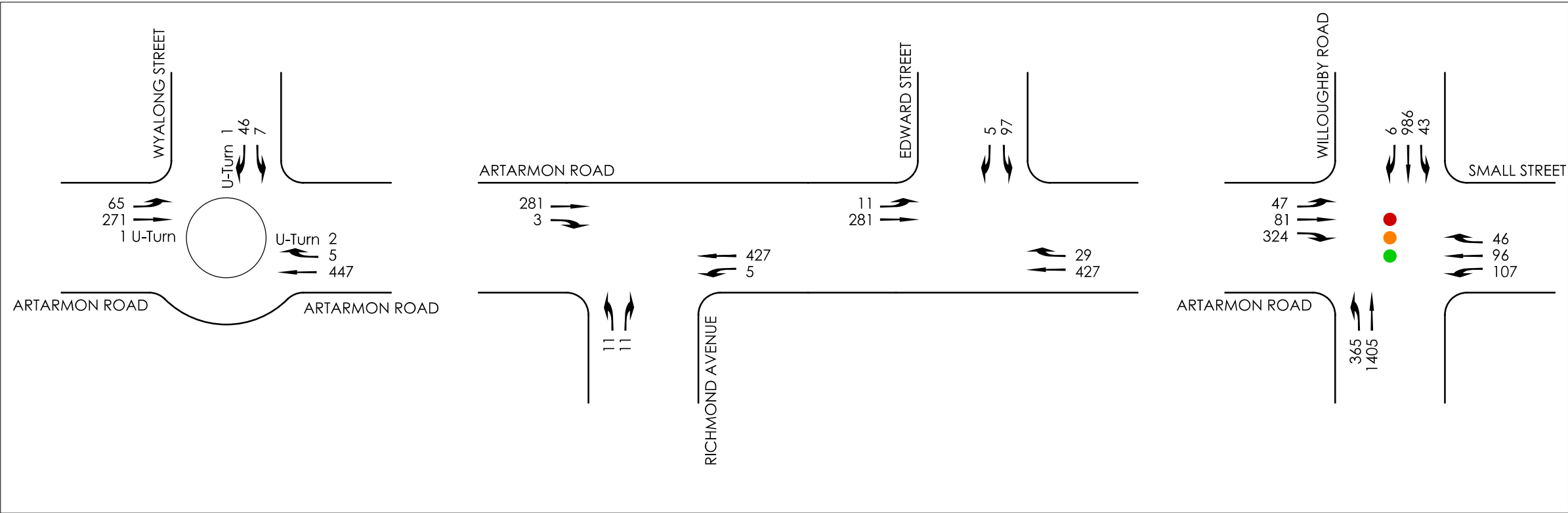
GTA CONSULTANTS MARK-UP
16S1405100 - CHANNEL 9 SITE REDEVELOPMENT
15/6/16

EXISTING TRAFFIC VOLUMES



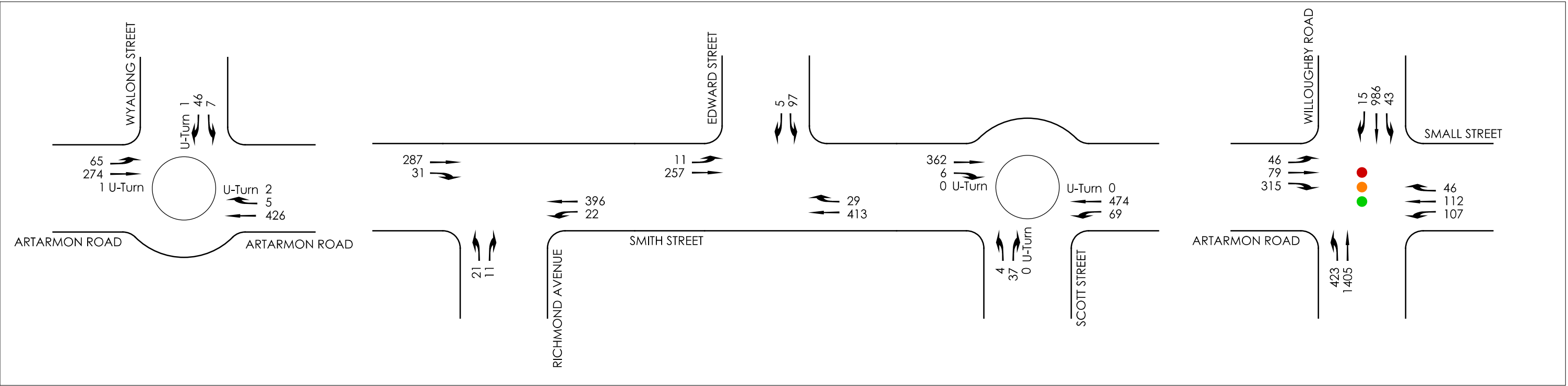
POST DEVELOPMENT TRAFFIC VOLUMES

THURSDAY PM PEAK HOUR



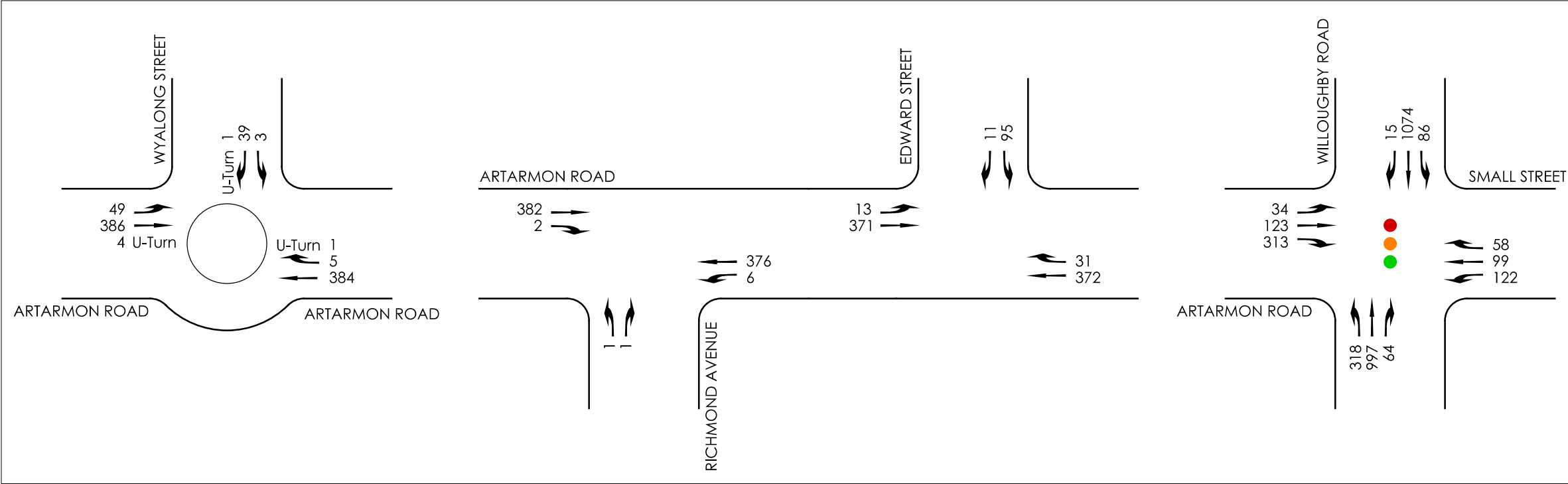
GTA CONSULTANTS MARK-UP
16S1405100 - CHANNEL 9 SITE REDEVELOPMENT
15/6/16

EXISTING TRAFFIC VOLUMES



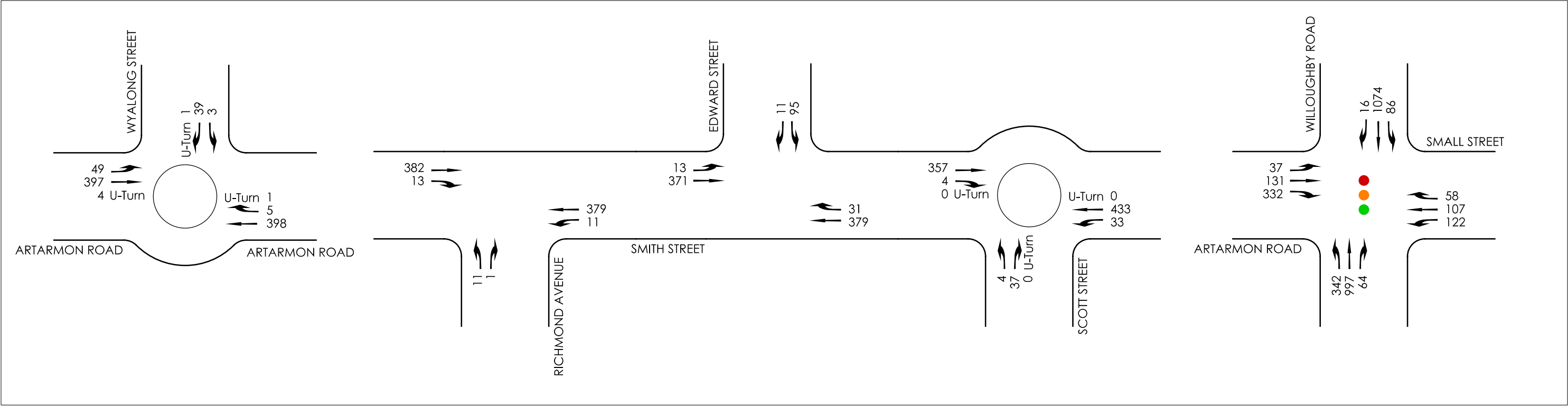
POST DEVELOPMENT TRAFFIC VOLUMES

SATURDAY PEAK HOUR



GTA CONSULTANTS MARK-UP
16S1405100 - CHANNEL 9 SITE REDEVELOPMENT
15/6/16

EXISTING TRAFFIC VOLUMES



POST DEVELOPMENT TRAFFIC VOLUMES

Appendix B

SIDRA INTERSECTION Results

MOVEMENT SUMMARY

▽ Site: Edward St/ Artarmon Rd - Sat Midday 400

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		veh	m		per veh	km/h
East: Artarmon Rd											
11	T1	377	0.8	0.220	0.2	LOS A	0.3	2.2	0.10	0.04	49.5
12	R2	31	0.0	0.220	6.3	LOS A	0.3	2.2	0.10	0.04	48.8
Approach		407	0.8	0.220	0.7	NA	0.3	2.2	0.10	0.04	49.4
North: Edward St											
1	L2	95	0.0	0.082	5.9	LOS A	0.3	2.2	0.41	0.61	45.7
3	R2	11	0.0	0.018	8.5	LOS A	0.1	0.4	0.55	0.73	44.0
Approach		105	0.0	0.082	6.2	LOS A	0.3	2.2	0.43	0.62	45.5
West: Artarmon Rd											
4	L2	13	0.0	0.197	4.6	LOS A	0.0	0.0	0.00	0.02	49.4
5	T1	371	0.0	0.197	0.0	LOS A	0.0	0.0	0.00	0.02	49.9
Approach		383	0.0	0.197	0.2	NA	0.0	0.0	0.00	0.02	49.9
All Vehicles		896	0.4	0.220	1.1	NA	0.3	2.2	0.09	0.10	49.1

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Edward St/ Artarmon Rd - Sat Midday 510

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		veh	m		per veh	km/h
East: Artarmon Rd											
11	T1	379	0.8	0.221	0.2	LOS A	0.3	2.2	0.10	0.04	49.5
12	R2	31	0.0	0.221	6.3	LOS A	0.3	2.2	0.10	0.04	48.8
Approach		409	0.8	0.221	0.7	NA	0.3	2.2	0.10	0.04	49.4
North: Edward St											
1	L2	95	0.0	0.082	5.9	LOS A	0.3	2.2	0.41	0.61	45.7
3	R2	11	0.0	0.018	8.5	LOS A	0.1	0.4	0.55	0.73	44.0
Approach		105	0.0	0.082	6.2	LOS A	0.3	2.2	0.43	0.62	45.5
West: Artarmon Rd											
4	L2	13	0.0	0.197	4.6	LOS A	0.0	0.0	0.00	0.02	49.4
5	T1	371	0.0	0.197	0.0	LOS A	0.0	0.0	0.00	0.02	49.9
Approach		383	0.0	0.197	0.2	NA	0.0	0.0	0.00	0.02	49.9
All Vehicles		898	0.4	0.221	1.1	NA	0.3	2.2	0.09	0.10	49.1

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Edward St/ Artarmon Rd - Sat Midday Ex

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		veh	m		per veh	km/h
East: Artarmon Rd											
11	T1	372	0.8	0.217	0.2	LOS A	0.3	2.2	0.10	0.04	49.5
12	R2	31	0.0	0.217	6.3	LOS A	0.3	2.2	0.10	0.04	48.8
Approach		402	0.8	0.217	0.7	NA	0.3	2.2	0.10	0.04	49.4
North: Edward St											
1	L2	95	0.0	0.082	5.9	LOS A	0.3	2.2	0.41	0.61	45.7
3	R2	11	0.0	0.018	8.5	LOS A	0.1	0.4	0.55	0.72	44.0
Approach		105	0.0	0.082	6.2	LOS A	0.3	2.2	0.43	0.62	45.5
West: Artarmon Rd											
4	L2	13	0.0	0.197	4.6	LOS A	0.0	0.0	0.00	0.02	49.4
5	T1	371	0.0	0.197	0.0	LOS A	0.0	0.0	0.00	0.02	49.9
Approach		383	0.0	0.197	0.2	NA	0.0	0.0	0.00	0.02	49.9
All Vehicles		891	0.4	0.217	1.1	NA	0.3	2.2	0.09	0.10	49.1

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Edward St/ Artarmon Rd - Thurs AM 400

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		veh	m		per veh	km/h
East: Artarmon Rd											
11	T1	198	0.5	0.157	0.8	LOS A	0.6	4.0	0.29	0.15	48.5
12	R2	62	0.0	0.157	6.5	LOS A	0.6	4.0	0.29	0.15	47.8
Approach		260	0.4	0.157	2.2	NA	0.6	4.0	0.29	0.15	48.3
North: Edward St											
1	L2	37	0.0	0.034	6.1	LOS A	0.1	0.9	0.44	0.61	45.6
3	R2	5	0.0	0.008	7.9	LOS A	0.0	0.2	0.51	0.67	44.3
Approach		42	0.0	0.034	6.4	LOS A	0.1	0.9	0.45	0.61	45.4
West: Artarmon Rd											
4	L2	11	20.0	0.232	4.8	LOS A	0.0	0.0	0.00	0.01	49.1
5	T1	440	0.2	0.232	0.0	LOS A	0.0	0.0	0.00	0.01	49.9
Approach		451	0.7	0.232	0.1	NA	0.0	0.0	0.00	0.01	49.9
All Vehicles		753	0.6	0.232	1.2	NA	0.6	4.0	0.12	0.09	49.1

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Edward St/ Artarmon Rd - Thurs AM 510

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		veh	m		per veh	km/h
East: Artarmon Rd											
11	T1	201	0.5	0.159	0.8	LOS A	0.6	4.1	0.28	0.15	48.5
12	R2	62	0.0	0.159	6.5	LOS A	0.6	4.1	0.28	0.15	47.8
Approach		263	0.4	0.159	2.1	NA	0.6	4.1	0.28	0.15	48.3
North: Edward St											
1	L2	37	0.0	0.034	6.1	LOS A	0.1	0.9	0.44	0.61	45.6
3	R2	5	0.0	0.008	7.9	LOS A	0.0	0.2	0.51	0.67	44.3
Approach		42	0.0	0.034	6.4	LOS A	0.1	0.9	0.45	0.62	45.4
West: Artarmon Rd											
4	L2	11	20.0	0.232	4.8	LOS A	0.0	0.0	0.00	0.01	49.1
5	T1	440	0.2	0.232	0.0	LOS A	0.0	0.0	0.00	0.01	49.9
Approach		451	0.7	0.232	0.1	NA	0.0	0.0	0.00	0.01	49.9
All Vehicles		756	0.6	0.232	1.2	NA	0.6	4.1	0.12	0.09	49.1

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Edward St/ Artarmon Rd - Thurs AM Ex

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Distance m		per veh	km/h	
East: Artarmon Rd											
11	T1	207	0.5	0.164	0.9	LOS A	0.6	4.2	0.29	0.15	48.5
12	R2	62	0.0	0.164	6.7	LOS A	0.6	4.2	0.29	0.15	47.8
Approach		269	0.4	0.164	2.2	NA	0.6	4.2	0.29	0.15	48.3
North: Edward St											
1	L2	37	0.0	0.036	6.3	LOS A	0.1	0.9	0.45	0.62	45.6
3	R2	5	0.0	0.009	8.2	LOS A	0.0	0.2	0.53	0.68	44.1
Approach		42	0.0	0.036	6.5	LOS A	0.1	0.9	0.46	0.63	45.4
West: Artarmon Rd											
4	L2	11	20.0	0.247	4.8	LOS A	0.0	0.0	0.00	0.01	49.1
5	T1	467	0.2	0.247	0.0	LOS A	0.0	0.0	0.00	0.01	49.9
Approach		478	0.7	0.247	0.1	NA	0.0	0.0	0.00	0.01	49.9
All Vehicles		789	0.5	0.247	1.2	NA	0.6	4.2	0.12	0.09	49.1

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Edward St/ Artarmon Rd - Thurs PM 400

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
East: Artarmon Rd											
11	T1	408	0.3	0.231	0.1	LOS A	0.3	1.9	0.07	0.04	49.6
12	R2	29	0.0	0.231	5.7	LOS A	0.3	1.9	0.07	0.04	48.9
Approach		438	0.2	0.231	0.5	NA	0.3	1.9	0.07	0.04	49.5
North: Edward St											
1	L2	97	0.0	0.074	5.4	LOS A	0.3	2.1	0.33	0.56	45.8
3	R2	5	0.0	0.008	7.8	LOS A	0.0	0.2	0.51	0.67	44.3
Approach		102	0.0	0.074	5.5	LOS A	0.3	2.1	0.34	0.56	45.8
West: Artarmon Rd											
4	L2	11	0.0	0.137	4.6	LOS A	0.0	0.0	0.00	0.02	49.4
5	T1	256	0.0	0.137	0.0	LOS A	0.0	0.0	0.00	0.02	49.9
Approach		266	0.0	0.137	0.2	NA	0.0	0.0	0.00	0.02	49.8
All Vehicles		806	0.1	0.231	1.0	NA	0.3	2.1	0.08	0.10	49.1

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Edward St/ Artarmon Rd - Thurs PM 510

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		veh	m		per veh	km/h
East: Artarmon Rd											
11	T1	413	0.3	0.234	0.1	LOS A	0.3	1.9	0.07	0.04	49.6
12	R2	29	0.0	0.234	5.7	LOS A	0.3	1.9	0.07	0.04	48.9
Approach		442	0.2	0.234	0.5	NA	0.3	1.9	0.07	0.04	49.5
North: Edward St											
1	L2	97	0.0	0.074	5.4	LOS A	0.3	2.1	0.34	0.56	45.8
3	R2	5	0.0	0.008	7.9	LOS A	0.0	0.2	0.51	0.67	44.3
Approach		102	0.0	0.074	5.5	LOS A	0.3	2.1	0.34	0.56	45.8
West: Artarmon Rd											
4	L2	11	0.0	0.138	4.6	LOS A	0.0	0.0	0.00	0.02	49.4
5	T1	257	0.8	0.138	0.0	LOS A	0.0	0.0	0.00	0.02	49.9
Approach		267	0.8	0.138	0.2	NA	0.0	0.0	0.00	0.02	49.8
All Vehicles		812	0.4	0.234	1.0	NA	0.3	2.1	0.08	0.10	49.1

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Edward St/ Artarmon Rd - Thurs PM Ex

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
East: Artarmon Rd											
11	T1	427	0.2	0.242	0.1	LOS A	0.3	1.9	0.07	0.04	49.6
12	R2	29	0.0	0.242	5.8	LOS A	0.3	1.9	0.07	0.04	48.9
Approach		457	0.2	0.242	0.5	NA	0.3	1.9	0.07	0.04	49.5
North: Edward St											
1	L2	97	0.0	0.076	5.5	LOS A	0.3	2.1	0.35	0.57	45.8
3	R2	5	0.0	0.009	8.2	LOS A	0.0	0.2	0.53	0.68	44.1
Approach		102	0.0	0.076	5.6	LOS A	0.3	2.1	0.36	0.57	45.7
West: Artarmon Rd											
4	L2	11	0.0	0.150	4.6	LOS A	0.0	0.0	0.00	0.02	49.4
5	T1	281	0.7	0.150	0.0	LOS A	0.0	0.0	0.00	0.02	49.9
Approach		292	0.7	0.150	0.2	NA	0.0	0.0	0.00	0.02	49.8
All Vehicles		851	0.4	0.242	1.0	NA	0.3	2.1	0.08	0.10	49.2

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Richmond Ave/ Artarmon Rd - Sat Midday 400

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
South: Richmond Ave											
1	L2	8	0.0	0.007	5.8	LOS A	0.0	0.2	0.40	0.55	45.7
3	R2	1	0.0	0.002	8.2	LOS A	0.0	0.0	0.54	0.62	44.1
Approach		9	0.0	0.007	6.1	LOS A	0.0	0.2	0.41	0.55	45.5
East: Artarmon Rd											
4	L2	9	0.0	0.200	4.6	LOS A	0.0	0.0	0.00	0.01	49.4
5	T1	378	0.8	0.200	0.0	LOS A	0.0	0.0	0.00	0.01	49.9
Approach		387	0.8	0.200	0.1	NA	0.0	0.0	0.00	0.01	49.9
West: Artarmon Rd											
11	T1	382	0.0	0.205	0.1	LOS A	0.1	0.8	0.04	0.02	49.8
12	R2	11	0.0	0.205	6.3	LOS A	0.1	0.8	0.04	0.02	49.1
Approach		393	0.0	0.205	0.2	NA	0.1	0.8	0.04	0.02	49.8
All Vehicles		789	0.4	0.205	0.3	NA	0.1	0.8	0.02	0.02	49.8

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Richmond Ave/ Artarmon Rd - Sat Midday 510

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
South: Richmond Ave											
1	L2	11	0.0	0.009	5.8	LOS A	0.0	0.2	0.40	0.55	45.7
3	R2	1	0.0	0.002	8.3	LOS A	0.0	0.0	0.54	0.62	44.1
Approach		12	0.0	0.009	6.0	LOS A	0.0	0.2	0.41	0.56	45.5
East: Artarmon Rd											
4	L2	11	0.0	0.201	4.6	LOS A	0.0	0.0	0.00	0.01	49.4
5	T1	379	0.8	0.201	0.0	LOS A	0.0	0.0	0.00	0.01	49.9
Approach		389	0.8	0.201	0.1	NA	0.0	0.0	0.00	0.01	49.9
West: Artarmon Rd											
11	T1	382	0.0	0.207	0.1	LOS A	0.1	0.9	0.04	0.02	49.8
12	R2	13	0.0	0.207	6.3	LOS A	0.1	0.9	0.04	0.02	49.1
Approach		395	0.0	0.207	0.3	NA	0.1	0.9	0.04	0.02	49.8
All Vehicles		796	0.4	0.207	0.3	NA	0.1	0.9	0.03	0.02	49.7

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Richmond Ave/ Artarmon Rd - Sat Midday Ex

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Distance m		per veh	km/h	
South: Richmond Ave											
1	L2	1	0.0	0.001	5.7	LOS A	0.0	0.40	0.50	45.7	
3	R2	1	0.0	0.002	8.1	LOS A	0.0	0.53	0.62	44.2	
Approach		2	0.0	0.002	6.9	LOS A	0.0	0.47	0.56	44.9	
East: Artarmon Rd											
4	L2	6	0.0	0.197	4.6	LOS A	0.0	0.00	0.01	49.4	
5	T1	376	0.8	0.197	0.0	LOS A	0.0	0.00	0.01	49.9	
Approach		382	0.8	0.197	0.1	NA	0.0	0.00	0.01	49.9	
West: Artarmon Rd											
11	T1	382	0.0	0.198	0.0	LOS A	0.0	0.01	0.00	50.0	
12	R2	2	0.0	0.198	6.3	LOS A	0.0	0.01	0.00	49.3	
Approach		384	0.0	0.198	0.0	NA	0.0	0.01	0.00	50.0	
All Vehicles		768	0.4	0.198	0.1	NA	0.0	0.00	0.01	49.9	

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Richmond Ave/ Artarmon Rd - Thurs AM 400

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
South: Richmond Ave											
1	L2	27	0.0	0.020	5.1	LOS A	0.1	0.5	0.27	0.51	46.0
3	R2	6	0.0	0.009	7.6	LOS A	0.0	0.2	0.49	0.66	44.5
Approach		34	0.0	0.020	5.6	LOS A	0.1	0.5	0.31	0.54	45.7
East: Artarmon Rd											
4	L2	12	0.0	0.105	4.6	LOS A	0.0	0.0	0.00	0.03	49.3
5	T1	192	0.5	0.105	0.0	LOS A	0.0	0.0	0.00	0.03	49.8
Approach		203	0.5	0.105	0.3	NA	0.0	0.0	0.00	0.03	49.8
West: Artarmon Rd											
11	T1	444	0.7	0.237	0.0	LOS A	0.1	0.7	0.02	0.01	49.9
12	R2	12	0.0	0.237	5.4	LOS A	0.1	0.7	0.02	0.01	49.2
Approach		456	0.7	0.237	0.2	NA	0.1	0.7	0.02	0.01	49.8
All Vehicles		693	0.6	0.237	0.5	NA	0.1	0.7	0.03	0.04	49.6

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Richmond Ave/ Artarmon Rd - Thurs AM 510

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
South: Richmond Ave											
1	L2	34	0.0	0.024	5.1	LOS A	0.1	0.7	0.28	0.52	46.0
3	R2	6	0.0	0.010	7.6	LOS A	0.0	0.2	0.49	0.66	44.5
Approach		40	0.0	0.024	5.5	LOS A	0.1	0.7	0.31	0.54	45.7
East: Artarmon Rd											
4	L2	13	0.0	0.106	4.6	LOS A	0.0	0.0	0.00	0.03	49.3
5	T1	194	0.5	0.106	0.0	LOS A	0.0	0.0	0.00	0.03	49.8
Approach		206	0.5	0.106	0.3	NA	0.0	0.0	0.00	0.03	49.8
West: Artarmon Rd											
11	T1	444	0.7	0.238	0.0	LOS A	0.1	0.8	0.02	0.02	49.8
12	R2	13	0.0	0.238	5.4	LOS A	0.1	0.8	0.02	0.02	49.1
Approach		457	0.7	0.238	0.2	NA	0.1	0.8	0.02	0.02	49.8
All Vehicles		703	0.6	0.238	0.5	NA	0.1	0.8	0.03	0.05	49.6

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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Project: P:\16S1400-1499\16S1405100 Channel 9 Redevelopment\Modelling\DQR 160607\Final SIDRA Adjustments\160608sid-16S1405100 AM existing 400 510 .sip6

MOVEMENT SUMMARY

▽ Site: Richmond Ave/ Artarmon Rd - Thurs AM Ex

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
South: Richmond Ave											
1	L2	4	0.0	0.003	5.1	LOS A	0.0	0.1	0.28	0.49	46.0
3	R2	6	0.0	0.010	7.8	LOS A	0.0	0.2	0.51	0.67	44.3
Approach		11	0.0	0.010	6.7	LOS A	0.0	0.2	0.41	0.60	45.0
East: Artarmon Rd											
4	L2	8	0.0	0.110	4.6	LOS A	0.0	0.0	0.00	0.02	49.4
5	T1	204	0.5	0.110	0.0	LOS A	0.0	0.0	0.00	0.02	49.9
Approach		213	0.5	0.110	0.2	NA	0.0	0.0	0.00	0.02	49.8
West: Artarmon Rd											
11	T1	472	0.7	0.247	0.0	LOS A	0.1	0.4	0.01	0.01	49.9
12	R2	6	0.0	0.247	5.5	LOS A	0.1	0.4	0.01	0.01	49.2
Approach		478	0.7	0.247	0.1	NA	0.1	0.4	0.01	0.01	49.9
All Vehicles		701	0.6	0.247	0.2	NA	0.1	0.4	0.01	0.02	49.8

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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Project: P:\16S1400-1499\16S1405100 Channel 9 Redevelopment\Modelling\DQR 160607\Final SIDRA Adjustments\160608sid-16S1405100 AM existing 400 510 .sip6

MOVEMENT SUMMARY

▽ Site: Richmond Ave/ Artarmon Rd - Thurs PM 400

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		Vehicles veh	m		per veh	km/h
South: Richmond Ave											
1	L2	19	0.0	0.017	6.0	LOS A	0.1	0.5	0.43	0.58	45.6
3	R2	11	0.0	0.017	8.2	LOS A	0.1	0.4	0.53	0.71	44.1
Approach		29	0.0	0.017	6.8	LOS A	0.1	0.5	0.47	0.63	45.1
East: Artarmon Rd											
4	L2	18	0.0	0.229	4.6	LOS A	0.0	0.0	0.00	0.02	49.4
5	T1	427	0.2	0.229	0.0	LOS A	0.0	0.0	0.00	0.02	49.8
Approach		445	0.2	0.229	0.2	NA	0.0	0.0	0.00	0.02	49.8
West: Artarmon Rd											
11	T1	281	0.7	0.166	0.3	LOS A	0.3	1.8	0.11	0.05	49.4
12	R2	24	0.0	0.166	6.5	LOS A	0.3	1.8	0.11	0.05	48.7
Approach		305	0.7	0.166	0.8	NA	0.3	1.8	0.11	0.05	49.4
All Vehicles		780	0.4	0.229	0.7	NA	0.3	1.8	0.06	0.05	49.5

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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Project: P:\16S1400-1499\16S1405100 Channel 9 Redevelopment\Modelling\DQR 160607\Final SIDRA Adjustments\160608sid-16S1405100 PM Existing 400 510.sip6

MOVEMENT SUMMARY

▽ Site: Richmond Ave/ Artarmon Rd - Thurs PM 510

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
South: Richmond Ave											
1	L2	21	0.0	0.019	5.9	LOS A	0.1	0.5	0.41	0.57	45.7
3	R2	11	0.0	0.017	8.1	LOS A	0.1	0.4	0.52	0.70	44.2
Approach		32	0.0	0.019	6.6	LOS A	0.1	0.5	0.45	0.62	45.2
East: Artarmon Rd											
4	L2	22	0.0	0.215	4.6	LOS A	0.0	0.0	0.00	0.03	49.3
5	T1	396	0.3	0.215	0.0	LOS A	0.0	0.0	0.00	0.03	49.8
Approach		418	0.3	0.215	0.3	NA	0.0	0.0	0.00	0.03	49.8
West: Artarmon Rd											
11	T1	287	0.7	0.174	0.3	LOS A	0.3	2.1	0.12	0.06	49.3
12	R2	31	0.0	0.174	6.4	LOS A	0.3	2.1	0.12	0.06	48.7
Approach		318	0.7	0.174	0.9	NA	0.3	2.1	0.12	0.06	49.3
All Vehicles		767	0.4	0.215	0.8	NA	0.3	2.1	0.07	0.06	49.4

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

▽ Site: Richmond Ave/ Artarmon Rd - Thurs PM Ex

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
South: Richmond Ave											
1	L2	11	0.0	0.010	6.0	LOS A	0.0	0.3	0.43	0.57	45.6
3	R2	11	0.0	0.017	8.0	LOS A	0.1	0.4	0.52	0.70	44.2
Approach		21	0.0	0.017	7.0	LOS A	0.1	0.4	0.47	0.63	44.9
East: Artarmon Rd											
4	L2	5	0.0	0.222	4.6	LOS A	0.0	0.0	0.00	0.01	49.4
5	T1	427	0.2	0.222	0.0	LOS A	0.0	0.0	0.00	0.01	49.9
Approach		433	0.2	0.222	0.1	NA	0.0	0.0	0.00	0.01	49.9
West: Artarmon Rd											
11	T1	281	0.7	0.148	0.0	LOS A	0.0	0.2	0.01	0.01	49.9
12	R2	3	0.0	0.148	6.4	LOS A	0.0	0.2	0.01	0.01	49.2
Approach		284	0.7	0.148	0.1	NA	0.0	0.2	0.01	0.01	49.9
All Vehicles		738	0.4	0.222	0.3	NA	0.1	0.4	0.02	0.02	49.8

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

 **Site: Scott St/ Artarmon Rd - Post Dev Sat Midday 400**

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		veh	m		per veh	km/h
South: Scott St											
1	L2	3	0.0	0.034	5.7	LOS A	0.2	1.1	0.50	0.65	44.3
3	R2	28	0.0	0.034	9.1	LOS A	0.2	1.1	0.50	0.65	44.9
Approach		32	0.0	0.034	8.8	LOS A	0.2	1.1	0.50	0.65	44.8
East: Artarmon Rd											
4	L2	25	0.0	0.272	3.6	LOS A	1.7	11.7	0.04	0.40	47.0
5	T1	432	0.7	0.272	3.6	LOS A	1.7	11.7	0.04	0.40	47.9
Approach		457	0.7	0.272	3.6	LOS A	1.7	11.7	0.04	0.40	47.9
West: Artarmon Rd											
11	T1	357	0.0	0.243	3.7	LOS A	1.6	11.1	0.15	0.40	47.5
12	R2	3	0.0	0.243	7.0	LOS A	1.6	11.1	0.15	0.40	47.4
Approach		360	0.0	0.243	3.8	LOS A	1.6	11.1	0.15	0.40	47.5
All Vehicles		848	0.4	0.272	3.9	LOS A	1.7	11.7	0.10	0.41	47.6

Level of Service (LOS) Method: Delay (RTA NSW).
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: Scott St/ Artarmon Rd - Post Dev Sat Midday 510**

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Scott St											
1	L2	4	0.0	0.044	5.8	LOS A	0.2	1.5	0.50	0.66	44.3
3	R2	37	0.0	0.044	9.1	LOS A	0.2	1.5	0.50	0.66	44.9
Approach		41	0.0	0.044	8.8	LOS A	0.2	1.5	0.50	0.66	44.8
East: Artarmon Rd											
4	L2	33	0.0	0.279	3.6	LOS A	1.7	12.2	0.04	0.40	47.0
5	T1	433	0.7	0.279	3.6	LOS A	1.7	12.2	0.04	0.40	47.9
Approach		465	0.7	0.279	3.6	LOS A	1.7	12.2	0.04	0.40	47.8
West: Artarmon Rd											
11	T1	357	0.0	0.250	3.8	LOS A	1.6	11.5	0.18	0.40	47.5
12	R2	4	0.0	0.250	7.1	LOS A	1.6	11.5	0.18	0.40	47.3
Approach		361	0.0	0.250	3.8	LOS A	1.6	11.5	0.18	0.40	47.5
All Vehicles		867	0.4	0.279	3.9	LOS A	1.7	12.2	0.12	0.41	47.5

Level of Service (LOS) Method: Delay (RTA NSW).
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: Scott St/ Artarmon Rd - Post Dev Thurs AM 400**

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Scott St											
1	L2	9	0.0	0.092	4.6	LOS A	0.5	3.2	0.37	0.62	44.7
3	R2	92	0.0	0.092	8.0	LOS A	0.5	3.2	0.37	0.62	45.3
Approach		101	0.0	0.092	7.6	LOS A	0.5	3.2	0.37	0.62	45.2
East: Artarmon Rd											
4	L2	13	0.0	0.157	3.7	LOS A	0.9	6.2	0.16	0.40	46.7
5	T1	206	0.5	0.157	3.8	LOS A	0.9	6.2	0.16	0.40	47.5
Approach		219	0.5	0.157	3.8	LOS A	0.9	6.2	0.16	0.40	47.5
West: Artarmon Rd											
11	T1	447	0.5	0.369	4.2	LOS A	2.6	18.2	0.33	0.46	46.9
12	R2	39	0.0	0.369	7.5	LOS A	2.6	18.2	0.33	0.46	46.7
Approach		486	0.4	0.369	4.4	LOS A	2.6	18.2	0.33	0.46	46.9
All Vehicles		806	0.4	0.369	4.7	LOS A	2.6	18.2	0.29	0.46	46.8

Level of Service (LOS) Method: Delay (RTA NSW).
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: Scott St/ Artarmon Rd - Post Dev Thurs AM 510**

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Scott St											
1	L2	12	0.0	0.117	4.7	LOS A	0.6	4.2	0.38	0.62	44.7
3	R2	117	0.0	0.117	8.0	LOS A	0.6	4.2	0.38	0.62	45.3
Approach		128	0.0	0.117	7.7	LOS A	0.6	4.2	0.38	0.62	45.2
East: Artarmon Rd											
4	L2	16	0.0	0.160	3.7	LOS A	0.9	6.4	0.17	0.40	46.7
5	T1	207	0.5	0.160	3.8	LOS A	0.9	6.4	0.17	0.40	47.5
Approach		223	0.5	0.160	3.8	LOS A	0.9	6.4	0.17	0.40	47.5
West: Artarmon Rd											
11	T1	438	0.5	0.376	4.4	LOS A	2.6	18.5	0.37	0.48	46.7
12	R2	39	0.0	0.376	7.6	LOS A	2.6	18.5	0.37	0.48	46.6
Approach		477	0.4	0.376	4.6	LOS A	2.6	18.5	0.37	0.48	46.7
All Vehicles		828	0.4	0.376	4.9	LOS A	2.6	18.5	0.32	0.48	46.7

Level of Service (LOS) Method: Delay (RTA NSW).
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: Scott St/ Artarmon Rd - Post Dev Thurs PM 400**

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		veh	m		per veh	km/h
South: Scott St											
1	L2	3	0.0	0.035	6.0	LOS A	0.2	1.2	0.52	0.65	44.2
3	R2	28	0.0	0.035	9.3	LOS A	0.2	1.2	0.52	0.65	44.8
Approach		32	0.0	0.035	9.0	LOS A	0.2	1.2	0.52	0.65	44.7
East: Artarmon Rd											
4	L2	54	0.0	0.314	3.6	LOS A	2.0	14.1	0.05	0.40	47.0
5	T1	469	0.2	0.314	3.6	LOS A	2.0	14.1	0.05	0.40	47.9
Approach		523	0.2	0.314	3.6	LOS A	2.0	14.1	0.05	0.40	47.8
West: Artarmon Rd											
11	T1	396	0.5	0.270	3.7	LOS A	1.8	12.9	0.16	0.40	47.5
12	R2	5	0.0	0.270	7.0	LOS A	1.8	12.9	0.16	0.40	47.3
Approach		401	0.5	0.270	3.8	LOS A	1.8	12.9	0.16	0.40	47.5
All Vehicles		956	0.3	0.314	3.9	LOS A	2.0	14.1	0.11	0.41	47.6

Level of Service (LOS) Method: Delay (RTA NSW).
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: Scott St/ Artarmon Rd - Post Dev Thurs PM 510**

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Scott St											
1	L2	4	0.0	0.045	6.0	LOS A	0.2	1.6	0.53	0.67	44.1
3	R2	37	0.0	0.045	9.4	LOS A	0.2	1.6	0.53	0.67	44.7
Approach		41	0.0	0.045	9.0	LOS A	0.2	1.6	0.53	0.67	44.7
East: Artarmon Rd											
4	L2	69	0.0	0.328	3.6	LOS A	2.2	15.1	0.06	0.41	47.0
5	T1	474	0.2	0.328	3.6	LOS A	2.2	15.1	0.06	0.41	47.9
Approach		543	0.2	0.328	3.6	LOS A	2.2	15.1	0.06	0.41	47.7
West: Artarmon Rd											
11	T1	362	0.6	0.255	3.8	LOS A	1.7	11.9	0.18	0.40	47.4
12	R2	6	0.0	0.255	7.1	LOS A	1.7	11.9	0.18	0.40	47.3
Approach		368	0.6	0.255	3.8	LOS A	1.7	11.9	0.18	0.40	47.4
All Vehicles		953	0.3	0.328	3.9	LOS A	2.2	15.1	0.13	0.41	47.5

Level of Service (LOS) Method: Delay (RTA NSW).
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: Willoughby Rd/ Artarmon Rd/ Small St - Post Dev Sat Midday - with upgrades 510

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand 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 per veh	Average Speed km/h
South: Willoughby Rd											
1	L2	342	0.6	0.782	33.0	LOS C	34.3	243.1	0.90	0.85	37.4
2	T1	997	2.0	0.782	26.4	LOS B	34.3	243.1	0.85	0.78	41.4
3	R2	64	1.6	0.534	54.8	LOS D	3.6	25.7	0.94	0.80	30.0
Approach		1403	1.7	0.782	29.3	LOS C	34.3	243.1	0.87	0.80	39.7
East: Small St											
4	L2	473	0.2	0.778	37.8	LOS C	23.1	161.8	0.96	1.01	34.7
5	T1	107	0.0	0.287	45.0	LOS D	5.4	37.9	0.90	0.71	31.0
6	R2	58	0.0	0.163	48.4	LOS D	2.8	19.9	0.87	0.74	31.1
Approach		638	0.2	0.778	40.0	LOS C	23.1	161.8	0.94	0.94	33.6
North: Willoughby Rd											
7	L2	86	0.0	0.708	31.5	LOS C	29.8	212.0	0.85	0.78	38.8
8	T1	1074	2.3	0.708	28.6	LOS C	29.8	212.0	0.87	0.79	40.6
9	R2	16	0.0	0.708	37.2	LOS C	25.3	180.2	0.89	0.80	36.8
Approach		1176	2.1	0.708	28.9	LOS C	29.8	212.0	0.87	0.79	40.4
West: Artarmon Rd											
10	L2	37	0.0	0.759	58.5	LOS E	14.8	104.0	1.00	0.90	29.3
11	T1	131	0.0	0.759	53.9	LOS D	14.8	104.0	1.00	0.90	28.3
12	R2	332	0.3	0.759	58.6	LOS E	14.8	104.0	1.00	0.89	28.9
Approach		499	0.2	0.759	57.4	LOS E	14.8	104.0	1.00	0.89	28.8
All Vehicles		3716	1.3	0.782	34.8	LOS C	34.3	243.1	0.90	0.83	36.9

Level of Service (LOS) Method: Delay (RTA NSW).

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 per ped
P2	East Full Crossing	46	19.9	LOS B	0.1	0.1	0.58	0.58
P3	North Full Crossing	114	52.5	LOS E	0.4	0.4	0.94	0.94
P4	West Full Crossing	33	21.6	LOS C	0.1	0.1	0.60	0.60
All Pedestrians		193	39.4	LOS D			0.79	0.79

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.

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MOVEMENT SUMMARY



Site: Willoughby Rd/ Artarmon Rd/ Small St - Post Dev Thurs AM - with upgrades 510

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Willoughby Rd											
1	L2	169	1.2	0.327	20.2	LOS B	10.6	76.1	0.57	0.62	43.0
2	T1	838	5.2	0.646	17.6	LOS B	25.5	186.2	0.69	0.65	46.2
3	R2	17	0.0	0.162	43.8	LOS D	0.8	5.6	0.79	0.72	32.9
Approach		1024	4.4	0.646	18.5	LOS B	25.5	186.2	0.67	0.64	45.4
East: Small St											
4	L2	78	2.7	0.249	23.7	LOS B	2.7	19.5	0.66	0.71	39.9
5	T1	54	2.0	0.558	64.6	LOS E	3.3	23.5	1.00	0.76	26.6
6	R2	21	5.0	0.235	67.5	LOS E	1.3	9.2	0.99	0.70	26.7
Approach		153	2.8	0.558	44.1	LOS D	3.3	23.5	0.83	0.73	32.1
North: Willoughby Rd											
7	L2	23	9.1	0.717	25.8	LOS B	32.4	235.1	0.79	0.73	41.5
8	T1	1517	4.2	0.717	20.1	LOS B	32.5	235.4	0.79	0.73	45.1
Approach		1540	4.2	0.717	20.2	LOS B	32.5	235.4	0.79	0.73	45.0
West: Artarmon Rd											
10	L2	33	0.0	0.726	51.3	LOS D	16.4	115.1	0.97	0.86	30.6
11	T1	40	0.0	0.726	46.7	LOS D	16.4	115.1	0.97	0.86	29.6
12	R2	520	0.4	0.726	51.3	LOS D	16.4	115.1	0.97	0.86	30.6
Approach		593	0.4	0.726	51.0	LOS D	16.4	115.1	0.97	0.86	30.5
All Vehicles		3309	3.5	0.726	26.3	LOS B	32.5	235.4	0.79	0.72	40.9

Level of Service (LOS) Method: Delay (RTA NSW).

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	Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	13	14.5	LOS B	0.0	0.0	0.49	0.49
P3	North Full Crossing	84	46.1	LOS E	0.3	0.3	0.88	0.88
P4	West Full Crossing	41	16.0	LOS B	0.1	0.1	0.52	0.52
All Pedestrians		138	34.3	LOS D			0.74	0.74

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.

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MOVEMENT SUMMARY



Site: Willoughby Rd/ Artarmon Rd/ Small St - Post Dev Thurs PM - with upgrades 510

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		veh	Distance m	per veh	km/h	
South: Willoughby Rd											
1	L2	423	0.0	0.778	23.5	LOS B	38.6	272.4	0.80	0.80	41.5
2	T1	1405	1.8	0.778	17.9	LOS B	38.8	276.1	0.80	0.76	45.9
3	R2	1	100.0	0.011	32.0	LOS C	0.0	0.5	0.64	0.62	38.0
Approach		1829	1.4	0.778	19.2	LOS B	38.8	276.1	0.80	0.77	44.8
East: Small St											
4	L2	107	0.0	0.211	16.4	LOS B	2.9	20.4	0.54	0.68	43.3
5	T1	112	0.0	0.763	64.1	LOS E	7.0	48.7	1.00	0.88	26.7
6	R2	46	0.0	0.333	64.0	LOS E	2.7	18.9	0.99	0.74	27.4
Approach		265	0.0	0.763	44.8	LOS D	7.0	48.7	0.81	0.78	31.8
North: Willoughby Rd											
7	L2	43	0.0	0.514	19.2	LOS B	19.6	139.8	0.61	0.56	44.8
8	T1	986	2.7	0.514	16.8	LOS B	19.6	139.8	0.65	0.60	46.9
9	R2	15	0.0	0.514	26.5	LOS B	16.9	120.9	0.72	0.64	41.2
Approach		1044	2.5	0.514	17.0	LOS B	19.6	139.8	0.65	0.60	46.7
West: Artarmon Rd											
10	L2	46	2.3	0.746	59.7	LOS E	13.1	92.0	1.00	0.88	28.8
11	T1	79	0.0	0.746	55.1	LOS D	13.1	92.0	1.00	0.88	27.9
12	R2	315	0.7	0.746	59.7	LOS E	13.1	92.0	1.00	0.88	28.7
Approach		440	0.7	0.746	58.8	LOS E	13.1	92.0	1.00	0.88	28.5
All Vehicles		3579	1.6	0.778	25.3	LOS B	38.8	276.1	0.78	0.73	41.1

Level of Service (LOS) Method: Delay (RTA NSW).

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	Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	2	11.7	LOS B	0.0	0.0	0.44	0.44
P3	North Full Crossing	67	54.3	LOS E	0.2	0.2	0.95	0.95
P4	West Full Crossing	22	13.1	LOS B	0.0	0.0	0.47	0.47
All Pedestrians		92	43.4	LOS E			0.82	0.82

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.

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MOVEMENT SUMMARY



Site: Willoughby Rd/ Artarmon Rd/ Small St - Sat Midday 400

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand 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 per veh	Average Speed km/h
South: Willoughby Rd											
1	L2	336	0.6	0.831	26.8	LOS B	43.6	308.9	0.87	0.84	40.2
2	T1	997	1.8	0.831	29.5	LOS C	43.6	308.9	0.91	0.88	39.8
3	R2	64	1.6	0.831	47.4	LOS D	27.1	192.9	0.97	0.95	33.2
Approach		1397	1.5	0.831	29.7	LOS C	43.6	308.9	0.90	0.88	39.5
East: Small St											
4	L2	122	0.9	0.662	63.7	LOS E	7.3	51.2	1.00	0.82	27.6
5	T1	105	0.0	0.852	65.9	LOS E	10.5	73.6	1.00	0.98	26.0
6	R2	58	0.0	0.852	70.5	LOS E	10.5	73.6	1.00	0.98	26.8
Approach		285	0.4	0.852	65.9	LOS E	10.5	73.6	1.00	0.91	26.8
North: Willoughby Rd											
7	L2	86	0.0	0.589	21.8	LOS B	24.1	171.4	0.68	0.64	43.2
8	T1	1074	2.3	0.589	20.0	LOS B	24.1	171.4	0.73	0.67	44.9
9	R2	15	0.0	0.589	30.0	LOS C	21.5	153.0	0.78	0.70	39.6
Approach		1175	2.1	0.589	20.3	LOS B	24.1	171.4	0.72	0.67	44.7
West: Artarmon Rd											
10	L2	36	0.0	0.825	63.6	LOS E	15.4	108.0	1.00	0.95	28.1
11	T1	128	0.0	0.825	59.0	LOS E	15.4	108.0	1.00	0.95	27.2
12	R2	326	0.3	0.825	63.7	LOS E	15.4	108.0	1.00	0.93	27.7
Approach		491	0.2	0.825	62.5	LOS E	15.4	108.0	1.00	0.94	27.6
All Vehicles		3347	1.4	0.852	34.3	LOS C	43.6	308.9	0.86	0.82	37.2

Level of Service (LOS) Method: Delay (RTA NSW).

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 per ped	
P2	East Full Crossing	46	13.1	LOS B	0.1	0.1	0.47	0.47	
P3	North Full Crossing	114	51.6	LOS E	0.4	0.4	0.93	0.93	
P4	West Full Crossing	33	14.5	LOS B	0.1	0.1	0.49	0.49	
All Pedestrians		193	36.0	LOS D			0.74	0.74	

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.

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MOVEMENT SUMMARY



Site: Willoughby Rd/ Artarmon Rd/ Small St - Sat Midday 510

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand 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 per veh	Average Speed km/h
South: Willoughby Rd											
1	L2	342	0.6	0.842	28.1	LOS B	45.7	323.4	0.89	0.86	39.6
2	T1	997	1.8	0.842	31.0	LOS C	45.7	323.4	0.92	0.90	39.1
3	R2	64	1.6	0.842	49.6	LOS D	27.5	195.3	0.98	0.97	32.5
Approach		1403	1.5	0.842	31.2	LOS C	45.7	323.4	0.91	0.89	38.9
East: Small St											
4	L2	122	0.9	0.662	63.7	LOS E	7.3	51.2	1.00	0.82	27.6
5	T1	107	0.0	0.862	66.7	LOS E	10.7	75.2	1.00	1.00	25.8
6	R2	58	0.0	0.862	71.3	LOS F	10.7	75.2	1.00	1.00	26.6
Approach		287	0.4	0.862	66.4	LOS E	10.7	75.2	1.00	0.92	26.7
North: Willoughby Rd											
7	L2	86	0.0	0.599	22.0	LOS B	24.7	176.0	0.68	0.65	43.1
8	T1	1074	2.3	0.599	20.7	LOS B	24.7	176.0	0.74	0.68	44.6
9	R2	16	0.0	0.599	31.4	LOS C	21.5	153.7	0.80	0.72	39.0
Approach		1176	2.1	0.599	20.9	LOS B	24.7	176.0	0.73	0.68	44.4
West: Artarmon Rd											
10	L2	37	0.0	0.839	64.7	LOS E	15.9	111.2	1.00	0.97	27.9
11	T1	131	0.0	0.839	60.1	LOS E	15.9	111.2	1.00	0.97	27.0
12	R2	332	0.3	0.839	64.8	LOS E	15.9	111.2	1.00	0.94	27.5
Approach		499	0.2	0.839	63.6	LOS E	15.9	111.2	1.00	0.95	27.4
All Vehicles		3365	1.4	0.862	35.4	LOS C	45.7	323.4	0.87	0.83	36.8

Level of Service (LOS) Method: Delay (RTA NSW).

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 per ped	
P2	East Full Crossing	46	13.1	LOS B	0.1	0.1	0.47	0.47	
P3	North Full Crossing	114	51.6	LOS E	0.4	0.4	0.93	0.93	
P4	West Full Crossing	33	14.5	LOS B	0.1	0.1	0.49	0.49	
All Pedestrians		193	36.0	LOS D			0.74	0.74	

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.

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MOVEMENT SUMMARY



Site: Willoughby Rd/ Artarmon Rd/ Small St - Sat Midday Ex

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand 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 per veh	Average Speed km/h
South: Willoughby Rd											
1	L2	318	0.7	0.816	26.1	LOS B	41.8	296.2	0.86	0.82	40.6
2	T1	997	1.8	0.816	28.1	LOS B	41.8	296.2	0.90	0.86	40.4
3	R2	64	1.6	0.816	45.1	LOS D	26.2	186.4	0.95	0.92	33.9
Approach		1379	1.5	0.816	28.4	LOS B	41.8	296.2	0.89	0.86	40.1
East: Small St											
4	L2	122	0.9	0.662	63.7	LOS E	7.3	51.2	1.00	0.82	27.6
5	T1	99	0.0	0.819	63.9	LOS E	9.9	69.3	1.00	0.95	26.4
6	R2	58	0.0	0.819	68.4	LOS E	9.9	69.3	1.00	0.95	27.1
Approach		279	0.4	0.819	64.7	LOS E	9.9	69.3	1.00	0.89	27.0
North: Willoughby Rd											
7	L2	86	0.0	0.585	21.7	LOS B	23.8	169.6	0.68	0.64	43.2
8	T1	1074	2.3	0.585	19.7	LOS B	23.8	169.6	0.72	0.67	45.1
9	R2	15	0.0	0.585	29.3	LOS C	21.4	152.5	0.78	0.70	39.9
Approach		1175	2.1	0.585	20.0	LOS B	23.8	169.6	0.72	0.66	44.9
West: Artarmon Rd											
10	L2	34	0.0	0.790	61.5	LOS E	14.4	100.7	1.00	0.92	28.6
11	T1	123	0.0	0.790	56.9	LOS E	14.4	100.7	1.00	0.92	27.7
12	R2	313	0.3	0.790	61.6	LOS E	14.4	100.7	1.00	0.90	28.2
Approach		469	0.2	0.790	60.4	LOS E	14.4	100.7	1.00	0.91	28.1
All Vehicles		3302	1.4	0.819	33.0	LOS C	41.8	296.2	0.85	0.80	37.7

Level of Service (LOS) Method: Delay (RTA NSW).

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 per ped	
P2	East Full Crossing	46	13.1	LOS B	0.1	0.1	0.47	0.47	
P3	North Full Crossing	114	51.6	LOS E	0.4	0.4	0.93	0.93	
P4	West Full Crossing	33	14.5	LOS B	0.1	0.1	0.49	0.49	
All Pedestrians		193	36.0	LOS D			0.74	0.74	

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.

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MOVEMENT SUMMARY



Site: Willoughby Rd/ Artarmon Rd/ Small St - Thurs AM 400

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Willoughby Rd											
1	L2	166	1.3	0.362	20.0	LOS B	12.0	86.4	0.58	0.61	43.2
2	T1	838	5.0	0.714	21.2	LOS B	28.1	205.0	0.76	0.72	44.1
3	R2	17	0.0	0.714	29.2	LOS C	28.1	205.0	0.83	0.75	40.0
Approach		1021	4.3	0.714	21.2	LOS B	28.1	205.0	0.73	0.70	43.9
East: Small St											
4	L2	78	1.4	0.726	70.2	LOS E	4.9	34.7	1.00	0.85	26.3
5	T1	53	0.0	0.664	64.5	LOS E	4.6	32.3	1.00	0.81	26.3
6	R2	21	5.0	0.664	69.1	LOS E	4.6	32.3	1.00	0.81	27.1
Approach		152	1.4	0.726	68.1	LOS E	4.9	34.7	1.00	0.83	26.4
North: Willoughby Rd											
7	L2	23	13.6	0.708	25.1	LOS B	31.8	231.3	0.78	0.72	41.8
8	T1	1517	4.4	0.708	19.4	LOS B	31.9	231.6	0.78	0.71	45.5
Approach		1540	4.5	0.708	19.5	LOS B	31.9	231.6	0.78	0.71	45.4
West: Artarmon Rd											
10	L2	32	0.0	0.718	52.8	LOS D	15.9	111.2	0.98	0.86	30.2
11	T1	38	0.0	0.718	48.3	LOS D	15.9	111.2	0.98	0.86	29.2
12	R2	497	0.2	0.718	52.8	LOS D	15.9	111.2	0.98	0.86	30.1
Approach		566	0.2	0.718	52.5	LOS D	15.9	111.2	0.98	0.86	30.0
All Vehicles		3279	3.6	0.726	28.0	LOS B	31.9	231.6	0.81	0.74	40.1

Level of Service (LOS) Method: Delay (RTA NSW).

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 per ped	
P2	East Full Crossing	13	14.0	LOS B	0.0	0.0	0.48	0.48	
P3	North Full Crossing	84	45.2	LOS E	0.2	0.2	0.87	0.87	
P4	West Full Crossing	41	15.5	LOS B	0.1	0.1	0.51	0.51	
All Pedestrians		138	33.5	LOS D			0.73	0.73	

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.

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MOVEMENT SUMMARY



Site: Willoughby Rd/ Artarmon Rd/ Small St - Thurs AM 510

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand 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 per veh	Average Speed km/h
South: Willoughby Rd											
1	L2	169	1.2	0.382	21.8	LOS B	12.9	92.6	0.61	0.64	42.3
2	T1	838	5.0	0.753	24.1	LOS B	29.8	217.7	0.81	0.75	42.6
3	R2	17	0.0	0.753	32.4	LOS C	29.8	217.7	0.88	0.80	38.6
Approach		1024	4.3	0.753	23.8	LOS B	29.8	217.7	0.78	0.74	42.5
East: Small St											
4	L2	21	5.0	0.318	63.9	LOS E	2.6	18.6	0.98	0.73	28.0
5	T1	54	0.0	0.770	62.2	LOS E	6.8	47.8	0.99	0.82	26.5
6	R2	78	1.4	0.770	69.2	LOS E	6.8	47.8	1.00	0.89	26.7
Approach		153	1.4	0.770	66.0	LOS E	6.8	47.8	1.00	0.85	26.8
North: Willoughby Rd											
7	L2	23	13.6	0.740	27.5	LOS B	33.7	245.2	0.82	0.76	40.7
8	T1	1517	4.4	0.740	21.8	LOS B	33.8	245.5	0.82	0.75	44.2
Approach		1540	4.5	0.740	21.8	LOS B	33.8	245.5	0.82	0.75	44.1
West: Artarmon Rd											
10	L2	33	0.0	0.759	53.4	LOS D	16.7	117.3	0.98	0.88	30.1
11	T1	40	0.0	0.759	48.9	LOS D	16.7	117.3	0.98	0.88	29.0
12	R2	520	0.2	0.759	53.5	LOS D	16.8	117.7	0.98	0.88	30.0
Approach		593	0.2	0.759	53.2	LOS D	16.8	117.7	0.98	0.88	29.9
All Vehicles		3309	3.5	0.770	30.1	LOS C	33.8	245.5	0.84	0.77	39.2

Level of Service (LOS) Method: Delay (RTA NSW).

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 per ped	
P2	East Full Crossing	13	15.5	LOS B	0.0	0.0	0.51	0.51	
P3	North Full Crossing	84	44.4	LOS E	0.2	0.2	0.86	0.86	
P4	West Full Crossing	41	17.1	LOS B	0.1	0.1	0.53	0.53	
All Pedestrians		138	33.6	LOS D			0.73	0.73	

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.

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MOVEMENT SUMMARY



Site: Willoughby Rd/ Artarmon Rd/ Small St - Thurs AM Ex

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Willoughby Rd											
1	L2	234	0.9	0.372	19.1	LOS B	12.3	88.3	0.56	0.64	43.3
2	T1	838	5.0	0.733	20.4	LOS B	29.9	218.2	0.77	0.73	44.5
3	R2	17	0.0	0.733	27.8	LOS B	29.9	218.2	0.82	0.75	40.6
Approach		1088	4.1	0.733	20.3	LOS B	29.9	218.2	0.72	0.71	44.2
East: Small St											
4	L2	78	1.4	0.565	65.6	LOS E	4.7	33.0	1.00	0.77	27.2
5	T1	74	0.0	0.660	62.1	LOS E	5.8	40.7	1.00	0.82	26.9
6	R2	21	5.0	0.660	66.7	LOS E	5.8	40.7	1.00	0.82	27.6
Approach		173	1.2	0.660	64.2	LOS E	5.8	40.7	1.00	0.80	27.1
North: Willoughby Rd											
7	L2	23	13.6	0.688	23.6	LOS B	30.5	222.1	0.75	0.69	42.5
8	T1	1517	4.4	0.688	17.9	LOS B	30.6	222.3	0.75	0.69	46.4
Approach		1540	4.5	0.688	18.0	LOS B	30.6	222.3	0.75	0.69	46.3
West: Artarmon Rd											
10	L2	27	0.0	0.721	56.3	LOS D	14.1	98.9	1.00	0.86	29.4
11	T1	34	0.0	0.721	51.7	LOS D	14.1	98.9	1.00	0.86	28.4
12	R2	431	0.2	0.721	56.3	LOS D	14.1	98.9	1.00	0.86	29.3
Approach		492	0.2	0.721	56.0	LOS D	14.1	98.9	1.00	0.86	29.2
All Vehicles		3293	3.5	0.733	26.8	LOS B	30.6	222.3	0.79	0.73	40.6

Level of Service (LOS) Method: Delay (RTA NSW).

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 per ped	
P2	East Full Crossing	13	13.1	LOS B	0.0	0.0	0.47	0.47	
P3	North Full Crossing	84	48.8	LOS E	0.3	0.3	0.90	0.90	
P4	West Full Crossing	41	14.5	LOS B	0.1	0.1	0.49	0.49	
All Pedestrians		138	35.3	LOS D			0.74	0.74	

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.

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MOVEMENT SUMMARY



Site: Willoughby Rd/ Artarmon Rd/ Small St - Thurs PM 400

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Willoughby Rd											
1	L2	403	0.0	0.788	24.9	LOS B	39.3	277.1	0.82	0.81	40.9
2	T1	1405	1.8	0.788	19.3	LOS B	39.9	283.6	0.83	0.78	45.1
Approach		1808	1.4	0.788	20.5	LOS B	39.9	283.6	0.82	0.79	44.1
East: Small St											
4	L2	107	0.0	0.578	62.4	LOS E	6.3	43.8	1.00	0.79	27.9
5	T1	107	0.0	0.800	62.9	LOS E	9.6	67.1	1.00	0.93	26.6
6	R2	46	0.0	0.800	67.5	LOS E	9.6	67.1	1.00	0.93	27.4
Approach		261	0.0	0.800	63.5	LOS E	9.6	67.1	1.00	0.87	27.3
North: Willoughby Rd											
7	L2	43	0.0	0.516	20.2	LOS B	19.7	141.0	0.63	0.58	44.2
8	T1	986	2.7	0.516	17.5	LOS B	19.7	141.0	0.67	0.61	46.5
9	R2	13	0.0	0.516	26.5	LOS B	17.4	124.4	0.72	0.64	41.2
Approach		1042	2.5	0.516	17.7	LOS B	19.7	141.0	0.66	0.61	46.3
West: Artarmon Rd											
10	L2	45	2.3	0.767	61.3	LOS E	12.9	91.1	1.00	0.90	28.4
11	T1	75	0.0	0.767	56.7	LOS E	12.9	91.1	1.00	0.90	27.5
12	R2	308	0.7	0.767	61.3	LOS E	12.9	91.1	1.00	0.89	28.2
Approach		428	0.7	0.767	60.5	LOS E	12.9	91.1	1.00	0.89	28.1
All Vehicles		3540	1.5	0.800	27.7	LOS B	39.9	283.6	0.81	0.75	40.1

Level of Service (LOS) Method: Delay (RTA NSW).

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	Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	2	12.6	LOS B	0.0	0.0	0.46	0.46
P3	North Full Crossing	67	52.4	LOS E	0.2	0.2	0.94	0.94
P4	West Full Crossing	22	14.0	LOS B	0.0	0.0	0.48	0.48
All Pedestrians		92	42.2	LOS E			0.82	0.82

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.

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MOVEMENT SUMMARY



Site: Willoughby Rd/ Artarmon Rd/ Small St - Thurs PM 510

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand 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 per veh	Average Speed km/h
South: Willoughby Rd											
1	L2	423	0.0	0.809	25.9	LOS B	40.9	288.9	0.85	0.83	40.4
2	T1	1405	1.8	0.809	20.3	LOS B	41.6	296.0	0.85	0.80	44.5
Approach		1828	1.4	0.809	21.6	LOS B	41.6	296.0	0.85	0.81	43.5
East: Small St											
4	L2	107	0.0	0.534	61.1	LOS E	6.2	43.2	0.99	0.79	28.1
5	T1	112	0.0	0.758	60.4	LOS E	9.6	67.4	1.00	0.89	27.1
6	R2	46	0.0	0.758	65.0	LOS E	9.6	67.4	1.00	0.89	27.9
Approach		265	0.0	0.758	61.5	LOS E	9.6	67.4	1.00	0.85	27.7
North: Willoughby Rd											
7	L2	43	0.0	0.537	21.1	LOS B	20.9	149.7	0.65	0.60	43.8
8	T1	986	2.7	0.537	19.0	LOS B	20.9	149.7	0.69	0.63	45.6
9	R2	15	0.0	0.537	29.2	LOS C	17.9	127.7	0.76	0.68	39.9
Approach		1044	2.5	0.537	19.2	LOS B	20.9	149.7	0.69	0.63	45.4
West: Artarmon Rd											
10	L2	46	2.3	0.787	62.2	LOS E	13.4	94.7	1.00	0.91	28.2
11	T1	79	0.0	0.787	57.6	LOS E	13.4	94.7	1.00	0.91	27.4
12	R2	315	0.7	0.787	62.3	LOS E	13.4	94.7	1.00	0.90	28.0
Approach		440	0.7	0.787	61.4	LOS E	13.4	94.7	1.00	0.90	27.9
All Vehicles		3578	1.5	0.809	28.8	LOS C	41.6	296.0	0.83	0.77	39.6

Level of Service (LOS) Method: Delay (RTA NSW).

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 per ped	
P2	East Full Crossing	2	13.1	LOS B	0.0	0.0	0.47	0.47	
P3	North Full Crossing	67	52.4	LOS E	0.2	0.2	0.94	0.94	
P4	West Full Crossing	22	14.5	LOS B	0.0	0.0	0.49	0.49	
All Pedestrians		92	42.4	LOS E			0.82	0.82	

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.

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MOVEMENT SUMMARY



Site: Willoughby Rd/ Artarmon Rd/ Small St - Thurs PM Ex

Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand 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 per veh	Average Speed km/h
South: Willoughby Rd											
1	L2	365	0.0	0.782	25.3	LOS B	38.5	272.1	0.83	0.81	40.8
2	T1	1405	1.8	0.782	19.7	LOS B	39.1	278.0	0.83	0.78	44.9
Approach		1771	1.4	0.782	20.9	LOS B	39.1	278.0	0.83	0.78	43.9
East: Small St											
4	L2	107	0.0	0.578	62.4	LOS E	6.3	43.8	1.00	0.79	27.9
5	T1	96	0.0	0.741	60.8	LOS E	8.6	60.5	1.00	0.88	27.0
6	R2	46	0.0	0.741	65.3	LOS E	8.6	60.5	1.00	0.88	27.8
Approach		249	0.0	0.741	62.3	LOS E	8.6	60.5	1.00	0.84	27.5
North: Willoughby Rd											
7	L2	43	0.0	0.487	20.4	LOS B	18.2	129.8	0.62	0.57	44.1
8	T1	986	2.7	0.487	16.2	LOS B	18.2	129.8	0.64	0.58	47.3
9	R2	6	0.0	0.487	23.1	LOS B	17.2	123.2	0.66	0.59	42.8
Approach		1036	2.5	0.487	16.4	LOS B	18.2	129.8	0.64	0.58	47.1
West: Artarmon Rd											
10	L2	47	2.2	0.767	60.5	LOS E	13.6	95.8	1.00	0.90	28.6
11	T1	81	0.0	0.767	55.9	LOS D	13.6	95.8	1.00	0.90	27.7
12	R2	324	0.6	0.767	60.6	LOS E	13.6	95.8	1.00	0.89	28.4
Approach		453	0.7	0.767	59.7	LOS E	13.6	95.8	1.00	0.89	28.3
All Vehicles		3508	1.6	0.782	27.5	LOS B	39.1	278.0	0.81	0.74	40.2

Level of Service (LOS) Method: Delay (RTA NSW).

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 per ped	
P2	East Full Crossing	2	13.1	LOS B	0.0	0.0	0.47	0.47	
P3	North Full Crossing	67	51.5	LOS E	0.2	0.2	0.93	0.93	
P4	West Full Crossing	22	14.5	LOS B	0.0	0.0	0.49	0.49	
All Pedestrians		92	41.7	LOS E			0.81	0.81	

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.

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MOVEMENT SUMMARY

 Site: Wyalong St/ Artarmon Rd - Sat Midday 400

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
South: Artarmon Rd											
1	L2	395	0.8	0.283	3.8	LOS A	1.9	13.3	0.20	0.47	46.6
3a	R1	5	0.0	0.283	6.3	LOS A	1.9	13.3	0.20	0.47	47.0
3u	U	1	0.0	0.283	8.6	LOS A	1.9	13.3	0.20	0.47	47.9
Approach		401	0.8	0.283	3.9	LOS A	1.9	13.3	0.20	0.47	46.6
NorthEast: Wyalong St											
24a	L1	3	0.0	0.046	5.3	LOS A	0.2	1.6	0.49	0.64	45.1
26a	R1	39	2.7	0.046	8.2	LOS A	0.2	1.6	0.49	0.64	44.9
26u	U	1	0.0	0.046	10.5	LOS A	0.2	1.6	0.49	0.64	45.7
Approach		43	2.4	0.046	8.1	LOS A	0.2	1.6	0.49	0.64	45.0
West: Artarmon Rd											
10a	L1	49	0.0	0.274	3.3	LOS A	1.7	11.8	0.06	0.60	45.9
12	R2	394	0.0	0.274	6.9	LOS A	1.7	11.8	0.06	0.60	46.0
12u	U	4	0.0	0.274	8.4	LOS A	1.7	11.8	0.06	0.60	46.5
Approach		447	0.0	0.274	6.5	LOS A	1.7	11.8	0.06	0.60	46.0
All Vehicles		892	0.5	0.283	5.4	LOS A	1.9	13.3	0.15	0.54	46.2

Level of Service (LOS) Method: Delay (RTA NSW).

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.

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MOVEMENT SUMMARY

 Site: Wyalong St/ Artarmon Rd - Sat Midday 510

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Artarmon Rd											
1	L2	398	0.8	0.285	3.8	LOS A	1.9	13.4	0.21	0.47	46.6
3a	R1	5	0.0	0.285	6.3	LOS A	1.9	13.4	0.21	0.47	47.0
3u	U	1	0.0	0.285	8.6	LOS A	1.9	13.4	0.21	0.47	47.9
Approach		404	0.8	0.285	3.9	LOS A	1.9	13.4	0.21	0.47	46.6
NorthEast: Wyalong St											
24a	L1	3	0.0	0.046	5.3	LOS A	0.2	1.6	0.49	0.64	45.1
26a	R1	39	2.7	0.046	8.2	LOS A	0.2	1.6	0.49	0.64	44.9
26u	U	1	0.0	0.046	10.5	LOS A	0.2	1.6	0.49	0.64	45.7
Approach		43	2.4	0.046	8.1	LOS A	0.2	1.6	0.49	0.64	44.9
West: Artarmon Rd											
10a	L1	49	0.0	0.276	3.3	LOS A	1.7	11.9	0.06	0.60	45.9
12	R2	397	0.0	0.276	6.9	LOS A	1.7	11.9	0.06	0.60	46.0
12u	U	4	0.0	0.276	8.4	LOS A	1.7	11.9	0.06	0.60	46.5
Approach		451	0.0	0.276	6.5	LOS A	1.7	11.9	0.06	0.60	46.0
All Vehicles		898	0.5	0.285	5.4	LOS A	1.9	13.4	0.15	0.54	46.2

Level of Service (LOS) Method: Delay (RTA NSW).

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.

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MOVEMENT SUMMARY

 Site: Wyalong St/ Artarmon Rd - Sat Midday Ex

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Artarmon Rd											
1	L2	384	0.8	0.276	3.8	LOS A	1.8	12.8	0.20	0.47	46.6
3a	R1	5	0.0	0.276	6.3	LOS A	1.8	12.8	0.20	0.47	47.0
3u	U	1	0.0	0.276	8.6	LOS A	1.8	12.8	0.20	0.47	47.9
Approach		391	0.8	0.276	3.9	LOS A	1.8	12.8	0.20	0.47	46.6
NorthEast: Wyalong St											
24a	L1	3	0.0	0.046	5.3	LOS A	0.2	1.6	0.48	0.64	45.2
26a	R1	39	2.7	0.046	8.2	LOS A	0.2	1.6	0.48	0.64	44.9
26u	U	1	0.0	0.046	10.4	LOS A	0.2	1.6	0.48	0.64	45.7
Approach		43	2.4	0.046	8.0	LOS A	0.2	1.6	0.48	0.64	45.0
West: Artarmon Rd											
10a	L1	49	0.0	0.269	3.3	LOS A	1.6	11.5	0.06	0.60	45.9
12	R2	386	0.0	0.269	6.9	LOS A	1.6	11.5	0.06	0.60	46.0
12u	U	4	0.0	0.269	8.4	LOS A	1.6	11.5	0.06	0.60	46.5
Approach		440	0.0	0.269	6.5	LOS A	1.6	11.5	0.06	0.60	46.0
All Vehicles		874	0.5	0.276	5.4	LOS A	1.8	12.8	0.15	0.54	46.2

Level of Service (LOS) Method: Delay (RTA NSW).

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.

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MOVEMENT SUMMARY

 Site: Wyalong St/ Artarmon Rd - Thurs AM 400

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
South: Artarmon Rd											
1	L2	238	0.4	0.178	3.8	LOS A	1.1	7.5	0.20	0.47	46.6
3a	R1	3	0.0	0.178	6.3	LOS A	1.1	7.5	0.20	0.47	47.0
3u	U	1	0.0	0.178	8.7	LOS A	1.1	7.5	0.20	0.47	47.9
Approach		242	0.4	0.178	3.9	LOS A	1.1	7.5	0.20	0.47	46.6
NorthEast: Wyalong St											
24a	L1	5	0.0	0.057	5.8	LOS A	0.3	2.0	0.53	0.66	45.0
26a	R1	45	0.0	0.057	8.6	LOS A	0.3	2.0	0.53	0.66	44.8
26u	U	1	0.0	0.057	10.9	LOS A	0.3	2.0	0.53	0.66	45.5
Approach		52	0.0	0.057	8.4	LOS A	0.3	2.0	0.53	0.66	44.8
West: Artarmon Rd											
10a	L1	54	3.9	0.315	3.3	LOS A	2.0	14.3	0.05	0.61	45.9
12	R2	465	0.5	0.315	6.9	LOS A	2.0	14.3	0.05	0.61	46.0
12u	U	3	0.0	0.315	8.4	LOS A	2.0	14.3	0.05	0.61	46.5
Approach		522	0.8	0.315	6.5	LOS A	2.0	14.3	0.05	0.61	46.0
All Vehicles		816	0.6	0.315	5.9	LOS A	2.0	14.3	0.13	0.57	46.1

Level of Service (LOS) Method: Delay (RTA NSW).

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.

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MOVEMENT SUMMARY

 Site: Wyalong St/ Artarmon Rd - Thurs AM 510

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Artarmon Rd											
1	L2	249	0.4	0.186	3.8	LOS A	1.1	7.9	0.20	0.47	46.6
3a	R1	3	0.0	0.186	6.4	LOS A	1.1	7.9	0.20	0.47	47.0
3u	U	1	0.0	0.186	8.7	LOS A	1.1	7.9	0.20	0.47	47.9
Approach		254	0.4	0.186	3.9	LOS A	1.1	7.9	0.20	0.47	46.6
NorthEast: Wyalong St											
24a	L1	5	0.0	0.057	5.8	LOS A	0.3	2.0	0.53	0.66	45.0
26a	R1	45	0.0	0.057	8.6	LOS A	0.3	2.0	0.53	0.66	44.8
26u	U	1	0.0	0.057	10.9	LOS A	0.3	2.0	0.53	0.66	45.5
Approach		52	0.0	0.057	8.4	LOS A	0.3	2.0	0.53	0.66	44.8
West: Artarmon Rd											
10a	L1	54	3.9	0.317	3.3	LOS A	2.0	14.4	0.05	0.61	45.9
12	R2	467	0.5	0.317	6.9	LOS A	2.0	14.4	0.05	0.61	46.0
12u	U	3	0.0	0.317	8.4	LOS A	2.0	14.4	0.05	0.61	46.5
Approach		524	0.8	0.317	6.5	LOS A	2.0	14.4	0.05	0.61	46.0
All Vehicles		829	0.6	0.317	5.8	LOS A	2.0	14.4	0.13	0.57	46.1

Level of Service (LOS) Method: Delay (RTA NSW).

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.

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MOVEMENT SUMMARY

 Site: Wyalong St/ Artarmon Rd - Thurs AM Ex

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Artarmon Rd											
1	L2	231	0.5	0.173	3.8	LOS A	1.0	7.3	0.20	0.47	46.6
3a	R1	3	0.0	0.173	6.3	LOS A	1.0	7.3	0.20	0.47	47.0
3u	U	1	0.0	0.173	8.7	LOS A	1.0	7.3	0.20	0.47	47.9
Approach		235	0.4	0.173	3.9	LOS A	1.0	7.3	0.20	0.47	46.6
NorthEast: Wyalong St											
24a	L1	5	0.0	0.058	5.9	LOS A	0.3	2.0	0.54	0.67	44.9
26a	R1	45	0.0	0.058	8.8	LOS A	0.3	2.0	0.54	0.67	44.7
26u	U	1	0.0	0.058	11.1	LOS A	0.3	2.0	0.54	0.67	45.4
Approach		52	0.0	0.058	8.5	LOS A	0.3	2.0	0.54	0.67	44.7
West: Artarmon Rd											
10a	L1	54	3.9	0.329	3.3	LOS A	2.1	15.1	0.05	0.61	45.9
12	R2	488	0.4	0.329	6.9	LOS A	2.1	15.1	0.05	0.61	46.0
12u	U	3	0.0	0.329	8.4	LOS A	2.1	15.1	0.05	0.61	46.5
Approach		545	0.8	0.329	6.6	LOS A	2.1	15.1	0.05	0.61	46.0
All Vehicles		832	0.6	0.329	5.9	LOS A	2.1	15.1	0.12	0.57	46.1

Level of Service (LOS) Method: Delay (RTA NSW).

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.

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MOVEMENT SUMMARY

 Site: Wyalong St/ Artarmon Rd - Thurs PM 400

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
South: Artarmon Rd											
1	L2	423	0.0	0.304	3.8	LOS A	2.0	14.3	0.22	0.47	46.6
3a	R1	5	0.0	0.304	6.4	LOS A	2.0	14.3	0.22	0.47	47.0
3u	U	2	0.0	0.304	8.7	LOS A	2.0	14.3	0.22	0.47	47.8
Approach		431	0.0	0.304	3.9	LOS A	2.0	14.3	0.22	0.47	46.6
NorthEast: Wyalong St											
24a	L1	7	0.0	0.053	4.6	LOS A	0.3	1.8	0.41	0.60	45.6
26a	R1	46	2.3	0.053	7.5	LOS A	0.3	1.8	0.41	0.60	45.3
26u	U	1	0.0	0.053	9.8	LOS A	0.3	1.8	0.41	0.60	46.1
Approach		55	1.9	0.053	7.2	LOS A	0.3	1.8	0.41	0.60	45.4
West: Artarmon Rd											
10a	L1	65	1.6	0.208	3.3	LOS A	1.2	8.4	0.06	0.59	46.1
12	R2	266	0.8	0.208	6.9	LOS A	1.2	8.4	0.06	0.59	46.1
12u	U	1	0.0	0.208	8.4	LOS A	1.2	8.4	0.06	0.59	46.7
Approach		333	0.9	0.208	6.2	LOS A	1.2	8.4	0.06	0.59	46.1
All Vehicles		818	0.5	0.304	5.1	LOS A	2.0	14.3	0.17	0.53	46.3

Level of Service (LOS) Method: Delay (RTA NSW).

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.

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MOVEMENT SUMMARY

 Site: Wyalong St/ Artarmon Rd - Thurs PM 510

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Artarmon Rd											
1	L2	426	0.0	0.307	3.8	LOS A	2.1	14.5	0.22	0.47	46.6
3a	R1	5	0.0	0.307	6.4	LOS A	2.1	14.5	0.22	0.47	47.0
3u	U	2	0.0	0.307	8.7	LOS A	2.1	14.5	0.22	0.47	47.8
Approach		434	0.0	0.307	3.9	LOS A	2.1	14.5	0.22	0.47	46.6
NorthEast: Wyalong St											
24a	L1	7	0.0	0.053	4.6	LOS A	0.3	1.8	0.41	0.61	45.6
26a	R1	46	2.3	0.053	7.5	LOS A	0.3	1.8	0.41	0.61	45.3
26u	U	1	0.0	0.053	9.8	LOS A	0.3	1.8	0.41	0.61	46.1
Approach		55	1.9	0.053	7.2	LOS A	0.3	1.8	0.41	0.61	45.4
West: Artarmon Rd											
10a	L1	65	1.6	0.213	3.3	LOS A	1.2	8.7	0.06	0.59	46.1
12	R2	274	0.8	0.213	6.9	LOS A	1.2	8.7	0.06	0.59	46.1
12u	U	1	0.0	0.213	8.4	LOS A	1.2	8.7	0.06	0.59	46.7
Approach		340	0.9	0.213	6.2	LOS A	1.2	8.7	0.06	0.59	46.1
All Vehicles		828	0.5	0.307	5.1	LOS A	2.1	14.5	0.17	0.53	46.3

Level of Service (LOS) Method: Delay (RTA NSW).

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.

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MOVEMENT SUMMARY

 Site: Wyalong St/ Artarmon Rd - Thurs PM Ex

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Artarmon Rd											
1	L2	447	0.0	0.320	3.9	LOS A	2.2	15.4	0.22	0.47	46.6
3a	R1	5	0.0	0.320	6.4	LOS A	2.2	15.4	0.22	0.47	47.0
3u	U	2	0.0	0.320	8.7	LOS A	2.2	15.4	0.22	0.47	47.8
Approach		455	0.0	0.320	3.9	LOS A	2.2	15.4	0.22	0.47	46.6
NorthEast: Wyalong St											
24a	L1	7	0.0	0.053	4.6	LOS A	0.3	1.8	0.41	0.60	45.6
26a	R1	46	2.3	0.053	7.5	LOS A	0.3	1.8	0.41	0.60	45.3
26u	U	1	0.0	0.053	9.8	LOS A	0.3	1.8	0.41	0.60	46.1
Approach		55	1.9	0.053	7.2	LOS A	0.3	1.8	0.41	0.60	45.4
West: Artarmon Rd											
10a	L1	65	1.6	0.211	3.3	LOS A	1.2	8.6	0.06	0.59	46.1
12	R2	271	0.8	0.211	6.9	LOS A	1.2	8.6	0.06	0.59	46.1
12u	U	1	0.0	0.211	8.4	LOS A	1.2	8.6	0.06	0.59	46.7
Approach		337	0.9	0.211	6.2	LOS A	1.2	8.6	0.06	0.59	46.1
All Vehicles		846	0.5	0.320	5.0	LOS A	2.2	15.4	0.17	0.53	46.3

Level of Service (LOS) Method: Delay (RTA NSW).

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.

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

Organisation: GTA CONSULTANTS | Processed: Wednesday, 8 June 2016 1:56:46 PM

Project: P:\16S1400-1499\16S1405100 Channel 9 Redevelopment\Modelling\DQR 160607\Final SIDRA Adjustments\160608sid-16S1405100 PM Existing 400 510.sip6

Appendix C

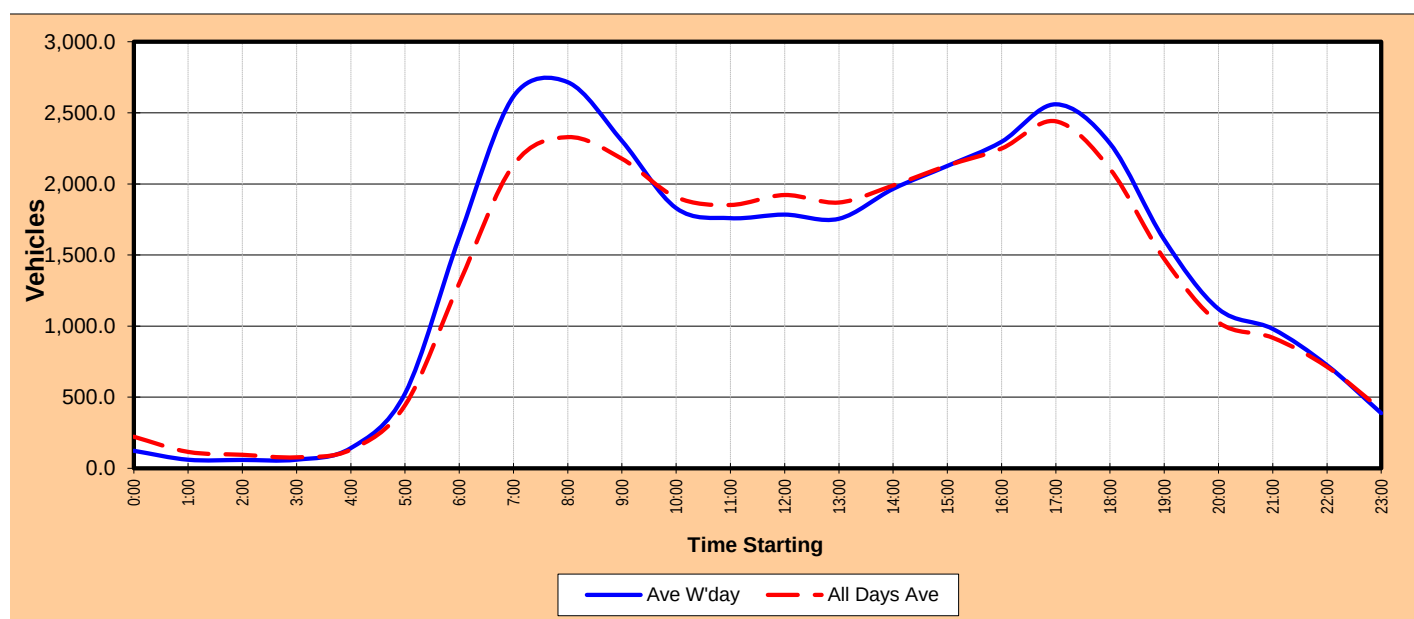
Swept Path Analysis

Appendix D

Survey Results

Road	Willoughby Rd	Average Weekday 33412 All Day Average 32032 Weekday Heavy's 5.8% All Day Heavy's 5.1%
Location	between Artarmon Rd and Walter St	
Site No.	1	
Start Date	Thursday 12/05/2016	
Direction	Two ways	

Starting Time	Day of Week							Ave W'day	All Days Ave
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
	16-May	17-May	18-May	12-May	13-May	14-May	15-May		
AM Peak	2687	2714	2710	2781	2706	2301	1924		
PM Peak	2533	2551	2523	2595	2598	2402	2131		
0:00	88	102	114		189	347	492	123	222
1:00	47	58	69	24	104	206	300	60	115
2:00	48	53	51	62	81	165	206	59	95
3:00	56	60	55	68	65	107	130	61	77
4:00	152	141	148	139	131	103	102	142	131
5:00	545	540	535	507	503	248	228	526	444
6:00	1623	1657	1647	1585	1614	591	393	1625	1301
7:00	2631	2714	2663	2507	2563	1223	632	2616	2133
8:00	2687	2694	2710	2781	2706	1721	1003	2716	2329
9:00	2189	2351	2338	2356	2278	2140	1587	2302	2177
10:00	1731	1801	1787	1933	1896	2301	1898	1830	1907
11:00	1634	1742	1766	1779	1875	2243	1924	1759	1852
12:00	1704	1768	1783	1789	1877	2402	2131	1784	1922
13:00	1711	1667	1725	1782	1889	2335	1976	1755	1869
14:00	1866	1802	1953	2047	2158	2199	1901	1965	1989
15:00	2056	2046	2106	2143	2282	2248	2021	2127	2129
16:00	2261	2217	2263	2310	2431	2208	2053	2296	2249
17:00	2533	2551	2523	2595	2598	2347	1935	2560	2440
18:00	2059	2251	2210	2444	2456	1834	1481	2284	2105
19:00	1388	1603	1522	1763	1760	1252	1015	1607	1472
20:00	950	1127	1165	1239	1122	818	764	1121	1026
21:00	785	950	1021	1170	977	854	671	981	918
22:00	533	606	696	847	943	951	425	725	714
23:00	234	281	374	419	632	718	237	388	414
Total	31511	32782	33224	34289	35130	31561	25505	33412	32032
% Heavy's	5.9%	6.0%	5.7%	5.8%	5.5%	3.7%	2.8%	5.8%	5.1%



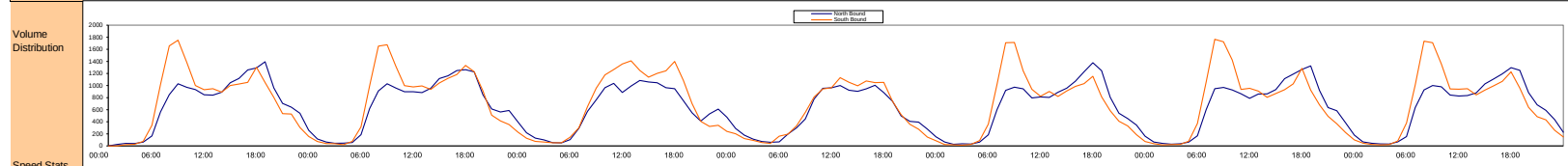
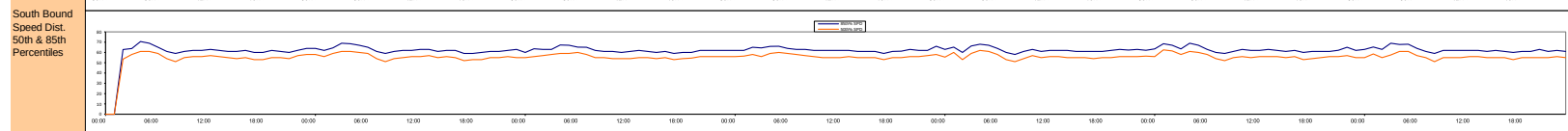
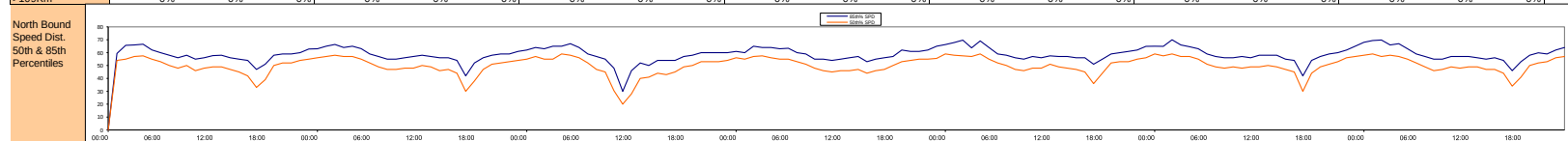
Willoughby Rd between Artarmon Rd and Walter St

Suburb	Willoughby
Siteld	1
Speed Limit	60

Job 7460

Map Ref

Date Record Interval (min)		Thursday 12/05/2016					Friday 13/05/2016					Saturday 14/05/2016					Sunday 15/05/2016					Monday 16/05/2016					Tuesday 17/05/2016					Wednesday 18/05/2016				
	60	North	Bound	South	Two ways	North	Bound	South	Two ways	North	Bound	South	Two ways	North	Bound	South	Two ways	North	Bound	South	Two ways	North	Bound	South	Two ways	North	Bound	South	Two ways							
Short	%	92.6%		93.7%	93.2%	92.9%		94.0%	93.5%	94.4%		96.0%	95.3%	96.1%		96.7%	96.4%	92.7%		93.3%	93.0%	92.3%		93.6%	93.0%	92.4%		93.8%	93.1%							
Med	%	4.0%		3.2%	3.6%	3.8%		3.1%	3.4%	2.5%		1.7%	2.1%	1.9%		1.4%	1.7%	4.0%		3.4%	3.7%	4.1%		3.2%	3.7%	4.0%		3.0%	3.5%							
Long	%	2.3%		2.2%	2.2%	2.2%		1.9%	2.1%	1.9%		1.6%	1.2%	1.1%		1.2%	2.2%	2.2%		2.2%	2.2%	2.3%		2.2%	2.3%	2.3%		2.1%	2.2%							
7am-7pm	Vol	12471		12995	26466	12546		14463	27009	11068		14133	25201	9839		10743	20542	12020		13042	25062	12047		13557	25604	12171		13656	25827							
7am-7pm	Vol	16180		17811	34389	16687		35144	14959	32143		12959	15959	15363		15175	25505	16158		31517	17025	16158		32174	17202	33517		32174	17202							
85%ile	Km	57.0		62.0	60.0	57.0		62.0	60.0	56.0		61.0	60.0	58.0		62.0	60.0	57.0		62.0	60.0	57.0		62.0	60.0	57.0		62.0	60.0							
Mean Spd		46.6		55.2	51.0	46.3		55.0	50.8	43.1		55.0	49.4	48.3		56.1	52.2	47.6		55.2	51.4	47.2		55.4	51.3	46.7		55.2	51.0							
Std Dev		11.3		8.1	10.7	11.5		8.1	10.8	14.3		8.3	12.9	10.6		6.7	9.7	10.7		8.0	10.2	10.9		7.6	10.2	11.5		7.9	10.7							
AM PK Interval Vol		1030		1751	2781	1030		1676	2706	1037		1358	2301	962		962	1924	973		1714	2687	969		1766	2714	1001		1735	2710							
AM PK Factor		0.06		0.10	0.08	0.06		0.09	0.08	0.07		0.08	0.07	0.08		0.07	0.08	0.06		0.11	0.09	0.06		0.10	0.08	0.06		0.10	0.08							
AM PK 85%		56.0		59.0	58.0	55.0		59.0	57.0	48.0		60.0	59.0	54.0		62.0	59.0	56.0		58.0	58.0	56.0		60.0	59.0	55.0		61.0	58.0							
AM PK 85%		08:00		08:00	08:00	08:00		08:00	08:00	11:00		11:00	11:00	11:00		11:00	08:00	08:00		08:00	08:00	08:00		08:00	08:00	08:00		08:00	08:00							
PM PK Interval Vol		1393		1303	2508	1263		1335	2598	1085		1409	2402	1000		1131	2131	1379		1154	2533	1235		1289	2551	1299		1227	2525							
PM PK Factor		0.08		0.07	0.08	0.08		0.07	0.07	0.08		0.08	0.09	0.08		0.09	0.08	0.09		0.08	0.08	0.08		0.08	0.08	0.08		0.08	0.07							
PM PK 85%		51.0		60.0	57.0	42.0		59.0	56.0	52.0		61.0	59.0	55.0		62.0	60.0	60.0		51.0	61.0	58.0		54.0	60.0	57.0		46.0	57.0							
PM PK starts		18:00		17:00	17:00	17:00		17:00	17:00	17:00		13:00	12:00	12:00		16:00	12:00	12:00		17:00	17:00	17:00		18:00	17:00	17:00		17:00	17:00							

[illegible]

Car+MotorCycle	15,002	16,398	31,400	15,208	17,060	32,268	13,569	16,065	29,634	11,916	12,391	24,307	13,939	14,824	28,763	14,290	15,672	29,962	14,563	15,847	30,410
2. Car + Trailer	257	294	551	289	272	561	206	223	429	136	144	280	280	272	552	258	264	522	249	284	533
3. 2 axle truck	496	409	905	479	417	896	233	171	404	192	110	302	458	371	829	479	401	880	477	346	823
4. 3 axle truck	89	94	183	101	105	206	75	82	157	32	57	89	96	112	208	86	88	174	97	92	189
5. 4 axle truck	70	63	133	59	44	103	55	39	94	19	16	35	52	66	118	85	64	149	66	74	140
6. 3 axle semi	20	36	56	27	34	61	23	20	43	18	14	32	24	38	62	32	32	64	26	36	62
7. 4 axle semi	265	245	510	257	223	480	220	174	394	117	105	222	242	225	467	265	254	519	260	244	504
8. 5 axle semi	15	16	31	11	17	28	10	10	20	1	7	8	11	8	19	7	13	20	14	13	27
9. 6 axle semi	45	60	105	56	58	114	19	19	38	16	17	33	31	53	84	63	52	115	48	58	106
10. 7/8 axle truck	14	16	30	8	8	16	7	0	7	0	1	18	19	19	37	8	3	11	6	5	11
11. Road Train	11	16	27	12	21	32	4	8	12	2	2	15	8	23	10	7	10	19	7	10	13
12. Road Train	5	7	12	4	6	10	1	1	2	0	0	4	1	5	3	7	10	3	6	9	9
13. Unknown	189	157	346	176	187	363	177	154	331	98	95	193	165	179	344	168	169	337	207	190	397
14. Motorcycle	208	213	421	220	215	435	232	171	403	103	96	199	191	193	384	208	202	410	251	210	461
Unpaired Axles	79	90	169	80	159	239	106	199	305	42	90	132	78	115	193	78	74	152	84	122	206

Definitions

85th Percentile Speed = The speed at or below which 85% of volume is observed to travel
15kph Pace Speed = The 15kph speed range within which the largest percentage of volume is observed to travel

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