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DESIGN NOTE

CASUARINA TOWN CENTRE – ALTERNATIVE INTERSECTION LAYOUT FOR CASUARINA WAY/THE BOULEVARD INTERSECTION

Cardno Eppell Olsen has been requested to provide a SIDRA assessment for a roundabout option at the intersection of Casuarina Way and The Boulevard, in the Casuarina Town Centre. This request has emerged from Part B14 of the Project Approval, as approved by the Acting Director, Regional Projects Assessment on 17 June 2010. The objective of this Design Note is to provide results so that the intersection can be assessed for signal warrants within RTA guidelines. Pedestrians have also been considered when assessing the roundabout scenario.

The traffic volumes used for this assessment are the same as the traffic volumes reported in the Casuarina Town Centre Concept Plan Traffic Impact Study dated June 2008 (Cardno Eppell Olsen). This Design Note will focus on the AM and PM peak periods for the years 2018 and 2028, representing the future assessment year horizons adopted in the June 2008 report. This Design Note should be read in conjunction with Plan DA119, attached to this document at Appendix B.

SIDRA Analysis

To model the operation of a roundabout the SIDRA Intersection 3.2 Programme (SIDRA) was used. This programme calculates the operation of intersections based on input parameters, including geometry and traffic volumes. As an output, SIDRA provides values for the degree of saturation (DOS), queues and delays. The DOS is a commonly used value, which is essentially a volume over capacity ratio. The typically adopted upper limit for the DOS is 0.85 for a roundabout. A DOS exceeding this value indicates that the intersection is nearing it operational capacity. Above this value, users of the intersection are likely to experience unsatisfactory queuing and delays.

Single Lane Roundabout

The single lane roundabout was modelled with a single lane approach and a single lane exit for all four legs. The roundabout island diameter was modelled as 10m which is measured along a line across the centre of the roundabout island. The circulating width was modelled as 5m around the whole roundabout with a single circulating lane.

Results for the single lane roundabout scenario are summarised in Table 1 for the AM and PM peak hours. Summary outputs from SIDRA, including intersection layouts are attached at Appendix A.

Table 1 ***SIDRA Analysis Results: Single Lane Roundabout***

Scenarios	AM Peak			PM Peak		
	DOS	Delay (s)	95th%le Queue (m)	DOS	Delay (s)	95th%le Queue (m)
2018 Masterplan Roundabout (single lane)	0.58	12	49	1.16	184	1,375
2028 Masterplan Roundabout (single lane)	0.68	13	68	1.23	279	1,888

The analysis shows that the single lane roundabout at the Casuarina Way/The Boulevard intersection is capable of accommodating the traffic during the AM peak, however during the PM peak the single lane roundabout would be over capacity due to the volume of traffic, resulting in long delays and queues.

A single lane roundabout is clearly not sufficient on traffic capacity grounds.

Two-Lane Roundabout

To achieve an increase in capacity at the roundabout, two-lane approaches and two-lane exits were added for each leg of the roundabout. An additional lane was added to the circulating lane to increase it from a signal lane to a double circulating lane. The increase in circulating lanes meant that the circulating width increased to 10m but the island diameter remained the same at 10m.

Intersection operation results for the two lane roundabout scenario are summarised in Table 2 for the AM and PM peak hours. Summary outputs from SIDRA, including intersection layouts are attached at Appendix A.

Table 2 ***SIDRA Analysis Results: Two Lane Roundabout***

Scenarios	AM Peak			PM Peak		
	DOS	Delay (s)	95th%le Queue (m)	DOS	Delay (s)	95th%le Queue (m)
2018 Masterplan Roundabout (two-lane)	0.37	10	22	0.52	12	34
2028 Masterplan Roundabout (two-lane)	0.44	11	28	0.58	13	47

The analysis shows that a two lane roundabout at the Casuarina Way/The Boulevard intersection is capable of accommodating the traffic which is likely to be generated for both scenarios and there is enough capacity at the intersection to allow for extra traffic beyond 2028.

Consideration of Pedestrians and Cyclists

Roundabouts are less preferred for pedestrian and cyclist movements than signalised intersections, due to the increased risks to pedestrian and cyclist safety. However, roundabouts can offer safe and effective pedestrian crossings, provided they are correctly designed. The aspects below should be considered in the design of the roundabout, to ensure the maximum safety level can be provided.

Vehicles leaving a roundabout are not required to give way to pedestrians. Given this, it is not appropriate for multi-lane roundabouts to require pedestrians to cross all lanes in a single movement, as it reduces opportunities for pedestrians to cross. Therefore, the design of the roundabout should include pedestrian medians/splitter islands on every leg, breaking up the pedestrian journey.

Pedestrian kerb ramps are to be provided one or two car lengths in advance of the holding line, preventing pedestrians from being impeded by vehicles waiting on the approach.

Other key design elements include:

- appropriate entry and exit geometry to reduce vehicle speeds;
- splitter islands that are large (wide) enough to comfortably accommodate pedestrians and enable drivers to anticipate their movement onto the road;
- prohibition of parking on approaches to provide clear visibility;
- pram crossings that are designed for persons who have a disability;
- street lighting;
- signs and vegetation located so as not to obscure 'smaller' pedestrians;
- conformance to the Australian *Commonwealth Disability and Discrimination Act (1992)* or the equivalent New Zealand Act as appropriate, and also AS 1428:2003 and NZS 4121:2001;

- provision of formal (eg. zebra) pedestrian crossings on approaches (where warrants are met).

U-Turn Pocket

A further design requirement for the local street network is the need to include a new u-turn pocket on The Boulevard, between the Casuarina Way/The Boulevard intersection and the Tweed Coast Road/The Boulevard intersection. This u-turn pocket is required in order to allow motorists who utilise the angle parking on the southern side of The Boulevard to return to the Casuarina Way/The Boulevard roundabout , instead of continuing to the Tweed Coast Road/The Boulevard intersection, thereby reducing the traffic flow at the latter intersection. Similarly, it allows vehicles from within Casuarina to access the angled parking on the northern side of The Boulevard without going through the Tweed Coast Road/The Boulevard intersection.

Summary

In conclusion, the analysis of the roundabout option demonstrates that a two lane roundabout will be sufficient to provide for the projected traffic demand at the Casuarina Way/The Boulevard intersection. The use of a roundabout, however, will require careful consideration of pedestrian provisions. The two lane roundabout and a u-turn pocket at the western end of The Boulevard, have been included in updated road layout plans (see DA119 at Appendix B) as prepared by Cardno.

Appendix A

SIDRA Outputs

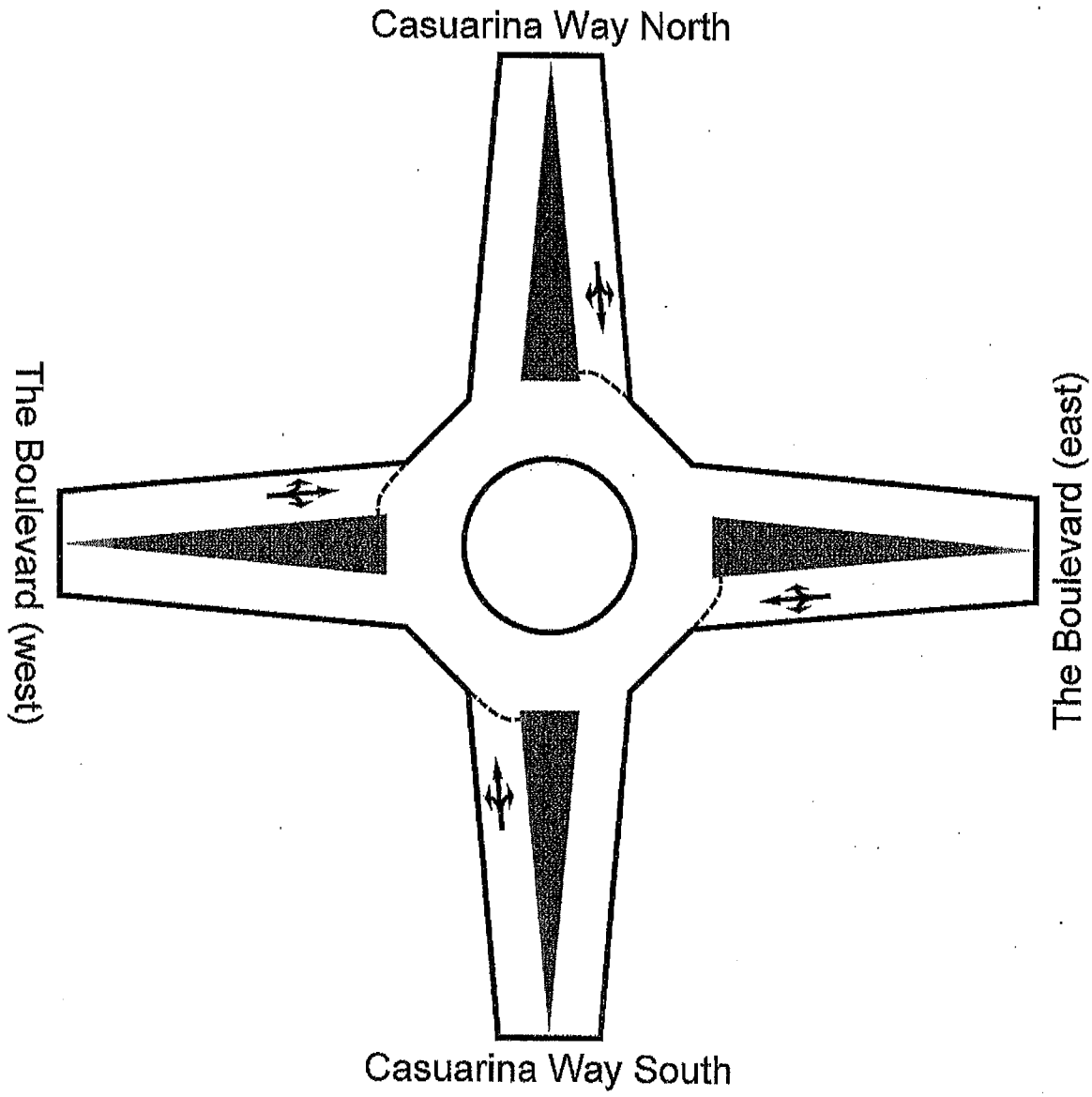

Casuarina Way North
The Boulevard (west)
The Boulevard (east)
Casuarina Way South

Table S.14 - Summary of Input and Output Data

Casuarina Way The Boulevard
2018 Masterplan AM Peak (Single Lane)
Intersection ID: 0
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Casuarina Way South												
1 LTR	146	138	11	295	4				0.466	15.0	33	500
	146	138	11	295	4				0.466	15.0	33	
East: The Boulevard (east)												
1 LTR	11	168	48	227	4				0.377	13.9	24	500
	11	168	48	227	4				0.377	13.9	24	
North: Casuarina Way North												
1 LTR	39	154	436	629	4				0.582	11.9	49	500
	39	154	436	629	4				0.582	11.9	49	
West: The Boulevard (west)												
1 LTR	334	112	75	521	4				0.489	9.9	38	150
	334	112	75	521	4				0.489	9.9	38	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1672	4	0.583	12.1	49

Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - Summary of Input and Output Data

Casuarina Way The Boulevard
2018 Masterplan PM Peak (Single Lane)
Intersection ID: 0
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Casuarina Way South												
1 LTR	254	339	24	617	4				1.049	155.2	506	500
	254	339	24	617	4				1.049	155.2	506	
East: The Boulevard (east)												
1 LTR	24	181	79	284	4				0.703	32.7	68	500
	24	181	79	284	4				0.703	32.7	68	
North: Casuarina Way North												
1 LTR	82	267	435	784	4				1.021	101.5	477	500
	82	267	435	784	4				1.021	101.5	477	
West: The Boulevard (west)												
1 LTR	452	203	282	937	4				1.160	318.3	1375	150
	452	203	282	937	4				1.160	318.3	1375	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	2622	4	1.160	184.2	1375

Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - Summary of Input and Output Data

Casuarina Way The Boulevard
2028 Masterplan AM Peak (Single Lane)
Intersection ID: 0
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Casuarina Way South												
1 LTR	146	149	11	306	4				0.546	18.5	44	500
	146	149	11	306	4				0.546	18.5	44	
East: The Boulevard (east)												
1 LTR	11	168	48	227	4				0.447	17.0	32	500
	11	168	48	227	4				0.447	17.0	32	
North: Casuarina Way North												
1 LTR	39	180	523	742	4				0.681	12.6	68	500
	39	180	523	742	4				0.681	12.6	68	
West: The Boulevard (west)												
1 LTR	370	112	75	557	4				0.531	10.1	43	150
	370	112	75	557	4				0.531	10.1	43	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1832	4	0.684	13.4	68

Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - Summary of Input and Output Data

Casuarina Way The Boulevard
2028 Masterplan PM Peak (Single Lane)
Intersection ID: 0
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Casuarina Way South												
1 LTR	254	360	24	638	4				1.136	291.2	867	500
	254	360	24	638	4				1.136	291.2	867	
East: The Boulevard (east)												
1 LTR	24	181	79	284	4				0.739	37.3	75	500
	24	181	79	284	4				0.739	37.3	75	
North: Casuarina Way North												
1 LTR	82	283	487	852	4				1.067	162.8	740	500
	82	283	487	852	4				1.067	162.8	740	
West: The Boulevard (west)												
1 LTR	523	203	282	1008	4				1.228	437.0	1888	150
	523	203	282	1008	4				1.228	437.0	1888	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	2782	4	1.230	278.8	1888

Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

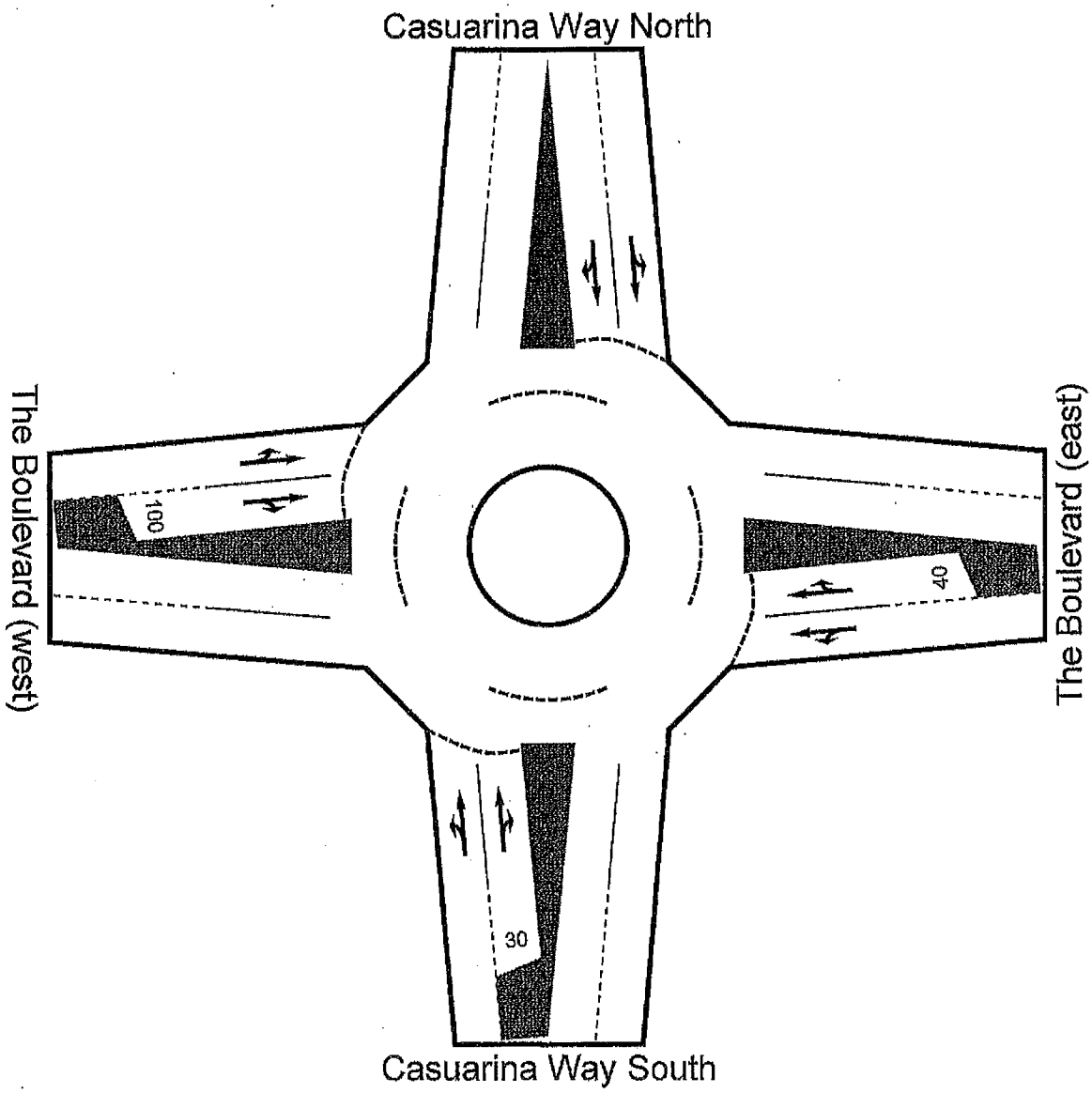

Casuarina Way North
The Boulevard (west)
The Boulevard (east)
Casuarina Way South
100
40
30

Table S.14 - Summary of Input and Output Data

Casuarina Way The Boulevard
2018 Masterplan AM Peak (Two Lane)
Intersection ID: 0
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Casuarina Way South												
1 LT	146	8		154	4				0.186	10.8	9	500
2 TR		130	11	141	5				0.186	10.5	9	30
	146	138	11	295	4				0.186	10.6	9	
East: The Boulevard (east)												
1 LT	11	107		118	5				0.142	9.5	7	500
2 TR		61	48	109	4				0.142	11.6	6	40
	11	168	48	227	4				0.142	10.5	7	
North: Casuarina Way North												
1 LT	39	154		193	4				0.216	8.3	11	500
2 R			436	436	4				0.368	12.3	22	250
	39	154	436	629	4				0.368	11.0	22	
West: The Boulevard (west)												
1 L	334			334	4				0.288	8.7	16	150
2 TR		112	75	187	4				0.194	9.6	10	100
	334	112	75	521	4				0.288	9.0	16	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1672	4	0.368	10.3	22

Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - Summary of Input and Output Data

Casuarina Way The Boulevard
2018 Masterplan PM Peak (Two Lane)
Intersection ID: 0
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Casuarina Way South												
1 LT	254	68		322	4				0.413	11.6	24	500
2 TR		271	24	295	4				0.413	11.6	24	30
	254	339	24	617	4				0.413	11.6	24	
East: The Boulevard (east)												
1 LT	24	128		152	4				0.235	11.2	12	500
2 TR		53	79	132	4				0.235	14.5	11	40
	24	181	79	284	4				0.235	12.7	12	
North: Casuarina Way North												
1 LT	82	267		349	4				0.440	10.4	26	500
2 R			435	435	4				0.497	14.8	33	250
	82	267	435	784	4				0.497	12.8	33	
West: The Boulevard (west)												
1 LT	452	28		480	4				0.515	10.8	34	150
2 TR		175	282	457	4				0.515	12.8	34	100
	452	203	282	937	4				0.515	11.8	34	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	2622	4	0.516	12.2	34

Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - Summary of Input and Output Data

Casuarina Way The Boulevard
2028 Masterplan AM Peak (Two Lane)
Intersection ID: 0
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Casuarina Way South												
1 LT	146	15		161	4				0.210	11.4	11	500
2 TR		134	11	145	4				0.210	11.2	11	30
	146	149	11	306	4				0.210	11.3	11	
East: The Boulevard (east)												
1 LT	11	108		119	5				0.155	10.0	7	500
2 TR		60	48	108	4				0.155	12.3	7	40
	11	168	48	227	4				0.155	11.1	7	
North: Casuarina Way North												
1 LT	39	180		219	4				0.251	8.4	13	500
2 R			523	523	4				0.438	12.3	28	250
	39	180	523	742	4				0.438	11.2	28	
West: The Boulevard (west)												
1 L	370			370	4				0.322	8.8	19	150
2 TR		112	75	187	4				0.203	9.8	10	100
	370	112	75	557	4				0.322	9.1	19	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1832	4	0.438	10.6	28

Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - Summary of Input and Output Data

Casuarina Way The Boulevard
2028 Masterplan PM Peak (Two Lane)
Intersection ID: 0
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Casuarina Way South												
1 LT	254	81		335	4				0.457	12.6	29	500
2 TR		279	24	303	4				0.457	12.7	28	30
	254	360	24	638	4				0.457	12.6	29	
East: The Boulevard (east)												
1 LT	24	129		153	4				0.254	11.6	13	500
2 TR		52	79	131	4				0.254	15.0	13	40
	24	181	79	284	4				0.254	13.2	13	
North: Casuarina Way North												
1 LT	82	283		365	4				0.485	11.5	33	500
2 R			487	487	4				0.578	16.3	47	250
	82	283	487	852	4				0.578	14.2	47	
West: The Boulevard (west)												
1 L	523			523	4				0.573	11.6	42	150
2 TR		203	282	485	4				0.563	13.4	40	100
	523	203	282	1008	4				0.573	12.5	42	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	2782	4	0.578	13.1	47

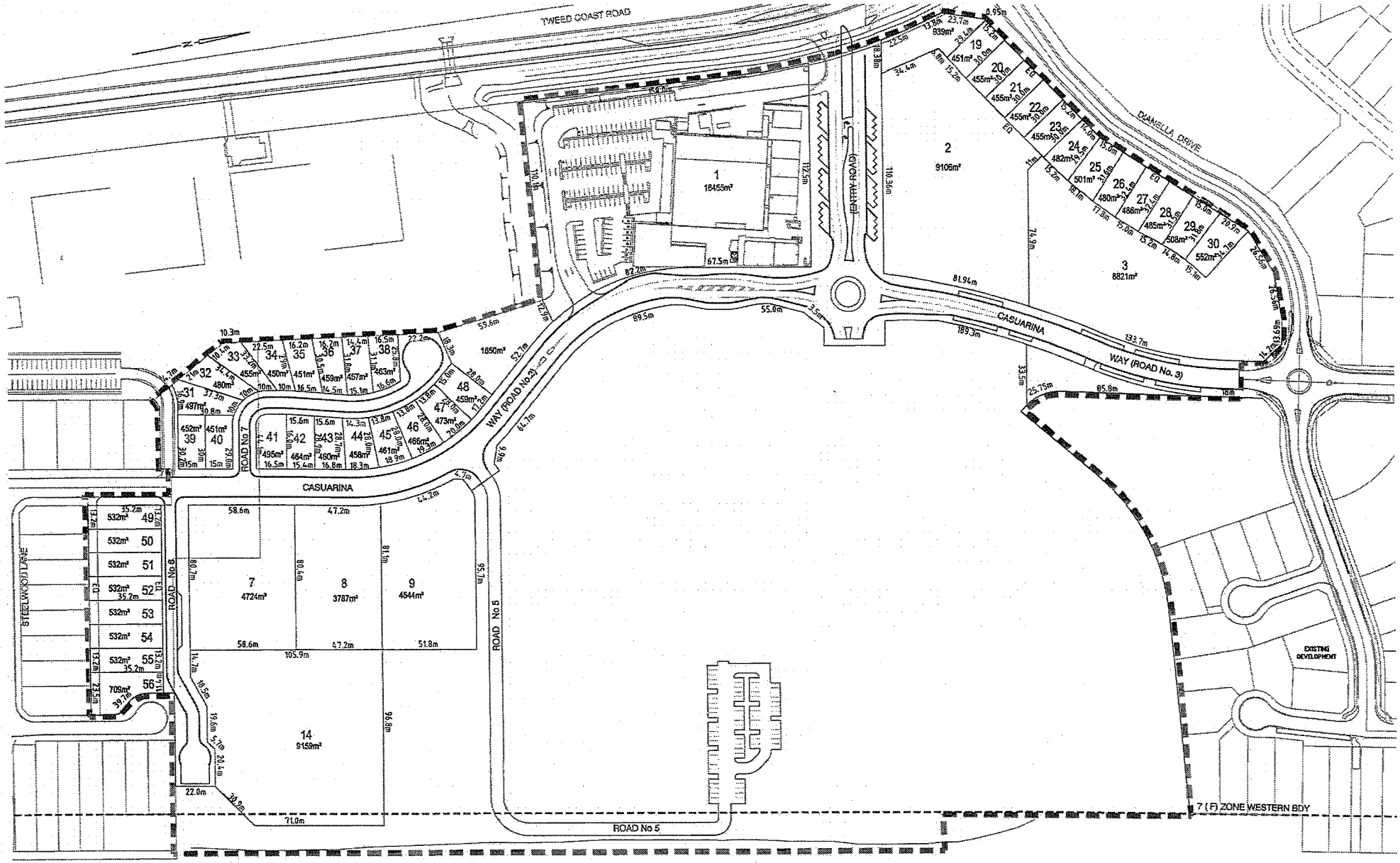
Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Appendix B

Casuarina Town Centre Subdivision Layout Plan



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SCALE BEFORE REDUCTION 1 : 1000

CAD FILE NAME: G:\7079\GC\01\DA Approval\7079\01\DA119.dwg

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KINGS BEACH (No. 2) PTY LTD	
CASUARINA BEACH	SCALE :- 1:1000 A1
TOWN CENTRE	DATE :- 18 OCTOBER, 2007 REV. A
DA SUBMISSION	DRAWING No. 7079/4/1-FIG DA119

FIGURE No.DA119(08/09/10)

SUBDIVISION
LAYOUT PLAN