FRASERS PROPERTY AUSTRALIA

SHELL COVE BOAT HARBOUR ROAD NETWORK TRAFFIC ASSESSMENT

PRECINT D

STAGE 1 ROADS DA

26th APRIL 2016

CHRISTOPHER HALLAM & ASSOCIATES PTY LTD

PO BOX 265, KURRAJONG NSW 2758

02 45731045

chris@christopherhallam.com

JOB: 3408

1.0 INTRODUCTION

Shell Cove Boat Harbour Precinct has been planned by Australand to provide a town centre for the developing Shell Cove residential area. The *Shell Cove Boat Harbour Precinct Concept Plan Application and Environmental Assessment* was prepared by LFA in February 2010, to provide an overall concept plan for the area. This was supported by a report by Maunsell titled *Shell Cove Boatharbour Precinct Traffic Study,* dated 24 March 2009. This Maunsell report set out an analysis of the traffic generation and road and intersection design for the area. From area network traffic modelling, Maunsell assessed individual intersections and developed the proposed intersection layouts.

Since the date of the 2009 Maunsell report, on-going refinements in the design of the Boat Harbour Precinct have been undertaken. Subsequently, Australand commissioned Christopher Hallam & Associates Pty Ltd to undertake a review of the road network, taking into account the precinct layout and land use details proposed. This report also considered car parking demands. This report, titled *Shell Cove Boat Harbour Precinct Masterplan Traffic and Parking Assessment,* was prepared in May 2015.

Australand – now Frasers Property Australia - commissioned Christopher Hallam & Associates Pty Ltd (CHA) to provide traffic design advice and to prepare a traffic and parking impact assessment for Stage 1 of the Shell Cove Boat Harbour Precinct.

Subsequently, Frasers Property Australia commissioned CHA to prepare a traffic impact report for the balance of the Shell Cove Boat Harbour road network not covered by the Stage 1 DA report. The Masterplan report provides important background to this assessment, as does the Stage 1 DA traffic assessment report.

This road network report is set out as follows:

- Section 2 briefly reviews the Shell Cove Boat Harbour Precinct
- Section 3 describes the proposed road network, reviews its function and capacity, and
- Section 4 sets out the conclusions.

2.0 SHELL COVE BOAT HARBOUR PRECINCT

2.1 Overview

The current concept plan for the ultimate development of Shell Cove Boat Harbour Precinct is shown on Figure 1. The details are as follows:

- Supermarket 3600 sq m
- Specialty shops 1424 sq m
- Restaurant 592 sq m (inside) plus 225 sq m (outside)
- Tavern 955 sq m (inside) plus 280 sq m (outside)
- Community 910 sq m; library 685 sq m
- Marina 300 berths
- Residential apartments
- Apartment hotel

There have been, and probably will continue to be on-going refinements in the post-Stage 1 details and designs, so that some changes to this plan in Figure 1 will occur. It should be seen as a Master Plan, illustrating the ultimate development, with details to be confirmed at each development application stage.

To properly assess the roads and intersections, we consider it desirable to assess the traffic implications of the full development. For this purpose, we have set out below our assessment of the traffic generation of the full development. The information in this Section is taken from our May 2015 report *Shell Cove Boat Harbour Precinct Masterplan Traffic and Parking Assessment.*

2.2 Traffic Generation Rates

In this Section we have set out our assessment of land use traffic generation rates and have made comparisons with the earlier traffic assessment by Maunsell, as a check that earlier roads planning is still applicable.

Standard Residential

Maunsell assumed standard rates from the 2002 RTA *Guide to Traffic Generating Developments,* this being 9.0 veh/day/dwelling, or 0.85 veh/hr/dwelling. The RMS has recently published a *Technical Direction TDT 2013/04a,* in August 2013. This provides the results of new traffic surveys and recommends some variations in traffic generation rates compared with those in the 2002 Guide. It distinguishes between sites in the Sydney Region and Regional sites. For Sydney sites the rate is 10.7

veh/day/dwelling while for Regional sites the rate is 7.4 veh/day/dwelling. The 2002 RTA Guide thus gives conservatively higher rates for dwellings in Regional areas. Relying on the 2002 Guide rates is thus conservative.

Medium Density Residential

Maunsell quote the RTA rate of 6 veh/day/dwelling. This is the rate from the 2002 Guide for large (three-bedroom) dwellings. There were no new surveys. The assumption of this rate is thus conservative.

Apartment Unit

Maunsell quote 4 veh/day/dwelling. From the 2002 Guide this is equivalent to a small (one-bedroom) medium density unit. The RMS 2013 surveys suggest for "High density residential flat building" in a Regional location a rate of 4.6 veh/day/unit. This is substantially higher than the recommended Sydney rate of 1.5 veh/day/unit. We are not confident that the Regional rate of 4.6 truly reflects the likely outcomes, particularly with the Regional low density rates being substantially lower. There could be an issue with survey sample size in these rates. We prefer to stick with the original Maunsell rate of 4 veh/day/unit.

Shops and Supermarket

Maunsell suggest rates that do not appear to come from the 2002 Guide. They suggest for supermarkets, 77.5 veh/day/100 sq m , and for shops, 30 veh/day/100 sq m. The 2002 Guide has various ways of estimating trip generation at shopping centres. We recommend using the disaggregated model, with differing rates for each retail type. For the Friday afternoon peak hour, the supermarket rate is 13.8 veh/hr/100 sq m, while for specialty shops it is 5.6 veh/hr/100 sq m. RTA surveys found that the daily traffic generation of shopping centres is about 10 times the afternoon peak hour generation. The resulting daily rates are thus supermarkets, 138 veh/day/100 sq m, and shops, 56 veh/day/100 sq m, with these rates derived from Friday surveys, which is appropriate given that Friday is likely to be the peak weekday at Boat Harbour. For the AM peak hour, from the RMS 2010/2011 shopping centre surveys, the ratio of AM Peak Trips/PM Peak Trips had a mean of 0.55. This can be used to estimate the AM peak hour trips from the PM peak hour trips.

Office and Commercial

Maunsell use the 2002 Guide rate of 10.0 veh/day/100 sq m (and a peak hour rate of 2.0 veh/hr/100 sq m). The RMS 2013 recommended rate is 11.0 veh/day/100 sq m, and peak hour figures of 1.6 veh/hr/100 sq m (AM) and 1.2 veh/hr/100 sq m (PM). This suggests a spreading of the peak movements.

Technology Park

Maunsell suggest a rate of 5.5 veh/day/100 sq m. The RTA 2002 Guide recommends for Factories 5 veh/day/100 sq m and 1 veh/hr/100 sq m, while for Business Parks there is no daily figure but there is a peak hour figure of 1.1 veh/hr/100 sq m. The Maunsell rate is this Business Park rate multiplied by the Factories peak to day expansion factor.

The RMS 2013 document presents different rates for Sydney and for Regional, with the Sydney rate being 4.60 veh/day/100 sq m and the Regional rate being 7.83 veh/day/100 sq m. It would be prudent to use the new Regional rates. The peak hour rates are 0.70 veh/hr/100 sq m (AM) and 0.78 veh/hr/100 sq m (PM).

Retirement Village

The Maunsell rate of 6 veh/day/dwelling is high, and higher than the standard RTA Guide rate of 2 veh/day/dwelling. RMS 2013 recommend a rate of 2.1 veh/day/dwelling, which is close to the 2002 Guide rate, and with a peak hour rate of 0.4 veh/hr/dwelling, but with this peak rate not occurring during the commuter peak hours. We recommend using the new 2.1 veh/day/dwelling rate.

Hotel

Maunsell suggest a rate of 32 veh/day/100 sq m. However the 2002 RTA Guide provides no rates, so the origin of this rate is not known.

For hotels, we consider that the generation needs to be broken down into accommodation and tavern (bar and bistro). For Accommodation we suggest the use of the 2002 Guide rate for Motels, of 3.0 veh/day/unit and 0.4 veh/hr/unit, assuming one-bedroom units. For two-bedroom units within an apartment hotel, we recommend using the apartment unit regional rates of 4.58 veh/day/unit, 0.53 veh/hr/unit (AM) and 0.32 veh/hr/unit (PM).

For the Tavern component, the RTA have always recommended that comparisons be drawn with similar developments. With the lack of details on the type of hotel and tavern proposed for the precinct, this is difficult. As a guide, we recommend using the RTA Guide rate for Restaurants, of 60 veh/day/100 sq m and 5.0 veh/hr/100 sq m for the evening peak hour.

Restaurant

As above, we recommend using the RTA 2002 Guide rates of 60 veh/day/100 sq m and 5.0 veh/hr/100 sq m.

Library/Community

Maunsell recommend a rate of 5 veh/day/100 sq m. The RTA 2002 Guide rates for Office/commercial are 10 veh/day/100 sq m and 2.0 veh/hr/100 sq m. The RMS 2013 rates are 11 veh/day/100 sq m, 1.6 veh/hr/100 sq m (AM) and 1.2 veh/hr/100 sq m (PM).

With car parking for the Community Centre being at the same rate of one space/40 sq m as the RTA Guide, we recommend using the 2013 rates for this use. For the Library floor area, with lower rates of parking provision, we recommend using the Maunsell rate of 5 veh/day/100 sq m.

Marina

This is a difficult land use to assess. It is a very seasonal use. From our surveys at Rose Bay and Point Piper Marinas on Sydney Harbour, compared with an assumed peak usage in December, the monthly variations between July and January were found to be:

July 53%; August 49%; September 59%; October 59%; November 50%; December 100%; January 79%

Marina usage tends to be busy on Summer weekends and not very busy on weekdays, or out of the warmer months. While some marinas on Sydney Harbour and Pittwater can have weekday evening peak usage through yacht races, this is not expected to be a feature of boat usage at Shell Cove. An important traffic generation will be from the commercial vessels, and even these will have seasonal variations in use, with whale watching only on some months of the year, and with weekends being busier than weekdays. Other commercial uses such as off-shore game fishing and diving will also likely to be busier on the weekend. Transient boat users who call in at the marina when sailing past will have minimal traffic generation, unless they hire a car for a few days.

We have based our traffic generation assessment on observed person movements per hour at Rose Bay & Point Piper Marinas on Summer weekends, with the factoring taking into account the parking supply for Boat Harbour Marina. As separately reviewed, we recommend the provision of 40 car parking spaces for Stage 1 of the marina, including provision for the five commercial vessel berths, with the intent being to undertaken monitoring of parking demand for the marina prior to further marina stages. For this assessment of the ultimate traffic generation of a 300 berth marina, for the balance of the 250 berths, we have assumed the rate of 0.223 spaces per berth, which is the rate for berths longer than 20m that we found in our extensive marina parking research. This requires an additional 55 spaces, taking the total to 95 spaces. Table 2.1 sets out our analysis of the hourly traffic movements on a Summer weekend, for Stage 1 and for Ultimate development of the 300 berth marina, based on surveys at Rose Bay and Point Piper Marinas. Note that the absolute figures for person movements at Rose Bay/Point Piper do not transpose into the car movements shown. The distribution of the person movements has been used to determine the traffic movements, assuming 100% use of the parking provided at some time during the day.

Table 2.1 Summer Weekend Person Movement and Traffic Generation

Time	Rose Bay Persons IN	Rose Bay Persons OUT	Shell Cove S1 Cars IN	Shell Cove S1 Cars OUT	Shell Cove Parking	Shell Cove Cars IN	Shell Cove Cars OUT	Shell Cove Parking
8-9am	7	0	6	0	6	15	0	15
9-10am	14	0	13	0	19	31	0	46
10-11am	15	2	14	2	31	33	4	75
11-12pm	7	3	7	2	36	15	5	85
12-1pm	7	3	6	2	40	15	5	95
1-2pm	2	7	2	6	36	5	15	85
2-3pm	4	8	4	8	32	10	18	77
3-4pm	1	12	1	12	21	3	29	51
4-5pm	0	20	0	19	2	0	46	5
Total	57	55	53	51	-	127	122	-

From Table 2.1 it can be seen that for Stage 1 of the marina, assuming all allocated parking is used, on a Summer weekend day the daily two-way traffic movements will be about 106 veh/day, while for the ultimate development of the marina, with 300 berths, the daily two-way traffic movements will be about 254 veh/day.

For weekdays, the use of the marina will be substantially lower. Again, based on usage rates observed at other marinas over the week, we have conservatively assumed that the weekday generation will be 50% of the weekend generation, or 53 veh/day for the Stage 1 and 127 veh/day

for the 300 berth marina. For reviewing weekday peak periods, the same 50% reduction can be assumed, so that for the morning and afternoon peak hours, the traffic movements will be:

Period	Weekday 50 berths	Weekday 300 berths
8-9am	3 veh/hr	8 veh/hr
4-5pm	10 veh/hr	23 veh/hr

As stated, the Stage 1 will include the five commercial vessel berths, which will have substantially higher rates of usage, while the additional 250 berths are assumed to be more typical private berths, with lower rates of use and parking demand.

2.3 Precinct Traffic Generation

As discussed in the Masterplan report, the TRACKS model assumed the total Shell Cove area to have a generation of 50,551 veh/day, with about 35% of this, or 18,000 veh/day from the Boat Harbour Precinct. The Maunsell assessment found a lower generation from the Boat Harbour Precinct, of about 14,000 veh/day, but to be conservative, Maunsell used the TRACKS outputs in their review of road hierarchy and intersections.

To check that this Maunsell assessment is still valid for the current mix of uses at the Boat Harbour Precinct, we have applied our generation rates set out in Section 2.2 to this current mix. This review includes residential flat buildings along the northern edge of the Precinct, where final apartment yields are not confirmed, but the numbers set out below are the current estimates.

Similarly for the apartment hotel, the assessment is based on the current projection of 110 two-bedroom apartments where 48 of these are dual-key, allowing separate use as 96 one-bedroom rooms. Some apartments within this hotel will be full-time residential. The traffic generation has been based on 96 motel units plus 62 two-bedroom apartments. This apartment hotel will include lobby, reception and various services that will not generate traffic in their own right. Some conference area is likely, but this has been assumed to be used by hotel residents only and not operate as an independent function centre. Current planning does not include public bar and restaurant facilities in this hotel, although there could be a low key lobby bar catering for in-house guests and residents.

Marine Offices

- 301 sq m @ 11/100 sq m/day = 33 veh/day
- AM peak @ 1.6/100 = 5 veh/hr; PM peak @1.2/100 = 4 veh/hr

Restaurants

- 592 sq m internal plus 225 sq m external = 817 sq m GFA assumed
- 817 sq m @ 60/100sq m/day = 490 veh/day

- AM peak 0; PM peak @ 5/100/hr = 41 veh/hr

Supermarket

- 3600 sq m GFA @ 13.8 veh/100 sq m/hr (Friday) = 497 veh/hr PM
- AM figure is 0.55 x 497 = 273 veh/hr
- Daily x10 = 4970 veh/day

Shops

- 1424 sq m GFA @ 5.6 /100 sq m/hr (Friday) = 80 veh/hr PM
- AM figure is 0.55 x 80 = 44 veh/hr
- Daily x 10 = 800 veh/day

Community/Library

- Community 910 sq m @ 10/100 sq m/day = 91 veh/day
- Peak @ 2.0 veh/100 sq m/hr = 18 veh/hr
- Library 685 sq m @ 5/100 sq m /day = 34 veh/day
- Peak @ 1.0 veh/100 sq m/hr = 7 veh/hr

Tavern

- 955 sq m indoors plus 280 sq m outdoors = 1235 sq m total GFA
- Daily 1235 sq m @ 60/100 sq m/day = 741 veh/day
- PM Peak 1235 sq m @ 5/100 sq m/hr = 62 veh/hr
- AM Peak: assume 0.1 x 62 = 6 veh/hr

Residential Apartments - East

- 25 apartments @ 4.58/day = 114 veh/day
- AM peak @ 0.53/hr = 13 veh/hr; PM peak @ 0.32/hr = 8 veh/hr

Residential Apartments – North

- 152 apartments @ 4.58/day = 696 veh/day
- AM peak @ 0.53/hr = 81 veh/hr; PM @ 0.32 = 49 veh/hr

Apartment Hotel

- 96 one-bedroom rooms @ 3.0/room/day =288 veh/day

- 62 two-bedroom units @ 4.58/unit/day = 284
- Peak 96 one-bedroom rooms @ 0.4 veh/room/hr =38 veh/hr AM & PM
- Peak 62 two-bedroom units @ 0.53/unit/hr = 33 veh/hr (AM); 62 @ 0.32/unit/hr = 20 veh/hr (PM)

Marina

- Stage 1 106 veh/day Weekend, 53 veh/day Weekday
- Stage 1: AM weekday 3 veh/hr; PM weekday 10 veh/hr
- Ultimate: 254 veh/day Weekend, 127 veh/day Weekday
- Ultimate: AM weekday 8 veh/hr; PM weekday 23 veh/hr

Total Precinct

Table 2.2 gives the projected daily and peak hour flows for the Precinct.

Table 2.2 Projected Weekday Traffic Generation of Boat Harbour Precinct

Land Use	Vehicles/Day	AM Peak Veh/Hr	PM Peak Veh/Hr
Marine offices	33	5	4
Restaurants	490	0	41
Supermarket	4970	273	497
Shops	800	44	80
Community/library	125	25	25
Tavern	741	6	62
Residential apartments - East	114	13	8
Residential apartments – North	696	81	49
Apartment hotel	572	71	58
Marina	S1:53; Ult 127	S1 3; Ult 8	S1 10; Ult 23
Total	Ult: 8,668	526	847

Note that some of these trips would be multi-purpose, for example, people shopping and then going to a restaurant or tavern, local residents walking to the restaurants or tavern and marina users using the restaurants or tavern after boating.

With the total weekday trip generation of about 18,000 veh/day that was estimated in the TRACKS modelling, the total in Table 2.2 of 8,668 veh/day is substantially less, and hence the analysis by Maunsell in their 2009 report of road hierarchy and intersections remains valid, with a conservative over-allowance for the total trips. This will allow for higher yields than currently proposed.

As a cross-check, we reviewed the land use information in Table 2.1 of the Maunsell report. For the Boat Harbour Precinct, and using our preferred generation rates, we estimated a total daily flow of 13,300 veh/day, plus marina traffic, for a total of under 13,500 veh/day. This compares with our estimate of 8,668 veh/day. For the remaining precinct land uses in the Maunsell Table 2.1, and using our generation rates, we estimate a total daily flow of just under 18,000 veh/day. Added to Boat Harbour Precinct this yields about 31,500 veh/day, a figure less than the 50,500 veh/day projected by the TRACKS model. The traffic flow outputs from the TRACKS model remain conservative.

The original assessment by Maunsell of the major road intersections along Harbour Boulevarde were reviewed in our report *Shell Cove Boat Harbour Precinct Masterplan Traffic and Parking Assessment.* Based on the traffic projections set out in Table 2.2 and on our assumptions on traffic distribution, we have prepared Figure 2 to set out *Projected Peak Hour Traffic Flows.* This Figure is used in Section 3.2, in our assessment of roads and intersection capacity.

3.0 BOAT HARBOUR ROAD NETWORK DEVELOPMENT APPLICATION

3.1 Description

Figure 3 shows the Boat Harbour Precinct road network covered by this report. It covers Road 10 – Cove Boulevarde – between Harbour Boulevarde and Road 11. This report also covers Road 12 between Road 11 and Road 10. The Private Road between Road 10 and Road MC01 is discussed in our separate *Stage 1 Traffic and Parking Assessment.*

Other figures not included in this report but that are referenced are:

- GSA: *Shell Cove – Precinct D Road Treatment*
- Worley Parsons: *Shell Cove – Subdivision Precinct D (Town Centre) Sight Line at Intersection of:* *(I) Road 12 & Road 10*

  (ii) Private Road & Road 10

  (iii) Private Road & MC01

  (iv) Road 11 & Road 12

  (v) Road 10 & Road 11

Within this proposed road network, the planned bus route is from Harbour Boulevarde, into Road 10 (Cove Boulevarde), a right-turn into Private Road in front of the proposed supermarket to access the bus stop at that location, then right onto Road MC01 and hence left back onto Harbour Boulevarde. The design of the intersections of Roads 10 & 12/Private Road, and Private Road & MC01 will accommodate the bus movements.

The road carriageway and reserve widths proposed, as set out on Figure 3, are:

Road	Reserve	Lanes	Median	Total Carriageway
10 (west of Road 12)	18.90m	2 x 3.5m	1.3m	8.30m
10 (east of Road 12)	18.90m	2 x 3.2m	1.3m	7.70m
Road 11	18.51m	2 x 3.5m	-	7.00m
Road 12	18.90m	2 x 3.5m	-	7.00m
Private Road	18.9m	2 x 3.5m	-	7.00m

These reserve and carriageway widths are appropriate for their function and projected traffic flows.

This currently proposed road network differs slightly from that in the Preferred Project Report, prepared by LFA and dated November 2010. This report shows what was then referred to as Road B

running parallel to Harbour Boulevarde, and further to the East – Figure 3 of the LFA report. Road B is now proposed to be deleted on its original eastern route between Road MC01 and Road 10 (Cove Boulevarde), but with this link replaced by the proposed private road just to the West, linking up with Road 12. At first glance of Figure 3, the original Road B was a Type 3A Connecting Street providing access between residential areas to the South-East and the town centre, as an alternative to using Harbour Boulevarde. In the traffic modelling however it did not attract much traffic. The *Concept Plan Application and Environmental Assessment – Appendix A – Traffic,* set out the background traffic analysis by Maunsell, in their report of 24 March 2009 titled *Shell Cove Boatharbour Precinct Traffic Study – Final Report*. This report provides details of all of the traffic modelling. The predicted year 2018 daily traffic flows on Road B were 700 vehicles per day north of Bass Point Road, 900 vehicles per day south of Cove Boulevarde and 1100 vehicles per day north of Cove Boulevarde (Table 3.2). The same table shows projected traffic flows "without Boat Harbour Precinct". This shows zero traffic on Road B, which means that Road B does not have a sub-regional role, and is only expected to carry traffic into and out of the Boat Harbour town centre. Page 17 of this Maunsell report provides further comment on Road B:

> ***"Road B** will be an important road, connecting Brigantine Drive in the north to Cove Boulevarde in the town centre, Road A, the proposed hotel and the Harbour Boulevarde near the Business Park in the south. The road network shown in a concept plan for the town centre (Figure 2.2), land-use and car park access pattern will encourage traffic to use Harbour Boulevarde rather than Road B. Thus, Road B is likely to be a relatively lightly trafficked road, providing opportunities for developing an attractive environment along this road corridor. Direct frontage access to properties, on-street parking and good pedestrian amenity can be encouraged along Road B".*

As set out in the following sections, the intersections of Road MC01/Private Road (12), and Road 10 (Cove Boulevarde)/Road 12/Private Road have been analysed and found to have future satisfactory operation, with the altered road network.

As to the road cross-sections, Road B was to be a Type 3A road, with 18.5m or 19.5m road reserves, the latter assuming it is a bus route. This road type would have a 10.6m carriageway (or a 10.0m carriageway if no bus route). These cross-sections allow for some kerbside parking, but with only one through traffic lane per direction. The current road network proposal will provide a 3.5m wide travel lane per direction. Where kerbside parking is proposed, such as in Road 12 north of Road 10, this parking will be outside of the 7.0m two-way carriageway. The functionality of a connecting street with one travel lane per direction (plus some parking outside of the main carriageway) will thus be maintained. Road 11, also a Type 3A road, will have a similar design, with a central 7.0m two-way carriageway and kerbside parking outside of the central carriageway.

In summary, the change in the road network with that set out in the Preferred Project Report will not have any negative impact on the accessibility and capacity of the road network.

In terms of the geometric design of intersections, the following design parameters have been adopted:

- SRV's (6.4m) should be able to make unencumbered turns at all intersections wherever possible;

- MRV (8.8m) is the standard design vehicle for Road 10, for Road 12 and the Private Road (buses excepted on the designed bus route). The road network should be designed such that vehicles of this size can enter and leave the precinct in a forward direction without leaving the carriageway;
- The designated bus route shall be designed such that 12.5m buses can enter and exit the road network in a forward direction without leaving the carriageway. Intersections on the bus route should be designed wherever possible such that the HRV 12.5m/bus turns are unencumbered. This will only apply in the designed direction of the bus route, i.e. from Harbour Blvd into Road 10, right into Road 12 and exiting back to /Harbour Blvd via MC01, and not in the reverse direction. Providing unencumbered bus turning within the town centre will reduce congestion in peak periods. Buses will not have to wait for the intersection to clear before making the required turn. The bus does not have to leave its lane when making an unencumbered turn;
- The Road 11 / Road 10 intersection has been designed to accept 12.5m encumbered turning movements. This vehicle length is likely to be required when the hotel site becomes operational, with access from Road 11. The 12.5m vehicle will enter Road 10 from Road 11, enter the hotel site from an access pint on Road 10 close to the Road 11 intersection, turn within the hotel site, enter Road 10 in a forward direction, and exit the town centre via Road 11; and
- The 19m AV will not be a design vehicle nor checking vehicle for the town centre road network, other than MC01.

Vehicle length restrictions are proposed to apply to Road 10, Road 12 and the Private Road (with buses excepted on the designed bus route and hotel service vehicles also excepted when the hotel becomes operational). This is acceptable from a traffic and road design perspective. Section 3.2 below, refer "Town Centre Road Design Parameters" provides additional information in this regard.

The *Shell Cove Boat Harbour Stage 1 Traffic and Parking Assessment* report (December 2015) provided a traffic capacity assessment of the junctions of Roads 10 and 12, and Roads MC01 and 12. Note that Road 12 between Road 10 and Road MC01 is not proposed to be a public road. The public road part of Road 12 is that between Roads 10 and 11. The assessment of the intersection capacities at the above two junctions is included for completeness sake in this road network report, as is our assessment of the intersection capacities of the Harbour Boulevarde intersections that was set out in our May 2015 report.

3.2 Traffic Generation and Impact

Harbour Boulevarde Intersections

The three Harbour Boulevarde intersections providing access to Boat Harbour town centre have been reviewed. The comments and recommendations made in the Maunsell (2009) report are provided in italics at the start of each intersection discussion. Our SIDRA analysis has been based on the Precinct peak hour flows shown on Table 2.2, plus the Maunsell predicted major road flows and turning movements shown on Figure 2.

Harbour Boulevard/Cove Boulevard (Road 10)

The Harbour Bvde/Cove Bvde intersection would operate efficiently as a single-lane roundabout. However, traffic signals may be an option here in the longer term, to enable easier pedestrian movements during peak periods if high traffic volumes occur on Harbour Bvde near Cove Bvde.

The effective queuing space between the Cove Bvde/Harbour Bvde and MC01 (previously Road A)/Harbour Bvde intersections is about 100m. This would be a potential problem for both the signals and roundabout arrangement at the Harbour Bvde/Cove Bvde intersection.

An analysis of intersection operation under roundabout and signalised control indicated that:

- *For the roundabout option, queues in excess of 100m would only occur in the PM peak. This could be reduced to 36m with a short additional lane for northbound left turns from Harbour Bvde into Cove Bvde.*
- *Queues beyond 100m are likely to occur at several periods of the day with signals.*

Queues would be significantly less in other time periods.

The choice of signals or a roundabout affects network efficiency, the risk of rat running through Stage 10 residential streets and pedestrian movements. A roundabout is recommended, although it may affect the movement of pedestrians in the longer-term future when traffic volumes build on Harbour Bvde.

The peak hour traffic modelling by Maunsell found that a one-lane roundabout would provide adequate capacity, with less queuing than with traffic signals. Under signal control, the intersection modelling found that in the year 2018 AM peak hour there would be queuing of around 70m on the Harbour Boulevard North approach and on the Cove Boulevard West approach, with a level of service of B. In the Year 2018 PM peak hour queuing of about 110m on the Harbour Boulevard South approach was predicted, with a level of service of B. For the Year 2018 Holiday Peak queuing of about 120m on the Harbour Boulevard South approach was predicted, again with a level of service of B. A level of service of B represents *"good with acceptable delays and spare capacity"* operation, from the RTA's *Guide to Traffic Generating Developments.*

A roundabout is the preferred treatment, from a traffic efficiency point of view. The approaches from Harbour Boulevarde are two plus two lanes in cross-section, in general. The approach from Cove Boulevard East is a one plus one lane undivided road while the approach from Cove Boulevard West is a one plus one lane divided road. The Harbour Boulevard North approach would be channelled down to a single lane approach, with a one-lane roundabout. For the Harbour Boulevard South approach, we recommend that the two approach lanes be maintained, to assist the left turn. The Cove Boulevard single lane approaches would provide for left plus through plus right turns.

The disadvantage of a roundabout is that it does not provide active pedestrian safety measures. It relies on the use of pedestrian refuges in the medians, to allow pedestrians to cross the roads in two movements. This was recognised in the analysis by Maunsell. Pedestrian refuges are not regulatory devices, unlike marked pedestrian crossings, and hence refuges are not subject to a warrant. They

should follow principles of safe design. The most recent RMS Technical Direction on Pedestrian Refuges is TDT 2011/01a, published in 2011. Traffic and pedestrian volume warrants or ranges for application are not given. Refuges can be adopted instead of marked crossings when a) there is insufficient pedestrian and/or vehicle volumes, b) inadequate sight distance for drivers, and/or c) excessive vehicle approach speed. Based on the Year 2018 predicted traffic flows along Harbour Boulevard near Cove Boulevard – 11,800-13,600 veh/day – the peak hour directional flows are likely to exceed 500 veh/hr. By this level, pedestrians, particularly aged pedestrians, tend to find it difficult to cross the street. Crossing one traffic lane to reach a refuge is clearly easier than crossing two lanes of traffic. We echo the concern raised by Maunsell about the possible need for traffic signals in the long term, for pedestrian safety, given that Cove Boulevard will be a key pedestrian approach route into the Boat Harbour Precinct.

The current proposal is for a roundabout, with one circulating lane, and with Cove Boulevarde having one lane approaches. Harbour Boulevarde would have one approach lane from the North, plus a 4.0m median, while from the South it would have a left-turn plus a through-right lane. This has been modelled in the SIDRA program. Table 3.1 reproduces guidelines to the modelling outputs, as taken from the RMS *Guide to Traffic Generating Developments,* with the modelling results set out in Table 3.2. Full results are set out in the Appendix.

Table 3.1 Level of Service Criteria for Intersections

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabouts	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

Table 3.2 SIDRA Modelling of Harbour Boulevarde & Cove Boulevarde (Road 10) – Roundabout

Approach	Move	AM Delay	AM Level	AM 95%	PM Delay	PM Level	PM 95%

		(secs/veh)	Of Service	Queue (m)	(secs/veh)	Of Service	Queue (m)
Harbour Bvd	Left	6	A	9	7	A	8
South	Thru	6	A	21	6	A	20
	Right	10	A	21	10	A	20
Cove Bvd	Left	11	A	8	10	A	15
East (Rd 10)	Thru	11	A	8	11	A	15
	Right	15	B	8	15	B	15
Harbour Bvd	Left	10	A	67	9	A	58
North	Thru	10	A	67	9	A	58
	Right	14	A	67	13	A	58
Cove Bvd	Left	10	A	46	10	A	39
West	Thru	11	A	46	10	A	39
	Right	15	B	46	14	A	39
ALL	All	9.6	A	(67)	9.2	A	(58)

Table 3.2 indicates satisfactory operation, with low delay levels and a good level of service. Queues will occur, mainly on the Harbour Boulevarde North and Cove Boulevarde West approaches.

Harbour Boulevard/Road MC01

> *The Harbour Boulevarde/Road A [MC01] intersection will not work satisfactorily under priority control, so either a roundabout or signals are needed here. A single-lane roundabout would be most efficient. It would provide a pedestrian refuge on each leg of the intersection to allow pedestrians to cross more easily here and should be adequate for the forecast traffic volumes at this location.*

The Year 2018 peak hour intersection modelling by Maunsell found that a one-lane roundabout at this junction would operate well in all peak periods, with a level of service of A, the highest level.

While the through traffic flows along Harbour Boulevard are projected to be substantial, the flows into and out of Road MC01 are lesser. A one-lane roundabout is recommended, and is proposed. South of Road MC01, Harbour Boulevarde is proposed to have a 12.0m combined two-way carriageway, while the carriageway will be divided north of Road MC01.

The current proposal is for a one-lane roundabout. This has been modelled with SIDRA. Table 3.3 sets out the results, with further details in the Appendix.

Table 3.3 SIDRA Modelling of Harbour Boulevarde & Road MC01 – Roundabout

Approach	Move	AM Delay	AM Level	AM 95%	PM Delay	PM Level	PM 95%

		(secs/veh)	Of Service	Queue (m)	(secs/veh)	Of Service	Queue (m)
Harbour Bvd	Thru	4	A	29	5	A	33
South	Right	9	A	29	9	A	33
Road MC01	Left	8	A	1	8	A	7
East	Right	13	A	1	13	A	7
Harbour Bvd	Left	4	A	27	5	A	30
North	Thru	5	A	27	5	A	30
ALL	All	4.7	A	(29)	5.4	A	(33)

Table 2.5 indicates satisfactory operation of a one-lane roundabout, providing adequate capacity.

Harbour Boulevard/Road 11

The Harbour Boulevarde/Road 11 (Previously Road C) intersection will operate satisfactorily under priority control. Queue lengths in the critical PM peak are expected to be less than 24m 95% of the time.

The Maunsell intersection modelling at this junction looked at a one-lane roundabout and found very good operation, with a level of service of A.

The projected traffic flows are less than for Road MC01. Priority control, as recommended in the Maunsell report, is supported. A right-turn bay should be provided in the median. The Harbour Boulevarde approaches would otherwise be in two lanes, with the southbound approach being left plus through in the kerb lane and a through lane next to the median. Northbound would be two through lanes plus the right-turn lane in the median. Table 3.4 summarises the SIDRA analysis results.

Table 3.4 SIDRA Modelling of Harbour Boulevarde & Road 11 - Priority

Approach	Move	AM Delay (secs/veh)	AM Level Of Service	AM 95% Queue (m)	PM Delay (secs/veh)	PM Level Of Service	PM 95% Queue (m)
Harbour Bvd	Thru	0	A	0	0	A	0
South	Right	9	A	0	9	A	1
Road 11	Left	31	C	7	25	B	2
East	Right	31	C	7	25	B	2
Harbour Bvd	Left	6	A	0	6	A	0
North	Thru	0	A	0	0	A	0
ALL	All	1.1	na	(7)	0.5	na	(1)

Table 3.4 indicates satisfactory operation under priority control. Should delays to the right turn out of Road 11 become higher, drivers have other route options, including the use of the Cove Boulevarde roundabout.

Town Centre Road Design Parameters

It was indicated in Section 3.1 above that the adopted design vehicle for Road 10, Road 12, and the Private Road (except on the design bus route and the Road 10/11 intersection for future hotel servicing) is the 8.8m long Medium Rigid Vehicle. The choice of design vehicle significantly affects the design of the intersections, the roadways and the median islands in terms of the swept paths. This design parameter has been selected so that architectural and urban design objectives can be met. It is considered mandatory that these roads be able to accept garbage trucks and fire fighting vehicles. Information from the Fire & Rescue NSW website indicates that the maximum length of their pumper vehicles is less than 8.8m. Deliveries to the small shops located off the town centre roads can be adequately made using vehicles no longer than 8.8m. Waste servicing with maximum 8.8m truck lengths within the town centre has been investigated and is considered to be feasible. It is noted and acknowledged that Council require further substantiation of this design parameter form a waste servicing perspective.

In adopting the MRV as the design vehicle for these roads, the proposed medians on Road 10 will be satisfactory. The medians on Road 10 are integral part of the streetscape design, providing opportunities for landscaping and street art. The landscaping proposed in this area and for the balance of the Town Centre precinct is for the placement of narrow trunk trees that on initial planting will have no restriction on car driver sight lines at a driver eye height of 1.15m. When first planted, trees should therefore have a minimum clear trunk height of 1.15m. At maturity, the selected trees should have a minimum clear height without foliage of 1.8m. The regular trimming of trees can maintain the required clear sight lines.

With regard to artwork, the proposal is to place narrow artworks called “dragonettes” along the centre of the median, with the artwork located at a clearance of 350mm from the kerb of the median, or alternatively, 350mm inside the roadway outer kerb. This clearance will be satisfactory in this low speed road design environment. The artworks of the narrow profile type envisaged will not have a significant adverse impact on driver sight lines. We suggest that they each have a frangible bracket at ground level, to minimise the impact of a vehicle colliding with them.

With the design objective of a town centre road network where the roads do not dominate and pedestrians feel comfortable with the low speed passing traffic, the carriageway widths have been kept moderate. In a high speed environment, sight lines from vehicle drivers to other vehicles in the vicinity are an important design factor. In a low speed environment, lesser sight line distances are appropriate. Worley Parsons have prepared sight line plans for

the intersections of Roads 10 & 12, Private Road & Road 10, Private Road & Road MC01, Roads 10 & 11 and Roads 11 & 12. These illustrate the design sight lines and where any restrictions might occur due to proposed parking bays. Street trees will not restrict sight lines provided that the recommended clear truck heights are achieved.

Road 10 (Cove Boulevarde) Shared Zone

A shared traffic zone at the eastern end of Road 10 (Cove Boulevard) was recommended in the Maunsell report. On the original Precinct road layout, that part of Road B north of Cove Blvd had a projected Year 2018 daily traffic flow of 1100 veh/day. With the deletion of the section of Road B south of Cove Boulevard at this point, and the provision of an alternative "Road B" further to the west – now Road 12 and the Private Road - linking Road MC01 with Road 11, traffic flow in this area will not be as high as the previously modelled 1100 veh/day. The peak hour flows in this section of Road 10 are not likely to be more than 100 veh/hour, based on the TRACKS modelling. Our recent modelling, as shown on Figure 2, indicates two-way peak hour flows of under 50 veh/hr. This is thus a lightly trafficked street, which makes it suitable for operation as a shared zone.

The RMS Technical Direction TTD 2014/003 *Design and implementation of shared zones including provision for parking* sets out the RMS's current guidelines. Under these guidelines, a Category 1 shared zone is recommended, with no kerbs on the perimeter of the carriageway, but using different coloured and textured surface treatments to differentiate the vehicle carriageway from the purely pedestrian area.

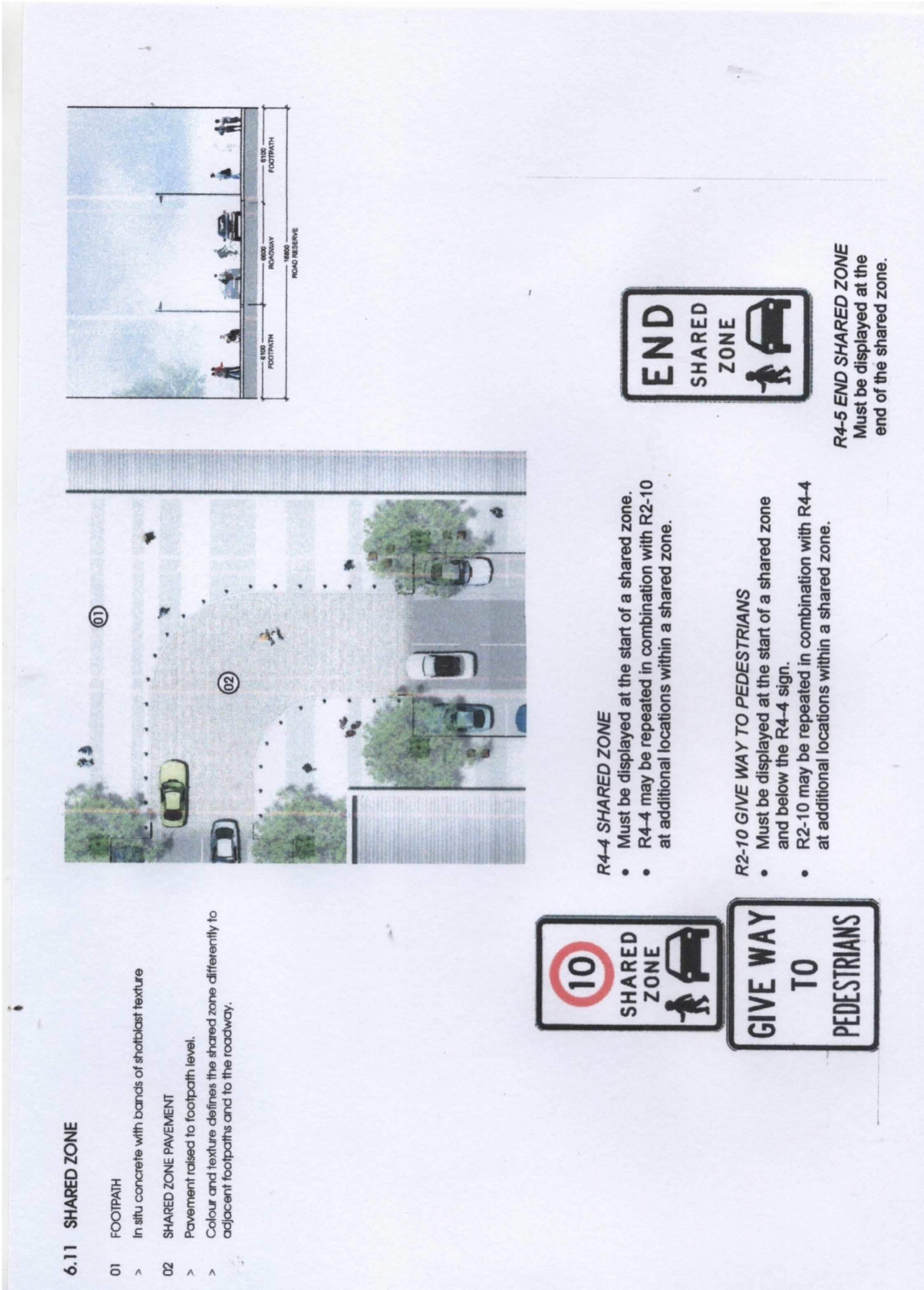

FIGURE 4 SHARED ZONE DESIGN

An indicative design of the shared zone is shown on Figure 4, together with the regulatory signage. This design makes the bend in the road network essentially a crossing point for vehicles and pedestrians, where pedestrians have right of way. This is an appropriate Category 1 design. It does not propose any kerbside parking within the shared zone, although there will be kerbside parking on the approaches. On the Road 10 (Cove Boulevard) approach parallel kerb parking is proposed. On Road 10 Road 11, right-angle parking and parallel parking is proposed. With the level of traffic movement and also the desire to keep traffic speeds low, right-angle parking is appropriate, if convenient and accessible parking near the community/library centre is a priority.

At the entrances to this shared zone, speed humps or platforms are not recommended. Rather, an initial band of coarser texture material is suggested as an easy visual indicator, followed by brick or other textured surface. Figure 4 shows path indicators outside the carriageway. These do not and should not need to function as a pedestrian barrier. Rather, they will provide an indication, particularly to the driver, of the vehicular path. An overall guide to the design of Road 10 within the Shared Zone is set out in the Group GSA figure *Shell Cove: Precinct D Road Treatment.*

As required by NSW Road Rule 83, all drivers must give way to pedestrians at all times in shared zones. A *Give Way to Pedestrians* (R2-10) sign must be installed below each *Shared Zone* (R4-4) sign. A speed limit sign indicating a maximum of 10 km/h must be installed at each entrance. These signs are illustrated on Figure 4.

The shared zone is a speed zone and as such must be approved by the RMS.

Other Intersections

In Cove Boulevarde (Road 10), the two-way peak hour flow between Harbour Boulevarde and Road 12 is projected to be 235 veh/hr in the morning peak hour and 326 veh/hr in the evening peak hour. In Cove Boulevarde east of the above junction, the projected traffic flow through the Shared Zone is 40 veh/hr two-way total in the morning peak hour and about the same in the evening peak hour. These are comfortably low levels of flow through this pedestrian oriented Shared Zone.

At the junction of Cove Boulevarde and Road 12, a simple priority junction is proposed, with priority given to Cove Boulevarde traffic, with Give Way signs on the side approaches. The operation of this priority junction has been assessed using the SIDRA6 traffic model.

The full results of the SIDRA analysis are set out in the Appendix. Table 3.5 summarises the key results.

Table 3.5 SIDRA Analysis of Cove Boulevarde (Road 10) & Road 12 Ultimate Traffic Flows

Approach	Move	AM Delay (secs/veh)	AM Level Of Service	AM 95% Queue (m)	PM Delay (secs/veh)	PM Level Of Service	PM 95% Queue (m)
Road 12	Left	6	A	1	6	A	4
South	Thru	5	A	1	5	A	4
	Right	6	A	1	6	A	4
Cove Bld	Left	6	A	1	6	A	1
East	Thru	0	A	1	0	A	1
	Right	6	A	1	6	A	1
Road 12	Left	7	A	2	7	A	1
North	Thru	5	A	2	5	A	1
	Right	6	A	2	7	A	1
Cove Bld	Left	6	A	3	6	A	4
West	Thru	0	A	3	0	A	4
	Right	6	A	3	6	A	4
ALL	All	5.0	(A)	(3)	5.2	(A)	(4)

Table 3.5 indicates that this intersection, operating under priority control, with priority to Cove Boulevarde traffic, would have low delay levels and a good level of service of A on all movements, in both future peak periods. Thus priority control for this intersection will be satisfactory.

Road MC01 is projected to carry a morning peak hour two-way flow of about 110 veh/hr, and an afternoon peak hour flow of about 360 veh/hr, east of Harbour Boulevarde. East of the Private Road the flows will be lower, with a morning two-way peak hour flow of about 60 veh/hr and an afternoon peak hour flow of about 260 veh/hr. The location of the egress from the supermarket basement parking area is the main generator of traffic in this part of the network. The intersection of Road MC01 and the private Road 12 will be a simple priority control junction, with priority to Road MC01 traffic, and Give Way signs on the minor road approaches. This has been modelled in SIDRA as having one lane approaches, as a worst case analysis. The currently proposed design will have the approach on Road MC01 from Harbour Boulevarde having a left turn lane as well as a central through plus right lane. The full results of the SIDRA analysis are set out in the Appendix, with Table 3.6 summarising the results.

Table 3.6 SIDRA Analysis of Road MC01 and Road 12 – Ultimate Traffic Flows

Approach	Move	AM Delay (secs/veh)	AM Level Of Service	AM 95% Queue (m)	PM Delay (secs/veh)	PM Level Of Service	PM 95% Queue (m)
Road 12	Left	5	A	1	5	A	1
South	Thru	3	A	1	4	A	1
	Right	5	A	1	5	A	1
Road MC01	Left	5	A	1	5	A	5
East	Thru	<1	A	1	<1	A	5
	Right	5	A	1	5	A	5
Road 12	Left	5	A	1	6	A	1
North	Thru	4	A	1	5	A	1
	Right	5	A	1	6	A	1
Road MC01	Left	5	A	2	5	A	3
West	Thru	0	A	2	<1	A	3
	Right	5	A	2	5	A	3
ALL	All	3.6	(A)	(2)	2.7	(A)	(5)

Table 3.6 indicates that this intersection will function in a very satisfactory manner under priority control. While this analysis has assumed one lane approaches, the proposed design has an additional left turn lane for the Road MC01 approach from the Harbour Boulevarde roundabout, to ensure free flowing traffic into the supermarket parking area.

With pedestrian movements, there will be footpaths beside the roads in this Stage 1 development. We recommend that the splitter islands on the roundabouts on Harbour Boulevarde incorporate pedestrian refuges, or at least island breaks to enable pedestrians to shelter, allowing them to cross each direction of traffic flow at one movement at a time. On Road MC01 the directional flows east of the roundabout are projected to be about 110 veh/hr in the morning peak hour and 360 veh/hr in the afternoon peak hour. The morning peak hour is reasonable for a pedestrian to cross. In the afternoon the total two-way flows are getting higher, but a pedestrian splitter island or median break will assist through allowing crossings to be undertaken in two movements. East of the private Road 12 junction the flows in Road MC01 will be lower, with about 50 veh/hr two-way in the morning and about 260 veh/hr two-way in the afternoon.

Road 11 will provide a northern circulation route for the town centre. As shown on Figure 2, the two-way peak hour flows both to the east and to the west of its junction with Road 12 will be less than 100 veh/hr, which will make for easy vehicular movement as well as flow levels able to be crossed by pedestrians without needing pedestrian crossing facilities.

Road 12 to the south of Road 11 is projected to have modest flows below the intersection of less than 50 veh/hr two-way, building up towards the Road 10 junction to about 100 veh/hr. These flows are low and not sufficient to require pedestrian crossing facilities.

In the section of Road 10 forming the north-east link from Road 10 to Road 11, past the community centre and apartment hotel, the projected peak hour flows are less than 50 veh/hr and hence will be satisfactory for both vehicular and pedestrian movement.

While the projected peak hour flows are low, to check on the capacity of all intersections, the junctions of Roads 11 and 12, and Roads 11 and 10 have been modelled with the SIDRA program, assuming one lane per direction on all approaches, and with Give Way controls, with Road 11 traffic having priority. To be conservative, we have doubled the peak hour flows shown on Figure 2 at these two intersections, for this analysis. Tables 3.7 and 3.8 set out the results of this analysis.

Table 3.7 SIDRA Analysis of Roads 11 and 12 T-junction – Ultimate Traffic Flows Doubled

Approach	Move	AM Delay (secs/veh)	AM Level of Service	AM 95% Queue (m)	PM Delay (secs/veh)	PM Level of Service	PM 95% Queue (m)
Road 12	Left	5	A	1	5	A	1
South	Right	5	A	1	5	A	1
Road 11	Left	5	A	0	5	A	0
East	Thru	0	A	0	0	A	0
Road 11	Thru	<1	A	1	<1	A	1
West	Right	5	A	1	5	A	1
ALL	All	2.2	n/a	(1)	2.1	n/a	(1)

Table 3.8 SIDRA Analysis of Roads 11 and 10 T-junction – Ultimate Traffic Flows Doubled

Approach	Move	AM Delay (secs/veh)	AM Level of Service	AM 95% Queue (m)	PM Delay (secs/veh)	PM Level of Service	PM 95% Queue (m)
Road 10	Left	5	A	1	5	A	1
South	Right	5	A	1	5	A	1
Road 11	Left	5	A	0	5	A	0
East	Thru	0	A	0	0	A	0
Road 11	Thru	0	A	1	<1	A	1
West	Right	5	A	1	5	A	1
ALL	All	3.7	n/a	(1)	3.4	n/a	(1)

At the priority-controlled T-junction of Road 11 with Road 12, Table 3.7 indicates very satisfactory operation with spare capacity.

At the priority-controlled junction of Road 11 with Road 10, Table 3.8 indicates very satisfactory operation, with spare capacity.

We conclude that all intersections in the Shell Cove Boat Harbour town centre precinct will have ample capacity with the intersection layouts proposed.

4.0 CONCLUSIONS

1. Our report *Shell Cove Boat Harbour Precinct Masterplan Traffic and Parking Assessment* sets out the wider planning of the road network at the Shell Cove Boat Harbour Precinct and the major intersections. This report also covers the cumulative parking demand issue for the ultimate development of the Precinct.

2. The first stage of the development will be the construction of the 3670 sq m supermarket, plus 953 sq m of specialty shops. The parking for this first stage will be to the immediate west of the supermarket and shops, in a basement under the supermarket and in front of a row of shops north of Road 10. The Stage 1 DA traffic report assesses the traffic implications of this Stage 1 development.

3. From the peak period traffic projections undertaken, the planned roads will operate in accordance with their road hierarchy function. All intersections within the precinct will have satisfactory peak period capacity, as tested using projected future peak hour traffic flows.

4. The road network now proposed differs slightly from the network that was part of the approval, as set out in the Preferred Project Report, in that Road B between Road MC01 and Road 10 will be moved further to the West, and will become part of the Road 12 link between Road 11 and Road MC01. The original traffic modelling has been reviewed, as to the effect of this change and the conclusion drawn that since Road B was only projected to carry local town centre traffic, the changes will have a minimal impact.

5. Vehicle length restrictions are proposed on Road 10, Road 11 and the Private Road (maximum 8.8m MRV). This is acceptable from a traffic and road design perspective.

6. The proposed bus route is from Harbour Boulevarde to Road 10, right turn into private Road 12, stop at bus stop in front of proposed supermarket and then right turn onto Road MC01 and subsequent left turn back onto Harbour Boulevarde. The intersections have been designed to cater for these unencumbered bus movements in the design direction of the bus route.

7. The intersection of road 10 and Road 11 has been designed to accept 12.5m HRV turning should this be required for future hotel servicing.

8. In conclusion, the proposed road network for the Boat Harbour town centre will be satisfactory and appropriate for the design objectives of the town centre.

FIGURE 1 SHELL COVE BOAT HARBOUR PRECINCT

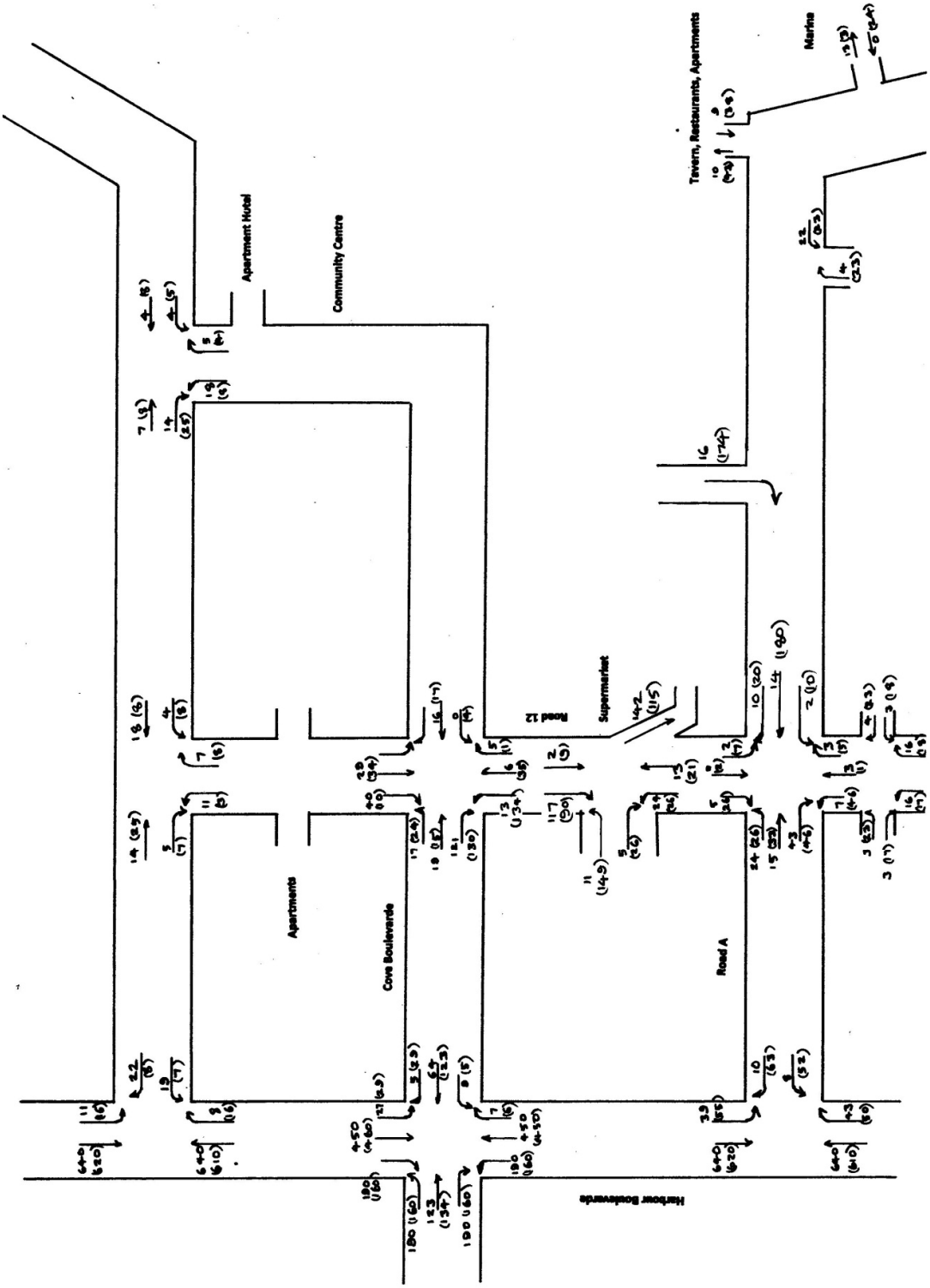

FIGURE 2 PROJECTED PEAK HOUR TRAFFIC FLOWS

KEY: 10 AM peak; (10) PM peak

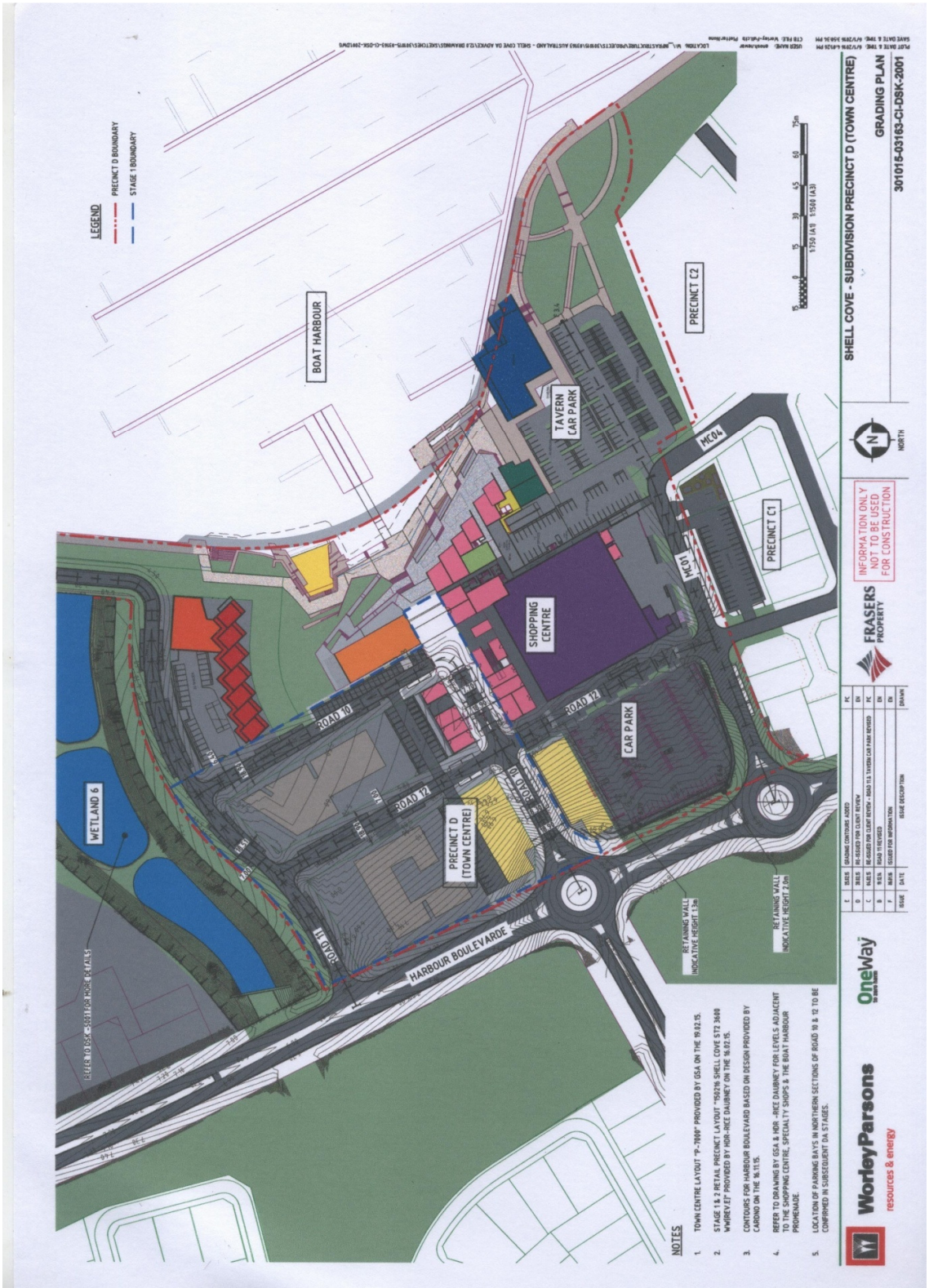

FIGURE 3 ROAD NETWORK

APPENDIX SIDRA MODELLING RESULTS

MOVEMENT SUMMARY

Site: Harbour BVD & Cove BVD - roundabout

Future AM
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	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Harbour Bvd South											
1	L2	200	5.0	0.214	6.2	LOS A	1.3	9.3	0.53	0.62	53.0
2	T1	474	5.0	0.384	5.8	LOS A	2.8	20.7	0.57	0.57	53.6
3	R2	7	5.0	0.384	10.0	LOS A	2.8	20.7	0.57	0.57	53.4
Approach		681	5.0	0.384	5.9	LOS A	2.8	20.7	0.56	0.59	53.5
East: Cove Bvd East											
4	L2	9	5.0	0.157	10.6	LOS A	1.1	7.7	0.87	0.83	50.0
5	T1	67	5.0	0.157	10.8	LOS A	1.1	7.7	0.87	0.83	51.1
6	R2	5	5.0	0.157	15.1	LOS B	1.1	7.7	0.87	0.83	50.9
Approach		82	5.0	0.157	11.1	LOS A	1.1	7.7	0.87	0.83	50.9
North: Harbour Bvd North											
7	L2	28	5.0	0.719	9.6	LOS A	9.2	66.9	0.89	0.88	50.0
8	T1	474	5.0	0.719	9.9	LOS A	9.2	66.9	0.89	0.88	51.1
9	R2	200	5.0	0.719	14.2	LOS A	9.2	66.9	0.89	0.88	50.9
Approach		702	5.0	0.719	11.1	LOS A	9.2	66.9	0.89	0.88	51.0
West: Cove Bvd West											
10	L2	200	5.0	0.626	10.4	LOS A	6.3	46.1	0.86	0.95	49.3
11	T1	129	5.0	0.626	10.7	LOS A	6.3	46.1	0.86	0.95	50.3
12	R2	200	5.0	0.626	14.9	LOS B	6.3	46.1	0.86	0.95	50.2
Approach		529	5.0	0.626	12.2	LOS A	6.3	46.1	0.86	0.95	49.9
All Vehicles		1995	5.0	0.719	9.6	LOS A	9.2	66.9	0.77	0.80	51.5

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: Harbour BVD & Cove BVD - roundabout

Future PM
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	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Harbour Bvd South											
1	L2	168	5.0	0.195	6.7	LOS A	1.1	7.9	0.54	0.65	52.9
2	T1	474	5.0	0.395	6.1	LOS A	2.8	20.5	0.59	0.61	53.5
3	R2	6	5.0	0.395	10.4	LOS A	2.8	20.5	0.59	0.61	53.3
Approach		648	5.0	0.395	6.3	LOS A	2.8	20.5	0.58	0.62	53.4
East: Cove Bvd East											
4	L2	5	5.0	0.293	10.4	LOS A	2.0	14.8	0.88	0.88	49.8
5	T1	129	5.0	0.293	10.6	LOS A	2.0	14.8	0.88	0.88	50.9
6	R2	31	5.0	0.293	14.9	LOS B	2.0	14.8	0.88	0.88	50.7
Approach		165	5.0	0.293	11.4	LOS A	2.0	14.8	0.88	0.88	50.8
North: Harbour Bvd North											
7	L2	31	5.0	0.683	8.6	LOS A	8.0	58.1	0.85	0.82	50.7
8	T1	484	5.0	0.683	8.8	LOS A	8.0	58.1	0.85	0.82	51.8
9	R2	168	5.0	0.683	13.1	LOS A	8.0	58.1	0.85	0.82	51.6
Approach		683	5.0	0.683	9.9	LOS A	8.0	58.1	0.85	0.82	51.7
West: Cove Bvd West											
10	L2	168	5.0	0.578	9.9	LOS A	5.3	38.9	0.84	0.92	49.7
11	T1	141	5.0	0.578	10.2	LOS A	5.3	38.9	0.84	0.92	50.8
12	R2	168	5.0	0.578	14.4	LOS A	5.3	38.9	0.84	0.92	50.6
Approach		478	5.0	0.578	11.6	LOS A	5.3	38.9	0.84	0.92	50.3
All Vehicles		1975	5.0	0.683	9.2	LOS A	8.0	58.1	0.76	0.78	51.8

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: Harbour Bvd/Road A - 1 lane roundabout

Future AM
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	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Harbour Bvd South											
2	T1	674	5.0	0.441	4.4	LOS A	4.0	29.1	0.11	0.42	55.6
3	R2	45	5.0	0.441	8.7	LOS A	4.0	29.1	0.11	0.42	55.4
Approach		719	5.0	0.441	4.7	LOS A	4.0	29.1	0.11	0.42	55.6
East: Road A East											
4	L2	8	5.0	0.025	7.9	LOS A	0.1	1.0	0.65	0.67	50.5
6	R2	11	5.0	0.025	12.5	LOS A	0.1	1.0	0.65	0.67	51.4
Approach		19	5.0	0.025	10.5	LOS A	0.1	1.0	0.65	0.67	51.0
North: Harbour Bvd North											
7	L2	41	5.0	0.481	4.4	LOS A	3.7	27.4	0.24	0.42	54.0
8	T1	674	5.0	0.481	4.7	LOS A	3.7	27.4	0.24	0.42	55.2
Approach		715	5.0	0.481	4.6	LOS A	3.7	27.4	0.24	0.42	55.1
All Vehicles		1453	5.0	0.481	4.7	LOS A	4.0	29.1	0.18	0.42	55.3

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.

MOVEMENT SUMMARY

Site: Harbour Bvd/Road A - 1 lane roundabout

Future PM
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	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Harbour Bvd South											
2	T1	642	5.0	0.494	4.8	LOS A	4.5	33.1	0.35	0.45	54.5
3	R2	53	5.0	0.494	9.1	LOS A	4.5	33.1	0.35	0.45	54.3
Approach		695	5.0	0.494	5.1	LOS A	4.5	33.1	0.35	0.45	54.5
East: Road A East											
4	L2	55	5.0	0.159	8.2	LOS A	0.9	6.7	0.69	0.77	50.3
6	R2	66	5.0	0.159	12.8	LOS A	0.9	6.7	0.69	0.77	51.2
Approach		121	5.0	0.159	10.7	LOS A	0.9	6.7	0.69	0.77	50.8
North: Harbour Bvd North											
7	L2	58	5.0	0.488	4.5	LOS A	4.1	30.0	0.28	0.43	53.8
8	T1	653	5.0	0.488	4.7	LOS A	4.1	30.0	0.28	0.43	55.0
Approach		711	5.0	0.488	4.7	LOS A	4.1	30.0	0.28	0.43	54.9
All Vehicles		1526	5.0	0.494	5.4	LOS A	4.5	33.1	0.34	0.47	54.4

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: Harbour Bld & Road C - priority

Future AM
Giveway / Yield (Two-Way)

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: Harbour Bvd South											
2	T1	674	5.0	0.178	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R2	8	5.0	0.013	9.4	LOS A	0.0	0.3	0.56	0.69	50.4
Approach		682	5.0	0.178	0.1	NA	0.0	0.3	0.01	0.01	59.8
East: Road C East											
4	L2	20	5.0	0.281	31.3	LOS C	0.9	6.7	0.79	0.89	38.8
6	R2	23	5.0	0.281	31.3	LOS C	0.9	6.7	0.79	0.89	38.7
Approach		43	5.0	0.281	31.3	LOS C	0.9	6.7	0.79	0.89	38.7
North: Harbour Bvd North											
7	L2	12	5.0	0.182	5.6	LOS A	0.0	0.0	0.00	0.02	57.9
8	T1	674	5.0	0.182	0.0	LOS A	0.0	0.0	0.00	0.01	59.9
Approach		685	5.0	0.182	0.1	NA	0.0	0.0	0.00	0.01	59.8
All Vehicles		1411	5.0	0.281	1.1	NA	0.9	6.7	0.03	0.04	58.8

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.

MOVEMENT SUMMARY

Site: Harbour Bld & Road C - priority

Future PM
Giveway / Yield (Two-Way)

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: Harbour Bvd South											
2	T1	642	5.0	0.170	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R2	17	5.0	0.026	9.3	LOS A	0.1	0.7	0.56	0.72	50.4
Approach		659	5.0	0.170	0.3	NA	0.1	0.7	0.01	0.02	59.7
East: Road C East											
4	L2	7	5.0	0.094	25.2	LOS B	0.3	2.0	0.75	0.81	41.5
6	R2	8	5.0	0.094	25.2	LOS B	0.3	2.0	0.75	0.81	41.4
Approach		16	5.0	0.094	25.2	LOS B	0.3	2.0	0.75	0.81	41.4
North: Harbour Bvd North											
7	L2	17	5.0	0.177	5.6	LOS A	0.0	0.0	0.00	0.03	57.8
8	T1	653	5.0	0.177	0.0	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		669	5.0	0.177	0.2	NA	0.0	0.0	0.00	0.01	59.8
All Vehicles		1344	5.0	0.177	0.5	NA	0.3	2.0	0.02	0.03	59.4

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.

MOVEMENT SUMMARY

▽ Site: Cove Boulevarde/Road 12

Future AM Peak
One lane approaches
Giveway / Yield (Two-Way)

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: Road 12 South											
1	L2	23	5.0	0.027	5.9	LOS A	0.1	0.7	0.05	0.56	53.4
2	T1	6	5.0	0.027	4.5	LOS A	0.1	0.7	0.05	0.56	53.5
3	R2	5	5.0	0.027	5.8	LOS A	0.1	0.7	0.05	0.56	52.8
Approach		35	5.0	0.027	5.7	LOS A	0.1	0.7	0.05	0.56	53.3
East: Cove Bld East											
4	L2	5	5.0	0.015	5.7	LOS A	0.1	0.5	0.12	0.21	55.8
5	T1	17	5.0	0.015	0.1	LOS A	0.1	0.5	0.12	0.21	57.5
6	R2	5	5.0	0.015	5.6	LOS A	0.1	0.5	0.12	0.21	55.2
Approach		27	5.0	0.015	2.2	NA	0.1	0.5	0.12	0.21	56.7
North: Road 12 North											
7	L2	5	5.0	0.079	6.5	LOS A	0.3	2.0	0.21	0.58	53.1
8	T1	31	5.0	0.079	5.1	LOS A	0.3	2.0	0.21	0.58	53.3
9	R2	42	5.0	0.079	6.4	LOS A	0.3	2.0	0.21	0.58	52.6
Approach		78	5.0	0.079	5.9	LOS A	0.3	2.0	0.21	0.58	52.9
West: Cove Bld west											
10	L2	18	5.0	0.095	5.7	LOS A	0.5	3.4	0.09	0.50	53.7
11	T1	20	5.0	0.095	0.1	LOS A	0.5	3.4	0.09	0.50	55.3
12	R2	127	5.0	0.095	5.6	LOS A	0.5	3.4	0.09	0.50	53.2
Approach		165	5.0	0.095	4.9	NA	0.5	3.4	0.09	0.50	53.5
All Vehicles		305	5.0	0.095	5.0	NA	0.5	3.4	0.12	0.50	53.6

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.

MOVEMENT SUMMARY

▽ Site: Cove Boulevarde/Road 12

Future PM Peak
One lane approaches
Giveway / Yield (Two-Way)

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: Road 12 South											
1	L2	137	5.0	0.128	5.9	LOS A	0.5	3.9	0.06	0.55	53.4
2	T1	37	5.0	0.128	4.5	LOS A	0.5	3.9	0.06	0.55	53.6
3	R2	5	5.0	0.128	5.8	LOS A	0.5	3.9	0.06	0.55	52.9
Approach		179	5.0	0.128	5.6	LOS A	0.5	3.9	0.06	0.55	53.4
East: Cove Bld East											
4	L2	5	5.0	0.016	5.7	LOS A	0.1	0.6	0.12	0.20	55.8
5	T1	18	5.0	0.016	0.1	LOS A	0.1	0.6	0.12	0.20	57.6
6	R2	5	5.0	0.016	5.6	LOS A	0.1	0.6	0.12	0.20	55.3
Approach		28	5.0	0.016	2.2	NA	0.1	0.6	0.12	0.20	56.8
North: Road 12 North											
7	L2	5	5.0	0.051	6.6	LOS A	0.2	1.3	0.15	0.55	53.4
8	T1	36	5.0	0.051	5.2	LOS A	0.2	1.3	0.15	0.55	53.6
9	R2	11	5.0	0.051	6.5	LOS A	0.2	1.3	0.15	0.55	52.8
Approach		52	5.0	0.051	5.6	LOS A	0.2	1.3	0.15	0.55	53.4
West: Cove Bld west											
10	L2	25	5.0	0.102	5.7	LOS A	0.5	3.7	0.09	0.51	53.6
11	T1	16	5.0	0.102	0.1	LOS A	0.5	3.7	0.09	0.51	55.2
12	R2	137	5.0	0.102	5.6	LOS A	0.5	3.7	0.09	0.51	53.0
Approach		178	5.0	0.102	5.1	NA	0.5	3.7	0.09	0.51	53.3
All Vehicles		437	5.0	0.128	5.2	NA	0.5	3.9	0.09	0.51	53.6

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.

MOVEMENT SUMMARY

▽ Site: Shell Cove Centre

Roads MC01 and 12
Future AM Peak
One lane approaches
Giveway / Yield (Two-Way)

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: Road 12 South											
1	L2	7	5.0	0.011	4.8	LOS A	0.0	0.3	0.06	0.51	46.6
2	T1	3	5.0	0.011	3.4	LOS A	0.0	0.3	0.06	0.51	46.7
3	R2	3	5.0	0.011	4.8	LOS A	0.0	0.3	0.06	0.51	46.2
Approach		14	5.0	0.011	4.5	LOS A	0.0	0.3	0.06	0.51	46.5
East: Road A East											
4	L2	2	5.0	0.015	4.7	LOS A	0.1	0.5	0.12	0.24	47.8
5	T1	15	5.0	0.015	0.1	LOS A	0.1	0.5	0.12	0.24	48.3
6	R2	11	5.0	0.015	4.7	LOS A	0.1	0.5	0.12	0.24	47.3
Approach		27	5.0	0.015	2.2	NA	0.1	0.5	0.12	0.24	47.9
North: Road 12 North											
7	L2	2	5.0	0.008	5.0	LOS A	0.0	0.2	0.09	0.52	46.4
8	T1	1	5.0	0.008	3.6	LOS A	0.0	0.2	0.09	0.52	46.5
9	R2	5	5.0	0.008	5.0	LOS A	0.0	0.2	0.09	0.52	46.0
Approach		8	5.0	0.008	4.8	LOS A	0.0	0.2	0.09	0.52	46.2
West: Road A West											
10	L2	26	5.0	0.049	4.7	LOS A	0.2	1.7	0.07	0.43	46.9
11	T1	16	5.0	0.049	0.0	LOS A	0.2	1.7	0.07	0.43	47.4
12	R2	45	5.0	0.049	4.7	LOS A	0.2	1.7	0.07	0.43	46.4
Approach		87	5.0	0.049	3.8	NA	0.2	1.7	0.07	0.43	46.7
All Vehicles		137	5.0	0.049	3.6	NA	0.2	1.7	0.08	0.40	46.9

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.

MOVEMENT SUMMARY

▽ Site: Shell Cove Centre

Roads MC01 and 12
Future PM Peak
One lane approaches
Giveway / Yield (Two-Way)

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: Road 12 South											
1	L2	48	5.0	0.044	5.4	LOS A	0.2	1.2	0.29	0.53	45.9
2	T1	1	5.0	0.044	4.0	LOS A	0.2	1.2	0.29	0.53	46.0
3	R2	5	5.0	0.044	5.4	LOS A	0.2	1.2	0.29	0.53	45.5
Approach		55	5.0	0.044	5.3	LOS A	0.2	1.2	0.29	0.53	45.9
East: Road A East											
4	L2	11	5.0	0.119	4.8	LOS A	0.7	4.8	0.17	0.07	48.5
5	T1	189	5.0	0.119	0.2	LOS A	0.7	4.8	0.17	0.07	49.1
6	R2	21	5.0	0.119	4.8	LOS A	0.7	4.8	0.17	0.07	48.1
Approach		221	5.0	0.119	0.9	NA	0.7	4.8	0.17	0.07	49.0
North: Road 12 North											
7	L2	7	5.0	0.042	6.2	LOS A	0.1	1.0	0.19	0.56	45.7
8	T1	2	5.0	0.042	4.8	LOS A	0.1	1.0	0.19	0.56	45.7
9	R2	26	5.0	0.042	6.2	LOS A	0.1	1.0	0.19	0.56	45.2
Approach		36	5.0	0.042	6.1	LOS A	0.1	1.0	0.19	0.56	45.3
West: Road A West											
10	L2	26	5.0	0.067	5.3	LOS A	0.3	2.5	0.32	0.33	46.7
11	T1	35	5.0	0.067	0.7	LOS A	0.3	2.5	0.32	0.33	47.2
12	R2	48	5.0	0.067	5.3	LOS A	0.3	2.5	0.32	0.33	46.2
Approach		109	5.0	0.067	3.8	NA	0.3	2.5	0.32	0.33	46.6
All Vehicles		421	5.0	0.119	2.7	NA	0.7	4.8	0.22	0.24	47.6

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.

MOVEMENT SUMMARY

▽ Site: Roads 11 & 12,

Future AM flows doubled
Giveway / Yield (Two-Way)

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: Road 12 South											
1	L2	23	5.0	0.028	4.8	LOS A	0.1	0.7	0.11	0.51	46.3
3	R2	15	5.0	0.028	4.8	LOS A	0.1	0.7	0.11	0.51	45.9
Approach		38	5.0	0.028	4.8	LOS A	0.1	0.7	0.11	0.51	46.1
East: Road 10 East											
4	L2	8	5.0	0.025	4.6	LOS A	0.0	0.0	0.00	0.10	48.9
5	T1	38	5.0	0.025	0.0	LOS A	0.0	0.0	0.00	0.10	49.4
Approach		46	5.0	0.025	0.8	NA	0.0	0.0	0.00	0.10	49.3
West: Road 10 West											
11	T1	29	5.0	0.022	0.1	LOS A	0.1	0.8	0.13	0.14	48.8
12	R2	11	5.0	0.022	4.7	LOS A	0.1	0.8	0.13	0.14	47.8
Approach		40	5.0	0.022	1.3	NA	0.1	0.8	0.13	0.14	48.6
All Vehicles		124	5.0	0.028	2.2	NA	0.1	0.8	0.08	0.24	48.1

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.

MOVEMENT SUMMARY

▽ Site: Roads 11 & 12,

Future PM flows doubled
Giveway / Yield (Two-Way)

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	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Road 12 South											
1	L2	6	5.0	0.019	4.8	LOS A	0.1	0.5	0.09	0.53	46.4
3	R2	17	5.0	0.019	4.8	LOS A	0.1	0.5	0.09	0.53	45.9
Approach		23	5.0	0.019	4.8	LOS A	0.1	0.5	0.09	0.53	46.0
East: Road 10 East											
4	L2	17	5.0	0.018	4.6	LOS A	0.0	0.0	0.00	0.27	47.9
5	T1	17	5.0	0.018	0.0	LOS A	0.0	0.0	0.00	0.27	48.5
Approach		34	5.0	0.018	2.3	NA	0.0	0.0	0.00	0.27	48.2
West: Road 10 West											
11	T1	53	5.0	0.037	0.1	LOS A	0.2	1.3	0.11	0.12	49.0
12	R2	15	5.0	0.037	4.7	LOS A	0.2	1.3	0.11	0.12	48.0
Approach		67	5.0	0.037	1.1	NA	0.2	1.3	0.11	0.12	48.8
All Vehicles		124	5.0	0.037	2.1	NA	0.2	1.3	0.08	0.24	48.1

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.

MOVEMENT SUMMARY

▽ Site: Roads 11 & 16

Future AM flows doubled
Giveway / Yield (Two-Way)

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: Road 16 South											
1	L2	38	5.0	0.033	4.7	LOS A	0.1	0.9	0.04	0.52	46.5
3	R2	11	5.0	0.033	4.7	LOS A	0.1	0.9	0.04	0.52	46.0
Approach		48	5.0	0.033	4.7	LOS A	0.1	0.9	0.04	0.52	46.4
East: Road 10 East											
4	L2	8	5.0	0.009	4.6	LOS A	0.0	0.0	0.00	0.27	47.9
5	T1	8	5.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.27	48.5
Approach		17	5.0	0.009	2.3	NA	0.0	0.0	0.00	0.27	48.2
West: Road 10 West											
11	T1	15	5.0	0.025	0.0	LOS A	0.1	0.9	0.07	0.36	47.8
12	R2	29	5.0	0.025	4.7	LOS A	0.1	0.9	0.07	0.36	46.8
Approach		44	5.0	0.025	3.1	NA	0.1	0.9	0.07	0.36	47.2
All Vehicles		109	5.0	0.033	3.7	NA	0.1	0.9	0.05	0.42	47.0

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.

MOVEMENT SUMMARY

▽ Site: Roads 11 & 16

Future PM flows doubled
Giveway / Yield (Two-Way)

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: Road 16 South											
1	L2	17	5.0	0.020	4.8	LOS A	0.1	0.5	0.06	0.52	46.4
3	R2	11	5.0	0.020	4.8	LOS A	0.1	0.5	0.06	0.52	46.0
Approach		27	5.0	0.020	4.8	LOS A	0.1	0.5	0.06	0.52	46.2
East: Road 10 East											
4	L2	11	5.0	0.015	4.6	LOS A	0.0	0.0	0.00	0.21	48.3
5	T1	17	5.0	0.015	0.0	LOS A	0.0	0.0	0.00	0.21	48.8
Approach		27	5.0	0.015	1.8	NA	0.0	0.0	0.00	0.21	48.6
West: Road 10 West											
11	T1	17	5.0	0.040	0.1	LOS A	0.2	1.4	0.10	0.40	47.5
12	R2	53	5.0	0.040	4.7	LOS A	0.2	1.4	0.10	0.40	46.5
Approach		69	5.0	0.040	3.6	NA	0.2	1.4	0.10	0.40	46.8
All Vehicles		124	5.0	0.040	3.4	NA	0.2	1.4	0.07	0.39	47.0

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.