Transport Management and Accessibility Plan Addendum

Ivanhoe Estate Redevelopment, Macquarie Park (SSD 8707)

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Revision History

Revision	Date	Details	Author	Approved by
-	24/08/2018	Draft	D. Budai	A. Johnson
1	27/08/2018	Issue I	D. Budai	A. Johnson
2	13/09/2018	Issue II	D. Budai	A. Johnson

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Appendices

1 Introduction

1.1 Background

Ason Group has prepared a Transport Management and Accessibility Plan (TMAP) report to support a Concept Development Application for the Ivanhoe Estate Masterplan, a State Significant Development (SSD) submitted to the Department of Planning and Environment (DP&E) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act) – the Proposal. It has been prepared for Aspire Consortium on behalf of NSW Land and Housing Corporation.

The Department of Planning and Environment conducted a review of the State Significant Development Application (SSD 8707) for Ivanhoe Estate, Macquarie Park (the Site). This review addressed the traffic and transport impacts, TMAP, Green Travel Plan and EIS documentation associated with this proposed development. DP&E also reviewed submissions from City of Ryde Council (Council), Road and Maritime Services (RMS) and Transport for NSW (TfNSW) and any other relevant submissions.

1.2 Objectives

The objectives of this report are as follows:

- Update the relevant sections of the TMAP with revised information following the review, submissions and discussions with relevant authorities
- Directly respond to the recommendations made following the review of the traffic and transport assessment in the Environmental Impact Statement (EIS) and comment on the technical adequacy and completeness of the assessment
- Review and respond to the appropriateness and effectiveness of management and mitigation measures recommended for the project, taking into account relevant guidelines, industry best practice and research on monitoring evidence
- Assess the overall implications of the revised development yield on the local and regional road network.

2 Proposed Development

Following the submission of the original applications some changes to the development yield and land uses are now proposed. The application now seeks approval for:

- The construction of around 3,400 dwellings (subject to future design development) with a maximum GFA of 278,000m^2 including around 1000 social units
- 120 bed residential aged care facility
- A 1000 student school
- Two 75 place child care centres
- Specialty retail shops
- Community swimming pool
- Community centre.

Figure 1 shows the Revised Ivanhoe Estate Masterplan noting that it includes revisions which directly respond to submissions received by the DP&E. These revisions are themselves discussed in further detail in sections below.

Figure 1: Revised Ivanhoe Estate Masterplan

3 Responses to Assessment of Key Issues

The Department of Planning and Environment conducted a review of the State Significant Development Application (SSD 8707) for Ivanhoe Estate, Macquarie Park. The following sections provide responses to the recommendations arising from that review as well as consolidated responses to submissions from Council, RMS and TfNSW.

3.1 Traffic Generation

The RMS, TfNSW and DP&E reviews considered that the trip rates used in the TMAP assessment were appropriate other than for the School component of the Proposal. The DP&E in its response suggested that trip modes surveyed at the Chatswood High School were more appropriate to the assessment. These surveys indicated that 14% of the Chatswood High School students travelled by car; it is noted that there is no information provided in the DP&E review to indicate whether this percentage travel mode applied to both the AM and PM peak periods, or more likely, the AM peak only.

Chatswood High School is located 1.2km from Chatswood Station Interchange, i.e. significantly further from the Interchange than suggested in the DP&E review, and moreover much further than the proposed High School is from Macquarie University Station (and Macquarie Centre Bus Interchange). Moreover, it is our opinion that a localised student population (as identified in the DP&E review) will further encourage walk and cycle trips, not more drop-off/pick-up trips as suggested in the review. Indeed, it was consideration of these very same factors – high school students, access to public transport within a CBD/TOD centre and a localised population - that led ARUP to the conclusion that the Arthur Phillip High Rise School in Parramatta would have no high school student drop-off or pick-up demand.

With consideration of the above, it remains our opinion that the travel modes surveyed at the St Mary's Cathedral College, and Marist College, North Sydney—schools which in our opinion provide an excellent comparison for the proposed High School—are more than appropriate for the assessment. If anything, the assignment of car driver trips in the assessment provides an (albeit marginal) over-estimate as it is expected that the future school will not permit students driving to the school as is the case at many other high schools.

The assessment undertaken by Ason Group at Marist included 460 students and 40 staff and captured 2 days of data. The surveys showed 3% Car Driver and 7% passenger. This is considered a very accurate survey and indeed has less accessibility to rail than Macquarie Park (900m from station).

The assessment undertaken at St Marys was responded to by 353 students and 57 staff and captured 1 month of data. The surveys showed 1% Car Driver and 7% passenger with the majority of students

travelling by train (59.9%). This is considered a very accurate survey although with less accessibility to rail than Macquarie Park (approximately 2km from Waverton an North Sydney stations).

Notwithstanding, the following changes to the assessment of the school have been agreed with DP&E and adopted for further analysis, thereby providing a worst-case assessment in terms of the potential impacts of the school:

- Car mode share of 14% for school students.
- The traffic generation for the school has been adjusted to take into account:
    - AM: 14% drop-off, 25% linked trips, 1.4 passengers per vehicle
    - PM: 5% drop-off, 0% linked trips, 1.4 passengers per vehicle
- The trip rate for the affordable housing dwellings will be adjusted to match that of the market dwellings (AM: 0.14, PM: 0.12)

Following discussions with Council, RMS, and DP&E, and with consideration of land-use and yield changes, the assumptions shown in **Table 1** have been used to revise the trip generation of the Site for a yield of 3,400 units, which also include a newly proposed community hub and pool.

The proposed changes to the generation rate and the inclusion of the community centre and pool results in a net increase in traffic generation to that previously considered. The development is now expected to generate in the order of 692veh/hr and 584veh/hr during the morning and evening peak hour respectively.

Table 1: Updated Trip Generation

3,400 Total Yield (as of 03/08/18)			Trip Rate		AM Peak Trips			PM Peak Trips		
Land Use	#	Unit	AM	PM	Total	IN	OUT	Total	IN	OUT
Market Dwellings	2,140		0.14	0.12	300	60	240	257	205	51
Social Dwellings	857		0.03	0.05	26	5	21	43	34	9
Market Independent Living Units	132		0.10	0.10	13	3	11	13	11	3
Social Independent Living Units	143		0.03	0.05	4	1	3	7	6	1
Affordable Units	128		0.14	0.12	18	4	14	15	12	3
Residential Aged Care Facility	120		0.10	0.10	12	2	10	12	10	2
Residential Sub-total					**373**	**75**	**298**	**347**	**278**	**69**
Child Care	150 (15)	Children (staff)	0.1 per child + 1 per staff	0.1 per child + 1 per staff	30	21	9	30	9	21
Mission Australia Offices	596	m^2	0.01	0.01	6	5	1	6	1	5
Ancillary Retail	960	m^2	0.01	0.01	10	5	5	10	5	5
Community Hub	1,000	m^2	1 parking space per $60m^2$, 0.5 trip per space	1 parking space per $60m^2$, 1 trip per space	8	8	0	17	8	8
Community Pool	NA	m^2	25 parking spaces @ 1 trip per space	25 parking spaces @ 2.5 trips per space	25	13	13	63	31	31
Commercial Sub-total (Child Care, Office, Retail, Community Hub & Pool)					**79**	**51**	**27**	**125**	**55**	**70**
High School	1000 (40)	Students (staff)	0.14 per student * 1.4 occupant per car * 2 (in & out) + 1 per staff	0.05 per student * 1.4 occupant per car * 2 (in & out) + 1 per staff	**240**	**140**	**100**	**111**	**36**	**76**
School 75% (external)					180	110	70	84	22	62
School 25% (linked)					60	30	30	28	14	14
Total Generation					**692**	266	426	**584**	369	216

3.2 Trip Distribution and Assignment

Issues were raised by DP&E in relation to the trip distribution and assignment. In this regard we provide the following clarification:

- The network diagrams relied on by DP&E provided intersection turn counts as specified in the SEARs. In the future scenarios, the internal network is altered due to the new bridge connection, which provides an alternative route to/from the Site via Lyonpark Road and the intersection of Giffnock Ave with Byfield Street. As this route was not reported, a net loss in vehicles was recorded based on the DP&E assessment methodology.

- The variation in volumes identified in the response were found to have some computational errors, thereby increasing the actual variations at some intersections.

Regardless of the above, the modelling undertaken for the revised development yield has been assessed and the network flows at the extremities of the model and at an intersection level have been recorded. **Table 2** provides an updated, direct comparison using the DP&E methodology to demonstrate and clarify the in/out directional traffic generated by the Proposal as well as the number of trips generated by the development and assumed in the revised modelling from the network flows shown in **Appendix C**. This shows a relatively low discrepancy that is attributable to the low latent demand and not due to a wider redistribution of traffic at intersections outside of the immediate study area.

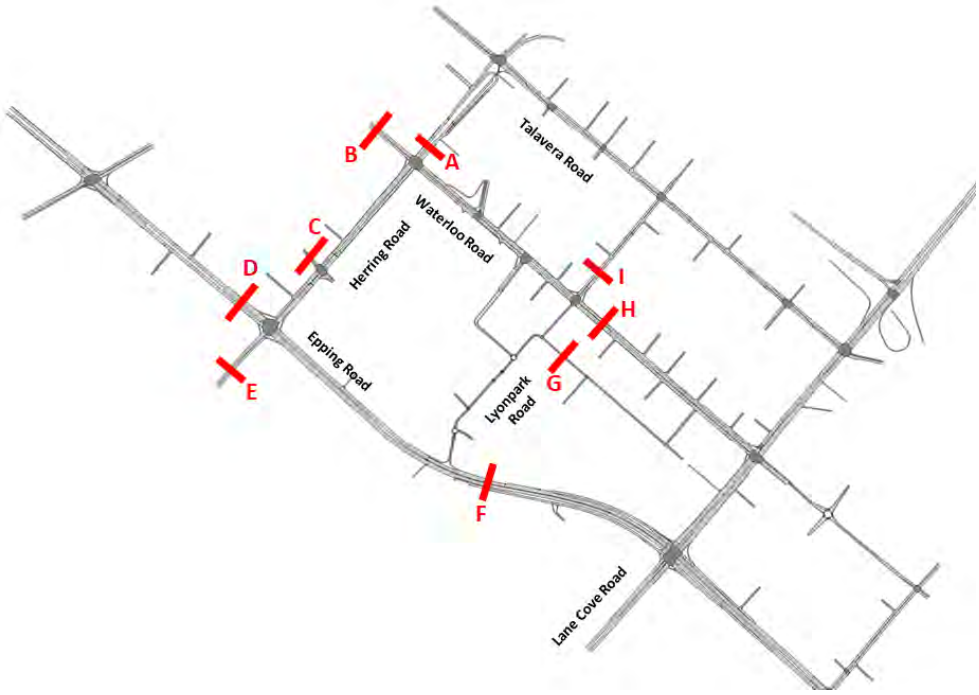
To provide a sound basis for demand adjustment, the counts have been checked and adjusted throughout the network for consistency. This also provides an additional check that the counts have been processed and imported into the model correctly. General traffic demand matrices for the model were developed for all travel zones for the respective peak periods (original matrices). The original matrices were then refined to calibrate the model demand to the observed traffic count data in the form of real data set.

Ultimately, the final 3-hour matrices (2 hours peak plus 30 minutes of warm-up and cool-down) were divided into 15-minute time slices. The outputs and results have been aggregated into the appropriate 1-hour peak periods for reporting purposes following the SIDRA analysis. The minor difference between the number of trips generated by the development and assumed in the modelling are because 2-hour Aimsun intersection counts were extracted and then aggregated for the SIDRA inputs. The minor differences are actually caused by "vehicles waiting to enter" in the Aimsun network.

The network diagrams provided in the TMAP were only for reference to intersection turn counts as specified in the SEARs. In the future scenarios, the internal network alters due to the new bridge connection, which provides alternative routes through the Site.

Table 2: Trips to/from Study Area

Scenarios	Point	AM Peak			PM Peak		
		In	Out	Total	In	Out	Total
Scenario 0: 2021 RMS Base	**A**	342	946	1,288	772	915	1,687
	B	335	307	642	519	334	853
	C	28	23	51	31	53	84
	D	2,524	1,112	3,636	1,424	1,993	3,417
	E	941	336	1,277	690	1,104	1,794
	F	1,476	1,851	3,327	2,184	2,274	4,458
	G	191	385	576	330	114	444
	H	820	373	1,193	626	863	1,489
	I	501	612	1,113	713	560	1,273
Total (Scenario 0)		**7,158**	**5,945**	**13,103**	**7,289**	**8,210**	**15,499**
Scenario 1: 2021 RMS Base + Ivanhoe Estate Development Traffic + Upgrades	**A**	324	976	1,300	796	964	1,760
	B	331	295	626	525	336	861
	C	28	23	51	30	41	71
	D	2,522	1,138	3,660	1,461	1,991	3,452
	E	953	385	1,338	743	1,146	1,889
	F	1,472	2,002	3,474	2,188	2,410	4,598
	G	438	456	894	437	103	540
	H	708	369	1,077	666	795	1,461
	I	535	604	1,139	647	537	1,184
Total (Scenario 1)		**7,311**	**6,248**	**13,559**	**7,493**	**8,323**	**15,816**
Development traffic		263	426	689	366	213	579
Flow Difference		**-110**	**-123**	**-233**	**-162**	**-100**	**-262**
% Flow Difference		**-2%**	**-2%**	**-2%**	**-2%**	**-1%**	**-2%**



3.3 Traffic Modelling

3.3.1 Revised Modelling Methodology

Ason Group has reviewed the relevant models provided by RMS. A suitable 2031 model was unable to be provided and as such it was agreed that further assessment of Ivanhoe Estate using the Aimsun 2031 model would be ineffectual and not provide a reasonable basis of assessment of the future impacts of the development. Accordingly, agreement was reached with RMS on an appropriate methodology and the following approach was undertaken:

1. A sensitivity analysis was conducted of the 2021 Aimsun Model for the revised traffic generation detailed in **Table 1** and as agreed previously with DP&E.

2. The future volumes were established through a scaling of the 2021 No Development Scenario using 2031 growth rates provided by RMS. The volumes and distribution of the development traffic was then superimposed onto this network based on the outputs from the workable 2021 model. This enabled the following comparisons:

    - 2031 No Development, and
    - 2031 With Development.

3. SIDRA modelling was undertaken for the 2031 scenario with development traffic at the intersections of:

    - Epping Road with Herring Road;
    - Herring Road with Ivanhoe Place;
    - Lyonpark Road with Main Street;
    - Lyonpark Road with Epping Road;
    - Herring Road with Waterloo Road; and
    - Waterloo Road with Byfield Street.

This approach enabled a comparison of the future operation of the road network adjacent to the Site and assisted in identifying any future upgrades resulting from the development and growth more generally.

SIDRA network modelling was undertaken for all 6 intersections. RMS requested that 4 intersections (Epping Road / Herring Road, Herring Road / Ivanhoe Place, Lyonpark Road / Main Street, Lyonpark Road / Epping Road) be modelled in a SIDRA network with a fixed cycle time of 149 seconds and appropriate coordination. The other two intersections (Herring Road / Waterloo Road, Waterloo Road /

Byfield Street) were assessed in a separate network with 139 seconds fixed cycle time and appropriate coordination. The governing traffic routes were specified in each scenario for each network so that SIDRA could allocate appropriate offsets.

It is noted that some minor variations in the Base model intersection operation has occurred from that previously reported in the TMAP report. This change has occurred due to changes in the signal times and offsets in the SIDRA modelling as directed by the RMS.

3.3.2 Revised Outputs

The modelling results derived from the methodology specified in Section 3.3.1 are shown in **Table 3** and **Table 4** and demonstrate acceptable, relative intersection performance in a hypothetical network for 2031 scenarios without significant upgrades to the state road intersections.

Table 3: SIDRA Results (AM)

Intersection	Criteria	2021		2031
		Base	Base + Dev + Upgrades	Background Growth + Dev + Upgrades
Epping Road / Herring Road	LoS	E	F	F
	Delay (s)	68	77	81
Herring Road / Ivanhoe Place	LoS	A	B	B
	Delay (s)	13	22	22
Lyonpark Road / Main Street	LoS	A	A	B
	Delay (s)	7	12	17
Lyonpark Road / Epping Road	LoS	A	A	A
	Delay (s)	6	6	6
Herring Road / Waterloo Road	LoS	C	D	D
	Delay (s)	39	48	47
Waterloo Road / Byfield Street	LoS	B	B	B
	Delay (s)	17	18	18

Table 4: SIDRA Results (PM)

Intersection	Criteria	2021		2031
		Base	Base + Dev + Upgrades	Background Growth + Dev + Upgrades
Epping Road / Herring Road	LoS	E	E	E
	Delay (s)	57	64	67
Herring Road / Ivanhoe Place	LoS	B	B	C
	Delay (s)	23	27	35
Lyonpark Road / Ivanhoe Main Street	LoS	A	A	B
	Delay (s)	6	13	17
Lyonpark Road / Epping Road	LoS	A	A	A
	Delay (s)	6	6	6
Herring Road / Waterloo Road	LoS	C	D	D
	Delay (s)	42	46	44
Waterloo Road / Byfield Street	LoS	B	B	C
	Delay (s)	23	21	36

- Each of these scenarios was assessed in two networks with fixed cycle times for each network.
- SIDRA was allowed to allocate phase times prioritising the major traffic movements for each scenario .
- The minor increase in delay in the 2031 PM scenario for the Epping Road / Herring Road intersection is attributed to negative growth rate and adjustment of phase times to allow for large westbound volumes on Epping Road. The forecast growth rates provided by RMS are shown in **Appendix D**.

In general the impacts of the development are greater in the morning peak which can be attributed to the trips generated by the proposed school. The impacts of the development however are significantly off-set by the provision of the new bridge connection between Herring Road with Lyonpark Road enabling eastbound movements to occur without the need for traversing the Epping Road with Herring Road intersection.

3.3.3 Lyonpark Road / Main Street Intersection

Further intersection modelling has been undertaken to assess the capacity of the Main Street and Lyonpark Road intersection during the AM and PM peak periods for the 2021 scenario. The existing priority controlled intersection performed acceptably in the 2021 scenario. However, the preferred layout option incorporates a 70m dedicated right turn bay into Main Street and has a separate southbound through lane. The results shown in **Table 5** demonstrate that the intersection continues to operate with a good level of service with the addition of the proposed development. The SIDRA outputs for this analysis are contained in **Appendix A**.

The future Lyonpark Road / Main Street intersection has been assessed and appropriate traffic control measures recommended given the volume of traffic this intersection is forecast to carry.

Table 5: Lyonpark Road / Main Street SIDRA results

Peak Period	Criteria	2021	
		Base	Base + Dev + Upgrades
AM	LoS	A	A
	Delay (s)	7	12
PM	LoS	A	A
	Delay (s)	6	13

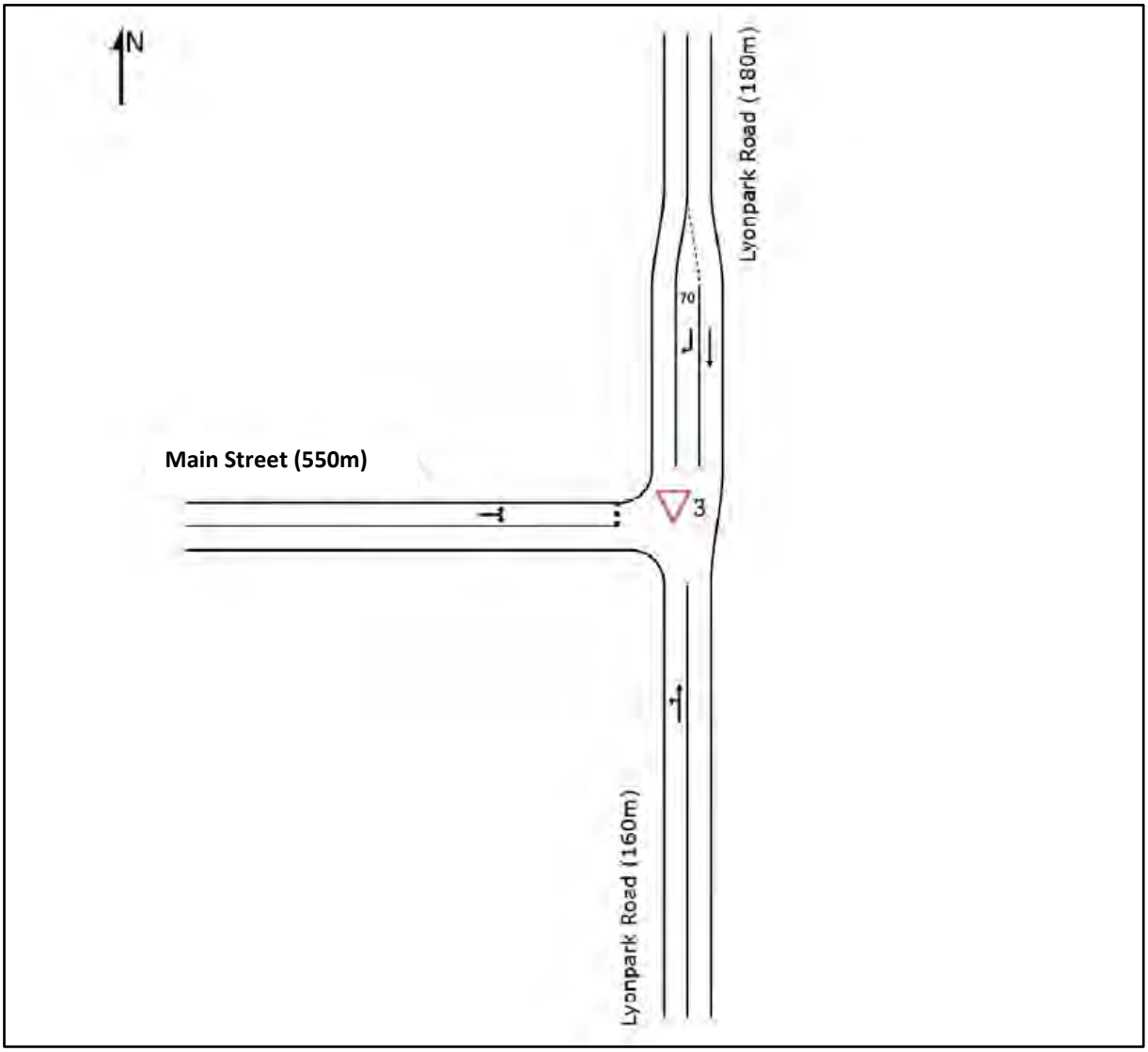


Figure 2: Main Street / Lyonpark Road SIDRA Intersection Layout

3.4 Site Access and Internal Design

3.4.1 Project Network Upgrades

In addition to the upgrades proposed as part of the Bus Priority Works a number of upgrades to the road network have been assessed and are proposed as part of this application. These upgrades are proposed to off-set the impacts of the Proposal on the operation of the road network and improve traffic movement within the Macquarie Park Precinct. A summary of the network changes assessed as part of the investigations is provided below.

Signalisation of the intersection of Ivanhoe Place with Herring Road

Following the issue of the Macquarie Park Bus Priority and Capacity Improvement Project Submissions (MPBPCI) report by RMS in October 2017 the reviewed layout and alignment of the proposed traffic signals at the interaction of Ivanhoe Place with Herring Road is illustrated in **Figure 3**. The intersection has been designed to facilitate double diamond phasing (as requested by RMS) and includes:

- a 44m right turn movement from Herring Road into Ivanhoe Place for northbound approach
- A left turn slip lane and dedicated right turn and through lane on the westbound approach within the Ivanhoe Estate,
- A 52m right turn lane for the southbound approach for vehicles turning into the Morling College, and
- A shared through / right turn lane and dedicated right turn lane for the eastbound approach.

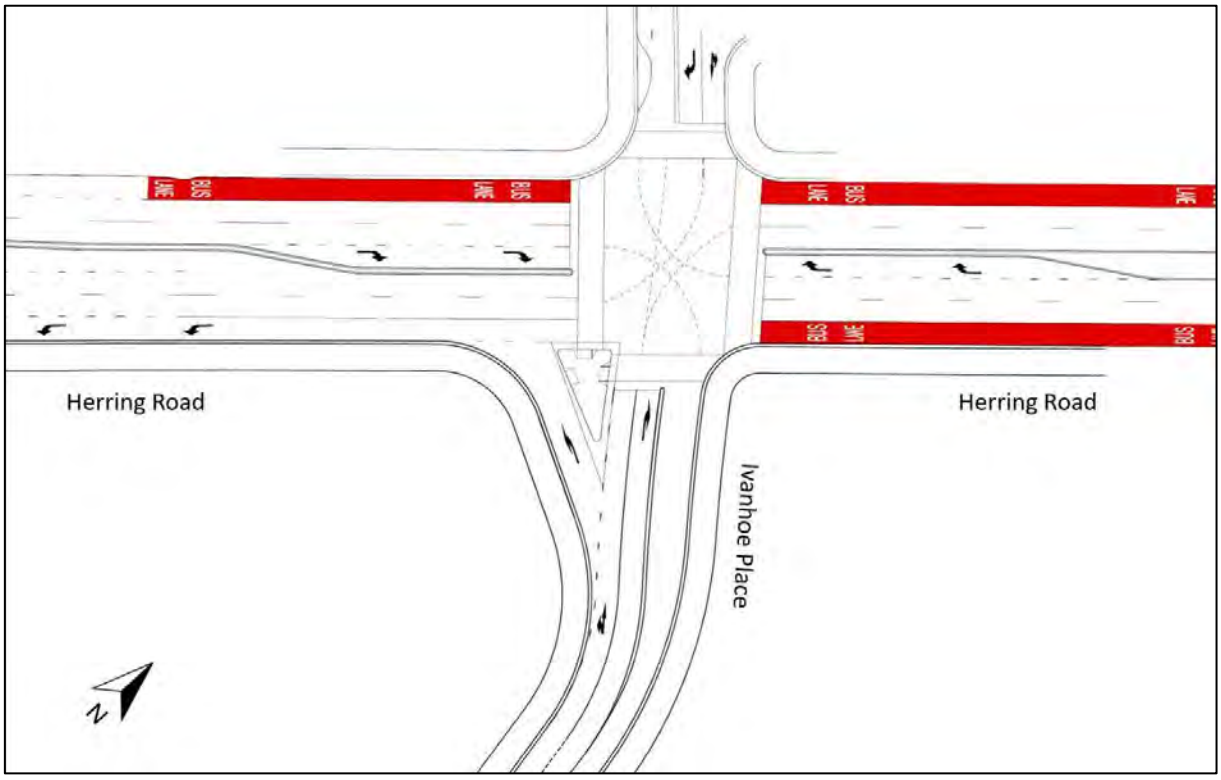


Figure 3: Herring Road and Ivanhoe Place intersection

The proposed intersection arrangements have been included in the future year models and provides the main access to the proposed development.

Left-in access from Epping Road to the Site

It is proposed that a new road connection from Epping Road be constructed approximately 300m east of the Herring Road with Epping Road intersection. The proposed access as shown on **Figure 4**, includes the construction of a new deceleration lane (to RMS requirements) and will provide access to the site without the need for vehicles to travel along Herring Road. This will provide reduced delays on Herring Road particularly during the evening peak hour.

Figure 4: Proposed left-in access from Epping Road to the Site

Bridge connection over Shrimptons Creek to Lyonpark Road

A bridge connection between Ivanhoe Place and Lyonpark Road is proposed, generally in accordance with Council's DCP Road Network and the Herring Road Finalisation Report. The inclusion of the bridge provides substantial benefits to both the future residents and existing stakeholders within Macquarie Park by providing an alternate east-west connection between the Giffnock Avenue / Optus Drive employment area and Herring Road. This provides an alternate route to Waterloo Road as well as access for future residents to Lyonpark Road and Epping Road.

This proposed bridge will provide passage across Shrimptons Creek for pedestrians and cyclists, both at road level and via boardwalk below the bridge, allowing diverse transition. The bridge will be designed to permit the continued north / south cycle connection along Shrimptons Creek. An indicative layout of the proposed bridge connection is provided in **Figure 5**.

Figure 5: Proposed bridge connection over Shrimptons Creek to Lyonpark Road

Peach Tree Road Connection

A vehicular connection between Ivanhoe Place with Peach Tree Road was considered as part of the application. The connection was proposed along Shrimptons Creek and was assessed as both a one-way and two-way connection. The connection which provided vehicular connectivity between the Site and Waterloo Road (via Peach Tree Road and Cottonwood Crescent) was deemed to provide limited benefit to either the Ivanhoe development or regional traffic due to the limited access to the network afforded by the connection that could not otherwise be achieved by virtue of the signalisation of Herring Road with Ivanhoe Place or the proposed bridge connection to Lyonpark Road.

Notwithstanding this, a vehicular connection has not been progressed due to the environmental impacts to Shrimptons Creek that would result as a consequence of the proposed road construction. As an alternative, a pedestrian and cycle connection are proposed which still provides for permeability through the Herring Road precinct with a substantially lower environmental impact. The removal of the vehicular connection was supported by Council. However, a future connection could potentially be provided to Peach Tree Road subject to the availability of additional land outside the Site for this purpose.

Signalisation of Lyonpark Road with Epping Road (Not Pursued)

A proposal for the signalisation Lyonpark Road into Epping Road was pursued in accordance with the City of Ryde Integrated Transport Strategy (2016) and discussions held with Ryde Council. As part of this assessment MU Group were engaged to provide conceptual signal layout plans suitable for assessment. In consultation with relevant authorities, the full signalisation (all movements) was not considered appropriate due to the delays that would result to the through movement on Epping Road. Accordingly, a hybrid solution was assessed as shown in **Figure 6**, which provided for northbound right turn movements (westbound to northbound) and the resulting signalisation of the eastbound left turn movement from Lyonpark Road.

The proposed signalisation was not pursed due to the resultant delays and queues during the PM peak on Lyonpark Road. The modelling demonstrated queues in excess of 450m and a resulting Level of Service F (compared to a LoS A under the 2021 Base Case model) due to the required left turn signalisation. This option is therefore not proposed as part of the network upgrades that form part of this application.

Figure 6: Proposed Lyonpark Road / Epping Road layout

3.4.2 Adopted Road Network & Staging

With regard to Section 3.4.2, the timing of future infrastructure works to support the Site development has been discussed with the relevant authorities and the timings have been identified in each stage based on development yields and modelling results as shown in **Figure 7**.

Figure 7: Road Infrastructure and Staging

3.4.3 U-Turn Facility

The redistribution of vehicles through the provision of connected streets within Ivanhoe Estate, effectively providing a "U-Turn" facility, has been reviewed and supported by the RMS subject to the following conditions:

- For Stage-2 (Ultimate) development: if a roundabout cannot be built then the U-turn movement facility will need to be provided within Ivanhoe Estate's local road network. It was mentioned in the submission that re-routing options throughout Macquarie Park would generate the travel time greater than 4 mins, which is not acceptable. Therefore, travel time assessment of performing the U-turn by going round the Ivanhoe Estate block in the internal road network, should be included in further submission.
- For Stage-1 Ivanhoe Estate development: a cul-de-sac turn head will need to be provided to allow U-turn movements and/or once Stage 2 BPIP works has been completed. The turn head shall be designed to allow for 8.8m service vehicle (Garbage Truck) to perform a U-turn to service Stage 1 development once it is open.

Until such time that roads associated with future stages of the Ivanhoe Estate are constructed — at the completion of Stage 1 — a strategy has been developed to enable sufficient access and turning areas to accommodate the U-turn manoeuvre with the provision of turning heads at the end of the proposed north and south roads (Main Street and Neighbourhood Street) as shown in **Figure 8**, consistent with

the RMS requirements. Having regard to this, and as the provision for a U-turn movement his provided within the proposed road network, the need for any travel time assessment is considered unnecessary. Accordingly, it is appropriate that this condition be amended such that the analysis only be required in the event that the internal road network design is significantly altered from that now proposed.

Figure 8: Proposed Iterim U-Turn Facility

3.4.4 Buses

Main Street and the bridge connection to Lyonpark Road have been designed to accommodate 14.5m buses and meet the relevant standards. 60m of indented bays have also been provided on Main Street to accommodate a minimum of two 14.5m buses as shown in **Figure 9**.

The internal road network has been designed to accommodate the relevant requirements for buses

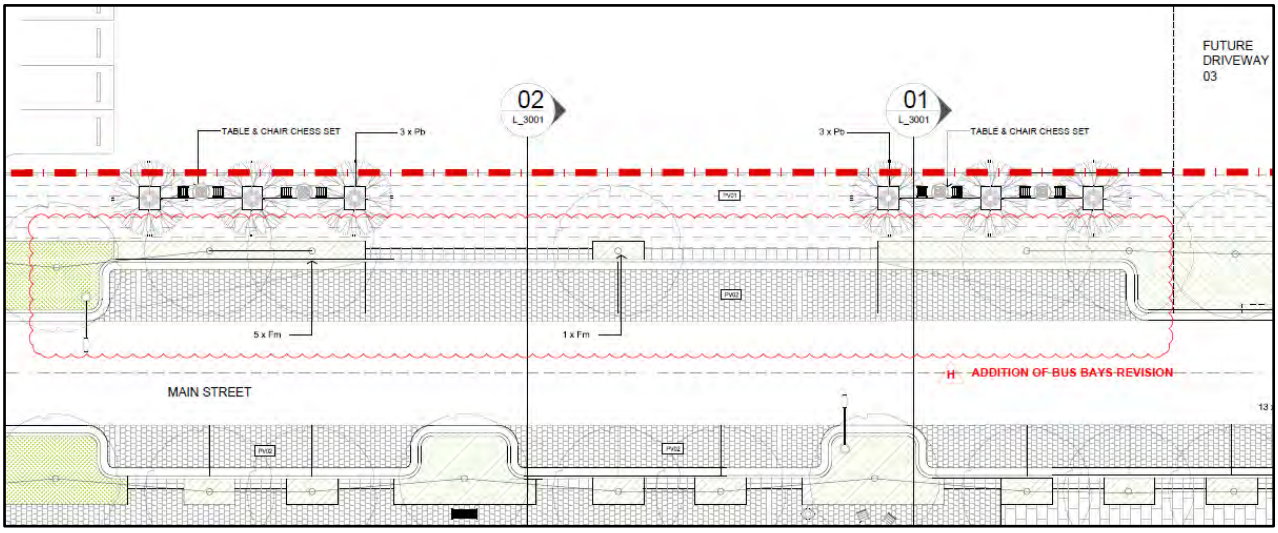


Figure 9: Main Street Bus Bay Revision

3.5 Parking

3.5.1 Proposed Car Parking Rates

Car parking for the development is proposed in accordance with the requirements of Council's Macquarie Park DCP and other relevant state planning documents. An updated summary of the parking rates proposed is provided in **Table 6** for both the residential and non-residential land uses proposed.

Adoption of the rates embodied within Council's DCP is supportable on traffic demand management point of view, recognising that the DCP rates are maximum rates based on the restrictive rates recommended for adoption under the RMS Guide to Traffic Generating Developments.

Table 6: Updated Parking Rates

Land Use	Proposed Rate	Comments
Residential (Market, Affordable and Social)		
1 Bed	Max 0.6 spaces per Unit	DCP Requirement
2 Bed	Max 0.9 spaces per Unit	DCP Requirement
3 Bed	Max 1.4 spaces per Unit	DCP Requirement
Visitor	1 spaces per 20 Units	Half DCP requirement: reasonable for a portion to be provided on-street, Site's access to public/active transport
Car Share	1 space per 50 parking spaces	DCP requirement
Residential Care Facility	1 space per 10 beds + 1 space per 2 employees	SEPP (Housing for seniors or people with a disability)
Independent Living Units	1 space per 5 dwellings	SEPP (Housing for seniors or people with a disability)
Non-Residential		
Retail	Max 1 space per 100m^2	LEP Requirement
Commercial	Max 1 space per 100m^2	LEP Requirement
Community Centre	1 space per 60m^2	The community centre is to service the local community and Ivanhoe development. As such a high proportion of non-car travel is expected.
Community Pool	25 Spaces	Based on review of similar developments within Ryde and neighbouring LGA's
Child Care	1 space per 8 children & 1 space per 2 employees	DCP Requirement
School	Pick Up / Drop Off facilities + maximum 30 staff spaces	No DCP requirement, may be operator driven, however minimal parking should be provided

It is proposed that visitor parking be at a rate of 1 space per 20 units, within each of the individual residential buildings (basement parking) across the Site, supplemented by on-street visitor parking across the Site. This is fully compliant with the maximum parking rates detailed in RDCP2014.

It is proposed that car share spaces also be provided in accordance with RDCP2014, i.e. at a rate of 1 space per 50 spaces—consistent with the recommended rate in the City of Ryde DCP.

School parking would be available directly adjacent to the School, with designated short stay parking provided to accommodate drop-off and pick-up demand during the arrival and departure peaks respectively. Approximately 25 spaces will be available for school pick up / drop-off purposes.

3.5.2 Bicycle Parking

Encouragement of local trips by bicycle is facilitated through the design of the built form of Ivanhoe Estate to accommodate public transport penetration into residential areas as well as good quality, highly permeable pedestrian and bicycle networks throughout, including crossing facilities where appropriate and end-of-trip facilities such as bicycle parking.

Bicycle parking will be provided for all residential units, with non-residential land uses to be provided bike parking at a rate consistent with Council's DCP.

Other areas of key open space will also have bicycle parking for leisure and recreational use. In addition, a single bike parking space is proposed for each unit, ensuring sufficient provision is provided for bike storage in accordance with RDCP2014.

3.6 Construction Traffic Management

A Construction Pedestrian and Traffic Management Plan (CPTMP) will be prepared to accompany each stage of development on the Site, and specifically detail how construction will be staged appropriately to manage interactions with future residents of the Site. The staged CPTMPs will also include:

- Clarification of how the construction traffic will be managed to coincide with construction activities between 7.00am and 7.00pm.
- A plan showing the allocation of parking spaces within the Site boundary and strategy to prevent construction workers from utilising on-street parking.

4 Conclusions

The key findings of this Transport Management and Accessibility Plan Addendum are:

- Ason Group prepared a Transport Management and Accessibility Plan (TMAP) report to support a Concept Development Application for the Ivanhoe Estate Masterplan, a State Significant Development (SSD) submitted to the Department of Planning and Environment (DP&E) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).
- DP&E conducted a review of the application (SSD 8707) as well as submissions from City of Ryde Council, Road and Maritime Services and Transport for NSW. This Addendum updates the relevant sections of the submitted TMAP with revised information following the review, submissions and discussions with relevant authorities and directly responds to the recommendations made following the review.
- Following discussions with Council, RMS, and DP&E, and with consideration of land-use and yield changes, the agreed, updated trip generation has been recalculated.
- Clarified trip distribution and assignment based on the revised trip generation has been used in the development of an agreed, modified modelling methodology for future scenario assessment.
- The modelling results demonstrate that, with the addition of the Proposal, the critical intersections operate with acceptable, relative intersection performance in a hypothetical network for 2031 scenarios without significant upgrades to the state road intersections.
- Additional modelling of the intersection of Main Street with Lyonpark Road with the preferred layout option incorporating a 70m dedicated right turn bay into Main Street and a separate southbound through lane demonstrate that the intersection continues to operate with a good level of service with the addition of the proposed development.
- The timing of future infrastructure works to support the Site development has been discussed with the relevant authorities and the timings have been identified in each stage based on development yields and modelling results.
- The redistribution of vehicles through the provision of connected streets within Ivanhoe Estate, effectively providing a U-Turn facility, is supported by RMS. Until such time that roads associated with future stages of the Ivanhoe Estate are constructed — at the completion of Stage 1 — a strategy has been developed to enable sufficient access and turning areas to accommodate the U-Turn manoeuvre with the provision of turning heads at the end of the proposed north and south roads (Main Street and Neighbourhood Street).
- The internal road network and bridge connection to Lyonpark Road have been designed to accommodate the relevant requirements for 14.5m buses including a minimum 3.5m travel lanes

and 3.0m wide bus parking bays. 60m of indented bays have also been provided on Main Street to accommodate a minimum of two 14.5m buses.

- Residential and car share parking will be provided across Ivanhoe Estate compliant with the maximum parking rates detailed in RDCP2014. Visitor parking will be provided at half the DCP requirement. This is considered reasonable considering the convenient access to public/active transport as well as a portion being provided on-street.
- A detailed Construction Pedestrian and Traffic Management Plan (CPTMP) will be prepared to accompany each stage of development on the Site, and specifically detail how construction will be staged appropriately to manage interactions with future residents of the Site and address hours of operation and construction parking.

It is therefore concluded that the proposed development is supportable from a traffic planning and parking perspective.

Appendix A

SIDRA Outputs

MOVEMENT SUMMARY

Site: 1 [AM_ Epping-Herring_ s2]

Network: N1 [AM_ Ivanhoe_ s2]

Epping Road x Herring Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 149 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Herring Road (250m)														
1	L2	15	0.0	15	0.0	1.017	106.1	LOS F	18.0	128.7	1.00	1.19	1.61	17.0
2	T1	734	2.4	734	2.4	1.017	112.0	LOS F	25.9	185.0	1.00	1.25	1.59	6.9
3	R2	314	1.3	314	1.3	0.909	90.8	LOS F	7.9	55.7	1.00	0.99	1.41	9.2
Approach		1062	2.1	1062	2.1	1.017	105.7	LOS F	25.9	185.0	1.00	1.17	1.54	7.6
East: Epping Road (630m)														
4	L2	107	2.0	107	2.0	0.425	34.0	LOS C	10.6	75.6	0.67	0.68	0.96	41.2
5	T1	1097	1.5	1097	1.5	0.425	25.8	LOS B	11.2	79.2	0.68	0.63	0.76	49.7
6	R2	418	3.5	418	3.5	1.032	141.8	LOS F	15.3	110.3	1.00	1.14	1.74	13.3
Approach		1622	2.1	1622	2.1	1.032	56.2	LOS D	15.3	110.3	0.76	0.76	1.02	34.5
North: Herring Road (180m)														
7	L2	88	15.5	88	15.5	0.123	29.9	LOS C	2.2	17.7	0.62	0.69	0.62	17.4
8	T1	355	3.9	355	3.9	0.543	60.7	LOS E	7.9	57.1	0.93	0.77	0.93	18.7
9	R2	239	1.8	239	1.8	0.896	92.8	LOS F	5.8	41.4	1.00	0.90	1.24	20.9
Approach		682	4.6	682	4.6	0.896	68.0	LOS E	7.9	57.1	0.91	0.80	1.00	19.7
West: Epping Road (600m)														
10	L2	566	1.5	566	1.5	0.695	31.5	LOS C	14.4	101.9	0.76	0.93	1.07	35.3
11	T1	2173	1.7	2173	1.7	1.007	102.8	LOS F	49.5	351.8	1.00	1.25	1.43	16.6
12	R2	21	0.0	21	0.0	0.286	86.1	LOS F	1.0	6.8	1.00	0.70	1.00	23.4
Approach		2760	1.6	2760	1.6	1.007	88.1	LOS F	49.5	351.8	0.95	1.18	1.35	18.7
All Vehicles		6126	2.2	6126	2.2	1.032	80.5	LOS F	49.5	351.8	0.91	1.03	1.26	20.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	27.2	LOS C	0.1	0.1	0.61	0.61
P2	East Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	35.7	LOS D	0.2	0.2	0.69	0.69
P4	West Full Crossing	53	61.3	LOS F	0.2	0.2	0.91	0.91
All Pedestrians		211	48.2	LOS E			0.79	0.79

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: 1 [AM_ Epping-Herring_ s2]

Network: N1 [AM_ Ivanhoe_ s2]

Epping Road x Herring Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 149 seconds (Network User-Given Cycle Time)

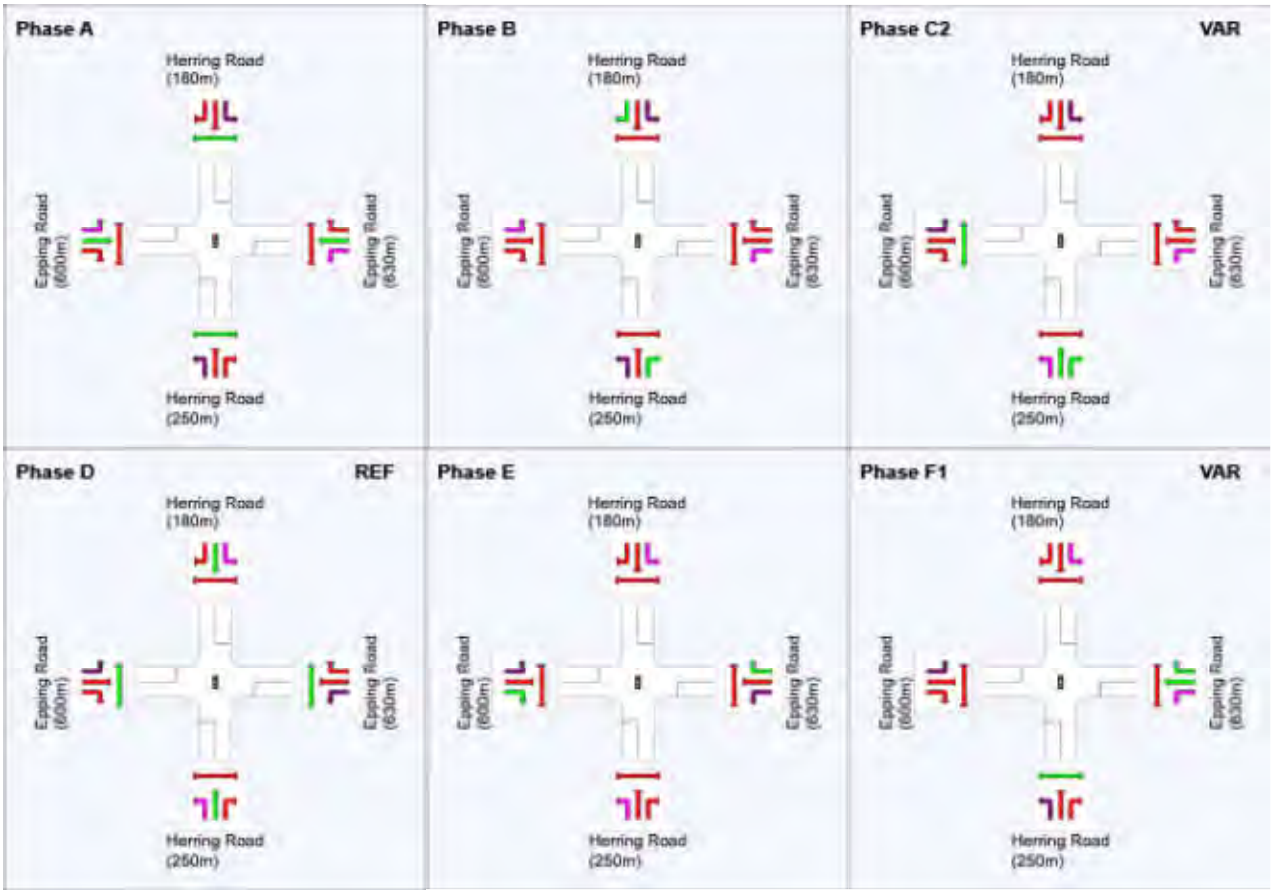
Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Green Split Priority has been specified
Phase Sequence: Variable Phasing
Reference Phase: Phase D
Input Phase Sequence: A, B, C1*, C2*, D, E, F1*, F2*
Output Phase Sequence: A, B, C2*, D, E, F1*
(* Variable Phase)

Phase Timing Summary

Phase	A	B	C2	D	E	F1
Phase Change Time (sec)	57	124	141	0	32	44
Green Time (sec)	61	11	2	26	6	7
Phase Time (sec)	67	17	8	32	12	13
Phase Split	45%	11%	5%	21%	8%	9%

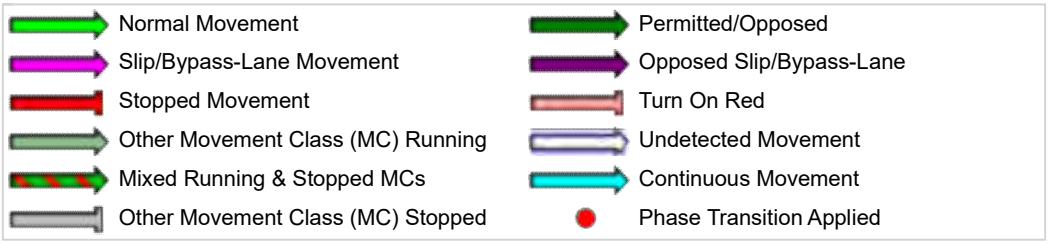
See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase

VAR: Variable Phase



MOVEMENT SUMMARY

Site: 2 [AM_ Herring-Ivanhoe_ s2]

Network: N1 [AM_ Ivanhoe_ s2]

Herring Road x Ivanhoe Place
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 149 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Herring Road (180m)														
1	L2	1	0.0	1	0.0	0.017	8.8	LOS A	0.0	0.6	0.09	0.09	0.09	21.1
2	T1	1459	2.3	1454	2.3	0.683	11.5	LOS A	18.7	132.8	0.37	0.34	0.37	45.0
3	R2	242	1.3	241	1.3	0.337	20.1	LOS B	3.6	25.6	0.36	0.66	0.36	22.6
Approach		1702	2.2	1696 N1	2.2	0.683	12.7	LOS A	18.7	132.8	0.37	0.38	0.37	42.6
East: Ivanhoe Main Road (550m)														
4	L2	417	1.5	417	1.5	0.349	7.1	LOS A	5.4	38.3	0.43	0.51	0.43	27.2
5	T1	8	0.0	8	0.0	0.349	5.7	LOS A	5.4	38.3	0.43	0.51	0.43	26.9
6	R2	128	0.8	128	0.8	0.684	74.1	LOS F	5.8	40.6	1.00	0.84	1.06	20.6
Approach		554	1.3	554	1.3	0.684	22.6	LOS B	5.8	40.6	0.57	0.59	0.58	24.6
North: Herring Road (380m)														
7	L2	103	1.0	103	1.0	0.330	65.0	LOS E	2.5	17.4	0.93	0.78	0.93	16.1
8	T1	244	6.5	244	6.5	0.330	55.5	LOS D	4.8	35.3	0.91	0.73	0.91	18.0
9	R2	16	0.0	16	0.0	0.204	84.3	LOS F	0.7	5.0	1.00	0.69	1.00	14.8
Approach		363	4.6	363	4.6	0.330	59.5	LOS E	4.8	35.3	0.92	0.74	0.92	17.2
West: Morling College (70m)														
10	L2	6	0.0	6	0.0	0.050	58.3	LOS E	0.6	4.3	0.86	0.68	0.86	19.2
11	T1	11	0.0	11	0.0	0.050	57.3	LOS E	0.6	4.3	0.86	0.68	0.86	5.3
12	R2	13	0.0	13	0.0	0.065	70.3	LOS E	0.5	3.6	0.93	0.68	0.93	4.4
Approach		29	0.0	29	0.0	0.065	63.1	LOS E	0.6	4.3	0.89	0.68	0.89	8.4
All Vehicles		2648	2.3	2643 N1	2.3	0.684	21.8	LOS B	18.7	132.8	0.49	0.48	0.49	31.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	56.8	LOS E	0.2	0.2	0.87	0.87
P3	North Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	22.1	LOS C	0.1	0.1	0.54	0.54
All Pedestrians		211	54.1	LOS E			0.84	0.84

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

PHASING SUMMARY

Site: 2 [AM_ Herring-Ivanhoe_ s2]

Network: N1 [AM_ Ivanhoe_ s2]

Herring Road x Ivanhoe Place
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 149 seconds (Network User-Given Cycle Time)

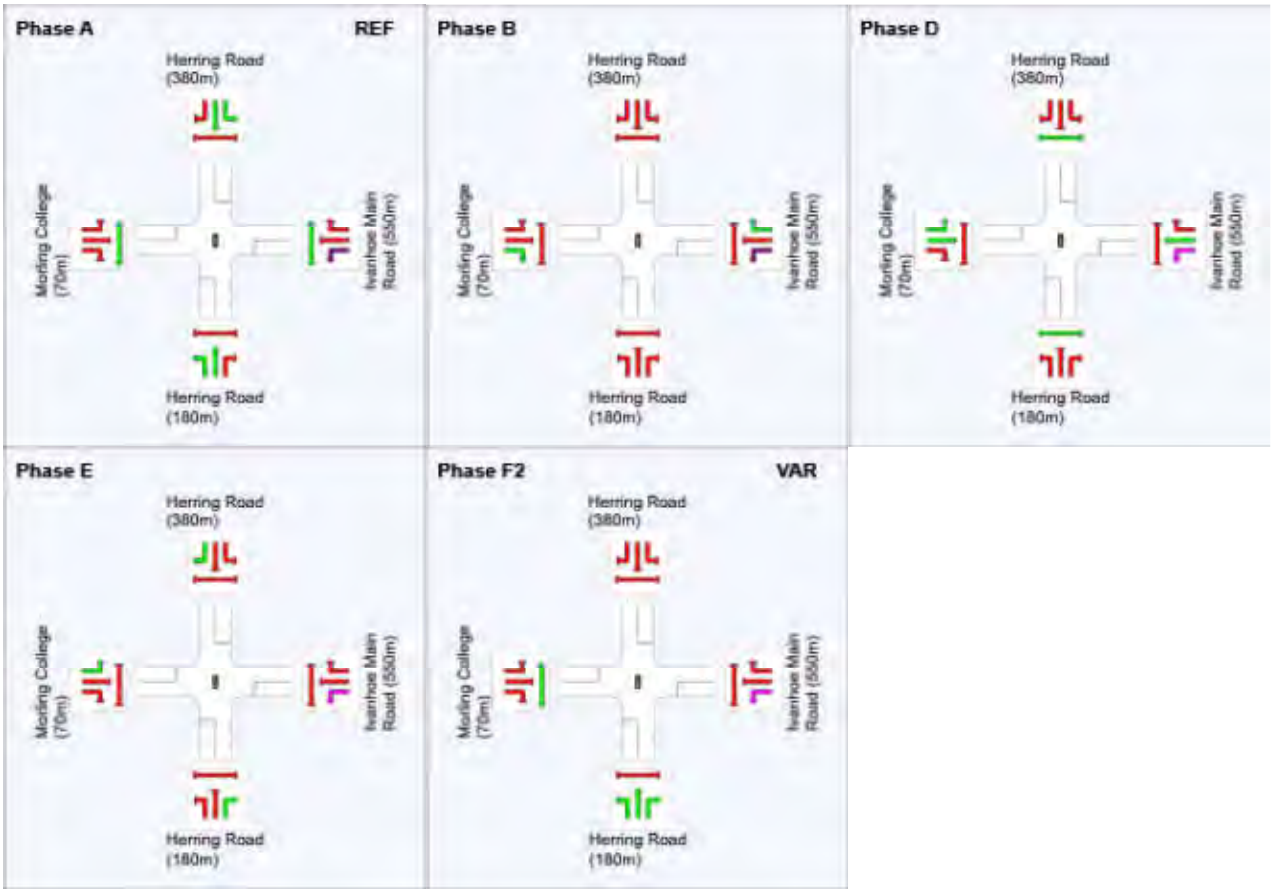
Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C1*, C2*, D, E, F1*, F2*
Output Phase Sequence: A, B, D, E, F2*
(* Variable Phase)

Phase Timing Summary

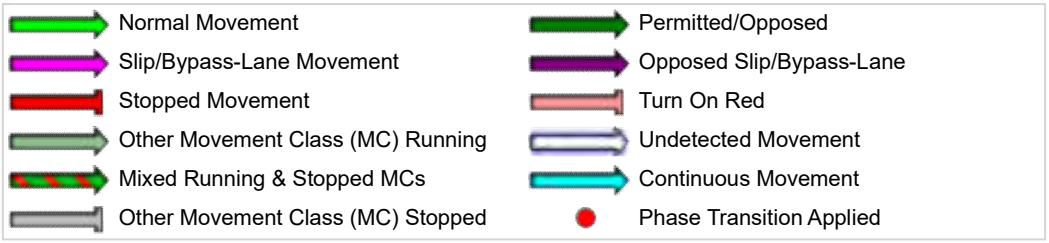
Phase	A	B	D	E	F2
Phase Change Time (sec)	57	92	113	144	7
Green Time (sec)	29	15	25	6	44
Phase Time (sec)	35	21	31	12	50
Phase Split	23%	14%	21%	8%	34%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: 3 [AM_ Lyonpark-Ivanhoe _ s2]

Network: N1 [AM_ Ivanhoe_ s2]

Ivanhoe Main Road x Lyonpark Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Three Leg Priority Controlled
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Lyonpark Road (160m)														
1	L2	19	0.0	19	0.0	0.269	4.6	LOS A	0.0	0.0	0.00	0.02	0.00	49.3
2	T1	494	1.3	492	1.3	0.269	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	49.6
Approach		513	1.2	511[N1]	1.2	0.269	0.2	NA	0.0	0.0	0.00	0.02	0.00	49.6
North: Lyonpark Road (180m)														
8	T1	286	1.5	286	1.5	0.151	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
9	R2	463	1.4	463	1.4	0.441	8.3	LOS A	1.2	8.5	0.63	0.89	0.84	31.2
Approach		749	1.4	749	1.4	0.441	5.1	NA	1.2	8.5	0.39	0.55	0.52	36.4
West: Ivanhoe Main Road (550m)														
10	L2	213	1.5	212	1.5	0.848	12.5	LOS A	3.7	26.0	0.85	1.84	2.55	27.6
12	R2	403	1.3	403	1.3	0.848	17.2	LOS B	3.7	26.0	0.85	1.84	2.55	24.4
Approach		616	1.4	615[N1]	1.4	0.848	15.6	LOS B	3.7	26.0	0.85	1.84	2.55	25.6
All Vehicles		1878	1.3	1875[N1]	1.3	0.848	7.2	NA	3.7	26.0	0.43	0.83	1.04	31.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 4 [AM_ Epping-Lyonpark_ s2]

Network: N1 [AM_ Ivanhoe_ s2]

Epping Road x Lyonpark Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Left In - Left Out
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Epping Road (670m)														
5	T1	1717	2.0	1717	2.0	0.227	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
Approach		1717	2.0	1717	2.0	0.227	0.0	NA	0.0	0.0	0.00	0.00	0.00	69.9
North: Lyonpark Road (160m)														
7	L2	412	1.0	411	1.0	0.227	4.4	LOS A	0.0	0.0	0.00	0.47	0.00	47.4
Approach		412	1.0	411[N1]	1.0	0.227	4.4	NA	0.0	0.0	0.00	0.47	0.00	47.4
West: Epping Road (630m)														
10	L2	661	1.4	658	1.4	0.364	6.4	LOS A	0.0	0.0	0.00	0.61	0.00	58.7
11	T1	1779	2.4	1772	2.4	0.313	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
Approach		2440	2.2	2430[N1]	2.2	0.364	1.8	NA	0.0	0.0	0.00	0.16	0.00	67.9
All Vehicles		4568	2.0	4558[N1]	2.0	0.364	1.4	NA	0.0	0.0	0.00	0.13	0.00	66.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 5 [AM_Herring-Waterloo_ s2]

Network: N2 [AM_ Waterloo_ s2]

Herring Road x Waterloo Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 139 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Herring Road (380m)														
1	L2	103	2.0	103	2.0	0.156	23.1	LOS B	2.3	17.5	0.61	0.68	0.61	39.0
2	T1	921	2.5	921	2.5	0.896	63.1	LOS E	22.2	157.3	0.99	1.03	1.19	24.7
3	R2	646	1.5	646	1.5	0.577	29.9	LOS C	7.5	53.0	0.89	0.82	0.89	26.8
Approach		1671	2.1	1671	2.1	0.896	47.8	LOS D	22.2	157.3	0.93	0.93	1.04	25.9
East: Waterloo Road (390m)														
4	L2	117	1.8	117	1.8	0.084	7.1	LOS A	0.4	2.7	0.08	0.60	0.08	50.5
5	T1	193	1.6	193	1.6	0.272	18.2	LOS B	3.4	23.9	0.45	0.38	0.45	42.5
6	R2	140	44.4	140	44.4	0.334	71.3	LOS F	3.3	23.6	1.00	0.78	1.00	22.9
Approach		449	15.0	449	15.0	0.334	31.9	LOS C	3.4	33.1	0.53	0.56	0.53	34.8
North: Herring Road (330m)														
7	L2	93	53.4	93	53.4	0.354	37.8	LOS C	2.9	30.6	0.88	0.76	0.88	22.0
8	T1	257	6.1	257	6.1	0.429	57.2	LOS E	4.7	33.1	0.95	0.76	0.95	26.2
9	R2	92	44.8	92	44.8	0.301	55.8	LOS D	3.2	31.3	0.88	0.77	0.88	24.7
Approach		441	24.1	441	24.1	0.429	52.7	LOS D	4.7	33.1	0.92	0.77	0.92	25.3
West: Waterloo Road (320m)														
10	L2	92	51.7	92	51.7	0.175	34.5	LOS C	2.4	24.5	0.68	0.74	0.68	31.5
11	T1	307	1.4	307	1.4	0.510	58.5	LOS E	5.9	42.0	0.97	0.78	0.97	15.8
Approach		399	12.9	399	12.9	0.510	53.0	LOS D	5.9	42.0	0.90	0.77	0.90	19.3
All Vehicles		2960	8.8	2960	8.8	0.896	46.8	LOS D	22.2	157.3	0.86	0.83	0.92	26.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	46.9	LOS E	0.2	0.2	0.82	0.82
All Pedestrians		211	59.5	LOS E			0.92	0.92

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: 5 [AM_Herring-Waterloo_ s2]

Network: N2 [AM_ Waterloo_ s2]

Herring Road x Waterloo Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 139 seconds (Network User-Given Cycle Time)

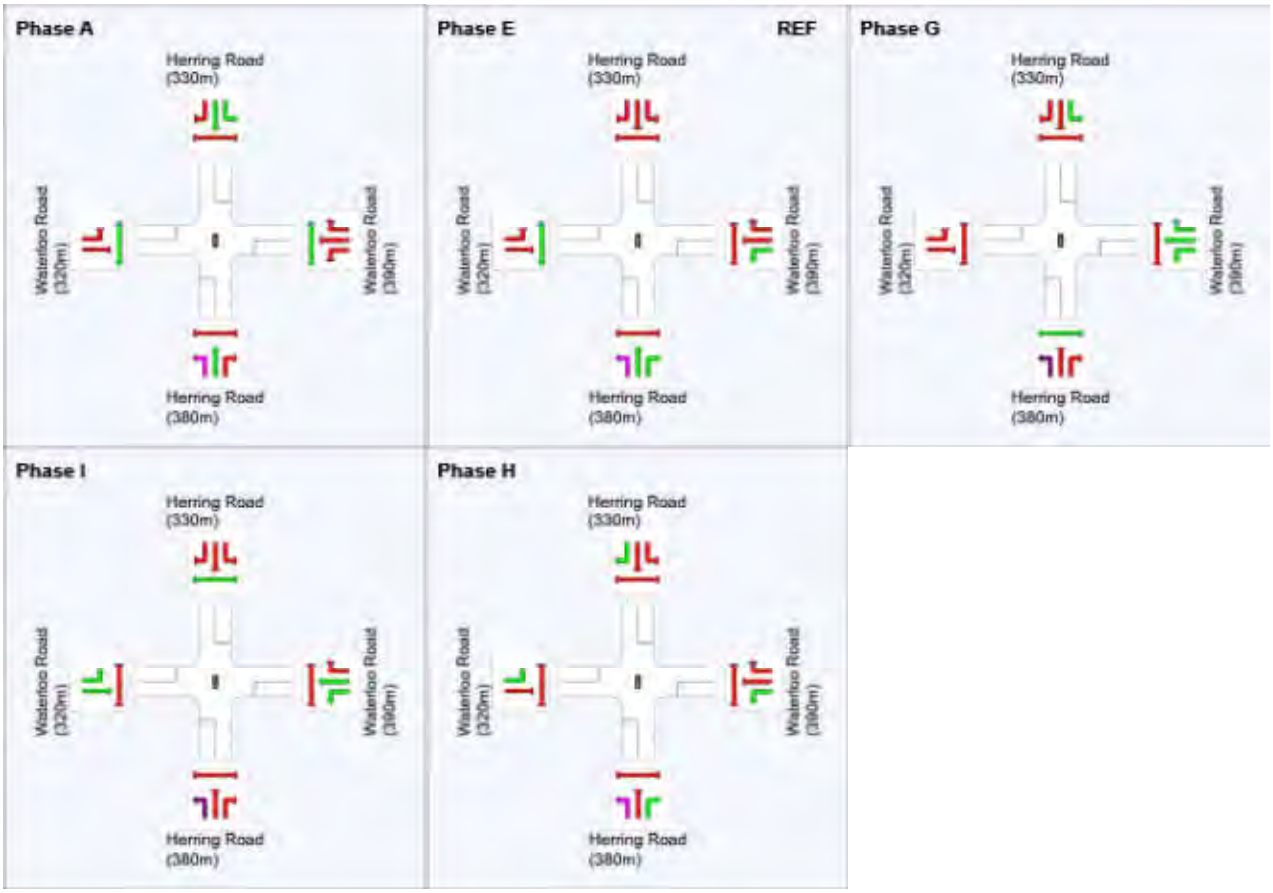
Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Green Split Priority has been specified
Phase Sequence: Variable Phasing
Reference Phase: Phase E
Input Phase Sequence: A, E, G, I, H
Output Phase Sequence: A, E, G, I, H

Phase Timing Summary

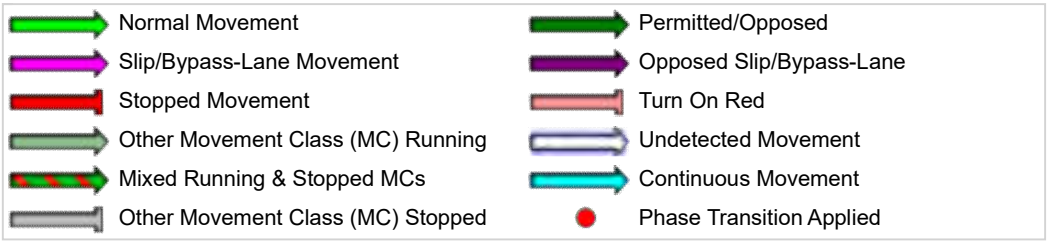
Phase	A	E	G	I	H
Phase Change Time (sec)	112	0	19	48	76
Green Time (sec)	21	13	23	22	30
Phase Time (sec)	27	19	29	28	36
Phase Split	19%	14%	21%	20%	26%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: 6 [AM_Waterloo-Byfield_ s2]

Network: N2 [AM_ Waterloo_ s2]

Waterloo Road x Byfield Sreet
2031 Background plus Development Traffic, with Upgrades
Site Category: Three Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 139 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Byfield Sreet (350m)														
1	L2	82	1.3	82	1.3	0.074	6.0	LOS A	0.5	3.3	0.19	0.56	0.19	40.8
3	R2	36	2.9	36	2.9	0.062	58.1	LOS E	0.6	4.5	0.88	0.69	0.88	19.6
Approach		118	1.8	118	1.8	0.074	21.8	LOS B	0.6	4.5	0.40	0.60	0.40	29.0
East: Waterloo Road (155m)														
4	L2	71	1.5	71	1.5	0.207	30.9	LOS C	2.4	24.0	0.64	0.61	0.64	29.1
5	T1	557	12.3	557	12.3	0.326	27.1	LOS B	7.3	52.1	0.69	0.60	0.69	16.4
Approach		627	11.1	627	11.1	0.326	27.3	LOS B	7.3	52.1	0.69	0.60	0.69	18.7
West: Waterloo Road (390m)														
11	T1	663	9.2	663	9.2	0.208	3.5	LOS A	2.2	15.9	0.20	0.17	0.20	54.5
12	R2	166	1.3	166	1.3	0.319	37.5	LOS C	4.4	30.9	0.67	0.74	0.67	31.3
Approach		829	7.6	829	7.6	0.319	10.3	LOS A	4.4	30.9	0.29	0.28	0.29	45.8
All Vehicles		1575	8.6	1575	8.6	0.326	18.0	LOS B	7.3	52.1	0.46	0.43	0.46	34.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	27.9	LOS C	0.1	0.1	0.63	0.63
P4	West Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		105	45.8	LOS E			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: 6 [AM_Waterloo-Byfield_ s2]

Network: N2 [AM_ Waterloo_ s2]

Waterloo Road x Byfield Sreet
2031 Background plus Development Traffic, with Upgrades
Site Category: Three Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 139 seconds (Network User-Given Cycle Time)

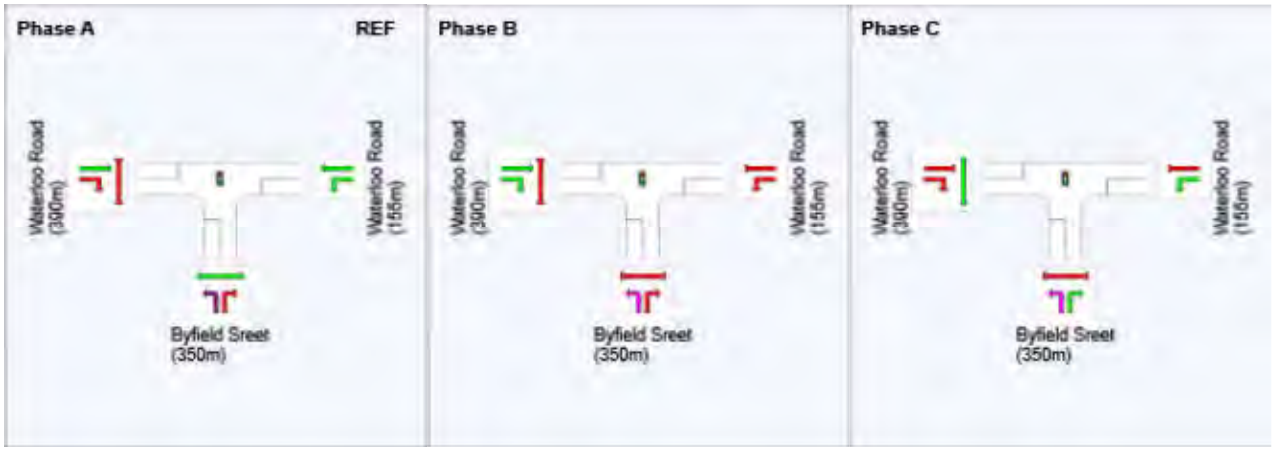
Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Green Split Priority has been specified
Phase Sequence: Opposed Turns
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	27	93	138
Green Time (sec)	60	39	22
Phase Time (sec)	66	45	28
Phase Split	47%	32%	20%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

MOVEMENT SUMMARY

Site: 1 [PM_ Epping-Herring_ s2]

Network: N1 [PM_ Ivanhoe_ s2]

Epping Road x Herring Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 149 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Herring Road (250m)														
1	L2	24	0.0	24	0.0	0.903	110.8	LOS F	16.9	120.6	1.00	1.10	1.94	20.4
2	T1	595	2.3	595	2.3	0.903	89.4	LOS F	16.9	120.6	1.00	1.07	1.56	9.4
3	R2	255	0.8	255	0.8	0.763	79.3	LOS F	5.8	40.8	1.00	0.87	1.15	10.2
Approach		874	1.8	874	1.8	0.903	87.1	LOS F	16.9	120.6	1.00	1.01	1.45	10.1
East: Epping Road (630m)														
4	L2	277	1.1	277	1.1	0.926	80.1	LOS F	30.5	215.4	1.00	1.11	1.67	25.8
5	T1	1523	1.1	1523	1.1	0.926	70.4	LOS E	30.5	215.4	1.00	1.07	1.31	33.3
6	R2	460	2.7	460	2.7	0.751	71.2	LOS F	11.0	78.9	1.00	0.87	1.06	22.5
Approach		2260	1.4	2260	1.4	0.926	71.7	LOS F	30.5	215.4	1.00	1.03	1.30	30.6
North: Herring Road (180m)														
7	L2	299	4.2	299	4.2	0.276	15.3	LOS B	5.4	39.5	0.47	0.70	0.47	26.6
8	T1	807	1.7	807	1.7	0.773	63.4	LOS E	18.0	127.8	1.00	0.88	1.01	18.1
9	R2	576	1.1	576	1.1	0.918	92.8	LOS F	14.1	99.9	1.00	0.93	1.19	21.0
Approach		1682	1.9	1682	1.9	0.918	64.9	LOS E	18.0	127.8	0.90	0.86	0.97	20.0
West: Epping Road (600m)														
10	L2	325	1.0	325	1.0	0.363	19.8	LOS B	6.9	48.8	0.54	0.73	0.54	43.2
11	T1	1162	1.0	1162	1.0	0.757	54.4	LOS D	15.9	112.6	0.98	0.86	1.00	26.0
12	R2	194	1.1	194	1.1	0.884	88.2	LOS F	9.6	67.7	1.00	0.94	1.30	23.0
Approach		1681	1.0	1681	1.0	0.884	51.6	LOS D	15.9	112.6	0.90	0.85	0.94	27.5
All Vehicles		6497	1.5	6497	1.5	0.926	66.8	LOS E	30.5	215.4	0.95	0.94	1.14	24.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	43.7	LOS E	0.2	0.2	0.77	0.77
P2	East Full Crossing	53	55.1	LOS E	0.2	0.2	0.86	0.86
P3	North Full Crossing	53	51.7	LOS E	0.2	0.2	0.83	0.83
P4	West Full Crossing	53	65.0	LOS F	0.2	0.2	0.93	0.93
All Pedestrians		211	53.9	LOS E			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: 1 [PM_ Epping-Herring_ s2]

Network: N1 [PM_ Ivanhoe_ s2]

Epping Road x Herring Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 149 seconds (Network User-Given Cycle Time)

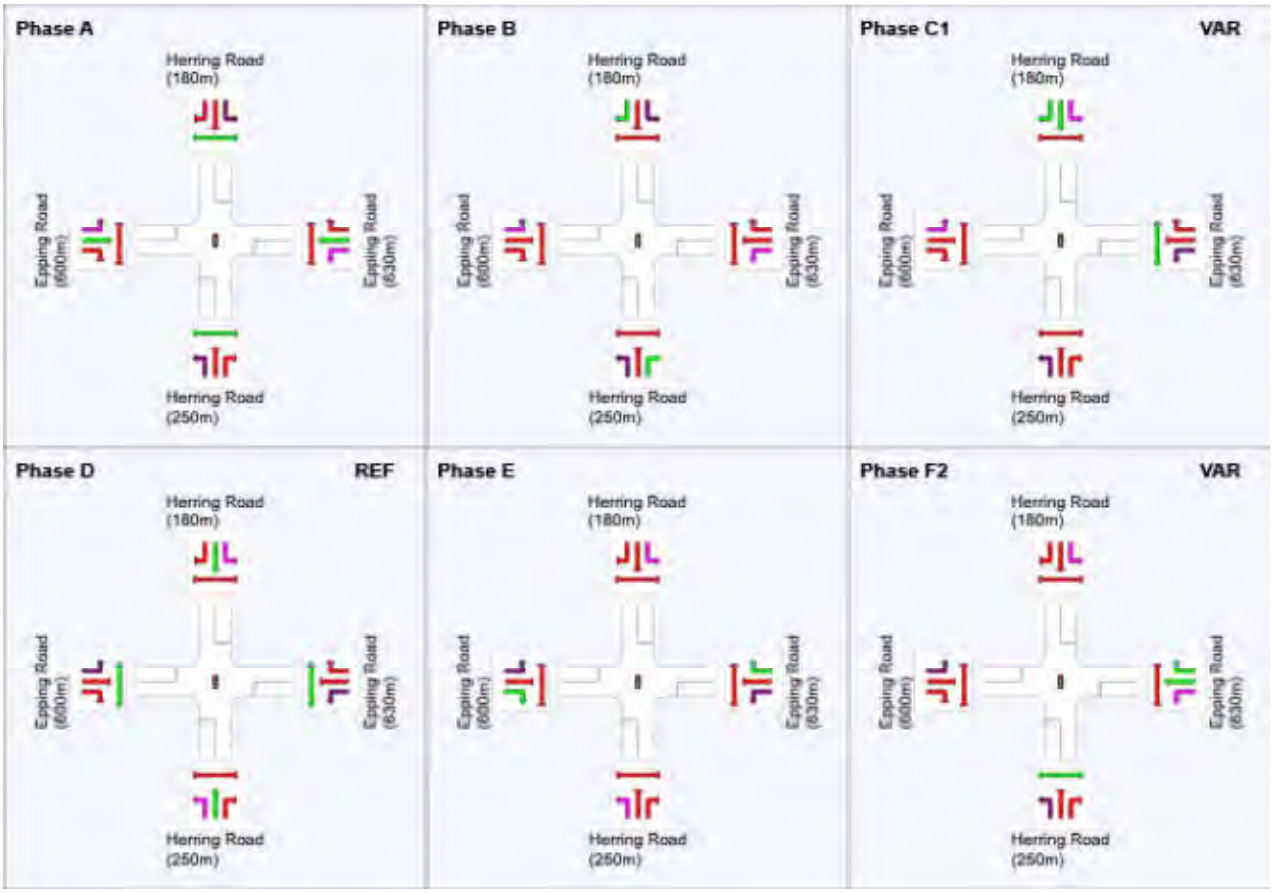
Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Variable Phasing
Reference Phase: Phase D
Input Phase Sequence: A, B, C1*, C2*, D, E, F1*, F2*
Output Phase Sequence: A, B, C1*, D, E, F2*
(* Variable Phase)

Phase Timing Summary

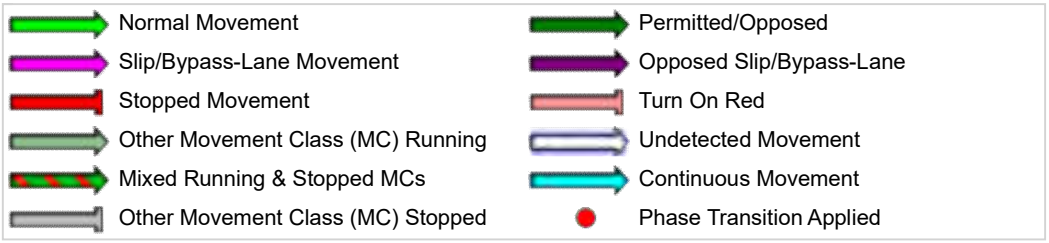
Phase	A	B	C1	D	E	F2
Phase Change Time (sec)	70	116	138	0	36	60
Green Time (sec)	40	16	5	30	18	4
Phase Time (sec)	46	22	11	36	24	10
Phase Split	31%	15%	7%	24%	16%	7%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: 2 [PM_ Herring-Ivanhoe_ s2]

Network: N1 [PM_ Ivanhoe_ s2]

Herring Road x Ivanhoe Place
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 149 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Herring Road (180m)														
1	L2	1	0.0	1	0.0	0.019	6.6	LOS A	0.0	0.2	0.03	0.05	0.03	22.3
2	T1	1351	1.8	1351	1.8	0.730	12.7	LOS A	18.1	127.8	0.43	0.39	0.43	43.9
3	R2	140	1.5	140	1.5	0.863	77.9	LOS F	6.3	45.0	0.93	0.93	1.26	8.1
Approach		1492	1.8	1492	1.8	0.863	18.8	LOS B	18.1	127.8	0.48	0.44	0.51	37.9
East: Ivanhoe Place (550m)														
4	L2	653	1.0	653	1.0	0.615	18.4	LOS B	14.9	105.2	0.69	0.77	0.79	23.7
5	T1	8	0.0	8	0.0	0.615	17.0	LOS B	14.9	105.2	0.69	0.77	0.79	23.8
6	R2	221	1.0	221	1.0	0.842	76.3	LOS F	10.4	73.7	1.00	0.99	1.19	20.3
Approach		882	1.0	882	1.0	0.842	32.9	LOS C	14.9	105.2	0.77	0.83	0.89	22.4
North: Herring Road (380m)														
7	L2	7	0.0	7	0.0	0.039	38.7	LOS C	0.5	5.8	0.68	0.55	0.68	24.1
8	T1	1020	2.2	1020	2.2	0.868	56.2	LOS D	23.6	166.8	0.98	0.97	1.10	17.8
9	R2	35	0.0	35	0.0	0.448	85.9	LOS F	1.6	11.3	1.00	0.72	1.00	14.6
Approach		1062	2.1	1062	2.1	0.868	57.1	LOS E	23.6	166.8	0.98	0.96	1.09	17.7
West: Morling College (70m)														
10	L2	21	0.0	21	0.0	0.056	53.1	LOS D	0.8	5.6	0.82	0.69	0.82	20.1
11	T1	2	0.0	2	0.0	0.056	52.1	LOS D	0.8	5.6	0.82	0.69	0.82	5.3
12	R2	8	0.0	8	0.0	0.129	83.4	LOS F	0.4	2.7	0.99	0.67	0.99	3.7
Approach		32	0.0	32	0.0	0.129	61.1	LOS E	0.8	5.6	0.86	0.69	0.86	14.7
All Vehicles		3467	1.6	3467	1.6	0.868	34.5	LOS C	23.6	166.8	0.71	0.70	0.79	25.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	58.6	LOS E	0.2	0.2	0.89	0.89
P2	East Full Crossing	53	38.5	LOS D	0.2	0.2	0.72	0.72
P3	North Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	25.5	LOS C	0.1	0.1	0.59	0.59
All Pedestrians		211	47.8	LOS E			0.79	0.79

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: 2 [PM_ Herring-Ivanhoe_ s2]

Network: N1 [PM_ Ivanhoe_ s2]

Herring Road x Ivanhoe Place
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 149 seconds (Network User-Given Cycle Time)

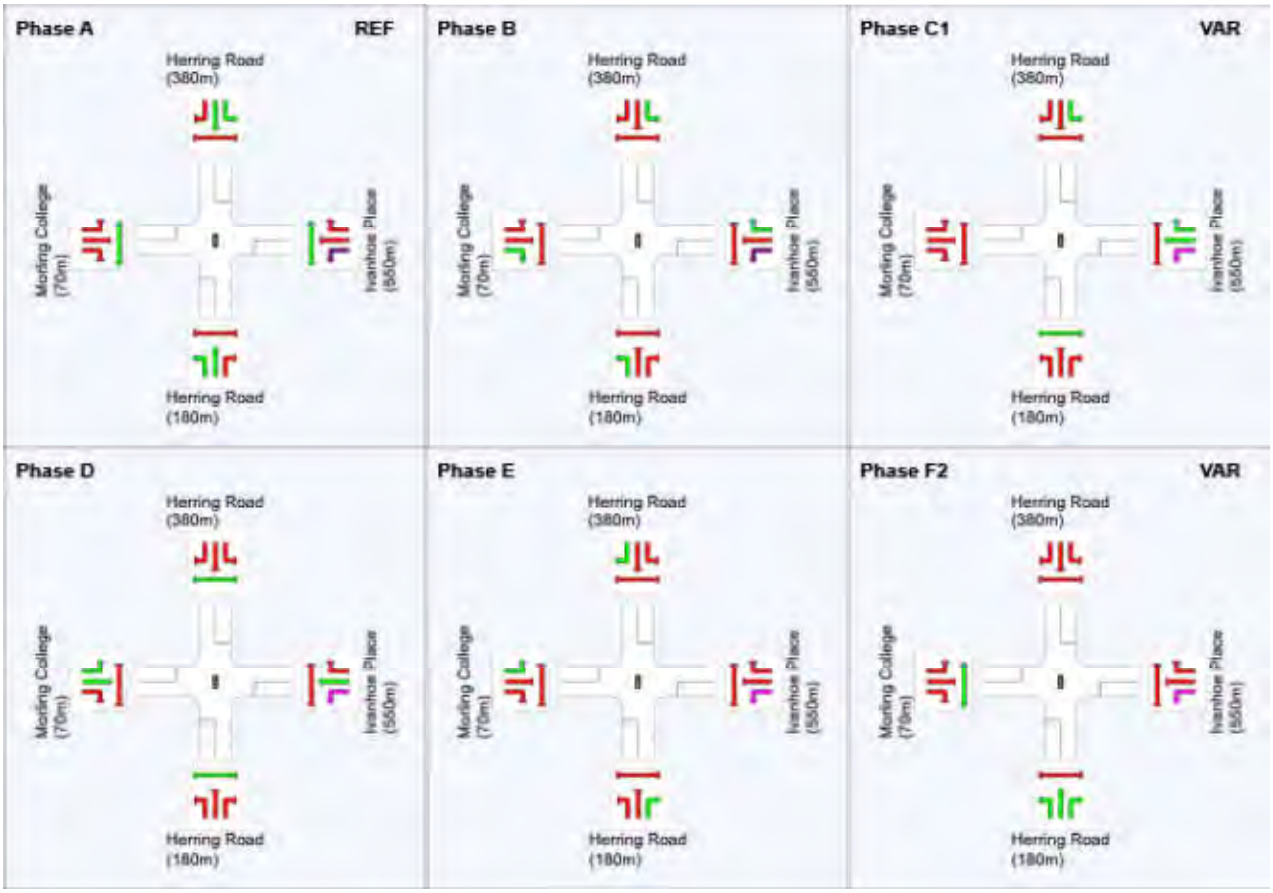
Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Variable phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C1*, C2*, D, E, F1*, F2*
Output Phase Sequence: A, B, C1*, D, E, F2*
(* Variable Phase)

Phase Timing Summary

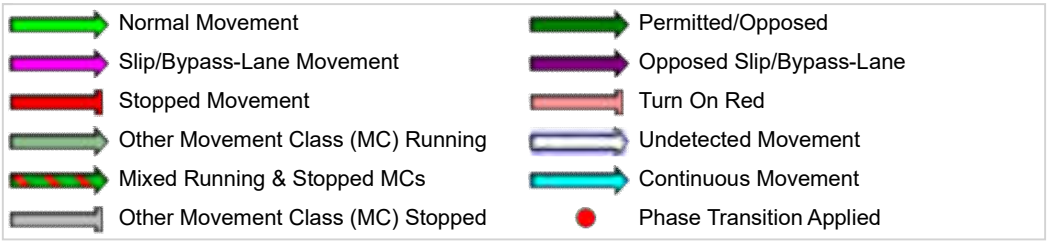
Phase	A	B	C1	D	E	F2
Phase Change Time (sec)	31	89	101	116	147	10
Green Time (sec)	52	6	9	25	6	15
Phase Time (sec)	58	12	15	31	12	21
Phase Split	39%	8%	10%	21%	8%	14%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: 3 [PM_ Lyonpark-Ivanhoe _ s2]

Network: N1 [PM_ Ivanhoe_ s2]

Ivanhoe Main Road x Lyonpark Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Three Leg Priority Controlled
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Lyonpark Road (160m)														
1	L2	139	0.8	139	0.8	0.168	4.6	LOS A	0.0	0.0	0.00	0.24	0.00	43.0
2	T1	174	1.2	174	1.2	0.168	0.0	LOS A	0.0	0.0	0.00	0.24	0.00	46.3
Approach		313	1.0	313	1.0	0.168	2.0	NA	0.0	0.0	0.00	0.24	0.00	45.3
North: Lyonpark Road (180m)														
8	T1	685	1.1	685	1.1	0.361	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
9	R2	865	1.0	865	1.0	0.650	8.4	LOS A	3.3	23.4	0.64	0.85	0.97	31.0
Approach		1551	1.0	1551	1.0	0.650	4.7	NA	3.3	23.4	0.36	0.47	0.54	37.3
West: Ivanhoe Main Road (550m)														
10	L2	44	0.0	44	0.0	0.477	5.1	LOS A	0.7	4.9	0.65	0.85	0.90	28.0
12	R2	139	0.8	139	0.8	0.477	17.3	LOS B	0.7	4.9	0.65	0.85	0.90	24.7
Approach		183	0.6	183	0.6	0.477	14.4	LOS A	0.7	4.9	0.65	0.85	0.90	25.6
All Vehicles		2046	1.0	2046	1.0	0.650	5.1	NA	3.3	23.4	0.33	0.47	0.49	34.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 4 [PM_ Epping-Lyonpark_ s2]

Network: N1 [PM_ Ivanhoe_ s2]

Epping Road x Lyonpark Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Left In - Left Out
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Epping Road (670m)														
5	T1	2281	1.4	2281	1.4	0.300	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
Approach		2281	1.4	2281	1.4	0.300	0.0	NA	0.0	0.0	0.00	0.00	0.00	69.9
North: Lyonpark Road (160m)														
7	L2	1351	0.9	1351	0.9	0.744	4.4	LOS A	0.0	0.0	0.00	0.46	0.00	47.2
Approach		1351	0.9	1351	0.9	0.744	4.4	NA	0.0	0.0	0.00	0.46	0.00	47.2
West: Epping Road (630m)														
10	L2	137	0.8	137	0.8	0.075	6.4	LOS A	0.0	0.0	0.00	0.61	0.00	58.7
11	T1	1406	1.6	1406	1.6	0.247	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
Approach		1543	1.6	1543	1.6	0.247	0.6	NA	0.0	0.0	0.00	0.05	0.00	69.3
All Vehicles		5175	1.3	5175	1.3	0.744	1.4	NA	0.0	0.0	0.00	0.14	0.00	62.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 5 [PM_Herring-Waterloo_ s2]

Network: N2 [PM_ Waterloo_ s2]

Herring Road x Waterloo Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 139 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Herring Road (380m)														
1	L2	119	0.9	119	0.9	0.141	18.3	LOS B	2.3	17.1	0.50	0.65	0.50	41.9
2	T1	998	2.0	998	2.0	0.702	36.4	LOS C	18.1	127.5	0.88	0.78	0.88	32.9
3	R2	532	1.0	532	1.0	0.617	33.0	LOS C	6.1	43.1	0.95	0.82	0.95	25.4
Approach		1648	1.6	1648	1.6	0.702	34.0	LOS C	18.1	127.5	0.87	0.78	0.87	31.5
East: Waterloo Road (390m)														
4	L2	379	1.1	379	1.1	0.263	7.1	LOS A	1.0	7.1	0.06	0.55	0.06	50.9
5	T1	144	1.5	144	1.5	0.263	5.0	LOS A	1.0	7.1	0.14	0.24	0.14	52.5
6	R2	155	40.8	155	40.8	0.340	37.4	LOS C	2.5	18.1	0.59	0.69	0.59	32.4
Approach		678	10.2	678	10.2	0.340	13.6	LOS A	2.5	18.1	0.20	0.52	0.20	45.4
North: Herring Road (330m)														
7	L2	79	77.3	79	77.3	0.262	29.7	LOS C	2.0	23.9	0.80	0.73	0.80	26.4
8	T1	678	2.8	678	2.8	0.915	72.4	LOS F	15.7	111.2	1.00	1.06	1.30	22.8
9	R2	144	31.4	144	31.4	0.881	85.2	LOS F	6.8	60.4	1.00	0.97	1.36	19.0
Approach		901	13.9	901	13.9	0.915	70.7	LOS F	15.7	111.2	0.98	1.02	1.26	22.2
West: Waterloo Road (320m)														
10	L2	131	35.5	131	35.5	0.312	46.9	LOS D	4.2	38.5	0.82	0.78	0.82	27.1
11	T1	505	1.0	505	1.0	0.837	68.1	LOS E	11.1	78.2	1.00	0.95	1.18	14.1
Approach		636	8.1	636	8.1	0.837	63.8	LOS E	11.1	78.2	0.96	0.92	1.10	16.7
All Vehicles		3863	7.1	3863	7.1	0.915	43.9	LOS D	18.1	127.5	0.79	0.81	0.88	27.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	58.1	LOS E	0.2	0.2	0.92	0.92
P3	North Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	35.3	LOS D	0.1	0.1	0.71	0.71
All Pedestrians		211	55.3	LOS E			0.89	0.89

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: 5 [PM_Herring-Waterloo_ s2]

Network: N2 [PM_ Waterloo_ s2]

Herring Road x Waterloo Road
2031 Background plus Development Traffic, with Upgrades
Site Category: Four Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 139 seconds (Network User-Given Cycle Time)

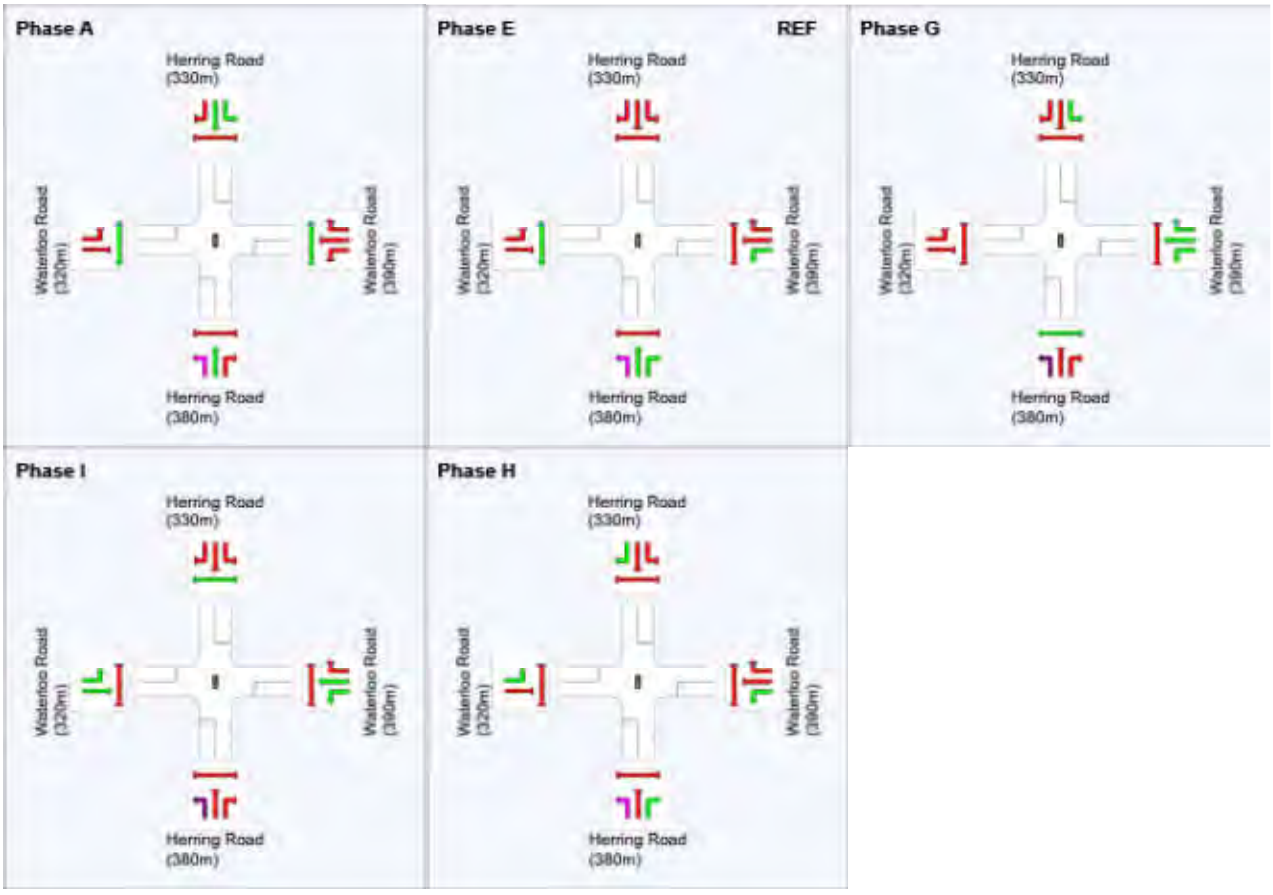
Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Green Split Priority has been specified
Phase Sequence: Variable Phasing
Reference Phase: Phase E
Input Phase Sequence: A, E, G, I, H
Output Phase Sequence: A, E, G, I, H

Phase Timing Summary

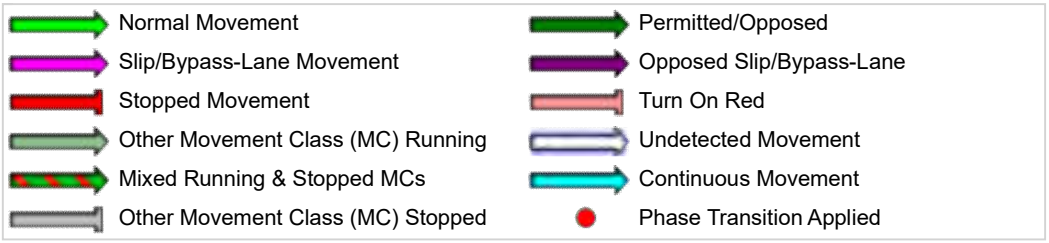
Phase	A	E	G	I	H
Phase Change Time (sec)	102	0	24	53	81
Green Time (sec)	31	18	23	22	15
Phase Time (sec)	37	24	29	28	21
Phase Split	27%	17%	21%	20%	15%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: 6 [PM_Waterloo-Byfield_ s2]

Network: N2 [PM_ Waterloo_ s2]

Waterloo Road x Byfield Sreet
2031 Background plus Development Traffic, with Upgrades
Site Category: Three Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 139 seconds (Network User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Byfield Sreet (350m)														
1	L2	120	0.9	120	0.9	0.115	11.6	LOS A	1.6	11.1	0.39	0.62	0.39	34.9
3	R2	16	0.0	16	0.0	0.027	57.4	LOS E	0.3	1.9	0.87	0.66	0.87	19.8
Approach		136	0.8	136	0.8	0.115	16.9	LOS B	1.6	11.1	0.44	0.63	0.44	31.2
East: Waterloo Road (155m)														
4	L2	29	0.0	29	0.0	0.235	44.9	LOS D	2.4	26.3	0.79	0.66	0.79	24.3
5	T1	980	7.2	980	7.2	0.909	64.3	LOS E	23.7	167.1	0.97	1.02	1.19	8.3
Approach		1009	7.0	1009	7.0	0.909	63.7	LOS E	23.7	167.1	0.97	1.01	1.18	8.8
West: Waterloo Road (390m)														
11	T1	1235	5.8	1235	5.8	0.398	6.4	LOS A	8.3	58.7	0.39	0.35	0.39	50.5
12	R2	486	1.1	486	1.1	0.910	60.4	LOS E	19.3	136.4	0.79	0.92	1.03	24.8
Approach		1721	4.5	1721	4.5	0.910	21.6	LOS B	19.3	136.4	0.50	0.51	0.57	37.1
All Vehicles		2866	5.2	2866	5.2	0.910	36.2	LOS C	23.7	167.1	0.66	0.69	0.78	25.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	42.0	LOS E	0.2	0.2	0.78	0.78
P4	West Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		105	52.9	LOS E			0.87	0.87

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: 6 [PM_Waterloo-Byfield_ s2]

Network: N2 [PM_ Waterloo_ s2]

Waterloo Road x Byfield Sreet
2031 Background plus Development Traffic, with Upgrades
Site Category: Three Leg Signalised
Signals - Fixed Time Coordinated Cycle Time = 139 seconds (Network User-Given Cycle Time)

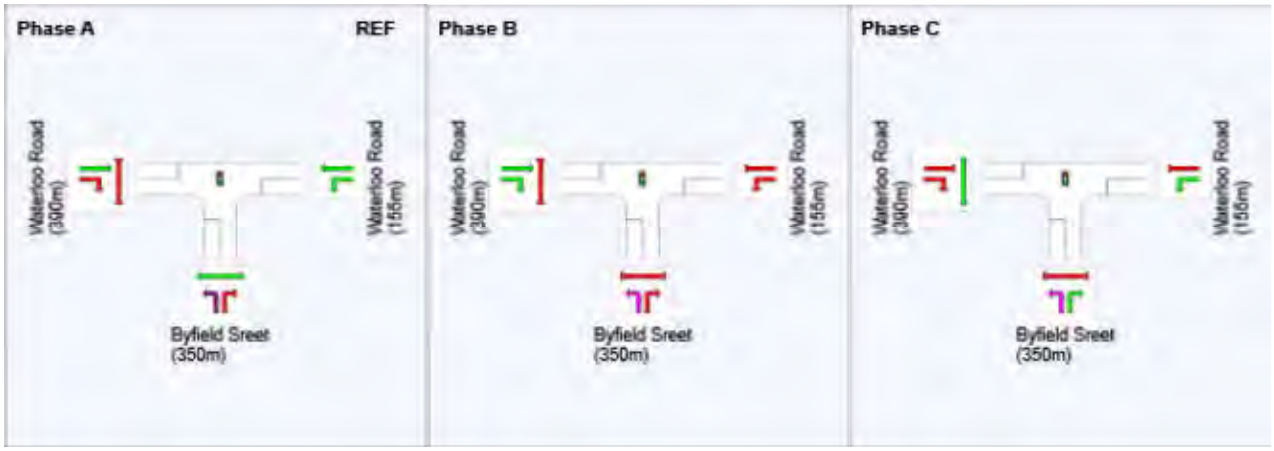
Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Green Split Priority has been specified
Phase Sequence: Opposed Turns
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	46	111
Green Time (sec)	40	59	22
Phase Time (sec)	46	65	28
Phase Split	33%	47%	20%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

Appendix B

RMS Email

From: AMIN Ahsanul <Ahsanul.AMIN@rms.nsw.gov.au>
Sent: Friday, 6 July 2018 4:06 PM
To: Andy Nixey <Andy.Nixey@planning.nsw.gov.au>; Andrew Johnson <andrew.johnson@asongroup.com.au>
Cc: Chris Koukoutaris <Chris.Koukoutaris@fraserspropery.com.au>; THORPE Lindsay <Lindsay.THORPE@rms.nsw.gov.au>; Cameron.Jackson@fraserspropery.com.au; Joshua Milston <Joshua.Milston@arup.com>; Cameron Sargent <Cameron.Sargent@planning.nsw.gov.au>; Thomas Hurrell <Thomas.Hurrell@facs.nsw.gov.au>; DAIZLI Marwan S <Marwan.DAIZLI@rms.nsw.gov.au>; HAMILTON Brad <Bradley.HAMILTON@rms.nsw.gov.au>; CARRUTHERS Peter <Peter.CARRUTHERS@rms.nsw.gov.au>; WALKER Vicky <Vicky.WALKER@rms.nsw.gov.au>; RATHAN Pahee <Pahee.RATHAN@rms.nsw.gov.au>
Subject: RMS response for SYD17/00415/06 - RMS further response to DP&E on Meeting Minute & Mesoscopic Model for 2031 and other issues for Ivanhoe Estate Residential Development - Cnr Herring Road & Ivanhoe Place - Macquarie Park - SSD 8707
Importance: High

Hi Andy

Thank you for your e-mail and subsequent discussion today, as we discuss Roads and Maritime requests to model the following intersections as a SIDRA Network Model rather than model in isolation. This will give us an understanding if there is any spill over onto the next intersection due to the queued traffic and potential impact in the network.

The modelling should be undertaken as per Roads and Maritime's Modelling Guidelines and calibrated & validated accordingly. Here is the link FYI: http://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/technical-manuals/modellingguidelines.pdf

Should you have any further enquiries regarding the above please do not hesitate to contact me on 02-8849 2762 during business hours or e-mail at development.sydney@rms.nsw.gov.au.

Kind regards,

Ahsanul Amin
A/Senior Land Use Planner
Sydney Division | North West Precinct
T 02 8849 2762 **| M** 0427 941 329
www.rms.nsw.gov.au
Every journey matters

Roads and Maritime Services
Level 5, 27 Argyle Street, Parramatta, NSW 2150

From: Andy Nixey [mailto:Andy.Nixey@planning.nsw.gov.au]
Sent: Friday, 6 July 2018 3:25 PM
To: Andrew Johnson
Cc: Chris Koukoutaris; THORPE Lindsay; AMIN Ahsanul; Cameron.Jackson@fraserspropery.com.au; Joshua Milston; Cameron Sargent; Thomas Hurrell
Subject: RE: HPE CM: RE: HPE CM: SYD17/00415/06 - RMS further response to DP&E on Meeting

Minute & Mesoscopic Model for 2031 and other issues for Ivanhoe Estate Residential Development - Cnr Herring Road & Ivanhoe Place - Macquarie Park - SSD 8707

Hi Andrew

Thanks for your email. I've discussed the matter with Josh Milston who agrees the proposed approach is reasonable subject to the following changes:

2. Sidra modelling be undertaken for the 2031 scenario at the intersections of

    - Epping Rd with Herring Rd and
    - Herring Road with Ivanhoe Place
    - Lyonpark Road with 'Main Street'
    - Lyonpark Road with Epping Road

However, I've not been able to discuss the proposed approach with Ahsanul. Given I'll now be on leave until 31st July, I'm happy for you to discuss the matter directly with Ahsanul/RMS to reach agreement on the proposed approach. Please copy myself and Cameron Sargent into any further emails.

Kind regards

Andy

From: Andrew Johnson [mailto:andrew.johnson@asongroup.com.au]
Sent: Wednesday, 4 July 2018 2:27 PM
To: Andy Nixey <Andy.Nixey@planning.nsw.gov.au>; Thomas Hurrell <Thomas.Hurrell@facs.nsw.gov.au>
Cc: Chris Koukoutaris <Chris.Koukoutaris@fraserspropery.com.au>; THORPE Lindsay <Lindsay.THORPE@rms.nsw.gov.au>; AMIN Ahsanul <Ahsanul.AMIN@rms.nsw.gov.au>; Cameron.Jackson@fraserspropery.com.au
Subject: HPE CM: RE: HPE CM: SYD17/00415/06 - RMS further response to DP&E on Meeting Minute & Mesoscopic Model for 2031 and other issues for Ivanhoe Estate Residential Development - Cnr Herring Road & Ivanhoe Place - Macquarie Park - SSD 8707

Dear Andy,

I refer to the meeting held on 22 June 2018 with officers from Roads and Maritime Services (RMS), Department of Planning & Environment (DPE) and representatives from Fraser Properties and the subsequent request from RMS to model the proposed development for a 2031 scenario. In this regard, we have reviewed the relevant models provided by RMS and note that we have undertaken consultation with Aecom (which developed the model on behalf of RMS). A summary of this is provided:

- The 2031 Stage 2 Ultimate model has been provided by RMS for adoption in our assessment

- This model has been run in the nominated version of Aimsun (as provided by Aecom) and the attached simulation density and AM / PM outputs have been reviewed by Aecom and confirmed that they are consistent with the outputs expected by Aecom.

- The simulations of the Stage 2 Ultimate model (provided) identified significant latent demand in the AM and PM (particularly the PM) with congestion within the model resulting in 7,400 and 16,650 unreleased vehicles respectively.

- Preliminary runs of the model in the AM peak are resulted in unsettled results due to the extent of latent demand (unreleased vehicles). The PM peak resulted in forecast gridlock of the network and is unusable.

These results are consistent with the modelling results achieved by Aecom / RMS. In this regard the *Macquarie Park Bus Priority and Capacity Improvement Project – Stage 2 Traffic Assessment* dated 11 August 2017 concludes that:

AM Peak

- 2031 Stage 2 Ultimate model (the model provided) the network would run and resulted in improved LoS at some intersections.

- **However,** it is recognised that the model has some 8,707 unreleased vehicles (compared to the 7,400 under Asons modelling) in the 2031 Scenario. Therefore the volume of traffic through the network is heavily discounted. Indeed, the modelling demonstrated 630 vehicles queueing to enter Herring Road (north bound) and 700 unreleased vehicles on Epping Rad (eastbound).

PM Peak

- The model provided & indeed the 2031 Stage 2 Ultimate Revised model (a model developed with additional unfunded upgrades) gridlocked at 17:15pm

- The delays in the PM peak during the 2031 were not reported on as no functioning model was developed to accommodate the regional and local growth within the Macquarie Park precinct.

Having regard to the above, we provide the following comments:

- The traffic growth was calculated using outputs from the STM for through traffic and by using DA yield information and RMS recommended trip rates to calculate growth in traffic travelling to, from and within the study area. The trip generation assumptions for Ivanhoe Estate that were modelled by RMS in the 2031 model compared with the updated TMAP assessment is provided below.

Table 2: Trip Comparison

	Ivanhoe Estate Trips	
	AM	**PM**
RMS 2031 Model	475	375
Submitted TMAP (with school)	538	434
Revised TMAP (no school)	448	419
Revised TMAP (with school)	663	505

- Traffic generation for all planned developments in the model were calculated using trip generation rates from the NSW RMS guidelines. These rates are higher than those established for Ivanhoe Este through the surveys undertaken for the study and confirmed as acceptable by Arup. The comparison between the RMS and Proposed is generally associated with the school.

- The 2031 RMS model shows that in the PM peak the network will become oversaturated (gridlocked), even with the Stage 2 BPIP proposal and potential (currently un-funded) additional upgrades at Epping Road/Wicks Road, Lane Cove Road/Talavera Road and Talavera

Road/Khartoum Road. **Accordingly there is no PM peak model that can be used to assess the 2031 impacts.**

- The extent of unreleased vehicles in the AM peak period is excessive and would generally be considered too high to reflect a stable model for assessment.

It is our view therefore that the 2031 scenario will not provide a reasonable basis of assessment of the future impacts of the development. Indeed, no workable 2031 PM model is currently available

On this basis, the following approach is proposed:

1. Ason to undertake sensitivity analysis of the 2021 Model for the revised traffic generation as agreed previously agreed in our meeting with DoPE and Arup

2. Sidra modelling be undertaken for the 2031 scenario at the intersections of

    - Epping Rd with Herring Rd and
    - Herring Road with Ivanhoe Place

The future volumes will be established through a scaling of the 2021 No development Scenario using 2031 growth rates provided by RMS. The volume and distribution of the development traffic can then be superimposed onto this network based on the outputs from the workable 2021 model. This will enable the following comparisons:

- 2031 No Development, and
- 2031 With Development

The proposed approach will allow for a comparison of the future operation of the road network adjacent to the site, and assist in identifying and future upgrades resulting from the development and growth more generally.

Can you please consider the proposed approach and advise accordingly.

Regards

Regards

Andrew Johnson
Director | Ason Group

M: +61 402 228 301 | T: +61 2 9083 6601 | E: andrew.johnson@asongroup.com.au
A: Suite 1202, Level 12, 220 George Street, Sydney NSW 2000

From: Andy Nixey <Andy.Nixey@planning.nsw.gov.au>
Sent: Tuesday, 26 June 2018 1:08 PM
To: Thomas Hurrell <Thomas.Hurrell@facs.nsw.gov.au>; Andrew Johnson <andrew.johnson@asongroup.com.au>
Cc: Chris Koukoutaris <Chris.Koukoutaris@fraserspropertyproperty.com.au>
Subject: FW: HPE CM: SYD17/00415/06 - RMS further response to DP&E on Meeting Minute & Mesoscopic Model for 2031 and other issues for Ivanhoe Estate Residential Development - Cnr Herring Road & Ivanhoe Place - Macquarie Park - SSD 8707

Hi Tom and Andrew

Please see comments below from Ahsanul at RMS following our meeting last week.

Kind regards

Andy

Andy Nixey
Principal Planner
Key Sites Assessments
NSW Planning & Environment| GPO Box 39 | Sydney NSW 2001
T 02 9274 6379 E Andy.Nixey@planning.nsw.gov.au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From: AMIN Ahsanul [mailto:Ahsanul.AMIN@rms.nsw.gov.au]
Sent: Tuesday, 26 June 2018 12:21 PM
To: Andy Nixey <Andy.Nixey@planning.nsw.gov.au>
Cc: HAMILTON Brad <Bradley.HAMILTON@rms.nsw.gov.au>; THORPE Lindsay <Lindsay.THORPE@rms.nsw.gov.au>; Joshua Milston <Joshua.Milston@arup.com>; RATHAN Pahee <Pahee.RATHAN@rms.nsw.gov.au>; Chris Koukoutaris <Chris.Koukoutaris@fraserspropery.com.au>
Subject: HPE CM: SYD17/00415/06 - RMS further response to DP&E on Meeting Minute & Mesoscopic Model for 2031 and other issues for Ivanhoe Estate Residential Development - Cnr Herring Road & Ivanhoe Place - Macquarie Park - SSD 8707

Attention	Andy Nixey
Department	Department of Planning & Environment

Dear Andy,

I refer to our meeting on 19 June 2018 regarding proposed Ivanhoe Estate development and our subsequent discussion on 22 June 2018 and advise as follows.

Roads and Maritime has reviewed the DRAFT meeting minute send by Fraser Properties on 22 June 2018 provides the following comments for Department's consideration:

1. Proposed temporary U-turn facility and further modelling: For Stage-2 (Ultimate) development: if a roundabout cannot be built then the U-turn movement facility will need to be provided within Ivanhoe Estate's local road network. It was mentioned in the submission by ASON Group on 21 February 2018 that re-routing options throughout Macquarie Park would generate the travel time greater than 4 mins,

which is not acceptable. Therefore, travel time assessment of performing the U-turn by going round the Ivanhoe Estate block in the internal road network, should be included in further submission.

2. 2031 modelling: Roads and Maritime records shows that Roads and Maritime requested the applicant/developer to model the proposed development for 2031 scenario. Roads and Maritime's correspondence with ASON Group has been *attached* with this e-mail for your information.

3. Developer's contribution for Road/Transport improvements: Roads and Maritime will re-word condition imposed to contribution as "amount to be paid prior to construction certificate being issued for Stage 1".

Roads and Maritime will review this Application further once RtS (Response to Submission) is received and would provide further comments/condition for Department's consideration. Meanwhile, if you have any further enquiries regarding the above please do not hesitate to contact me on 02-8849 2762 or e-mail at development.sydney@rms.nsw.gov.au.

Kind regards,

Ahsanul Amin
A/Senior Land Use Planner
Sydney Division | North West Precinct
T 02 8849 2762 **| M** 0427 941 329
www.rms.nsw.gov.au
Every journey matters

Roads and Maritime Services
Level 5, 27 Argyle Street, Parramatta, NSW 2150

From: Chris Koukoutaris [mailto:Chris.Koukoutaris@fraserspropery.com.au]
Sent: Friday, 22 June 2018 9:16 AM
To: Cameron Jackson; Andrew Johnson; Communities Plus Ivanhoe; Andy Nixey; AMIN Ahsanul; Joshua.Milston@arup.com
Cc: Scott Clohessy
Subject: RE: RMS / DOPE Meeting Minutes 19/6/2018

Morning All,

Please find below minute points of meeting held Tuesday 19/6/18.

Please let me know if you have any further comments.

Thanks

- RMS advised in the meeting the Herring / Ivanhoe Place & Herring Road / Epping Road intersection upgrades works would be undertaken by RMS with Fraser contributing their appropriate contribution amount

- RMS to undertake the costing for the proposed Herring Road / Ivanhoe Place intersection upgrades and Herring Road / Epping Road intersection upgrades, which are to be provided to Frasers in approximately 4 weeks for our review

- RMS to confirm why FPA is contributing the Epping Road/Herring Road as this was not considered under the Herring Road Finalisation Report. See Appendix A of the Finalisation Report which states that Macquarie University will deliver "$7.2M contribution to RMS towards upgrade of intersections on Herring Road".

- Based on RMS carrying out the Ivanhoe Place / Herring Road intersection works RMS to re-word condition imposed to contribution amount to be paid prior to **"construction certificate being issued for stage 1"**

- RMS verbally advised in the meeting that Frasers approximate contribution to the Herring Road / Epping Road intersection would be in the order of 10% of the cost of the works based in trip generations

- Ason Group to re-issue correspondence to RMS with previously agreed correspondence regarding the temporary turning heads to be provided in stage 1 and there subsequent removal once internal road network is completed which would allow
U-turn access via the proposed internal road-network within the Ivanhoe estate.

- Ason Group to provide high level design sketches of our the possible school drop off zones could possibly work. Frasers / Ason Group also advised in the meeting that the school is subject to future development application

- Ason Group / Frasers to look at other possible school sites for further survey analysis regarding school drop-offs

- Ason Group advised in the meeting that it was agreed by RMS in a meeting held on the 7/4/2017 that the 2021 traffic model to be used in lieu of the 2031 model. RMS to confirm. Ason Group also advised that the 2031 model had issues as the extent of upgrades required to accommodate existing and future traffic volumes would need to be extensive. As such the 2021 model was a more suitable model for analysis.

- Ason Group questioned in the meeting which report Arup have been assessing. Ason Group to re-issue all traffic modelling and report to Arup

- Arup / DOPE agreed in the meeting the applied 1:20 visitor parking (in the basements) is appropriate and approved on this basis.

- DOP asked the question on Councils comment on widening the bridge on the northern side which, Frasers responded that It should also be noted that any footpath on the northern side will not be able to be extended beyond the bridge initially due to the existing crib wall on the northern boundary of the LIF site and the acquisition area not being wide enough to accommodate shifting the whole road to the south. Frasers will also respond via our submission responses.

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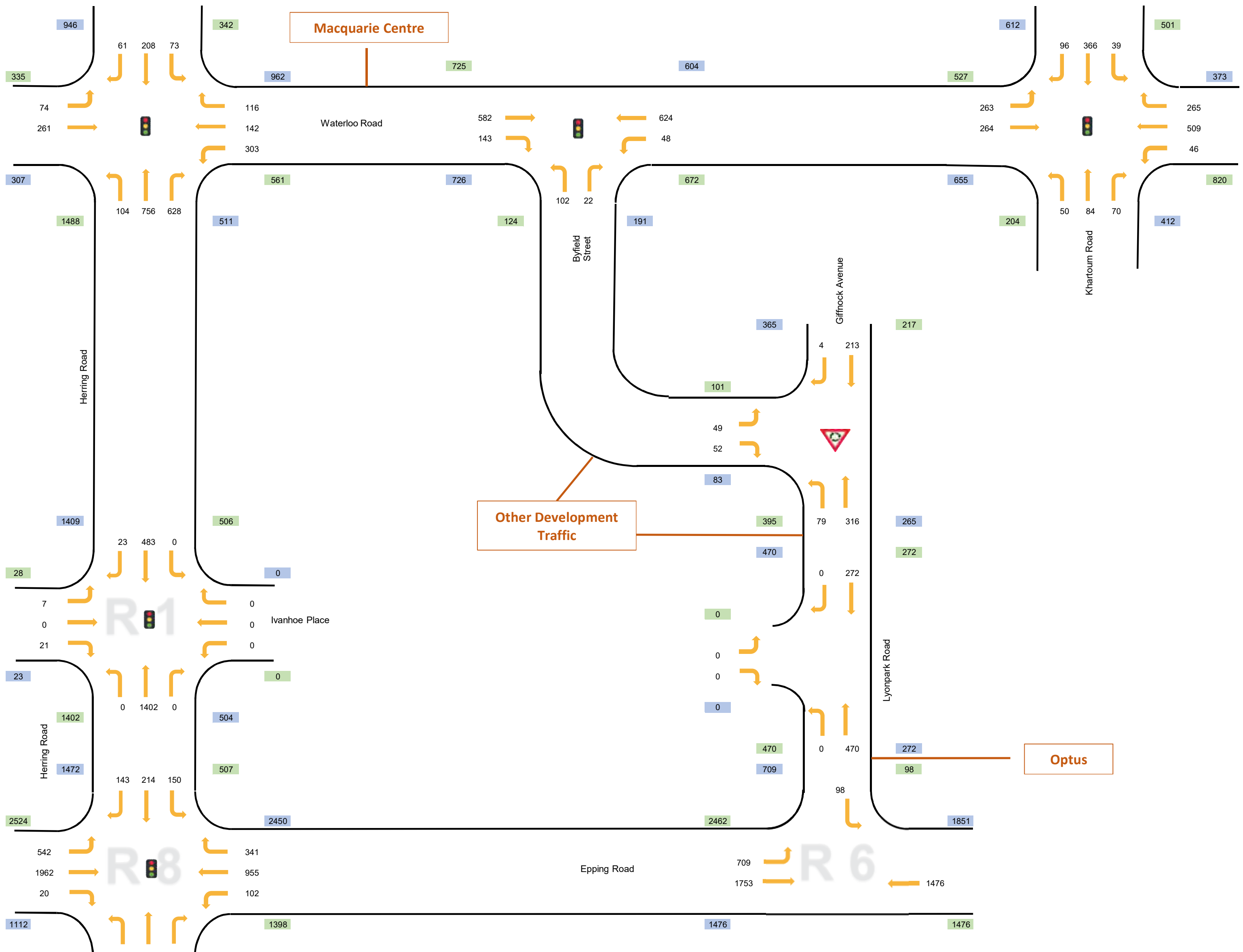
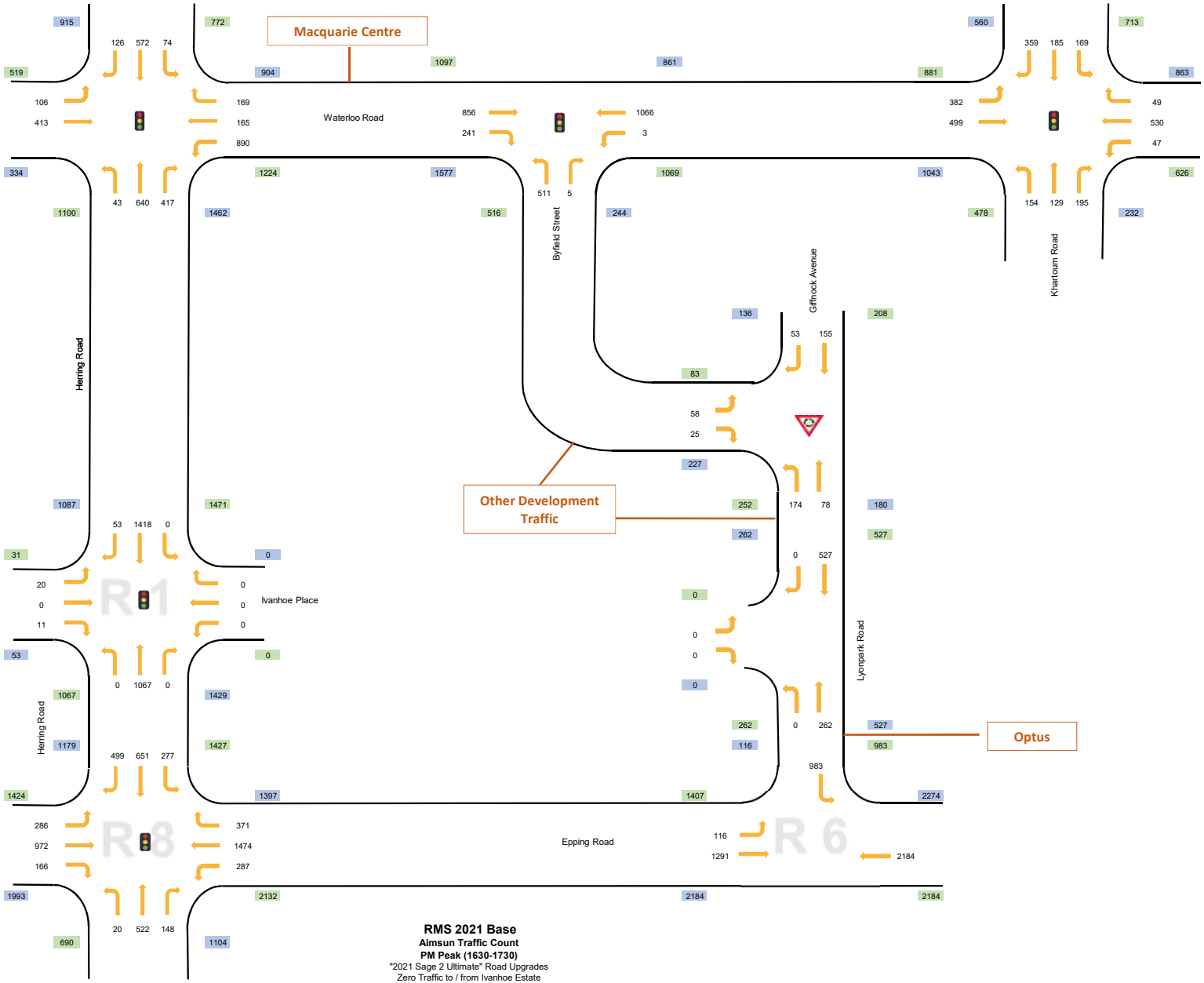
Appendix C

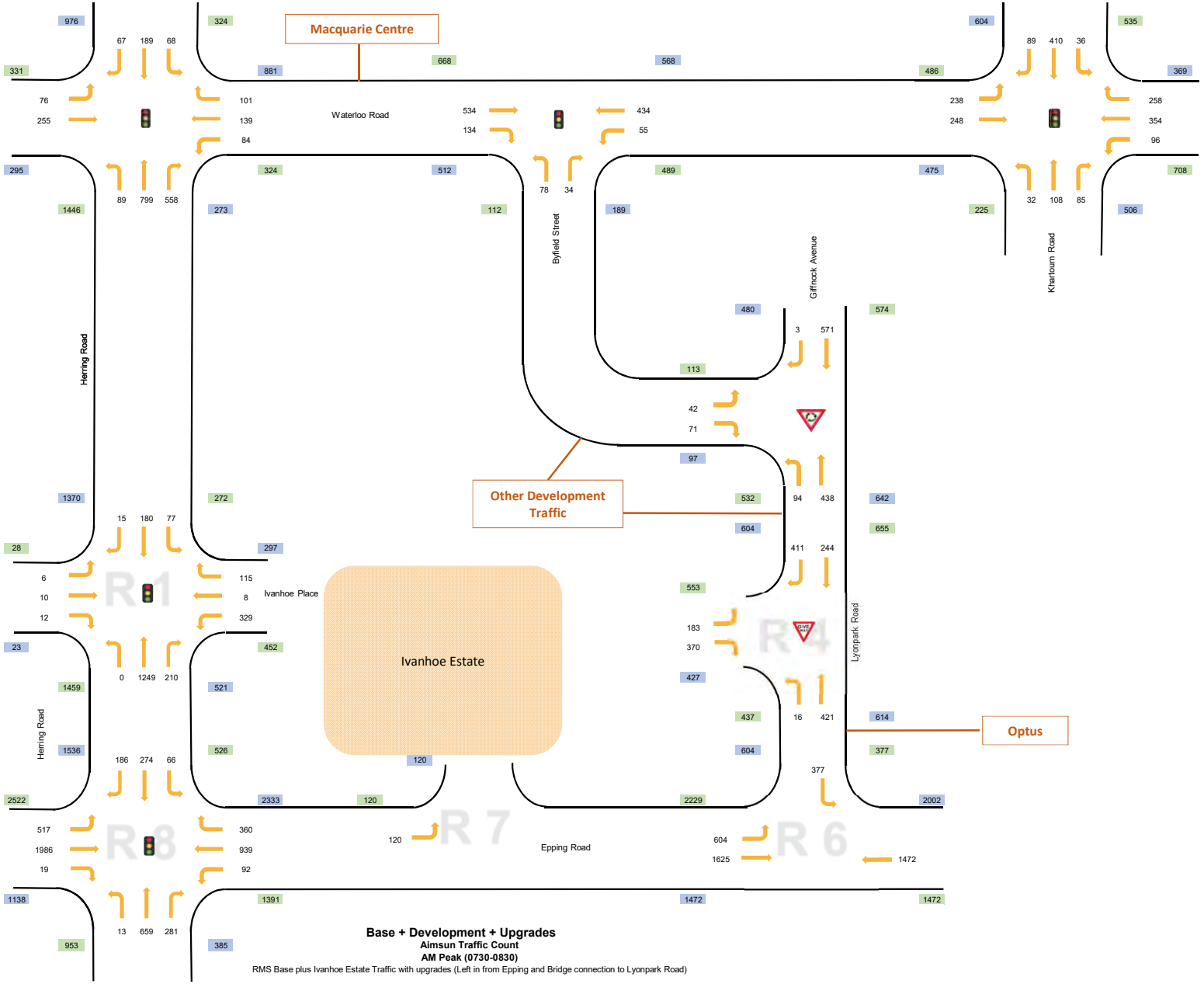
Network Flow Diagrams



RMS 2021 Base
Aimsun Traffic Count
AM Peak (0730-0830)
"2021 Sage 2 Ultimate" Road Upgrades
Zero Traffic to / from Ivanhoe Estate



RMS 2021 Base
Aimsun Traffic Count
PM Peak (1630-1730)
"2021 Sage 2 Ultimate" Road Upgrades
Zero Traffic to / from Ivanhoe Estate

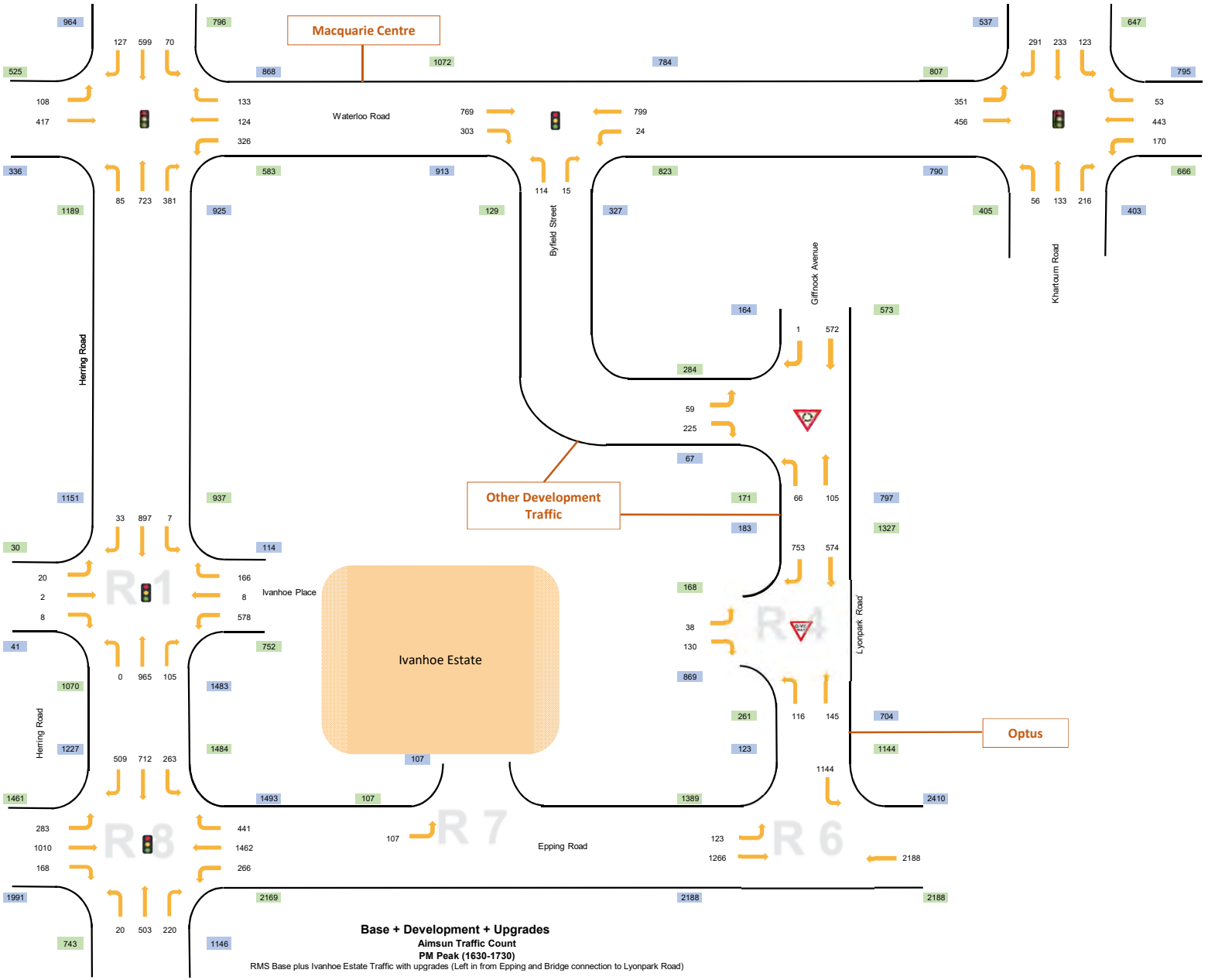


Base + Development + Upgrades

Aimsun Traffic Count

AM Peak (0730-0830)

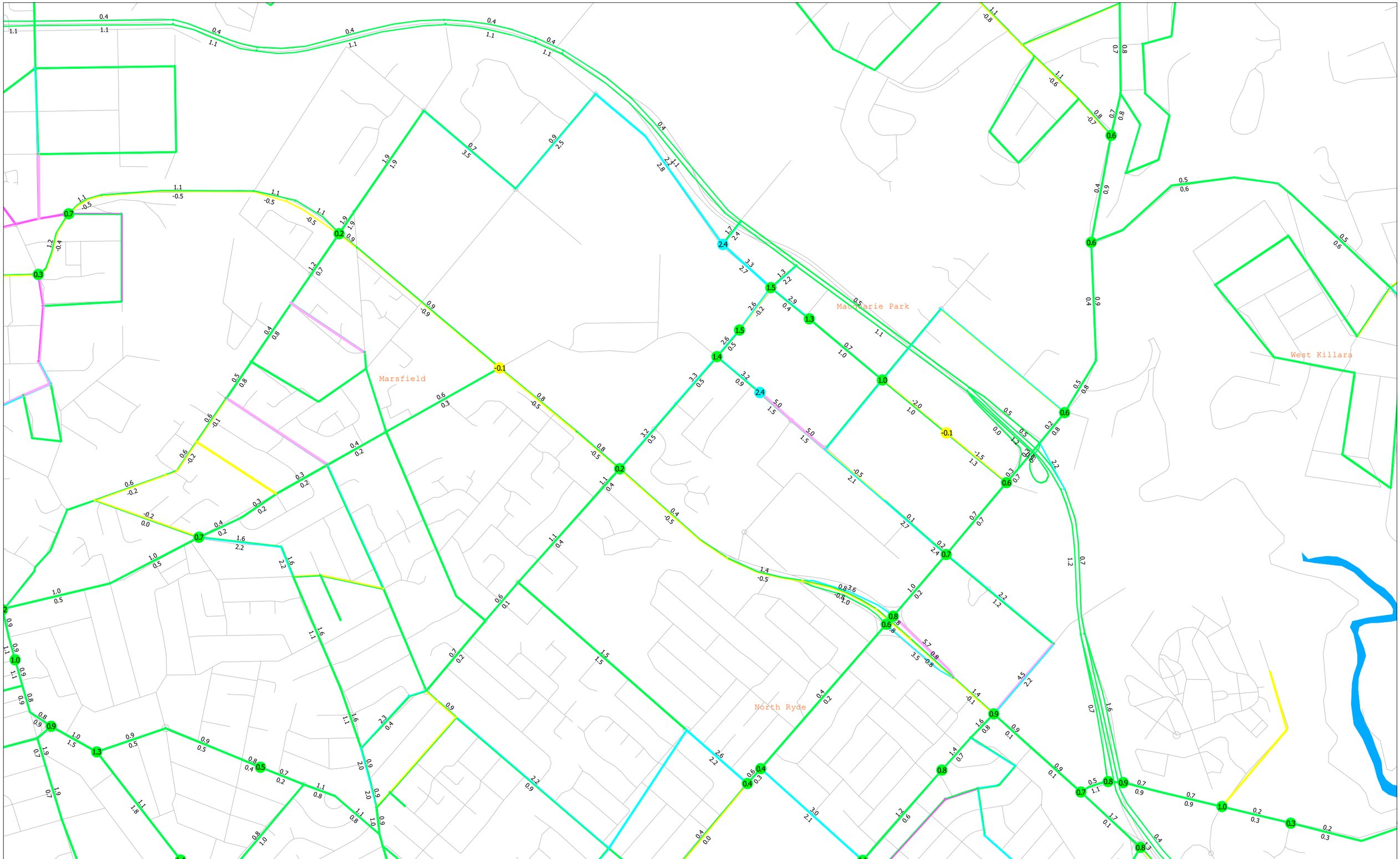
RMS Base plus Ivanhoe Estate Traffic with upgrades (Left in from Epping and Bridge connection to Lyonpark Road)


Macquarie Centre
Waterloo Road
Byfield Street
Giffnock Avenue
Khartoum Road
Herring Road
Herring Road
Ivanhoe Place
Ivanhoe Estate
Other Development Traffic
Lyonpark Road
Optus
Epping Road
R1
R4
R7
R8
R6
964
796
537
647
525
868
1072
784
807
795
336
583
913
823
790
666
1189
925
129
327
405
403
164
573
284
1151
937
171
797
183
1327
30
114
168
41
752
869
1070
1483
261
704
1227
1484
107
1123
1144
1461
1493
107
1389
2410
1991
2169
2188
2188
743
20
503
220
1146
Base + Development + Upgrades
Aimsun Traffic Count
PM Peak (1630-1730)
RMS Base plus Ivanhoe Estate Traffic with upgrades (Left in from Epping and Bridge connection to Lyonpark Road)

Appendix D

EMME Growth Rates

ROAD TRAFFIC GROWTH (%YR, 2HRSPK) LINKS & INTERSECTIONS

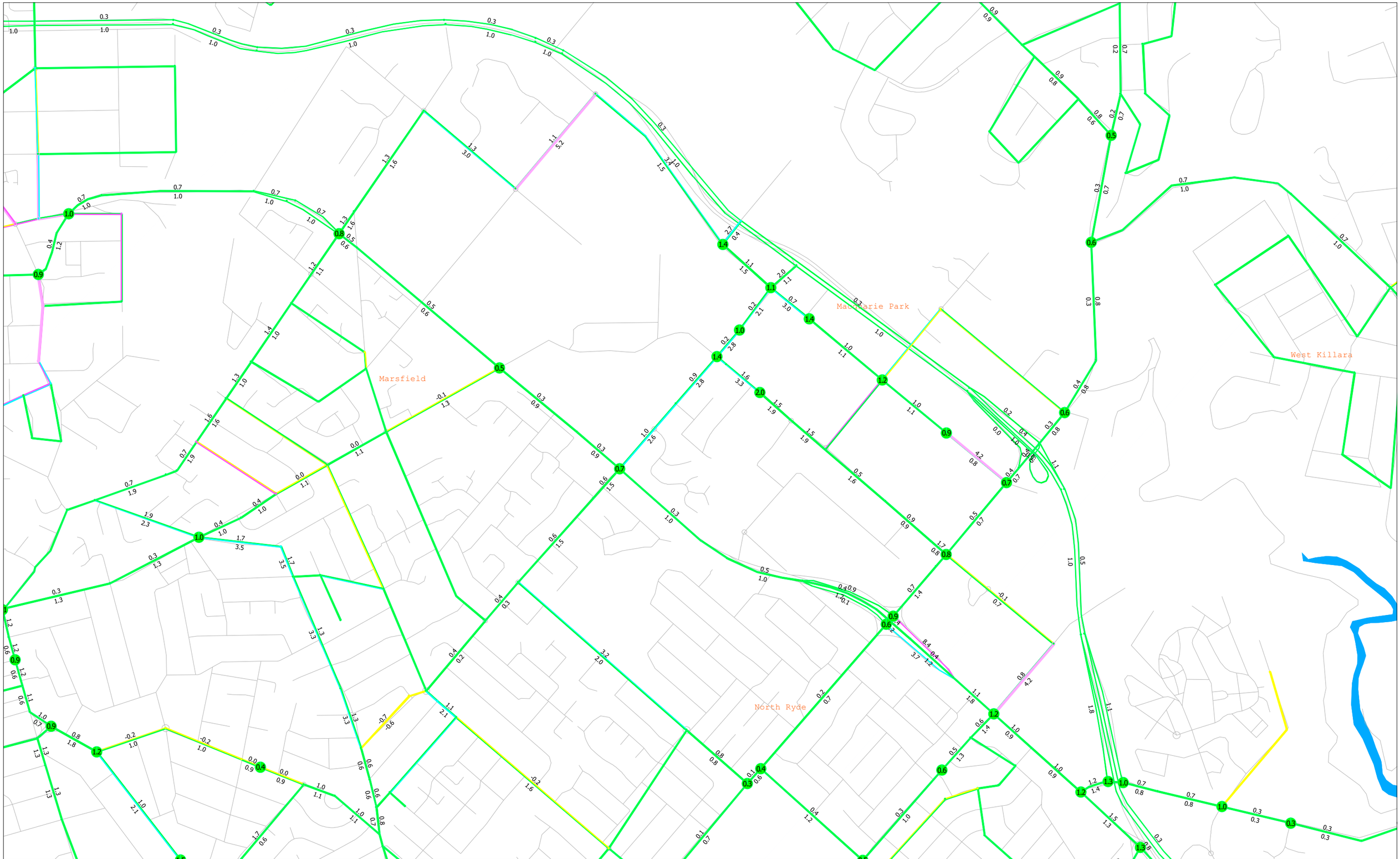


2011TZ SYDNEY GMA STRATEGIC TRAFFIC FORECASTING MODEL
Scenario 20260: 2026 SYDNEY TRAFFIC FORECASTING MODEL(LU2016V1.3)4-6PM(mf54)
2018-07-09 08:50

Growth(YR):

- <0
- <2.00
- 2.01-4.00
- 4.01-6.00
- >6.00
- New Links=999

ROAD TRAFFIC GROWTH (%YR, 2HRSPK) LINKS & INTERSECTIONS

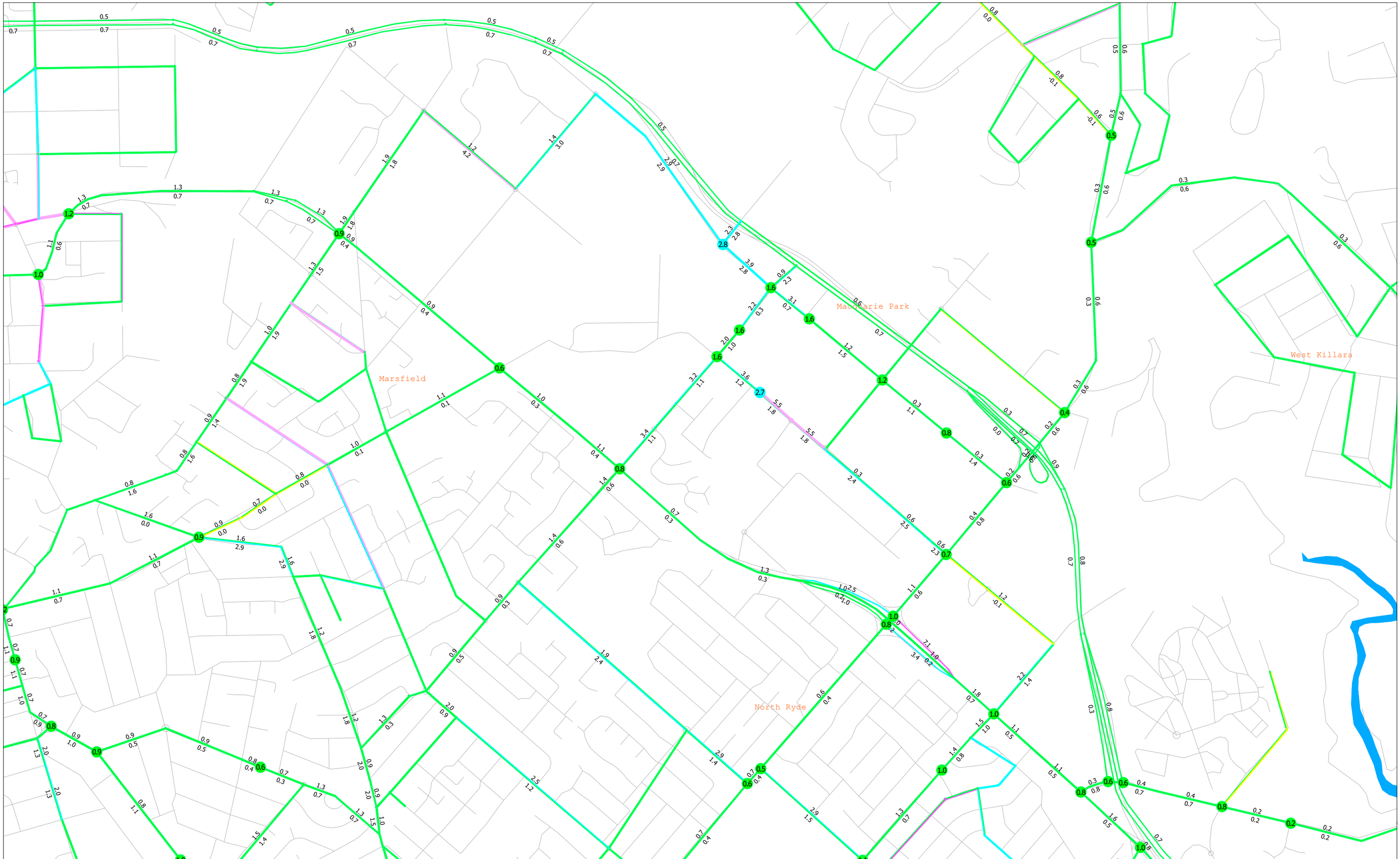


2011TZ SYDNEY GMA STRATEGIC TRAFFIC FORECASTING MODEL
Scenario 2026: 2026 SYDNEY TRAFFIC FORECASTING MODEL(LU2016V1.3)7-9AM(mf34)
2018-07-09 08:49

Growth(YR):

- <0
- <2.00
- 2.01-4.00
- 4.01-6.00
- >6.00
- New Links=999

ROAD TRAFFIC GROWTH (%YR, 2HRSPK) LINKS & INTERSECTIONS

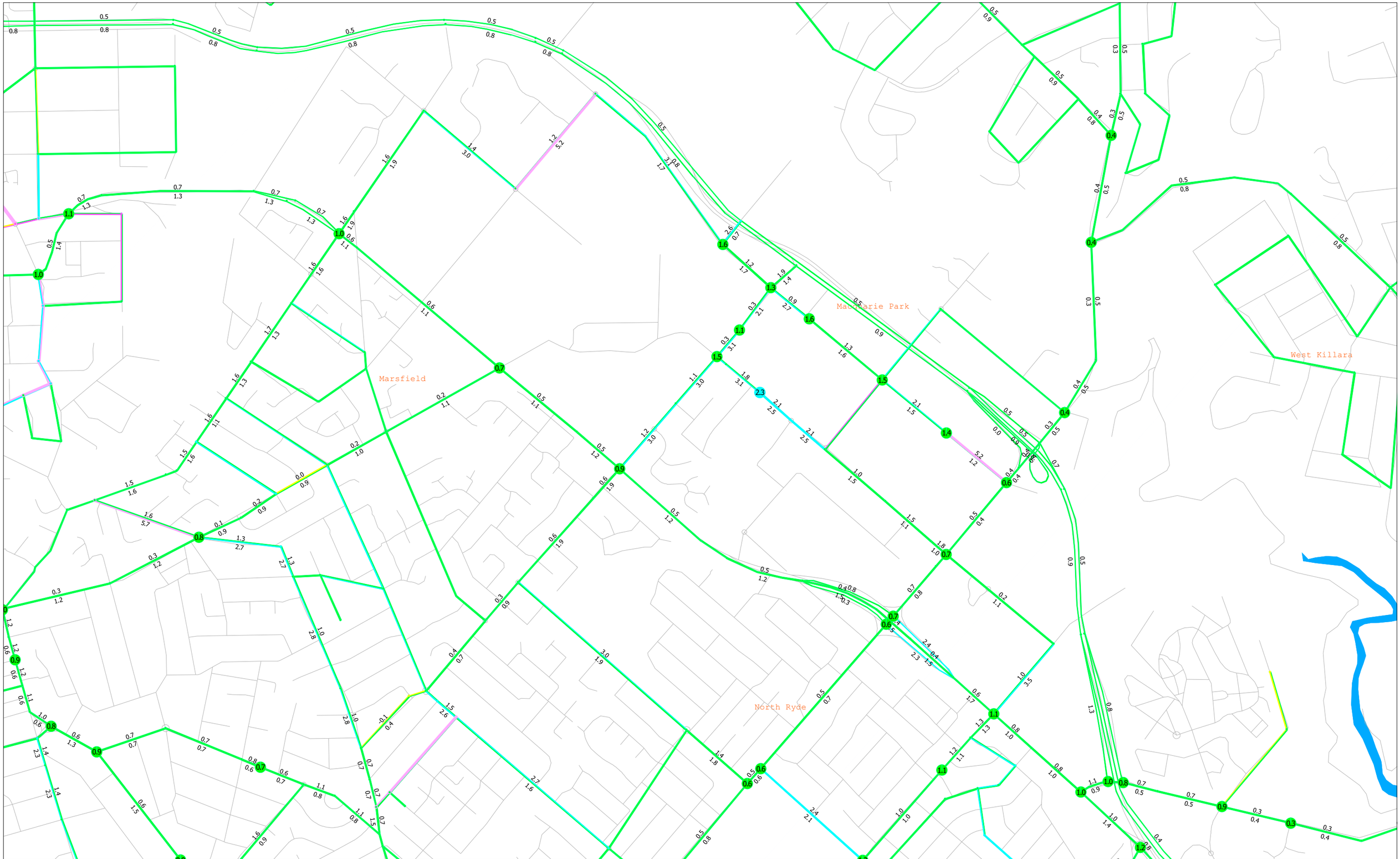


2011TZ SYDNEY GMA STRATEGIC TRAFFIC FORECASTING MODEL
Scenario 20360: 2036 SYDNEY TRAFFIC FORECASTING MODEL(LU2016V1.3)4-6PM(mf56)
2018-07-09 08:51

Growth(YR):

<0
<2.00
2.01-4.00
4.01-6.00
>6.00
New Links=999

ROAD TRAFFIC GROWTH (%YR, 2HRSPK) LINKS & INTERSECTIONS



2011TZ SYDNEY GMA STRATEGIC TRAFFIC FORECASTING MODEL
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2018-07-09 08:50

Growth(YR):

<0
<2.00
2.01-4.00
4.01-6.00
>6.00
New Links=999