6 FUTURE YEAR BASE NETWORK PERFORMANCE

6.1 Introduction

The following sections describe the results of modelling assessment for the future year Base models for the year 2021, 2026 and 2031. Comparisons of different future year Base models are summarised to assess the impacts of background traffic growth on the network performance.

The network assessment results are reported in terms of:

— global network performance statistics

— travel time changes along the key corridors

— change in network flows

— intersection performance by SIDRA.

6.2 Network performance statistics

Vehicle kilometres travelled (VKT) and vehicles hours travelled (VHT) are used to assess and compare the overall network performance for the entire network and entire time period. The summary of the network performance statistics for future year Base models for the AM and PM peak periods are shown in Table 6.1 and Table 6.2. It should be noted that the VKT, VHT and thus average network vehicle speed are calculated only after vehicles have left the network within the entire simulation time period. Therefore, the amount of unreleased or incomplete trips and the distribution of these trips (longer trips versus shorter trips) can distort the VKT, VHT and average network vehicle speed results. The network statistics are generally for the average across five seeds. However, because of increasing demand and network delays in future years, the run time to converge future models increased significantly. The results summarised in the table (with one seed) should be interpreted as representing an optimistic outcome, as the unreleased trips of different future year models are mostly zero, except in 2031 PM model with only 36 vehicles.

The results of future year base models indicate that the future year Base network would be able to accommodate future year traffic growth by increasing network delays at difference locations. The provision of hypothetical assumptions for potential road upgrades (which are uncommitted/unfunded/pre-feasibility) in future years to accommodate traffic demands increases the throughput of network, mainly in 2021. Therefore, network statistics in 2021 indicate that the network speed would remain almost same in both AM and PM peak periods. Over the next 15 years, the network speed would drop to 35 km/h (13% reduction) and 29 km/h (27% reduction) in the respective AM and PM peak hours compared with 2016 results. In summary, the PM network shows more congestion than AM network in all future Base years.

Table 6.1 AM peak network statistic comparison

Year	2016	2021	2026	2031
Vehicle Kilometres Travelled (VKT)	256,187	280,367	311,243	344,239
Vehicle Hours Travelled (VHT)	6,434	7,002	8,007	9,818
Average network speed (km/h)	40	40	39	35
Completed trips	64,919	69,542	76,382	81,900
Incomplete trips	1,551	1,692	1,987	2,285
Unreleased trips	0	0	0	0
% Complete	98%	98%	97%	97%

(Statistics are based on vehicles which complete their journey only)

Table 6.2 PM peak network statistic comparison

Year	2016	2021	2026	2031
Vehicle Kilometres Travelled (VKT)	317,761	336,202	368,765	414,923
Vehicle Hours Travelled (VHT)	8,514	8,963	10,442	14,525
Average network speed	37	38	35	29
Completed trips	79,666	83,306	90,646	96,272
Incomplete trips	1,753	1,947	2,112	2,953
Unreleased trips	0	0	0	36
% Complete	98%	98%	98%	97%

(Statistics are based on vehicles which complete their journey only)

6.3 Key corridor statistics

The travel times on key corridors for the future year Base models have been extracted and are summarised in the Table 6.3 and Table 6.4. Travel time results indicate that the provision of hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), in the future year would generally improve the corridor travel times for the short term period. Over the next 15 years, from 2016 to 2031, both AM and PM peak period models indicate an increase in travel time along key corridors:

— Modelling results indicate a significant increase of travel time along the Northern Road corridor in 2031, particularly for the southbound direction in both AM and PM peak periods. This high congestion was a result of having insufficient capacity on the Parker Street section, from Oxford Street to Great Western Highway. Side streets like Cox Avenue, Copeland Street, Oxford Street would experience high delays due to the capacity constraint on Parker Street.

— Dunheved Road – Christie Street corridor indicates a minor increase of travel time until 2026. Additional delays were noted in 2031, mainly at Richmond Road/Dunheved Road, Werrington Road/Dunheved Road and Christie Street/Forrester Road intersections.

— Along the Glossop Street – Forrester Road corridor, travel time results show a moderate increase of travel time from 2026 to 2031.

— Figure 6.1 and Figure 6.2 show network delay plots from all future year Base models for the respective AM and PM peak hours.

Table 6.3 Travel time comparison (8.00 am–9.00 am)

Route	Direction	2016 Base	2021 Base	2026 Base	2031 Base
The Northern Road	NB	07:49	07:59	08:13	08:24
The Northern Road	SB	10:27	11:26	11:22	13:51
Glossop Street–Forrester Road	NB	07:33	07:35	09:30	09:24
Glossop Street–Forrester Road	SB	08:10	08:08	10:07	11:07
Dunheved Road–Christine Street	EB	07:54	08:08	08:07	12:05
Dunheved Road–Christine Street	WB	08:00	08:05	08:13	08:35
Werrington Road	NB	02:25	02:25	02:28	03:55
Werrington Road	SB	03:48	03:09	03:26	05:24

Table 6.4 Travel time comparison (5.00 pm–6.00 pm)

Route	Direction	2016 Base	2021 Base	2026 Base	2031 Base
The Northern Road	NB	08:08	08:09	08:30	09:34
The Northern Road	SB	09:42	09:21	12:27	24:06
Glossop Street–Forrester Road	NB	07:50	07:49	09:29	12:14
Glossop Street–Forrester Road	SB	08:08	08:02	08:36	11:55
Dunheved Road–Christine Street	EB	07:28	07:35	07:42	12:48
Dunheved Road–Christine Street	WB	08:24	08:28	09:06	11:00
Werrington Road	NB	02:21	02:24	02:39	03:59
Werrington Road	SB	03:01	02:38	02:55	08:32

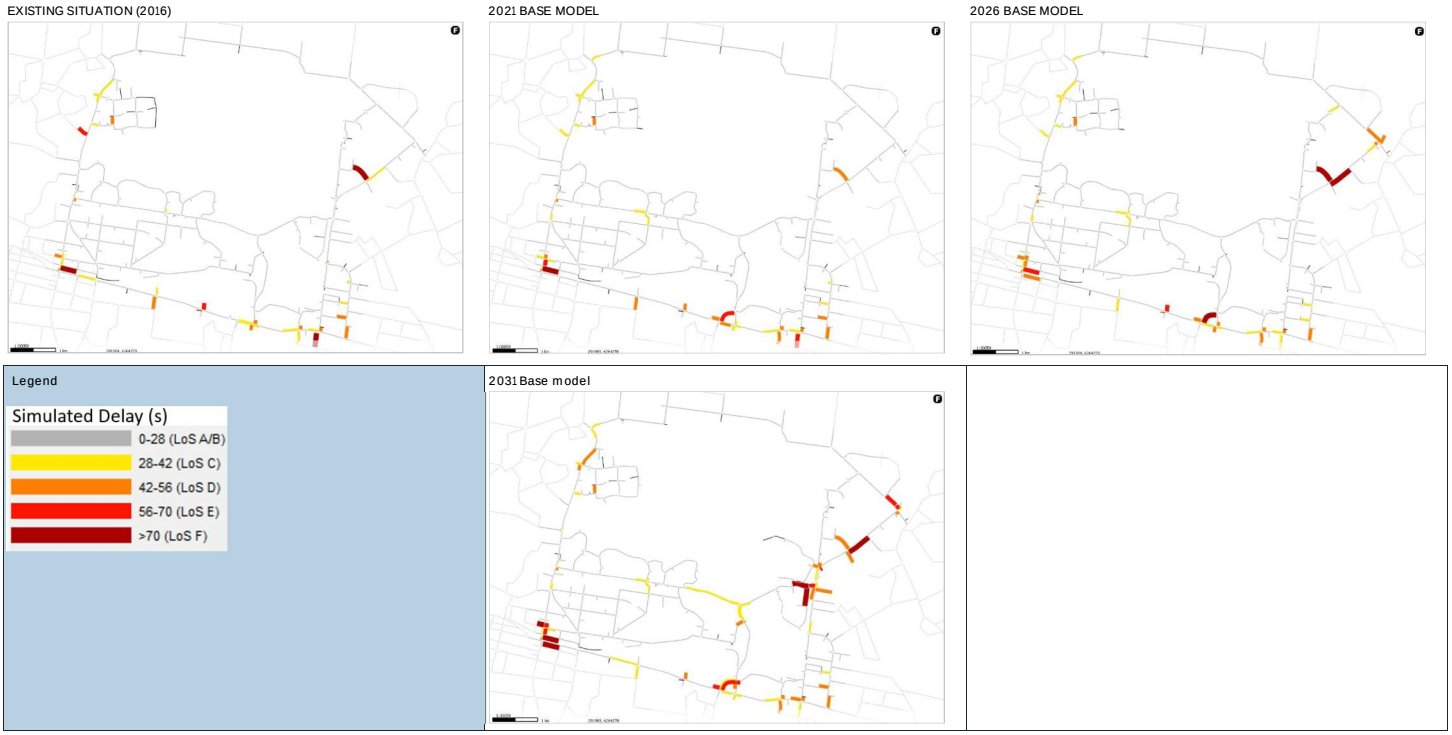


Figure 6.1 AM peak link delays for existing and future year base models (8.00 am–9.00 am)

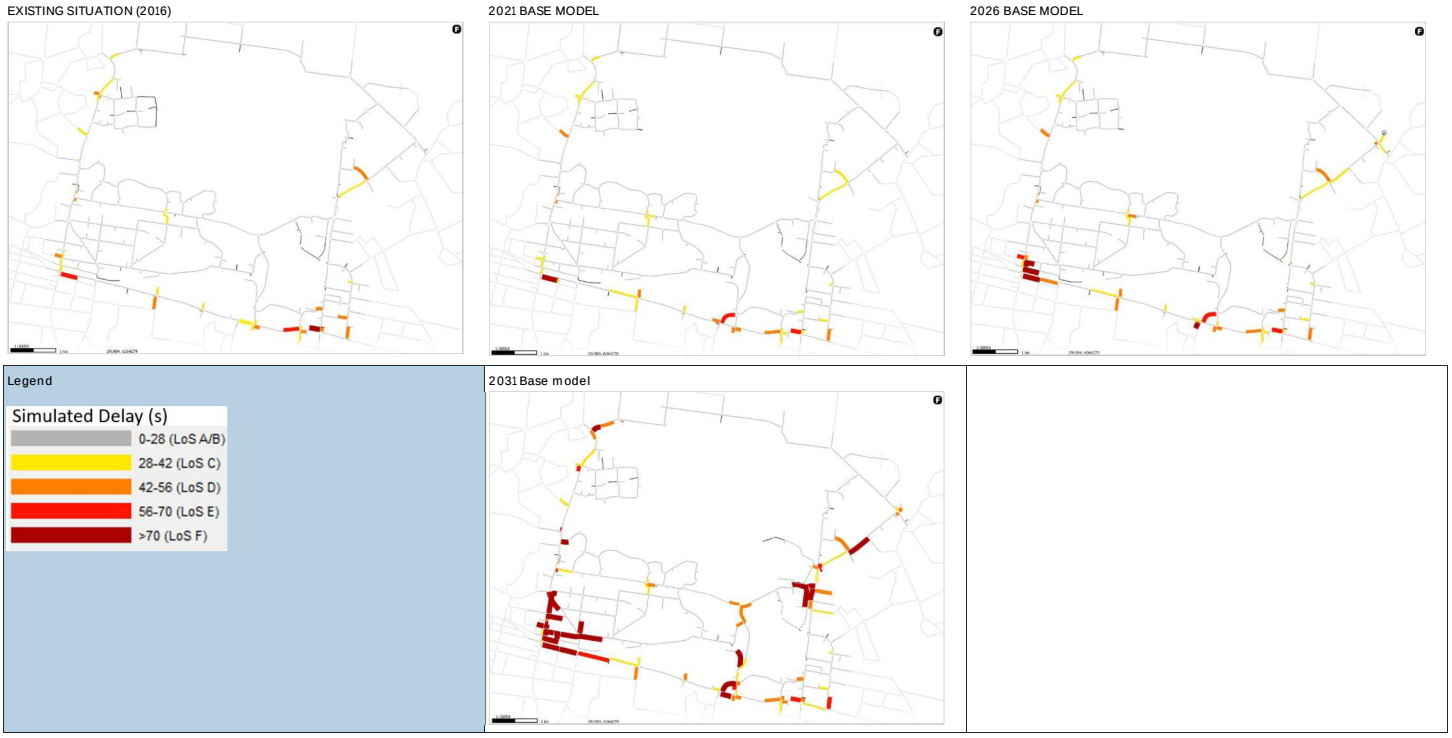


Figure 6.2 PM peak link delays for existing and future year base models (5.00 pm–6.00 pm)

6.4 Network flows

The network flows on key corridors in both directions for all future year base models in the respective AM and PM peak periods are summarised in Table 6.5 and Table 6.6.

Overall, the data indicates the following trends:

— Over the next 15 years, the Northern Road will experience an average traffic growth of 1.9% and 1.6% per annum during the AM and PM peak periods.

— Traffic along Dunheved Road is expected to increase an average of 1.8% per annum from 2016 to 2031, except a minor reduction of total traffic flow in 2031 AM peak. This is mainly because of the eastbound heavy traffic flow would experience additional delays.

— Traffic on Werrington Road is projected to grow strongly with an average of 3.1% to 3.7% per annum from 2016 to 2031.

— Traffic growth on Forrester Road would experience a steady increase from 2016 AM to 2021 AM, while the PM peak model indicates a minor increase in traffic during the same year. From 2026 to 2031, traffic along Forrester Road would increase about 6.7% and 5.4 % per annum in the respective AM and PM peak periods. This a higher than average annual traffic growth rate.

— From 2016 to 2021, traffic growth on Glossop Street is expected to decline in both AM and PM peak periods, followed by a strong increase about 3 % and 5% per annum from 2021 to 2031 in the respective AM and PM peak periods.

— Great Western Highway, east of Reserve Road would experience a drop in traffic from 2016 to 2021 before recovering with an average growth of 2% per annum from 2021 to 2031. The reduction of traffic from 2016 to 2021 is mainly because of the introduction of new ramps on M4 with Kent Road, which connects directly with Gipps Street. Traffic would divert from Mamre Road to Gipps Street because of this new M4 ramp.

The network flows for all future year AIMSUN base models during the AM and PM peak hours are shown in Figure 6.3 and Figure 6.4.

Table 6.5 Network flow in both directions during AM peak (7.00 am–9.00 am)

#	Name	Location	2016 AM	2021 AM		2026 AM		2031 AM	
			Flow	Flow	Growth p.a.	Flow	Growth p.a.	Flow	Growth p.a.
1	The Northern Road	North of Andrews Street	4,983	5,541	2.2%	5,982	1.6%	6,522	1.8%
2	Great Western Highway	East of Reserve Road	5,733	5,349	-1.3%	5,533	0.7%	6,323	2.9%
3	Dunheved Road	West of Werrington Road	3,610	3,897	1.6%	4,279	2.0%	4,256	-0.1%
4	Werrington Road	North of Parkes Avenue	2,452	2,793	2.8%	3,316	3.7%	3,799	2.9%
5	Glossop Street	South of Griffiths Street	3,589	3,554	-0.2%	4,105	3.1%	4,745	3.1%
6	Forrester Road	East of Ellsworth Drive	2,783	2,905	0.9%	3,840	6.4%	5,186	7.0%

Table 6.6 Network flow in both directions during PM peak (4.00 pm–6.00 pm)

#	Name	Location	2016 PM	2021 PM		2026 PM		2031 PM	
			Flow	Flow	Growth p.a.	Flow	Growth p.a.	Flow	Growth p.a.
1	The Northern Road	North of Andrews Street	6,085	6,376	1.0%	6,858	1.5%	7,631	2.3%
2	Great Western Highway	East of Reserve Road	6,712	5,921	-2.4%	6,163	0.8%	7,219	3.4%
3	Dunheved Road	West of Werrington Road	4,410	4,703	1.3%	5,333	2.7%	5,660	1.2%
4	Werrington Road	North of Parkes Avenue	2,792	3,398	4.3%	4,143	4.4%	4,645	2.4%
5	Glossop Street	South of Griffiths Street	3,584	3,339	-1.4%	4,084	4.5%	5,187	5.4%
6	Forrester Road	East of Ellsworth Drive	2,756	2,759	0.0%	3,753	7.2%	4,430	3.6%

Figure 6.3 AM peak network flows for existing and future year base models (8.00 am-9.00 am)

Figure 6.4 PM peak network flows for existing and future year base models (5.00 pm–6.00 pm)

6.5 SIDRA assessment

All future year SIDRA intersection modelling has optimised traffic signal phasing settings to adequately assign phase and cycle times with future traffic demands for optimum intersection performance.

The 2021 Base SIDRA analysis results are shown in Table 6.7.

Table 6.7 2021 Base intersection performance – base road network

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.94	36	C	378	The Northern Road (NW)
		PM	0.85	25	B	245	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.81	35	C	173	The Northern Road (N)
		PM	0.84	36	C	201	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.56	12	A	107	The Northern Road (N)
		PM	0.62	15	B	123	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.68	18	B	126	The Northern Road (N)
		PM	0.78	18	B	174	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	0.61	141	F	16	Trinity Drive (E)
		PM	1.12	468	F	118	Richmond Road (S)
I-10	Richmond Road and Dunheved Road	AM	0.76	21	B	185	Richmond Road (N)
		PM	0.83	25	B	202	Richmond Road (N)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.73	27	B	140	Richmond Road (N)
		PM	0.77	25	B	171	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	0.93	50	D	288	Parker Street (N)
		PM	1.14	140	F	563	Great Western Highway (E)
I-15	Palmyra Avenue and Australis Drive	AM	0.38	14	A	52	Palmyra Avenue (SE)
		PM	0.38	14	A	63	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	0.64	20	B	96	Palmyra Avenue (SE)
		PM	0.74	20	B	136	Palmyra Avenue (SE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	0.82	34	C	90	Ropes Crossing Boulevard (N)
		PM	0.61	24	B	44	Ropes Crossing Boulevard (N)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-19	Forrester Road, Christie Street and Boronia Road	AM	0.84	35	C	111	Forrester Road (S)
		PM	1.07	196	F	536	Forrester Road (S)
I-21	Great Western Highway and Glossop Street	AM	0.90	25	B	125	Great Western Highway (E)
		PM	0.87	21	B	89	Glossop Street (N)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.55	13	A	41	Dunheved Road (W)
		PM	0.73	21	B	81	Werrington Road (S)
I-24	Werrington Road and Great Western Highway	AM	0.87	24	B	158	Werrington Road (N)
		PM	0.82	17	B	69	Werrington Road (N)
I-25	Dunheved Road and John Oxley Avenue	AM	0.54	19	B	2	John Oxley Avenue (S)
		PM	0.66	27	B	4	John Oxley Avenue (S)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	0.92	30	C	157	Dunheved Road (W)
		PM	0.89	28	B	221	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.86	9	A	63	Greenbank Drive (N)
		PM	0.71	5	A	34	Greenbank Drive (N)

The 2021 base with hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 6.8.

Table 6.8 2021 Base intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	DoS	Average delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.66	19	B	97	The Northern Road (NW)
		PM	0.57	19	B	92	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.82	35	C	174	The Northern Road (N)
		PM	0.84	36	C	201	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.68	18	B	126	The Northern Road (N)
		PM	0.76	17	B	165	Richmond Road (S)

The 2021 Base with hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Figure 6.5.

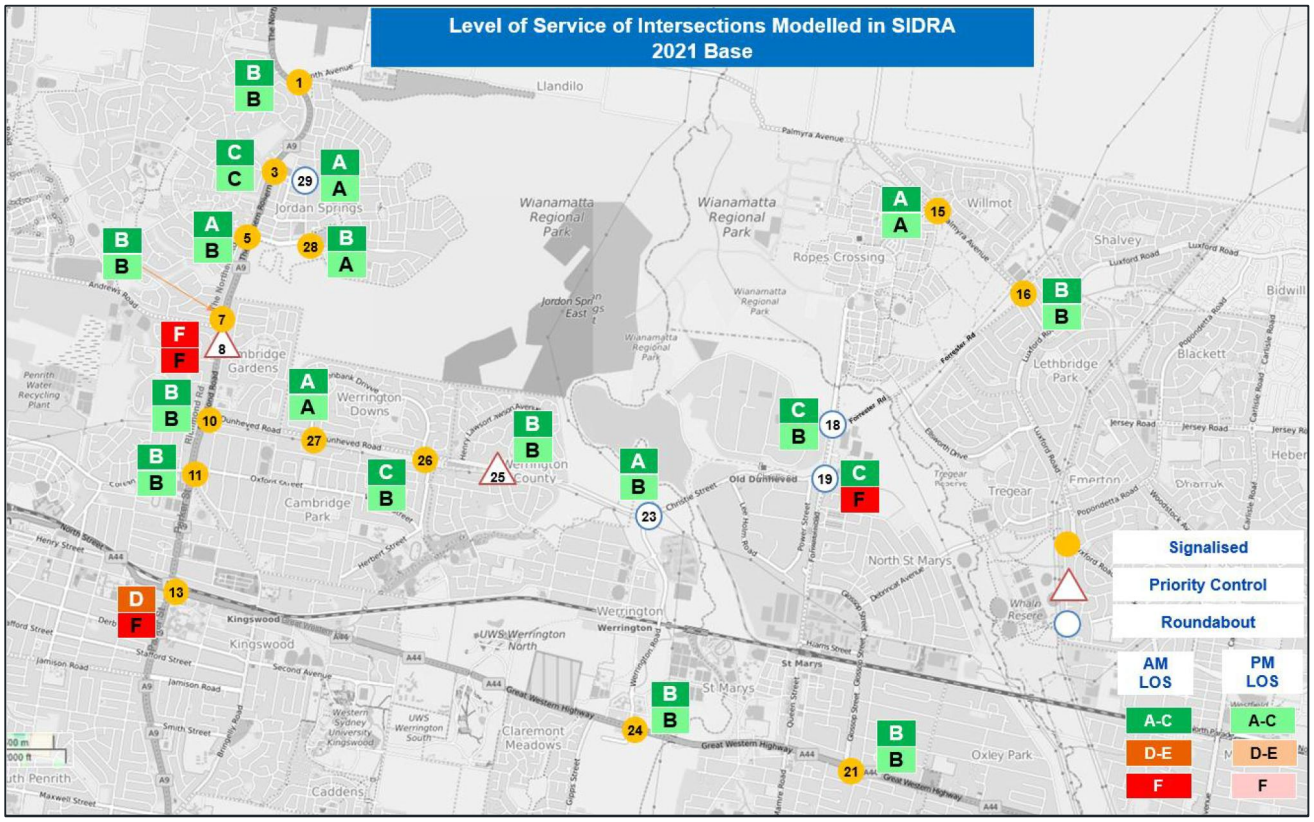


Figure 6.5 2021 Base intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

The 2026 Base SIDRA analysis results are shown in Table 6.9.

Table 6.9 2026 Base intersection performance – base road network

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	1.00	52	D	584	The Northern Road (NW)
		PM	0.92	35	C	394	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.88	39	C	224	The Northern Road (N)
		PM	0.79	38	C	213	The Northern Road (S)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.60	12	A	120	The Northern Road (N)
		PM	0.63	14	A	126	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.85	24	B	187	Richmond Road (S)
		PM	0.79	18	B	205	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	1.66	1506	F	196	Trinity Drive (E)
		PM	1.43	1035	F	234	Trinity Drive (E)
I-10	Richmond Road and Dunheved Road	AM	0.85	23	B	271	Richmond Road (N)
		PM	0.79	25	B	186	Richmond Road (N)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.81	28	B	162	Richmond Road (N)
		PM	0.82	26	B	195	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.06	88	F	610	Parker Street (N)
		PM	1.10	120	F	441	Parker Street (S)
I-15	Palmyra Avenue and Australis Drive	AM	0.51	19	B	69	Palmyra Avenue (NW)
		PM	0.42	16	B	71	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	1.21	290	F	1098	Palmyra Avenue (NW)
		PM	1.35	390	F	1864	Forrester Road (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	1.30	576	F	1418	Ropes Crossing Boulevard (N)
		PM	1.10	297	F	533	Ropes Crossing Boulevard (N)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.62	1157	F	2379	Forrester Road (S)
		PM	2.14	2095	F	3869	Forrester Road (S)
I-21	Great Western Highway and Glossop Street	AM	0.90	24	B	119	Great Western Highway (E)
		PM	0.89	21	B	95	Great Western Highway (E)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.75	14	A	91	Christie Street (E)
		PM	1.09	215	F	713	Werrington Road (S)
I-24	Werrington Road and Great Western Highway	AM	0.82	25	B	124	Werrington Road (N)
		PM	0.92	23	B	120	Werrington Road (N)
I-25	Dunheved Road and John Oxley Avenue	AM	0.59	25	B	2	John Oxley Avenue (S)
		PM	0.75	47	D	10	John Oxley Avenue (S)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	0.93	35	C	207	Dunheved Road (W)
		PM	0.93	38	C	354	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.87	8	A	58	Greenbank Drive (N)
		PM	0.71	5	A	32	Greenbank Drive (N)

The 2026 Base with hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) SIDRA analysis results are shown in Table 6.10.

Table 6.10 2026 Base intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.70	19	B	108	The Northern Road (NW)
		PM	0.65	20	B	105	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.80	39	C	233	The Northern Road (N)
		PM	0.78	38	C	222	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.85	24	B	187	Richmond Road (S)
		PM	0.80	18	B	195	Richmond Road (S)
I-16	Palmyra Avenue and Forrester Road	AM	1.42	607	F	1646	Palmyra Avenue (NW)
		PM	1.63	748	F	2457	Forrester Road (NE)

The 2031 Base SIDRA analysis results are shown in Table 6.11.

Table 6.11 2031 Base intersection performance – base road network

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	1.13	126	F	1135	The Northern Road (NW)
		PM	1.13	131	F	981	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.96	49	D	339	The Northern Road (N)
		PM	0.88	38	C	342	The Northern Road (S)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.66	12	A	140	The Northern Road (N)
		PM	0.69	15	B	143	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.89	32	C	257	Richmond Road (S)
		PM	0.85	22	B	312	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	3.94	5620	F	519	Richmond Road (S)
		PM	4.18	7733	F	958	Trinity Drive (E)
I-10	Richmond Road and Dunheved Road	AM	0.90	29	C	430	Richmond Road (N)
		PM	0.79	22	B	182	Richmond Road (S)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.82	28	B	195	Richmond Road (N)
		PM	0.88	29	C	213	Parker Street (S)
I-13		AM	1.09	107	F	737	Parker Street (N)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
	Great Western Highway and Parker Street	PM	1.15	164	F	590	Great Western Highway (E)
I-15	Palmyra Avenue and Australis Drive	AM	0.51	17	B	61	Palmyra Avenue (SE)
		PM	0.61	20	B	94	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	1.28	361	F	842	Forrester Road (SW)
		PM	1.27	280	F	687	Palmyra Avenue (SE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	2.02	821	F	2301	Forrester Road (S)
		PM	3.92	1967	F	2506	Forrester Road (S)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.34	629	F	1932	Christie Street (W)
		PM	1.20	285	F	1090	Forrester Road (S)
I-21	Great Western Highway and Glossop Street	AM	0.89	34	C	266	Great Western Highway (W)
		PM	0.90	21	B	106	Glossop Street (N)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	1.58	747	F	2137	Dunheved Road (W)
		PM	1.55	657	F	2664	Christie Street (E)
I-24	Werrington Road and Great Western Highway	AM	1.05	47	D	391	Werrington Road (N)
		PM	1.01	33	C	222	Werrington Road (N)
I-25	Dunheved Road and John Oxley Avenue	AM	0.56	21	B	4	John Oxley Avenue (S)
		PM	12.00	20500	F	783	Dunheved Road (W)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	0.94	37	C	241	Dunheved Road (W)
		PM	0.92	38	C	330	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.88	8	A	53	Greenbank Drive (N)
		PM	0.71	6	A	37	Greenbank Drive (N)

The 2031 Base with hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) SIDRA analysis results are shown in Table 6.12.

Table 6.12 2031 Base intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.82	23	B	139	The Northern Road (NW)
		PM	0.91	28	B	176	The Northern Road (SE)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.84	40	C	270	The Northern Road (N)
		PM	0.81	37	C	263	The Northern Road (S)
I-07	The Northern Road and Andrews Road	AM	0.89	32	C	257	Richmond Road (S)
		PM	0.83	21	B	306	Richmond Road (S)
I-16	Palmyra Avenue and Forrester Road	AM	1.97	1356	F	3511	Forrester Road (SW)
		PM	1.96	1217	F	2897	Forrester Road (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	2.60	1809	F	5196	Forrester Road (S)
		PM	2.86	1805	F	3717	Forrester Road (S)
I-19	Forrester Road, Christie Street and Boronia Road	AM	4.42	2987	F	5340	Forrester Road (N)
		PM	3.98	3059	F	5491	Forrester Road (N)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	1.58	747	F	2137	Dunheved Road (W)
		PM	1.55	657	F	2664	Christie Street (E)

6.6 Network assessment summary

The Base SIDRA analysis results for years 2021, 2026 and 2031 are shown summarised in Figure 6.6, reflecting the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), scenarios. The summary illustrates the locations where LoS E or F are expected, highlighting a number of locations which are forecast to be overcapacity with the Base scenario.

Figure 6.6 Future base SIDRA summary results

ID	Intersection	Peak period	2021 Base		2026 Base		2031 Base	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-01	The Northern Road and Ninth Avenue	AM	C	B	D	B	F	B
		PM	B	B	C	B	F	B
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	C	C	C	C	D	C
		PM	C	C	C	C	C	C
I-05	The Northern Road and Jordan Springs Boulevard	AM	A		A		A	
		PM	B		A		B	
I-07	The Northern Road and Andrews Road	AM	B	B	B	B	C	C
		PM	B	B	B	B	B	B
I-08	Richmond Road and Trinity Drive	AM	F		F		F	
		PM	F		F		F	
I-10	Richmond Road and Dunheved Road	AM	B		B		C	
		PM	B		B		B	
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	B		B		B	
		PM	B		B		C	

ID	Intersection	Peak period	2021 Base		2026 Base		2031 Base	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-13	Great Western Highway and Parker Street	AM	D		F		F	
		PM	F		F		F	
I-15	Palmyra Avenue and Australis Drive	AM	A		B		B	
		PM	A		B		B	
I-16	Palmyra Avenue and Forrester Road	AM	B		F	F	F	F
		PM	B		F	F	F	F
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	C		F		F	F
		PM	B		F		F	F
I-19	Forrester Road, Christie Street and Boronia Road	AM	C		F		F	F
		PM	F		F		F	F
I-21	Great Western Highway and Glossop Street	AM	B		B		C	
		PM	B		B		B	
I-22	Christie Street, Lee Holm Road and Links Road	AM	-	-	-	-	-	-
		PM	-	-	-	-	-	-

ID	Intersection	Peak period	2021 Base		2026 Base		2031 Base	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	A		A		F	F
		PM	B		F		F	F
I-24	Werrington Road and Great Western Highway	AM	B		B		D	
		PM	B		B		C	
I-25	Dunheved Road and John Oxley Avenue	AM	B		B		B	
		PM	B		D		F	
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	C		C		C	
		PM	B		C		C	
I-27	Dunheved Road and Greenbank Drive (west)	AM	A		A		A	
		PM	A		A		A	
I-28	Jordan Springs Boulevard and Lakeside Parade	AM	B		B		B	
		PM	A		A		A	
I-29	Greenwood Parkway, Water Gum Drive and Discovery Way	AM	A		A		A	
		PM	A		A		A	

6.7 Summary

The future year Base assessment has been undertaken at years 2021, 2026 and 2031, with 2021 being the year of full completion, 2026 being 5 years after and 2031 being 10 years after. The Base assessment has been undertaken including the current development quantum which is in place in St Marys Development Site.

The Strategic Model has been used for the purpose of developing future year Base matrices for use with the AIMSUN AM and PM peak models. The AIMSUN modelling has been undertaken reflecting the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility). The AIMSUN turning volumes at key intersections have been exported to SIDRA for detailed intersection analysis which has been undertaken with base road network and hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility). It is seen that at the base years there are a number of intersections which are forecast to have LoS F, particularly at 2031.

7 FUTURE YEAR PROJECT NETWORK PERFORMANCE

7.1 Without rezoning scenario

The performance of the future year road network based on high level scenario 'without rezoning' is reported in this section of the report.

7.1.1 Network performance statistics

The network statistics based on the without rezoning scenario during the AM model period are shown in Table 7.1 while the PM model period is shown in Table 7.2. It is seen that at each assessment year, the Project scenarios result in an increase in vehicle kilometres travelled (VKT) and vehicle hours travelled (VHT) and also a marginal reduction in average network speed. The number of completed trips is shown, representing the increase in trips with the Project scenarios.

Table 7.1 Network statistics – without rezoning scenario AM (6.00 am–10.00 am)

Scenario	2021 Base	2021 project		2026 Base	2026 project		2031 Base	2031 project	
		Without Links Road	With Links Road		Without Links Road	With Links Road		Without Links Road	With Links Road
Vehicle Kilometres Travelled (VKT)	280,367	326,200	325,651	311,243	353,335	356,505	344,239	390,654	391,922
Vehicle Hours Travelled (VHT)	7,002	8,373	8,303	8,007	9,612	9,845	9,818	12,724	12,685
Average network speed	40	39	39	39	37	36	35	31	31
Completed trips	69,542	79,201	79,165	76,382	85,977	86,180	81,900	91,078	90,994
Incomplete trips	1,692	1,990	2,042	1,987	2,160	2,138	2,285	3,379	3,234
Unreleased trips	0	0	0	0	0	0	0	0	0
% Complete	98%	98%	98%	97%	98%	98%	97%	96%	97%

Table 7.2 Network statistics – without rezoning scenario PM (3.00 pm–7.00 pm)

Scenario	2021 Base	2021 project		2026 Base	2026 Project		2031 Base	2031 Project	
		Without Links Road	With Links Road		Without Links Road	With Links Road		Without Links Road	With Links Road
Vehicle Kilometres Travelled (VKT)	336,202	406,355	405,542	368,765	432,988	433,158	414,923	466,255	464,273
Vehicle Hours Travelled (VHT)	8,963	11,244	11,175	10,442	13,069	12,785	14,525	16,436	15,761
Average network speed	38	36	36	35	33	34	29	28	29
Completed trips	83,306	97,488	97,446	90,646	103,963	103,713	96,272	108,863	108,802
Incomplete trips	1,947	2,196	2,289	2,112	2,465	2,429	2,953	3,278	3,284
Unreleased trips	0	0	0	0	0	0	36	13	9
% Complete	98%	98%	98%	98%	98%	98%	97%	97%	97%

7.1.2 Key corridor travel times

The travel times along key corridors, based on the without rezoning scenario, during the AM peak hour are shown in Table 7.3. It is seen that Project travel times marginally increase compared with the base travel times on a number of corridors. The Northern Road (southbound) is seen to experience a high increase in travel time when the 2031 Project is compared with the 2031 Base, indicating the need for mitigation measures to be introduced.

The travel times during the PM peak hour are shown in Table 7.4 and generally demonstrate a similar trend to that observed during the AM peak hour.

Table 7.3 Travel time comparison – without rezoning AM (8.00 am–9.00 am)

Scenario		2021 Base	2021 project		2026 Base	2026 Project		2031 Base	2031 Project	
			Without Links Road	With Links Road		Without Links Road	With Links Road		Without Links Road	With Links Road
The Northern Rd	NB	07:59	08:11	08:17	08:13	08:12	08:17	08:24	09:33	09:33
The Northern Rd	SB	11:26	13:03	11:45	11:22	12:49	13:43	13:51	17:31	18:29
Glossop St - Forrester Rd	NB	07:35	07:58	07:54	09:30	09:49	10:58	09:24	11:16	12:23
Glossop St - Forrester Rd	SB	08:08	09:02	08:39	10:07	11:44	10:50	11:07	13:39	13:25
Dunheved Rd - Christine St	EB	08:08	08:08	08:39	08:07	08:35	09:51	12:05	11:33	12:38
Dunheved Rd - Christine St	WB	08:05	07:51	08:03	08:13	07:53	08:05	08:35	08:22	08:31
Werrington Rd	NB	02:25	02:24	02:25	02:28	02:28	02:27	03:55	04:16	04:28
Werrington Rd	SB	03:09	03:10	03:06	03:26	03:42	04:08	05:24	06:37	06:50

Table 7.4 Travel time comparison – without rezoning PM (5.00 pm–6.00 pm)

Scenario		2021 Base	2021 project		2026 Base	2026 Project		2031 Base	2031 Project	
			Without Links Road	With Links Road		Without Links Road	With Links Road		Without Links Road	With Links Road
The Northern Rd	NB	08:09	08:51	08:47	08:30	08:47	08:40	09:17	09:34	08:51
The Northern Rd	SB	09:21	09:54	09:59	12:27	15:45	14:42	22:19	24:06	22:01
Glossop St-Forrester Rd	NB	07:49	08:34	08:33	09:29	10:16	09:16	12:18	12:14	10:19
Glossop St-Forrester Rd	SB	08:02	09:10	08:23	08:36	11:59	09:50	11:40	11:55	13:47
Dunheved Rd-Christine St	EB	07:35	07:38	08:00	07:42	07:47	08:34	14:28	12:48	10:33
Dunheved Rd-Christine St	WB	08:28	08:45	09:13	09:06	09:31	09:46	10:43	11:00	10:27
Werrington Rd	NB	02:24	02:28	02:32	02:39	02:47	02:53	03:54	03:59	04:21
Werrington Rd	SB	02:38	02:45	02:44	02:55	03:32	03:09	07:00	08:32	07:04

7.1.3 Network plots

The delay plots at 2021 are shown in Figure 7.1, highlighting the AM and PM peak hour delay experienced with the Base and Project scenarios. It is seen that delay is generally not significant and there is only marginal worsening between the Base and Project scenarios.

The delay plots at 2026 are shown in Figure 7.2, highlighting the AM and PM peak hour delay experienced with the Base and Project scenarios. At 2026 the impact of the Project is becoming more significant, with the higher Base traffic volumes resulting in less available capacity to cater for the development traffic. The noticeable congestion hot spots are located along Forrester Road.

The delay plots at 2031 are shown in Figure 7.3, highlighting the AM and PM peak hour delay experienced with the Base and Project scenarios. The Base delay has worsened with relation to the 2021 Base and 2026 Base, and the impact of the development traffic is also more significant with higher number of locations experiencing higher delay.

The 2021 flow difference plots are shown in Figure 7.4, highlighting the AM and PM peak hour impact of Project without Links Road extension compared with Base, and also Project with Links Roads extension compared to Project without Links Road extension. The impact of the Project is demonstrated together with the impact of introducing Links road extension.

The 2026 flow difference plots are shown in Figure 7.5, highlighting the AM and PM peak hour impact of Project without Links Road extension compared with Base, and also Project with Links Roads extension compared to Project without Links Road extension.

The 2031 flow difference plots are shown in Figure 7.6, highlighting the AM and PM peak hour impact of Project without Links Road extension compared with Base, and also Project with Links Roads extension compared to Project without Links Road extension.

The introduction of Links Road extension creates an additional access point for development traffic. The model results indicate the flow changes in the western side of the modelled area are insignificant, particularly along The Northern Road. However, The Links Road extension will take a proportion of traffic away from Forrester Road/Ropes Crossing Boulevard/Links Road and Forrester Road/Christie Street/Boronia Road intersections.

2021 AM Base	2021 AM Project _No Rezoning _ No Links	2021 AM Project _No Rezoning _ With Links

2021 PM Base	2021 PM Project _No Rezoning _ No Links	2021 PM Project _No Rezoning _ With Links

Figure 7.1 Delay plots– without rezoning scenario 2021

2026 AM Base	2026 AM Project _No Rezoning _ No Links	2026 AM Project _No Rezoning _ With Links
		
2026 PM Base	**2026 PM Project _No Rezoning _ No Links**	**2026 PM Project _No Rezoning _ With Links**
		

Figure 7.2 Delay plots– without rezoning scenario 2026

2031 AM Base	2031 AM Project _No Rezoning _ No Links	2031 AM Project _No Rezoning _ With Links

2031 PM Base	2031 PM Project _No Rezoning _ No Links	2031 PM Project _No Rezoning _ With Links

Figure 7.3 Delay plots– without rezoning scenario 2031

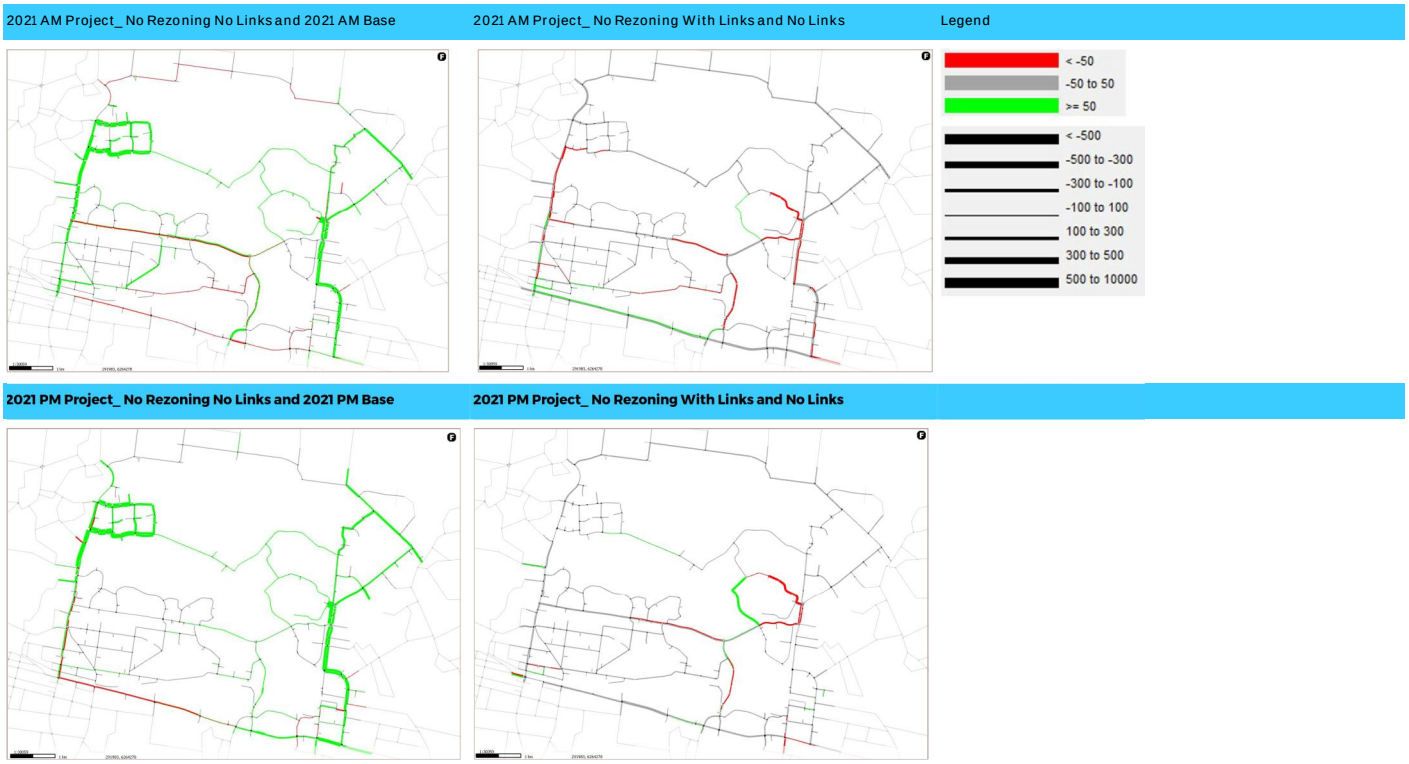


Figure 7.4 Flow difference plots– without rezoning scenario 2021

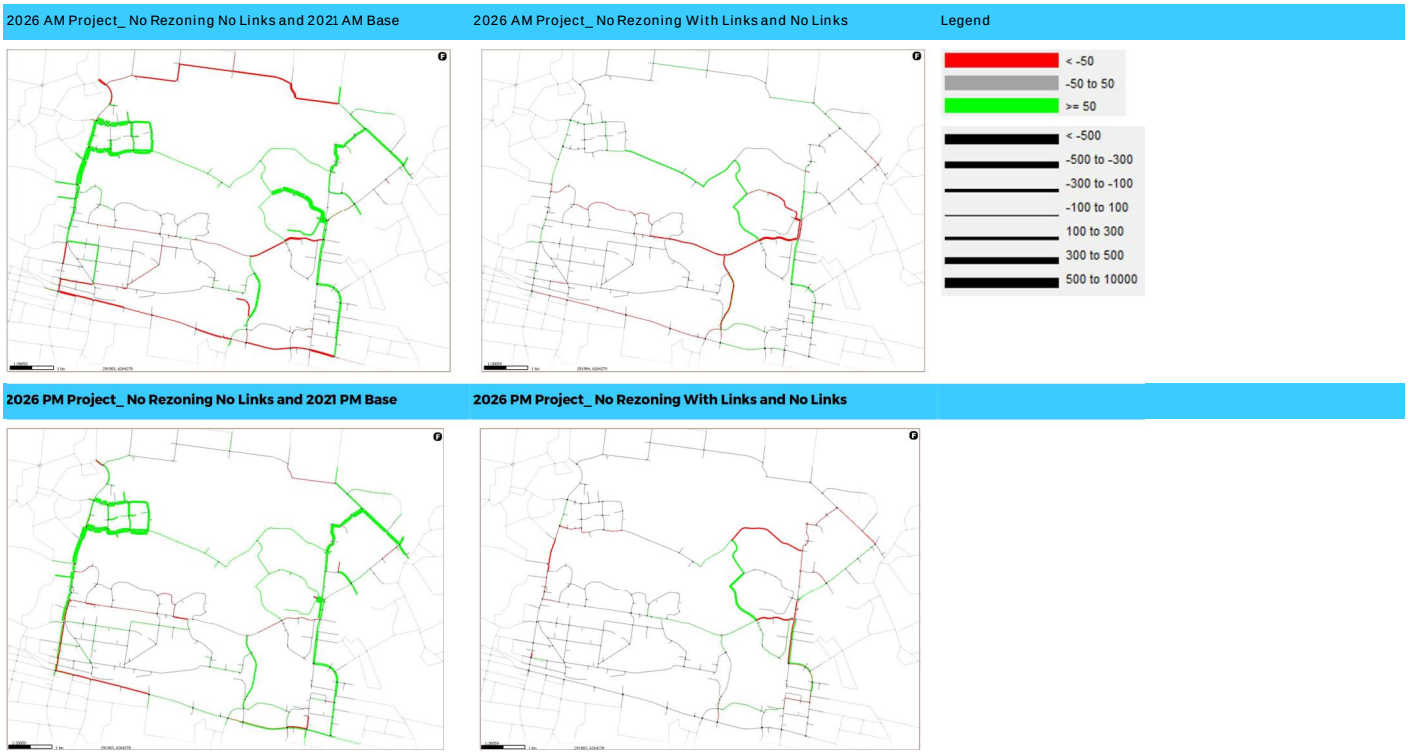
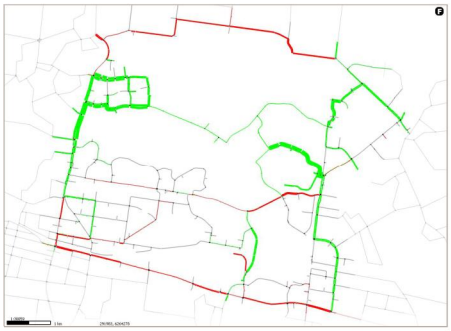
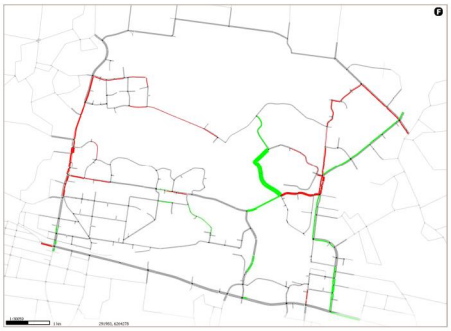


Figure 7.5 Flow difference plots– without rezoning scenario 2026

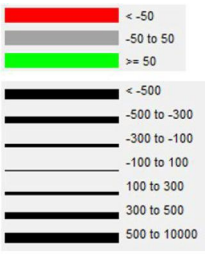
2031 AM Project_ No Rezoning No Links and 2021 AM Base



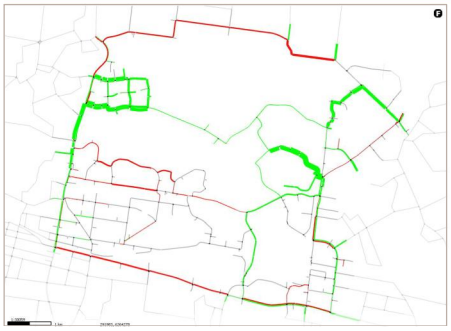
2031 AM Project_ No Rezoning With Links and No Links



Legend



2031 PM Project_ No Rezoning No Links and 2021 PM Base



2031 PM Project_ No Rezoning With Links and No Links

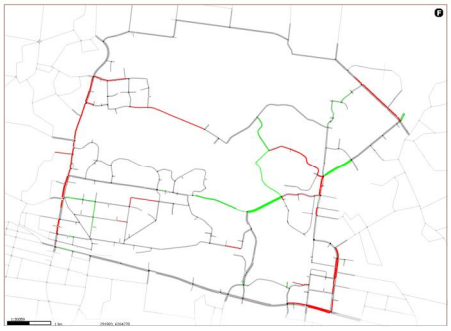


Figure 7.6 Flow difference plots – without rezoning scenario 2031

7.1.4 SIDRA assessment

This section contains the SIDRA analysis results based on the Project (with development) and 'without rezoning' scenario, undertaken at 2021, 2026 and 2031, for AM and PM peaks. There are with two sub scenarios for each assessment, which are 'without Links Road extension' and 'with Links Road extension'.

7.1.4.1 2021 without links road extension

The 2021 Project without rezoning, without Links Road extension, SIDRA analysis results are shown in Table 7.5.

Table 7.5 2021 Project without rezoning without Links Road extension intersection performance – base road network layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.87	25	B	247	The Northern Road (NW)
		PM	0.91	35	C	399	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.05	92	F	366	The Northern Road (N)
		PM	1.08	145	F	644	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.73	19	B	162	The Northern Road (N)
		PM	0.80	21	B	149	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.90	29	C	492	The Northern Road (N)
		PM	0.82	21	B	290	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	3.76	5520	F	288	Richmond Road (S)
		PM	0.93	229	F	49	Richmond Road (S)
I-10	Richmond Road and Dunheved Road	AM	0.89	29	C	453	Richmond Road (N)
		PM	0.80	25	B	180	Richmond Road (N)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.82	29	C	169	Richmond Road (N)
		PM	0.84	27	B	200	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.11	117	F	794	Parker Street (N)
		PM	1.13	129	F	496	Great Western Highway (E)
I-15	Palmyra Avenue and Australis Drive	AM	0.51	20	B	75	Palmyra Avenue (NW)
		PM	0.57	20	B	89	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	0.79	23	B	135	Palmyra Avenue (SE)
		PM	0.85	25	B	186	Palmyra Avenue (SE)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	1.70	1311	F	3169	Links Road (W)
		PM	1.99	1794	F	5667	Links Road (W)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.11	253	F	832	Forrester Road (S)
		PM	1.95	1749	F	3731	Forrester Road (S)
I-21	Great Western Highway and Glossop Street	AM	0.88	29	C	129	Great Western Highway (E)
		PM	0.90	21	B	106	Great Western Highway (E)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.61	13	A	49	Dunheved Road (W)
		PM	0.84	33	C	123	Werrington Road (S)
I-24	Werrington Road and Great Western Highway	AM	0.84	22	B	151	Werrington Road (N)
		PM	0.91	23	B	120	Great Western Highway (E)
I-25	Dunheved Road and John Oxley Avenue	AM	0.63	21	B	2	John Oxley Avenue (S)
		PM	0.69	29	C	6	John Oxley Avenue (S)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	0.95	40	C	255	Dunheved Road (W)
		PM	0.91	31	C	239	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.87	10	A	59	Greenbank Drive (N)
		PM	0.80	6	A	40	Greenbank Drive (N)

The 2021 Project without rezoning, without Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.6.

Table 7.6 2021 Project without rezoning without Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.61	18	B	88	The Northern Road (NW)
		PM	0.62	19	B	107	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.89	35	C	147	The Northern Road (N)
		PM	0.88	46	D	199	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.90	30	C	492	The Northern Road (N)
		PM	0.82	21	B	290	Richmond Road (S)

7.1.4.2 2021 with Links Road extension

The 2021 Project without rezoning, with Links Road extension, SIDRA analysis results are shown in Table 7.7.

Table 7.7 2021 Project without rezoning with Links Road extension intersection performance – base road network layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.87	25	B	246	The Northern Road (NW)
		PM	0.91	39	C	454	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.09	105	F	346	The Northern Road (N)
		PM	1.08	140	F	634	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.73	19	B	161	The Northern Road (N)
		PM	0.79	21	B	145	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.88	26	B	375	The Northern Road (N)
		PM	0.82	20	B	275	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	2.67	3424	F	243	Richmond Road (S)
		PM	0.85	234	F	33	Richmond Road (S)
I-10	Richmond Road and Dunheved Road	AM	0.88	28	B	412	Richmond Road (N)
		PM	0.75	24	B	173	Richmond Road (N)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.82	28	B	160	Richmond Road (N)
		PM	0.83	27	B	199	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.10	105	F	724	Parker Street (N)
		PM	1.13	121	F	528	Great Western Highway (E)
I-15	Palmyra Avenue and Australis Drive	AM	0.54	21	B	75	Palmyra Avenue (NW)
		PM	0.62	20	B	98	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	0.79	23	B	131	Palmyra Avenue (SE)
		PM	0.83	26	B	188	Palmyra Avenue (SE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	1.72	1333	F	2484	Ropes Crossing Boulevard (N)
		PM	1.90	1636	F	5074	Links Road (W)
I-19	Forrester Road, Christie Street and Boronia Road	AM	0.98	71	F	277	Forrester Road (S)
		PM	1.47	878	F	2395	Forrester Road (S)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-21	Great Western Highway and Glossop Street	AM	0.89	29	C	131	Great Western Highway (E)
		PM	0.89	22	B	124	Glossop Street (N)
I-22	Christie Street, Lee Holm Road and Links Road	AM	0.43	10	B	71	Christie Street (W)
		PM	0.50	12	B	91	Christie Street (E)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.58	13	A	46	Dunheved Road (W)
		PM	0.85	37	C	130	Werrington Road (S)
I-24	Werrington Road and Great Western Highway	AM	0.89	22	B	163	Werrington Road (N)
		PM	0.84	18	B	76	Great Western Highway (E)
I-25	Dunheved Road and John Oxley Avenue	AM	0.61	28	B	2	John Oxley Avenue (S)
		PM	0.69	31	C	5	John Oxley Avenue (S)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	0.94	36	C	218	Dunheved Road (W)
		PM	0.91	29	C	232	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.87	10	A	58	Greenbank Drive (N)
		PM	0.74	6	A	36	Greenbank Drive (N)

The 2021 Project without rezoning, with Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.8.

Table 7.8 2021 Project without rezoning with Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.60	18	B	86	The Northern Road (NW)
		PM	0.66	19	B	111	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.90	36	C	145	The Northern Road (N)
		PM	0.84	45	D	192	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.88	26	B	375	The Northern Road (N)
		PM	0.82	20	B	275	Richmond Road (S)

7.1.4.3 2026 without Links Road extension

The 2026 Project without rezoning, without Links Road extension, SIDRA analysis results are shown in Table 7.5.

Table 7.9 2026 Project without rezoning without Links Road extension intersection performance – base road network layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.91	32	C	358	The Northern Road (NW)
		PM	0.99	57	E	662	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.09	130	F	531	The Northern Road (N)
		PM	1.10	157	F	721	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.75	19	B	167	The Northern Road (N)
		PM	0.80	21	B	160	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.95	45	D	693	The Northern Road (N)
		PM	0.87	23	B	396	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	8.00	13350	F	496	Richmond Road (S)
		PM	1.10	1335	F	123	Richmond Road (S)
I-10	Richmond Road and Dunheved Road	AM	0.97	47	D	712	Richmond Road (N)
		PM	0.83	25	B	192	Richmond Road (S)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.81	28	B	199	Richmond Road (N)
		PM	0.85	31	C	259	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.09	97	F	679	Parker Street (N)
		PM	1.09	110	F	473	Parker Street (S)
I-15	Palmyra Avenue and Australis Drive	AM	0.67	21	B	82	Palmyra Avenue (SE)
		PM	0.95	30	C	235	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	1.35	394	F	1177	Palmyra Avenue (NW)
		PM	1.55	593	F	2695	Forrester Road (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	1.58	1056	F	3720	Forrester Road (S)
		PM	1.52	947	F	2797	Links Road (W)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.47	874	F	2188	Forrester Road (S)
		PM	2.32	2411	F	4605	Forrester Road (S)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-21	Great Western Highway and Glossop Street	AM	0.92	37	C	244	Great Western Highway (W)
		PM	0.89	21	B	109	Great Western Highway (E)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.82	19	B	120	Dunheved Road (W)
		PM	1.05	155	F	593	Werrington Road (S)
I-24	Werrington Road and Great Western Highway	AM	0.83	25	B	125	Werrington Road (N)
		PM	0.89	26	B	131	Werrington Road (N)
I-25	Dunheved Road and John Oxley Avenue	AM	0.70	30	C	3	John Oxley Avenue (S)
		PM	0.75	36	C	4	John Oxley Avenue (S)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	1.15	92	F	515	Francis Street (S)
		PM	0.89	35	C	284	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.88	8	A	53	Greenbank Drive (N)
		PM	0.74	5	A	35	Greenbank Drive (N)

The 2026 Project without rezoning, without Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.6.

Table 7.10 2026 Project without rezoning without Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.69	19	B	100	The Northern Road (NW)
		PM	0.74	21	B	123	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.08	126	F	504	The Northern Road (N)
		PM	1.01	90	F	521	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.95	45	D	693	The Northern Road (N)
		PM	0.87	23	B	396	Richmond Road (S)
I-16	Palmyra Avenue and Forrester Road	AM	1.50	730	F	1585	Palmyra Avenue (NW)
		PM	1.89	914	F	3242	Forrester Road (NE)

7.1.4.4 2026 with Links Road extension

The 2026 Project without rezoning, with Links Road extension, SIDRA analysis results are shown in Table 7.7.

Table 7.11 2026 Project without rezoning with Links Road extension intersection performance – base road network layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.93	36	C	400	The Northern Road (NW)
		PM	1.02	70	E	747	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.10	146	F	539	The Northern Road (N)
		PM	1.11	159	F	716	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.76	19	B	177	The Northern Road (N)
		PM	0.78	21	B	157	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.93	39	C	591	The Northern Road (N)
		PM	0.85	22	B	374	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	8.77	14697	F	577	Richmond Road (S)
		PM	0.97	3129	F	43	Richmond Road (S)
I-10	Richmond Road and Dunheved Road	AM	0.96	46	D	707	Richmond Road (N)
		PM	0.85	22	B	374	Richmond Road (S)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.82	28	B	200	Richmond Road (N)
		PM	0.89	30	C	238	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.05	87	F	687	Parker Street (N)
		PM	1.10	117	F	465	Parker Street (S)
I-15	Palmyra Avenue and Australis Drive	AM	0.66	20	B	79	Palmyra Avenue (SE)
		PM	0.91	27	B	195	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	1.33	404	F	1206	Palmyra Avenue (NW)
		PM	1.53	603	F	2572	Forrester Road (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	1.64	1188	F	2933	Forrester Road (S)
		PM	1.58	1063	F	2894	Forrester Road (S)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.23	451	F	1484	Forrester Road (S)
		PM	1.84	1537	F	3399	Forrester Road (S)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-21	Great Western Highway and Glossop Street	AM	0.90	37	C	252	Great Western Highway (W)
		PM	0.89	21	B	109	Great Western Highway (E)
I-22	Christie Street, Lee Holm Road and Links Road	AM	0.53	14	B	101	Christie Street (W)
		PM	0.62	17	B	118	Christie Street (E)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.69	14	A	73	Christie Street (E)
		PM	1.23	451	F	1452	Werrington Road (S)
I-24	Werrington Road and Great Western Highway	AM	0.93	28	B	215	Werrington Road (N)
		PM	0.89	22	B	105	Werrington Road (N)
I-25	Dunheved Road and John Oxley Avenue	AM	0.63	22	B	2	John Oxley Avenue (S)
		PM	0.79	51	D	7	John Oxley Avenue (S)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	0.97	41	C	242	Dunheved Road (W)
		PM	0.92	34	C	286	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.85	8	A	50	Greenbank Drive (N)
		PM	0.75	5	A	36	Greenbank Drive (N)

The 2026 Project without rezoning, with Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.8.

Table 7.12 2026 Project without rezoning with Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.72	20	B	104	The Northern Road (NW)
		PM	0.77	22	B	129	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.10	134	F	519	The Northern Road (N)
		PM	1.02	92	F	519	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.93	39	C	591	The Northern Road (N)
		PM	0.85	22	B	374	Richmond Road (S)
I-16	Palmyra Avenue and Forrester Road	AM	1.53	741	F	1713	Forrester Road (SW)
		PM	1.80	877	F	3200	Forrester Road (NE)

7.1.4.5 2031 without Links Road extension

The 2031 Project without rezoning, without Links Road extension, SIDRA analysis results are shown in Table 7.13.

Table 7.13 2031 Project without rezoning without Links Road extension intersection performance – base road network layouts

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	1.05	84	F	743	The Northern Road (NW)
		PM	1.07	107	F	954	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.12	187	F	649	The Northern Road (N)
		PM	1.11	177	F	754	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.80	19	B	199	The Northern Road (N)
		PM	0.84	22	B	172	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.99	76	F	838	The Northern Road (N)
		PM	1.02	67	E	1023	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	8.33	13926	F	534	Richmond Road (S)
		PM	1.62	10135	F	287	Richmond Road (S)
I-10	Richmond Road and Dunheved Road	AM	0.98	51	D	790	Richmond Road (N)
		PM	0.87	25	B	306	Richmond Road (S)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.89	30	C	228	Richmond Road (N)
		PM	0.91	35	C	276	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.09	107	F	725	Parker Street (N)
		PM	1.15	171	F	657	Parker Street (S)
I-15	Palmyra Avenue and Australis Drive	AM	0.85	23	B	142	Palmyra Avenue (SE)
		PM	1.19	136	F	1177	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	1.28	344	F	905	Forrester Road (SW)
		PM	1.12	157	F	536	Forrester Road (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	4.09	1369	F	2657	Forrester Road (S)
		PM	2.62	988	F	2202	Forrester Road (S)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.40	673	F	2070	Christie Street (W)
		PM	1.40	572	F	1613	Forrester Road (N)

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-21	Great Western Highway and Glossop Street	AM	0.89	39	C	279	Great Western Highway (W)
		PM	0.91	22	B	111	Glossop Street (N)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	1.65	725	F	2168	Dunheved Road (W)
		PM	1.60	727	F	2641	Christie Street (E)
I-24	Werrington Road and Great Western Highway	AM	1.05	51	D	445	Werrington Road (N)
		PM	1.16	59	E	518	Werrington Road (N)
I-25	Dunheved Road and John Oxley Avenue	AM	0.60	26	B	3	John Oxley Avenue (S)
		PM	2.35	2805	F	231	Dunheved Road (W)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	1.08	67	E	348	Francis Street (S)
		PM	0.87	31	C	250	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.90	8	A	49	Greenbank Drive (N)
		PM	0.81	6	A	41	Greenbank Drive (N)

The 2031 Project without rezoning, without Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.14.

Table 7.14 2031 Project without rezoning without Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.82	23	B	138	The Northern Road (SE)
		PM	0.86	25	B	141	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.13	164	F	706	The Northern Road (N)
		PM	1.02	96	F	494	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.99	76	F	838	The Northern Road (N)
		PM	1.02	67	E	1023	Richmond Road (S)
I-16	Palmyra Avenue and Forrester Road	AM	2.00	1302	F	3378	Forrester Road (SW)
		PM	1.89	1029	F	3344	Forrester Road (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	3.40	2613	F	4923	Forrester Road (S)
		PM	4.72	3139	F	5999	Forrester Road (S)

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-19	Forrester Road, Christie Street and Boronia Road	AM	4.86	3158	F	6145	Forrester Road (N)
		PM	4.40	2974	F	6736	Forrester Road (N)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	1.65	725	F	2168	Dunheved Road (W)
		PM	1.60	727	F	2641	Christie Street (E)

7.1.4.6 2031 with Links Road extension

The 2031 Project without rezoning, with Links Road extension, SIDRA analysis results are shown in Table 7.15.

Table 7.15 2031 Project without rezoning with Links Road extension intersection performance – base road network layouts

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	1.09	96	F	796	The Northern Road (NW)
		PM	1.04	91	F	875	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.12	177	F	677	The Northern Road (N)
		PM	1.12	168	F	777	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.75	17	B	172	The Northern Road (N)
		PM	0.81	22	B	164	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.94	50	D	600	The Northern Road (N)
		PM	0.94	26	B	450	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	8.47	14189	F	549	Richmond Road (S)
		PM	2.36	9620	F	387	Trinity Drive (E)
I-10	Richmond Road and Dunheved Road	AM	0.94	38	C	643	Richmond Road (N)
		PM	0.81	23	B	241	Richmond Road (S)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.87	29	C	221	Richmond Road (N)
		PM	0.90	33	C	252	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.08	103	F	753	Parker Street (N)
		PM	1.14	144	F	541	Parker Street (S)
I-15	Palmyra Avenue and Australis Drive	AM	0.77	22	B	113	Palmyra Avenue (SE)
		PM	1.14	131	F	1161	Palmyra Avenue (SE)

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-16	Palmyra Avenue and Forrester Road	AM	1.35	435	F	1082	Palmyra Avenue (NW)
		PM	1.12	165	F	516	Forrester Road (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	1.97	684	F	1854	Forrester Road (S)
		PM	2.77	1132	F	2066	Links Road (W)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.28	475	F	1214	Christie Street (W)
		PM	1.34	494	F	1458	Forrester Road (N)
I-21	Great Western Highway and Glossop Street	AM	1.16	87	F	491	Great Western Highway (E)
		PM	0.90	25	B	125	Great Western Highway (E)
I-22	Christie Street, Lee Holm Road and Links Road	AM	1.05	92	F	811	Christie Street (W)
		PM	0.65	14	B	131	Christie Street (E)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	1.68	808	F	2303	Dunheved Road (W)
		PM	1.72	852	F	3201	Christie Street (E)
I-24	Werrington Road and Great Western Highway	AM	1.08	53	D	477	Werrington Road (N)
		PM	1.24	75	F	674	Werrington Road (N)
I-25	Dunheved Road and John Oxley Avenue	AM	0.60	25	B	3	John Oxley Avenue (S)
		PM	2.31	2712	F	233	Dunheved Road (W)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	1.36	156	F	751	Francis Street (S)
		PM	0.94	31	C	287	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.74	8	A	42	Greenbank Drive (N)
		PM	0.69	6	A	33	Greenbank Drive (N)

The 2031 Project without rezoning, with Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.16.

Table 7.16 2031 Project without rezoning with Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.83	23	B	137	The Northern Road (SE)
		PM	0.83	23	B	138	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.12	149	F	632	The Northern Road (N)
		PM	0.99	79	F	452	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.94	50	D	600	The Northern Road (N)
		PM	0.92	26	B	440	Richmond Road (S)
I-16	Palmyra Avenue and Forrester Road	AM	2.06	1443	F	3519	Forrester Road (SW)
		PM	1.92	1051	F	3301	Forrester Road (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	4.34	2684	F	4307	Forrester Road (S)
		PM	6.02	3932	F	4844	Forrester Road (S)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.28	475	F	1214	Christie Street (W)
		PM	4.24	3071	F	6727	Forrester Road (N)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	1.68	808	F	2303	Dunheved Road (W)
		PM	1.72	852	F	3201	Christie Street (E)

7.2 With rezoning scenario

The performance of the future year road network based on high level scenario 'with rezoning' is reported in this section of the report.

7.2.1 Network performance statistics

The network statistics based on the with rezoning scenario during the AM peak are shown in Table 7.17 while the PM peak is shown in Table 7.18. It is seen that at each assessment year, the Project scenarios result in an increase in vehicle kilometres travelled (VKT) and vehicle hours travelled (VHT) and also a marginal reduction in average network speed. The number of completed trips is shown, representing the increase in trips with the Project scenarios.

Table 7.17 Network statistics – with rezoning scenario AM (6.00 am–10.00 am)

Scenario	2021 Base	2021 project		2026 Base	2026 Project		2031 Base	2031 Project	
		Without Links Road	With Links Road		Without Links Road	With Links Road		Without Links Road	With Links Road
Vehicle Kilometres Travelled (VKT)	280,367	323,248	323,609	311,243	351,701	351,943	344,239	388,750	386,750
Vehicle Hours Travelled (VHT)	7,002	8,251	8,284	8,007	9,729	9,613	9,818	12,780	12,679
Average network speed	40	39	39	39	36	37	35	30	31
Completed trips	69,542	78,754	78,818	76,382	85,763	85,481	81,900	90,743	90,301
Incomplete trips	1,692	1,998	1,976	1,987	2,168	2,215	2,285	3,363	3,450
Unreleased trips	0	0	0	0	0	0	0	0	0
% Complete	98%	98%	98%	97%	98%	97%	97%	96%	96%

Table 7.18 Network statistics– with rezoning scenario PM (3.00 pm–7.00 pm)

Scenario	2021 Base	2021 project		2026 Base	2026 Project		2031 Base	2031 Project	
		Without Links Road	With Links Road		Without Links Road	With Links Road		Without Links Road	With Links Road
Vehicle Kilometres Travelled (VKT)	336,202	407,378	406,178	368,765	433,651	435,414	414,923	463,316	467,046
Vehicle Hours Travelled (VHT)	8,963	11,393	11,231	10,442	12,941	12,857	14,525	16,382	15,815
Average network speed	38	36	36	35	34	34	29	28	30
Completed trips	83,306	97,613	97,361	90,646	104,141	104,092	96,272	108,473	109,134
Incomplete trips	1,947	2,306	2,285	2,112	2,378	2,438	2,953	3,516	3,012
Unreleased trips	1	1	1	0	0	0	36	85	64
% Complete	98%	98%	98%	98%	98%	98%	97%	97%	97%

7.2.2 Key Corridor travel times

The travel times along key corridors, based on the with rezoning scenario, during the AM peak are shown in Table 7.19. It is seen that Project travel times marginally increase compared with the base travel times on a number of corridors. The Northern Road (southbound) is seen to experience a high increase in travel time when the 2031 Project is compared with the 2031 Base, indicating the need for mitigation measures to be introduced.

The travel times during the PM peak are shown in Table 7.20 and generally demonstrate a similar trend to that observed during the AM peak.

Table 7.19 Travel time comparison – with rezoning scenario AM (8.00 am–9.00 am)

Scenario		2021 Base	2021 project		2026 Base	2026 Project		2031 Base	2031 Project	
			Without Links Road	With Links Road		Without Links Road	With Links Road		Without Links Road	With Links Road
The Northern Rd	NB	07:59	07:58	07:59	08:13	07:59	08:09	08:24	09:08	08:36
The Northern Rd	SB	11:26	12:35	11:58	11:22	14:08	12:45	13:51	19:14	19:17
Glossop St - Forrester Rd	NB	07:35	08:02	07:59	09:30	09:43	11:05	09:24	11:55	13:06
Glossop St - Forrester Rd	SB	08:08	09:02	08:37	10:07	11:45	10:19	11:07	14:06	14:11
Dunheved Rd - Christine St	EB	08:08	08:09	08:45	08:07	08:39	09:41	12:05	11:27	12:10
Dunheved Rd - Christine St	WB	08:05	07:51	07:59	08:13	07:58	08:08	08:35	08:24	08:30
Werrington Rd	NB	02:25	02:23	02:22	02:28	02:30	02:28	03:55	04:02	04:07
Werrington Rd	SB	03:09	03:07	03:08	03:26	04:31	03:55	05:24	07:34	07:29

Table 7.20 Travel time comparison – with rezoning scenario PM (5.00 pm–6.00 pm)

Scenario		2021 Base	2021 project		2026 Base	2026 Project		2031 Base	2031 Project	
			Without Links Road	With Links Road		Without Links Road	With Links Road		Without Links Road	With Links Road
The Northern Rd	NB	08:09	09:12	08:45	08:30	08:46	08:59	09:17	10:01	09:01
The Northern Rd	SB	09:21	09:52	11:10	12:27	15:27	14:27	22:19	21:42	21:14
Glossop St - Forrester Rd	NB	07:49	08:28	08:43	09:29	10:19	09:10	12:18	13:46	12:54
Glossop St - Forrester Rd	SB	08:02	08:33	08:22	08:36	11:58	10:35	11:40	11:09	12:18
Dunheved Rd - Christine St	EB	07:35	07:35	08:16	07:42	07:56	10:09	14:28	09:03	10:56
Dunheved Rd - Christine St	WB	08:28	08:47	09:04	09:06	09:31	10:07	10:43	11:43	10:40
Werrington Rd	NB	02:24	02:39	02:37	02:39	02:59	03:08	03:54	04:00	04:16
Werrington Rd	SB	02:38	02:43	02:41	02:55	03:26	03:28	07:00	07:23	07:21

7.2.3 Network plots

The delay plots at 2021 are shown in Figure 7.7, highlighting the AM and PM peak delay experienced with the Base and Project scenarios. It is seen that delay is generally not significant and there is only marginal worsening between the Base and Project scenarios.

The delay plots at 2026 are shown in Figure 7.8, highlighting the AM and PM peak delay experienced with the Base and Project scenarios. At 2026 the impact of the Project is becoming more significant, with the higher Base traffic volumes resulting in less available capacity to cater for the development traffic.

The delay plots at 2031 are shown in Figure 7.9, highlighting the AM and PM peak delay experienced with the Base and Project scenarios. The Base delay has worsened with relation to the 2021 Base and 2026 Base, and the impact of the development traffic is also more significant with higher number of locations experiencing higher delay.

The 2021 flow difference plots are shown in Figure 7.10, highlighting the AM and PM peak impact of Project without Links Road extension compared with Base, and also Project with Links Roads extension compared to Project without Links Road extension. The impact of the Project is demonstrated together with the impact of introducing Links road extension.

The 2026 flow difference plots are shown in Figure 7.11, highlighting the AM and PM peak impact of Project without Links Road extension compared with Base, and also Project with Links Roads extension compared to Project without Links Road extension.

The 2031 flow difference plots are shown in Figure 7.12, highlighting the AM and PM peak impact of Project without Links Road extension compared with Base, and also Project with Links Roads extension compared to Project without Links Road extension.

2021 AM Base	2021 AM Project _With Rezoning _ No Links	2021 AM Project _With Rezoning _ With Links
		
2021 PM Base	**2021 PM Project _With Rezoning _ No Links**	**2021 PM Project _With Rezoning _ With Links**
		

Figure 7.7 Delay plots– with rezoning scenario 2021

2026 AM Base	2026 AM Project _With Rezoning _ No Links	2026 AM Project _With Rezoning _ With Links
		
2026 PM Base	**2026 PM Project _With Rezoning _ No Links**	**2026 PM Project _With Rezoning _ With Links**
		

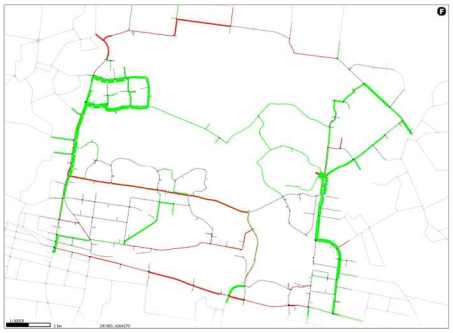
Figure 7.8 Delay plots - with rezoning scenario 2026

2031 AM Base	2031 AM Project _With Rezoning _ No Links	2031 AM Project _With Rezoning _ With Links

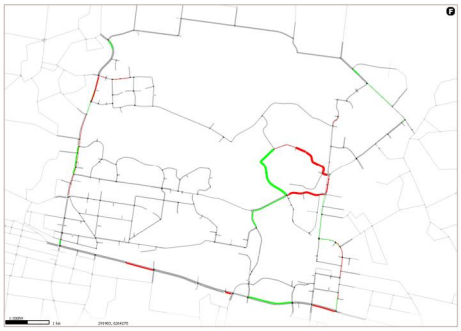
2031 PM Base	2031 PM Project _With Rezoning _ No Links	2031 PM Project _With Rezoning _ With Links

Figure 7.9 Delay plots - with rezoning scenario 2031

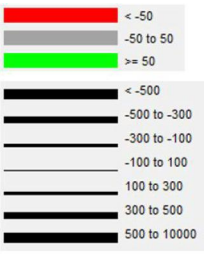
2021 AM Project_ With Rezoning No Links and 2021 AM Base



2021 AM Project_ With Rezoning With Links and No Links



Legend



2021 PM Project_ With Rezoning No Links and 2021 PM Base

2021 PM Project_ With Rezoning With Links and No Links

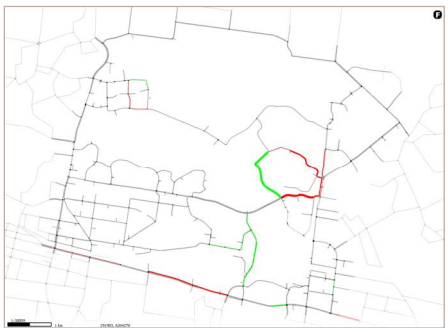
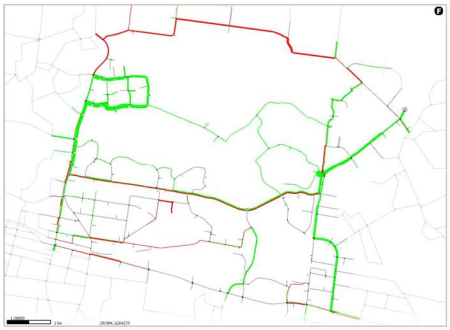
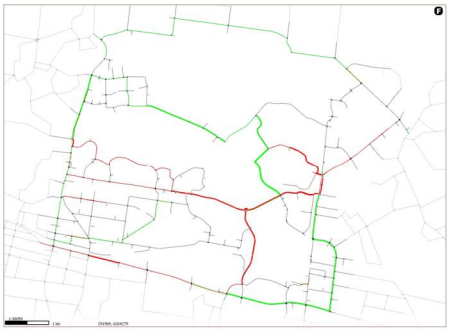


Figure 7.10 Flow difference plots - with rezoning scenario 2021

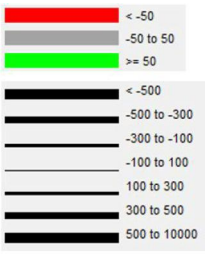
2026 AM Project_ With Rezoning No Links and 2021 AM Base



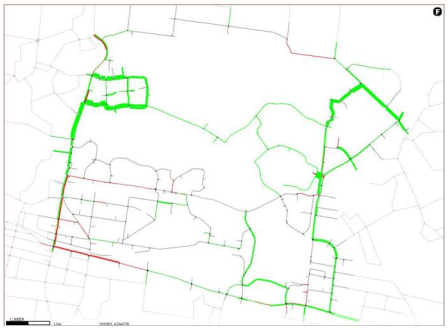
2026 AM Project_ With Rezoning With Links and No Links



Legend



2026 PM Project_ With Rezoning No Links and 2021 PM Base



2026 PM Project_ With Rezoning With Links and No Links

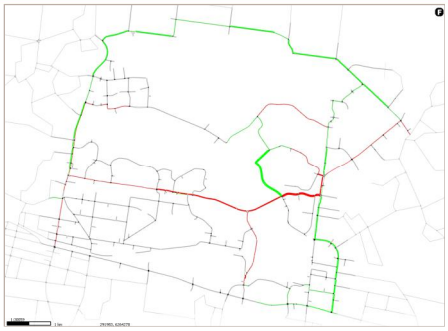
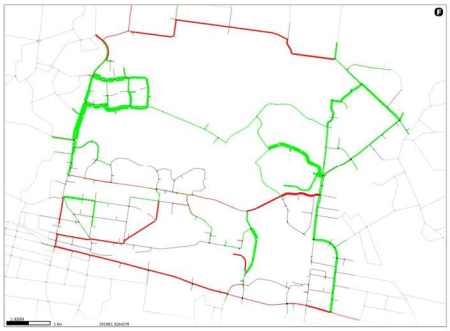
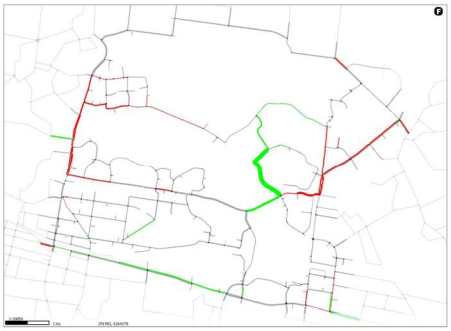


Figure 7.11 Flow different plots - with rezoning scenario 2026

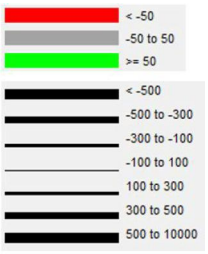
2031 AM Project_ No Rezoning With Links and 2021 AM Base



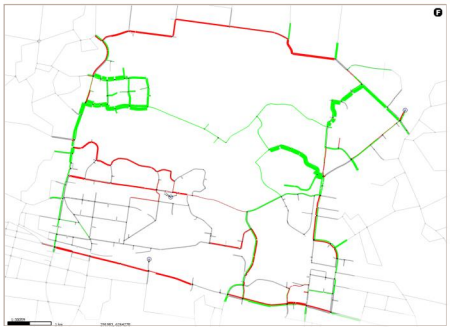
2031 AM Project_ With Rezoning With Links and No Links



Legend



2031 PM Project_ With Rezoning No Links and 2021 PM Base



2031 PM Project_ With Rezoning With Links and No Links

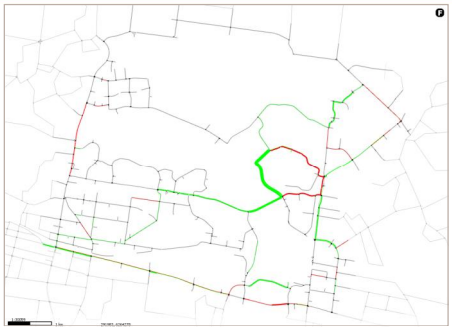


Figure 7.12 Flow difference plots - with rezoning scenario 2031

7.2.4 SIDRA assessment

This section contains the SIDRA analysis results based on the Project (with development) and 'with rezoning' scenario, undertaken at 2021, 2026 and 2026, for AM and PM peaks. There are with two sub-scenarios for each assessment, which are 'without Links Road extension' and 'with Links Road extension'.

Please note that results of the intersection performance table following is due to both the developments traffic and background traffic growth.

7.2.4.1 2021 without Links Road extension

The 2021 Project with rezoning, without Links Road extension, SIDRA analysis results are shown in Table 7.21.

Table 7.21 2021 Project with rezoning without Links Road extension intersection performance – base road network layout

ID	Intersection	Peak period	DoS	Average delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.86	22	B	195	The Northern Road (NW)
		PM	0.92	41	C	457	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.99	54	D	231	The Northern Road (N)
		PM	1.10	162	F	669	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.75	19	B	164	The Northern Road (N)
		PM	0.81	22	B	152	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.90	28	B	442	The Northern Road (N)
		PM	0.84	21	B	311	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	3.67	5723	F	247	Richmond Road (S)
		PM	0.80	207	F	29	Richmond Road (S)
I-10	Richmond Road and Dunheved Road	AM	0.89	28	B	447	Richmond Road (N)
		PM	0.82	24	B	175	Richmond Road (N)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.78	28	B	175	Richmond Road (N)
		PM	0.87	29	C	213	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.10	109	F	764	Parker Street (N)
		PM	1.13	137	F	552	Great Western Highway (E)
I-15	Palmyra Avenue and Australis Drive	AM	0.50	20	B	69	Palmyra Avenue (NW)
		PM	0.60	20	B	96	Palmyra Avenue (SE)

ID	Intersection	Peak period	DoS	Average delay (s)	LoS	Queue (m)	Approach with worst queue
I-16	Palmyra Avenue and Forrester Road	AM	0.76	23	B	127	Palmyra Avenue (SE)
		PM	0.83	24	B	177	Palmyra Avenue (SE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	1.60	1123	F	3314	Links Road (W)
		PM	1.84	1531	F	4818	Links Road (W)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.10	236	F	740	Forrester Road (S)
		PM	1.92	1684	F	3706	Forrester Road (S)
I-21	Great Western Highway and Glossop Street	AM	0.88	30	C	131	Great Western Highway (W)
		PM	0.89	22	B	131	Great Western Highway (W)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.57	13	A	46	Christie Street (E)
		PM	0.86	35	C	131	Werrington Road (S)
I-24	Werrington Road and Great Western Highway	AM	0.89	23	B	166	Werrington Road (N)
		PM	0.87	19	B	84	Great Western Highway (E)
I-25	Dunheved Road and John Oxley Avenue	AM	0.60	19	B	1	John Oxley Avenue (S)
		PM	0.70	30	C	5	John Oxley Avenue (S)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	0.91	35	C	222	Dunheved Road (W)
		PM	0.89	30	C	217	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.85	10	A	56	Greenbank Drive (N)
		PM	0.82	7	A	41	Greenbank Drive (N)

The 2021 Project with rezoning, without Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.22.

Table 7.22 2021 Project with rezoning without Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.59	18	B	81	The Northern Road (NW)
		PM	0.65	20	B	111	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.99	52	D	231	The Northern Road (N)
		PM	1.00	89	F	464	The Northern Road (N)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-07	The Northern Road and Andrews Road	AM	0.90	28	B	442	The Northern Road (N)
		PM	0.84	21	B	311	Richmond Road (S)

7.2.4.2 2021 with Links Road extension

The 2021 Project with rezoning, with Links Road extension, SIDRA analysis results are shown in Table 7.23.

Table 7.23 2021 Project with rezoning with Links Road extension intersection performance – base road network layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.86	22	B	197	The Northern Road (NW)
		PM	0.92	40	C	462	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.03	85	F	317	The Northern Road (N)
		PM	1.11	161	F	690	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.71	19	B	153	The Northern Road (N)
		PM	0.79	21	B	144	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.87	25	B	382	The Northern Road (N)
		PM	0.82	21	B	293	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	3.18	4339	F	301	Richmond Road (S)
		PM	0.89	523	F	26	Richmond Road (S)
I-10	Richmond Road and Dunheved Road	AM	0.87	27	B	405	Richmond Road (N)
		PM	0.82	24	B	168	Richmond Road (N)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.81	28	B	159	Richmond Road (N)
		PM	0.87	29	C	212	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.10	107	F	740	Parker Street (N)
		PM	1.13	129	F	558	Great Western Highway (E)
I-15	Palmyra Avenue and Australis Drive	AM	0.51	20	B	77	Palmyra Avenue (NW)
		PM	0.59	20	B	91	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	0.79	24	B	135	Palmyra Avenue (SE)
		PM	0.83	25	B	184	Palmyra Avenue (SE)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	1.55	1041	F	2426	Links Road (W)
		PM	1.78	1428	F	4536	Links Road (W)
I-19	Forrester Road, Christie Street and Boronia Road	AM	0.98	53	D	191	Forrester Road (S)
		PM	1.51	946	F	2550	Forrester Road (S)
I-21	Great Western Highway and Glossop Street	AM	0.90	30	C	139	Great Western Highway (E)
		PM	0.90	23	B	131	Great Western Highway (W)
I-22	Christie Street, Lee Holm Road and Links Road	AM	0.50	14	B	90	Christie Street (W)
		PM	0.50	12	B	91	Christie Street (E)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.61	13	A	53	Christie Street (E)
		PM	0.91	51	D	176	Werrington Road (S)
I-24	Werrington Road and Great Western Highway	AM	0.89	22	B	165	Werrington Road (N)
		PM	0.87	19	B	81	Great Western Highway (E)
I-25	Dunheved Road and John Oxley Avenue	AM	0.60	21	B	1	John Oxley Avenue (S)
		PM	0.66	27	B	6	John Oxley Avenue (S)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	0.93	37	C	223	Dunheved Road (W)
		PM	0.93	31	C	231	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.86	11	A	62	Greenbank Drive (N)
		PM	0.74	6	A	36	Greenbank Drive (N)

The 2021 Project with rezoning, with Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.24.

Table 7.24 2021 Project with rezoning with Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.60	18	B	81	The Northern Road (NW)
		PM	0.65	19	B	112	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.05	82	F	293	The Northern Road (N)
		PM	1.00	89	F	483	The Northern Road (N)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-07	The Northern Road and Andrews Road	AM	0.87	25	B	382	The Northern Road (N)
		PM	0.82	21	B	293	Richmond Road (S)

7.2.4.3 2026 without Links Road extension

The 2026 Project with rezoning, without Links Road extension, SIDRA analysis results are shown in Table 7.25.

Table 7.25 2026 Project with rezoning without Links Road extension intersection performance – base road network layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.89	25	B	259	The Northern Road (NW)
		PM	0.96	53	D	587	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.03	79	F	343	The Northern Road (N)
		PM	1.08	150	F	667	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.72	20	B	159	The Northern Road (N)
		PM	0.81	22	B	164	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.95	44	D	692	The Northern Road (N)
		PM	0.86	23	B	380	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	7.50	12457	F	462	Richmond Road (S)
		PM	2.00	4116	F	279	Trinity Drive (E)
I-10	Richmond Road and Dunheved Road	AM	0.98	52	D	750	Richmond Road (N)
		PM	0.84	25	B	192	Richmond Road (N)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.80	28	B	208	Richmond Road (N)
		PM	0.89	30	C	236	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.08	101	F	723	Parker Street (N)
		PM	1.09	118	F	531	Parker Street (S)
I-15	Palmyra Avenue and Australis Drive	AM	0.59	21	B	72	Palmyra Avenue (NW)
		PM	0.92	29	C	250	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	1.35	381	F	1136	Palmyra Avenue (NW)
		PM	1.49	614	F	2500	Forrester Road (NE)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	1.50	920	F	3616	Forrester Road (S)
		PM	1.78	1427	F	3759	Forrester Road (S)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.32	620	F	1604	Forrester Road (S)
		PM	2.39	2536	F	4824	Forrester Road (S)
I-21	Great Western Highway and Glossop Street	AM	0.91	29	C	127	Great Western Highway (E)
		PM	0.89	20	B	108	Great Western Highway (E)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.78	18	B	101	Christie Street (E)
		PM	1.18	356	F	1228	Werrington Road (S)
I-24	Werrington Road and Great Western Highway	AM	0.83	24	B	125	Werrington Road (N)
		PM	0.89	24	B	117	Werrington Road (N)
I-25	Dunheved Road and John Oxley Avenue	AM	0.67	27	B	2	John Oxley Avenue (S)
		PM	0.78	57	E	7	Dunheved Road (W)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	1.11	73	F	415	Francis Street (S)
		PM	0.93	40	C	357	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.85	7	A	44	Greenbank Drive (N)
		PM	0.79	6	A	39	Greenbank Drive (N)

The 2026 Project with rezoning, without Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.26.

Table 7.26 2026 Project with rezoning without Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.66	18	B	92	The Northern Road (NW)
		PM	0.70	20	B	119	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.02	77	F	352	The Northern Road (N)
		PM	1.00	86	F	490	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.95	44	D	692	The Northern Road (N)
		PM	0.86	23	B	380	Richmond Road (S)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-16	Palmyra Avenue and Forrester Road	AM	1.60	862	F	1655	Forrester Road (SW)
		PM	1.75	887	F	3158	Forrester Road (NE)

7.2.4.4 2026 with Links Road extension

The 2026 Project with rezoning, with Links Road extension, SIDRA analysis results are shown in Table 7.27.

Table 7.27 2026 Project with rezoning with Links Road extension intersection performance – base road network layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.92	32	C	335	The Northern Road (NW)
		PM	1.02	77	F	835	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.04	98	F	389	The Northern Road (N)
		PM	1.09	151	F	694	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.70	19	B	151	The Northern Road (N)
		PM	0.80	21	B	158	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.91	34	C	506	The Northern Road (N)
		PM	0.94	26	B	439	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	5.52	8710	F	421	Richmond Road (S)
		PM	1.27	6782	F	97	Trinity Drive (E)
I-10	Richmond Road and Dunheved Road	AM	0.95	40	C	633	Richmond Road (N)
		PM	0.78	23	B	201	Richmond Road (S)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.81	28	B	197	Richmond Road (N)
		PM	0.90	31	C	248	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.06	82	F	635	Parker Street (N)
		PM	1.10	114	F	493	Parker Street (S)
I-15	Palmyra Avenue and Australis Drive	AM	0.63	21	B	74	Palmyra Avenue (NW)
		PM	1.00	43	D	355	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	1.30	384	F	1173	Palmyra Avenue (NW)
		PM	1.57	593	F	2589	Forrester Road (NE)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	1.54	1028	F	2919	Forrester Road (S)
		PM	1.66	1214	F	3383	Forrester Road (S)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.32	617	F	1820	Forrester Road (S)
		PM	1.96	1757	F	4048	Forrester Road (S)
I-21	Great Western Highway and Glossop Street	AM	0.92	35	C	224	Great Western Highway (W)
		PM	0.91	22	B	119	Great Western Highway (E)
I-22	Christie Street, Lee Holm Road and Links Road	AM	0.53	13	B	100	Christie Street (W)
		PM	0.57	16	B	111	Christie Street (E)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.71	14	A	78	Christie Street (E)
		PM	1.18	368	F	1245	Werrington Road (S)
I-24	Werrington Road and Great Western Highway	AM	0.86	23	B	128	Werrington Road (N)
		PM	0.93	31	C	149	Great Western Highway (E)
I-25	Dunheved Road and John Oxley Avenue	AM	0.60	21	B	2	John Oxley Avenue (S)
		PM	0.80	69	E	9	Dunheved Road (W)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	0.90	34	C	208	Dunheved Road (W)
		PM	0.90	36	C	332	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.91	8	A	50	Greenbank Drive (N)
		PM	0.73	6	A	35	Greenbank Drive (N)

The 2026 Project with rezoning, with Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.28.

Table 7.28 2026 Project with rezoning with Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.68	20	B	100	The Northern Road (NW)
		PM	0.77	23	B	139	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.04	90	F	389	The Northern Road (N)
		PM	0.99	83	F	479	The Northern Road (N)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-07	The Northern Road and Andrews Road	AM	0.91	34	C	506	The Northern Road (N)
		PM	0.94	26	B	439	Richmond Road (S)
I-16	Palmyra Avenue and Forrester Road	AM	2.37	924	F	1716	Palmyra Avenue (NW)
		PM	2.01	934	F	2967	Forrester Road (NE)

7.2.4.5 2031 without Links Road extension

The 2031 Project with rezoning, without Links Road extension, SIDRA analysis results are shown in Table 7.29.

Table 7.29 2031 Project with rezoning without Links Road extension intersection performance – base road network layouts

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	1.03	71	F	646	The Northern Road (NW)
		PM	1.07	110	F	981	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.16	187	F	868	The Northern Road (S)
		PM	1.12	160	F	710	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.76	18	B	175	The Northern Road (N)
		PM	0.82	21	B	165	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.97	58	E	842	The Northern Road (N)
		PM	1.00	59	E	928	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	8.83	14817	F	568	Richmond Road (S)
		PM	1.14	7592	F	174	Richmond Road (S)
I-10	Richmond Road and Dunheved Road	AM	0.93	32	C	497	Richmond Road (N)
		PM	0.86	26	B	296	Richmond Road (S)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.90	31	C	205	Richmond Road (N)
		PM	0.88	31	C	252	Parker Street (S)

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-13	Great Western Highway and Parker Street	AM	1.08	104	F	726	Parker Street (N)
		PM	1.17	187	F	694	Parker Street (S)
I-15	Palmyra Avenue and Australis Drive	AM	0.70	20	B	102	Palmyra Avenue (SE)
		PM	1.15	134	F	1269	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	1.35	413	F	953	Palmyra Avenue (NW)
		PM	1.14	180	F	552	Forrester Road (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	2.06	703	F	2113	Forrester Road (S)
		PM	2.71	985	F	2100	Forrester Road (S)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.39	618	F	1759	Forrester Road (N)
		PM	1.41	655	F	1534	Forrester Road (S)
I-21	Great Western Highway and Glossop Street	AM	1.02	59	E	371	Great Western Highway (W)
		PM	0.91	23	B	122	Great Western Highway (E)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	1.64	708	F	2111	Dunheved Road (W)
		PM	1.57	716	F	2526	Christie Street (E)
I-24	Werrington Road and Great Western Highway	AM	1.09	56	D	512	Werrington Road (N)
		PM	1.02	36	C	237	Werrington Road (N)
I-25	Dunheved Road and John Oxley Avenue	AM	0.61	21	B	2	John Oxley Avenue (S)
		PM	5.65	9054	F	387	Dunheved Road (W)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	1.23	119	F	600	Francis Street (S)
		PM	0.89	32	C	275	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.87	9	A	45	Greenbank Drive (N)
		PM	0.77	6	A	38	Greenbank Drive (N)

The 2031 Project with rezoning, without Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.30.

Table 7.30 2031 Project with rezoning without Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.83	22	B	145	The Northern Road (SE)
		PM	0.83	25	B	148	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.12	175	F	586	The Northern Road (N)
		PM	1.00	87	F	471	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.97	58	E	842	The Northern Road (N)
		PM	1.00	58	E	928	Richmond Road (S)
I-16	Palmyra Avenue and Forrester Road	AM	2.02	1383	F	3356	Forrester Road (SW)
		PM	1.90	1097	F	3379	Forrester Road (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	4.25	2766	F	4916	Forrester Road (S)
		PM	4.79	3494	F	6742	Forrester Road (S)
I-19	Forrester Road, Christie Street and Boronia Road	AM	4.58	3100	F	6627	Forrester Road (N)
		PM	4.40	2977	F	5994	Forrester Road (N)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	1.64	708	F	2111	Dunheved Road (W)
		PM	1.57	716	F	2526	Christie Street (E)

7.2.4.6 2031 with Links Road extension

The 2031 Project with rezoning, with Links Road extension, SIDRA analysis results are shown in Table 7.31.

Table 7.31 2031 Project with rezoning with Links Road extension intersection performance – base road network layouts

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	1.02	70	E	638	The Northern Road (NW)
		PM	1.10	111	F	967	The Northern Road (NW)

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.14	171	F	635	The Northern Road (S)
		PM	1.09	155	F	679	The Northern Road (N)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.73	17	B	166	The Northern Road (N)
		PM	0.80	21	B	159	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.96	56	D	708	The Northern Road (N)
		PM	0.95	30	C	534	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	6.17	10087	F	371	Richmond Road (S)
		PM	2.25	12553	F	398	Trinity Drive (E)
I-10	Richmond Road and Dunheved Road	AM	0.90	30	C	458	Richmond Road (N)
		PM	0.83	24	B	270	Richmond Road (S)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.83	29	C	203	Richmond Road (N)
		PM	0.95	35	C	260	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.06	91	F	670	Parker Street (N)
		PM	1.17	180	F	718	Parker Street (S)
I-15	Palmyra Avenue and Australis Drive	AM	0.71	21	B	95	Palmyra Avenue (SE)
		PM	1.18	177	F	1461	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	1.33	383	F	929	Palmyra Avenue (NW)
		PM	1.17	197	F	603	Forrester Road Avenue (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	2.02	754	F	1920	Links Road (W)
		PM	2.66	1122	F	2161	Forrester Road (E)
I-19	Forrester Road, Christie Street and Boronia Road	AM	1.25	401	F	1360	Forrester Road (N)
		PM	1.29	405	F	1259	Forrester Road (N)
I-21	Great Western Highway and Glossop Street	AM	0.92	42	C	283	Great Western Highway (W)
		PM	0.92	23	B	127	Great Western Highway (E)
I-22	Christie Street, Lee Holm Road and Links Road	AM	0.79	18	B	134	Christie Street (W)
		PM	0.65	15	B	137	Christie Street (E)

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-23	Christie Street, Dunheved Road and Werrington Road	AM	1.73	856	F	2344	Dunheved Road (W)
		PM	1.70	788	F	3096	Christie Street (E)
I-24	Werrington Road and Great Western Highway	AM	1.11	63	E	583	Werrington Road (N)
		PM	1.03	38	C	260	Werrington Road (N)
I-25	Dunheved Road and John Oxley Avenue	AM	0.59	23	B	2	John Oxley Avenue (S)
		PM	3.92	5729	F	351	Dunheved Road (W)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	1.08	71	F	348	Francis Street (S)
		PM	0.94	39	C	345	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.82	10	A	45	Greenbank Drive (N)
		PM	0.68	6	A	32	Greenbank Drive (N)

The 2031 Project with rezoning, with Links Road extension, including the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), SIDRA analysis results are shown in Table 7.32.

Table 7.32 2031 Project with rezoning with Links Road extension intersection performance – hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) layouts

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.80	22	B	133	The Northern Road (SE)
		PM	0.84	25	B	150	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	1.10	158	F	636	The Northern Road (N)
		PM	0.99	79	F	432	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.96	56	D	708	The Northern Road (N)
		PM	0.95	30	C	534	Richmond Road (S)
I-16	Palmyra Avenue and Forrester Road	AM	2.03	1336	F	3477	Forrester Road (SW)
		PM	1.96	1130	F	3493	Forrester Road (NE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	4.93	2715	F	4151	Forrester Road (S)
		PM	5.91	3661	F	5156	Forrester Road (S)
I-19	Forrester Road, Christie Street and Boronia Road	AM	5.14	3158	F	6337	Forrester Road (N)
		PM	3.95	2949	F	6537	Forrester Road (N)

ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	Queue (m)	Approach with worst queue
I-23	Christie Street, Dunheved Road and Werrington Road	AM	1.73	856	F	2344	Dunheved Road (W)
		PM	1.70	788	F	3096	Christie Street (E)

7.3 Network assessment summary

The 2021 SIDRA summary results are shown in Table 7.33, reflecting the Base and Project scenarios which have been assessed, prior to identifying the need for any further mitigation measures. It is seen that there are a number of intersections which show LoS E or F and these are addressed in the following section.

Table 7.33 2021 SIDRA summary results

ID	Intersection	Peak period	Base		Project – Without rezoning				Project – With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-01	The Northern Road and Ninth Avenue	AM	C	B	B	B	B	B	B	B	B	B
		PM	B	B	C	B	C	B	C	B	C	B
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	C	C	F	C	F	C	D	D	F	F
		PM	C	C	F	D	F	D	F	F	F	F
I-05	The Northern Road and Jordan Springs Boulevard	AM	A		B		B		B		B	
		PM	B		B		B		B		B	
I-07	The Northern Road and Andrews Road	AM	B	B	C	C	B	B	B	B	B	B
		PM	B	B	B	B	B	B	B	B	B	B

ID	Intersection	Peak period	Base		Project – Without rezoning				Project – With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-08	Richmond Road and Trinity Drive	AM	F		F		F		F		F	
		PM	F		F		F		F		F	
I-10	Richmond Road and Dunheved Road	AM	B		C		B		B		B	
		PM	B		B		B		B		B	
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	B		C		B		B		B	
		PM	B		B		B		C		C	
I-13	Great Western Highway and Parker Street	AM	D		F		F		F		F	
		PM	F		F		F		F		F	
I-15	Palmyra Avenue and Australis Drive	AM	A		B		B		B		B	
		PM	A		B		B		B		B	
I-16	Palmyra Avenue and Forrester Road	AM	B		B		B		B		B	
		PM	B		B		B		B		B	
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	C		F		F		F		F	
		PM	B		F		F		F		F	

ID	Intersection	Peak period	Base		Project – Without rezoning				Project – With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-19	Forrester Road, Christie Street and Boronia Road	AM	C		F		F		F		D	
		PM	F		F		F		F		F	
I-21	Great Western Highway and Glossop Street	AM	B		C		C		C		C	
		PM	B		B		B		B		B	
I-22	Christie Street, Lee Holm Road and Links Road	AM	-	-	-	-	B		-	-	B	
		PM	-	-	-	-	B		-	-	B	
I-23	Christie Street, Dunheved Road and Werrington Road	AM	A		A		A		A		A	
		PM	B		C		C		C		D	
I-24	Werrington Road and Great Western Highway	AM	B		B		B		B		B	
		PM	B		B		B		B		B	
I-25	Dunheved Road and John Oxley Avenue	AM	B		B		B		B		B	
		PM	B		C		C		C		B	

ID	Intersection	Peak period	Base		Project – Without rezoning				Project – With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	C		C		C		C		C	
		PM	B		C		C		C		C	
I-27	Dunheved Road and Greenbank Drive (west)	AM	A		A		A		A		A	
		PM	A		A		A		A		A	

The 2026 SIDRA summary results are shown in Table 7.34, reflecting the Base and Project scenarios which have been assessed, prior to identifying the need for any further mitigation measures. It is seen that there are a number of intersections which show LoS E or F and these are addressed in the following section.

Table 7.34 2026 SIDRA summary results

ID	Intersection	Peak period	Base		Project - Without rezoning				Project - With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-01	The Northern Road and Ninth Avenue	AM	D	B	C	B	C	B	B	B	C	B
		PM	C	B	E	B	E	B	D	B	F	B
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	C	C	F	F	F	F	F	F	F	F
		PM	C	C	F	F	F	F	F	F	F	F
I-05	The Northern Road and Jordan Springs Boulevard	AM	A		B		B		B		B	
		PM	A		B		B		B		B	
I-07	The Northern Road and Andrews Road	AM	B	B	D	D	C	C	D	D	C	C
		PM	B	B	B	B	B	B	B	B	B	B
I-08	Richmond Road and Trinity Drive	AM	F		F		F		F		F	
		PM	F		F		F		F		F	

ID	Intersection	Peak period	Base		Project - Without rezoning				Project - With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-10	Richmond Road and Dunheved Road	AM	B		D		D		D		C	
		PM	B		B		B		B		B	
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	B		B		B		B		B	
		PM	B		C		C		C		C	
I-13	Great Western Highway and Parker Street	AM	F		F		F		F		F	
		PM	F		F		F		F		F	
I-15	Palmyra Avenue and Australis Drive	AM	B		B		B		B		B	
		PM	B		C		B		C		D	
I-16	Palmyra Avenue and Forrester Road	AM	F	F	F	F	F	F	F	F	F	F
		PM	F	F	F	F	F	F	F	F	F	F
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	F		F		F		F		F	
		PM	F		F		F		F		F	

ID	Intersection	Peak period	Base		Project - Without rezoning				Project - With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-19	Forrester Road, Christie Street and Boronia Road	AM	F		F		F		F		F	
		PM	F		F		F		F		F	
I-21	Great Western Highway and Glossop Street	AM	B		C		C		C		C	
		PM	B		B		B		B		B	
I-22	Christie Street, Lee Holm Road and Links Road	AM	-	-	-	-	B		-	-	B	
		PM	-	-	-	-	B		-	-	B	
I-23	Christie Street, Dunheved Road and Werrington Road	AM	A		B		A		B		A	
		PM	F		F		F		F		F	
I-24	Werrington Road and Great Western Highway	AM	B		B		B		B		B	
		PM	B		B		B		B		C	
I-25	Dunheved Road and John Oxley Avenue	AM	B		C		B		B		B	
		PM	D		C		D		E		E	

ID	Intersection	Peak period	Base		Project - Without rezoning				Project - With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	C		F		C		F		C	
		PM	C		C		C		C		C	
I-27	Dunheved Road and Greenbank Drive (west)	AM	A		A		A		A		A	
		PM	A		A		A		A		A	

The 2031 SIDRA summary results are shown in Table 7.35, reflecting the Base and Project scenarios which have been assessed, prior to identifying the need for any further mitigation measures. It is seen that there are a number of intersections which show LoS E or F and these are addressed in the following section.

Table 7.35 2031 SIDRA summary results

ID	Intersection	Peak period	Base		Project - Without rezoning				Project - With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-01	The Northern Road and Ninth Avenue	AM	F	B	F	B	F	B	F	B	E	B
		PM	F	B	F	B	F	B	F	B	F	B
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	D	C	F	F	F	F	F	F	F	F
		PM	C	C	F	F	F	F	F	F	F	F
I-05	The Northern Road and Jordan Springs Boulevard	AM	A		B		B		B		B	
		PM	B		B		B		B		B	
I-07	The Northern Road and Andrews Road	AM	C	C	F	F	D	D	E	E	D	D
		PM	B	B	E	E	B	B	E	E	C	C
I-08	Richmond Road and Trinity Drive	AM	F		F		F		F		F	
		PM	F		F		F		F		F	

ID	Intersection	Peak period	Base		Project - Without rezoning				Project - With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-10	Richmond Road and Dunheved Road	AM	C		D		C		C		C	
		PM	B		B		B		B		B	
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	B		C		C		C		C	
		PM	C		C		C		C		C	
I-13	Great Western Highway and Parker Street	AM	F		F		F		F		F	
		PM	F		F		F		F		F	
I-15	Palmyra Avenue and Australis Drive	AM	B		B		B		B		B	
		PM	B		F		F		F		F	
I-16	Palmyra Avenue and Forrester Road	AM	F	F	F	F	F	F	F	F	F	F
		PM	F	F	F	F	F	F	F	F	F	F
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	F	F	F	F	F	F	F	F	F	F
		PM	F	F	F	F	F	F	F	F	F	F

ID	Intersection	Peak period	Base		Project - Without rezoning				Project - With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-19	Forrester Road, Christie Street and Boronia Road	AM	F	F	F	F	F	F	F	F	F	F
		PM	F	F	F	F	F	F	F	F	F	F
I-21	Great Western Highway and Glossop Street	AM	C		C		F		E		C	
		PM	B		B		B		B		B	
I-22	Christie Street, Lee Holm Road and Links Road	AM	-	-	-	-	F		-	-	B	
		PM	-	-	-	-	B		-	-	B	
I-23	Christie Street, Dunheved Road and Werrington Road	AM	F	F	F	F	F	F	F	F	F	F
		PM	F	F	F	F	F	F	F	F	F	F
I-24	Werrington Road and Great Western Highway	AM	D		D		D		D		E	
		PM	C		E		F		C		C	
I-25	Dunheved Road and John Oxley Avenue	AM	B		B		B		B		B	
		PM	F		F		F		F		F	

ID	Intersection	Peak period	Base		Project - Without rezoning				Project - With rezoning			
					Without Links Road		With Links Road		Without Links Road		With Links Road	
			Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)	Base road network	Hypothetical road network enhancements (which are uncommitted/ unfunded/ pre-feasibility)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	C		E		F		F		F	
		PM	C		C		C		C		C	
I-27	Dunheved Road and Greenbank Drive (west)	AM	A		A		A		A		A	
		PM	A		A		A		A		A	

7.4 Potential Links Road extension

Overall, both AIMSUN and SIDRA modelling results indicated that the Links Road extension would not improve the network performance significantly in future years.

The Links Road extension was assessed to redirect approximately 300 vehicles per hour (vph) in 2021 and 600 vph in 2031 from the Forrester Road/Ropes Crossing Boulevard and Forrester Road/ Christie Street intersections. Whilst these reductions result in a slight performance improvement at the two intersections, both the '*with link road extension*' and '*without link road extension*' scenarios yield LoS 'F' if the intersections are not subjected to further upgrades.

Flow difference plots comparing with the 'with' and 'without' Links Road extension were provided in the Figure 7.10 to Figure 7.12.

7.5 With and without rezoning

There is minimal difference in the traffic generated between 'with rezoning' and 'without rezoning' scenarios and therefore the traffic impacts on the external road network between the 'with rezoning' and 'without rezoning' scenarios are considered negligible.

One key difference between the 'with rezoning' and 'without rezoning' scenarios is the directional traffic splits which reflects on the difference in the type of land uses. In the 'without rezoning' scenario, 38 hectares of Jordan Springs East precinct have been assigned to employment land, which derives higher proportion of inbound trips in the AM peak and outbound trips in the PM peak.

Conversely, the 'with rezoning' scenario (i.e. a scenario where the employment land are replaced with 500 additional low-density residential dwellings) derives higher proportion of outbound trips in the AM peak and higher inbound trips in the PM peak.

With regards to the St Marys development's impact to the external road network, the 'with rezoning' scenario is considered to provide a more conservative outcome as the additional residential dwellings in lieu of the employment land result in a directional traffic split which would be more in line with the surrounding developments.

Mitigation investigation of the road network as such have been based on the 'with rezoning' scenario.

7.6 Summary

The Project analysis has been undertaken at years 2021, 2026 and 2031 for the purpose of assessing the impact of the planned development within the St Marys Development Site. There are two main Project scenarios, which are 'without rezoning' and 'with rezoning', relating to the conversion of employment land within Jordan Springs East to allow for 500 residential dwelling houses. For each land use scenario, there are tests 'without Links Road extension' and with 'Links Road extension', followed by all scenarios being undertaken under base road network and hypothetical assumptions for potential road upgrades (which are uncommitted/unfunded/pre-feasibility).

The SIDRA analysis at each of the three assessment years has identified a number of intersections which are forecast to be LoS E or F and there is therefore a requirement for mitigation measures to be identified. The focus of the mitigation measures will be on the 'with rezoning' and 'with Links Road extension' scenario.

There is minimal difference in the traffic generated between with the 'with rezoning' and 'without rezoning' scenarios and therefore the traffic impacts on the external road network between the 'with rezoning' and 'without rezoning' scenarios is negligible. One key difference between the 'with rezoning' and 'without rezoning' scenarios is the directional traffic splits, with the majority of traffic exiting in the AM peak and entering in the PM peak for residential dwellings, with a vice-versa directional slits for employment land uses, whereby the majority of traffic enters in the AM peak and exits in the PM peak. Due to the 'with rezoning' scenario being more conservative in regards to traffic generation, this scenario was considered for mitigation purposes.

The SIDRA analysis at each of the three assessment years has identified a number of intersections which are forecast to be LoS E or F and there is therefore a requirement for mitigation measures to be identified. The focus of the mitigation measures will be on the 'with rezoning' and 'with Links Road extension' scenario.

8 FUTURE YEAR INTERSECTION PERFORMANCE - WITH MITIGATION MEASURES FOR IMPROVED INTERSECTION PERFORMANCE

8.1 Introduction

Following the assessment of the intersection results, we have undertaken analysis to identify the improvements required at those intersections where LoS E or F has been forecast. The majority of improvements relate to intersection upgrades, intersection modifications and revised signal phasing. The assessment of mitigation measures have all been undertaken reflecting the following:

— Project (with development)

— with rezoning (as the worst case scenario)

— with hypothetical assumptions for potential road upgrades (which are uncommitted/unfunded/pre-feasibility) (this relates to the intersection layout 'footprint' required to coincide with the Roads and Maritime Strategic Model at that year).

Please note that mitigation measures prepared are for improvements to intersection performance due to both the developments traffic and background traffic growth.

The following intersection layout terminology has been utilised for mitigation reporting purposes:

Base layout – existing road and intersection layout.

Hypothetical layout – hypothetical road intersection layout (which are uncommitted/unfunded/pre-feasibility) – this relates to the intersection layout 'footprint' required to coincide with the Roads and Maritime Strategic Model at that year.

Upgraded layout – the layout of the intersection required so that the intersection operates an overall satisfactory level of service. This upgraded layout would be based on intersection modifications on either the base layout or hypothetical layout.

A further sensitivity run has been included for the 'with Links Road extension' whereby Links Road and Links Road extension road capacities have been revised as well as the intersection layout for Christie Street, Lee Holm Road and Links Road extension. The results for this sensitivity run are denoted with the letter 'S' in the ID column for the 'with Link Road extension' scenario.

8.2 2021 Project with rezoning

The required mitigation measures at 2021 Project with rezoning with hypothetical assumptions for potential road upgrades (which are uncommitted/unfunded/pre-feasibility) have been undertaken based on the both the 'without Links Road extension' and potential 'with Links Road extension' scenarios.

8.2.1.1 without Links Road extension

The proposed layout for Intersection I-03 (The Northern Road/Borrowdale Way/Greenwood Parkway) at 2021 without Links Road extension is shown in Figure 8.1.

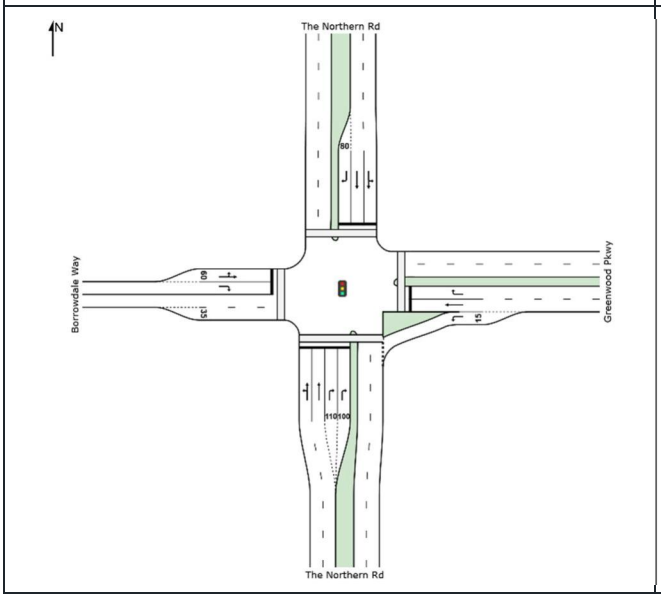
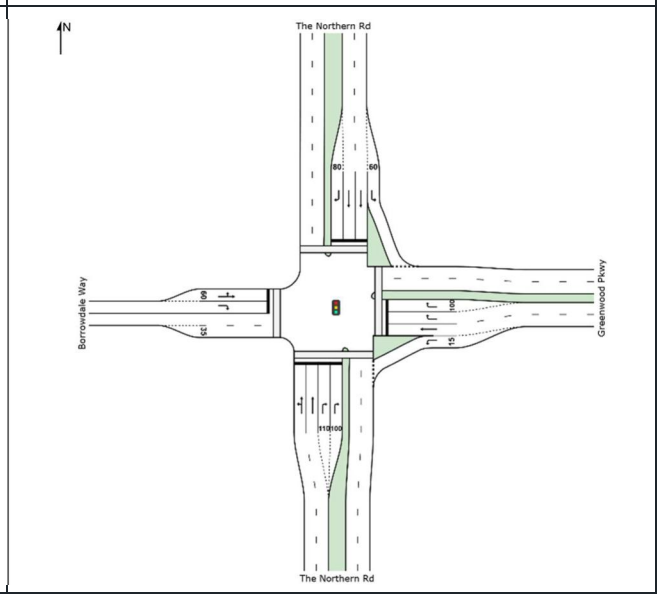
Hypothetical Layout	Upgraded Layout
	

Figure 8.1 2021 without Links Road extension - The Northern Road/Borrowdale Way/Greenwood Parkway

The following modifications were applied to the intersection for improved performance:

— 60 m left turn slip lane on the northern approach

— 100 m short right turn bay on western approach.

The operation of Intersection I-03 at 2021 without Links Road extension with the upgraded layout is shown in Table 8.1. It is seen that with the upgraded layout, the AM peak is forecast to have LoS C while the PM peak is forecast to have LoS D.

Table 8.1 2021 without Links Road extension - I-03 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-03	Hypothetical layout	AM	0.99	52	D	231	The Northern Road (N)
		PM	1.00	89	F	464	The Northern Road (N)
I-03	Upgraded layout	AM	0.81	32	C	120	The Northern Road (N)
		PM	0.88	47	D	209	The Northern Road (N)

The proposed layout for Intersection I-08 (Richmond Road/Trinity Drive) at 2021 without Links Road extension is shown in Figure 8.2, reflecting upgrade to traffic signals.

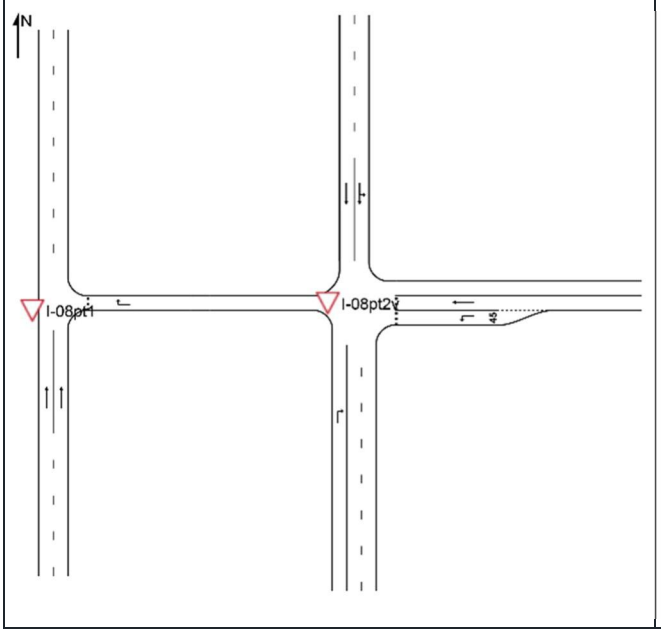
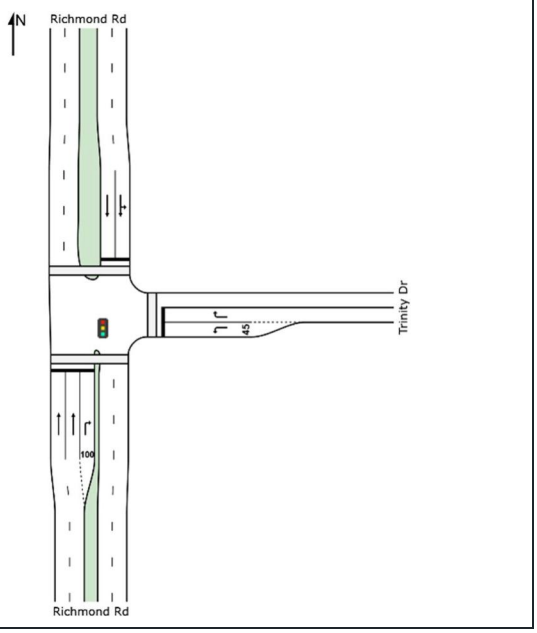
Base Layout	Upgraded Layout
	

Figure 8.2 2021 without Links Road extension - Richmond Road/Trinity Drive

The operation of Intersection I-08 at 2021 without Links Road extension with the upgraded layout is shown in Table 8.2. It is seen that with the upgraded layout, the AM peak is forecast to have LoS B while the PM peak is forecast to have LoS A.

Table 8.2 2021 without Links Road extension - I-08 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-08	Base layout	AM	3.67	5723	F	247	Richmond Road (S)
		PM	0.80	207	F	29	Richmond Road (S)
I-08	Upgraded layout	AM	0.94	18	B	631	Richmond Road (N)
		PM	0.90	13	A	466	Richmond Road (S)

The proposed layout for Intersection I-13 (Great Western Highway/Parker Street) at 2021 without Links Road extension is shown in Figure 8.3, with all legs modified with the exception of the western leg.

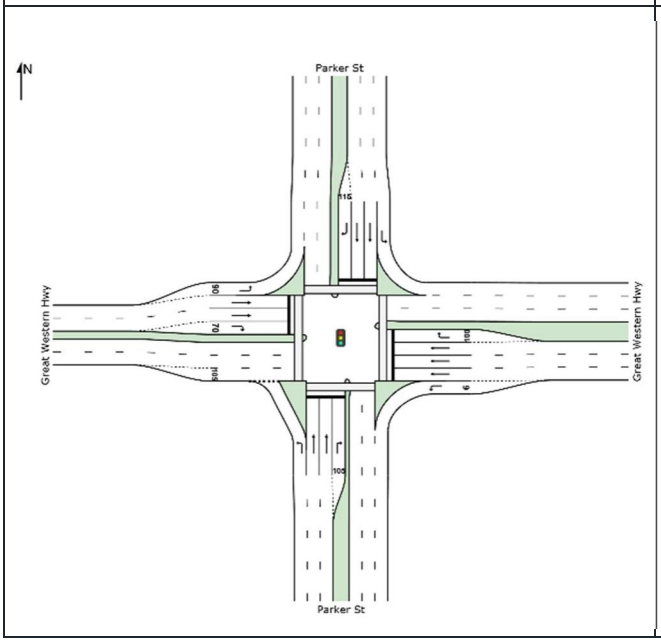
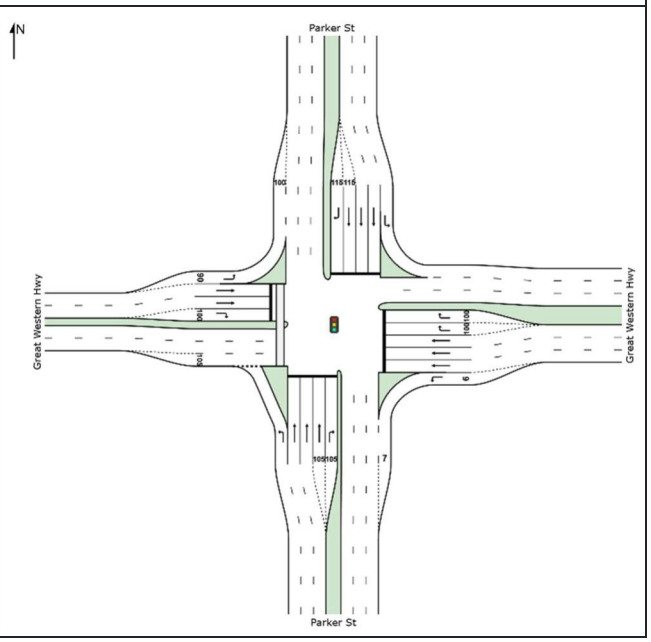
Base Layout	Upgraded Layout
	

Figure 8.3 2021 without Links Road extension - Great Western Highway/Parker Street

The operation of Intersection I-13 at 2021 without Links Road extension with the upgraded layout is shown in Table 8.3. It is seen that with the upgraded layout, the AM and PM peaks are both forecast to have LoS D.

Table 8.3 2021 without Links Road extension - I-13 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-13	Base layout	AM	1.10	109	F	764	Parker Street (N)
		PM	1.13	137	F	552	Great Western Highway (E)
I-13	Upgraded layout	AM	0.85	43	D	207	Parker Street (N)
		PM	0.88	45	D	185	Great Western Highway (W)

The proposed layout for Intersection I-18 (Forrester Road/Ropes Crossing Boulevard/Links Road) at 2021 without Links Road extension is shown in Figure 8.4, reflecting upgrade to traffic signals.

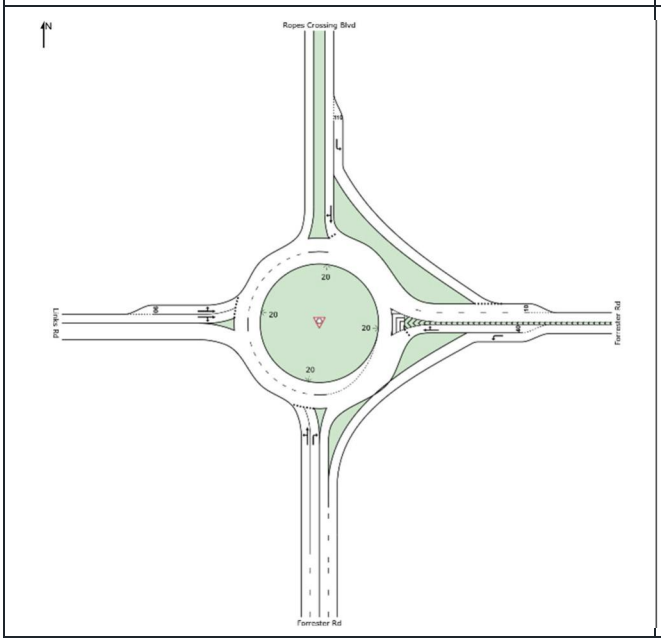
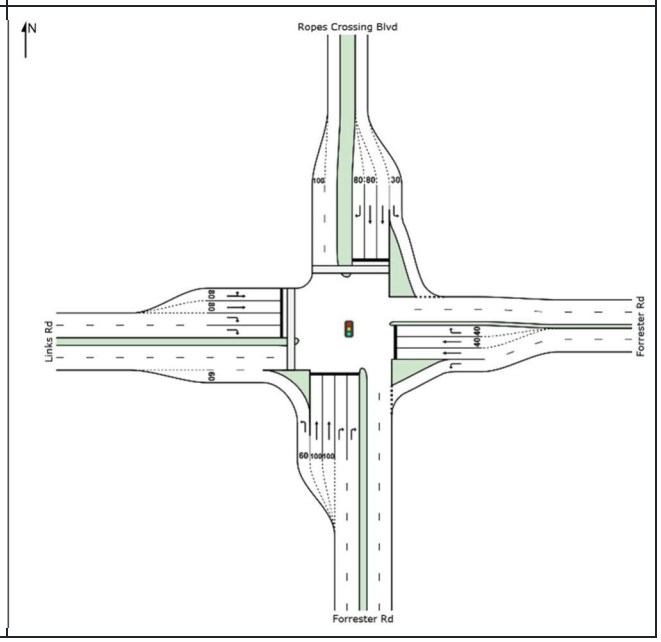
Base Layout	Upgraded Layout
	

Figure 8.4 2021 without Links Road extension - Forrester Road/Ropes Crossing Boulevard/Links Road

The operation of Intersection I-18 at 2021 without Links Road extension with the upgraded layout is shown in Table 8.4. It is seen that with the upgraded layout, the AM will operated at a LoS D and the PM peak LoS C.

Table 8.4 2021 without Links Road extension - I-18 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-18	Base layout	AM	1.60	1123	F	3314	Links Road (W)
		PM	1.84	1531	F	4818	Links Road (W)
I-18	Upgraded layout	AM	0.94	55	D	310	Links Road (W)
		PM	0.94	39	C	165	Forrester Road (E)

The proposed layout for Intersection I-19 (Forrester Road/Christie Street/Boronia Road) at 2021 without Links Road extension is shown in Figure 8.5, reflecting upgrade to traffic signals.

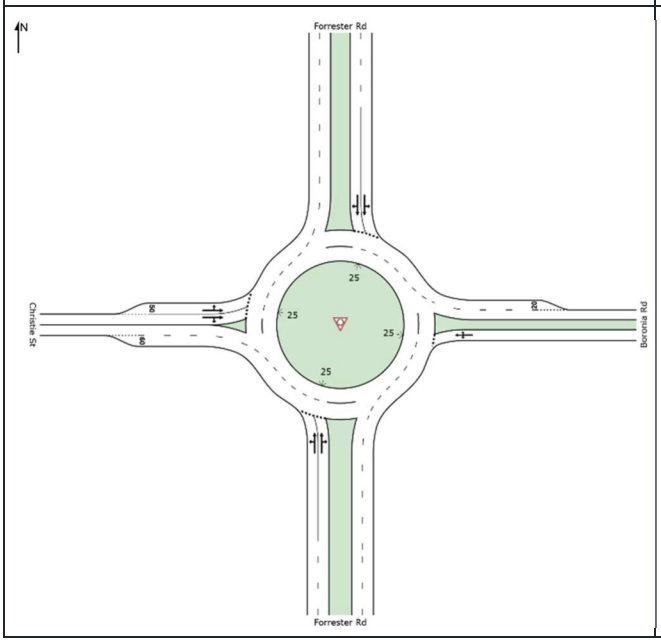
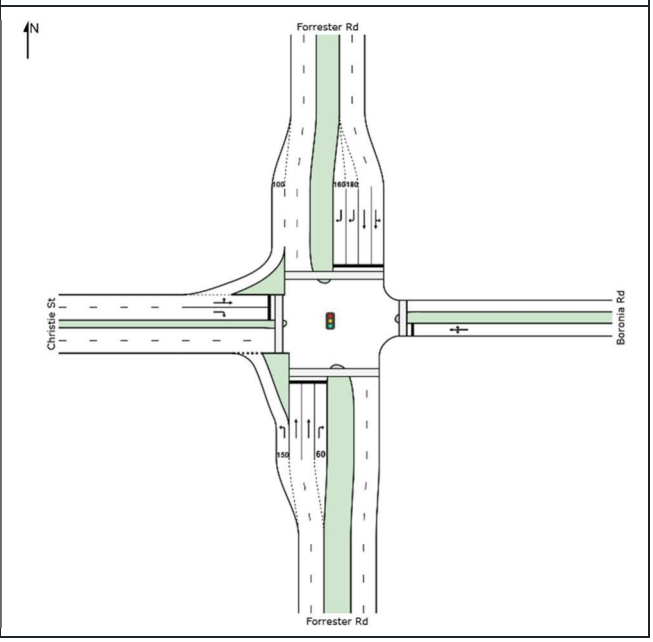
Base Layout	Upgraded Layout
	

Figure 8.5 2021 without Links Road extension - Forrester Road/Christie Street/Boronia Road

The operation of Intersection I-19 at 2021 without Links Road extension with the upgraded layout is shown in Table 8.5. It is seen that with the upgraded layout, the AM and PM peaks are both forecast to have LoS C.

Table 8.5 2021 without Links Road extension - I-19 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-19	Base layout	AM	1.10	236	F	740	Forrester Road (S)
		PM	1.92	1684	F	3706	Forrester Road (S)
I-19	Upgraded layout	AM	0.92	37	C	224	Forrester Road (N)
		PM	0.85	39	C	267	Forrester Road (S)

8.2.1.2 With Links Road extension

The proposed layout for Intersection I-03 (The Northern Road/Borrowdale Way/Greenwood Parkway) at 2021 with Links Road extension is shown in Figure 8.6.

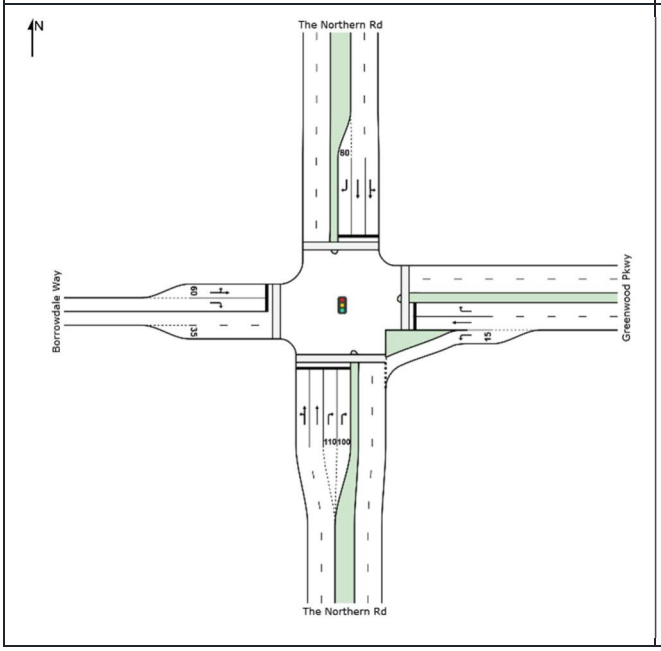
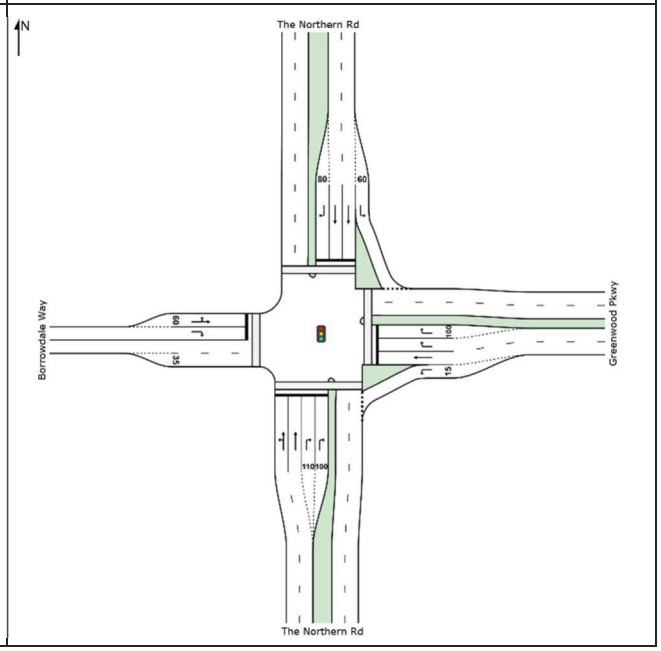
Hypothetical Layout	Upgraded Layout
	

Figure 8.6 2021 with Links Road extension - The Northern Road/Borrowdale Way/Greenwood Parkway

The following modification were applied to the intersection for improved performance:

— 60 m left turn slip lane on the northern approach

— 100 m short right turn bay on western approach.

The operation of Intersection I-03 at 2021 with Links Road extension with the upgraded layout is shown in Table 8.6. It is seen that with the upgraded layout, the AM peak is forecast to have LoS C and the PM peak is forecast to have LoS D.

Table 8.6 2021 with Links Road extension - I-03 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-03	Hypothetical layout	AM	1.05	82	F	293	The Northern Road (N)
		PM	1.00	89	F	483	The Northern Road (N)
I-03	Upgraded layout	AM	0.86	34	C	129	The Northern Road (N)
		PM	0.87	46	D	201	The Northern Road (N)
I-03S	Upgraded layout	AM	0.83	32	C	123	The Northern Road (N)
		PM	0.89	45	D	194	The Northern Road (N)

The proposed layout for Intersection I-08 (Richmond Road/Trinity Drive) at 2021 with Links Road extension is shown in Figure 8.7, with the intersection being upgraded to traffic signals.

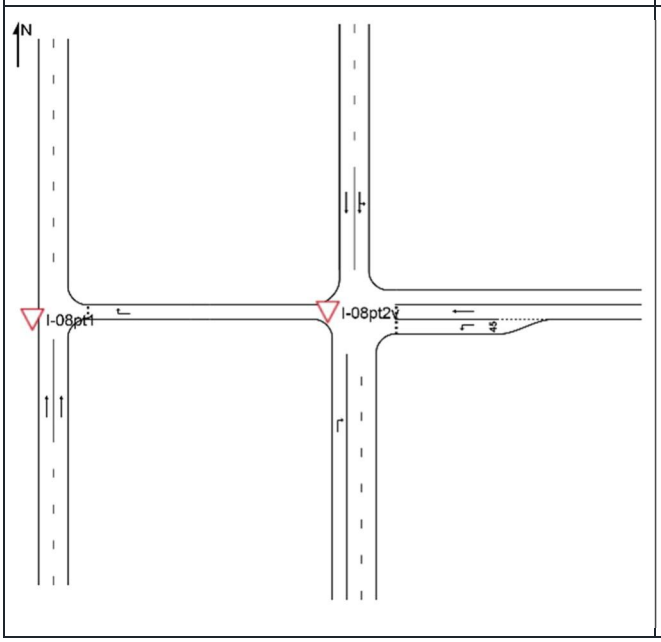
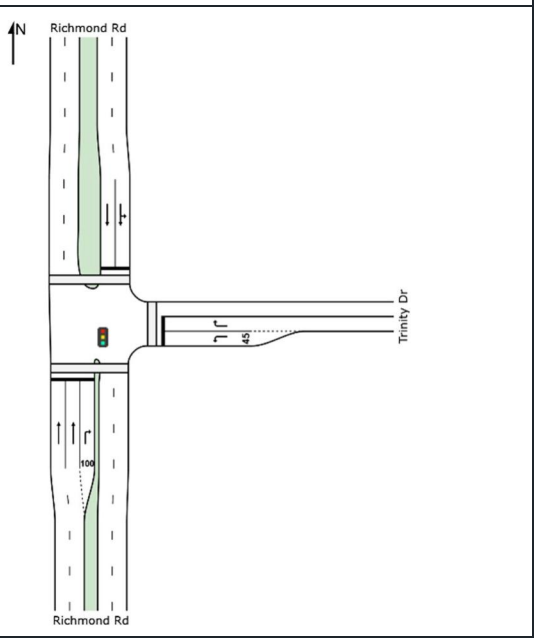
Base Layout	Upgraded Layout
	

Figure 8.7 2021 with Links Road extension – Richmond Road/Trinity Drive

The operation of Intersection I-08 at 2021 with Links Road extension with the upgraded layout is shown in Table 8.7. It is seen that with the upgraded layout, the AM and PM peaks are both forecast to have LoS A.

Table 8.7 2021 with Links Road extension – I-08 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-08	Base layout	AM	3.18	4339	F	301	Richmond Road (S)
		PM	0.89	523	F	26	Richmond Road (S)
I-08	Upgraded layout	AM	0.91	12	A	508	Richmond Road (N)
		PM	0.80	9	A	271	Richmond Road (S)
I-08S	Upgraded layout	AM	0.91	12	A	500	Richmond Road (N)
		PM	0.81	9	A	262	Richmond Road (S)

The proposed layout for Intersection I-13 (Great Western Highway/Parker Street) at 2021 with Links Road extension is shown in Figure 8.8, reflecting modifications to each leg with the exception of the western leg.

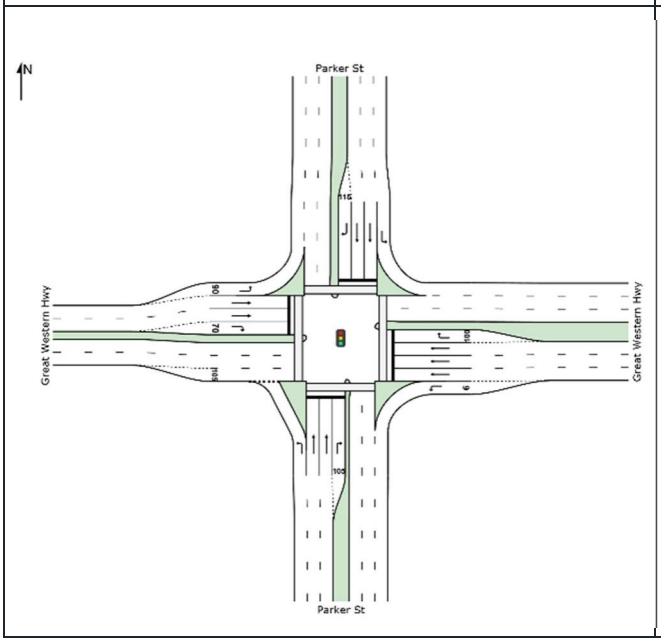
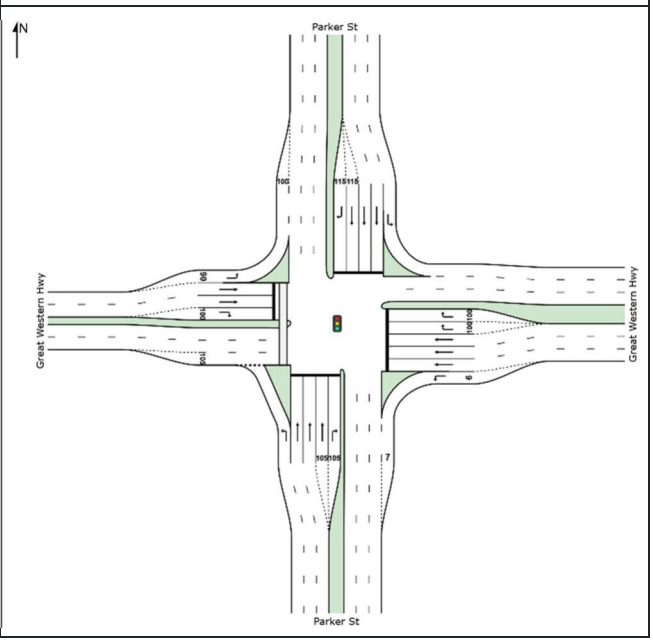
Base Layout	Upgraded Layout
	

Figure 8.8 2021 with Links Road extension – Great Western Highway/Parker Street

The operation of Intersection I-13 at 2021 with Links Road extension with the upgraded layout is shown in Table 8.8. It is seen that with the upgraded layout, the AM peak is forecast to have LoS C and the PM peak is forecast to have LoS D.

Table 8.8 2021 with Links Road extension – I-13 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-13	Base layout	AM	1.10	107	F	740	Parker Street (N)
		PM	1.13	129	F	558	Great Western Highway (E)
I-13	Upgraded layout	AM	0.83	42	C	201	Parker Street (N)
		PM	0.90	46	D	199	Great Western Highway (W)
I-13S	Upgraded layout	AM	0.82	41	C	195	Parker Street (N)
		PM	0.90	46	D	201	Great Western Highway (W)

The proposed layout for Intersection I-18 (Forrester Road/Ropes Crossing Boulevard/Links Road) at 2021 with Links Road extension is shown in Figure 8.9, reflecting upgrade to traffic signals.

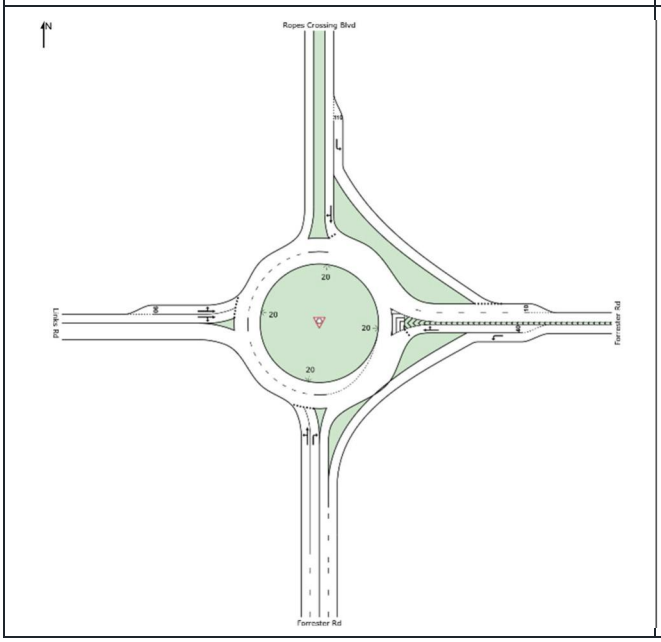
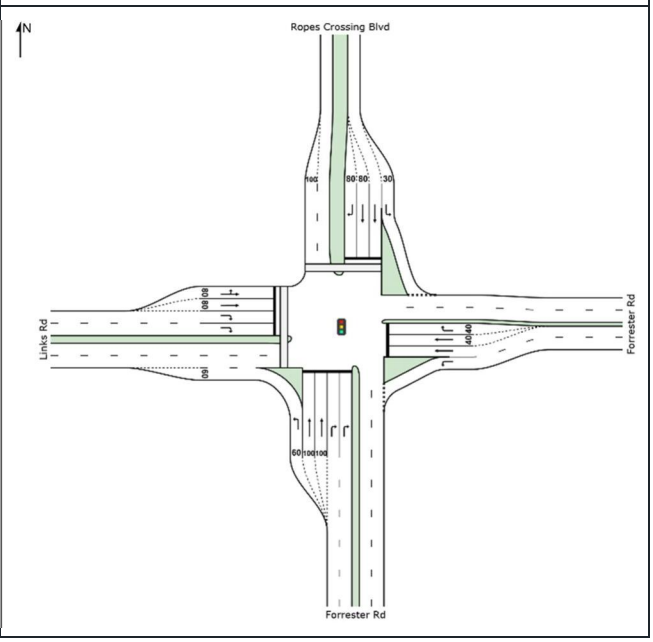
Base Layout	Upgraded Layout
	

Figure 8.9 2021 with Links Road extension – Forrester Road/Ropes Crossing Boulevard/Links Road

The operation of Intersection I-18 at 2021 with Links Road extension with the upgraded layout is shown in Table 8.9. It is seen that with the upgraded layout, the AM peak is forecast to have LoS D and the PM peak is forecast to have LoS C.

Table 8.9 2021 with Links Road extension – I-18 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-18	Base layout	AM	1.55	1041	F	2426	Links Road (W)
		PM	1.78	1428	F	4536	Links Road (W)
I-18	Upgraded layout	AM	0.90	48	D	250	Forrester Road (S)
		PM	0.91	36	C	145	Forrester Road (E)
I-18S	Upgraded layout	AM	0.89	46	D	235	Forrester Road (S)
		PM	0.88	33	C	127	Forrester Road (E)

The proposed layout for Intersection I-19 (Forrester Road/Christie Street/Boronia Road) at 2021 with Links Road extension is shown in Figure 8.10, reflecting upgrade to traffic signals.

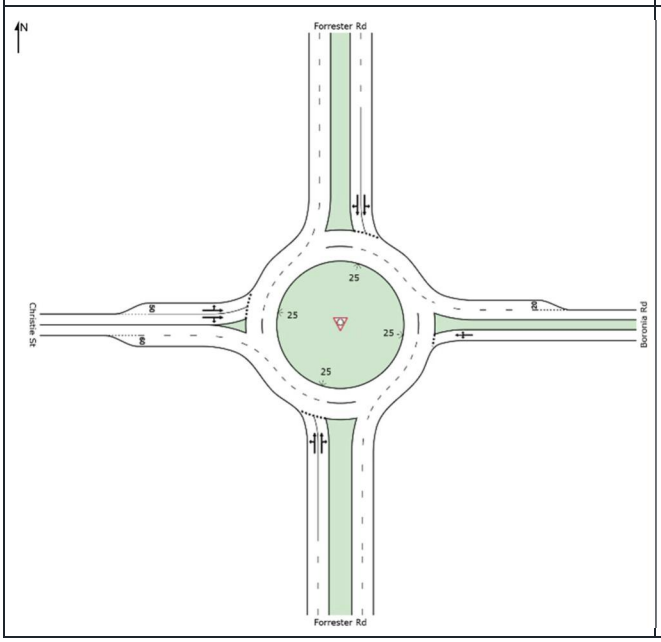
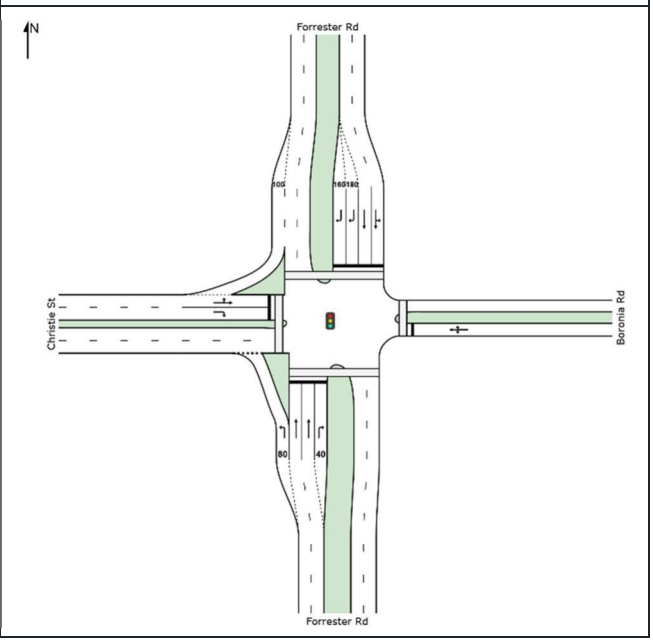
Base Layout	Upgraded Layout
	

Figure 8.10 2021 with Links Road extension – Forrester Road/Christie Street/Boronia Road

The operation of Intersection I-19 at 2021 with Links Road extension with the upgraded layout is shown in Table 8.10. It is seen that with the upgraded layout, the AM and PM peaks are both forecast to have LoS C.

Table 8.10 2021 with Links Road extension – I-19 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-19	Base layout	AM	0.98	53	D	191	Forrester Road (S)
		PM	1.51	946	F	2550	Forrester Road (S)
I-19	Upgraded layout	AM	0.91	34	C	190	Forrester Road (N)
		PM	0.89	35	C	211	Forrester Road (S)
I-19S	Upgraded layout	AM	0.89	36	C	198	Forrester Road (N)
		PM	0.82	31	C	177	Forrester Road (S)

8.3 2026 Project with rezoning

The required mitigation measures at 2026 Project with rezoning with hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) have been generally undertaken based on the 'with Links Road extension' scenario, except for those locations where the 'without Links Road extension' performance is worse.

The proposed layout for Intersection I-03 (The Northern Road/Borrowdale Way/Greenwood Parkway) at 2026 with Links Road extension is shown in Figure 8.11.

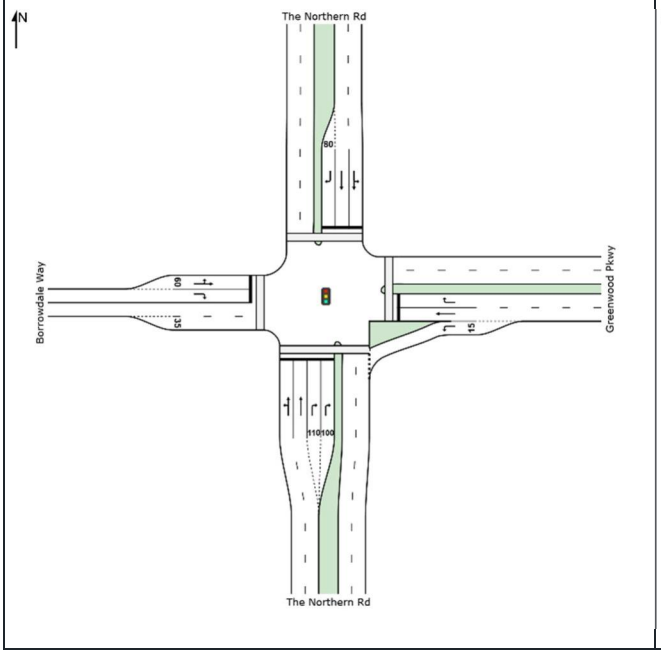
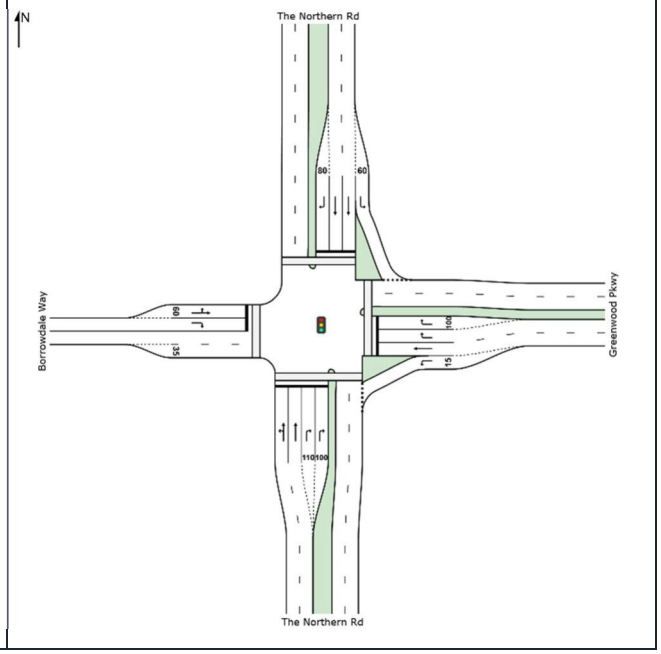
Hypothetical Layout	Upgraded Layout
	

Figure 8.11 2026 with Links Road extension – The Northern Road/Borrowdale Way/Greenwood Parkway

The operation of Intersection I-03 at 2026 with Links Road extension with the upgraded layout is shown in Table 8.11. It is seen that with the upgraded layout, the AM peak is forecast to have LoS C and the PM peak is forecast to have LoS D.

Table 8.11 2026 with Links Road extension – I-03 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-03	Hypothetical layout	AM	1.04	90	F	389	The Northern Road (N)
		PM	0.99	83	F	479	The Northern Road (N)
I-03	Upgraded layout	AM	0.88	35	C	153	The Northern Road (N)
		PM	0.86	45	D	210	The Northern Road (N)
I-03S	Upgraded layout	AM	0.87	34	C	152	The Northern Road (N)
		PM	0.86	44	D	203	The Northern Road (N)

The upgraded intersection layout recommended in 2021 is suitable for 2026 operation.

The following modification were applied to the intersection for improved performance:

— 60 m left turn slip lane on the northern approach

— 100 m short right turn bay on western approach.

The proposed layout for Intersection I-08 (Richmond Road/Trinity Drive) at 2026 with Links Road extension is shown in Figure 8.12.

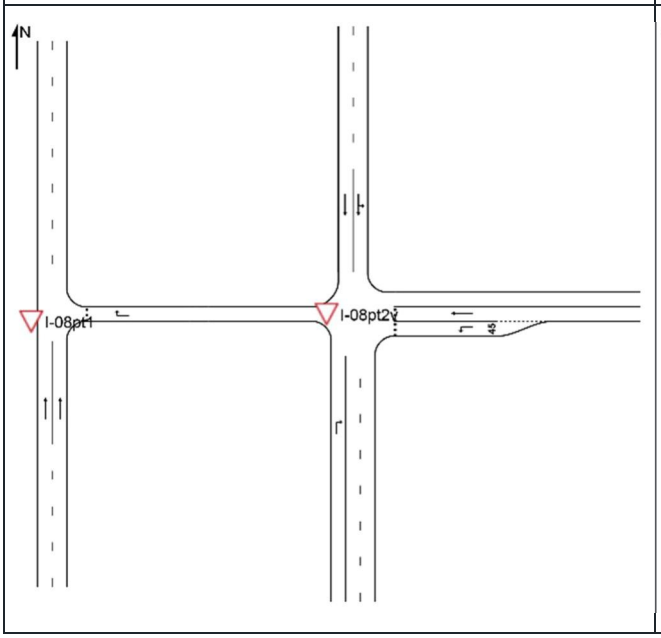
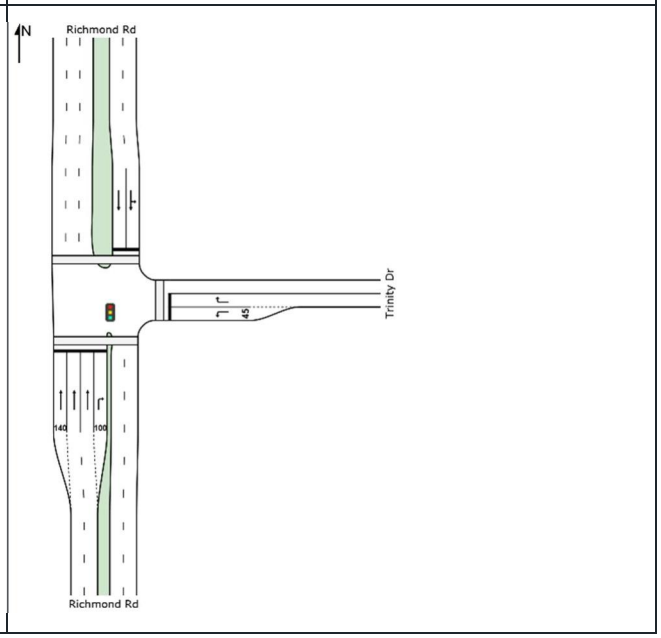
Base Layout	Upgraded Layout
	

Figure 8.12 2026 with Links Road extension - Richmond Road/Trinity Drive

The operation of Intersection I-08 at 2026 with Links Road extension with the upgraded layout is shown in Table 8.12. It is seen that with the upgraded layout, the AM peak is forecast to have LoS C and the PM peak is forecast to have LoS A.

Table 8.12 2026 with Links Road extension - I-08 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-08	Base layout	AM	5.52	8710	F	421	Richmond Road (S)
		PM	1.27	6782	F	97	Trinity Drive (E)
I-08	Upgraded layout	AM	0.97	33	C	863	Richmond Road (N)
		PM	0.79	10	A	167	Richmond Road (N)

The upgraded intersection layout recommended in 2021 is NOT suitable for 2026 operation.

The following modification were applied to the intersection for improved performance:

— 140 m short through lane on the southern approach

— 140 m short lane on the northern departure.

The proposed layout for Intersection I-13 (Great Western Highway/Parker Street) at 2026 with Links Road extension is shown in Figure 8.13.

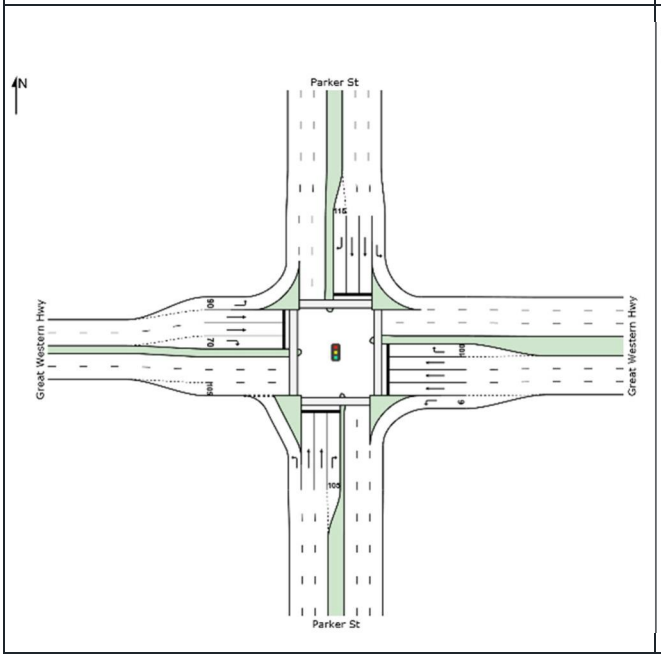
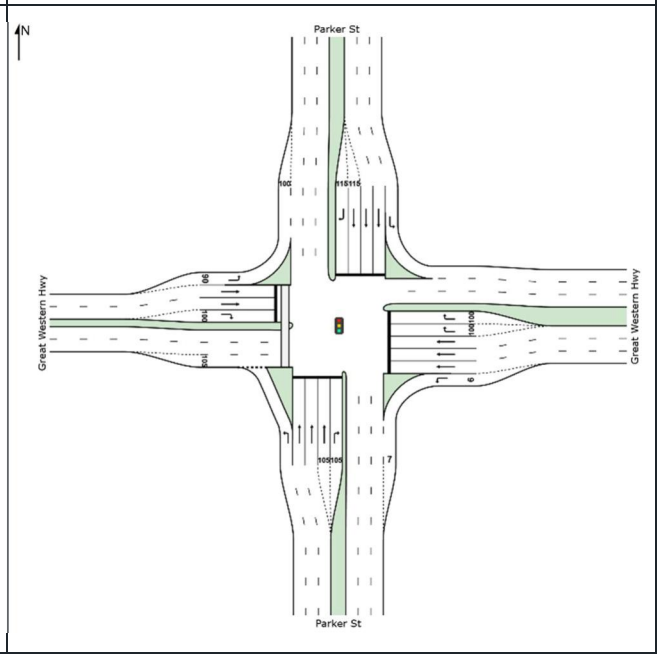
Base Layout	Upgraded Layout
	

Figure 8.13 2026 with Links Road extension – Great Western Highway/Parker Street

The operation of Intersection I-13 at 2026 with Links Road extension with the upgraded layout is shown in Table 8.13. It is seen that with the upgraded layout, the AM peak is forecast to have LoS C and the PM peak is forecast to have LoS D.

Table 8.13 2026 with Links Road extension – I-13 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-13	Base layout	AM	1.06	82	F	635	Parker Street (N)
		PM	1.10	114	F	493	Parker Street (S)
I-13	Upgraded layout	AM	0.82	41	C	207	Parker Street (N)
		PM	0.93	52	D	188	Parker Street (S)
I-13S	Upgraded layout	AM	0.82	41	C	201	Parker Street (N)
		PM	0.92	49	D	179	Parker Street (S)

The upgraded intersection layout recommended in 2021 is suitable for 2026 operation.

The proposed layout for Intersection I-16 (Palmyra Avenue/Forrester Road) at 2026 with Links Road extension is shown in Figure 8.14.

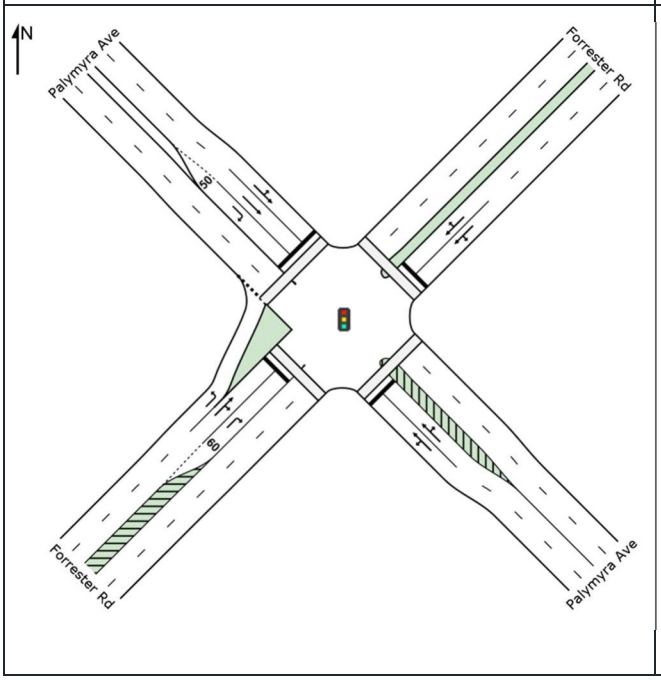
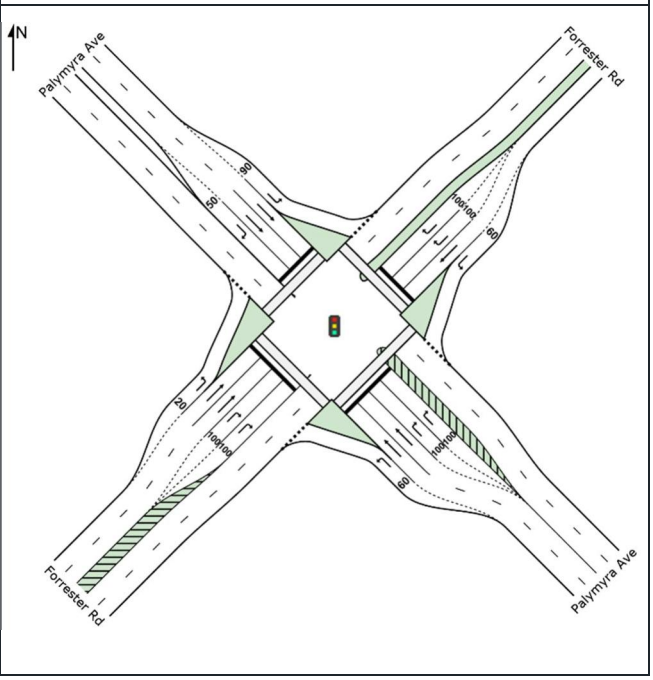
Hypothetical Layout	Upgraded Layout
	

Figure 8.14 2026 with Links Road extension – Palmyra Avenue/Forrester Road

The operation of Intersection I-16 at 2026 with Links Road extension with the upgraded layout is shown in Table 8.14. It is seen that with the upgraded layout, the AM and PM peaks are both forecast to have LoS D.

Table 8.14 2026 with Links Road extension – I-16 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-16	Hypothetical layout	AM	2.37	924	F	1716	Palmyra Avenue (NW)
		PM	2.00	934	F	2967	Forrester Road (NE)
I-16	Upgraded layout	AM	0.95	50	D	258	Palmyra Avenue (NW)
		PM	0.95	45	D	225	Forrester Road (NE)
I-16S	Upgraded layout	AM	0.94	50	D	275	Palmyra Avenue (NW)
		PM	0.98	55	D	289	Forrester Road (NE)

This intersection gains an additional leg in the 2026. Forrester Road is extended to the east creating a four leg signalised intersection.

The hypothetical layout was assumed based on the Roads and Maritime Strategic Model. In order for the intersection to perform well, some modifications were applied.

The proposed layout for Intersection I-18 (Forrester Road/Ropes Crossing Boulevarde/Links Road) at 2026 with Links Road extension is shown in Figure 8.15.

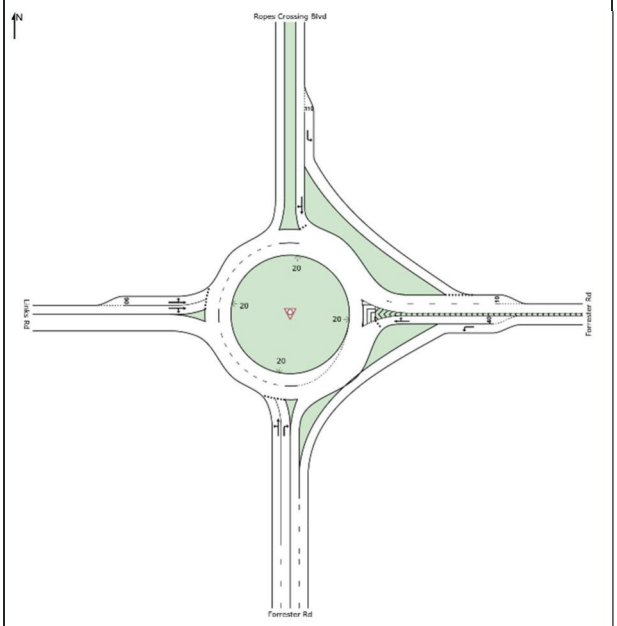
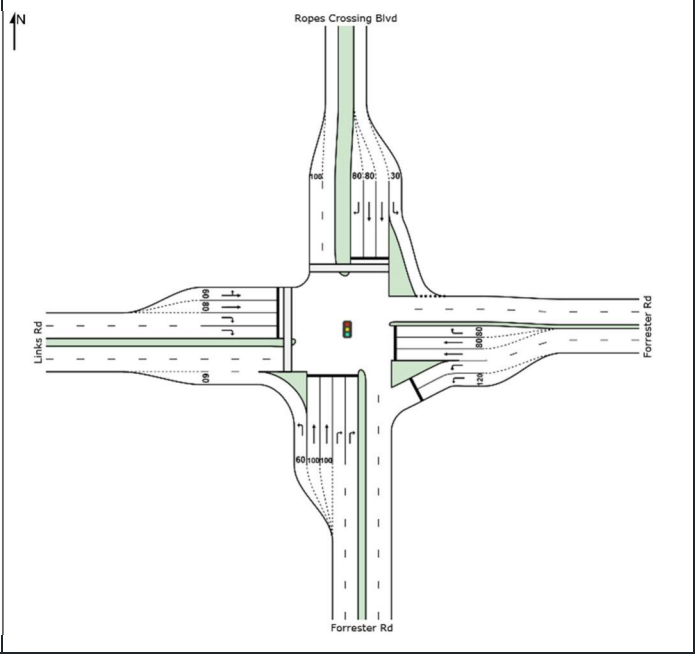
Base Layout	Upgraded Layout
	

Figure 8.15 2026 with Links Road extension – Forrester Road/Ropes Crossing Boulevarde/Links Road

The operation of Intersection I-18 at 2026 with Links Road extension with the upgraded layout is shown in Table 8.15. It is seen that with the upgraded layout, the AM and PM peaks are both forecast to have LoS D.

Table 8.15 2026 with Links Road extension – I-18 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-18	Base layout	AM	1.54	1028	F	2919	Forrester Road (S)
		PM	1.66	1214	F	3383	Forrester Road (S)
I-18	Upgraded layout	AM	0.97	66	E	417	Forrester Road (S)
		PM	0.95	50	D	196	Forrester Road (S)
I-18S	Upgraded layout	AM	0.93	54	D	371	Forrester Road (S)
		PM	0.92	44	D	198	Forrester Road (S)

The upgraded intersection layout recommended in 2021 is NOT suitable for 2026 operation.

The base layout shown above is not the 2021 recommended layout.

The following modification were applied to the intersection for improved performance:

— Signalisation, additional turn lanes and through lanes.

The proposed layout for Intersection I-19 (Forrester Road/Christies Street/Boronia Road) at 2026 with Links Road extension is shown in Figure 8.16.

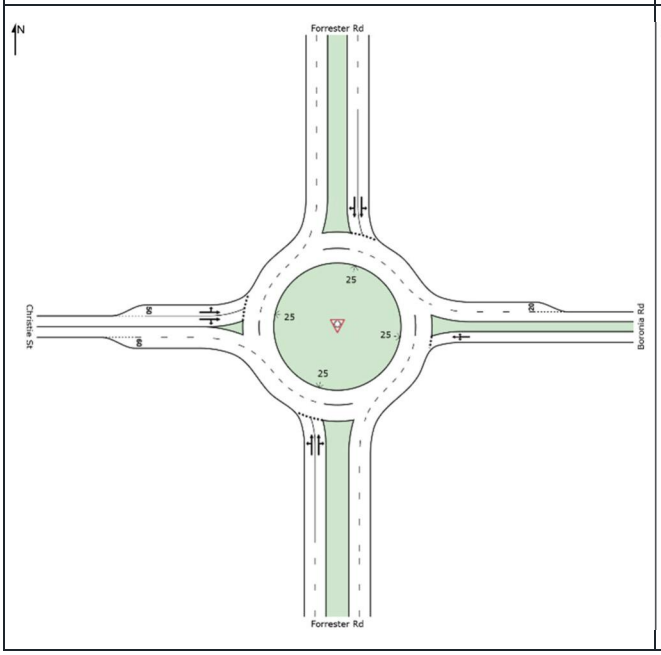
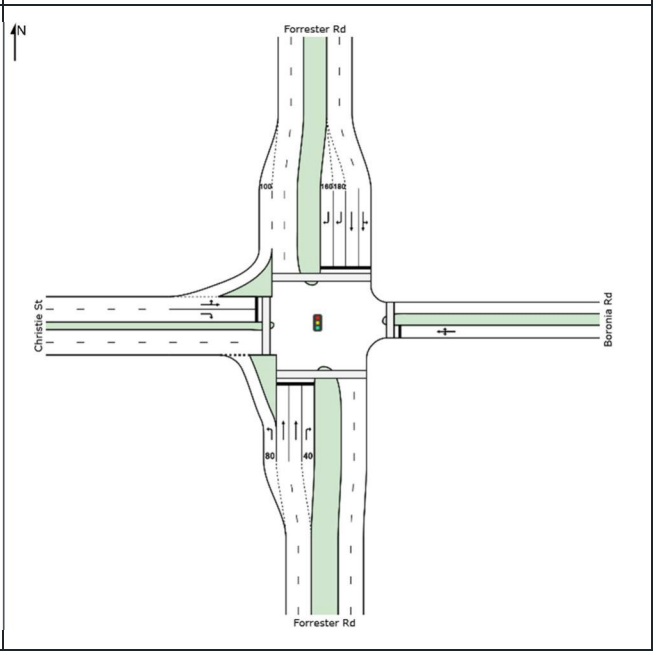
Base Layout	Upgraded Layout
	

Figure 8.16 2026 with Links Road extension – Forrester Road/Christies Street/Boronia Road

The operation of Intersection I-19 at 2026 with Links Road extension with the upgraded layout is shown in Table 8.16. It is seen that with the upgraded layout, the AM and PM peaks are both forecast to have LoS D.

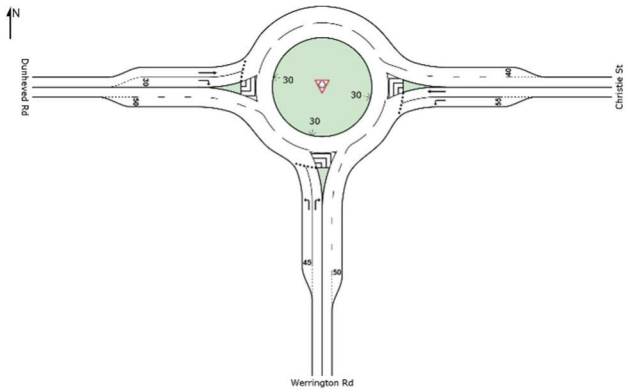
Table 8.16 2026 with Links Road extension – I-19 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-19	Base layout	AM	1.32	617	F	1820	Forrester Road (S)
		PM	1.96	1757	F	4048	Forrester Road (S)
I-19	Upgraded layout	AM	0.93	45	D	286	Forrester Road (S)
		PM	0.98	52	D	337	Forrester Road (S)
I-19S	Upgraded layout	AM	0.95	52	D	264	Forrester Road (S)
		PM	0.95	42	C	244	Forrester Road (S)

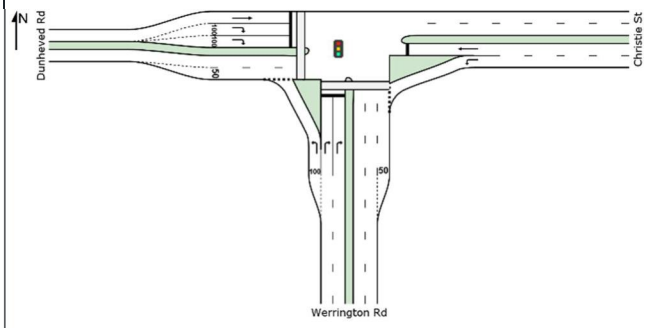
The upgraded intersection layout recommended in 2021 is suitable for 2026 operation.

The proposed layout for Intersection I-23 (Christie Street/Dunheved Road/Werrington Road) at 2026 with Links Road extension is shown in Figure 8.17.

Base Layout



Upgraded Layout 1



Upgraded Layout 2

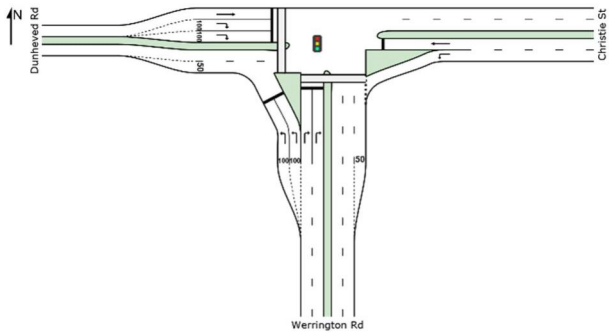


Figure 8.17 2026 with Links Road extension – Christie Street/Dunheved Road/Werrington Road

The operation of Intersection I-23 at 2026 with Links Road extension with the upgraded layout is shown in Table 8.17. It is seen that with the upgraded layout, the AM peak is forecast to have LoS B and the PM peak is forecast to have LoS D.

Table 8.17 2026 with Links Road extension – I-23 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-23	Base layout	AM	0.71	13	A	78	Christie Street (E)
		PM	1.18	368	F	1245	Werrington Road (S)
I-23	Upgraded layout 1	AM	0.74	15	B	85	Dunheved Road (W)
		PM	1.03	51	D	485	Werrington Road (S)
I-23S	Upgrade layout 2	AM	0.81	20	B	163	Dunheved Road (W)
		PM	1.02	56	D	597	Christie Street (E)

New intersection layout is required in 2026 due to poor PM peak performance under base layout. This intersection will require road widening and signalisation.

The proposed layout for Intersection I-25 (Dunheved Road/John Oxley Avenue) at 2026 with Links Road extension is shown in Figure 8.18.

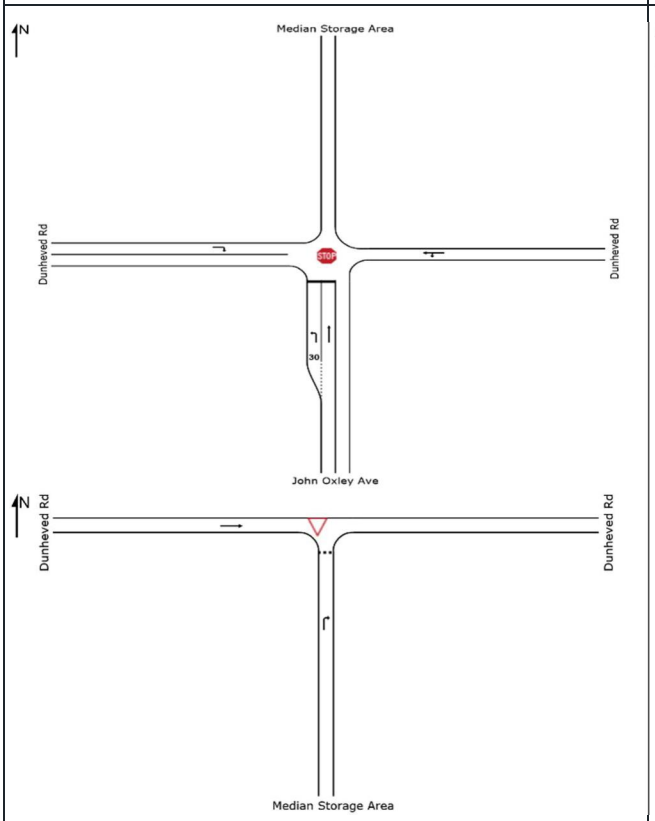
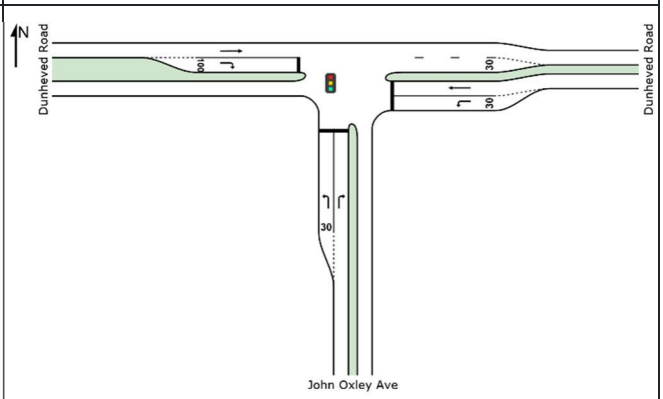
Base Layout	Upgraded Layout
	

Figure 8.18 2026 with Links Road extension – Dunheved Road/John Oxley Avenue

The operation of Intersection I-25 at 2026 with Links Road extension with the upgraded layout is shown in Table 8.18. It is seen that with the upgraded layout, the AM peak is forecast to have LoS A and the PM peak is forecast to have LoS D.

Table 8.18 2026 with Links Road extension – I-25 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-25	Base layout	AM	0.60	21	B	2	John Oxley Avenue (S)
		PM	0.80	69	E	9	Dunheved Road (W)
I-25	Upgraded layout	AM	0.75	6	A	85	Dunheved Road (E)
		PM	1.03	47	D	135	Dunheved Road (E)
I-25S	Upgraded layout	AM	0.76	12	A	88	Dunheved Road (E)
		PM	1.03	44	D	974	Dunheved Road (E)

This intersection requires upgrading in 2026 to traffic signals due to poor performance in the PM peak.

The proposed layout for Intersection I-26 (Dunheved Road, Greenbank Drive and Francis Street) at 2026 with Links Road extension is shown in Figure 8.19.

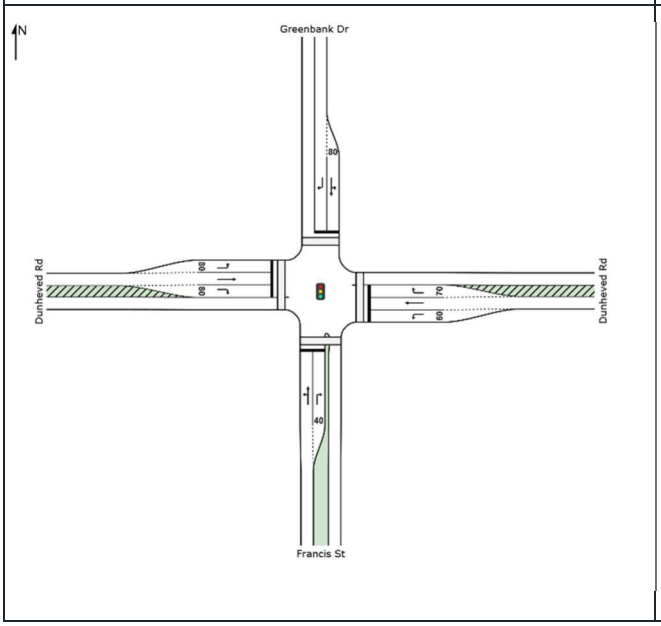
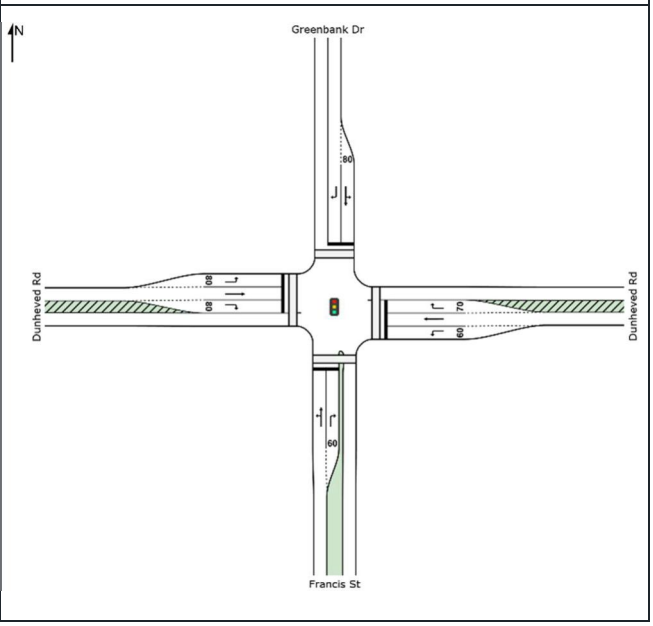
Base Layout	Upgraded Layout
	

Figure 8.19 2026 with Links Road extension – Dunheved Road, Greenbank Drive and Francis Street

The operation of Intersection I-26 at 2026 with Links Road extension with the upgraded layout is shown in Table 8.19. It is seen that with the upgraded layout, the AM peak is forecast to have LoS D and the PM peak is forecast to have LoS C under the without Links Road scenario. With Links Road, the intersection operates at a LoS C under both peaks.

Table 8.19 2026 with Links Road extension – I-26 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-26	Base layout – without Links Road	AM	0.78	57	F	415	Francis Street (S)
		PM	1.11	73	C	357	Dunheved Road (E)
I-26	Upgraded layout – without Links Road	AM	1.05	55	D	324	Francis Street (S)
		PM	0.91	36	C	318	Dunheved Road (E)
I-26S	Upgraded layout – with Links Road	AM	0.89	33	C	212	Dunheved Road (W)
		PM	0.92	33	C	279	Dunheved Road (E)

This intersection requires upgrades in 2026. The right turn bay on the southern approach needs to be extended to 90 metres in length and signal phasing modifications applied to the AM peak.

8.4 2031 Project with rezoning

The required mitigation measures at 2031 Project with rezoning with hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) have been generally undertaken based on the 'with Links Road extension' scenario, except for those locations where the 'without Links Road extension' performance is worse.

The proposed layout for Intersection I-03 (The Northern Road/Borrowdale Way/Greenwood Parkway) at 2031 with Links Road extension is shown in Figure 8.20.

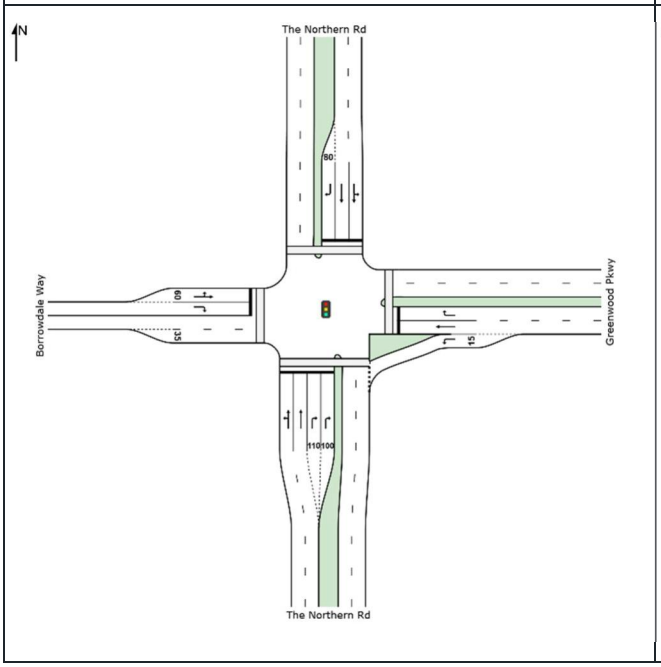
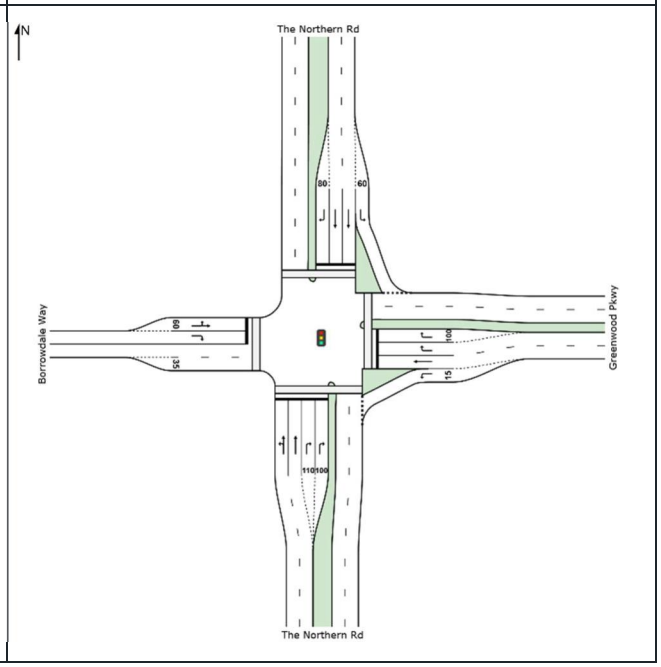
Hypothetical Layout	Upgraded Layout
	

Figure 8.20 2031 with Links Road extension – The Northern Road/Borrowdale Way/Greenwood Parkway

The operation of Intersection I-03 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.20. It is seen that with the upgraded layout, the AM and PM peaks are both forecast to have LoS D.

Table 8.20 2031 with Links Road extension – I-03 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-03	Hypothetical layout	AM	1.10	158	F	636	The Northern Road (N)
		PM	0.99	79	F	432	The Northern Road (N)
I-03	Upgraded layout	AM	0.96	54	D	247	The Northern Road (N)
		PM	0.91	48	D	225	The Northern Road (N)
I-03S	Upgraded layout	AM	0.91	48	D	225	The Northern Road (N)
		PM	0.88	48	D	235	The Northern Road (N)

The upgraded intersection layout recommended in 2021 is suitable for 2031 operation.

The proposed layout for Intersection I-07 (The Northern Road/Andrews Road) at 2031 with Links Road extension is shown in Figure 8.21.

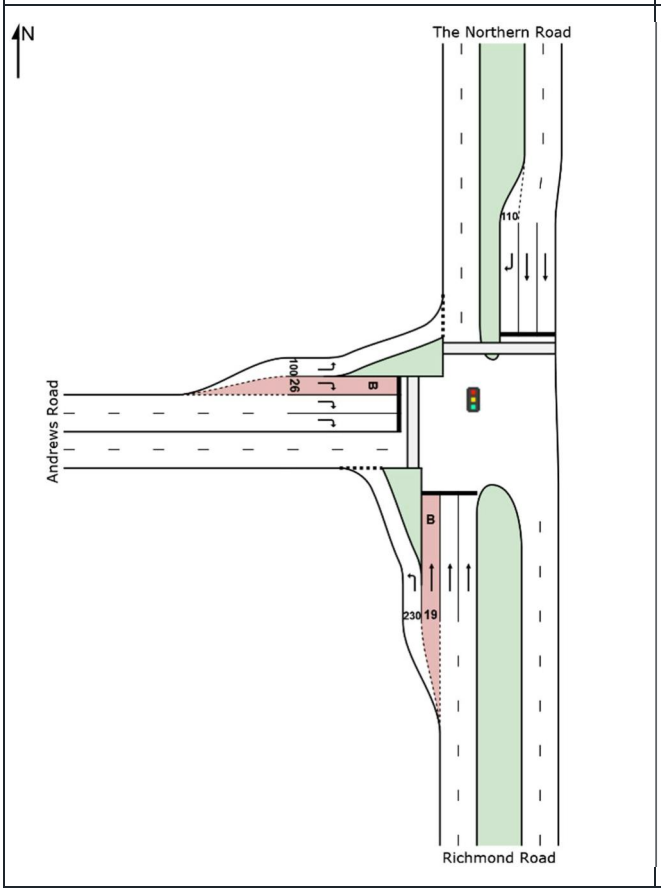
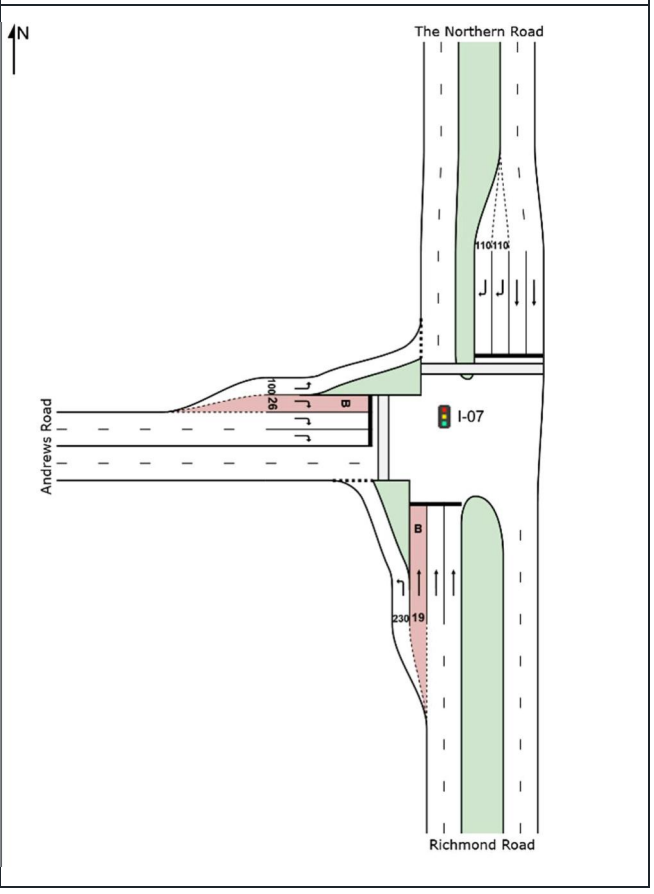
Hypothetical Layout	Upgraded Layout
	

Figure 8.21 2031 with Links Road extension – The Northern Road/Andrews Road

The operation of Intersection I-07 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.21. It is seen that with the upgraded layout, the AM peak is forecast to have LoS C and the PM peak is forecast to have LoS E. Under the sensitivity run, the intersection operates at a LoS B in the PM peak.

Table 8.21 2031 with Links Road extension – I-07 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-07	Hypothetical layout – without Links Road	AM	0.96	58	E	842	The Northern Road (N)
		PM	1.00	58	E	928	Richmond Road (S)
I-07	Upgraded layout – without Links Road	AM	0.93	36	C	622	The Northern Road (N)
		PM	1.00	58	E	916	Richmond Road (S)
I-07S	Upgraded layout – with Links Road	AM	0.92	35	C	516	The Northern Road (N)
		PM	0.86	22	B	395	Richmond Road (S)

This intersection requires upgrading in 2031 under the 'without Links Road' scenario. This will require an additional right-turn bay on the northern approach.

The proposed layout for Intersection I-08 (Richmond Road/Trinity Drive) at 2031 with Links Road extension is shown in Figure 8.22.

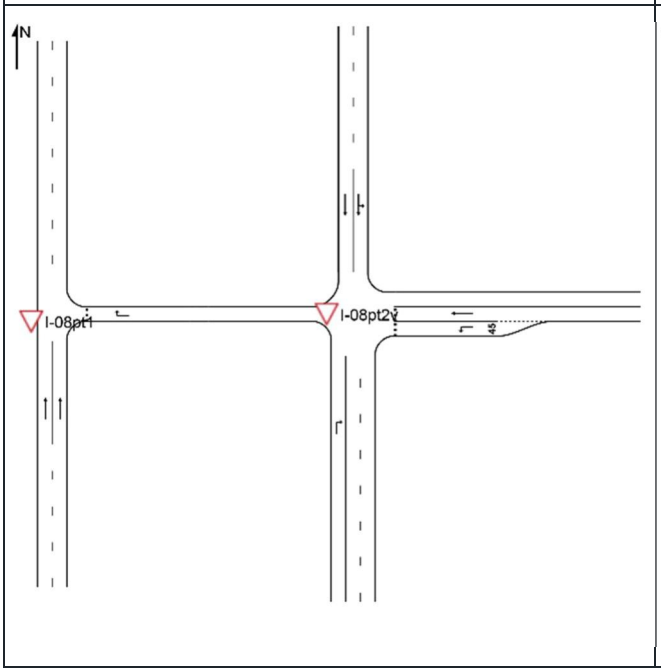
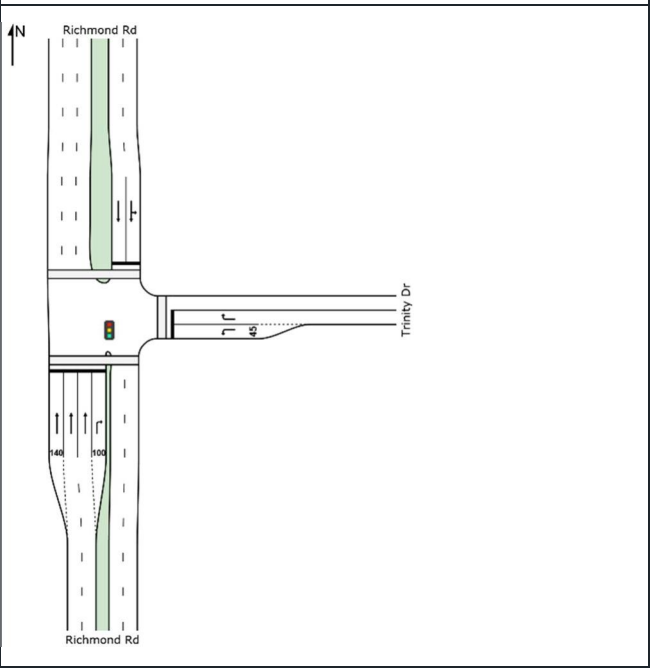
Base Layout	Upgraded Layout
	

Figure 8.22 2031 with Links Road extension – Richmond Road/Trinity Drive

The operation of Intersection I-08 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.22. It is seen that with the upgraded layout, the AM peak is forecast to have LoS B and the PM peak is forecast to have LoS A. Under the sensitivity run, the intersection operates at a LoS C in the AM peak.

Table 8.22 2031 with Links Road extension – I-08 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-08	Base layout	AM	6.17	10087	F	371	Richmond Road (S)
		PM	2.25	12553	F	398	Trinity Drive (E)
I-08	Upgraded layout	AM	0.94	18	B	631	Richmond Road (N)
		PM	0.92	11	A	159	Richmond Road (N)
I-08S	Upgraded layout	AM	0.98	41	C	982	Richmond Road (N)
		PM	0.89	11	A	160	Richmond Road (N)

The upgraded intersection layout recommended in 2026 is suitable for 2031 operation.

The proposed layout for Intersection I-13 (Great Western Highway/Parker Street) at 2031 with Links Road extension is shown in Figure 8.23.

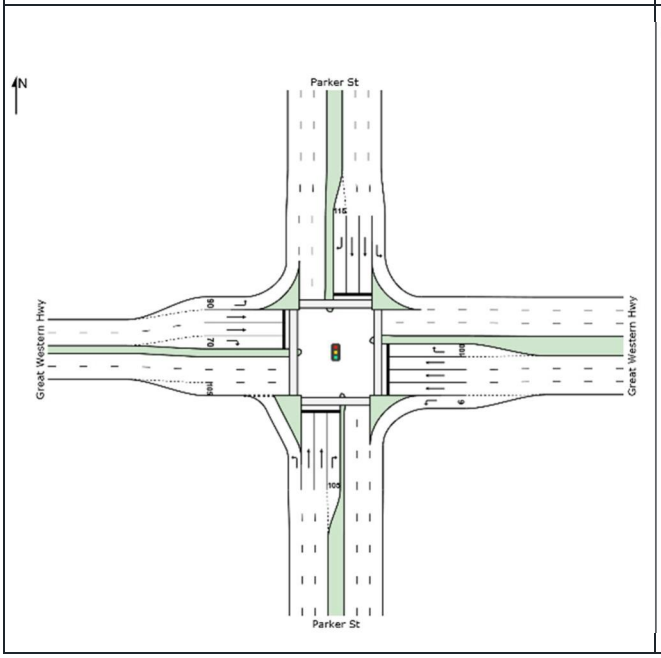
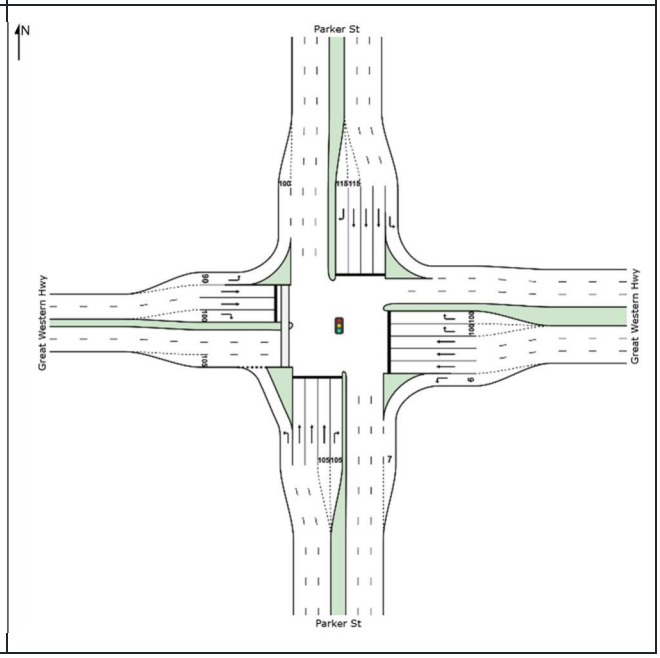
Base Layout	Upgraded Layout
	

Figure 8.23 2031 with Links Road extension – Great Western Highway/Parker Street

The operation of Intersection I-13 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.23. It is seen that with the upgraded layout, the AM peak is forecast to have LoS C and the PM peak is forecast to have LoS F.

Table 8.23 2031 with Links Road extension – I-13 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	approach with worst queue
I-13	Base layout	AM	1.06	91	F	670	Parker Street (N)
		PM	1.17	180	F	717	Parker Street (S)
I-13	Upgraded layout	AM	0.83	42	C	198	Parker Street (N)
		PM	1.32	196	F	671	Parker Street (S)
I-13S	Upgraded layout	AM	0.84	43	D	207	Parker Street (N)
		PM	1.09	83	F	382	Parker Street (S)

The feasibility of this intersection upgrade is currently unknown.

The proposed layout for Intersection I-15 (Palmyra Avenue/Australis Drive) at 2031 with Links Road extension is shown in Figure 8.24.

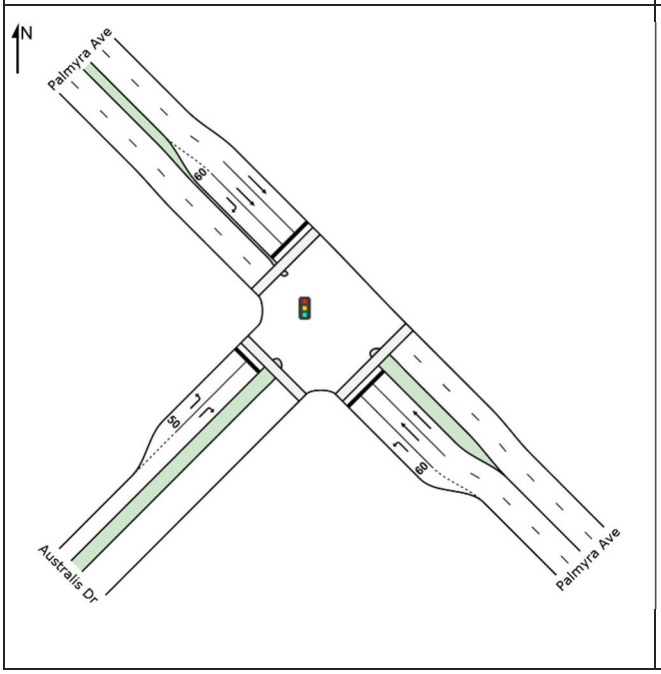
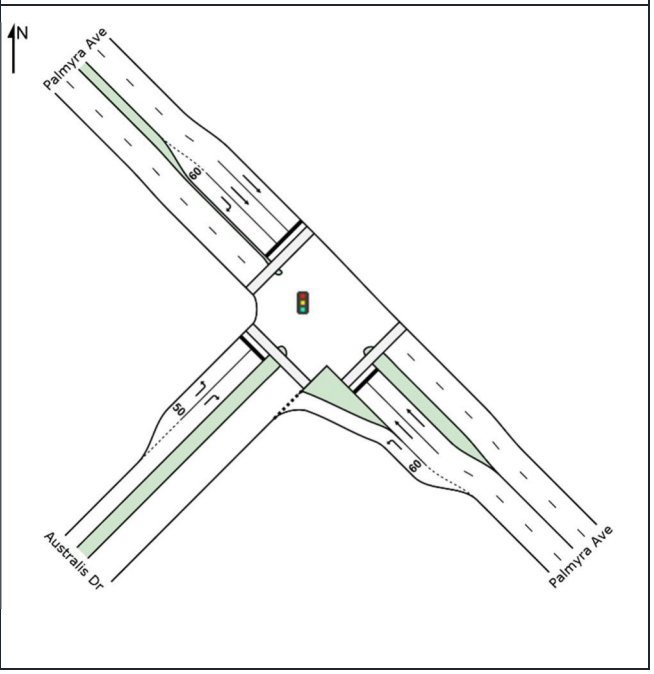
Base Layout	Upgraded Layout
	

Figure 8.24 2031 with Links Road extension – Palmyra Avenue/Australis Drive

The operation of Intersection I-15 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.24. It is seen that with the upgraded layout, the AM peak is forecast to have LoS B and the PM peak is forecast to have LoS C.

Table 8.24 2031 with Links Road extension – I-15 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-15	Base layout	AM	0.71	21	B	95	Palmyra Avenue (SE)
		PM	1.18	177	F	1461	Palmyra Avenue (SE)
I-15	Upgraded layout	AM	0.58	18	B	80	Palmyra Avenue (NW)
		PM	0.96	42	C	485	Palmyra Avenue (SE)
I-15S	Upgraded layout	AM	0.59	18	B	74	Palmyra Avenue (NW)
		PM	0.98	42	C	482	Palmyra Avenue (SE)

This intersection requires an upgrade in 2031 to include a left-turn slip lane on the southern approach due to heavy left-turn demands in the PM peak.

The proposed layout for Intersection I-16 (Palmyra Avenue/Forrester Road) at 2031 with Links Road extension is shown in Figure 8.25.

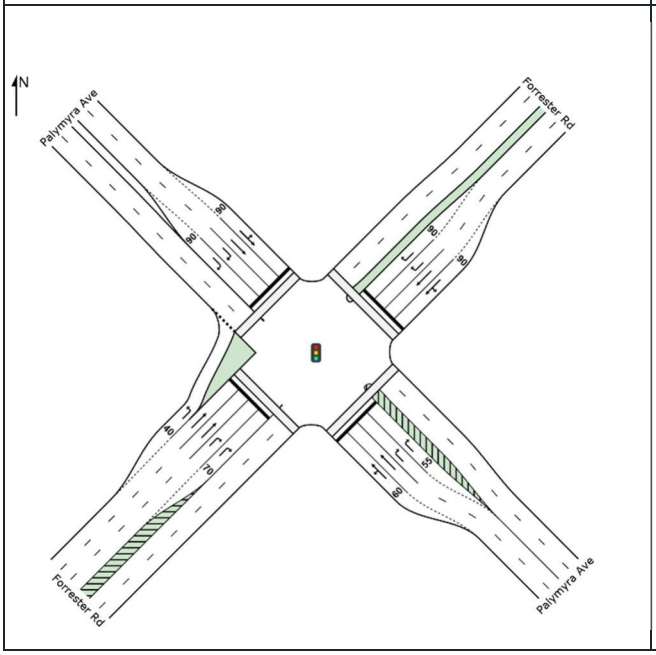
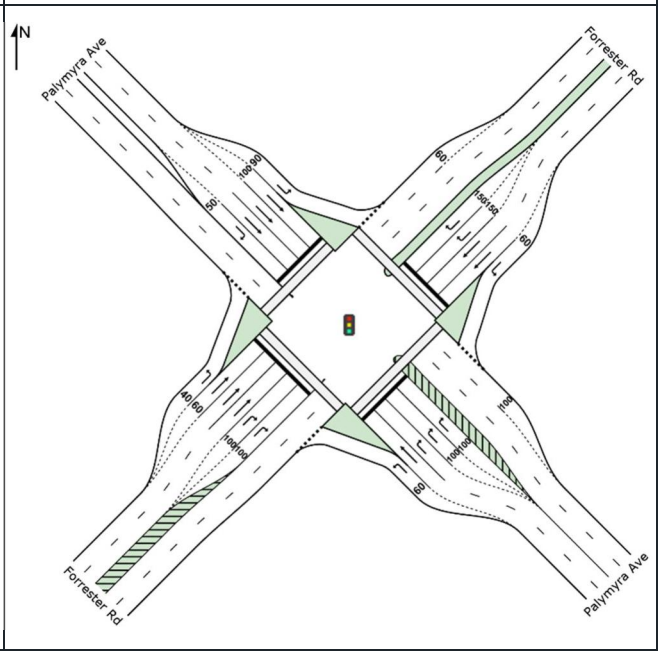
Base Layout	Upgraded Layout
	

Figure 8.25 2031 with Links Road extension – Palmyra Avenue/Forrester Road

The operation of Intersection I-16 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.25. It is seen that with the upgraded layout, the AM and PM peaks are both forecast to have LoS D.

Table 8.25 2031 with Links Road extension – I-16 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-16	Base layout	AM	1.33	383	F	929	Palmyra Avenue (NW)
		PM	1.17	197	F	603	Forrester Road (NE)
I-16	Upgraded layout	AM	0.94	52	D	214	Forrester Road (SW)
		PM	0.91	50	D	263	Forrester Road (NE)
I-16S	Upgraded layout	AM	0.95	55	D	229	Forrester Road (SW)
		PM	0.91	50	D	259	Forrester Road (NE)

The new intersection layout recommended in 2026 is NOT suitable for 2031 operation. Further modifications are required to enable suitable operation in 2031.

The proposed layout for Intersection I-18 (Forrester Road/Ropes Crossing Boulevarde/Links Road) at 2031 with Links Road extension is shown in Figure 8.26.

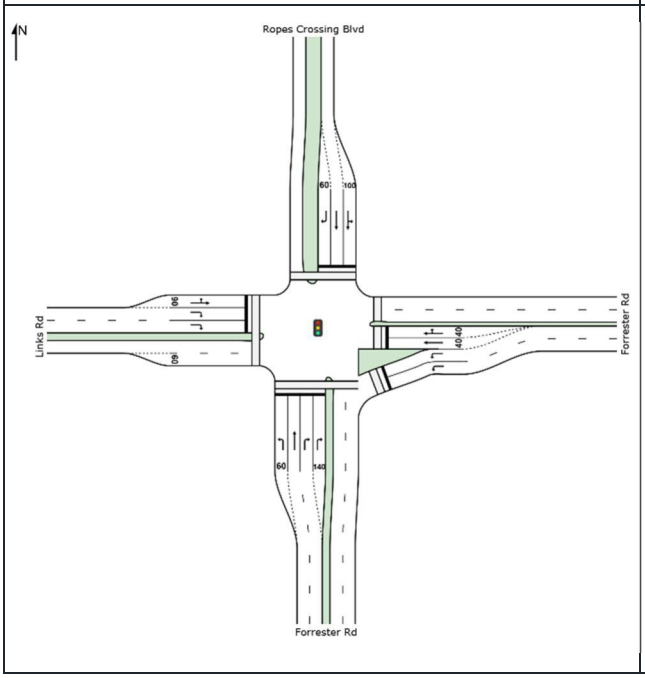
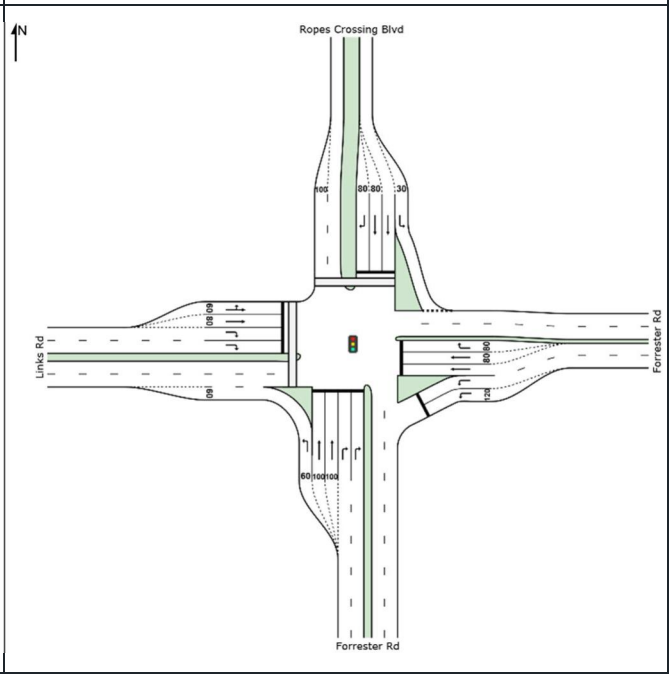
Base Layout	Upgraded Layout
	

Figure 8.26 2031 with Links Road extension – Forrester Road/Ropes Crossing Boulevard/Links Road

The operation of Intersection I-18 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.26. It is seen that with the upgraded layout, the AM peak is forecast to have LoS E and the PM peak is forecast to have LoS C.

Table 8.26 2031 with Links Road extension – I-18 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-18	Base layout	AM	2.02	754	F	1920	Links Road (W)
		PM	2.66	1122	F	2161	Links Road (W)
I-18	Upgraded layout	AM	0.96	54	D	319	Forrester Road (S)
		PM	0.90	41	C	171	Forrester Road (E)
I-18S	Upgraded layout	AM	0.97	56	D	342	Forrester Road (S)
		PM	0.88	38	C	174	Forrester Road (E)

The upgraded intersection layout in 2026 is suitable for 2031 operation.

The proposed layout for Intersection I-19 (Forrester Road/Christies Street/Boronia Road) at 2031 with Links Road extension is shown in Figure 8.27.

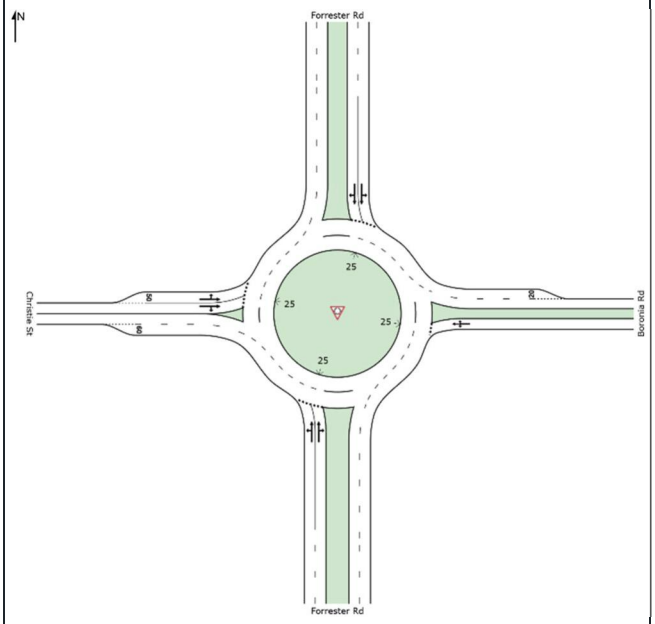
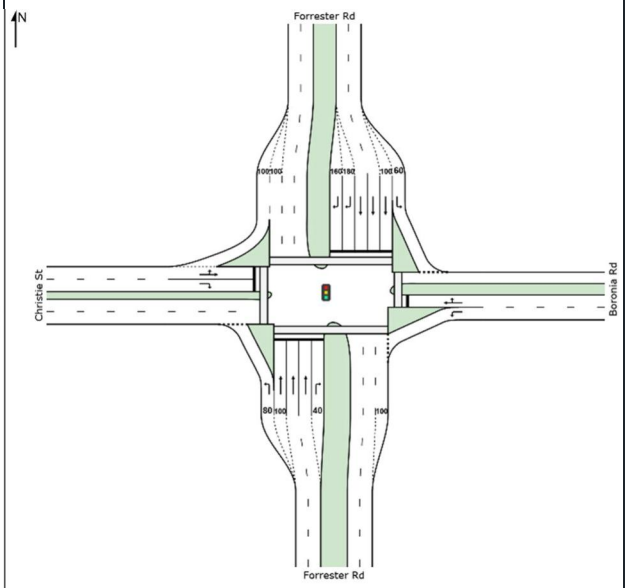
Base Layout	Upgraded Layout
	

Figure 8.27 2031 with Links Road extension – Forrester Road/Christies Street/Boronia Road

The operation of Intersection I-19 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.27. It is seen that with the upgraded layout, the AM peak is forecast to have LoS C and the PM peak is forecast to have LoS D.

Table 8.27 2031 with Links Road extension – I-19 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-19	Base layout	AM	1.25	401	F	1360	Forrester Road (N)
		PM	1.29	405	F	1259	Forrester Road (N)
I-19	Upgraded layout	AM	0.92	41	C	244	Forrester Road (N)
		PM	0.98	53	D	329	Forrester Road (N)
I-19S	Upgraded layout	AM	0.92	40	C	237	Forrester Road (N)
		PM	0.96	47	D	291	Forrester Road (N)

The upgraded intersection layout in 2021 is NOT suitable for 2031 operation. Further modifications are required to enable suitable operation in 2031.

The proposed layout for Intersection I-21 (Great Western Highway/Glossop Street) at 2031 with Links Road extension is shown in Figure 8.28.

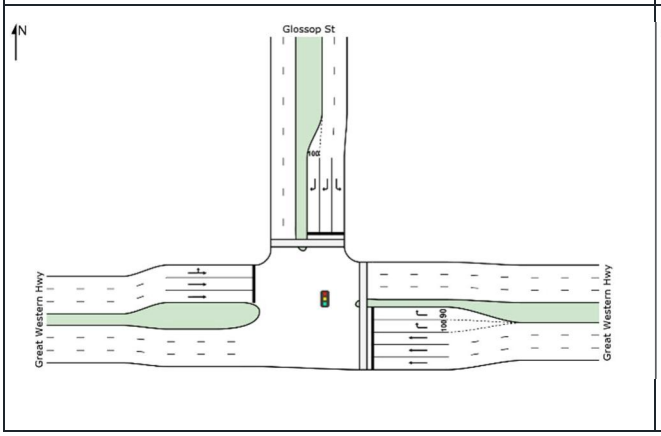
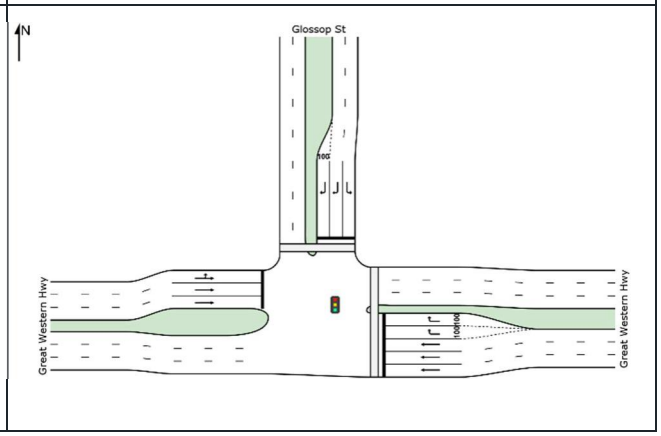
Base Layout	Upgraded Layout
	

Figure 8.28 2031 with Links Road extension – Great Western Highway/Glossop Street

The operation of Intersection I-21 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.28. It is seen that with the upgraded layout, the AM peak is forecast to have LoS D and the PM peak is forecast to have LoS B. Under the sensitivity run, it performs at LoS C in the AM peak.

Table 8.28 2031 with Links Road extension – I-21 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-21	Base layout – without Links Road	AM	1.02	59	E	371	Great Western Highway (W)
		PM	0.91	23	B	122	Great Western Highway (E)
I-21	Upgraded layout	AM	0.96	50	D	371	Great Western Highway (W)
		PM	0.91	23	B	122	Great Western Highway (E)
I-21S	Upgraded layout	AM	0.90	40	C	279	Great Western Highway (W)
		PM	0.89	24	B	133	Great Western Highway (E)

The upgrade of this intersection to achieve LoS D requires the extension of the right most right turn lane on the eastern approach by 10 metres, however as this is a minimal improvement this may be deemed not necessary.

The proposed layout for Intersection I-23 (Christie Street/Dunheved Road/Werrington Road) at 2031 with Links Road extension is shown in Figure 8.29.

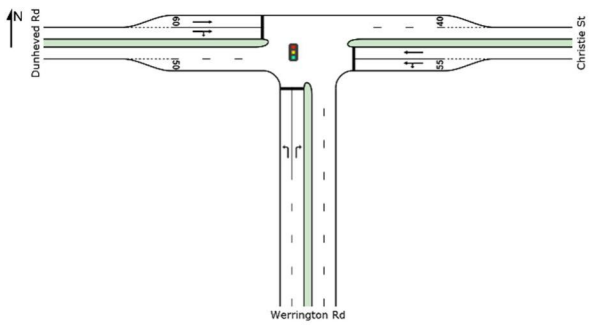
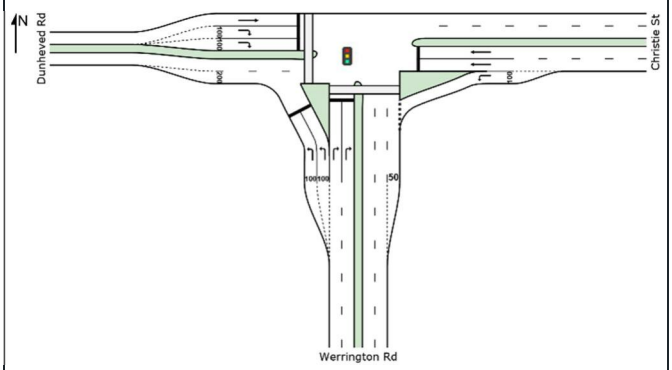
Hypothetical Layout	Upgraded Layout
	

Figure 8.29 2031 with Links Road extension – Christie Street, Dunheved Road and Werrington Road

The operation of Intersection I-23 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.29. It is seen that with the upgraded layout, the AM peak is forecast to have LoS B and the PM peak is forecast to have LoS C.

Table 8.29 2031 with Links Road extension – I-23 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-23	Hypothetical layout	AM	1.73	856	F	2344	Dunheved Road (W)
		PM	1.70	788	F	3096	Christie Street (E)
I-23	Upgraded layout	AM	0.73	24	B	166	Dunheved Road (W)
		PM	0.81	30	C	153	Christie Street (E)
I-23S	Upgraded layout	AM	0.73	24	B	166	Dunheved Road (W)
		PM	0.81	30	C	153	Christie Street (E)

The intersection layout recommended in 2026 is NOT suitable for 2031 operation. Further modifications are required to enable suitable operation in 2031.

The proposed layout for Intersection I-24 (Great Western Highway/Werrington Road) at 2031 with Links Road extension is shown in Figure 8.30.

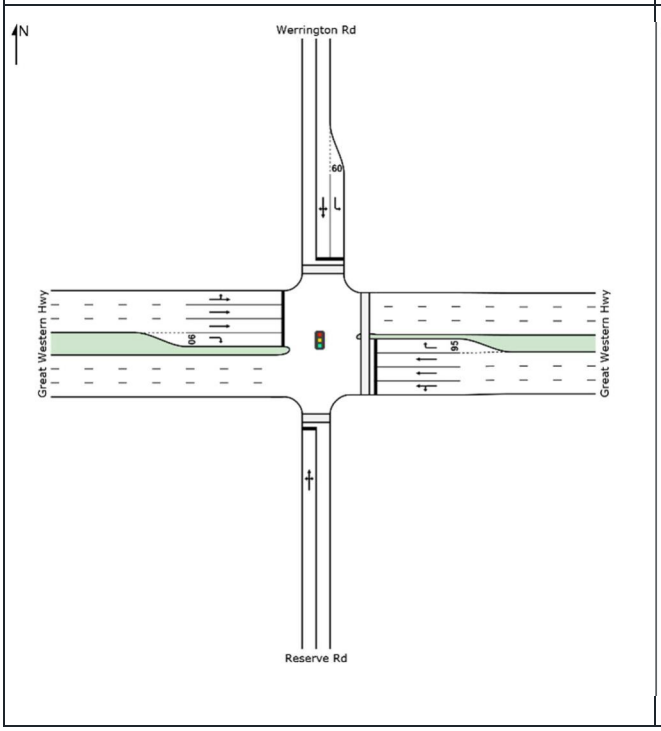
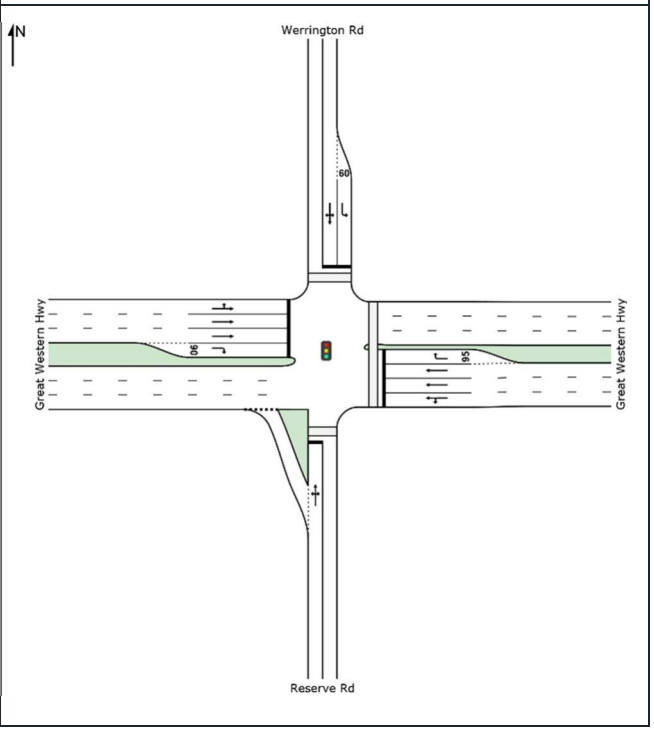
Base Layout	Upgraded Layout
	

Figure 8.30 2031 with Links Road extension – Great Western Highway/Werrington Road

The operation of Intersection I-24 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.30. It is seen that with the upgraded layout, the AM peak is forecast to have LoS D and the PM peak is forecast to have LoS B. Under the sensitivity run, it performs at LoS C in the PM peak.

Table 8.30 2031 with Links Road extension – I-24 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-24	Base layout	AM	1.11	63	E	583	Werrington Road (N)
		PM	1.03	38	C	260	Werrington Road (N)
I-24	Upgraded layout	AM	1.04	48	D	421	Werrington Road (N)
		PM	0.89	27	B	131	Werrington Road (N)
I-24S	Upgraded layout	AM	1.03	44	D	383	Werrington Road (N)
		PM	0.96	31	C	177	Werrington Road (N)

This intersection requires upgrading in 2031 due to poor performance in the AM peak.

The proposed layout for Intersection I-25 (Dunheved Road/John Oxley Avenue) at 2031 with Links Road extension is shown in Figure 8.31.

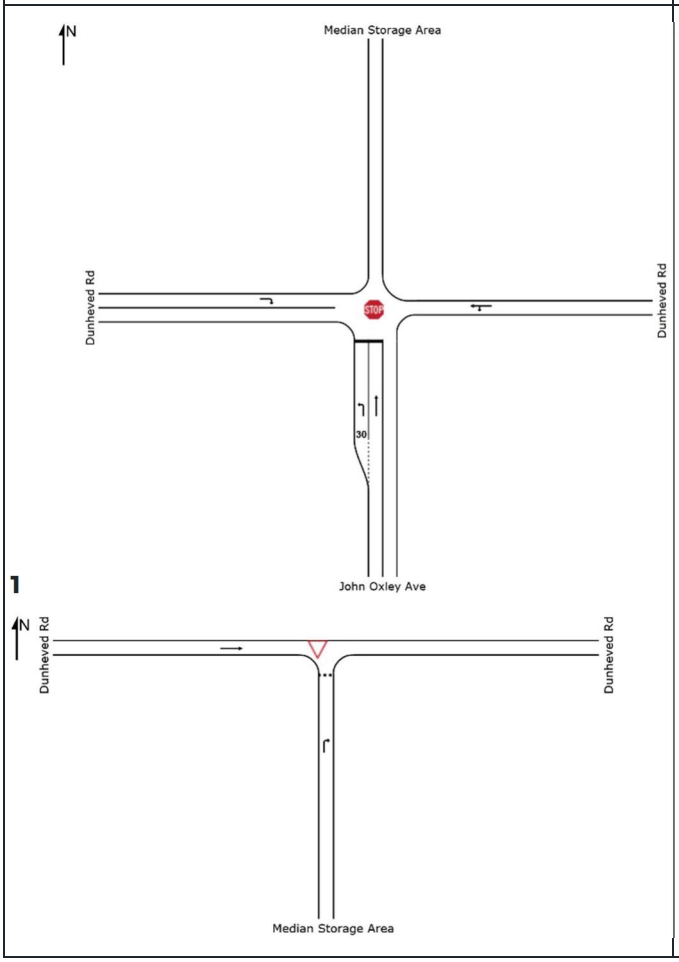
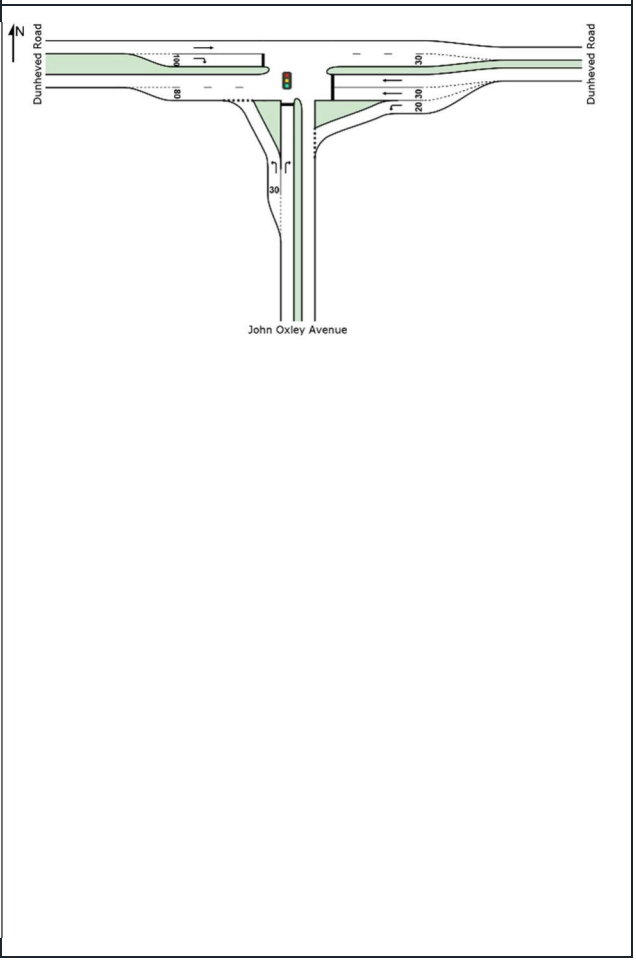
Base Layout	Upgraded Layout
	

Figure 8.31 2031 with Links Road extension – Dunheved Road/John Oxley Avenue

The operation of Intersection I-25 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.31. It is seen that with the upgraded layout, the AM peak is forecast to have LoS A and the PM peak is forecast to have LoS D.

Table 8.31 2031 with Links Road extension – I-25 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-25	Base layout	AM	0.59	23	B	2	John Oxley Avenue (S)
		PM	3.92	5729	F	351	Dunheved Road (W)
I-25	Upgraded layout	AM	0.77	6	A	57	Dunheved Road (E)
		PM	0.84	7	A	126	Dunheved Road (E)
I-25S	Upgraded layout	AM	0.78	6	A	58	Dunheved Road (E)
		PM	0.83	7	A	120	Dunheved Road (E)

The intersection layout recommended in 2026 is NOT suitable for 2031 operation.

The proposed layout for Intersection I-26 (Dunheved Road, Greenbank Drive and Francis Street) at 2031 with Links Road extension is shown in Figure 8.32.

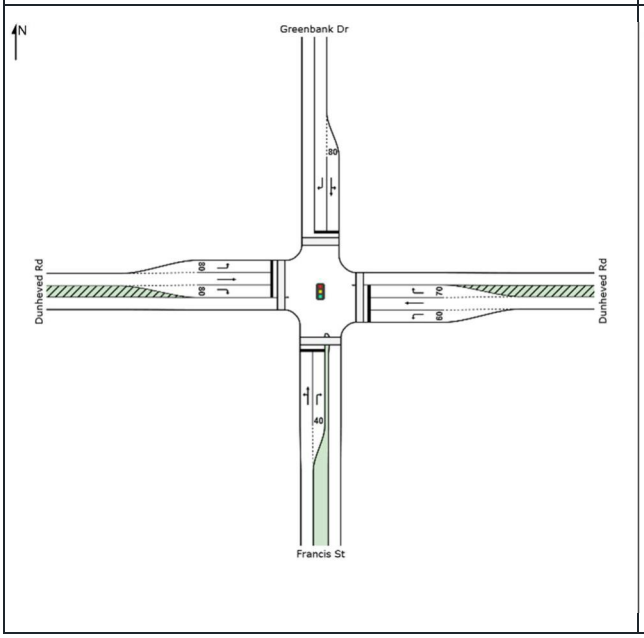
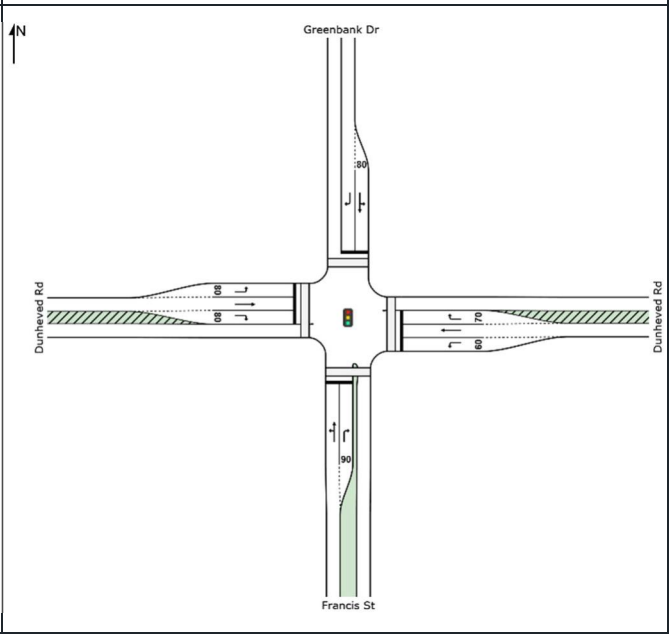
Base Layout	Upgraded Layout
	

Figure 8.32 2031 with Links Road extension – Dunheved Road/Greenbank Drive/Francis Street

The operation of Intersection I-26 at 2031 with Links Road extension with the upgraded layout is shown in Table 8.32. It is seen that with the upgraded layout, the AM peak is forecast to have LoS D and the PM peak is forecast to have LoS C.

Table 8.32 2031 with Links Road extension – I-26 upgraded intersection performance

ID	Description	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-26	Base layout	AM	1.08	71	F	348	Francis Street (S)
		PM	0.94	39	C	345	Dunheved Road (E)
I-26	Upgraded layout	AM	1.02	56	D	272	Francis Street (S)
		PM	0.89	35	C	310	Dunheved Road (E)
I-26S	Upgraded layout	AM	0.95	48	D	218	Dunheved Road (W)
		PM	0.89	32	C	266	Dunheved Road (E)

The intersection layout recommended in 2026 is suitable for 2031 operation.

8.5 Summary

We have developed mitigation measures for implementation at those intersections where LoS E or F have been forecast at years 2021, 2026 and 2031. The mitigation measures have resulted in the forecasting of acceptable LoS at each intersection under assessment.

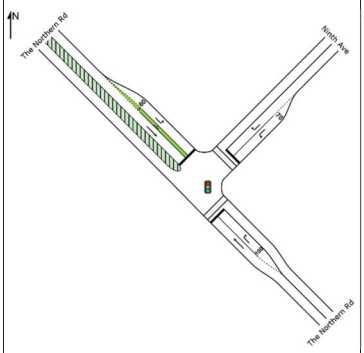
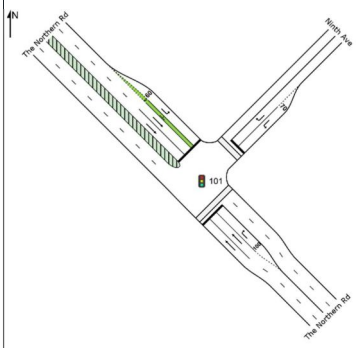
9 KEY FINDINGS AND DISCUSSION

9.1 Intersection layout summary

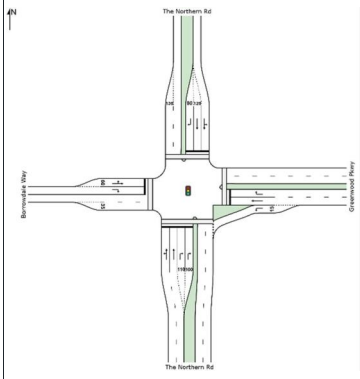
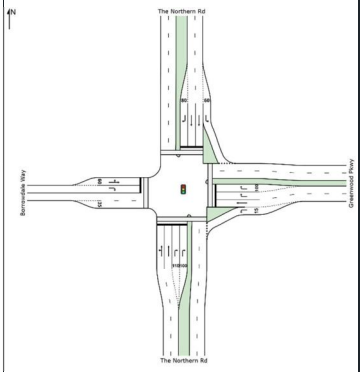
This section presents a summary of the study intersection layouts required for the 'Project' with rezoning scenarios in 2021, 2026 and 2031, based on the intersection performance results as discussed in section 7 and mitigation measures for intersection upgrades discussed in section 8. The tables present existing intersection and upgraded layouts for suitable intersection operation in that year. For some intersections, upgrades proposed in an earlier assessment year, may or may not be suitable in a future year. Should the intersection layout require upgrading again in a future year, this is clearly explained.

Please note that improvements in the form of intersection upgrades for improved intersection performance are due to both the developments traffic and background traffic growth for assessed years 2016, 2021, 2026 and 2031.

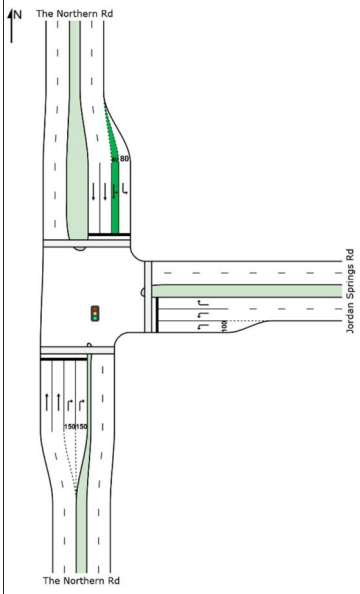
9.1.1 I-01 The Northern Road and Ninth Avenue

2016	2021	2026	2031
		No upgrade required to 2021 layout	No upgrade required to 2021 layout
— Existing layout	— Hypothetical layout	— As per hypothetical 2021 layout	— As per hypothetical 2021 layout
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (hypothetical road network)		
— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B

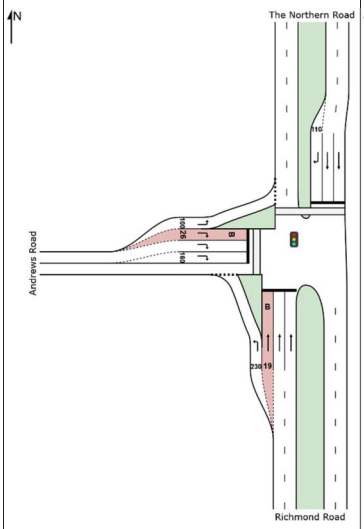
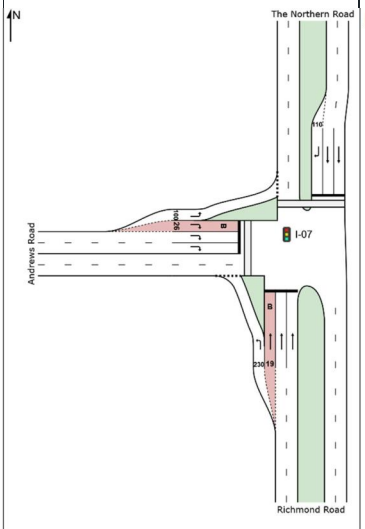
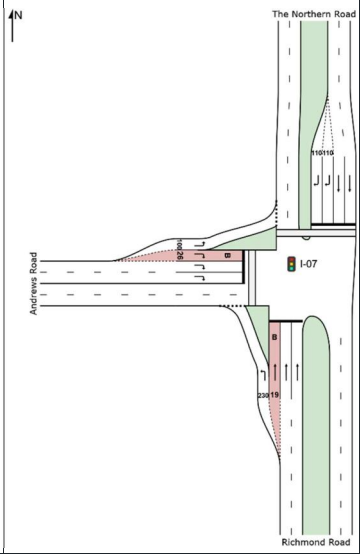
9.1.2 I-03 The Northern Road, Borrowdale Way and Greenwood Parkway

2016	2021	2026	2031
		No upgrade required to 2021 layout	No upgrade required to 2021 layout
— Existing layout	— Addition of 60 m left turn slip lane on northern approach — Addition of 100 m right turn bay on western approach	— As per 2021 upgraded layout	— As per 2021 upgraded layout
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (hypothetical road network)		
— AM Peak LoS: C — PM Peak LoS: C	— AM Peak LoS: C — PM Peak LoS: D	— AM Peak LoS: C — PM Peak LoS: D	— AM Peak LoS: D — PM Peak LoS: D

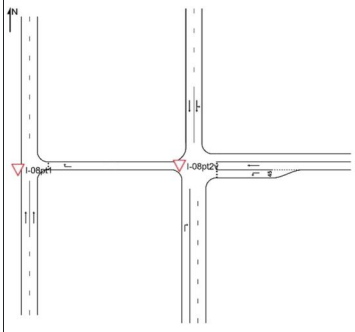
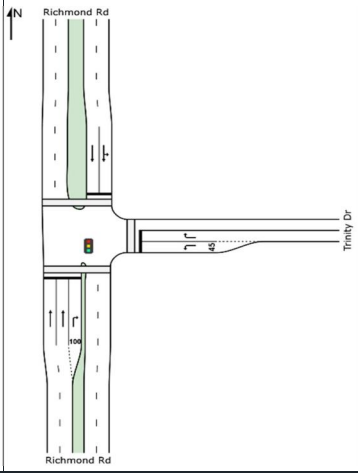
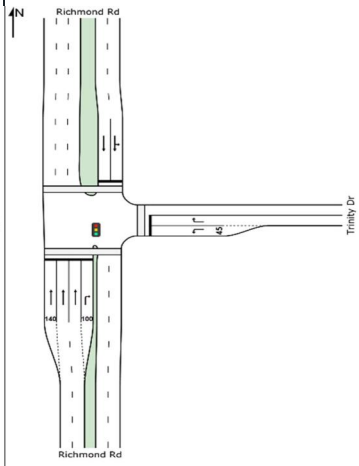
9.1.3 I-05 The Northern Road and Jordan Springs Boulevard

2016	2021	2026	2031
	No upgrade required to 2016 layout	No upgrade required to 2016 layout	No upgrade required to 2016 layout
— Existing layout	— As per existing layout	— As per existing layout	— As per existing layout
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (base road network)		
— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B

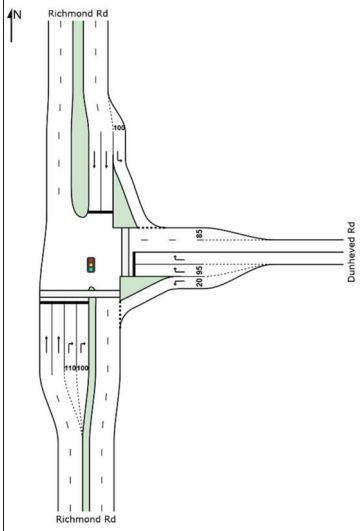
9.1.4 I-07 The Northern Road and Andrews Road

2016	2021	2026	2031
		No upgrade required to **2021** layout	
— Existing layout	— Hypothetical layout	— As per 2021 hypothetical layout	— Addition of 110 m right turn bay on northern approach
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (hypothetical road network)		
— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: C — PM Peak LoS: B	— AM Peak LoS: C — PM Peak LoS: B

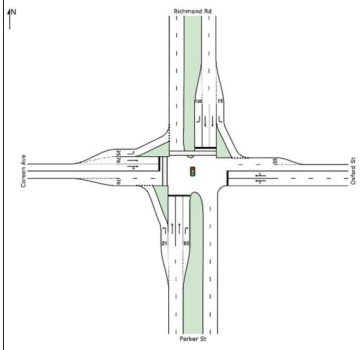
9.1.5 I-08 Richmond Road and Trinity Drive

2016	2021	2026	2031
			No upgrades required to 2026 layout
— Existing layout	— Signalisation	— Addition of 140 m through lane on southern approach — Addition of 140 m departure lane on northern leg	— As per 2026 upgraded layout
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (base road network)		
— AM Peak LoS: F — PM Peak LoS: D	— AM Peak LoS: A — PM Peak LoS: A	— AM Peak LoS: C — PM Peak LoS: A	— AM Peak LoS: C — PM Peak LoS: A

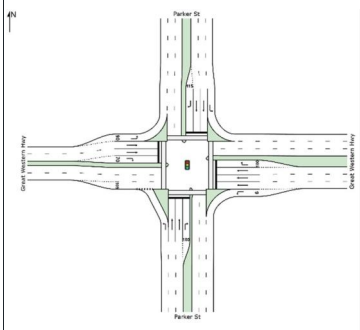
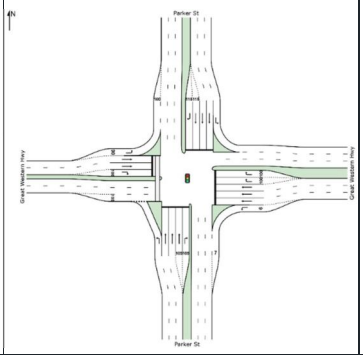
9.1.6 I-10 Richmond Road and Dunheved Road

2016	2021	2026	2031
	No upgrades required to 2016 layout	No upgrades required to 2016 layout	No upgrades required to 2016 layout
— Existing layout	— As per the existing layout	— As per the existing layout	— As per the existing layout
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (base road network)		
— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: C — PM Peak LoS: B	— AM Peak LoS: C — PM Peak LoS: B

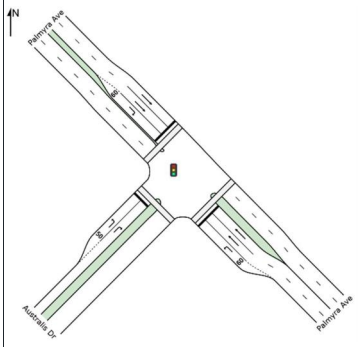
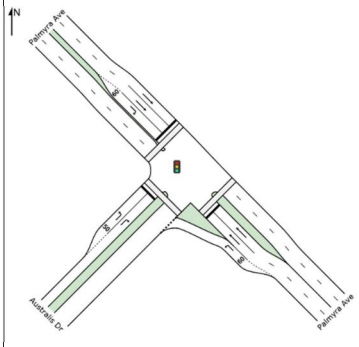
9.1.7 I-11 Richmond Road, Parker Street, Coreen Avenue and Oxford Street

2016	2021	2026	2031
	No upgrades required to 2016 layout	No upgrades required to 2016 layout	No upgrades required to 2016 layout
— Existing layout	— As per the existing layout	— As per the existing layout	— As per the existing layout
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (base road network)		
— AM Peak LoS: C — PM Peak LoS: C	— AM Peak LoS: B — PM Peak LoS: C	— AM Peak LoS: B — PM Peak LoS: C	— AM Peak LoS: C — PM Peak LoS: C

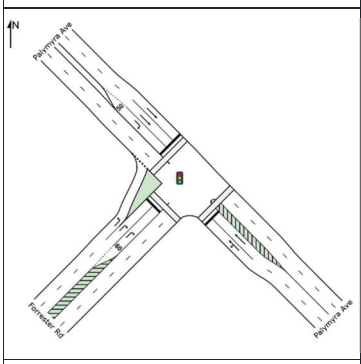
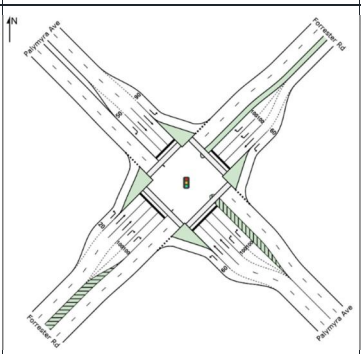
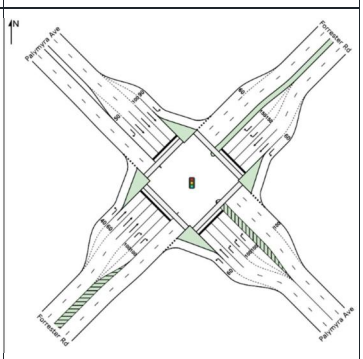
9.1.8 I-13 Great Western Highway and Parker Street

2016	2021	2026	2031
		No upgrades required to 2021 layout	Further upgrades are required to 2021 upgraded layout
— Existing layout	— 115 m shorth through lane on northern approach — 100 m right turn bay on eastern approach — 105 m short through lane on southern approach	— As per 2021 upgraded layout	— Further upgrades required — Feasibility of further upgrades is currently unknown
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (base road network)		
— AM Peak LoS: D — PM Peak LoS: F	— AM Peak LoS: C — PM Peak LoS: D	— AM Peak LoS: C — PM Peak LoS: D	— AM Peak LoS: C — PM Peak LoS: F

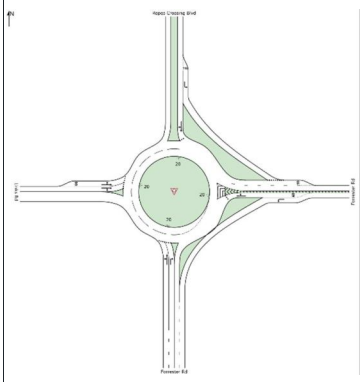
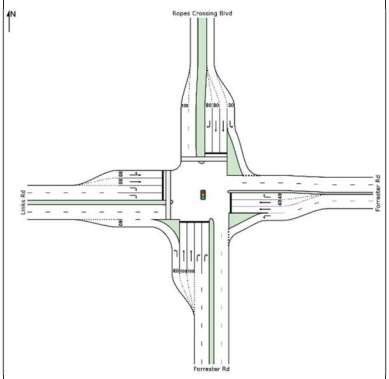
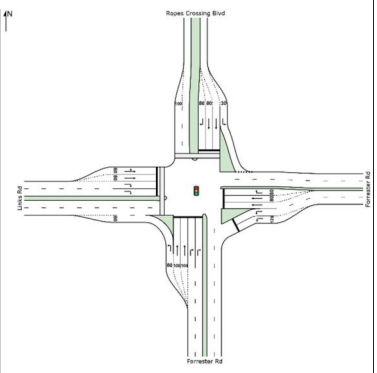
9.1.9 I-15 Palmyra Avenue and Australis Drive

2016	2021	2026	2031
	No upgrades required to **2016** layout	No upgrades required to **2016** layout	
— Existing layout	— As per the existing layout	— As per the existing layout	— Addition of left turn slip lane on south eastern approach
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (base road network)		
— AM Peak LoS: A — PM Peak LoS: A	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: D	— AM Peak LoS: B — PM Peak LoS: C

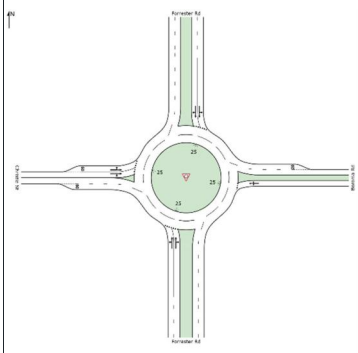
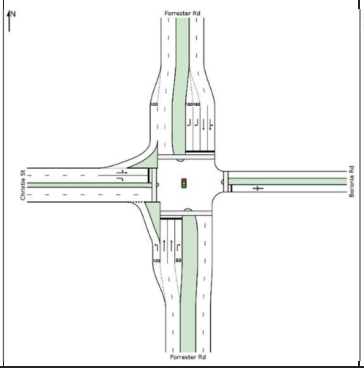
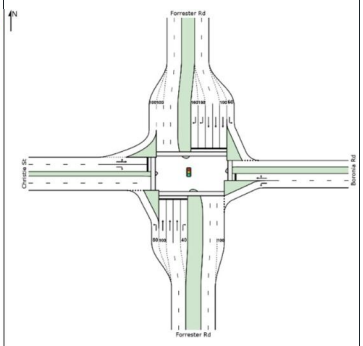
9.1.10 I-16 Palmyra Avenue and Forrester Road

2016	2021	2026	2031
	No upgrades required to **2016** layout		
— Existing layout	— As per the existing layout	— Hypothetical layout — Addition of new north eastern leg — Addition of left turn slip lanes on all approaches — Addition of dual right turn bays on all approaches except north western approach	— Addition of dual right turn bay on northern western approach — Addition of 100 m through lane on north western approach and departure lane on south eastern approach — Addition of left turn slip lane on all approaches
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (hypothetical road network)		
— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: D — PM Peak LoS: D	— AM Peak LoS:D — PM Peak LoS: D

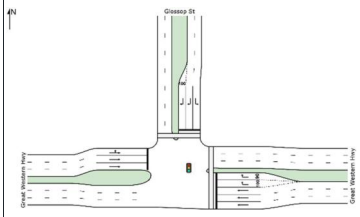
9.1.11 I-18 Forrester Road, Ropes Crossing Boulevard and Links Road

2016	2021	2026	2031
			No upgrades required to 2026 layout
— Existing layout	— Signalisation — Significant upgrades to all approaches	— Addition of dual left turn signalised slip lane on eastern approach	— As per 2026 upgraded layout
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (hypothetical road network)		
— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: D — PM Peak LoS: C	— AM Peak LoS: D — PM Peak LoS: D	— AM Peak LoS: D — PM Peak LoS: C

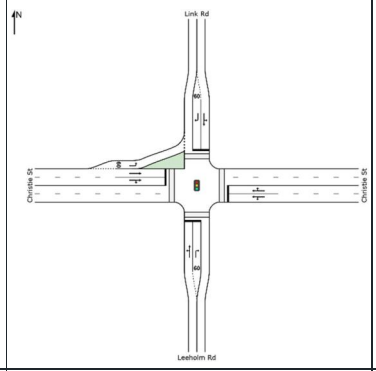
9.1.12 I-19 Forrester Road, Christie Street and Boronia Road

2016	2021	2026	2031
		No upgrades required to **2021** layout	
— Existing layout	— Signalisation — Significant upgrades to the northern, western and southern legs.	— As per the 2021 upgraded layout	— Hypothetical layout — Addition of 60 m left turn slip lane on northern approach — Addition of left turn slip lane on eastern approach — Addition of 100 m through and departure lane on northern and southern approaches in both directions
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (hypothetical road network)		
— AM Peak LoS: B — PM Peak LoS: F	— AM Peak LoS: C — PM Peak LoS: C	— AM Peak LoS: D — PM Peak LoS: C	— AM Peak LoS: C — PM Peak LoS: D

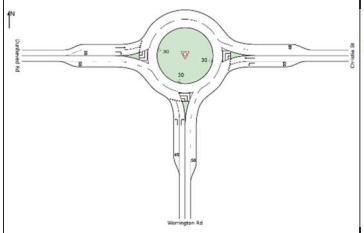
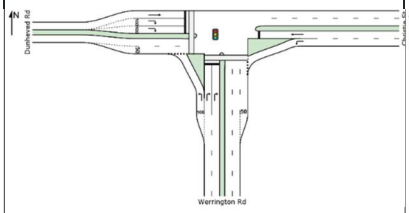
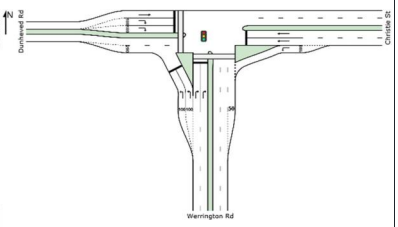
9.1.13 I-21 Great Western Highway and Glossop Street

2016	2021	2026	2031
	No upgrades required to 2016 layout	No upgrades required to 2016 layout	No upgrades required to 2016 layout
— Existing layout	— As per existing layout	— As per existing layout	— As per existing layout
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (base road network)		
— AM Peak LoS: C — PM Peak LoS: C	— AM Peak LoS: C — PM Peak LoS: B	— AM Peak LoS: C — PM Peak LoS: B	— AM Peak LoS: C — PM Peak LoS: B

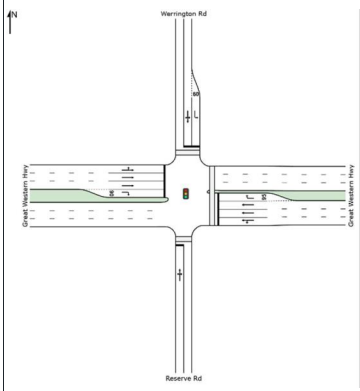
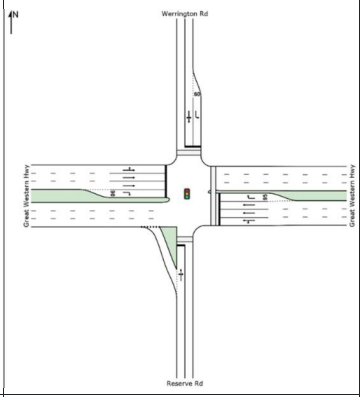
9.1.14 I-22 Christie Street, Lee Holm Road and Links Road extension

2016	2021	2026	2031
No Links Road extension in existing layout		No upgrades required to 2021 layout	No upgrades required to 2021 layout
— No Links Road extension at present	— Proposed Layout — Duplication of Christie Street in both directions — Left turn slip lane on western approach	— As per proposed layout	— As per proposed layout
N/A	Intersection performance future with rezoning with Links Road extension (base/hypothetical road network)		
	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B

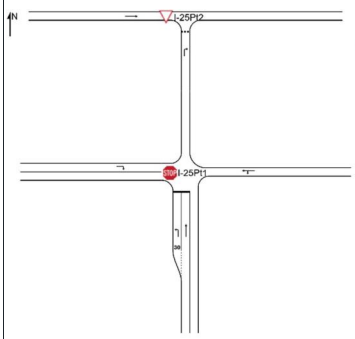
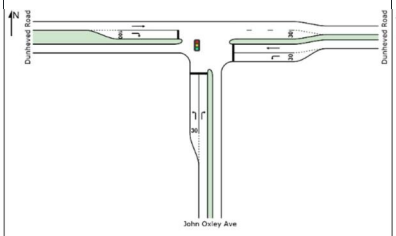
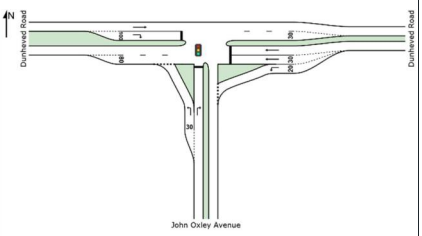
9.1.15 I-23 Christie Street, Dunheved Road and Werrington Road

2016	2021	2026	2031
	No upgrades required to **2021** layout		
— Existing layout	— Existing layout	— Signalisation — Duplication of Werrington Road	— Hypothetical Layout — Duplication of Christie Street on eastern approach — Signalised left turn slip lane on southern approach
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (hypothetical road network)		
— AM Peak LoS: A — PM Peak LoS: B	— AM Peak LoS: A — PM Peak LoS: D	— AM Peak LoS: B — PM Peak LoS: D	— AM Peak LoS: B — PM Peak LoS: C

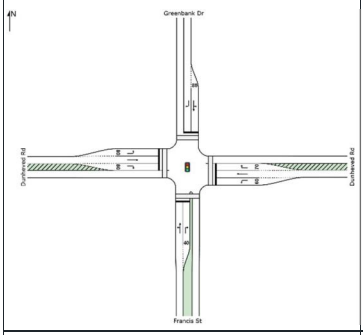
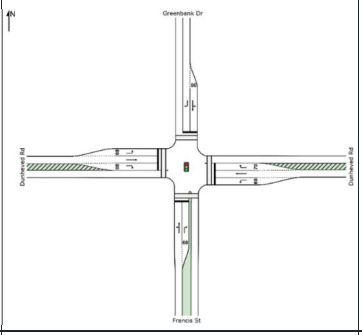
9.1.16 I-24 Werrington Road and Great Western Highway

2016	2021	2026	2031
	No upgrades required to **2016** layout	No upgrades required to **2016** layout	
— Existing layout	— As per existing layout	— As per existing layout	— Addition of left turn slip lane on southern approach
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (base road network)		
— AM Peak LoS: C — PM Peak LoS: D	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: C	— AM Peak LoS: D — PM Peak LoS: C

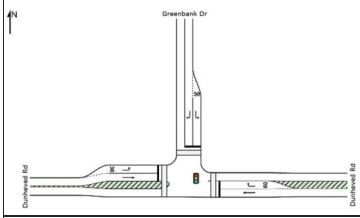
9.1.17 I-25 Dunheved Road and John Oxley Avenue

2016	2021	2026	2031
	No upgrades required to **2016** layout		
— Existing layout	— As per existing layout	— Signalisation — Addition of 100 m right turn bay on western approach — Addition of 30 m left turn lane on eastern approach	— Addition of left turn slip lane on southern approach — Addition of short through lane on eastern approach — Addition of left turn slip lane on eastern approach — Addition of 60 m departure lane on western leg
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (base road network)		
— AM Peak LoS: A — PM Peak LoS: B	— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: A — PM Peak LoS: D	— AM Peak LoS: A — PM Peak LoS: A

9.1.18 I-26 Dunheved Road, Greenbank Drive and Francis Street

2016	2021	2026	2031
	No upgrades required to **2016** layout		No upgrades required to 2026 layout
— Existing layout	— As per the existing layout	— Extension of right turn bay to 90 m from 40 m on southern approach	— As per 2026 upgraded layout
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (base road network)		
— AM Peak LoS: B — PM Peak LoS: B	— AM Peak LoS: C — PM Peak LoS: C	— AM Peak LoS: C — PM Peak LoS: C	— AM Peak LoS: D — PM Peak LoS: C

9.1.19 I-27 Dunheved Road and Greenbank Drive (west)

2016	2021	2026	2031
	No upgrades required to 2016 layout	No upgrades required to 2016 layout	No upgrades required to 2016 layout
— Existing layout	— As per existing layout	— As per existing layout	— As per existing layout
Intersection performance existing	Intersection performance future with rezoning with Links Road extension (base road network)		
— AM Peak LoS: A — PM Peak LoS: A	— AM Peak LoS: A — PM Peak LoS: A	— AM Peak LoS: A — PM Peak LoS: A	— AM Peak LoS: A — PM Peak LoS: A

10 CONCLUSION

The Maryland Development Company Pty Limited, a subsidiary of Lendlease, has appointed WSP to undertake a traffic modelling study to evaluate the impact of the St Marys Development Site on the existing road network. The St Marys Development Site is located 5 km to the north-east of Penrith and comprises five discrete precincts identified as; Jordan Springs, Jordan Springs East, Ropes Crossing, North Dunheved and South Dunheved.

At project commencement in 2016, both Jordan Springs and Ropes Crossing were substantially complete with a large proportion of residential dwellings built and occupied. Similarly, planning and construction work has substantially commenced at Jordan Springs East with occupation of the first dwellings expected in early 2018. The North Dunheved and South Dunheved precincts are planned for development upon the completion of Jordan Springs East.

WSP has been commissioned to prepare traffic modelling and reporting in accordance with the agreed expectations of the Traffic Steering Committee. The development of a contemporary traffic model has been undertaken according to the agreed scopes of a steering committee and generally in accordance with the Roads and Maritime Modelling Guidelines.

The 2016 Base model development process has included model development, demand development, model calibration and model validation stages associated with the AM and PM peak AIMSUN models. The 2016 Base AIMSUN models have been developed based on the existing development which is currently in place, together with the existing road network. Intersection traffic volumes at key intersections have been exported to SIDRA for further detailed analysis and development of calibrated and validated intersection models for the AM and PM peaks. Intersections I-8 (Richmond Road/Trinity Drive), I-13 (Great Western Highway/Parker Street) and I-19 (Forrester Road/Christie Street/Boronia Road) experience LoS F during the peak periods.

In addition to the 2016 Base SIDRA models, we have also developed 2016 Pure Base SIDRA models, which have been obtained by a process whereby the existing generated traffic associated with St Marys Development Site has been removed. With the 2016 Pure Base, only I-13 (Great Western Highway/Parker Street) experiences LoS E during the peak periods, with the other intersections having LoS D or better.

The St Marys Development Site comprises five distinct precincts; Jordan Springs, Jordan Springs East, Ropes Crossing, North Dunheved and South Dunheved. Jordan Springs and Ropes Crossing are currently partially developed, with Jordan Springs having 1,897 occupied dwelling houses and Ropes Crossing having 1,950 occupied dwelling houses respectively at December 2016. The study has been undertaken based on two land use scenarios; existing zoning and rezoning, with the rezoning scenario involving the replacement of 38 hectares of employment land within Jordan Springs East with 500 dwelling houses.

The total development of St Marys Development Site is by year 2021, when with rezoning there will be a total of 7,712 dwelling houses, 599 apartments, 14,335 m^2 retail/shopping centre and 99,000 m^2 industrial together with commercial, childcare, medical centre and school facilities.

The generated traffic which is forecast for the St Marys Development Site has been forecast based on trip rates and directional split which have been adopted for each specific component of land use. The traffic generation forecasting process has included consideration of internal trips, linked external trips and new external trips for each land use component within each of the five precincts. The assessment of the development has been undertaken based on two key network scenarios, 'without Links Road extension' and 'with Links Road extension'.

Both AIMSUN and SIDRA modelling results indicated that the Links Road extension would not improve the network performance significantly in future years. Traffic, mainly from the Central Precinct development site and North Dunheved industrial area would access via this Links Road extension which would reduce a proportion of traffic (about 300 vph in 2021 to 600 vph in 2031) from the Forrester Road/Ropes Crossing Boulevard and Forrester Road/Christie Street intersections. It would slightly improve traffic delays, but still both intersections would operate at LoS F in all future years with potential Links Road extension.

The future year model development process has involved the use of the Strategic Model to develop matrices for input to AIMSUN at each of the three future assessment years (2021, 2026 and 2031), for the Base, Project without rezoning and Project with rezoning scenarios.

There is minimal difference in the traffic generated between 'with rezoning' and 'without rezoning' scenarios and therefore the traffic impacts on the external road network between the 'with rezoning' and 'without rezoning' scenarios is negligible. One key difference between the 'with rezoning' and 'without rezoning' scenarios is the directional traffic splits, with the majority of traffic exiting in the AM peak and entering in the PM peak for residential dwellings, with a vice-versa directional slits for employment land uses, whereby the majority of traffic enters in the AM peak and exits in the PM peak. Due to the 'with rezoning' scenario being more conservative in regards to traffic generation, this scenario was considered for mitigation purposes.

The AIMSUN Base and Project networks have been developed reflecting the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) which are scheduled at each assessment year. The AIMSUN Project network also includes the east-west link road within the development site and then there are scenarios without and with Links Road extension, connecting with Christie Street in the south. The SIDRA Base and project networks are consistent with the AIMSUN, with the exception that the SIDRA has an additional set of assessments which use the base road network.

The future year Base assessment has been undertaken at years 2021, 2026 and 2031, with 2021 being the year of full completion, 2026 being 5 years after and 2031 being 10 years after. The Base assessment has been undertaken including the current development quantum which is in place in St Marys Development Site.

The Strategic Model has been used for the purpose of developing future year Base matrices for use with the AIMSUN AM and PM peak models. The AIMSUN modelling has been undertaken reflecting the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility. The AIMSUN turning volumes at key intersections have been exported to SIDRA for detailed intersection analysis which has been undertaken with the base road network and hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility). It is seen that at the base years there are a number of intersections which are forecast to have LoS F, particularly at 2031.

The Project analysis has been undertaken at years 2021, 2026 and 2031 for the purpose of assessing the impact of the planned development within the St Marys Development Site. There are two main Project scenarios, which are 'without rezoning' and 'with rezoning', relating to the conversion of the employment land within Jordan Springs East to allow for 500 residential dwelling houses. For each land use scenario, there are tests 'without Links Road extension' and with 'Links Road extension', followed by all scenarios being undertaken with the base road network and hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility). The SIDRA analysis at each of the three assessment years has identified a number of intersections which are forecast to be LoS E or F and there is therefore a requirement for mitigation measures to be identified. The focus of the mitigation measures will be on the 'with rezoning' and 'with Links Road extension' scenario.

We have developed mitigation measures for implementation at those intersections where LoS E or F have been forecast at years 2021, 2026 and 2031. The mitigation measures have resulted in the forecasting of acceptable LoS at each intersection under assessment.