
TO Reece Gibson
 COPY John Denney
 FROM Chris Morahan
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 FILE 6-XT177.62/305DC
 SUBJECT Traffic Modelling of SH6A/Ballarat Street
 Intersection (Amended Layout)

t: +64 3 363 5400
 f: +64 3 365 7858
 w: www.opus.co.nz

1 Introduction

An upgrade of the State Highway 6A (SH6A)/Ballarat Street intersection was previously investigated in the Opus memorandum dated 28 May 2015. This recommended a preferred option (Option E1) for an upgraded signalised intersection, which included two approach lanes on all legs, comprising a short right-turn lane and a combined left-turn and through lane.

It has been proposed that the northeast Ballarat Street approach be reduced to a single approach lane only. This memorandum assesses the impact of this change on the intersection performance.

2 Intersection Layout

Figure 1 shows the proposed single lane layout for the Stanley Street (SH6A)/ Ballarat Street intersection, together with the previously modelled layout for comparison.

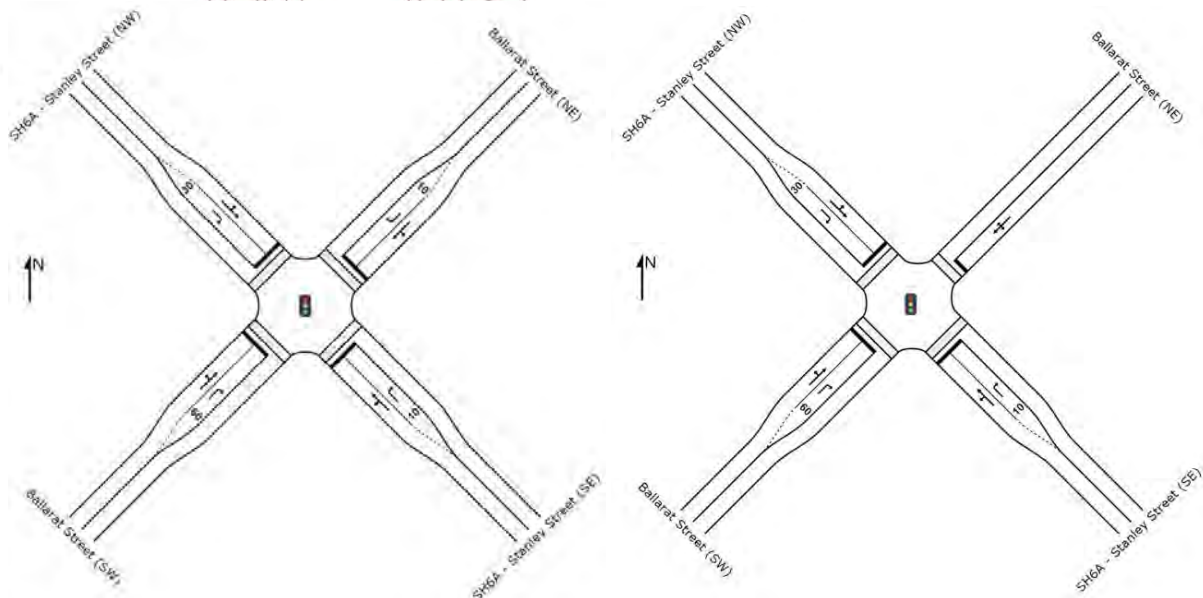


Figure 1 – Stanley Street (SH6A)/ Ballarat Street updated signalised intersection, previously modelled (left) and proposed (right)



3 Results

The intersection was modelled using SIDRA INTERSECTION 6.1. The model used the same gap acceptance parameters and phase settings as in the previously completed modelling. The results from the proposed signalised intersection are summarised in Table 1, with detailed results provided in Appendix A. The results for the existing roundabout and previously modelled option are also shown for ease of comparison.

Intersection Layout	Measure	24 December 2014		23 April 2015		
		AM	PM	AM	PM	
Existing roundabout and zebra crossing	Intersection level of service	F	E	F	F	
	Average vehicle delay (s)	95	60	115	145	
	95 percentile queue length (m)	SE	275	176	137	146
		NE	11	9	10	14
		NW	797	656	1751	2000
SW		85	61	16	24	
Previously modelled option	Intersection level of service	B	B	B	B	
	Average vehicle delay (s)	18	16	12	17	
	95 percentile queue length (m)	SE	150	132	68	81
		NE	9	9	8	12
		NW	75	70	88	132
SW		53	44	34	62	
Proposed single lane option	Intersection level of service	B	B	B	B	
	Average vehicle delay (s)	18	16	12	17	
	95 percentile queue length (m)	SE	150	132	68	81
		NE	14	13	11	18
		NW	75	70	88	132
SW		54	44	34	62	

Table 1 – Modelling results for updated signalised intersection

The results show that the number of approach lanes on the northeast Ballarat Street approach would have little impact on the intersection performance. With a single approach lane on the northeast approach, average vehicle delays would not change by more than a second in any peak period, compared to having two approach lanes on the northeast approach. The 95th percentile queue length would increase slightly on the northeast Ballarat Street approach, from 12m to 18m in the December PM peak period. Queue lengths on the State Highway approaches (southeast and northwest), and the southwest Ballarat Street approach, would not change by more than 1m.



4 Conclusions and Recommendation

The SH6A/Ballarat Street has been modelled in SIDRA using a single approach lane on the northeast Ballarat Street approach, rather than two lanes as was used in previous modelling.

The effect of this change on the intersection performance is minor. There would be slightly longer queues on the northeast Ballarat Street approach, but no appreciable change to queue lengths on the other approaches, or overall intersection delays.

It is recommended that the proposed single lane option is investigated further.

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Appendix A

Detailed SIDRA Outputs for Updated Signalised Intersection Layout

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MOVEMENT SUMMARY

 Site: Stanley_Ballarat Updated Layout - AM Peak - Dec 2014

New Site

Signals - Fixed Time Isolated Cycle Time = 60 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
SouthEast: SH6A - Stanley Street (SE)											
1	L2	257	3.7	0.817	19.9	LOS B	21.0	150.2	0.81	0.85	35.7
2	T1	549	1.7	0.817	15.3	LOS B	21.0	150.2	0.81	0.85	36.7
3	R2	53	2.0	0.117	17.8	LOS B	1.0	7.3	0.68	0.71	36.4
Approach		859	2.3	0.817	16.8	LOS B	21.0	150.2	0.80	0.84	36.4
NorthEast: Ballarat Street (NE)											
4	L2	31	0.0	0.227	27.2	LOS C	2.0	13.8	0.88	0.73	32.9
5	T1	18	0.0	0.227	22.6	LOS C	2.0	13.8	0.88	0.73	23.2
6	R2	28	0.0	0.227	27.2	LOS C	2.0	13.8	0.88	0.73	23.7
Approach		77	0.0	0.227	26.1	LOS C	2.0	13.8	0.88	0.73	28.3
NorthWest: SH6A - Stanley Street (NW)											
7	L2	36	0.0	0.573	13.3	LOS B	10.5	74.7	0.66	0.60	35.8
8	T1	543	1.7	0.573	8.7	LOS A	10.5	74.7	0.66	0.60	41.8
9	R2	37	11.4	0.149	24.7	LOS C	0.9	6.8	0.81	0.72	19.9
Approach		616	2.2	0.573	9.9	LOS A	10.5	74.7	0.67	0.61	40.5
SouthWest: Ballarat Street (SW)											
10	L2	87	0.0	0.312	27.6	LOS C	3.0	20.7	0.89	0.75	19.4
11	T1	26	0.0	0.312	23.0	LOS C	3.0	20.7	0.89	0.75	23.1
12	R2	241	1.3	0.763	34.2	LOS C	7.6	53.7	1.00	0.92	27.8
Approach		355	0.9	0.763	31.7	LOS C	7.6	53.7	0.97	0.87	26.2
All Vehicles		1906	1.9	0.817	17.7	LOS B	21.0	150.2	0.79	0.77	35.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue		Prop. Queued	Effective Stop Rate per ped	
					Pedestrian ped	Distance m			
P1	SouthEast Full Crossing	333	24.6	LOS C	0.5	0.5	0.91	0.91	
P2	NorthEast Full Crossing	43	8.0	LOS A	0.0	0.0	0.52	0.52	
P3	NorthWest Full Crossing	148	24.5	LOS C	0.2	0.2	0.91	0.91	
P4	SouthWest Full Crossing	12	9.6	LOS A	0.0	0.0	0.57	0.57	
All Pedestrians		536	22.9	LOS C			0.87	0.87	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

 Site: Stanley_Ballarat Updated Layout - PM Peak - Dec 2014

New Site

Signals - Fixed Time Isolated Cycle Time = 60 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m		per veh	km/h
SouthEast: SH6A - Stanley Street (SE)											
1	L2	217	4.9	0.774	17.3	LOS B	18.3	132.2	0.79	0.79	37.4
2	T1	556	3.0	0.774	12.7	LOS B	18.3	132.2	0.79	0.79	38.4
3	R2	39	2.7	0.083	16.9	LOS B	0.7	5.2	0.65	0.69	36.8
Approach		812	3.5	0.774	14.1	LOS B	18.3	132.2	0.78	0.79	38.1
NorthEast: Ballarat Street (NE)											
4	L2	25	0.0	0.204	27.0	LOS C	1.8	12.7	0.87	0.71	33.2
5	T1	26	4.0	0.204	22.4	LOS C	1.8	12.7	0.87	0.71	23.6
6	R2	19	0.0	0.204	27.0	LOS C	1.8	12.7	0.87	0.71	24.1
Approach		71	1.5	0.204	25.3	LOS C	1.8	12.7	0.87	0.71	28.2
NorthWest: SH6A - Stanley Street (NW)											
7	L2	40	0.0	0.536	13.1	LOS B	9.7	69.6	0.65	0.59	35.9
8	T1	505	2.9	0.536	8.5	LOS A	9.7	69.6	0.65	0.59	41.9
9	R2	36	5.9	0.130	23.6	LOS C	0.8	6.2	0.79	0.71	20.5
Approach		581	2.9	0.536	9.8	LOS A	9.7	69.6	0.66	0.59	40.6
SouthWest: Ballarat Street (SW)											
10	L2	73	1.4	0.287	27.4	LOS C	2.8	19.4	0.89	0.74	19.6
11	T1	34	0.0	0.287	22.8	LOS C	2.8	19.4	0.89	0.74	23.3
12	R2	212	0.5	0.670	32.1	LOS C	6.3	44.3	0.99	0.86	28.6
Approach		318	0.7	0.670	30.1	LOS C	6.3	44.3	0.95	0.82	26.8
All Vehicles		1781	2.7	0.774	16.0	LOS B	18.3	132.2	0.78	0.73	36.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue		Prop. Queued	Effective Stop Rate	
		ped/h	sec		Pedestrian ped	Distance m		per ped	per ped
P1	SouthEast Full Crossing	299	24.6	LOS C	0.5	0.5	0.91	0.91	
P2	NorthEast Full Crossing	52	8.0	LOS A	0.0	0.0	0.52	0.52	
P3	NorthWest Full Crossing	154	24.5	LOS C	0.2	0.2	0.91	0.91	
P4	SouthWest Full Crossing	29	9.6	LOS A	0.0	0.0	0.57	0.57	
All Pedestrians		534	22.1	LOS C			0.85	0.85	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

 Site: Stanley_Ballarat Updated Layout - AM Peak - Apr 2015

New Site

Signals - Fixed Time Isolated Cycle Time = 50 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m		per veh	km/h
SouthEast: SH6A - Stanley Street (SE)											
1	L2	29	10.7	0.612	10.6	LOS B	9.3	68.0	0.62	0.56	42.8
2	T1	620	5.1	0.612	6.0	LOS A	9.3	68.0	0.62	0.56	44.1
3	R2	47	0.0	0.114	15.1	LOS B	0.8	5.3	0.66	0.70	37.8
Approach		697	5.0	0.612	6.8	LOS A	9.3	68.0	0.62	0.57	43.5
NorthEast: Ballarat Street (NE)											
4	L2	19	0.0	0.312	28.1	LOS C	1.6	11.1	0.95	0.73	32.9
5	T1	29	0.0	0.312	23.5	LOS C	1.6	11.1	0.95	0.73	23.3
6	R2	17	0.0	0.312	28.1	LOS C	1.6	11.1	0.95	0.73	23.8
Approach		65	0.0	0.312	26.0	LOS C	1.6	11.1	0.95	0.73	27.2
NorthWest: SH6A - Stanley Street (NW)											
7	L2	42	2.5	0.750	12.9	LOS B	12.2	87.5	0.66	0.65	36.1
8	T1	684	2.6	0.750	8.3	LOS A	12.2	87.5	0.66	0.65	42.1
9	R2	162	3.2	0.353	15.1	LOS B	2.8	19.8	0.70	0.75	25.8
Approach		888	2.7	0.750	9.8	LOS A	12.2	87.5	0.66	0.67	39.9
SouthWest: Ballarat Street (SW)											
10	L2	158	2.7	0.763	31.4	LOS C	4.8	34.0	1.00	0.95	17.6
11	T1	16	0.0	0.763	26.8	LOS C	4.8	34.0	1.00	0.95	21.2
12	R2	35	0.0	0.135	27.0	LOS C	0.8	5.6	0.93	0.71	30.6
Approach		208	2.0	0.763	30.3	LOS C	4.8	34.0	0.99	0.91	20.8
All Vehicles		1859	3.4	0.763	11.5	LOS B	12.2	87.5	0.70	0.66	38.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue		Prop. Queued	Effective Stop Rate	
		ped/h	sec		Pedestrian ped	Distance m		per ped	per ped
P1	SouthEast Full Crossing	41	19.4	LOS B	0.1	0.1	0.88	0.88	
P2	NorthEast Full Crossing	12	5.8	LOS A	0.0	0.0	0.48	0.48	
P3	NorthWest Full Crossing	36	19.4	LOS B	0.0	0.0	0.88	0.88	
P4	SouthWest Full Crossing	139	7.3	LOS A	0.1	0.1	0.54	0.54	
All Pedestrians		227	11.3	LOS B			0.65	0.65	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

 Site: Stanley_Ballarat Updated Layout - PM Peak - Apr 2015

New Site

Signals - Fixed Time Isolated Cycle Time = 65 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m		per veh	km/h
SouthEast: SH6A - Stanley Street (SE)											
1	L2	22	9.5	0.583	12.3	LOS B	11.2	80.6	0.61	0.55	41.5
2	T1	598	2.8	0.583	7.7	LOS A	11.2	80.6	0.61	0.55	42.7
3	R2	40	0.0	0.111	19.6	LOS B	0.9	6.0	0.69	0.70	35.5
Approach		660	2.9	0.583	8.6	LOS A	11.2	80.6	0.62	0.56	42.1
NorthEast: Ballarat Street (NE)											
4	L2	40	0.0	0.350	33.5	LOS C	2.6	18.0	0.95	0.75	30.4
5	T1	21	0.0	0.350	28.9	LOS C	2.6	18.0	0.95	0.75	20.6
6	R2	23	0.0	0.350	33.5	LOS C	2.6	18.0	0.95	0.75	21.2
Approach		84	0.0	0.350	32.4	LOS C	2.6	18.0	0.95	0.75	26.4
NorthWest: SH6A - Stanley Street (NW)											
7	L2	53	0.0	0.817	18.5	LOS B	18.6	132.4	0.68	0.72	31.0
8	T1	702	2.4	0.817	13.9	LOS B	18.6	132.4	0.68	0.72	38.2
9	R2	164	2.6	0.355	18.4	LOS B	3.6	25.9	0.71	0.75	23.4
Approach		919	2.3	0.817	15.0	LOS B	18.6	132.4	0.69	0.73	36.1
SouthWest: Ballarat Street (SW)											
10	L2	206	0.5	0.823	39.0	LOS D	8.8	62.1	1.00	1.00	15.4
11	T1	40	2.6	0.823	34.4	LOS C	8.8	62.1	1.00	1.00	18.6
12	R2	49	0.0	0.157	30.3	LOS C	1.4	9.7	0.89	0.73	29.3
Approach		296	0.7	0.823	36.9	LOS D	8.8	62.1	0.98	0.96	18.7
All Vehicles		1959	2.1	0.823	16.9	LOS B	18.6	132.4	0.72	0.71	34.8

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue		Prop. Queued	Effective Stop Rate	
		ped/h	sec		Pedestrian ped	Distance m		per ped	
P1	SouthEast Full Crossing	68	26.9	LOS C	0.1	0.1	0.91	0.91	
P2	NorthEast Full Crossing	59	6.9	LOS A	0.1	0.1	0.46	0.46	
P3	NorthWest Full Crossing	166	27.0	LOS C	0.3	0.3	0.91	0.91	
P4	SouthWest Full Crossing	171	8.4	LOS A	0.2	0.2	0.51	0.51	
All Pedestrians		464	17.6	LOS B			0.71	0.71	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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