NSW Department of Education and Communities

Lindfield Learning Village

Traffic and Transport Assessment

Rev C | 13 June 2017

Job number

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ARUP

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Appendices

Executive Summary

Lindfield Learning Village is expected to cater for some 2,100 students and 160 teaching staff. It would also provide community facilities. Key findings of the transport study undertaken are summarised below.

Footpaths and walking (section 3.5.3)

Local roads leading to the site have poor pedestrian accessibility, with several footpaths and key crossing facilities missing. A comprehensive Pedestrian Accessibility Mobility Plan (PAMP) should be carried out to assess the required pedestrian safety improvements, with the issues addressed before commencement of the learning village. Implementation of school zones along Eton Road, south of Winchester Avenue should be implemented. However given the unique start and finish times of the homebases, further consultation with RMS is required.

Existing road performance (section 3.4)

Lady Game / Grosvenor Road intersection is at capacity (during the AM peak) with high southbound traffic causing a queue which extends past the roundabout. Future traffic to the site would avoid this route and would use the Pacific Highway. No future upgrades to the regional road are currently proposed according to the RMS website.

Pacific Highway / Grosvenor Road intersection experiences a slow rolling queue preventing southbound vehicles from crossing the intersection. This occurred approximately four percent of the time over the hour (roughly two minutes).

Parking within the learning village (section 5.3)

No parking is proposed to be provided for year 12 students. A total of 151 parking spaces are proposed to be allocated to the 160 staff. Other employees on the campus are provided with car parking in accordance with DCP rates.

After hours parking demand to the Greenhalgh Auditorium complies with the KDCP. However given the large capacity of the auditorium, possible parking spillover to local roads can be mitigated through several measure. For example providing a shuttle bus during operational hours or restricting the maximum patronage.

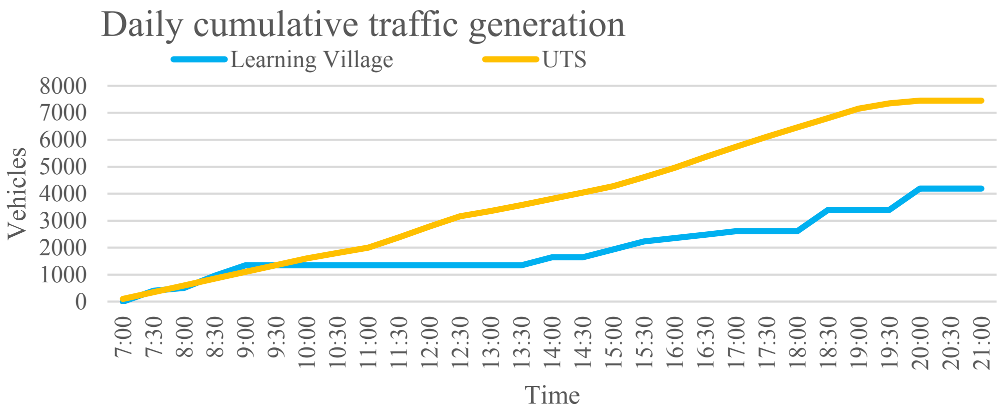
Future road performance (section 8.2)

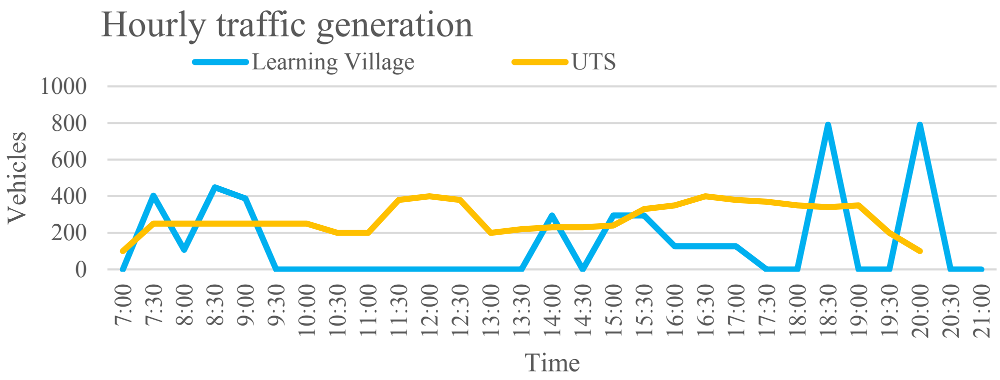
In terms of the daily total traffic demand on the local roads, it would perform at a similar or lower level as during the UTS operation. Local roads would experience a higher peak hour traffic, but lower traffic volumes during off-peak periods.

Peak hour modelling has been carried out for the existing and future performance of key intersections. All of the intersections are predicted to perform close to existing conditions in the future with the exception to the Pacific Highway / Grosvenor Road intersection.

Upgrades to extend the right turn bay from the Pacific Highway into Grosvenor Road would improve the performance of the intersection to an acceptable level.

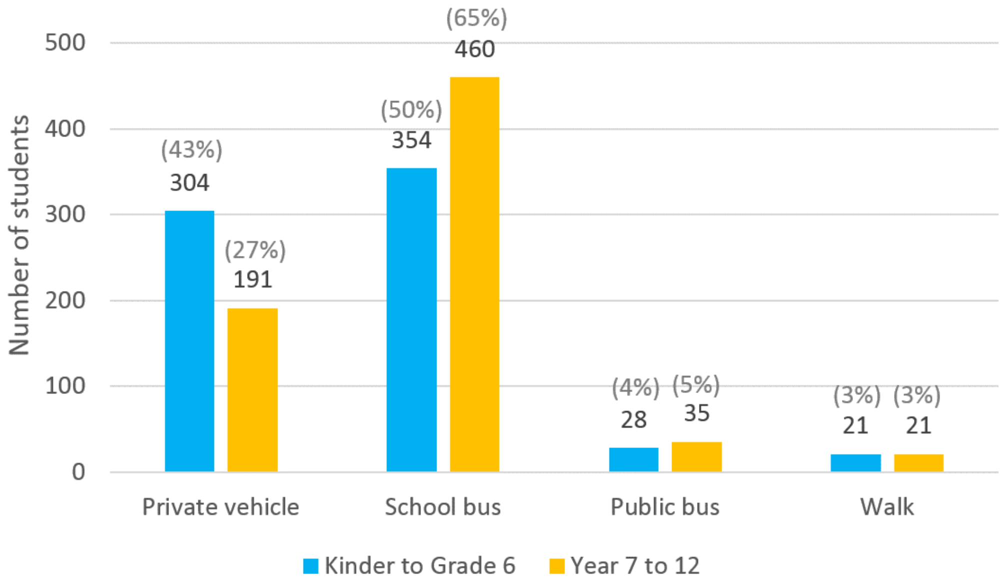
The levels of traffic generated by UTS and the learning village is shown below.





Transport strategies (section 6)

A list of travel strategies, as an alternative to private vehicle usage have been proposed. Given that the site will be used by students and teachers in a new location, sustainable travel alternatives would be more easily implemented as well as adopted. The possible mode splits are shown below. The high proportion of school bus users have been proposed based on a successful example in Killara High School.



The implementation and promotion of the proposed strategies are therefore paramount in enabling the transport functionality of the Lindfield Learning Village. Upgrades of the Grosvenor Road / Pacific Highway would still be required regardless of the effectiveness of the travel strategies implemented.

A staged opening of the proposed school is essential to reasonably allow for traffic impact monitoring and review of final operating scale.

1 Introduction

The NSW Department of Education and Communities has commissioned Arup to develop a Traffic and Transport Assessment for the proposed Lindfield Learning Village. The proposed site is located at the former UTS Ku-ring-gai Campus, which has since been vacated in 2015.

The existing facilities at the site will be converted into the Lindfield Learning Village, with a new K – 12 School and a range of other facilities, for up to 2,100 students and over 160 teaching staff.

The learning village would reduce the existing strain on schools which are currently facing a high demand of new enrolments. It would also provide community facilities to the public, such as auditoriums and gyms.

1.1 Scope

This report will be a Transport Assessment, supporting the proposed development, suitable for the SSD lodgement.

- Generation of people and car trips
- Travel Demand Management strategy
- Vehicle access
- Any required road/intersection upgrades
- Public transport accessibility
- Car parking arrangements
- Pedestrian and bicycle access

1.2 Previous studies

The site has a long history of providing education facilities for tertiary studies. Several studies have been prepared previously.

McLaren Traffic Engineering conducted a traffic and parking impact assessment of the proposed Lindfield Combined K-12 School, dated October 2014. The report undertook the analysis for 1,950 staff and students, offices and a childcare centre. Key findings were:

- A public school is a community facility. It provides a real benefit to the community it serves and it is expected that some burden will be placed on the community to support its operation.
- The balance of burden and benefit should be considered and does not exclude a new school from having to adequately address these issues. Instead it merely allows a higher tolerance of burden compared to developments which do not necessarily benefit the community.

- Having a school at the terminal end of a peninsular is uncommon, and as such, assumptions have been introduced to perform analysis of the site. It is recommended that staged opening of the proposed school is essential to reasonably allow for traffic impact monitoring and review of final operating scale.
- AM Peak hour (8am to 9am) of 796 trips in, 761 trips out
- School Peak hour (2:30pm to 3:30pm) of 580 trips in and 629 out

The graph in Figure 1, extracted from the report is a comparison of the future traffic generation.

- Existing UTS traffic is relatively stable throughout the day with peaks not exceeding the collector road amenity of 500 vtph
- Projected School traffic has two distinct peaks, one overlapping the background AM peak and one prior to the background PM peak. The School traffic alone exceeds the residential amenity and LOS C Capacity for approximately two hours of the day

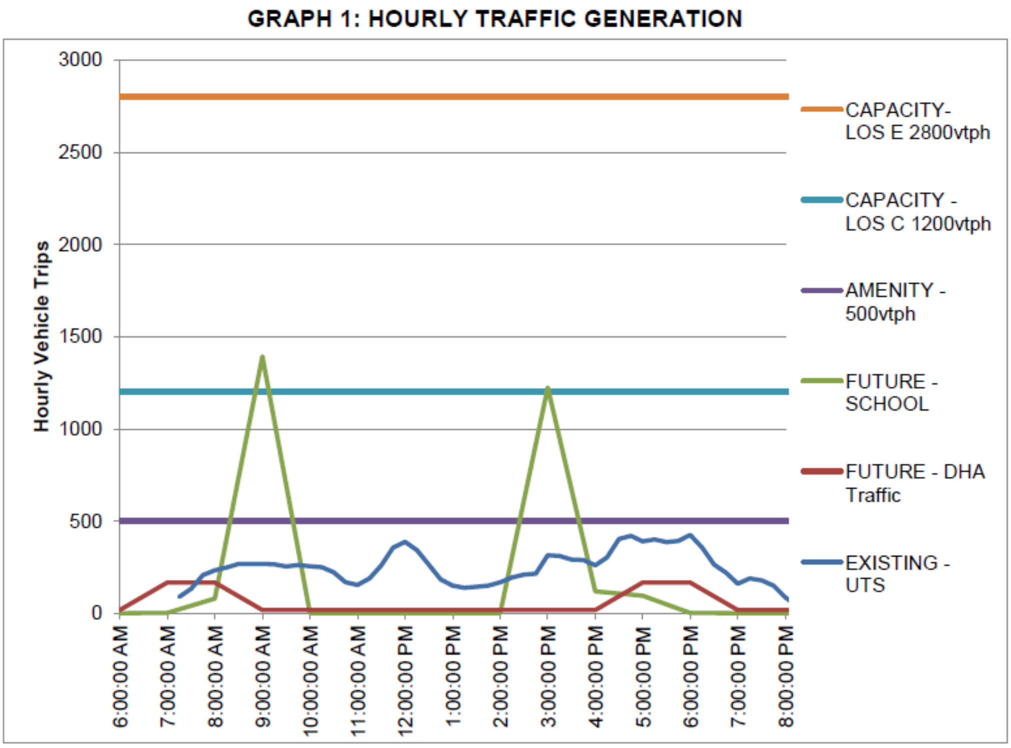


Figure 1: Hourly Traffic Generation, McLaren Traffic Engineering 2014

The report therefore highlights that due to the peak arrival of parents dropping of children at the future school, the traffic generated would be above the amenity of a collector road, and likely exceed the typical capacity.

1.3 Consultation

The consultant team has attended several consultation meetings with TfNSW and Roads and Maritime Services (RMS) to discuss traffic and transport aspects of the proposal.

7 March 2017, TfNSW, Tim Dewey and Brendan Pegg

An outline of the proposal was provided and discussion occurred regarding the transport requirements for access to the school. It was recognised that increased bus activity could impact on the road network operations and that a meeting with RMS would be beneficial

16 March RMS and TfNSW

Representatives from RMS were briefed on the project and a discussion occurred regarding the likely level of traffic generation and bus movements. A draft copy of the traffic report was provided for initial review. TfNSW and Roads and Maritime Services provided combined comments on the Traffic Report in an email on 24 March 2017, requesting further information as follows:

- Traffic generation – surveys at similar primary and high schools
- Mode split
- Traffic distribution
- Bus operation
- Impact on Pacific Highway Operation
- Proposed Upgrades
- School Zones

This information has been addressed in the report and highlighted in Table 1 below.

Table 1: TfNSW and RMS combined comments along with Arup's responses

#	TfNSW / RMS combined comments	Arup response
1	It is noted that traffic generation is estimated based on the high school traffic generation. The proposed school is proposed to accommodate K-12 students. TfNSW requests that the applicant revises the traffic generation and traffic analysis based on the surveys undertaken at primary school s. Department of Education has undertaken surveys at K-6 public schools as part of the O'Connell Street, Parramatta public school project. The results of the surveys by Department of Education could be used for the subject school.	Section 6, Arup has conducted travel and occupancy surveys at Lindfield Public School and Killara High School. The modelling assumptions have been updated with little change to the initial modelling results.
2	TfNSW understands that staggered commencing and closing times are proposed for the subject school. TfNSW supports this approach but further details need to be provided to understand the relationship with traffic generation at peak times. It is suggested that traffic analysis includes staggered starting scenario as well as a worst case scenario assuming that the all students will start the school between 8:00 am – 9:00 am be modelled.	Section 11.2.4
3	For high school traffic generation, a similar school, that is 10 minutes bus ride from a station, needs to be surveyed. Please note that the mode split for a school within 10 minutes walking distance would likely to be different to a school with 10 minutes bus ride from a station.	Section 6
3	It is requested that the Traffic Report includes number of children using each mode of transport for K-6 and 7-12 separately (walk, bus, bus/walk, private vehicle).	Section 8
4	The Traffic Report assumes that all traffic generated from the proposed school is expected to arrive via Grosvenor Road/Pacific Highway. It is requested that more details in relation to catchment area and traffic movements to and from Lady Game Drive be provided.	Section 5.1 shows a preliminary catchment boundary. Future catchment details will be provided at a later planning stage of the school. Section 10.1, vehicles are likely to avoid the north approach of Lady Game Drive / Grosvenor Road intersection due to the significant congestion experienced in the AM peak. This assumption is for modelling purposes and is considered conservative. Vehicles however still leave via Lady Game drive during the AM peak.
5	Traffic report needs to outline the mode split based on the traffic surveys and include with detailed assessment on bus	Section 8, mode split and design.

#	TfNSW / RMS combined comments	Arup response
	infrastructure requirements including kerb space.	
6	The possible drop-off/pick-up zones documented in Section 5.2 (page 13) needs to be reviewed, as the current design will involve conflict between parents queuing for the drop-off/pick-up zone and bus operations.	Section 5.2.3
7	Elton Road Bus Bay may have space to cater for five (5) buses, however there is only one drop-off/pick-up area. Without the provision of more space, this would considerably hinder the loading/unloading process and cause significant delays. The 'Learning Village' suggests that the proposed number of students is 2,100 and it is anticipated that school buses as the most viable and sustainable means to transport students to the site. Therefore, the design and operation of bus bay should envisage a complete replacement of the existing bus bay and related facilities to provide safer ingress/egress and pedestrian connections for students.	Section 9
8	Section 5.2.1 'School and public buses' (page 26) provides an initial swept path indicating a bus manoeuvre past stationary buses in the Elton Road Bus Bay. It should be noted that in order to successfully complete this manoeuvre the bus has to travel/straddle to the opposite side of the road, considering the significant levels of parents/caregivers potentially picking-up/dropping primary school children at the southern end of the site, this manoeuvre is risk to pedestrian safety and impractical. It is noted that the bus movement in this proposed manoeuvre is having impact with stationary buses. Furthermore, under Austroads Guidelines a total of 14.5m should be used when conducting a swept path analysis.	Section 9, swept paths have been updated to correctly reflect a bus manoeuvre with a 14.5m bus.
9	TfNSW is concerned regarding the level of on-street parking outside the proposed 'Learning Village' as it has the potential to reduce the available roadway (as surrounding streets are extremely restricted) available to bus services accessing to the site and potentially be detrimental to bus operations. It is noted in Section 3.8.2 'On-street' regarding potential locations for on-street parking for users of the development, however TfNSW asserts that some parking restrictions may need to occur on Elton	Section 5.5

#	TfNSW / RMS combined comments	Arup response
	Road, Grosvenor Road and Abingdon Road between 0700 to 1630 to ensure that buses can traverse through these streets to the site.	
10	Further clarification is sought regarding Section 5.4 ‘Bicycle Parking’ (page 34) as it indicates that the site has existing bicycle racks, however no indication is given on how many spaces are provided and whether this would cater for the needs of the development. It has been stated that an estimated 42 students will walk/cycle and 50% of staff will need to access the site via public/active transport. Therefore, TfNSW recommends a number of bicycle parking is documented accordingly, in addition to whether any end-of-trip facilities will be provided.	Section 5.4
11	It should be noted that TfNSW asserted on the 7 March 2017 that any proposed increase to public route 565 frequency will be subject to TfNSW Growth Service’s initiative and should be documented under Section 6.1.2 ‘Public bus - Consultation with TfNSW’ (page 38).	It is proposed that a large majority of the students would travel to school by school buses. However as an alternative, increasing bus 565 frequencies can be considered.
12	TfNSW commends the active transport initiative of the ‘Walking School Bus’ (Section 6.1.5, page 42), as it encourages active travel and sustainable means of transport to the site. However, whether this would be feasible in context of this site considering that Section 3.5.3 ‘Walking’ states that the site has ‘poor pedestrian accessibility’, with certain key links dilapidated and/or missing.	Noted and agreed. Should this initiative be adopted, clear and precise routes need to be planned so that walking routes would be safe for both students and walking volunteers.
13	It is noted that the proposal will have a significant impact on the operation of the Pacific Highway even with the proposed upgrade to the Pacific Highway / Grosvenor Road / Burleigh Street intersection as the queuing along the right turn bay is expected to extend beyond the right turn bay and block through vehicle movements along the Pacific Highway based on the traffic report.	Noted
14	Whilst TfNSW notes Section 8.2.2 ‘Suggested upgrades on the Pacific Highway’ (page 57) proposes possible upgrades, it is not clear from the traffic report how second right turn bay on the Pacific Highway is achievable. It is requested that the traffic report includes an overlay of the proposed improvements onto an aerial map to show that all suggested upgrades are physically feasible.	Section 11.2.2.

#	TfNSW / RMS combined comments	Arup response
15	School zones will be implemented only on street with direct vehicle and/or pedestrian access to the proposed school. TfNSW and Roads and Maritime Services support the staggered starting time. Staggered school start time should be within the standard school zone times, but with appropriate time buffer (suggested 15min minimum).	Section 3.5.5.

2 SEARs Report

A Secretary's Environmental Assessment Requirements (SEARs) report has been submitted by the Department of Planning.

- Application Number SSD: 8114
- Proposal Name: Lindfield Learning Village
- Location: 100 Eton Road, Lindfield (former UTS Ku-ring-gai Campus)
- Applicant: Urbis, on behalf of the Department of Education
- Date of Issue 16 December 2016

The following details in Table 2 responds to the requirements raised in the SEARs report.

Table 2: Secretary's Environmental Assessment Requirements and response

#	SEARs Report	Arup response
1	Include a transport and accessibility impact assessment, which details, but not limited to the following:	Minor external construction works are proposed at the premise, where a turning circle would be provided (section 5.2). A CTMP outline is provided in section 12.
2	accurate details of the current daily and peak hour vehicle, public transport, pedestrian and cycle movement and existing traffic and transport facilities provided on the road network located adjacent to the proposed development;	Refer to section 3
3	an assessment of the operation of existing and future transport networks including the bus network and their ability to accommodate the forecast number of trips to and from the development;	Refer to section 3.5.1. Additional bus frequencies are proposed in section 7.1.2.
4	an estimate of the total daily and peak hour trips generated by the proposal, including vehicle, public transport, pedestrian and cycle trips;	Refer to section 9.
5	the adequacy of public transport, pedestrian and bicycle networks and infrastructure to meet the likely future demand of the proposed development;	Refer to section 6.
6	the impact of the proposed development on existing and future public transport infrastructure within the vicinity of the site in consultation with Roads and Maritime Services and Transport for NSW and identify measures to integrate the development with the transport network;	Public transport access to the school will be managed using school buses. See Section 7.1.

#	SEARs Report	Arup response
7	details of any upgrading or road improvement works required to accommodate the proposed development;	Refer to section 11.2.2 for likely upgrades required to the Grosvenor Road / Pacific Highway intersection. This is to be further consulted with RMS.
8	the preparation of a Green Travel Plan that outlines proposals to encourage sustainable travel choices and details programs for implementation;	Refer to section 6 for a list of transport strategies which the learning village should implement.
9	the impact of trips generated by the development on nearby intersections, with consideration of the cumulative impacts from other approved developments in the vicinity, and the need/associated funding for upgrading or road improvement works, if required (note: traffic modelling is to be undertaken with scope to be agreed by TfNSW and RMS in advance);	Refer to section 11.
10	the proposed active transport access arrangements and connections to public transport services;	Refer to section 6.
11	details of proposed school bus routes along bus capable roads (i.e. travel lanes of 3.5 m minimum) and infrastructure (bus stops, bus layovers etc.);	Refer to section 7.1.1
12	the proposed access arrangements, including car and bus pick- up/drop-off facilities, and measures to mitigate any associated traffic impacts and impacts on public transport, pedestrian and bicycle networks, including pedestrian crossings and refuges and speed control devices and zones;	Refer to section 5
13	measures to maintain road and personal safety in line with CPTED principles;	To be consulted with security consultants
14	the proposed car and bicycle parking provision, including end of trip facilities, which must be taken into consideration of the availability of public transport and the requirements of Council's relevant parking codes and Australian Standards;	Refer to section 0.
15	details of the proposed number of car parking spaces and compliance with appropriate parking codes and justify the level of car parking provided on-site;	Refer to section 5
16	details of emergency vehicle access arrangements;	The current internal roadway has been designed for larger vehicles to access loading docks around the site and are hence suitable for emergency vehicle access.
17	an assessment of road and pedestrian safety adjacent to the proposed development and the details of required road safety measures;	Refer to section 3.5.3

#	SEARs Report	Arup response
18	service vehicle access, delivery and loading arrangements and estimated service vehicle movements (including vehicle type and the likely arrival and departure times);	The current internal roadway has been designed for larger vehicles to access loading docks around the site.
19	an assessment of road safety at key intersection and locations subject to heavy vehicle construction traffic movements and high pedestrian activity;	Refer to section 12. A more detailed construction management plan will be produced at a later stage.
20	details of construction program detailing the anticipated construction duration and highlighting significant and milestone stages and events during the construction process;	
21	details of anticipated peak hour and daily construction vehicle movements to and from the site;	
22	details of access arrangements of construction vehicles, construction workers to and from the site, emergency vehicles and service vehicle;	
23	details of temporary cycling and pedestrian access during construction;	
24	traffic and transport impacts during construction, including cumulative impacts associated with other construction activities, and how these impacts will be mitigated for any associated traffic, pedestrian, cyclists, parking and public transport, including the preparation of a draft Construction Traffic Management Plan to demonstrate the proposed management of the impact.	

3 Existing Conditions

This section examines the existing conditions in terms of transport infrastructure around the site.

3.1 Study area

The proposed site is located about 2km from Lindfield and Roseville Station and approximately 17km north of the Sydney CBD.

The area is located at the end of Eaton Road, surrounded by nature reserves in the south. Towards the north, the area mainly consists of low density houses.

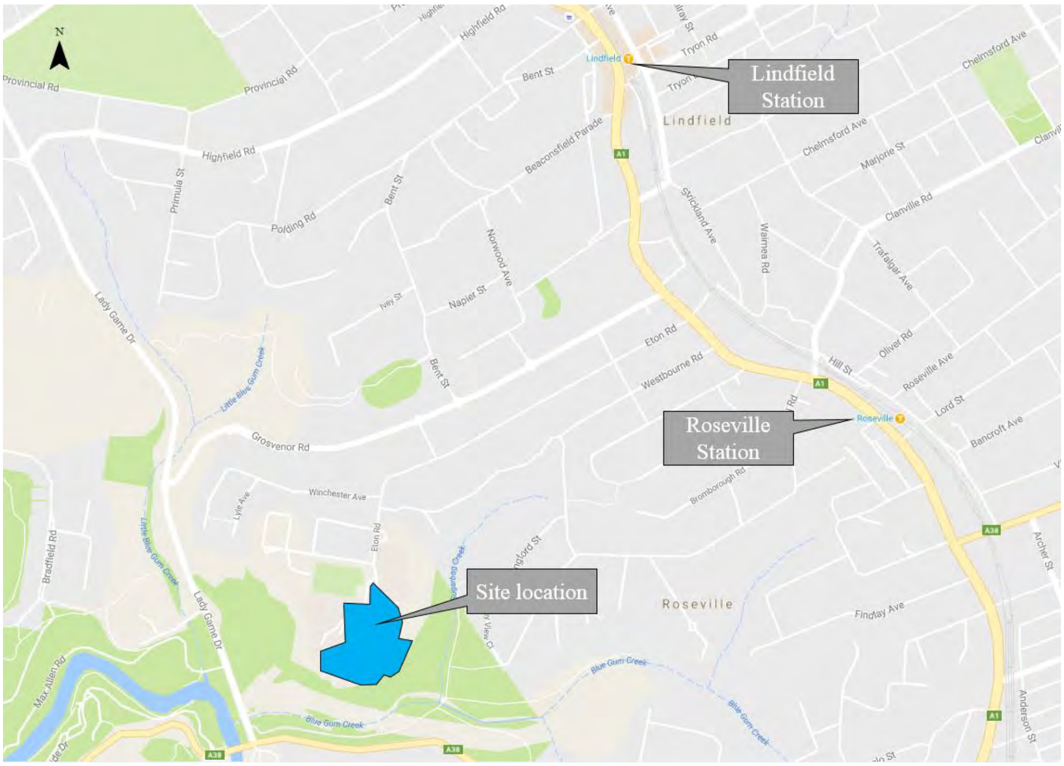


Figure 2: Proposed site location of the Lindfield learning village

3.2 Travel characteristics

The Journey to Work data for the travel zone which covers the site is shown below in Figure 3. The data indicates that 410 people worked in the zone at the time of the survey and 70% used private car for their commute to work (66% driver/4% passenger). Only 55 people (14%) used public transport. There is an opportunity to improve public transport accessibility to the site.

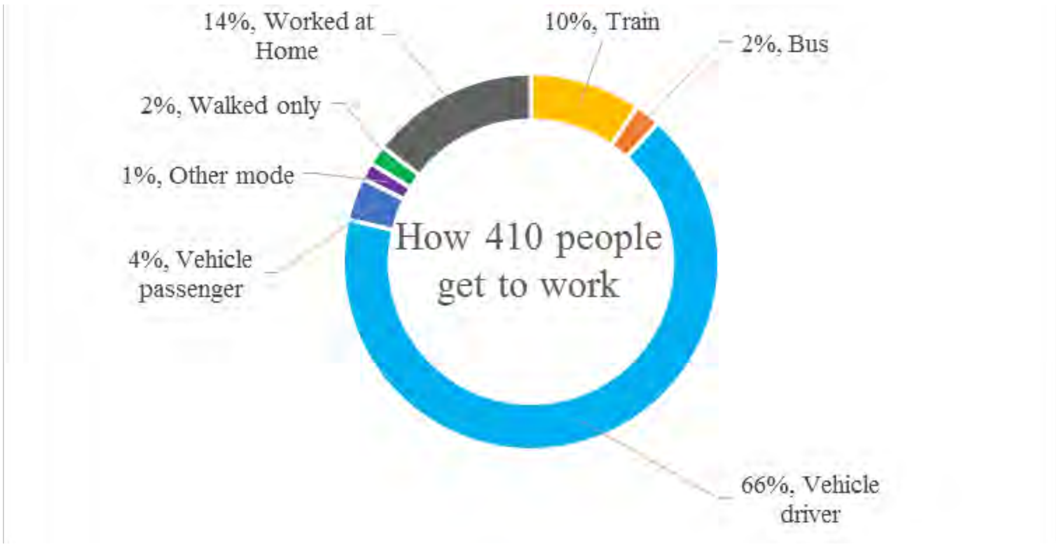


Figure 3: BTS 2011 Journey to Work Data [1]

3.3 Road classifications

The classified road around the site is illustrated in Figure 4. Key roads which provide access to the site are:

- Pacific Highway (State Road)
- Lady Game Drive (Regional Road)
- Grosvenor Road, Eaton Road, Westbourne Road (Local Roads)

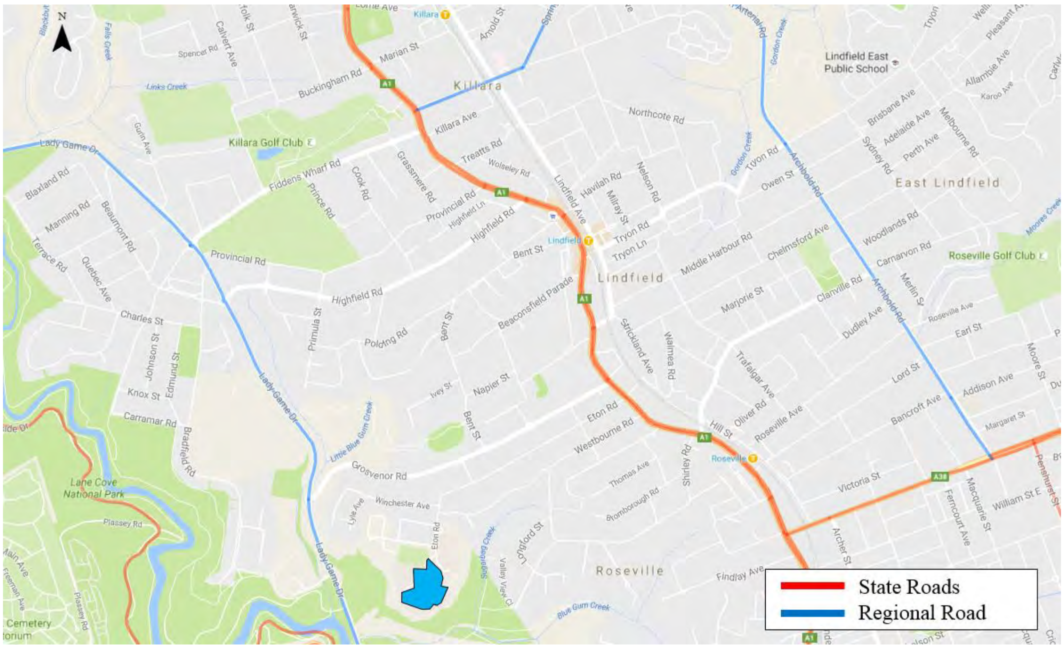


Figure 4: Classified Roads around the site

[1] http://visual.bts.nsw.gov.au/jtwbasic/#1717

3.4 Road performance

Pacific Highway / Grosvenor Road intersection

Within the vicinity of the site, the Pacific Highway currently operates efficiently during school peak periods and the evening peak periods. During the AM peak, there is a high demand of southbound traffic heading to the city. Videos provided on the day of the survey indicated that during the peak hour, a slow rolling queue prevented southbound vehicles from crossing the intersection. This occurred approximately four percent of the time over the hour (roughly two minutes).

Austral Avenue / Grosvenor Road and Eton Road

These local roads mainly consist of one lane carriageways, forming unsignalised intersections and roundabouts. They provide access to low density residential areas, with Eton Road providing access to medium density residential areas near the learning village. All the local roads currently operate efficiently with no delays observed.

Lady Game Drive / Grosvenor Road intersection

The intersection consists of a three leg roundabout. Lady Game Drive provides access to North Ryde via Dehli Road and to Chatswood via Millwood Avenue. During the AM peak, the high southbound traffic demand creates a queue which extends past the roundabout, starting from the Millwood Avenue intersection.

A screenshot of the typical AM peak queue length is shown in Figure 5. The intersection is performing at capacity and would not be able to accommodate any additional southbound traffic during the AM peak period.

Figure 5: Lady Game Drive / Grosvenor Road intersection

3.5 Public transport

The site is directly serviced by a bus route, number 565. There is an opportunity to improve bus frequencies to create a multi modal service of trains and buses to the site.

3.5.1 Bus

A bus stop is located just north of the site, providing convenient access to future patrons. Bus route 565, which operates hourly, services Chatswood and Macquarie University. It predominantly travels along the Pacific Highway and services the residential area around the site. Typical bus travel times during the morning 8am peak is shown in Table 3. The bus route currently serves Beumont Road Public School.

Table 3: Weekday bus 565 timetable and travel times

Departing from	Travel time to site	Service period
Macquarie University	29 mins	AM – First service 6:56am
		PM – Last service 5:42pm
Chatswood	19 mins	AM – First service 7:37am
		PM – Last service 6:08pm
Roseville Station Pacific Highway	9 mins	AM – First service 7:48am
		PM – Last service 6:13pm
Lindfield Station Pacific Highway	9 mins	AM – First service 6:32am
		PM – Last service 6:15pm

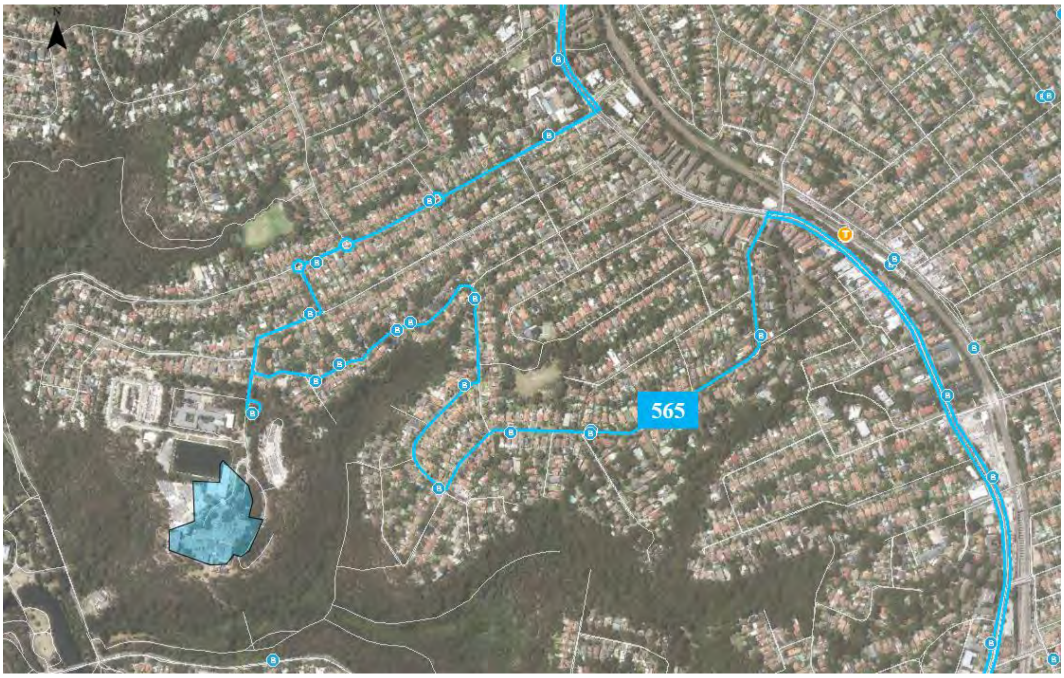


Figure 6: Bus route 565

Bus infrastructure

The closest bus stop to the site is located along Eton Road, shown in Figure 7. Eton Road bus bay forms a loop, allowing buses to enter, exit and drop off passengers efficiently.

Figure 7: Eton Road Bus Bay

3.5.2 Train

The site is located about a 2km (approximately 20 minute walk) from both Lindfield and Roseville Station. Trains to Lindfield Station run frequently during peak hours along the T1 North Shore Line.

Patrons to the site would likely catch the train followed by the bus. However given that bus 565 only operates on an hourly basis, scheduling would be difficult. There is an opportunity to improve existing bus frequencies to better service the site.

The general facilities at each train station is shown in Table 4.

Table 4: General facilities at train stations

Facilities	Lindfield Station	Roseville Station
Kiss and Ride	✓	✓
Ramp (1:20 gradient)	✓	✗
Lift	✓	✗
Portable boarding ramp	✓	✓

3.5.3 Walking

The site is has poor pedestrian accessibility, with several footpaths and key crossing facilities missing. Missing footpath and pedestrian crossing links should be addressed to encourage walking and improve safety of pedestrians, before the opening of the learning village.

Footpaths are provided on both sides of Grosvenor Road, shown in Photo 1.

Photo 1: Grosvenor Road, at Lindfield Public School

On Eton Road, footpaths are only provided on the northern side of the road, shown in Photo 2.

Photo 2: Eton Road facing west (Google Street view 2016)

An example of an improper crossing is shown in Photo 3, where kerb ramps do not align to the splitter island along Eton Road.

Photo 3: Improper splitter island at Eton Road / Ortona Road intersection (Google Street view 2016)

The missing pedestrian footpaths and crossing facilities are shown in Figure 8. A comprehensive Pedestrian Accessibility Mobility Plan (PAMP) should be carried out to assess the required pedestrian safety improvements.

Figure 8: Missing footpaths and crossing facilities

3.5.4 Cycling

The recommended RMS cycle routes are shown in Figure 9. While the Pacific Highway does not provide a dedicated cycle route, the site can be accessed from a network of smaller, more accessible local streets.

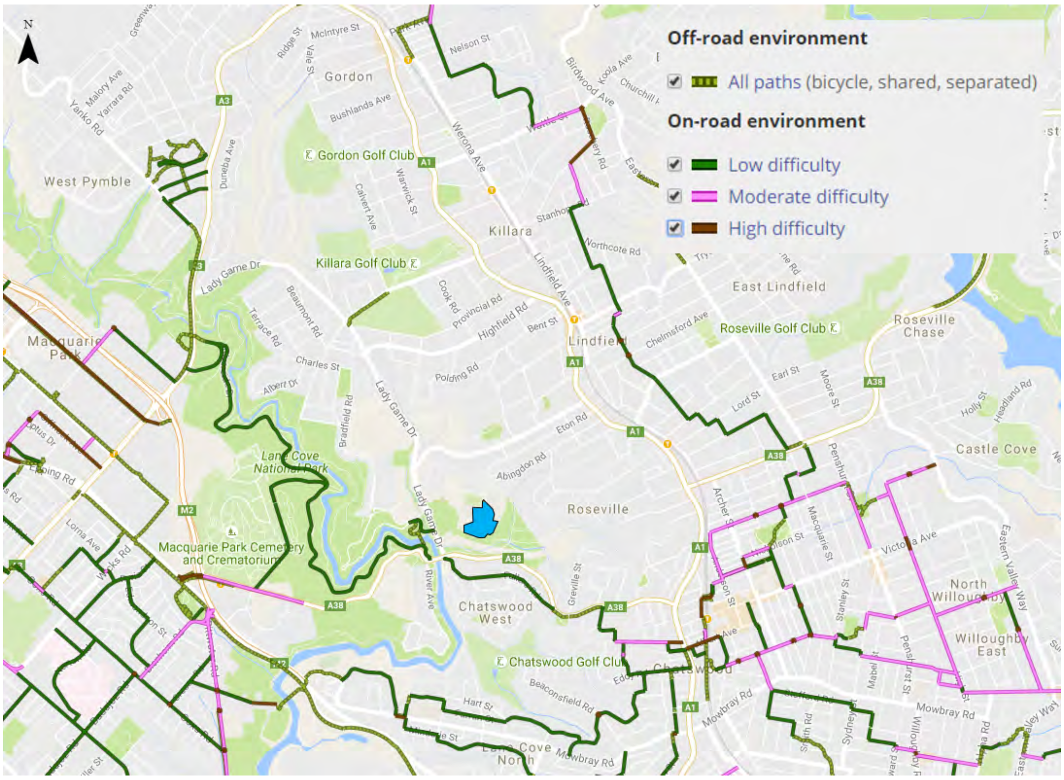


Figure 9: RMS recommended cycle routes

3.5.5 Safety

Eton Road, south of Winchester Road should have reduced speeds to 40km/h which is most appropriately enforced by implementing a school zone. It is noted that the school start times are different from typical schools with the following start and finish times:

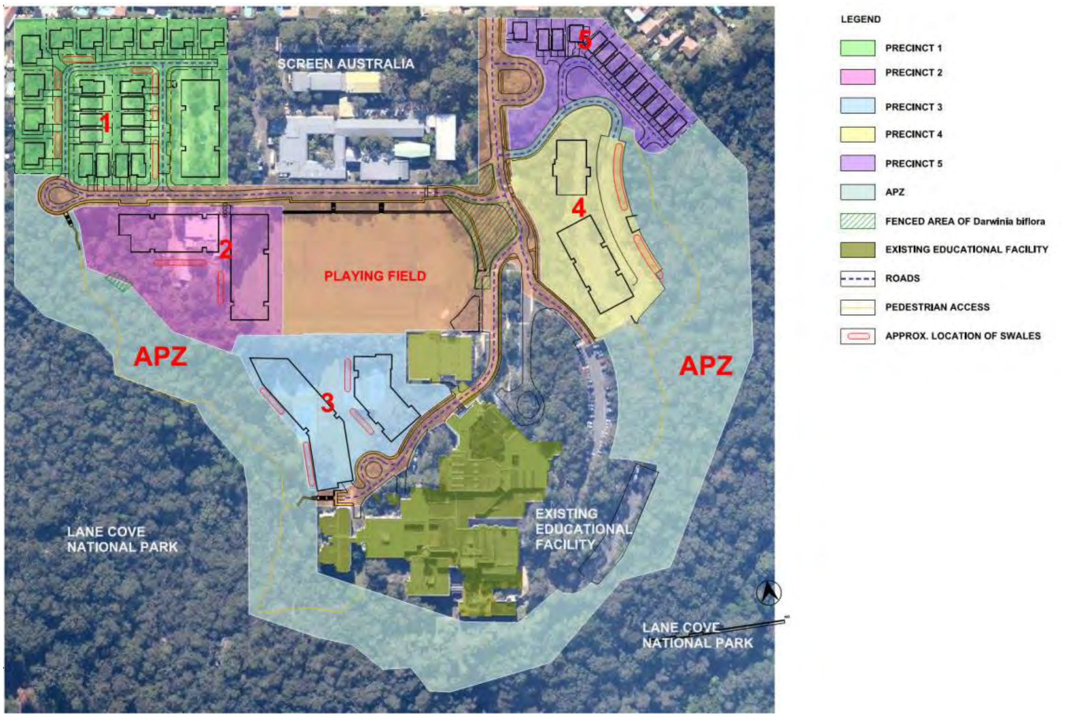
- 2 homebases commence at 7:30am, finish at 2:00pm
- 2 homebases commence at 8:30am, finish at 3:00pm
- 2 homebases commence at 9:00am, finish at 3:30pm

Whilst there is precedence for changing the standard school zone timings as shown in Figure 10, this may not be appropriate at the learning village. The implementation of safety measure would require further consultation with RMS.

Figure 10: Bells Line of Road School Zone

3.6 Existing land use

Within the immediate surroundings of the site, several parcels of land have been designated for housing. These dwellings consist of medium to high density residential developments. Most of these parcels have finished construction, with occupancy likely to increase in the future.



3.7 Traffic surveys

Arup commissioned AusTraffic to carry out survey counts at key intersections during the following periods:

- Tuesday, 16 August 2016, 7:00am to 10:00am
- Tuesday, 16 August 2016, 2:00pm to 7:00pm

A 24 hour tube count was also carried out on the same day, with the locations shown in Figure 11. Detailed outputs of the surveys can be found in Appendix A.

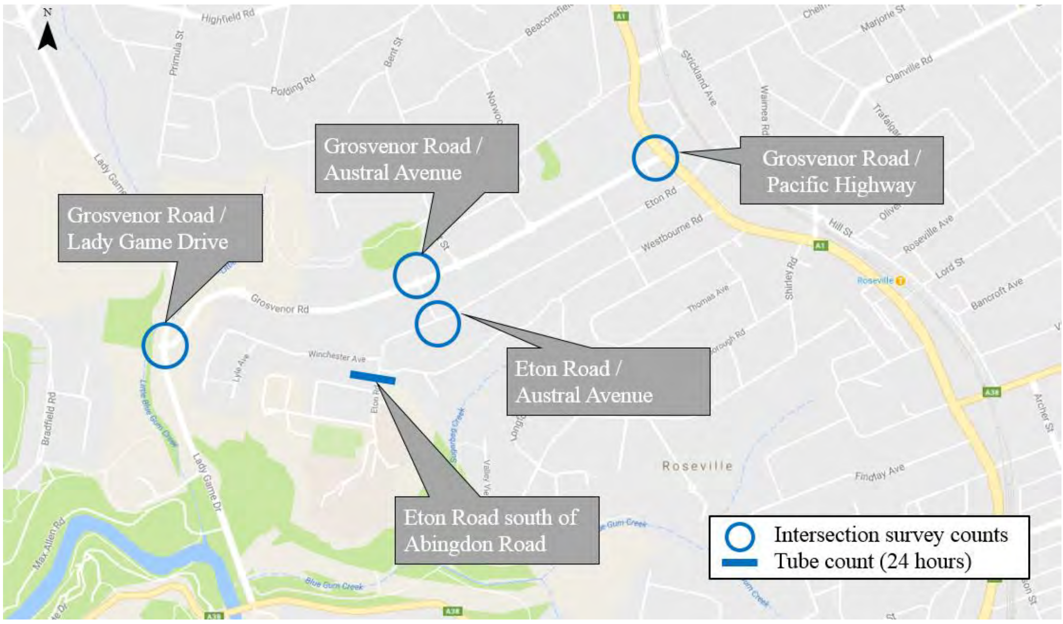


Figure 11: Traffic survey locations

3.7.1 Existing traffic volumes departing the site

Based on the tube count survey data, the northbound vehicle movements leaving the vicinity of the site is shown in Figure 12. The data suggests that some 81 vehicles left the vicinity between 8:00am to 9:00am. This likely consists of resident vehicles.

The McLaren 2014 report has estimated that the full completion of the DHA sites would generate some 175 vehicles per hour. Given that the site is not fully occupied, the remaining 94 vehicles generated will be added on to the future traffic numbers and assumptions.

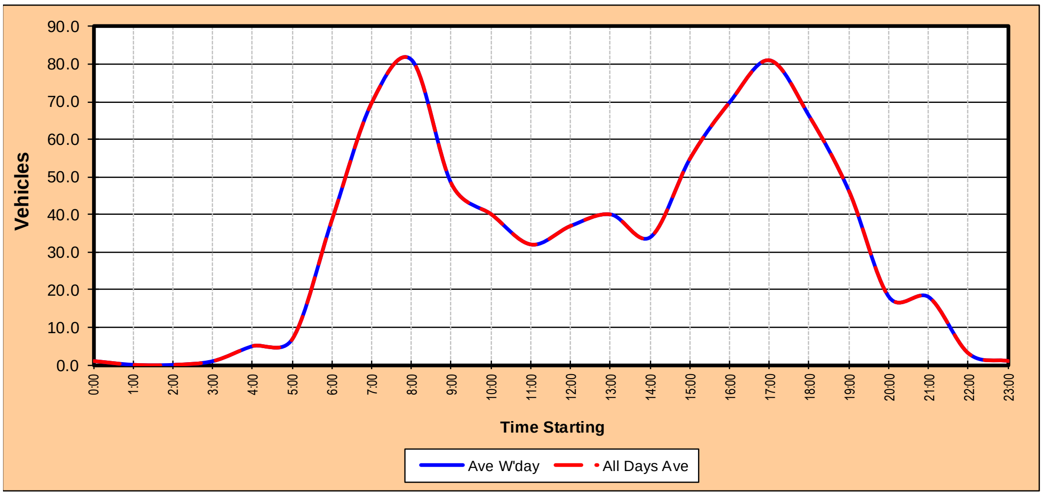


Figure 12: Northbound one way traffic movements in the vicinity of the site

3.8 Existing parking supply

3.8.1 On-site

Surveys undertaken have found 184 marked parking spaces within the learning village. The areas are illustrated in Figure 13, with detailed drawings found in the appendix.

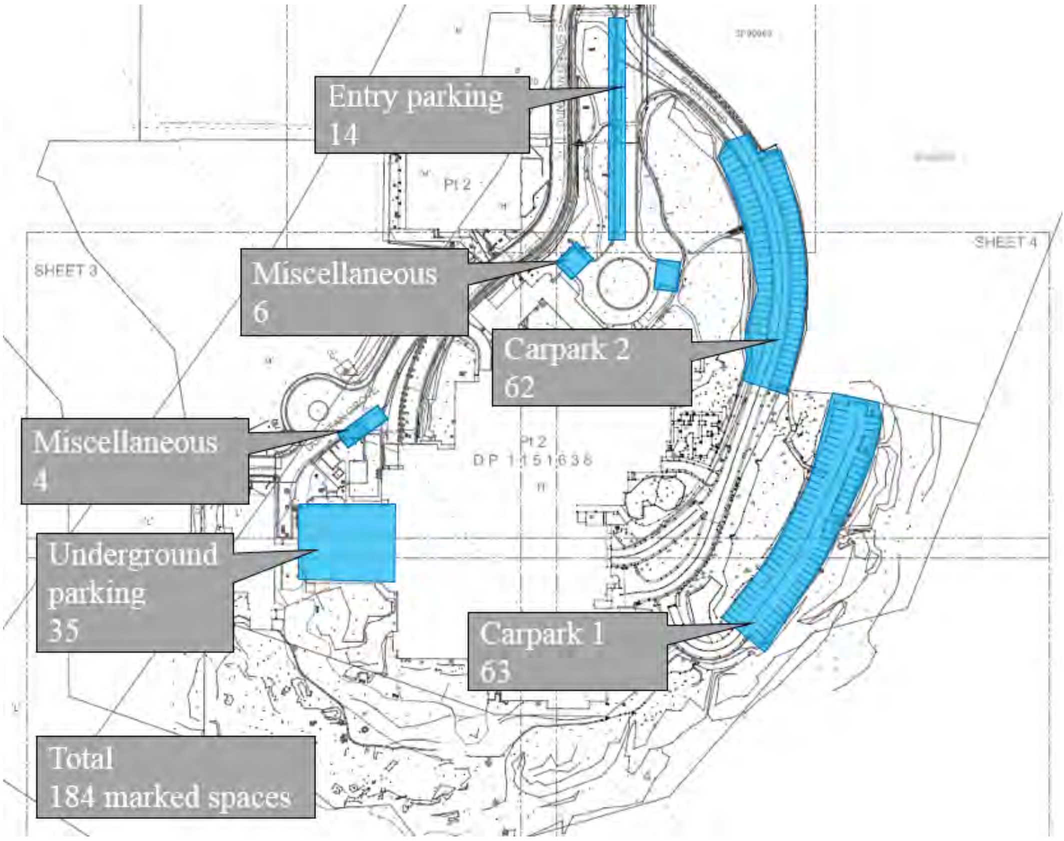


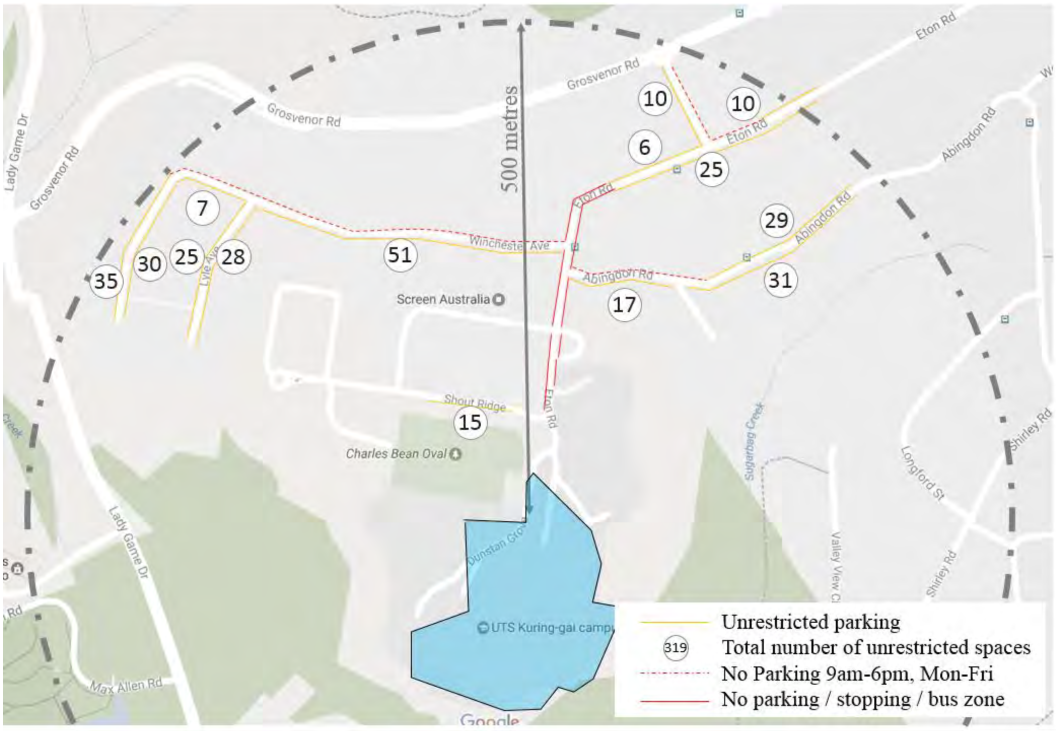
Figure 13: Existing parking locations around the learning village

3.8.2 On-street

A total of 319 unrestricted spaces were found on the local streets within 500 metres of the site. With a majority of the houses around the site having a garage and driveway space, existing on-street parking occupancy was low.

There are 15 parking spaces located along Shout Ridge, providing parking to the Charles Bean Oval users, which is typically busy during the weekends and evening periods.

Abingdon Road, and Winchester Avenue have "No Parking" restrictions between 9am to 6pm, from Monday to Friday. These spaces would therefore be utilised by residents outside of these hours.



4 Future Upgrades

Electronic message sign on Ryde Road, near Lady Game Drive

The sign will provide northbound motorists with up-to-date information on traffic conditions and advanced warning about planned and unplanned incidents and events in Pymble, the north shore, the northern beaches and the wider Sydney region.

Lady Game Drive roundabout planned upgrades

Ku-Ring-Gai Council has developed a traffic and transport plan for 2011 to 2021. The study includes the planned upgrades of the following:

- Lady Game Drive at Grosvenor – possibly alter existing roundabout
- Lady Game Drive / Highfield Road / Moore Avenue – Reconstruct existing roundabout

Sydney Metro Northwest

The new Sydney Metro trains would provide more frequent and efficient train services from Epping to Chatswood, shown by the black line in Figure 14. This would provide additional public transport capacity to the learning village.

The $8.3 billion Sydney Metro Northwest is the first stage of Sydney Metro – Australia's biggest public transport project. The Northwest Rapid Transit Consortium (NRT) is delivering eight new railway stations, 23km of new track, 4,000 commuter parking spaces and Sydney's new generation of safe, reliable and fully automated metro trains. NRT will deliver this critical infrastructure and operate and maintain it for 15 years.

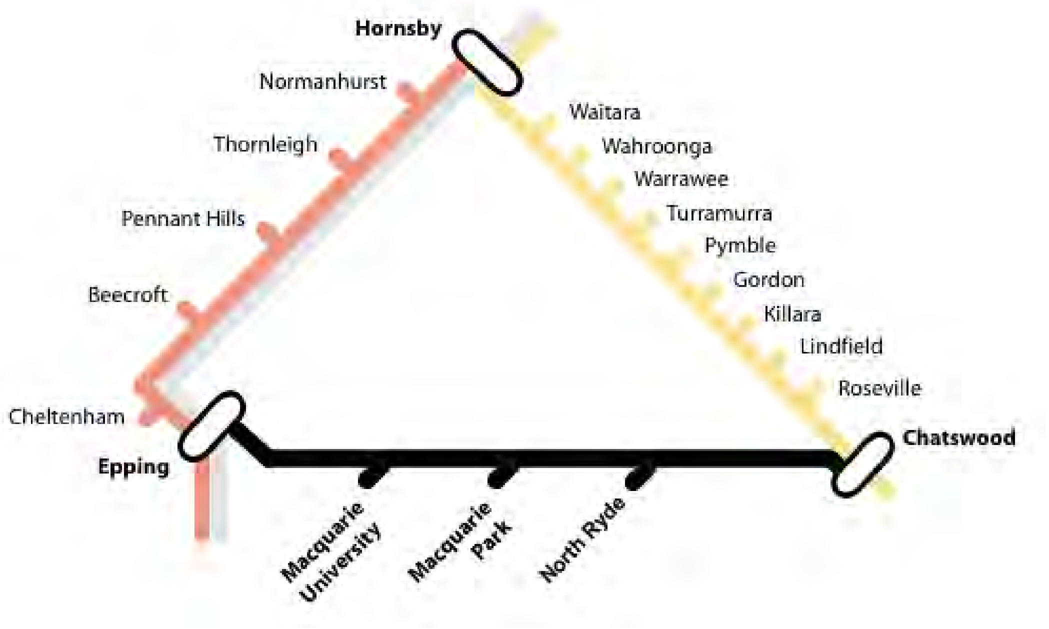


Figure 14: Sydney metro northwest

5 Proposed Development

The proposal utilises the ex- Lindfield UTS site to convert it into the Lindfield Learning Village, with a new K - 12 School and other facilities. A staged opening of the proposed school is essential to reasonably allow for traffic impact monitoring and review of final operating scale.

The site is likely to provide approximately:

Kinder to year 12 homebases

- 2,100 students from Kinder to year 12. The students would grouped into 6 homebases which would commence at staggered times
  - 2 homebases commence at 7:30am
  - 2 homebases commence at 8:30am
  - 2 homebases commence at 9:00am
- A proportion of the students would attend extracurricular activities after finishing school, which would also be staggered.
- Approximately 160 teachers and administration staff

Other facilities

- Childcare consisting, 94 children and 12 staff
- Aurora College, 12 staff

After hour facilities for community use

- Existing Greenhalgh Auditorium, 750 seat capacity
- Existing Lecture Theatre 1,180 seat capacity
- Existing Lecture Theatre 2,100 seat capacity

Generally, the development is contained to retrofitting the ex-Lindfield UTS site. Minor landscaping works to the site is also envisaged. Enrolments are not anticipated until 2017 to allow for the construction phase.

The staggered arrival and departure of students would reduce the peak traffic generated, minimising the impact to the surrounding road network. This would also reduce the demand on the public transport network and the number of required buses.

Existing auditorium and lecture theatres would provide a learning and function space for the community. These spaces would likely function outside of the road network peak hours, allowing visitors to use them after work. Minimal traffic is hence envisaged to be generated during the peak hours, from afterhours use.

5.1 Catchment

Public school catchment boundaries and the total enrolments of each school for the year 2016 is shown in Figure 15.

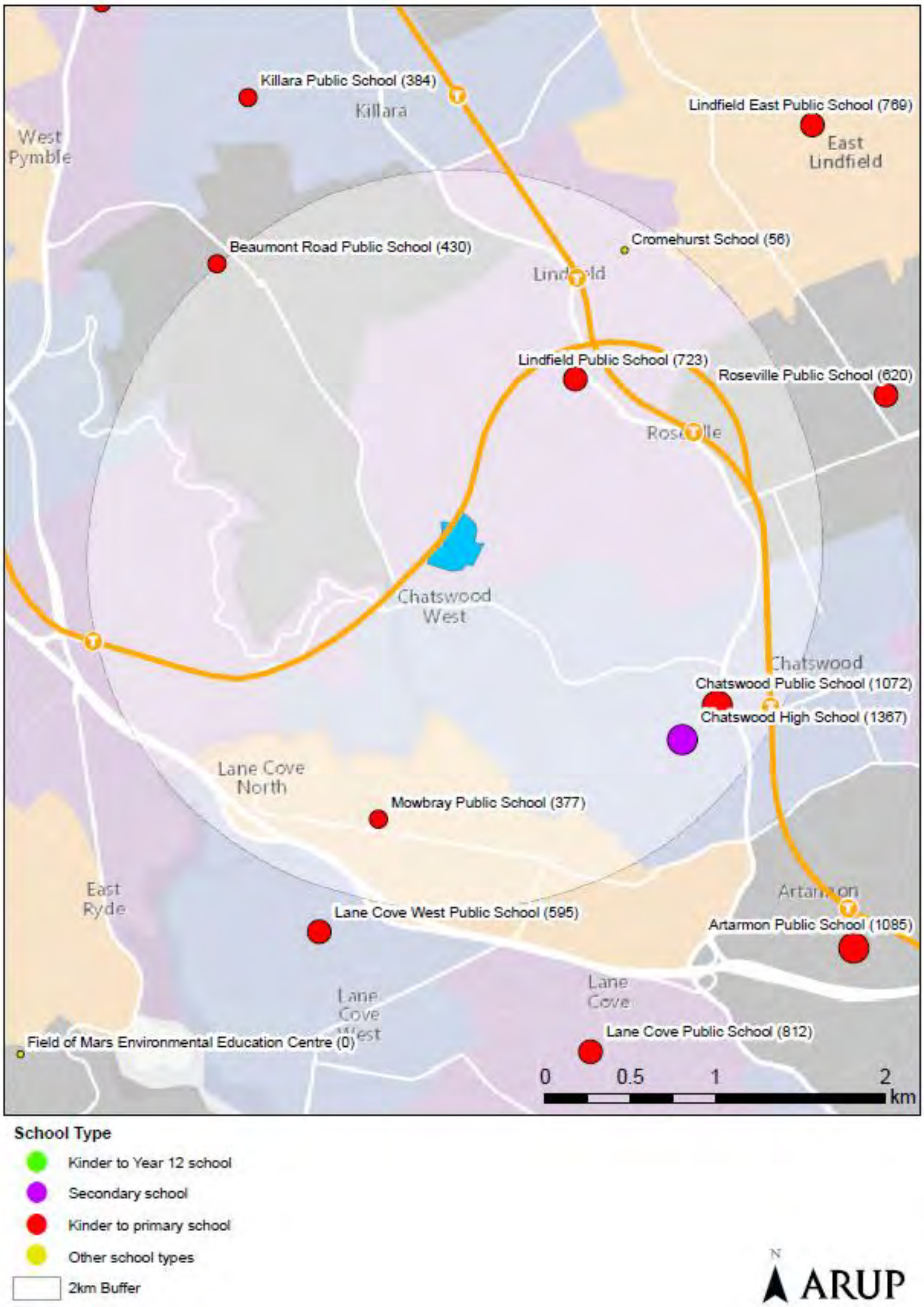


Figure 15: Public school catchment and enrolments, 2016

Source: http://data.nsw.gov.au/data/dataset/, viewed September 2016

While enrolments to the school have not commenced, the learning village would have a wider catchment area. A proportion of the future enrolments would be from the existing schools within the wider vicinity of the learning village. This would reduce the existing strain on schools which are currently facing a high demand of new enrolments.

5.2 Drop-off and pick-up access

The possible drop-off and pick-up locations for the learning village are shown in Figure 16. The bus zones and the proposed private vehicle drop-off/pick-up zones are located in separate areas.

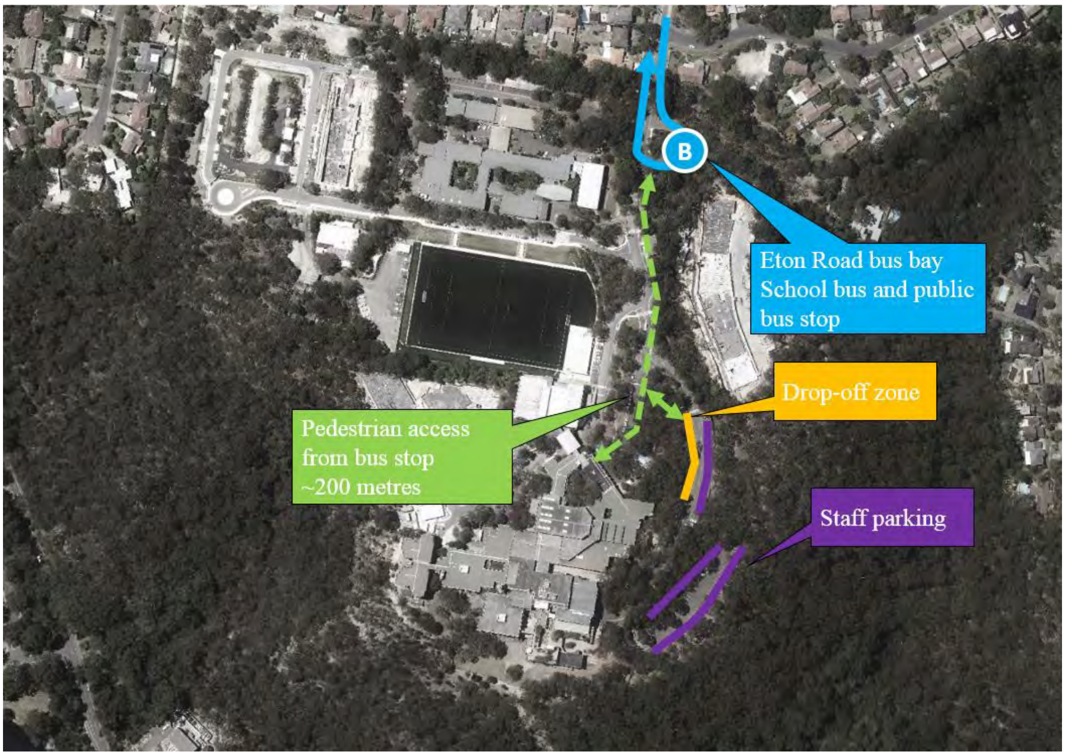


Figure 16: Bus pick-up and drop-off location

5.2.1 Buses

More information on the Eton Road bus bay operations can be found in section 9.

5.2.2 Private vehicles

Drop-off

The proposed drop-off and pick-up location is on the upper level car parks, which consists of approximately 62 – 90 degree car spaces. A turning head at the loading dock area, would allow vehicles to make a U-turn to access the drop-off bays. This would require minor works to existing kerbs shown in Figure 17.

Figure 17: Proposed location of turning head

The drop-off arrangement is shown in Figure 18, and allows for 10 vehicles to queue at the drop-off bay at any one time. This would require 21 spaces to be converted into drop off bays during the morning peak. These bays can then function as parking spaces for visitors, outside of the school peak hours.

The bays would have no parking permitted from 8:30am to 9:30am and 2:30pm to 3:30pm on school days. This arrangement creates an efficient turnover.

Ten spaces on the eastern side of the car park would be used for short term, 5 minute parking from 8:30am to 9:30am and 2:30pm to 3:30pm on school days. This would allow parents with younger children to walk with their kids to school.

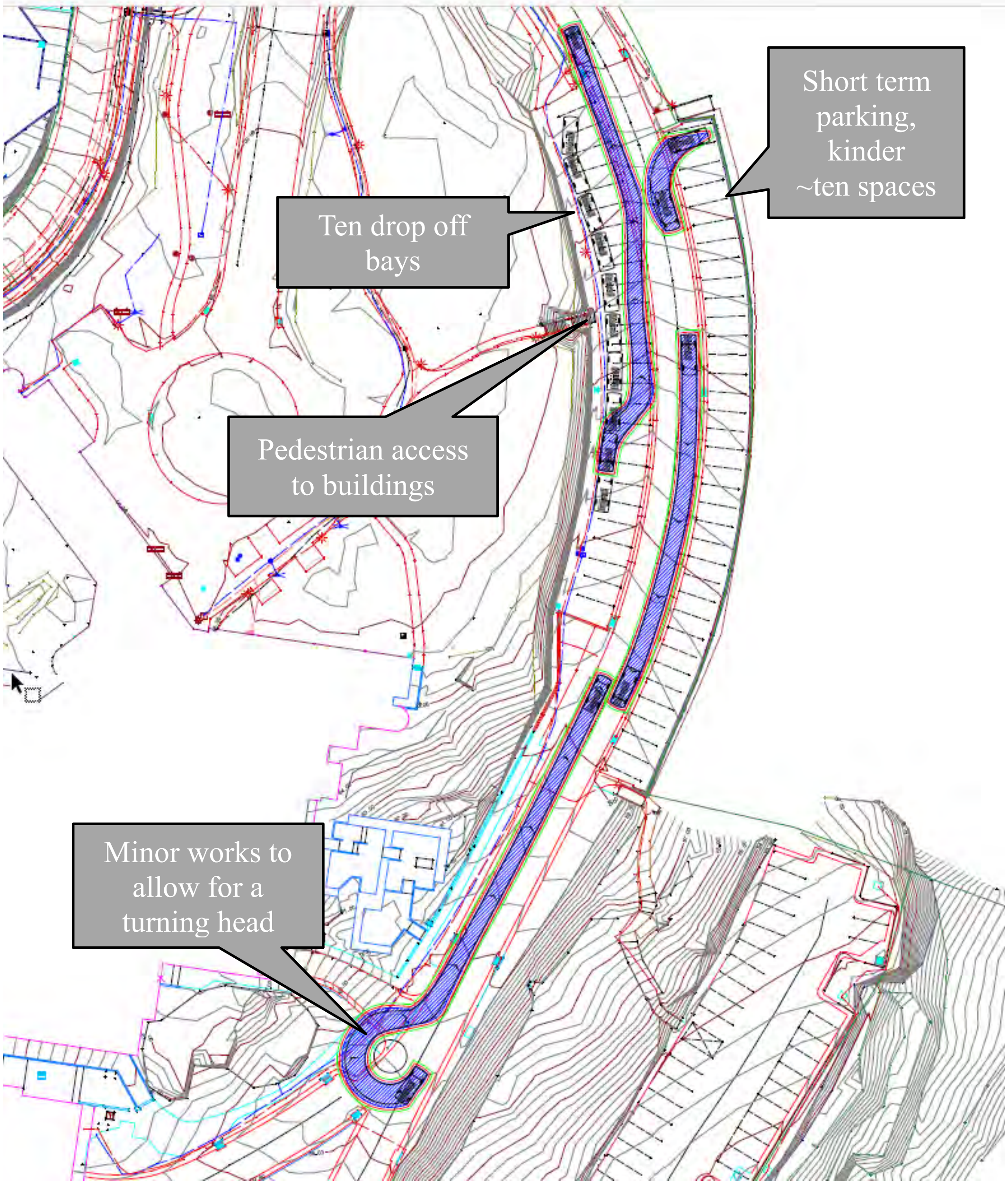


Figure 18: Drop-off arrangement with a proposed turning head

Pick-up

A similar arrangement to Figure 18 is proposed for the pick-up arrangement. Parents should be advised to arrive only after school finishes, rather than park and wait for their children to finish school. This would reduce the number of cars waiting at the pick-up point at any one time.

Case studies

Recent studies were carried out at Chatswood High School and Chatswood Public School to assess the drop-off and pick-up capacity requirements, on September 2016. Both schools utilise the same drop-off location along Centennial Avenue and have a combined enrolment of approximately 2,439 students. The surveys have indicated a total peak usage of approximately:

- 15 car spaces are used for drop-offs (occurring over 15 minutes)
- 30 car spaces are used for pick-ups (occurring over 30 minutes)

The proposed drop-off and pick-up arrangement would encourage a faster turnover with a turning head. The nine bays would likely be sufficient to service each family group, given the staggered start and finish time.

5.2.3 Queuing capacity

This drop-off arrangement provides a queuing capacity of some 350 metres before reaching the internal roads where passing stationary vehicles would be restrictive, shown in Figure 19. This length equates to some 60 vehicles (6 metres per car). Given that some 284 vehicles would arrive for the before 8:30am and each vehicle drop-off would take no more than 30 seconds, the 10 drop-off bays can accommodate 20 vehicles per minute. 284 vehicles would therefore take 14 minutes. The likelihood of vehicles exceeding the 70 vehicle queue length is unlikely. Should this happen however, a traffic warden can be deployed to ensure minimal conflicts occur between buses, pedestrians and private vehicles, and also improve the effects of platooning.

Figure 19: Availability of queuing from drop-off zone

5.3 Car parking

As discussed in section 3.8, there are currently about 184 car spaces located within the site. Due to the topographic and heritage nature of the site, additional parking is not recommended to be constructed. Parking space allocations would therefore have to be based on existing provisions.

There is an ample supply of parking on-street with some 319 unrestricted parking spaces, discussed in section 3.8.2. While a majority of the parking is proposed to be provided on-site, through proper allocation, enforcement and alternative transport strategies, there may be some spill-over parking. These can be effectively accommodated on the local streets. The learning village would have to constantly monitor the on-street parking capacities. Further enforcements such as time restricted parking schemes can be considered in busier areas closer to the learning village.

5.3.1 Proposed parking spaces

The Ku-ring-gai Development Control Plan 2015 (KDCP) provides parking guidelines for the minimum number of parking spaces required for each landuse. Table 5 outlines the car parking requirements.

Student parking

The KDCP suggests a minimum number of 21 parking spaces for year 12 students. A majority of the schools around the area, such as Ravenswood Girls School, Lindfield Public School and Chatswood High School do not provide parking for students. Providing parking spaces to students would encourage a non-sustainable mode of transport to the site and would likely compromise pedestrian safety within the school.

If alternative transport strategies are unsuccessful in persuading year 12 students from driving, there is an ample supply of parking on-street with some 319 unrestricted parking spaces, discussed in section 3.8.2. It is expected that approximately 20% to 40% of the 166 year 12 students could drive to school. This equates to approximately 33 to 66 students driving and parking on-street in the surrounding local roads. Students would therefore occupy between 10% and 20% of the available on-street parking spaces. This figure is well below the maximum available capacity with most residents having a garage on their properties.

The number of students driving to the learning village would be significantly lower than that of the UTS students, when the university was still operational. This is apparent from the fact that UTS students are older and a much larger proportion would be able to drive to the campus. On-street parking utilisation would likely be lower than when the UTS campus was operational.

Staff parking

Due to the topographic and heritage nature of the site, additional parking is not recommended to be constructed. After allocating spaces to employees and the childcare, the remaining 151 spaces can be allocated to staff parking. This equates to 9 of the staff required to use public transport, active transport modes or car sharing, all of which are achievable through the transport strategies developed.

If alternative transport strategies are unsuccessful, it is likely that some 9 additional staff would drive to school and park on-street. Spill-over parking from staff can be accommodated on-street, as discussed above.

Based on 9 staff and between 33 and 66 students parking on-street, this would equate to between 17% and 24% of the on-street parking spaces being occupied by the learning village.

After hours parking

The Greenhalgh Auditorium, lecture theatres and gymnasium would be used by external visitors after school hours. These spaces may use the parking spaces provided within the learning village which have been vacated by teaching staff and employees. Based on the KDCP, some 195 spaces would be required. The additional spaces can be found throughout the learning village, for example at loading dock areas.

Whilst the development can comply with the KDCP requirement for car parking, the operational nature of these uses needs to be considered. If the auditorium is used for a 1,000 person event and 90% of people drive with a car occupancy of 3 people, then up to 300 car parking spaces would be required. With 184 on-site, this would result in overflow to local streets of over 100 cars. This equates to approximately 30% of on-street capacity.

After hours parking demand to the Greenhalgh Auditorium can be mitigated through several measure such as providing a shuttle bus during operational hours or restricting the maximum patronage.

Monitoring on-street parking

The learning village and council would be encouraged to constantly monitor the on-street parking capacities and the effectiveness of the implemented travel strategies. Further enforcements such as time restricted parking schemes can be considered in busier areas closer to the learning village.

Table 5: Proposed allocation of parking spaces

School use	No. of people	K DCP Standards 2015 Minimum parking	KDCP Minimum	Proposed
Year 12 students	166	1 space per 8 Year 12 students	21	0
Teachers	160	1 space per equivalent full-time employee	160	151
Childcare	94	1 space per 4 children in care	23	23
Aurora College staff and visitors	17	1 space per 33m2 gross floor area (GFA) plus 1 space if resident manager or caretaker. Suggested split: 90%: employee parking 10% visitor parking based on $20m^2$ GFA per person this equates to approximately 60% provision per person	9	9
Total			296	**184**
Greenhalgh Auditorium After hours	750	Public Halls - Minimum parking provision to be 1 space per 10 seats, for day time parking. Recommended parking provision is 1 space per 6 seats, for Friday / Saturday evening	125	125 after hours shared
Lecture theatres After hours	280			
Gymnasium* After hours	100	1 space per $17m^2$ gross floor area.	70	70 after hours shared
Total			195	**184**

*Gym derived based on a typical gym occupancy of 70%, with all visitors driving

5.3.2 Proposed parking allocations

The proposed parking arrangements for parking within the learning village is illustrated in Figure 20.

As discussed in section 5.2, Carpark 2 would require modifications during school drop-off and pick-up periods:

- 21 spaces to be allocated for drop-off and pick-ups
- 10 spaces to be allocated for short term parking

These 31 spaces can operate as visitor or staff parking spaces outside of school drop-off and pick-up periods.

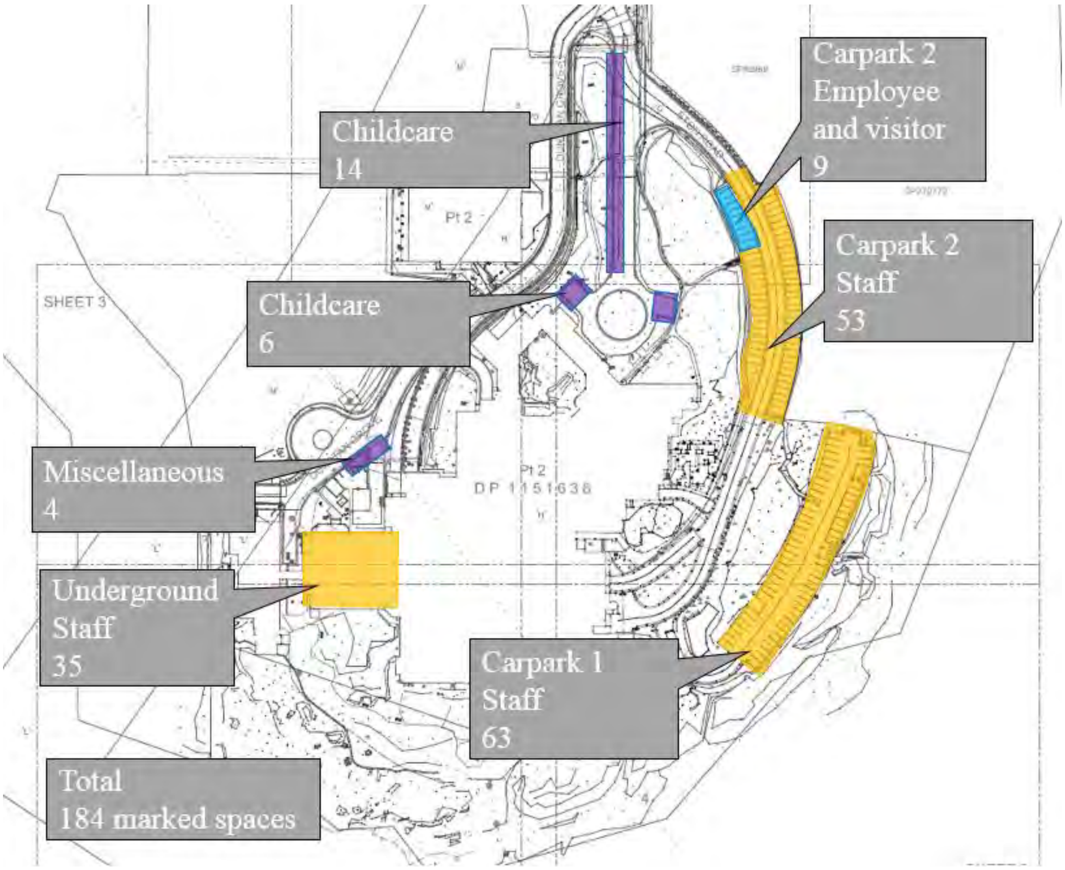


Figure 20: Parking allocations

5.3.3 Key findings

School periods

On-site parking meets the KDCP requirements, with exception to teacher and year 12 student parking requirements. Alternative transport strategies would reduce the number of vehicles driving to the learning village. However, as a conservative estimate, some 9 staff and 66 students parking on-street, would equate to 24% of the on-street parking spaces being occupied by the learning village (within a 500 metre catchment). On-street parking utilisation would likely be lower than when the UTS campus was operational.

After school hours

During the operation of the after hour facilities, with 184 parking spaces on-site, this would result in overflow to local streets of over 100 cars. With more on-street parking being available after-hours, these 100 cars would be accommodated on-street effectively.

5.4 Bicycle parking

The Department of Education website states that:

- Not all schools have the facilities to store students' bikes. The decision to install and maintain bike racks is made by the school. Some schools choose not to have bikes brought into the school. This may be due to safety reasons, or the inability to safely secure bikes. Principals have the authority to stop students from bringing bikes, scooters and skateboards onto school property.
- Bikes need to be stored in the area specified by the school. The school accepts no responsibility for loss, damage or theft. We recommend that students lock their bikes with a secure chain.
- The school may assist with safe storage of helmets if space permits.

Source: https://education.nsw.gov.au/road-safety-education/safe-student-travel/bikes

The Kuring-Gai DCP does not provide guidance on the number of bicycle parking facilities required.

There are existing bicycle racks throughout the learning village at key buildings. These are deemed substantial and can be increased based on the future demands. Any additional bicycle parking facilities should be designed in accordance to *Standards Australia AS2890.3 (Bicycle Parking Facilities).*

Based on the proposed mode splits discussed later in section 8, 69 students and staff are expected to travel to the learning village by active transport. Assuming 60% of them cycle to school, a minimum of 42 bicycle parking spaces should be present within the learning village. There are existing shower facilities within the learning village which can be used as end of trip facilities.

5.5 On-street parking changes

On-street parking occupancy was observed to be low during site visits, as discussed in section 3.8. There is a high supply of on-street parking spaces with most of the residential houses having a driveway or garage. Completion of the learning village would require an increase of some 11 school buses during school peak hours. These buses would follow the existing bus 565 route through Austral Avenue and Eton Road.

School buses would arrive in groups of five or six, to service each homebase. They would then leave within 20 minutes of arriving. The likelihood of buses passing each other is therefore likely to be low. However parking restrictions at certain areas would allow a wider manoeuvring width for buses to pass each other.

The proposed on-street parking changes along Eton Road would allow the safe manoeuvre of buses to pass each other. Existing unrestricted parking spaces on the west of Austral Avenue should be monitored for future changes. These proposed changes would result in 15 car spaces be lost along Eton Road, shown in Figure 21.

Figure 21: Proposed on-street parking changes

6 Case Studies of Existing Schools

In order to get an understanding of the likely future mode split of the Lindfield Learning Village students, Arup has carried out on-site travel surveys at two schools located near the site (Figure 22):

- Lindfield Public School, Kinder to Grade 6, 0.7 km from Lindfield Station
- Killara High School, Year 7 to 12 , 1.9 km from Killara Station

Both schools are located at a relatively inaccessible distance from train stations and would have a similar demography to the learning village given their proximity to the site.

We also obtained information on the operations at Chatswood High School from the principal and from previous studies.

- Chatswood High School, Year 7 to 12 , 0.7 km from Chatswood Station

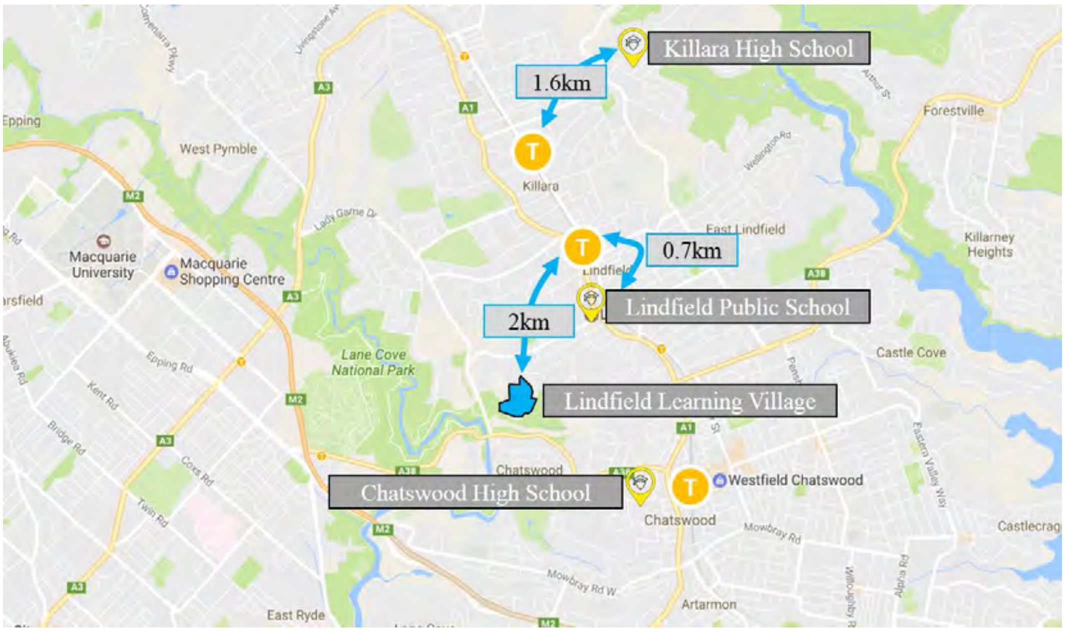


Figure 22: Schools surveyed

Surveys observed the following:

- The number of cars with students arriving
- The number of students in each car
- Number of school buses
- Travel behaviour of students
- Duration of pick-up and drop-off periods
- Questionnaire surveys were also conducted when parents arrived without a car to determine if they walked to school or parked on another street.

6.1 Lindfield Public School

Lindfield Public School is located off Grosvenor Road, and has approximately 723 kinder to primary school students enrolled. The main access is located on the northern side of Grosvenor Road where seven drop of spaces are located, just west of the Pacific Highway intersection.

Lindfield Public School commences at 9:00am and finishes at 3:30pm.

6.1.1 Drop-off occupancy surveys

Arup conducted occupancy surveys on Tuesday 21 March 2017 for the drop-off period between 8:00am to 9:10am. Parents with younger children were found to park along local roads highlighted in green, shown in Figure 23, and would then accompany their children to school. Drop-off bays were also examined along Gladstone Parade and Grosvenor Road.

Figure 23: Parking and drop-off areas for Lindfield Public School

Photo 4: Parents walking to school with children after parking

Photo 5: Drop-off bay along Gladstone Parade

The number of children arriving by cars and the number of cars recorded to be carrying students, is shown in Figure 24. The following key findings were found:

- Total number of K to grade 6 students in Lindfield Public School: 700 students (based on Department of Education datasets 2016[2])
- Number of students arriving by car: 298 students
- (%) of students arriving by car: 43%
- Number of Cars dropping-off students: 186 cars
- Car student occupancy rate: 1.602 students per car

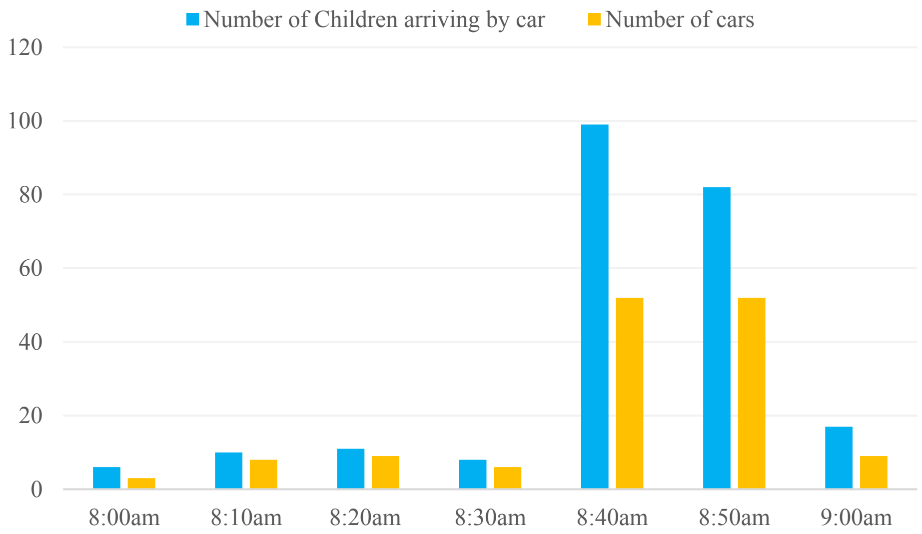


Figure 24: Number of children and cars arriving in 10 minute intervals

Key findings

A proportion of students were found to arrive by walking and buses as a mode of transport. It was a common observation for parents to have more than one student in each vehicle. This suggests that siblings tend to attend the same school in Lindfield Public School or a high occurrence of car-pooling.

6.1.2 Pick-up occupancy surveys

During pick-up periods, existing on-street parking is generally taken up by residents along Grosvenor Road before parents arrive. Parents were found to park along Ortona Road and Eton Road. The pick-up bays continue to operate efficiently.

Similar occupancy surveys were carried out on Tuesday 21 March 2017 for the drop-off period between 2:50pm to 3:20pm for the pick-up periods. Parents who drove were observed parking on street, then walking to the school to the school entrance to wait for their children.

[2] https://data.nsw.gov.au/data/dataset/nsw-government-school-locations

Photo 6: Student boarding bus 565

Photo 7: Parents parked along Ortona Road

The number of children arriving by cars and the number of cars recorded to be carrying students, is shown in Figure 26. The following key findings were found:

- Total K to grade 6 students in Lindfield Public School: 700 students
- Number of students leaving by car: 166 students
- (%) of students leaving by car: 24%
- Number of cars picking-up students: 107cars
- Car student occupancy rate: 1.551 students per car

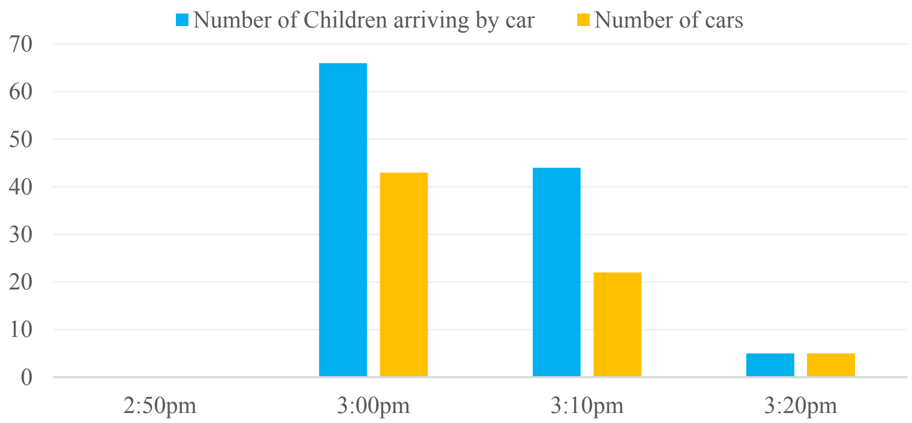


Figure 25: Number of children and cars arriving in 10 minute intervals

Key findings

The pick-up duration finishes more quickly than the drop-off period. A proportion of students were found to leave school in larger groups by walking or carpooling. Parents were also found to accompany large groups of children walking home.

6.2 Killara High School

Killara High School is located along Koola Avenue, 1.6km from Killara Train Station, which is outside the walking catchment. Lindfield Learning Village is located 2km from the Lindfield Train Station, making this case study a viable example of student travel.

Killara High School has approximately 1,600 year 7 to 12 students enrolled. The high school is exemplary in showing that students can use sustainable travel alternatives such as school buses, walking and public transport. This is reflected by the well organised bus ranks and arrival times of school buses which were observed to be at capacity on most occasions.

Albeit school bus capacities and numbers were observed to be insufficient with overcrowding on buses and students having to wait for another bus, it reflects the high for these travel modes. Surveys have recorded that some 75% of the students in Killara High School get picked-up by a school bus.

6.2.1 Bus ranks

The high school has nine bus ranks (timetable in Table 6) located along Koola Avenue. These ranks have pedestrian fences installed shown in Photo 8.

Table 6: School bus rank summary

Rank	School bus	Time	Direction
Rank 1	9097	3:10pm	To CSIRO
Rank 2	9064	3:10pm	To West Lindfield
Rank 3	9006	3:10pm	To UTS
Rank 4	9048	3:08pm	To Roseville Public School
Rank 4	9062	3:15pm	To Roseville
Rank 5	9059	3:10pm	To East Lindfield
Rank 6	9077	3:09pm	To Killara Station
Rank 7	9073	3:09pm	To Killara Station
Rank 8	214	3:05pm	To St Ives Chase
Rank 9	9082	3:06pm	To Gordon Station
Rank 9	9004	3:10pm	To Gordon Station
Rank 9	9121	3:10pm	To Killara and Gordon

Source: http://www.transdevnsw.com.au/uploads/timetables/287/attachment/KillHS.pdf

Photo 8: Pedestrian fences along each bus rank

6.2.2 Drop-off occupancy surveys

Arup conducted occupancy surveys on Monday 3 April 2017 for the drop-off period between 8:00am to 9:00am. Weather conditions were wet on the day of the survey. The existing kerbside restrictions are shown in Figure 26.

Existing unrestricted spaces were found to be utilised by residents or teachers, with a high proportion of students using public and school buses.

Figure 26: Parking and drop-off areas for Killara High School

Photo 9: Unrestricted parking occupied along Koola Avenue

Photo 10: Drop-off bays at 8:51am

The following key findings were found:

Private vehicles

- Total number of students in Killara High School: 1,600 students
- Number of students arriving by car: 153 students
- (%) of students arriving by car: 10%
- Number of Cars dropping-off students: 110 cars
- Car student occupancy rate: 1.4 students per car

School buses

- 14 buses arriving between 8:00am and 9:00am,
- Each bus staying at a rank for no more than 5 minutes.
- All school buses were close to capacity with 43 seated and some students standing

Key findings

A high proportion of students were found to arrive by school and public buses. Drop-off bays located along Koola Avenue were operating efficiently.

Photo 11: Bus ranking system at Killara High School. Each rank clearly state the routes taken

Photo 12: Bus ranking system at Killara High School

6.2.3 Pick-up occupancy surveys

Key findings for the pick-up survey are:

Private vehicles

- Total number of students in Killara High School: 1,600 students
- Number of students leaving by car: 85 students
- (%) of students leaving by car: 5%
- Number of Cars dropping-off students: 68 cars
- Car student occupancy rate: 1.25 students per car

School buses

- 16 buses arriving between 3:00pm to 3:20pm,
- Each bus staying at a rank for no more than 5 minutes.
- All school buses were close to capacity with 43 seated and up to 60 standing.
- Approximately 1,200 (75%) students were found boarding school buses

Photo 13: School bus 9121 at capacity

Photo 14: Students waiting at bus ranks

Photo 15: School buses picking up students

Photo 16: Pic-up bays operating effeciently

Key findings

A high proportion of students were found to leave by school and public buses. There was insufficient space on most buses with students having to squeeze. Drop-off bays located along Koola Avenue were operating efficiently.

6.3 Chatswood High School

Chatswood High School is a public school located approximately 3.5km south of the proposed learning village site. The school currently has 1,400 students and 107 staff.

A travel survey was conducted, to gain an understanding of how students travelled to school. A total of 275 students, from year 7 and year 10 grades were surveyed. The responses are illustrated in Figure 27. The survey indicates that a large majority of the respondents currently use public transport and walking to get to school.

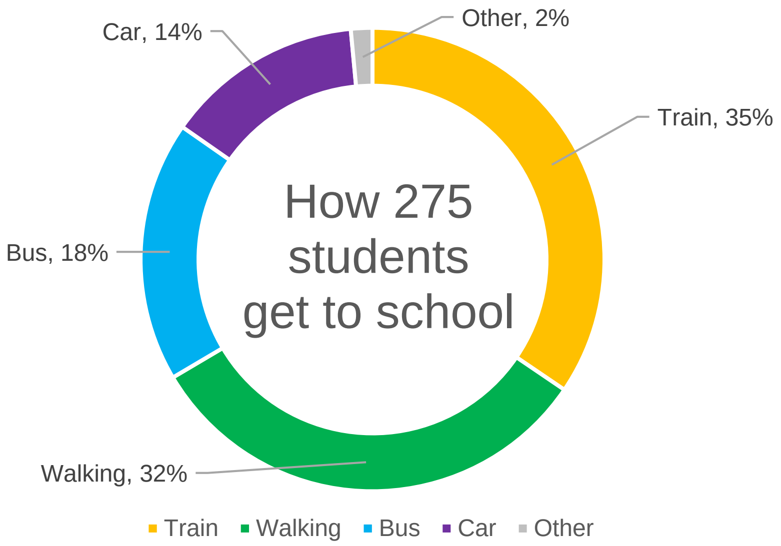


Figure 27: How 146 year 7 and 126 year 10 students travel to school

The High School is well serviced by the Chatswood train and bus interchange and an efficient pedestrian network.

- Walking from Chatswood train station to Chatswood High School takes approximately 10 minutes over an 800 metre distance.
- A shuttle bus from Lindfield train station to the learning village takes approximately eight minutes (morning peak 8:30am) over a 2km distance
- The travel times from train stations are relatively similar when comparing both schools

The learning village and Chatswood High School are likely to have a similar demography of students. The high school has a mode share of only 14% of the students using private vehicles as a mode of transport to school. This shows that by providing the required public transport and infrastructure, favourable travel strategies can be achieved.

7 Transport Strategies

The Learning Village has the potential to be efficiently serviced by a range of sustainable transport measures, in place of higher energy consumption travel modes such as single occupant car travel.

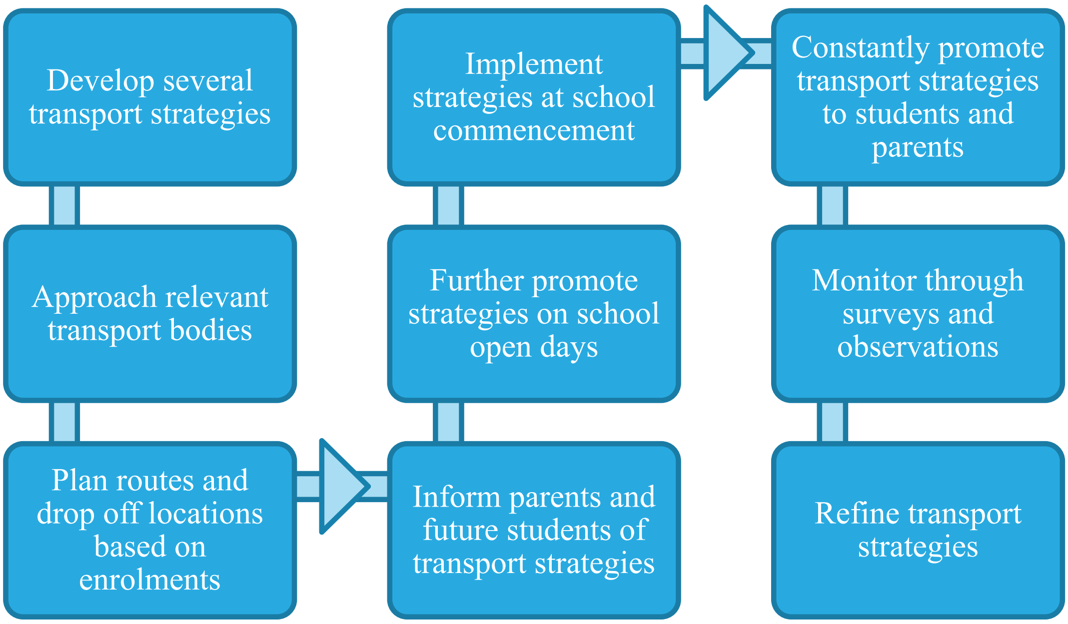
Given that the site will be used by students and teachers in a new location, sustainable travel alternatives would be more easily implemented as well as adopted.

These initiatives aim to cultivate a long term sustainable means of transport to the Learning Village in order to:

- Reduce private vehicle usage from staff and therefore parking demand
- Reduce private vehicle usage (pick-ups and drop-offs) from students
- Reduce traffic congestion and reduce impact on intersection performance

The targets associated with these travel methods aim to reduce car trips to the development so there is minimal impact to local streets and the surrounding intersection performance. Certain transport strategies may be implemented in conjunction with Lindfield Public School and private residential developments within the proximity of the learning village, benefiting the wider community.

Implementing, enforcing and educating these strategies before and throughout the various stages of the site's opening would play a major role in achieving these targets.



The success of Travel Smart schools

In Western Australia, the Government has put in place targets to halt the trend of increasing car use by managing travel demand to achieve increases in cycling, walking and public transport use. The TravelSmart to School program works with primary schools to promote safe and active ways to travel to school.

The initiative has achieved:

- 9% less car trips and 12% more walking, cycling and public transport use.
- 30 participating schools (with 13,666 students), up from 8 schools and 2,337 students in 2012.
- 209 school activity blogs posted, up from 54 in 2012.

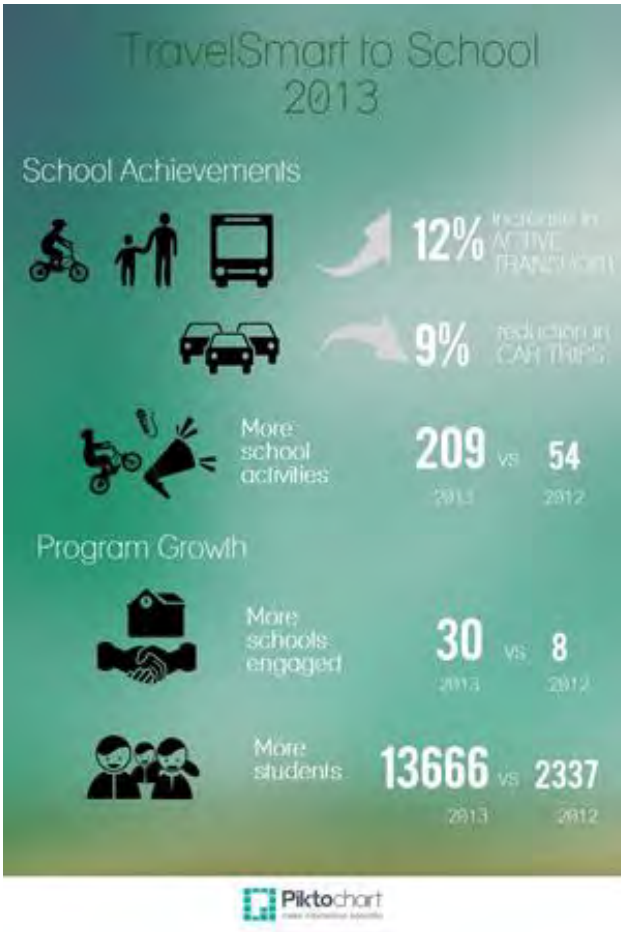


Figure 28: Travel Smart[3]

[3] http://www.transport.wa.gov.au/activetransport/about-travelsmart.asp

7.1 Possible transport strategies

This section discusses the various transport strategies which the Learning Village may implement.

7.1.1 School buses

School bus routes can be tailored to suit the needs of the learning village. This can be done by altering existing bus routes or introducing a new bus route. Schools near the learning village, which include

- Chatswood High School (Forest Coaches, Transdev)
- Chatswood Public School (Forest Coaches, Transdev)
- Roseville Public School (Transdev)
- Beumont Road Public School (Shorelink Bus 565)

Each school bus can accommodate approximately 70 students. An appropriate school bus route should be developed with consultation of TfNSW, bus companies, and surrounding schools.

Figure 29: School bus 683 which stops at Chatswood Station

7.1.2 Public bus

As discussed in section 3.5.1, a bus stop is located just north of the site, providing convenient access to future patrons from Bus Route 565. The bus route services key train stations which high train frequencies such as Macquarie University, Chatswood, Lindfield and Roseville.

It is proposed that a large majority of the students would travel to school by school buses. However as an alternative, this section investigates initiatives that can be taken to improve the amenity of existing bus routes, and various incentive measures.

Improving bus frequencies

The existing bus route 565 only runs once every hour, which would make it difficult for students to access and may prove to be a capacity issue. Increasing the frequencies during School peak periods would allow students and staff to more easily access the buses from the train stations and would be viewed as a more convenient mode of transport.

The bus route currently serves Beumont Road Public School. This improved bus frequency would also provide amenity to the Beumont Road Public School and residential dwelling located around the site.

According to Sydney Buses, rigid buses (standard) carry a maximum of 58 people (43 seated and 15 standing) or some 70 students. For the purpose of this analysis, each bus would be able to accommodate 60 students.

Table 7: Recommended bus route 565 improved frequencies

School peak period	Proposed frequency	Capacity	User type
7:30am to 9:00am	5 per hour	300	Students, staff, residents
2:30pm to 3:30pm	5 per hour	300	Students, staff,
4:00pm to 7:00pm	3 per hour	180	Staff, extracurricular students, residents

Consultation with TfNSW

In 2016, NSW government announced that some 3,800 extra weekly service will be added as part of a $108 million investment to buses. As part of the Budget commitment, there will be 12 new or extended routes including a new cross suburban link between the Inner West and Lower North Shore.

Consultation with representatives from TfNSW on 7 March 2017 has indicated that the proposed increased frequencies of bus service 565 is favourable in assisting the efficient operation of the learning village, businesses and residential dwellings. However this increase in bus frequencies would be subject to TfNSW Growth Service’s initiative.

7.1.3 Subsidised public transport travel

The School Student Transport Scheme (SSTS)[4]. The SSTS provides eligible school students with free or subsidised travel on public transport between home and school, on trains, buses, ferries and long distance coach services.

This initiative can be implemented before the opening of the school. An information package can be sent to parents to inform them of this scheme. The Learning Village can also assist parents in applying for this scheme for the students.

Figure 30: Student Opal Card

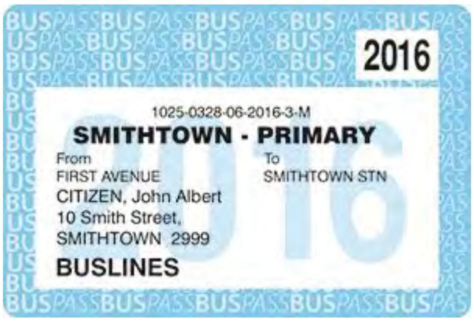


Figure 31: Travel pass for students in rural/regional areas

To be eligible for this scheme, students need to be a resident of NSW, or an overseas student eligible for free government education. Other criteria are stated below.

Students from Kindergarten-Year 2 are eligible if:

- Aged 4 years 6 months, or older.
- No minimum distance criteria applies to these students.

Primary school students from years 3-6 are eligible if:

- The straight line distance from their home address to school is 1.6 km or further.
- The walking distance from home to school is 2.3 km or further.

Secondary school students from years 7-12 are eligible if:

- The straight line distance from their home address to school is 2 kilometres, or further, or
- The walking distance from home to school is 2.9 kilometres or further.

School students who live too close to the school to be eligible for free travel may qualify for a School Term Bus Pass which provides bus travel at a discounted price for the whole school term.

[4] (http://www.131500.com.au/planyourtrip/ upload/links/schoolstudenttransportscheme)

7.1.4 Carpooling

The Learning Village may set up a system where real-time carpool information from participants can be displayed or changed. Schedules can be managed through a cloud, google maps or various smartphone applications. Carpooling should be a long term initiative. With consistent promotion of this travel mode and incentives, students and parents will become aware of the benefits and convenience.

An implementation strategy would need to be considered so that student privacy is protected. It is assumed that such an initiative would likely operate through parents on a carpooling forum. This initiative would operate under management of the Learning Village by encouraging parents to be proactive in offering carpooling services. This can be promoted in Learning Village newsletters, parent teacher meetings and by educating students on the benefits of this initiative. As an incentive for parents, car pool stickers can be given out, giving these shared cars prioritised and designated drop off locations.

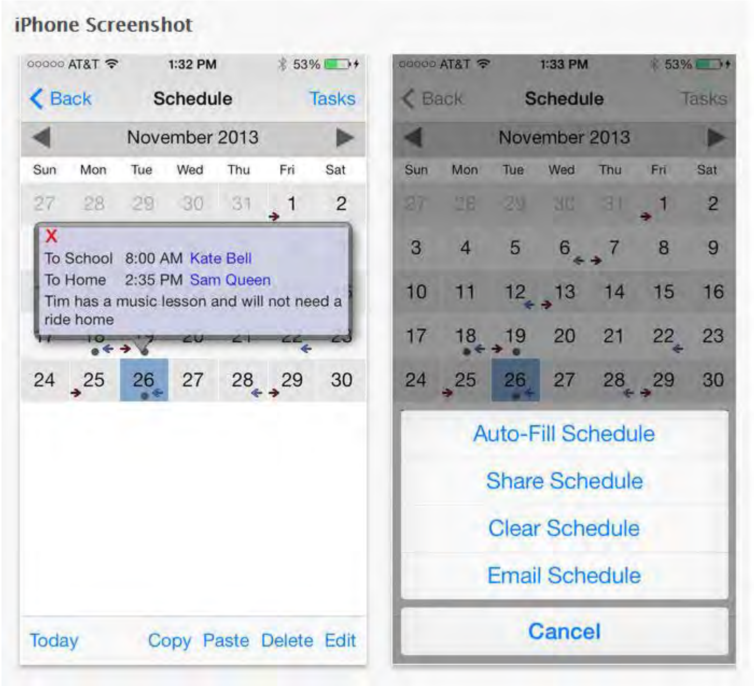
Carpooling initiatives provide an opportunity to significantly reduce cars on the road network.

7.1.4.1 Car pool Apps

A range of free apps are currently available online to assist with the implementation of this initiative; two examples are provided below for information. The School will investigate the most appropriate app that aligns with its Child Protection Policies before promoting this initiative.

Carpool – School Edition

This app is designed specifically for students who carpool to school. It allows students to identify which of their friends live nearby and invite them from their contacts provided they have the app as well. This app is available only on iPhone Operating Systems, however the calendar schedule can be emailed to computers.



Source: iTunes

Figure 32: Carpool School Edition

KarPooler

KarPooler acts as a scheduler and also lets you text all adults linked to the kids in the carpool.

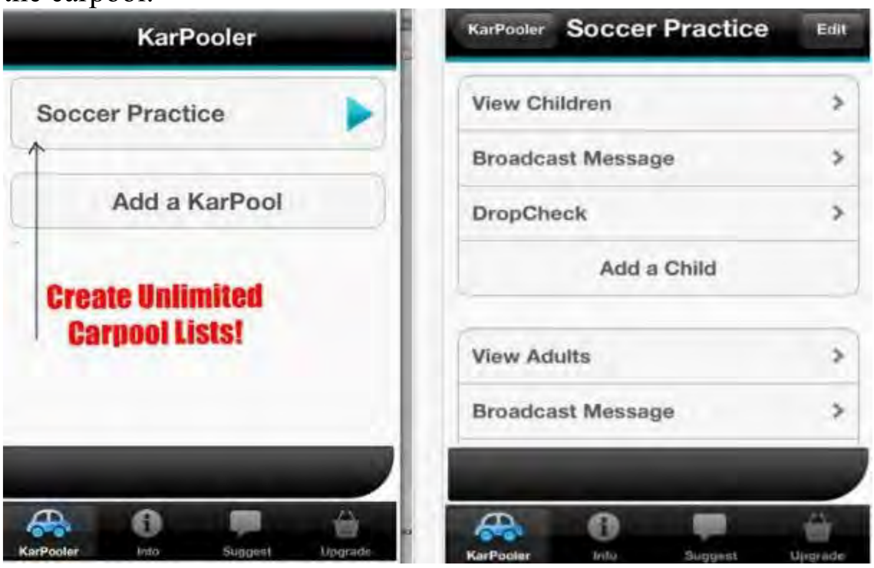


Figure 33: KarPooler app

7.1.5 Walking School Bus

Walking school buses promote a healthy lifestyle by keeping children active, as well as providing a safe environment for walking. Walking to and from school gives children the opportunity to engage in physical activities with their peers. Children walk in a group, with adult volunteers at the front and rear of the group.

Figure 34: Phoenix Primary School WA students walking to school[5]

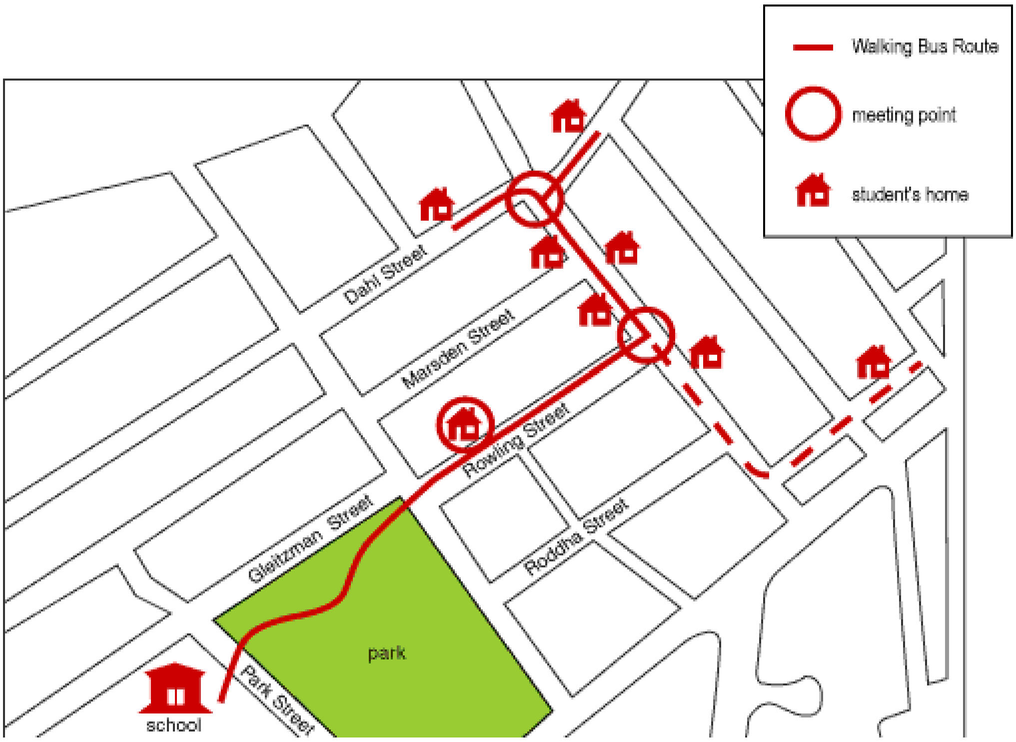


Figure 35: Walking school bus route example[6]

[5] http://www.transport.wa.gov.au/mediaFiles/active-transport/AT_TS_P_TSTS_community.pdf
[6] http://www.travelsmart.gov.au/schools/schools2.html#download

How It Works:

- Children will be picked up along the way to school by a volunteer parent at designated walking bus stops, or at the train station
- Walking bus stops may be in a form of a landmark, like a bus stop, or at the front gate of the student's house
- Typical sizes of walking school buses are 8-12 children with two adults, with a maximum of 8 children for every adult
- Routes used should be the fastest and safest, with a maximum of 30 minutes travel or 2km (train stations are located within this proximity)

Benefits[7]:

- Children gain a sense of independence and get regular physical activity and exercise
- Develop as individuals through involvement in a responsible and disciplined activity
- Experience being part of a group or team
- Learn about traffic safety and good road sense and become more familiar with their own neighbourhood and surroundings
- Have a chance to build friendships
- Have fun getting to school
- Arrive at school alert and ready to learn.

Issues to be aware of[8]:

- Identification of potential risk and implementation of strategies to minimise risk to children in the traffic environment. This would include assessment of local traffic conditions, distance students need to travel, age of students and other risks or hazards.
- Provision of public liability insurance
- Heavy school bags
- Implementation of satisfactory child protection procedures
- Provision of strategies to address absences/unavailability of bus 'drivers' and supervisors

[7] https://www.vichealth.vic.gov.au/programs-and-projects/walking-school-bus
[8] http://www.curriculumsupport.education.nsw.gov.au/policies/road/travel/walkingbus1.htm

7.2 Promoting transport strategies

Before and after the implementation of the preferred travel alternatives, the Learning Village should develop ways to promote and support the travel methods continuously. This section details several initiatives which can be carried out.

7.2.1 Promoting green travel

Marketing and encouraging the different travel strategies will be an important aspect in promoting and implementing the plan. Getting students and staff involved will create a more relaxed and fun environment to encourage students and staff to walk or cycle to Learning Village.

7.2.2 Technology

In previous studies carried out by Arup, the issue of students carrying heavy bags was identified as a reason why students are less likely to walk to school.

A culture shift to electronic based teaching and learning is required to aid the initiatives identified. Text books could be provided electronically to limit the need to carry heavy books to and from Learning Village. Therefore, students will then have to carry less material to school.

7.2.3 Student involvement

Student involvement is a fun way of educating them about active travel. For example, Cottesloe Primary holds a drawing contest for the healthy travel to School plan logo. Student leaders are also appointed who will encourage and teach peers on the benefits of active transport. These leaders should be properly trained in road safety rules which will help educate peers. This will boost the Learning Village spirit and foster leadership skills to achieve change. Some possible incentives include:

- Food or snack vouchers can be given to students who walk or cycle to Learning Village. This can be given out to by teachers at entrances.
- Pedometers for walking competitions
- Awards such as different pins for cyclists or children who walk to Learning Village
- Most number of steps walked for each year competition

7.2.4 Active travel

A mode shift from motorised transportation (principally being driven by car) to active transport improves children's health by[9]:

- Increasing levels of physical activity (and associated physical, psychological and social health benefits)
- Helping children maintain healthy weight
- Reducing injury due to motor vehicle crashes
- Reducing the environmental health damage caused by excessive car use (eg air and noise pollution, global warming)
- Reducing inequalities in children's health associated with physical activity, obesity, and motor vehicle crash injuries.

The Learning Village would support students walking to precinct either for the entire journey or for the last part of a journey from a drop-off point remote from the Learning Village.

There are a number of approaches the Learning Village could take to provide input to improving pedestrian facilities around the Learning Village.

- Local Councils are required to maintain footpaths and crossing points to meet public requirements.
- Safe Routes to school is a road safety program that aims to reduce children's involvement in road accidents. These require the agencies to work together where there is an identified need.
- Local Councils usually undertake PAMP studies across defined areas. This then enables funding to be allocated between local and state government to implement the recommendations of the study.

[9] Active transport: Children and young people, Dr Jan Garrard, 2009

8 Future Mode Split

This section discusses the travel modes future students and staff would likely use to get to school. It is expected that different mode split profiles would be observed for Kinder to Grade 6 and Year 7 to Year 12 students.

8.1 Students

The homebases commencing at 8:30am and 9:00am are investigated given that it is the peak period of traffic generation from the learning village. These two homebases would comprise of 1,400 students. With an even split of 700 Kinder to Grade 6 students and 700 Year 7 to 12 students. Their preferred future mode split of each age group is shown in Figure 36.

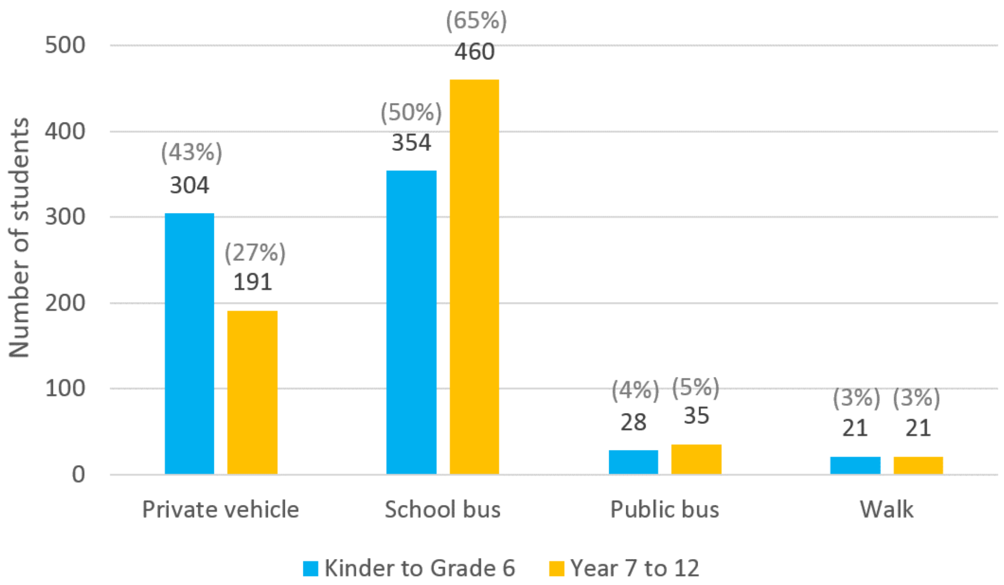


Figure 36: Future mode split of students

The overall mode split of both age groups is shown in Table 8. Based on this mode split, the learning village would likely generate an additional 310 cars and 12 buses.

Table 8: Desired mode share of transport strategy for students (first 4 homebases)

Student commute method	Number of students	Number of vehicles
Private vehicle	496 (35%)	310 cars (1.6 students per car)
School bus	814 (58%)	11 buses (75 students per bus)
Public bus	64 (5%)	1 bus (existing)
Walk	26 (3%)	
Total	**1400 (100%)**	**310 cars and 12 buses**

8.2 Staff

Due to the topographic and heritage nature of the site, additional parking is not recommended to be constructed. After allocating spaces to employees and the childcare, the remaining 151 spaces can be allocated to staff parking. Approximately 100 staff (from two homebases) will arrive within the 8am to 9am peak period.

This equates to 3 staff in each homebase, or 6 staff during the peak hour adopting an alternative form of transport. Carpooling has for example, has been a very successful form of transport alternative in schools.

8.3 Future school peak hour traffic generated

Based on these mode splits, the learning village is likely to generate the following number of vehicles during the morning school peak hour:

- 310 cars from students from drop-off traffic
- 100 cars from staff
- 11 school buses

9 Eton Road Bus Bay

School and public buses are proposed to use the existing bus bay at Eton Road. Students and staff would then walk 200 metres, approximately 2 minutes, to the school. The bus bay currently serves only one bus route 565. Completion of the learning village would increase the frequency of school buses accessing the bus bay.

Pedestrian access from the bus bay to the learning village campus is efficient with a comprehensive network of pedestrian crossing facilities. Traffic wardens should be positioned at key crossing locations to ensure safety of students and staff.

9.1 Design

Eton Road bus bay is built on a cantilever structure. Any further upgrades such as widening would be costly. This design proposes to utilise existing space to create efficient bus and pedestrian amenity for the future.

The bus loop is proposed to be upgraded by extending footpaths to three metres. This would provide additional queuing space for students to wait at during the pick-up PM period. Fencing along the footpath edges would improve safety with openings in between for students to board. The bus loop would consist of four ranks, with each rank serving a different bus route. Each rank would be clearly sign posted to show the routes.

Figure 37: Illustration of proposed design

Swept paths

Swept paths of the bus bay using a 12.5 metre bus is shown in Figure 38. The red outline indicates the extent of the proposed pedestrian fence, offset 3 metres from the outer wall of the bus bay. Yellow sections of the red outline represent the four bus ranks proposed in the design. The orange circles indicate the queuing system which would still allow for the outer radius of the loop for pedestrians to walk around it. Swept paths for a 14.5 metre bus indicates that a smaller footpath width of 2.5 metres will be achieved.

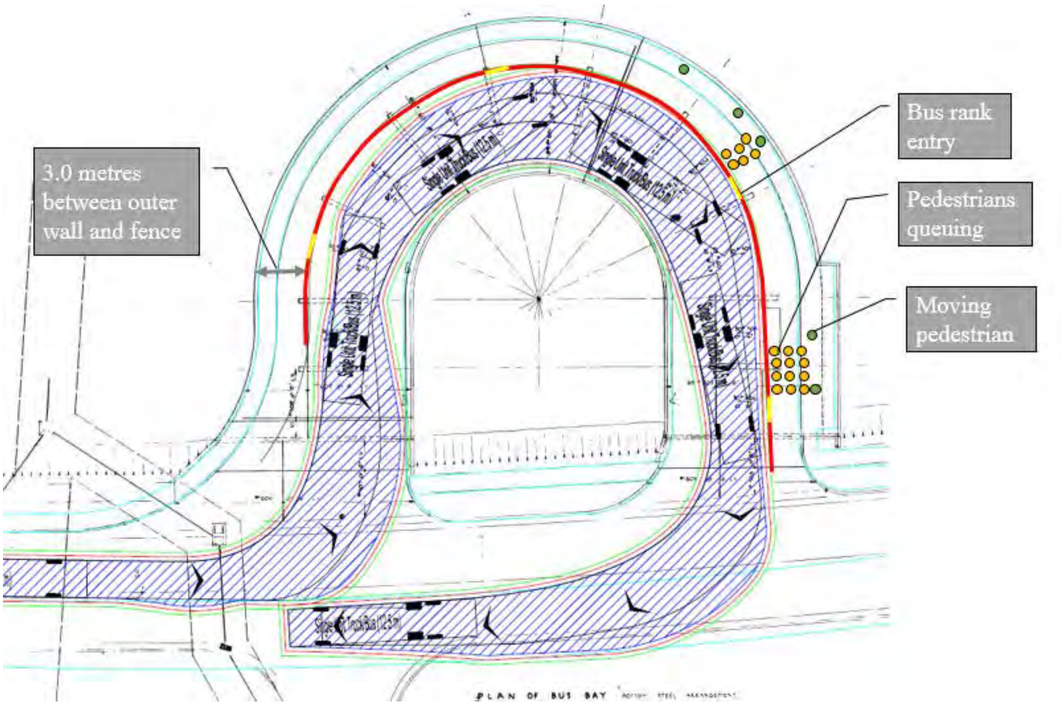


Figure 38: Swept paths of Eton Road Bus Bay proposed design

Bus bay queuing capacity

The pick-up will period would require the most amount of queuing. Buses would arrive before students finish school allowing students to board immediately upon arriving the bus bays. A Fruin Pedestrian level of service analysis provides an indication of the level of amenity a pedestrian might expect to perceive based on the density (number of pedestrians per m^2) of the area. For this analysis, the following have been used:

- Each homebase would attract an additional 445 students and staff using bus / school buses at the Eton Road bus bay
- Minimal queuing is expected given school buses arrive before students do.
- The bus bay footpath area, between the pedestrian fence and outer wall has an area of 256m^2 not inclusive of clear widths.
- As a conservative estimate, the 445 people queuing in the area would result in 1.73 people per square metre
- An efficient Fruin Level of Service C or D would be expected (Level of service A - best, F - worst)

9.2 Drop-off

School and public bus drop-offs would operate as efficiently with students alighting within several minutes. Buses would arrive periodically with minimal queuing anticipated.

9.3 Pick-up

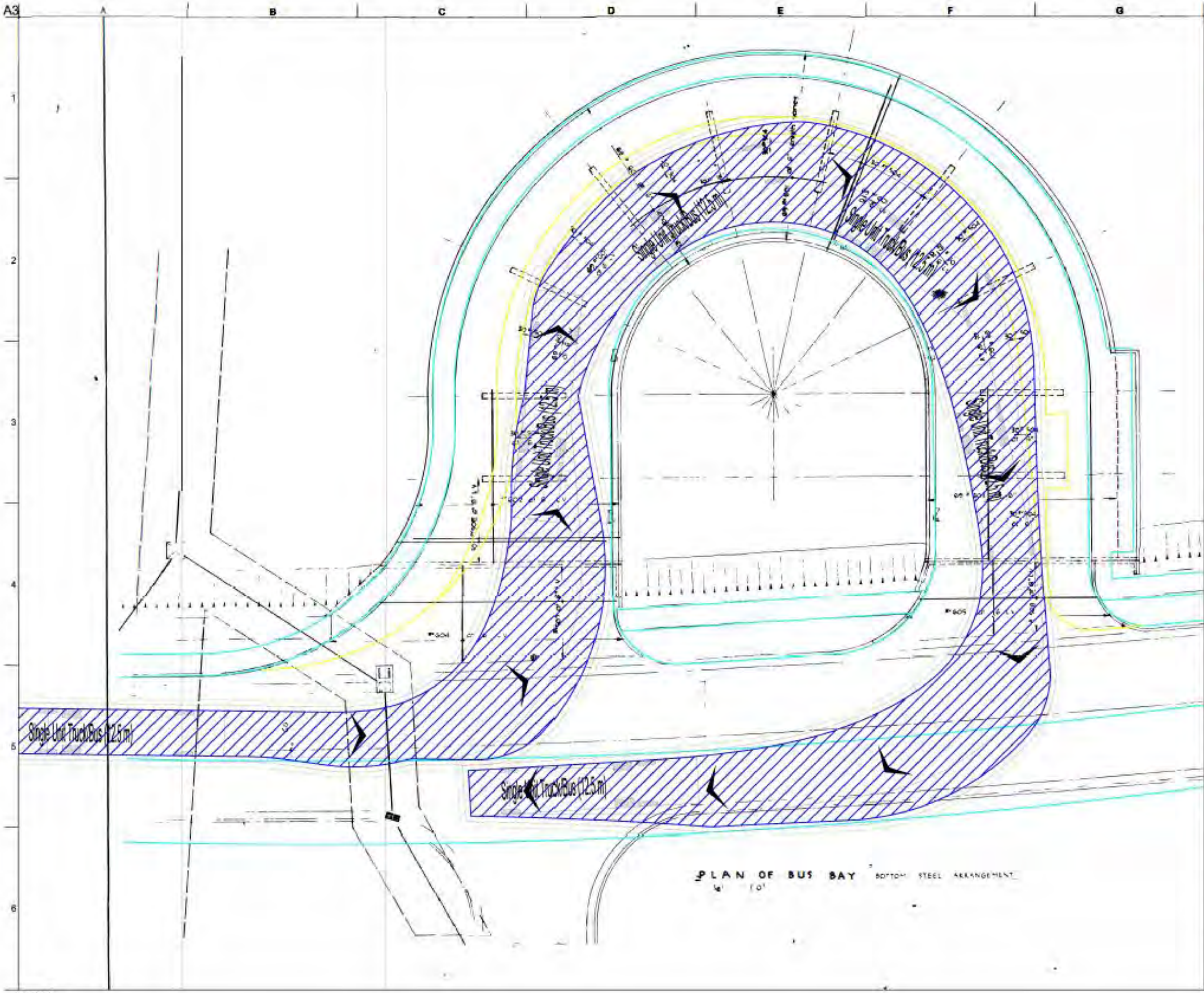
The peak pick-up period would occur between 3:00pm and 4:00pm where the last four homebases finish. The scheduled staggered start and finish times are:

- 2 homebases commence at 7:30am, finish at 2:00pm, 5 school buses
- 2 homebases commence at 8:30am, finish at 3:00pm. 6 school buses
- 2 homebases commence at 9:00am, finish at 3:30pm, 5 school buses

Buses would wait for students to arrive after school bell times, reducing the need for students to queue along the bus bay. The proposed bus schedule in Table 9 would ensure that bus arrivals are staggered and would not interfere with public bus arrival times. This would ensure that Rank 1 buses always arrive first, mitigating the need for buses to pass each other along the loop. By ensuring buses arrive before students, pedestrian queuing on the bus bay can be reduced.

Table 9: Arrival and departure times of school and public buses at Eton Road Bus Bay

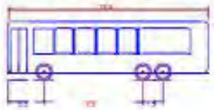
Rank 1	Bus	Arrival time	Departure time
1	565	1:54pm	1:57pm
1	565	2:21pm	2:24pm
1	Sch 1	1:55pm	2:15pm
2	Sch 2	1:55pm	2:15pm
3	Sch 3	2:00pm	2:15pm
4	Sch 4	2:00pm	2:20pm
1	Sch 5	2:15pm	2:25pm
1	565	3:01pm	3:04pm
1	Sch 6	3:05pm	3:20pm
2	Sch 7	3:10pm	3:20pm
3	Sch 8	3:10pm	3:20pm
4	Sch 9	3:15pm	3:20pm
1	565	3:26pm	3:29pm
1	Sch 10	3:30pm	3:35pm
2	Sch 11	3:30pm	3:35pm
1	Sch 12	3:35pm	3:50pm
2	Sch 13	3:35pm	3:50pm
3	Sch 14	3:38pm	3:50pm
4	Sch 15	3:38pm	3:50pm
1	Sch 16	3:50pm	3:55pm
1	565	4:01pm	4:03pm



Legend

Body Envelope	
300mm Envelope	
600mm Envelope	
Wheel Envelope	

Design Vehicle(s)



Single Unit Truck/Bus (12.5m)	
Overall Length	12.500m
Overall Width	2.500m
Overall Body Height	3.800m
Min Body Ground Clearance	0.400m
Track Width	2.500m
Lock to Lock Time	6.00 sec
Curb to Curb Turning Radius	12.500m

Issue	Date	By	Chkd	Appd
A	07/04/17	JRT	AMH	AMH
	For Information			

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Client
Design Inc.

Job Title
Lindfield Learning Village

Drawing Title
Turning Paths
12.5m buses

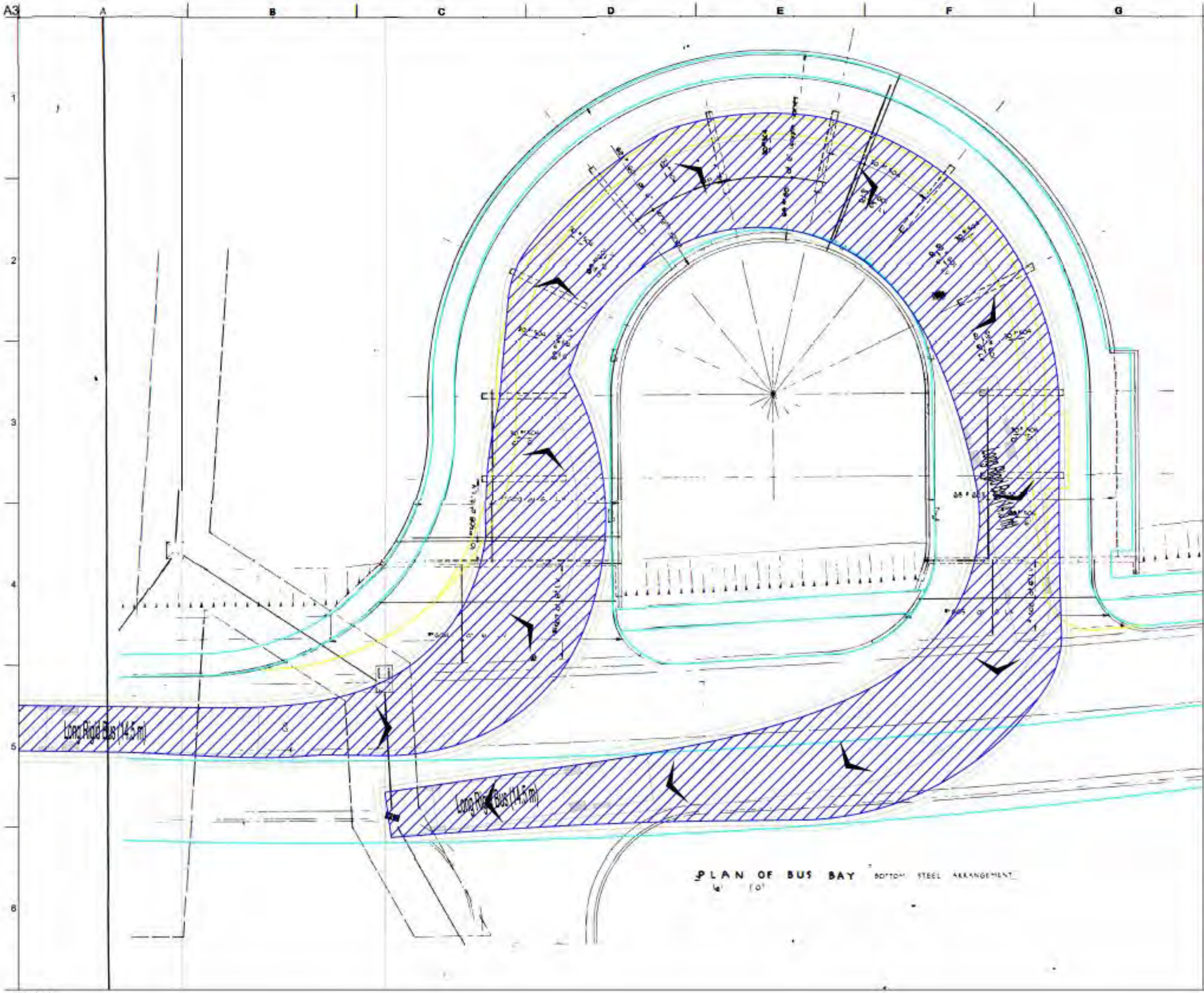
Scale at A3 1:200

Discipline Transport

Drawing Status
Draft

Job No	Drawing No	Issue
601138-00	SKT002	A

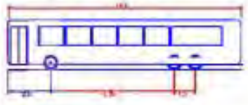
Do not scale



Legend

- Body Envelope
- 300mm Envelope
- 600mm Envelope
- Wheel Envelope

Design Vehicle(s)



Long Rigid Bus (14.5 m)	
Overall Length	14.500m
Overall Width	2.500m
Overall Body Height	3.103m
Min Body Ground Clearance	0.387m
Track Width	2.500m
Lock to Lock Time	6.00 sec
Curb to Curb Turning Radius	15.000m

Issue	Date	By	Chkd	Appd
A	07/04/17	JRT	AMH	AMH
	For Information			

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14.5m buses

Scale at A3 1:200

Discipline Transport

Drawing Status
Draft

Job No	Drawing No	Issue
601138-00	SKT003	A

Do not scale

10 Impact Assessment

10.1 Traffic distribution

The assumed traffic distribution for arrivals and departures are shown in Figure 39 and Figure 40. Vehicles are likely to avoid the north approach of Lady Game Drive / Grosvenor Road intersection due to the significant congestion experienced in the AM peak. These vehicles have been directed via Highfield Road to access via the Pacific Highway during the AM peak only.

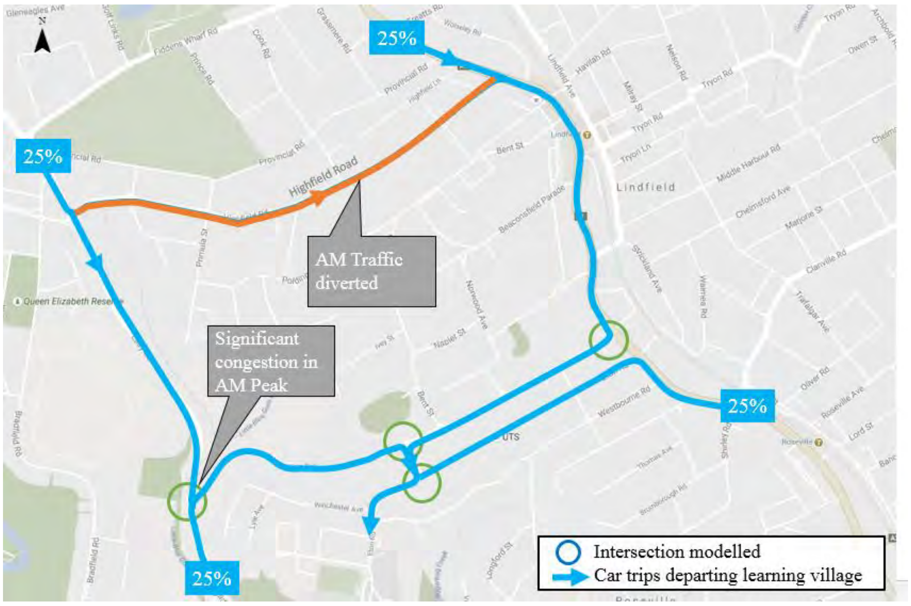


Figure 39: Car trips to the Learning Village

Figure 40: Car trips departing the Learning Village

10.2 Traffic generation

As a majority of the future enrolments would come from surrounding schools, the learning village would divert traffic along the main roads (example the Pacific Highway) rather than generate additional traffic. Traffic however, would still be generated along local roads such as Eton Road and Grosvenor Road.

The site proposes to have:

Kinder to year 12 homebases

- 2,100 students from Kinder to year 12. The students would grouped into 6 homebases which would commence at staggered times
  - 2 homebases commence at 7:30am
  - 2 homebases commence at 8:30am
  - 2 homebases commence at 9:00am
- A proportion of the students would attend extracurricular activities after finishing school, which would also be staggered.
- Approximately 160 teachers and administration staff

Other facilities

- Childcare consisting, 94 children and 12 staff
- Aurora College, 12 staff

After hour facilities for community use

- Existing Greenhalgh Auditorium, 750 seat capacity
- Existing Lecture Theatre 1,180 seat capacity
- Existing Lecture Theatre 2,100 seat capacity

Full occupancy of DHA residential buildings

The McLaren 2014 report has estimated that the full completion of the DHA sites would generate some 175 vehicles per hour. Given that the site is not fully occupied, the remaining 94 vehicles generated will be added on to the future traffic numbers and assumptions. This is based on tube count numbers discussed in section 3.7.1.

10.2.1 Traffic generation rates

With further promotion and emphasis of proposed travel strategies to the learning village, residents and staff, a higher proportion of public transport users is likely achievable.

Key assumed traffic generation rates are:

- Students: **42%** arrive by car with a car occupancy rate of 1.2 people/car
- Staff and employees: 50% arrive by car based on car spaces available

These rates are applied to the proposed number of students and staff. A traffic generation timetable can be found in Appendix A.

10.2.2 Local road impacts

In terms of the daily total traffic demand on the local roads, the learning village would perform at a similar level as during the UTS operation, shown in Figure 41. Local roads would experience a higher peak hour traffic, but lower traffic volumes during off-peak periods shown in Figure 42.

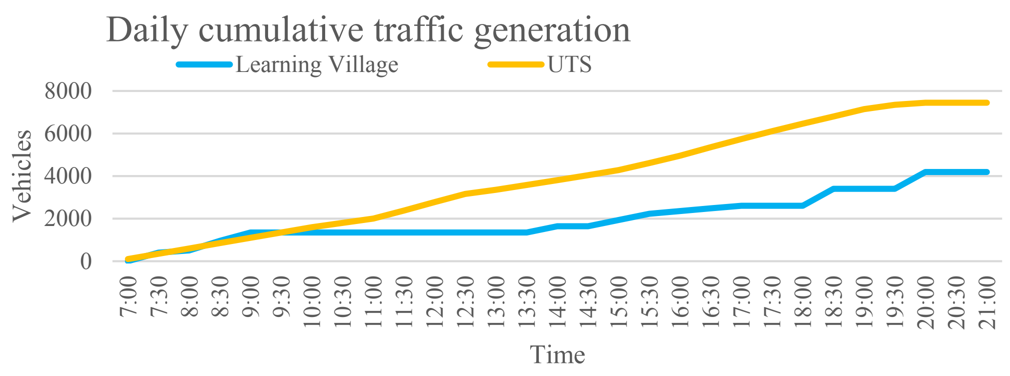


Figure 41: Cumulative traffic generated over a typical day

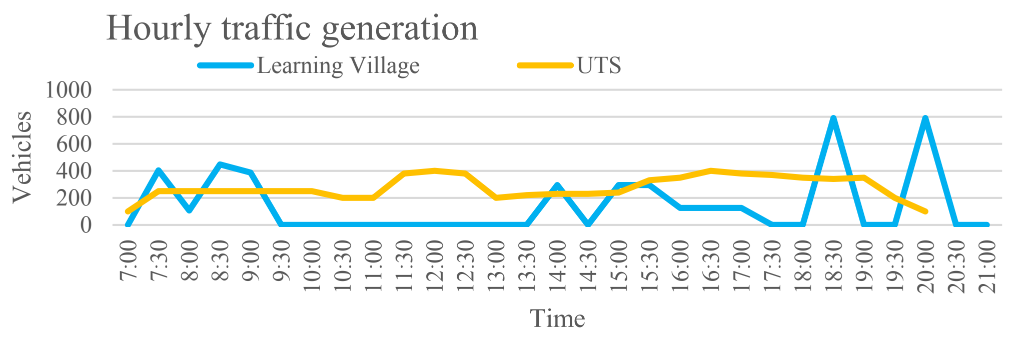


Figure 42: Hourly traffic generated

Based on the travel strategy numbers and a staggered arrival of the homebases, the busiest hourly periods are shown below in Table 10. The majority of the traffic is likely generated from the two homebases commencing at 8:30am and 9:00am which would likely result in an overlap.

Table 10: Traffic generated

Peak period	Time period	Vehicles to site	Vehicles out of site
Morning road peak	8:00am to 9:00am	482	354
Afternoon school peak	2:30pm to 3:00pm	294	294
Evening road peak	5:00pm to 6:00pm	126	126

The key morning road peak would coincide with the arrival of drop-offs to the site. Historical peak hour two way volumes, and likely future traffic generated from the site is shown in Figure 43. The figure indicates that background traffic has reduced with the closure of UTS, however a large proportion of traffic would be generated on the local and collector roads.

There is a significant two-way traffic volume of 1,000 vehicles in one hour. This comprises 354 drop-off vehicles, 128 staff arriving and existing traffic levels. This level of traffic is significantly above the environmental capacity of a local street and very busy even for a collector road function.

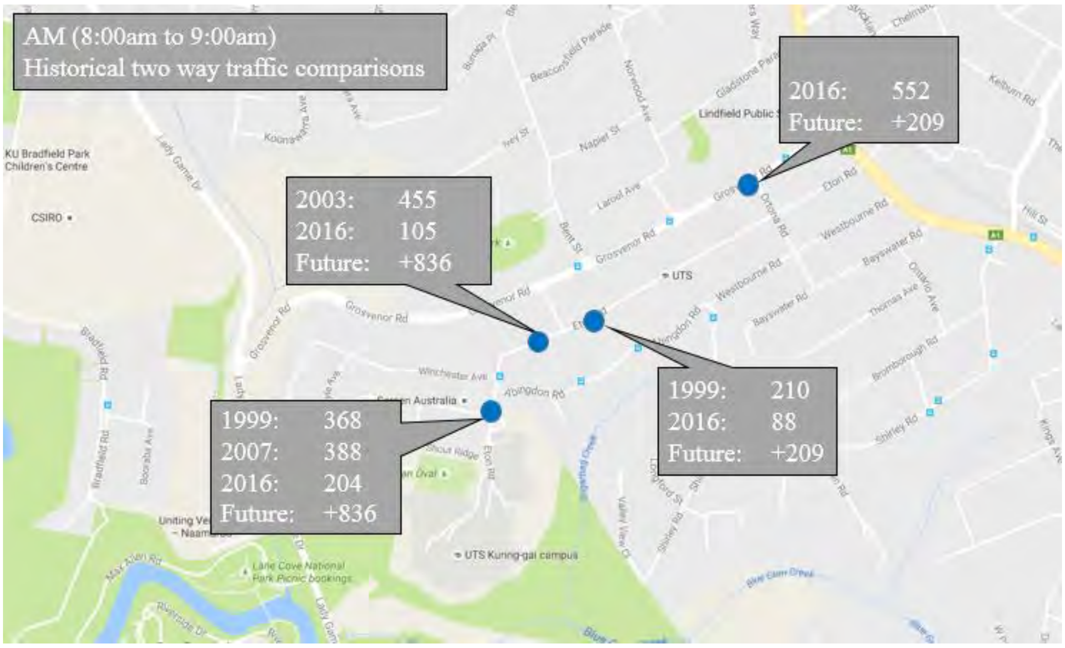


Figure 43: Historical and future traffic generated.

10.2.3 Historic Traffic Volumes - 2007

This section examines the historical traffic volumes. The average weekday two-way traffic volumes on key roads providing access to the UTS site are presented in Table 11.

Table 11 Traffic Volumes at Roads Surrounding the Development

Road	2007 Average Weekday Two-Way Traffic	Function	Desirable Maximum Daily Two-way Traffic Volume
Abingdon Road	810	Local	2,000
Austral Avenue	3,500	Local/Collector	5,000
Eton Road	3,955	Local/Collector	5,000
Grosvenor Road	7,385	Collector	10,000
Lady Game Drive	15,192	Sub-Arterial	20,000

From Table 11 the following can be said:

- 2007 traffic volumes along Eton Road and Austral Avenue were above the desirable maximum for a local road (2,000 vehicles per day). The higher flows reflect the collector road function that these roads currently perform. This is to be expected as the road provided access to both the UTS Kuring-gai and Film Australia sites as well as local residences. The desirable maximum of 2,000 vehicles per day for local roads assumes that they service residential areas only which is not the case for this area.
- Traffic volumes along Grosvenor Road are less than the desirable maximum for the collector road (10,000 vehicles per day) function that the road performs.
- Traffic volumes along Lady Game Drive are less than the desirable maximum for the Sub-arterial (20,000 vehicles per day) function that the road performs.

10.2.4 Key findings

With UTS being vacated, the existing daily two-way traffic volumes have decreased on the key roads.

Upon completion of the learning village, daily two-way traffic volumes would likely increase to a similar or lower traffic volumes given no expansion of the existing building is proposed. The key roads around the learning village would still operate within the desirable maximum daily two-way traffic volumes.

However, while the future daily desirable maximum volumes are likely to meet the criteria of each road function, the hourly peak periods would be more intense. Unlike UTS where arrivals are spread out over the day, the learning village would generate traffic during key peak hour periods. Residents along Eton Road and Grosvenor Road would inevitably experience a higher peak hour traffic volume.

11 Traffic modelling

Modelling assessment criteria

The intersections have been assessed using RMS approved software SIDRA software. The existing intersection performance is assessed in this report in terms of the following three factors for each intersection.

- Degree of Saturation
- Average Delay (Seconds per vehicle)
- Level of Service

In urban areas, the traffic capacity of the major road network is generally a function of the performance of key intersections. This performance is quantified in terms of Level of Service (LoS), is based on the average delay per vehicle. LoS ranges from A = very good to F = unsatisfactory (see Table 12).

Table 12: Level of service criteria for intersections

Level of Service	Average delay (seconds)	Description
A	Less than 14	Good operation
B	15 to 28	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Operating near capacity
E	57 to 70	At Capacity. At signals, incidents will cause excessive delays. Roundabouts require other control mode
F	Greater than 71	Unsatisfactory with excessive queuing

Another common measure of intersection performance is the degree of saturation (DoS), which provides an overall measure of the capability of the intersection to accommodate additional traffic. A DoS of 1.0 indicates that an intersection is operating at capacity. The desirable maximum degree of saturation for an intersection is 0.9.

The existing scenario SIDRA models were calibrated to match existing queue lengths observed during the site visit on 7 May 2015. These observations were made during the same periods when traffic surveys were conducted.

The following peak time periods were modelled.

Peak period	Time period
Morning road peak (AM)	8:00am to 9:00am
Afternoon school peak (SCH)	2:30pm to 3:00pm
Evening road peak (PM)	5:00pm to 6:00pm

11.1 Existing performance

The modelled results of the existing intersection performance is shown in Table 13.

The Grosvenor Road Lady / Game Drive in the AM peak intersection was found to be operating close to capacity during the AM peak as discussed in section 3.4. The north approach is experiencing significant delays

The Grosvenor Road / Pacific Highway intersection experiences a slow rolling queue southbound along the Pacific Highway. This is due to the downstream traffic in the Chatswood area. Based on video observations, dead green time, where vehicles were found to be unable to move despite a green phase, was modelled. 14 seconds was allocated to dead green time in the AM peak model.

The other scenarios modelled were found to operate efficiently at a level of service C or better.

Table 13: Existing scenario SIDRA results

Scenario	Peak	Deg. Satn	Average Delay (s)	Level of Service	95%ile q (m)	95%ile q Approach
Grosvenor Road / Lady Game Drive	AM	1.039	416	F	1,082	N
	PM	0.708	8.6	A	58	S
	SCH	0.483	6.6	A	21.8	E
Grosvenor Road / Austral Avenue	AM	0.183	6.2	A	7.3	S
	PM	0.256	6.6	A	11.7	W
	SCH	0.228	6.4	A	9.3	E
Grosvenor Road / Pacific Highway / Burleigh Street	AM	0.772	30.2	C	257.1	S
	PM	0.908	30.2	C	495.3	S
	SCH	0.972	20.9	B	289.2	S
Eton Road Austral / Avenue Existing	AM	0.053	6.0	A	1.8	N
	PM	0.099	6.1	A	2.5	N
	SCH	0.053	5.9	A	1.8	N

Note: SCH indicates school peak period

11.2 Future performance with travel strategies

This section examines the likely traffic impacts upon completion of the school. It also assumes minimal transport strategies are in place where:

- 43% of the students use private vehicles
  - 1.602 students per car
- One car per teacher

Kinder to Grade 6

The 43% student public transport mode split is based on survey findings at Lindfield Public School, discussed in section 6.1.1. This estimate is a fair estimate for the mode split of Kinder to Grade 6 students.

Year 7 to Year 12

A similar rate is used for future high school students of the learning village. This is considered a conservative estimate given that high school students are more likely to take public transport, based on Killara High School surveys, which observed an efficient use of the school bus system.

These conservative assumptions are for modelling purposes only. It is likely that a well-planned fleet of school buses, with a similar operating scheme to Killara High School, would yield a similarly high public transport usage for high school students. Killara High School has achieved an approximate 75% mode share for students using school buses.

Traffic assignment

Traffic distribution assumptions (section 7.1) and traffic generation rates (section 7.2) were used to model the likely impacts of the completion of the learning village. Traffic generated is added on to existing traffic numbers based on the direction of entry.

The learning village would reduce the existing strain on surrounding schools which are currently facing a high demand of new enrolments.

Existing traffic from student drop-offs, from other schools, would therefore be diverted rather than added to the existing traffic numbers. While the right turning vehicles and left turning vehicles from the Pacific Highway into Grosvenor Road would increase, through movements along the Pacific Highway would likely decrease as a result of these diversions.

As a general traffic modelling assumption, 50% of the generated traffic would be diverted from through movements along the Pacific Highway, shown in Figure 44.

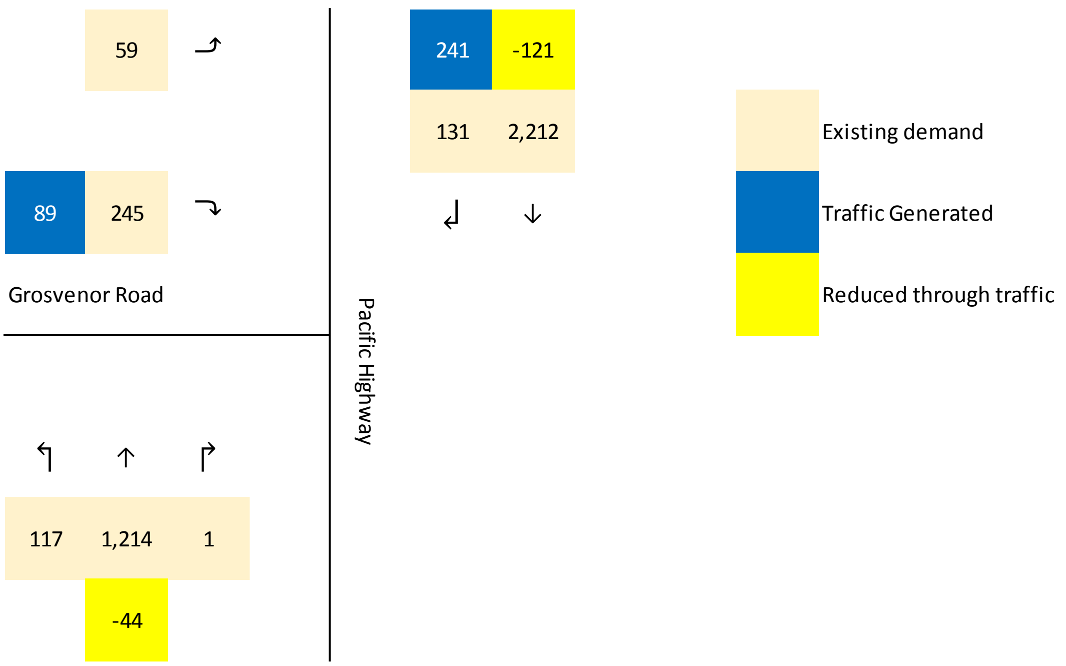


Figure 44: AM peak diverted traffic along Pacific Highway

11.2.1 Do-nothing results

The results in Table 14 indicate that upon completion of the learning village, the Grosvenor Road / Pacific Highway intersection is likely to perform at unsatisfactory levels during the AM. The right turns from the Pacific Highway into Grosvenor Road and the west approach from Grosvenor Road are predicted to perform poorly, especially in the AM peak. Right turn bay queue lengths from the north approach of Pacific Highway into Grosvenor Road is predicted to be 337 metres (current capacity of 70 metres).

This is due to the traffic from the northwest avoiding the Grosvenor Road / Lady Game drive roundabout, and being diverted to the Pacific Highway southbound direction.

The other intersections are predicted to continue to operate at an efficient level of service, with exception to Grosvenor Road / Lady Game Drive roundabout, which remains at capacity during the AM peak.

Table 14: Future scenario, with travel strategies, SIDRA results

Scenario	Peak	Deg. Satn	Average Delay (s)	Level of Service	95%ile q (m)	95%ile q Approach
Grosvenor Road / Lady Game Drive	AM	1.039	416	F	1,082	N
	PM	0.939	21.2	B	160.3	S
	SCH	1.015	30.6	C	293.2	E
Grosvenor Road / Austral Avenue	AM	0.834	11.2	A	107.3	S
	PM	0.456	6.3	A	25	W
	SCH	0.799	9.5	A	90.4	E
Grosvenor Road / Pacific Highway / Burleigh Street	AM	1.020	77.4	F	608	S
	PM	0.944	39.8	C	596.0	S
	SCH	0.969	53.4	D	585.1	S
Eton Road Austral / Avenue Existing	AM	0.158	2.6	A	3.5	N
	PM	0.104	3.6	A	2.6	N
	SCH	0.136	2.8	A	3.1	N

11.2.2 Suggested upgrades on the Pacific Highway

The intersection would require an extended right turn bay from the Pacific Highway into Grosvenor Road. This requires a short section of northbound kerbside lane to be removed on the western side of the Pacific Highway. No additional northbound lanes would be required. This will need to be considered in consultation with the Roads and Maritime Services.

The proposed upgrades are shown below with a schematic illustration shown in Figure 47.

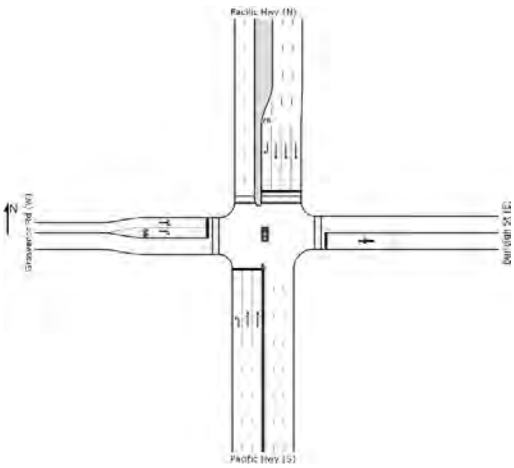
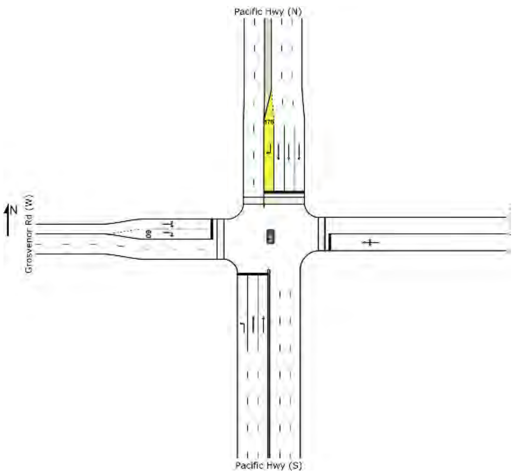
<table>
<tr><th>Existing geometry</th><th>Upgraded geometry</th></tr>
<tr><td>
Figure 45: Existing</td><td>

Figure 46: Possible upgrades</td></tr>
<tr><td>• Single right turn bay into Grosvenor Road
• Left turns out of Grosvenor Road during Pacific Highway right turn phase are not allowed</td><td>• Extending the right turn bay on the north approach to approximately 170 metres.
• Modify phasing to allow left turns out of Grosvenor Road during Pacific Highway right turn phase</td></tr>
</table>

Figure 47: Schematic of proposed upgrades

11.2.3 Upgrade results

Extending the north approach right turn bay to 170 metres at the Grosvenor Road / Pacific Highway / Burleigh Street intersection would improve the overall performance of the intersection to a level of service C during the AM peak. The model predicts a 95%ile queue length of 200 metres along the right turn bay. Queuing past the right turn bay is therefore likely to happen only periodically over the hour.

Table 15: Future scenario, travel strategies, with right turn bay extensions, SIDRA results

Scenario	Peak	Deg. Satn	Average Delay (s)	Level of Service	95%ile q (m)	95%ile q Approach
Grosvenor Road / Pacific Highway / Burleigh Street	AM	0.856	37.7	C	336.4	S
	PM	0.885	26.8	B	457.1	S
	SCH	0.851	27.3	B	362.5	S

11.2.4 No Staggered start times

A worst case scenario model has been developed to observe the effects of no staggered start times. This assumes all six home bases would arrive and leave at the same school peak times. Modelling results show that the Grosvenor Road / Pacific Highway / Burleigh Street intersection would perform at a level of service E. The model predicts a 95%ile queue length of 346 metres along the right turn bay, from the north approach.

Table 16: No staggered start times scenario, travel strategies, with right turn bay extensions, SIDRA results

Scenario	Peak	Deg. Satn	Average Delay (s)	Level of Service	95%ile q (m)	95%ile q Approach
Grosvenor Road / Pacific Highway / Burleigh Street	AM	0.973	61.9	E	520.4	S
	PM	0.898	29.3	C	484.8	S
	SCH	0.854	30.1	C	390.9	S

11.3 Key findings

Key findings of the modelling are summarised below:

- The intersection most affected by the learning village would be the Grosvenor Road / Pacific Highway during the AM peak, due to the high right turn demands upon completion of the site.
- Three scenarios have been modelled for each peak period
  - Existing
  - Future, travel strategies 43% of the students and 50% of staff take public transport
  - Road upgrades, an extension of the north approach right turn bay to 170 metres
  - No staggered start times with upgrades
- Modelling results show that travel strategies result in the intersection performing at a level of service F with delays of 77 seconds delay at the Grosvenor Road / Pacific Highway
- Extending the right turn bay along the Pacific Highway into Grosvenor Road would improve the performance of the intersection to a level of service C or better.
- The intersection would not operate efficiently even with upgrades, should staggered start times not be implemented.

The implementation and promotion of the proposed strategies and staggered start times are therefore paramount in enabling the transport functionality of the Lindfield Learning Village. Upgrades of the Grosvenor Road / Pacific Highway would still be required regardless of the effectiveness of the travel strategies implemented.

12 Interaction with Lindfield Public School

Arup conducted site visits on Wednesday 7 December 2016 to assess the existing drop-off and pick-up conditions, in order to anticipate any potential cumulative impacts both schools might have on the surrounding network.

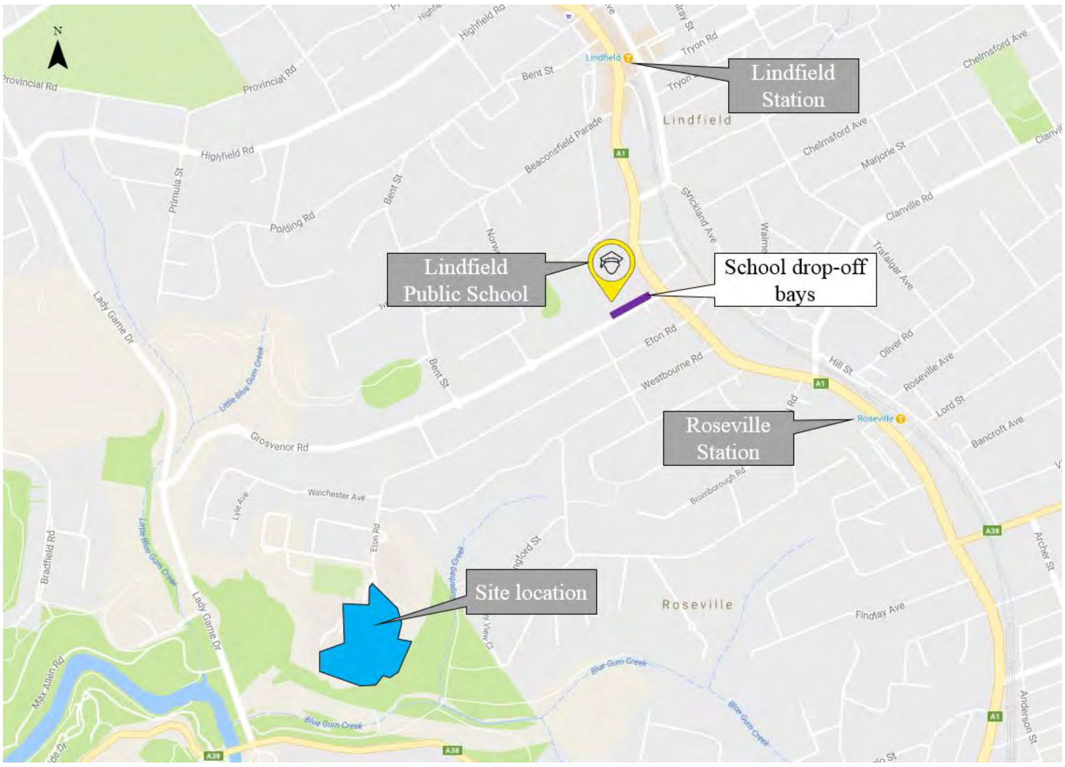


Figure 48: Location of Lindfield Public School in relation to the site

12.1 Existing drop-off periods

Surveys were carried out from 8:00am to 9:00am. Observations of the road performance in the area are detailed in Table 17.

Table 17: Observations at the Lindfield Public School drop-off area

Table colour	
8:00am to 8:15am	Drop-off bays are not utilised. Grosvenor Road experiences minimal congestion and queuing.
8:15am to 8:30am	Drop-off bays are not utilised, however traffic volumes increase slightly along Grosvenor Road. Grosvenor Road experiences minimal congestion and queuing. The intersection continues to perform efficiently.
8:30am to 8:45am	Up to three drop-off bays were utilised during this period. A traffic crossing warden is also present from 8:30am onwards at the zebra crossing along Grosvenor Road. Queuing of eastbound vehicles is observed due to vehicles giving way at the zebra crossing. No significant queues were observed at the intersection.
8:45am to 9:00am	This is the busiest drop-off period. Drop-off bays are fully utilised with a high turnover and operate efficiently. Eastbound queue lengths from the zebra crossing were found to propagate to the Lumeah Road / Grosvenor Road roundabout, periodically. Minimal queuing and congestion however was observed at the Pacific Highway / Grosvenor Road intersection.

Photo 17: 8:10am, facing east

Photo 18: 8:30am, facing east

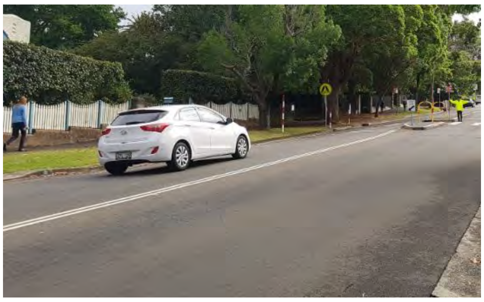


Photo 19: 8:51am facing east

Photo 20: 8:55am facing west, queue caused by zebra crossing

12.2 Interaction with the site

Drop-off period

The busiest period of the Lindfield Public School occurs at 8:45am to 9:00am, the site has homebases commencing at 7:30am, 8:30am and 9:00am would result in cumulative traffic generated from both schools. Grosvenor Road likely to experience an increase in traffic, with the profile shown in Figure 49. These numbers are based on a 43% car mode share with 1.602 students per car.

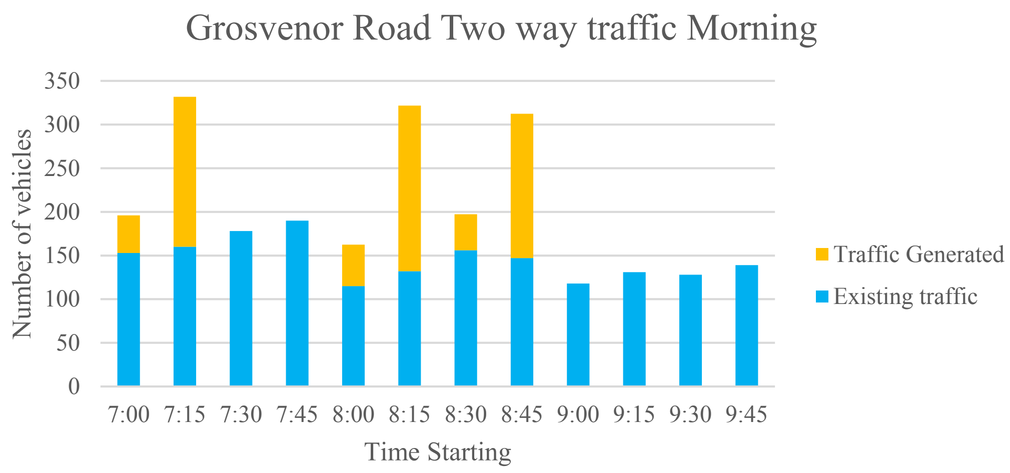


Figure 49: Two way traffic flows along Grosvenor Road

Pick-up period

Pick-up periods have a more scattered profile in terms of traffic generated due to a proportion of students staying after school for extracurricular activities. The cumulative traffic impacts of both schools, illustrated in Figure 39 would not be as significant as during the drop-off periods.

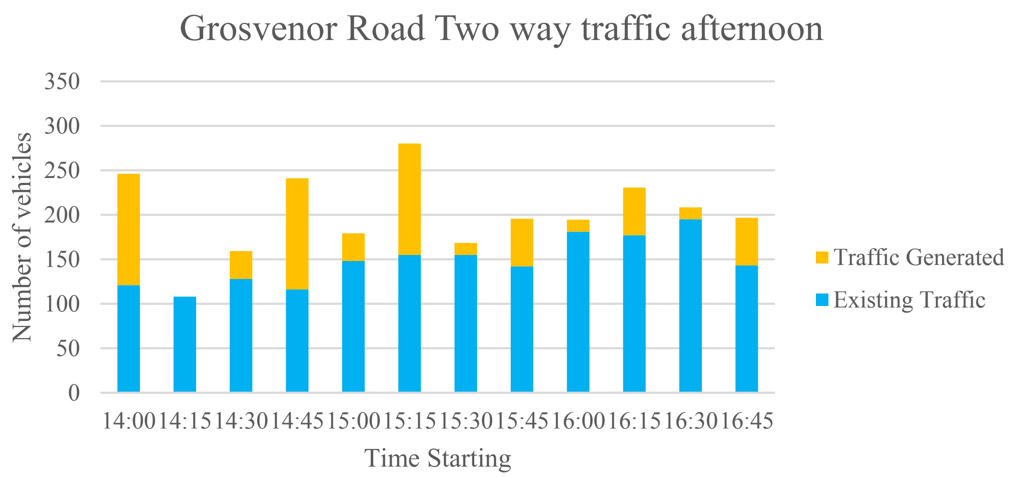


Figure 50: Two way traffic flows along Grosvenor Road

12.3 Queuing issues

The busiest period at the Lindfield Public School is during the drop-off period, from 8:45am to 9:00am. This period is likely to coincide with the homebase of the learning village which commences at 9:00am.

During this period, it is expected that approximately 25% of the traffic from one homebase would leave and enter via Grosvenor Road (refer to traffic distribution diagram in section 10.1). This equates to 50 cars entering and leaving, based on a 42% driver rate

Existing eastbound queue lengths along Grosvenor Road, from the zebra crossing were found to propagate to the Lumeah Road / Grosvenor Road roundabout, periodically. This is caused by the zebra crossing in facilitating students to cross Grosvenor Road to Lindfield Public School. Minimal queuing and congestion however was observed at the Pacific Highway / Grosvenor Road intersection.

With the opening of the learning village, the queue lengths are likely to be exacerbated. As a worst case scenario, an additional 50 cars during the peak 15 minute period would cause a queue length to Austral Avenue / Grosvenor Road roundabout. This however would only occur periodically and would clear once the zebra crossing is no longer in effect (typically at 9am).

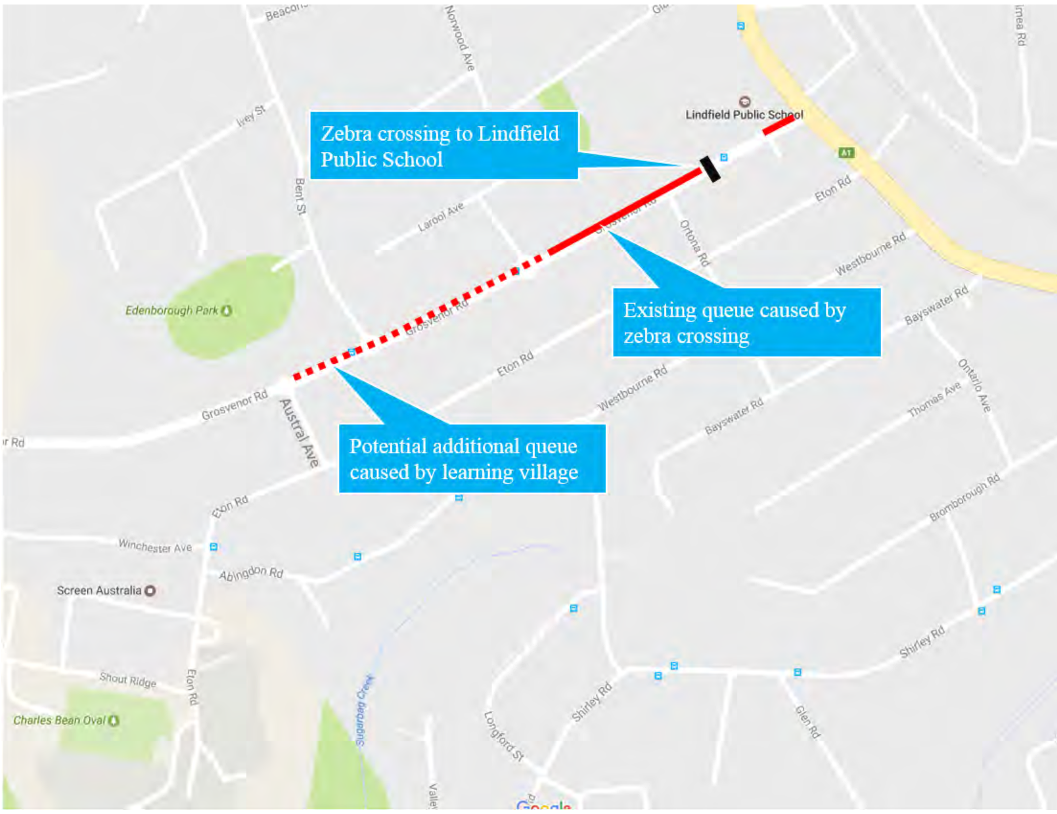


Figure 51: Existing and potential queuing effects in the future

13 Outline Construction Traffic Management Plan (CTMP)

Minor construction works are proposed at the premise, where a turning circle would be constructed (section 5.2). Disruption to all road users during the construction period would be kept to a minimum.

13.1 Construction Activity

The key building works proposed involve demolition of internal fixtures and rebuilding of internal fixtures to the new room layouts. No major external building works are proposed. There are also minor civil works proposed on the internal road system and associated footpaths.

The level of construction traffic will be low with up to 2 trucks per hour expected at busy times for removal of demolished materials and delivery of new building materials. Construction workers will arrive at the start of the shift and park in available parking areas within the site.

- The Contractor's compound will be set up within the existing building.
- The upper car park will be available for site drop off, loading and deliveries.
- The lower car park will be available for Contractors onsite parking

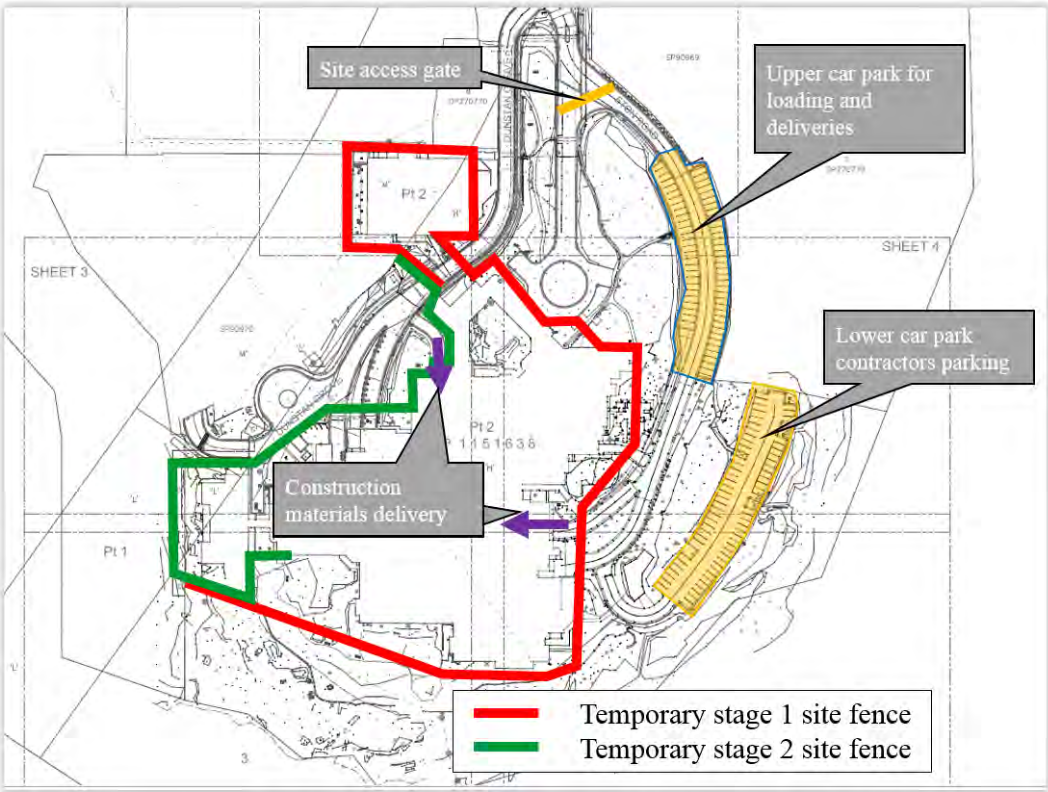


Figure 52: Construction activity plan

13.2 Access:

Site Access: Vehicular Access to and from the site shall be from Eton Road. The site access gate will be set up at Eton Road southern end where the junction forks to the lower car park. Access to Dunstan Grove and Shout Ridge Road shall be unaffected.

Road Access: The main arterial road to the North East of the site is the Pacific Highway and to the South West is Lady Game Drive, with Grosvenor Road used as the main link road between the two, illustrated in Figure 53.

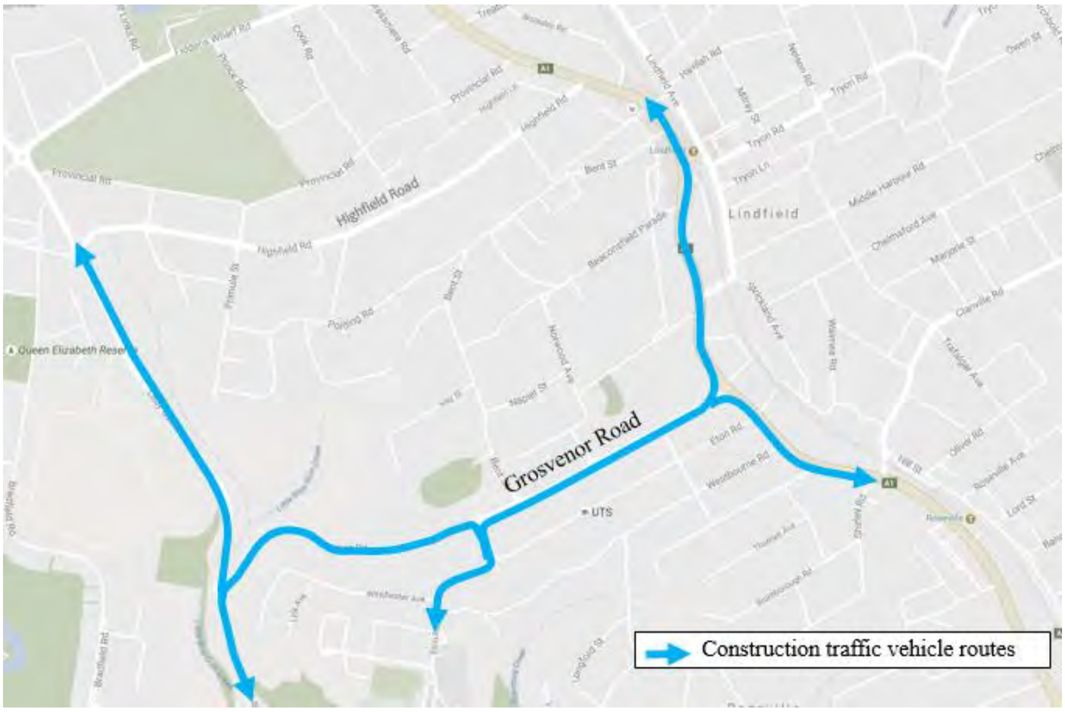


Figure 53: Construction traffic vehicle routes

13.3 Traffic Management

Key traffic management principles include:

- Local Impact: The site is accessed by the existing road network and no significant impact to the local traffic or the local environment is envisaged.
- Traffic Control: Disruption to all road users during the construction period would be kept to a minimum.

13.4 Proposed Working Hours

Depending on the construction stage, the workforce which includes both construction and design personnel, will vary. Construction would be undertaken during standard working hours which are assumed to be as follows:

- Monday to Friday: between 7am-6pm.
- Saturday: between 8am-1pm.
- Sunday and public holidays: no work.

In some cases, it may be necessary to undertake night works to minimise disruption to traffic. Further assessments of these requirements would be undertaken once the detailed design stage is undertaken and the requirements are known. All night works would be undertaken in accordance with the Roads and Maritime Services Environmental Noise Management Manual (RTA 2001): Practice Note vii – Road works outside normal working hours, as well as the Office of Environment and Heritage Interim Construction Noise Guideline (DECC 2009).

Prior notice would be given to the community if any works are planned to be undertaken outside normal construction hours.

14 Conclusion

A traffic and transport assessment has been carried out for the proposed Lindfield Learning Village, which would consist of some 2,100 students and 160 teaching staff. The learning village would reduce the existing strain on schools which are currently facing a high demand of new enrolments. It would also provide community facilities to the public, such as auditoriums and gyms.

Residents along Eton Road and Grosvenor Road would inevitably experience a higher peak hour traffic volume. However, the daily road volumes are expected to be similar during the operational period of the UTS campus.

A public school is a community facility. It provides a real benefit to the community it serves and it is expected that some burden will be placed on the community to support its operation.

Alternative travel strategies as opposed to private vehicle usage, and the improvement of the surrounding infrastructure, would alleviate the traffic generated by the learning village to a manageable level. It is within the interest of the learning village and stakeholders that these travel strategies be implemented and promoted.

A staged opening of the proposed school is essential to reasonably allow for traffic impact monitoring and review of final operating scale.

Existing infrastructure

- The site is has poor pedestrian accessibility, with several footpaths and key crossing facilities missing. A comprehensive Pedestrian Accessibility Mobility Plan (PAMP) should be carried out to assess the required pedestrian safety improvements. Missing footpath and pedestrian crossing links should be addressed to encourage walking and improve safety of pedestrians, before the opening of the learning village.
- Proposed drop-off and parking arrangements have been discussed
- An appropriate school bus route should be developed with consultation of TfNSW, bus companies, and surrounding schools.

Parking

- On-site parking meets the KDCP requirements, with exception to teacher and year 12 student parking requirements. Alternative transport strategies would reduce the number of vehicles driving to the learning village.
- As a conservative estimate, some on 50 staff and 66 students parking on-street, would equate to 36% of the 319 available on-street parking spaces being occupied by the learning village (within a 500 metre catchment). On-street parking utilisation would likely be lower than when the UTS campus was operational.
- During the operation of the after hour facilities, with 184 parking spaces on-site, this would result in overflow to local streets of over 100 cars. With more

on-street parking being available after-hours, these 100 cars would be accommodated on-street effectively.

- After hours parking demand to the Greenhalgh Auditorium can be mitigated through several measure such as providing a shuttle bus during operational hours or restricting the maximum patronage.

Travel strategies

- A list of travel strategies, as an alternative to private vehicle usage have been proposed. Given that the site will be used by students and teachers in a new location, sustainable travel alternatives would be more easily implemented as well as adopted.
- Case studies of three different schools near the learning village have been examined. Case studies provided information such as travel behaviour and car occupancy rates.
- In particular, Killara High School is exemplary in showing that students can use sustainable travel alternatives such as school buses, walking and public transport. Surveys have recorded that some 75% of the students in Killara High School get picked-up by a school bus.
- Certain transport strategies may be implemented in conjunction with Lindfield Public School and private residential developments within the proximity of the learning village, benefiting the wider community.

Traffic impacts

- Modelling results show that favourable travel strategies result in the intersection performing at a level of service F with delays of 77 seconds delay at the Grosvenor Road / Pacific Highway
- Extending the right turn bay along the Pacific Highway into Grosvenor Road would improve the performance of the intersection to a level of service C or better.
- The busiest period at the Lindfield Public School is during the drop-off period, from 8:45am to 9:00am. With the opening of the Learning Village, the queue lengths are likely to be exacerbated. As a worst case scenario, an additional 50 cars during the peak 15 minute period would cause a queue length to Austral Avenue / Grosvenor Road roundabout. This however would only occur periodically and would clear once the zebra crossing is no longer in effect (typically at 9am).

The implementation and promotion of the proposed strategies are therefore paramount in enabling the transport functionality of the Lindfield Learning Village. Upgrades of the Grosvenor Road / Pacific Highway would still be required regardless of the effectiveness of the travel strategies implemented.

Appendix A

Arrival and departure timetables to the learning village

A1 Arrival timetable, trip generation

Arrivals											AM													School			PM				After Hours			After Hours Departure		
School use	**No. of people**	**Arrival time**	**Proportion of people who arrive by car**	**Number of people who arrive by car**	**Car occupancy**	**Car Trips generated**	**Trips generated after Travel initiatives**	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00
K to 12 students Family Group 1	700	7:30am	43%	304	1.602	190			190													133				57										
K to 12 students Family Group 2	700	8:30am	43%	304	1.602	190					190													133			57									
K to 12 students Family Group 3	700	9:00am	43%	304	1.602	190						190													133			57								
Teachers Group 1	100	7:00am	100%	100	1	100			100													70				30										
Teachers Group 2	100	8:00am	100%	100	1	100					100													70			30									
Teachers Group 3	100	8:30am	100%	100	1	100						100													70			30								
Childcare	94	8:00am	70%	64	1.2	54				54																										
Childcare staff	12	7:30am	70%	8	1	8			8																											
Macquarie Park admin	70	8:30am	70%	49	1	49					49																									
Aurora College staff and visitors	17	8:30am	70%	12	1	12					12																									
Greenhalgh Auditorium	750	6:30pm	70%	525	1	525																									525					
Lecture theatres	280	6:30pm	70%	196	1	196																									196					
Gymnasium After hours external use	100	6:30pm	70%	70	1	70																									70					
											641													**406**			**174**			134						

A2 Departure timetable, trip generation

Departures											AM													School			PM				After Hours			After Hours Departure		
School use	**No. of people**	**Arrival time**	**Proportion of people who arrive by car**	**Number of people who arrive by car**	**Car occupancy**	**Car Trips generated**	**Trips generated after Travel initiatives**	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00
K to 12 students Family Group 1	700	7:30am	43%	304	1.602	190			190													133				57										
K to 12 students Family Group 2	700	8:30am	43%	304	1.602	190					190													133			57									
K to 12 students Family Group 3	700	9:00am	43%	304	1.602	190						190													133			57								
Teachers Group 1	100	7:00am	100%	100	1	100																70				30										
Teachers Group 2	100	8:00am	100%	100	1	100																		70			30									
Teachers Group 3	100	8:30am	100%	100	1	100																			70			30								
Childcare	94	8:00am	70%	64	1.2	54				54																										
Childcare staff	12	7:30am	70%	8	1	8			8																											
Macquarie Park admin	70	8:30am	70%	49	1	49																														
Aurora College staff and visitors	17	8:30am	70%	12	1	12																														
Greenhalgh Auditorium	750	6:30pm	70%	525	1	525																												525		
Lecture theatres	280	6:30pm	70%	196	1	196																												196		
Gymnasium After hours external use	100	6:30pm	70%	70	1	70																												70		
											380													**406**			**174**			134						

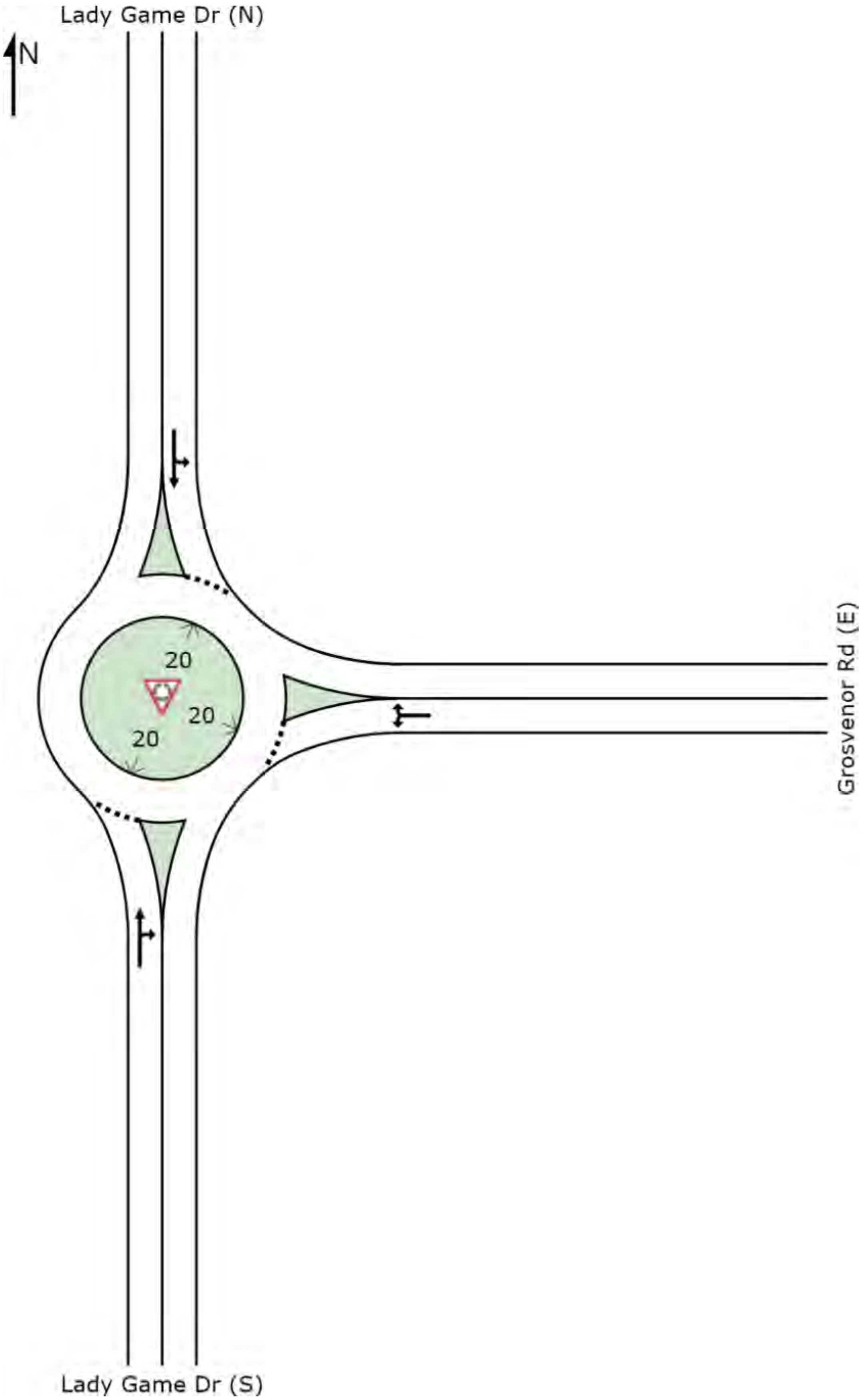
Appendix B

SIDRA Results

SITE LAYOUT

Site: 01_Grosvenor Road_Lady Game Drive Existing AM

New Site
Roundabout



LANE SUMMARY

Site: 01_Grosvenor Road_Lady Game Drive Existing AM

New Site
Roundabout

Lane Use and Performance	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Lady Game Dr (S)													
Lane 1[d]	173	0.8	1175	0.147	100	6.7	LOS A	0.9	6.0	Full	500	0.0	0.0
Approach	173	0.8		0.147		6.7	LOS A	0.9	6.0				
East: Grosvenor Rd (E)													
Lane 1[d]	321	0.8	991	0.324	100	6.7	LOS A	2.3	16.1	Full	500	0.0	0.0
Approach	321	0.8		0.324		6.7	LOS A	2.3	16.1				
North: Lady Game Dr (N)													
Lane 1[d]	449	0.8	432	1.039	100	416.3	LOS F	153.5	1082.2	Full	500	-32.5	37.5
Approach	449	0.8		1.039		416.3	LOS F	153.5	1082.2				
Intersection	943	0.8		1.039		201.7	LOS F	153.5	1082.2				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 01_Grosvenor Road_Lady Game Drive Existing PM

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Lady Game Dr (S)													
Lane 1 [d]	812	0.1	1147	0.708	100	8.6	LOS A	8.3	58.0	Full	500	0.0	0.0
Approach	812	0.1		0.708		8.6	LOS A	8.3	58.0				
East: Grosvenor Rd (E)													
Lane 1 [d]	323	0.1	1261	0.256	100	7.0	LOS A	1.7	11.8	Full	500	0.0	0.0
Approach	323	0.1		0.256		7.0	LOS A	1.7	11.8				
North: Lady Game Dr (N)													
Lane 1 [d]	318	0.1	541	0.587	100	8.6	LOS A	4.4	30.9	Full	500	0.0	0.0
Approach	318	0.1		0.587		8.6	LOS A	4.4	30.9				
Intersection	1453	0.1		0.708		8.2	LOS A	8.3	58.0				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 01_Grosvenor Road_Lady Game Drive Existing School

New Site
Roundabout

Lane Use and Performance	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Lady Game Dr (S)													
Lane 1[d]	413	1.9	1130	0.365	100	6.3	LOS A	2.4	17.4	Full	500	0.0	0.0
Approach	413	1.9		0.365		6.3	LOS A	2.4	17.4				
East: Grosvenor Rd (E)													
Lane 1[d]	349	1.9	1198	0.291	100	6.6	LOS A	1.8	13.1	Full	500	0.0	0.0
Approach	349	1.9		0.291		6.6	LOS A	1.8	13.1				
North: Lady Game Dr (N)													
Lane 1[d]	308	1.9	638	0.483	100	5.6	LOS A	3.1	21.8	Full	500	0.0	0.0
Approach	308	1.9		0.483		5.6	LOS A	3.1	21.8				
Intersection	1070	1.9		0.483		6.2	LOS A	3.1	21.8				

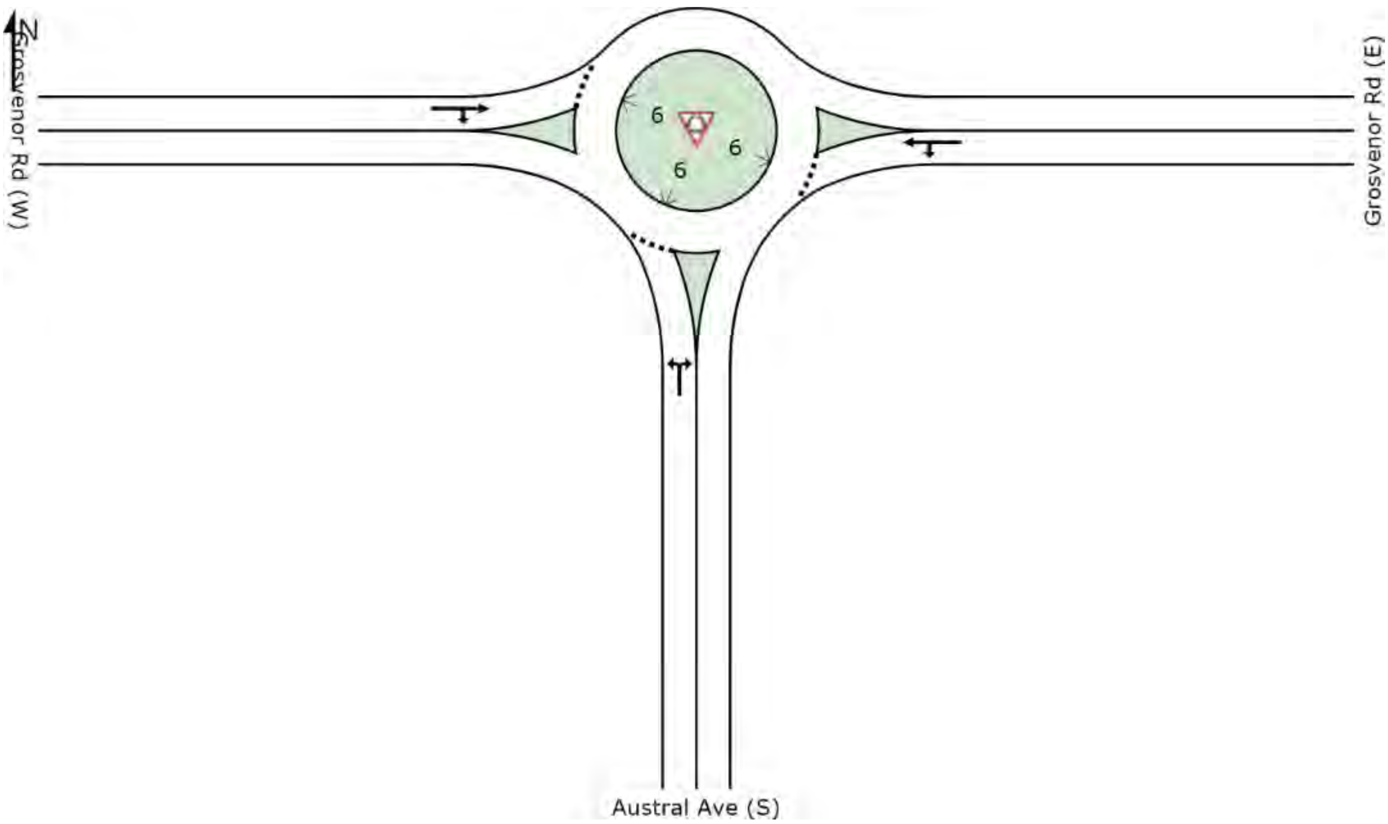
Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SITE LAYOUT

Site: 02_Grosvenor Road_Austral Avenue Existing AM

Roundabout



LANE SUMMARY

Site: 02_Grosvenor Road_Austral Avenue Existing AM

Roundabout

Lane Use and Performance														
	Demand Flows		Cap.	Deg.	Lane	Average	Level of	95% Back of Queue		Lane	Lane	Cap.	Prob.
	Total	HV		Satn	Util.	Delay	Service	Veh	Dist	Config	Length	Adj.	Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Austral Ave (S)													
Lane 1[d]	141	1.1	1046	0.135	100	6.2	LOS A	0.7	4.9	Full	100	0.0	0.0
Approach	141	1.1		0.135		6.2	LOS A	0.7	4.9				
East: Grosvenor Rd (E)													
Lane 1[d]	262	1.1	1416	0.185	100	3.9	LOS A	1.0	7.3	Full	500	0.0	0.0
Approach	262	1.1		0.185		3.9	LOS A	1.0	7.3				
West: Grosvenor Rd (W)													
Lane 1[d]	218	1.1	1336	0.163	100	4.4	LOS A	0.9	6.6	Full	500	0.0	0.0
Approach	218	1.1		0.163		4.4	LOS A	0.9	6.6				
Intersection	621	1.1		0.185		4.6	LOS A	1.0	7.3				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 02_Grosvenor Road_Austral Avenue Existing PM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Austral Ave (S)													
Lane 1[d]	108	0.8	987	0.109	100	6.6	LOS A	0.6	4.0	Full	100	0.0	0.0
Approach	108	0.8		0.109		6.6	LOS A	0.6	4.0				
East: Grosvenor Rd (E)													
Lane 1[d]	329	0.8	1310	0.251	100	4.2	LOS A	1.5	10.4	Full	500	0.0	0.0
Approach	329	0.8		0.251		4.2	LOS A	1.5	10.4				
West: Grosvenor Rd (W)													
Lane 1[d]	361	0.8	1410	0.256	100	4.5	LOS A	1.7	11.7	Full	500	0.0	0.0
Approach	361	0.8		0.256		4.5	LOS A	1.7	11.7				
Intersection	798	0.8		0.256		4.7	LOS A	1.7	11.7				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

Organisation: ARUP PTY LTD | Processed: Friday, 4 November 2016 3:33:38 PM
Project: \\global.arup.com\australasia\SYD\Projects\251000\251272-00 Lindfield Learning Traffic\Work\Internal\01 Analysis\03 SIDRA\Existing_2016.sip6

LANE SUMMARY

Site: 02_Grosvenor Road_Austral Avenue Existing School

Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Austral Ave (S)													
Lane 1[d]	119	2.8	976	0.122	100	6.4	LOS A	0.6	4.5	Full	100	0.0	0.0
Approach	119	2.8		0.122		6.4	LOS A	0.6	4.5				
East: Grosvenor Rd (E)													
Lane 1[d]	316	2.8	1385	0.228	100	4.0	LOS A	1.3	9.3	Full	500	0.0	0.0
Approach	316	2.8		0.228		4.0	LOS A	1.3	9.3				
West: Grosvenor Rd (W)													
Lane 1[d]	226	2.8	1400	0.161	100	4.4	LOS A	1.0	6.8	Full	500	0.0	0.0
Approach	226	2.8		0.161		4.4	LOS A	1.0	6.8				
Intersection	661	2.8		0.228		4.6	LOS A	1.3	9.3				

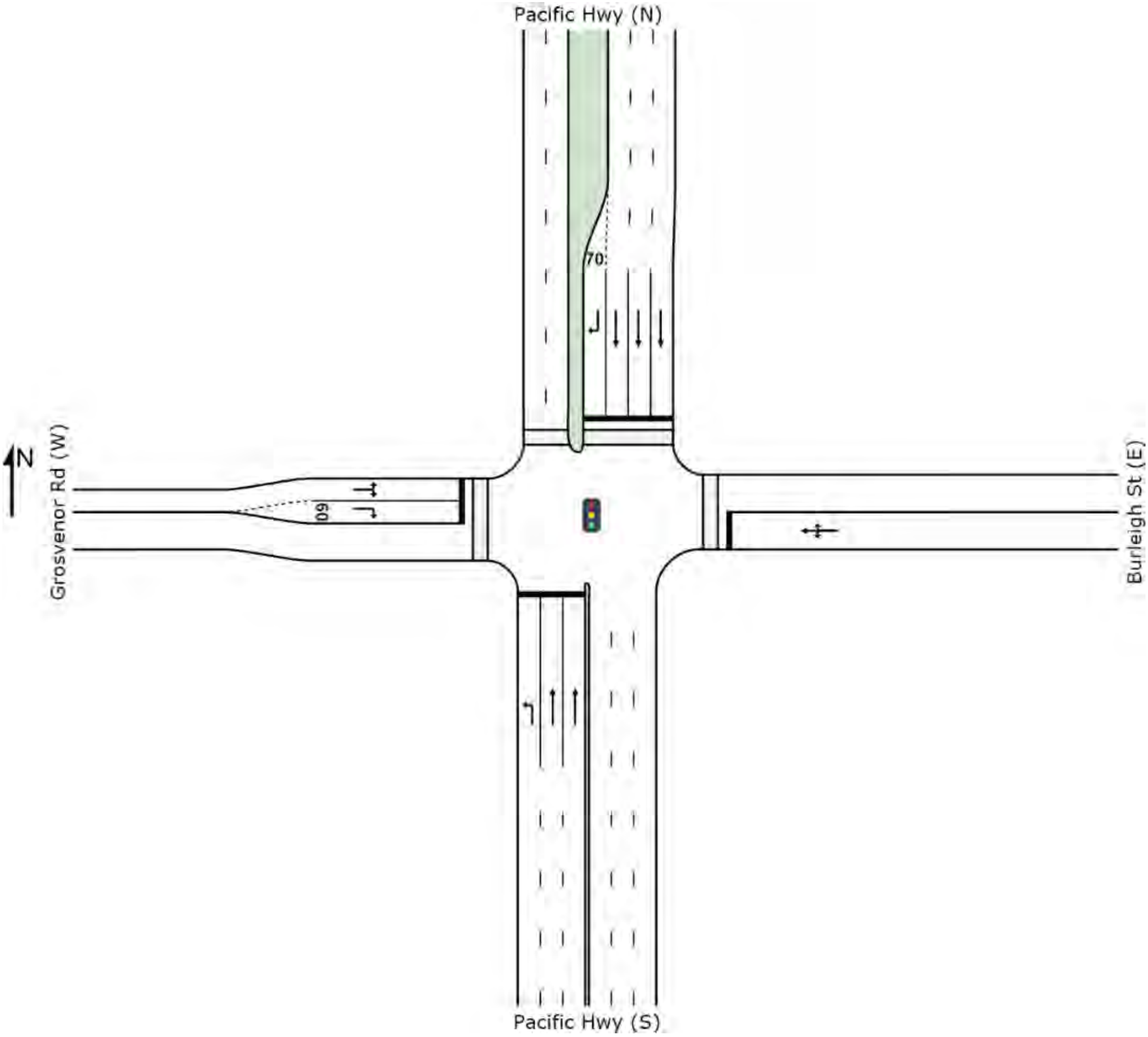
Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SITE LAYOUT

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Existing AM

Signals - Fixed Time Isolated



PHASING SUMMARY

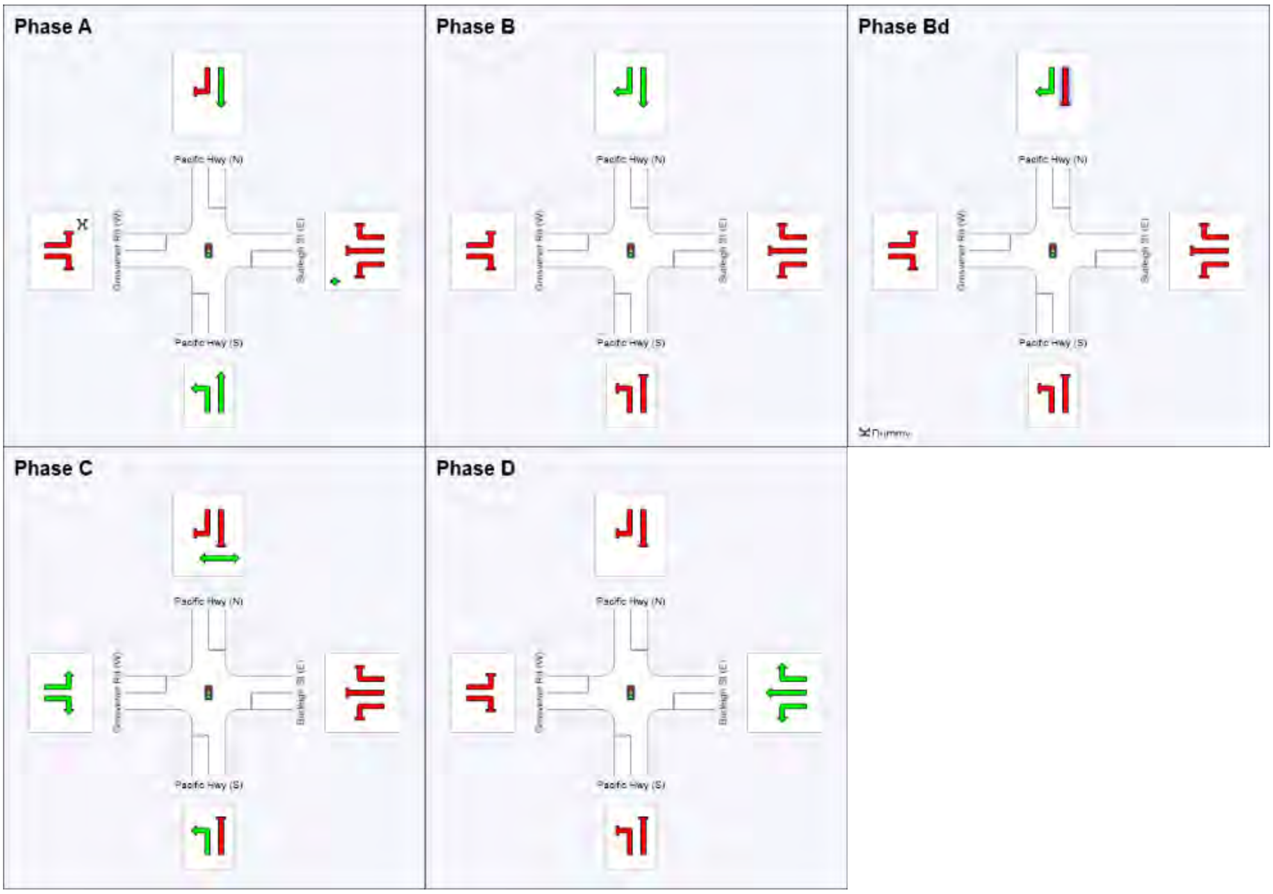
Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Existing AM

Signals - Fixed Time Isolated   Cycle Time = 149 seconds (User-Given Phase Times)

Phase times specified by the user
Sequence: Video AM
Movement Class: All Movement Classes
Input Sequence: A, B, Bd, C, D
Output Sequence: A, B, Bd, C, D

Phase Timing Results

Phase	A	B	Bd	C	D
Reference Phase	Yes	No	No	No	No
Phase Change Time (sec)	0	70	96	110	134
Green Time (sec)	67	20	8	18	9
Yellow Time (sec)	4	4	4	4	2
All-Red Time (sec)	2	2	2	2	1
Phase Time (sec)	73	26	14	24	12
Phase Split	49 %	17 %	9 %	16 %	8 %



Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class Running	Other Movement Class Stopped
Mixed Running & Stopped Movement Classes	
Undetected Movement	Phase Transition Applied

PHASING SUMMARY

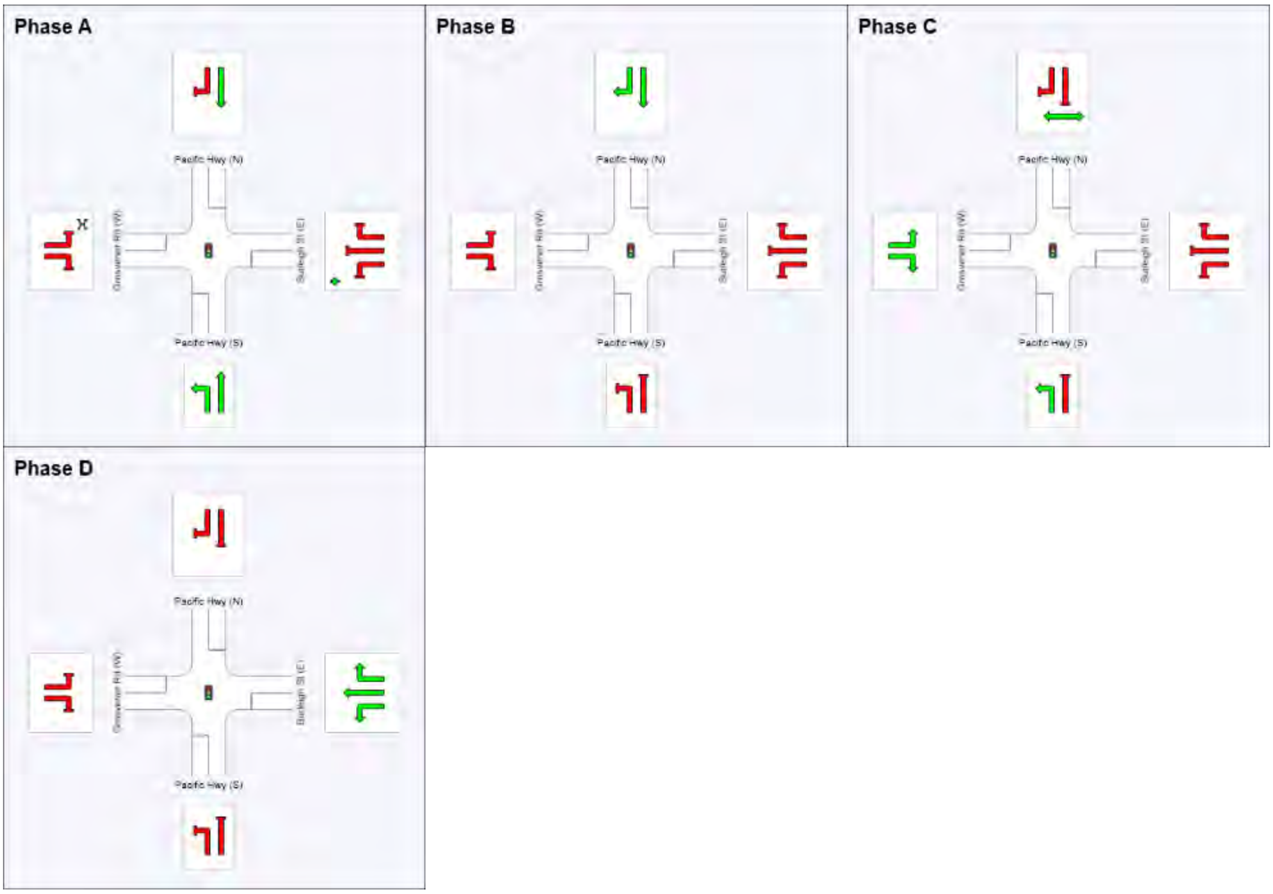
Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Existing PM

Signals - Fixed Time Isolated   Cycle Time = 145 seconds (User-Given Cycle Time)

Phase times determined by the program
Sequence: Video PM
Movement Class: All Movement Classes
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	Yes	No	No	No
Phase Change Time (sec)	0	88	105	133
Green Time (sec)	85	11	22	6
Yellow Time (sec)	4	4	4	2
All-Red Time (sec)	2	2	2	1
Phase Time (sec)	91	17	28	9
Phase Split	63 %	12 %	19 %	6 %



- Normal Movement
- Permitted/Opposed
- Slip/Bypass-Lane Movement
- Opposed Slip/Bypass-Lane
- Stopped Movement
- Turn On Red
- Other Movement Class Running
- Other Movement Class Stopped
- Mixed Running & Stopped Movement Classes
- Undetected Movement
- Phase Transition Applied

PHASING SUMMARY

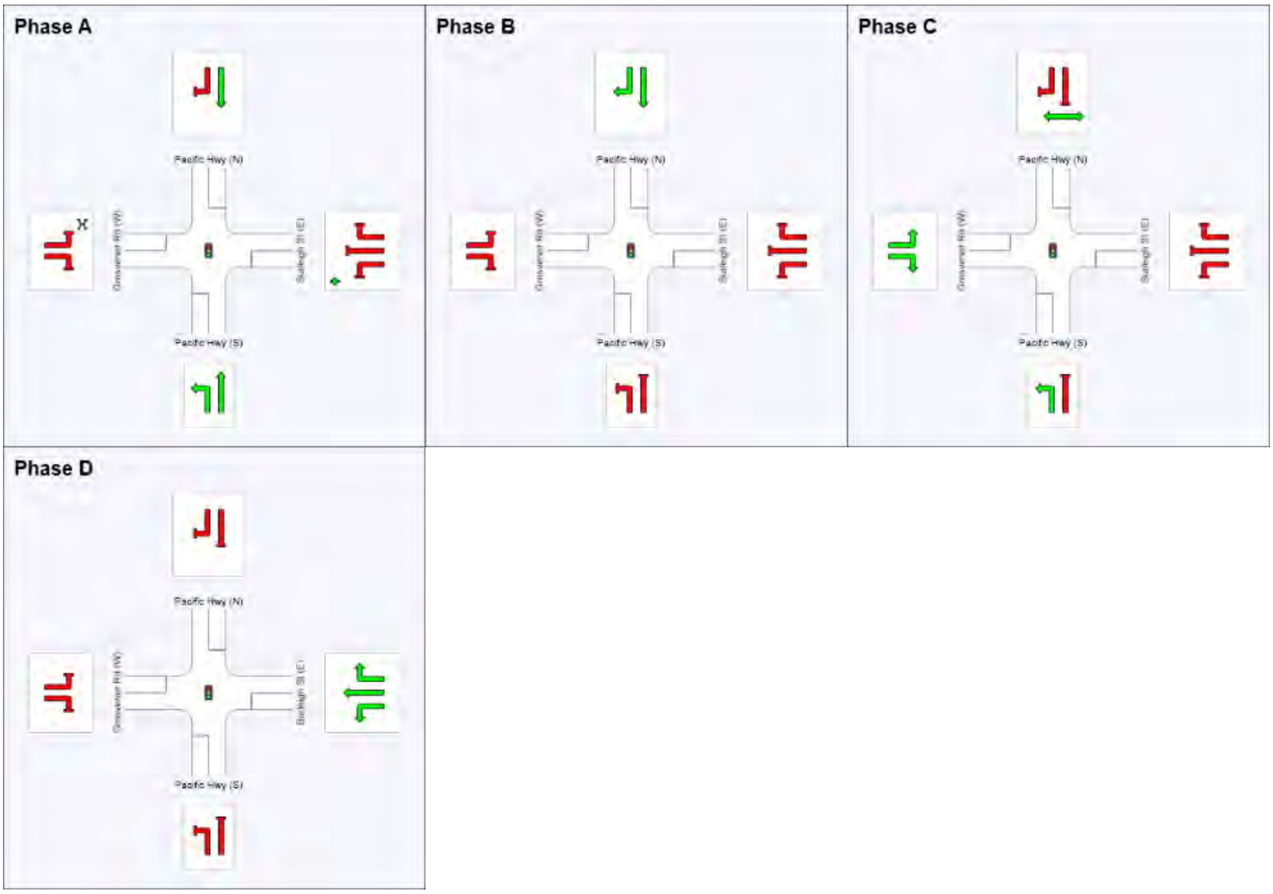
Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Existing School

Signals - Fixed Time Isolated   Cycle Time = 134 seconds (User-Given Phase Times)

Phase times specified by the user
Sequence: Video PM
Movement Class: All Movement Classes
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	Yes	No	No	No
Phase Change Time (sec)	0	83	102	123
Green Time (sec)	80	13	15	5
Yellow Time (sec)	4	4	4	2
All-Red Time (sec)	2	2	2	1
Phase Time (sec)	86	19	21	8
Phase Split	64 %	14 %	16 %	6 %



Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class Running	Other Movement Class Stopped
Mixed Running & Stopped Movement Classes	
Undetected Movement	Phase Transition Applied

LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Existing AM

Signals - Fixed Time Isolated   Cycle Time = 149 seconds (User-Given Phase Times)

Lane Use and Performance														
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	117	4.2	917	0.128	100	14.4	LOS A	2.9	20.9	Full	500	0.0	0.0
Lane 2	607	4.2	840	0.722	100	35.4	LOS C	35.4	257.1	Full	500	0.0	0.0
Lane 3	607	4.2	840	0.722	100	35.4	LOS C	35.4	257.1	Full	500	0.0	0.0
Approach	1331	4.2		0.722		33.6	LOS C	35.4	257.1				
East: Burleigh St (E)													
Lane 1	77	4.2	119	0.644	100	80.8	LOS F	5.8	42.0	Full	100	0.0	0.0
Approach	77	4.2		0.644		80.8	LOS F	5.8	42.0				
North: Pacific Hwy (N)													
Lane 1	773	4.2	1166	0.662	100	18.9	LOS B	35.2	255.3	Full	500	0.0	0.0
Lane 2	773	4.2	1166	0.662	100	18.9	LOS B	35.2	255.3	Full	500	0.0	0.0
Lane 3	667	4.2	1006[1]	0.662	100	17.2	LOS B	27.7	200.7	Full	500	0.0	0.0
Lane 4	131	4.2	405	0.323	100	55.0	LOS D	7.9	57.5	Short	70	0.0	NA
Approach	2343	4.2		0.662		20.4	LOS B	35.2	255.3				
West: Grosvenor Rd (W)													
Lane 1	138	4.2	179	0.772	100	78.7	LOS F	10.5	76.0	Full	500	0.0	0.0
Lane 2	166	4.2	214	0.772	100	76.6	LOS F	12.4	89.9	Short	60	0.0	NA
Approach	304	4.2		0.772		77.5	LOS F	12.4	89.9				
Intersection	4055	4.2		0.772		30.2	LOS C	35.4	257.1				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the adjacent full-length lanes. Some upstream delays at entry to short lanes are not included.

LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Existing PM

Signals - Fixed Time Isolated   Cycle Time = 145 seconds (User-Given Cycle Time)

Lane Use and Performance														
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	279	1.4	1248	0.223	100	7.9	LOS A	3.8	26.8	Full	500	0.0	0.0
Lane 2	1013	1.4	1115	0.908	100	36.9	LOS C	69.9	495.3	Full	500	0.0	4.1
Lane 3	1013	1.4	1115	0.908	100	36.9	LOS C	69.9	495.3	Full	500	0.0	4.1
Approach	2305	1.4		0.908		33.4	LOS C	69.9	495.3				
East: Burleigh St (E)													
Lane 1	17	1.4	85	0.201	100	78.0	LOS F	1.2	8.7	Full	100	0.0	0.0
Approach	17	1.4		0.201		78.0	LOS F	1.2	8.7				
North: Pacific Hwy (N)													
Lane 1	426	1.4	1338	0.318	100	8.6	LOS A	11.2	79.3	Full	500	0.0	0.0
Lane 2	426	1.4	1338	0.318	100	8.6	LOS A	11.2	79.3	Full	500	0.0	0.0
Lane 3	426	1.4	1338	0.318	100	8.6	LOS A	11.2	79.3	Full	500	0.0	0.0
Lane 4	123	1.4	137	0.896	100	89.1	LOS F	9.9	70.2	Short	70	0.0	NA
Approach	1400	1.4		0.896		15.7	LOS B	11.2	79.3				
West: Grosvenor Rd (W)													
Lane 1	149	1.4	234	0.637	100	69.3	LOS E	10.3	72.6	Full	500	0.0	0.0
Lane 2	175	1.4	275	0.637	100	66.6	LOS E	11.8	83.7	Short	60	0.0	NA
Approach	324	1.4		0.637		67.8	LOS E	11.8	83.7				
Intersection	4046	1.4		0.908		30.2	LOS C	69.9	495.3				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Existing School

Signals - Fixed Time Isolated   Cycle Time = 134 seconds (User-Given Phase Times)

Lane Use and Performance

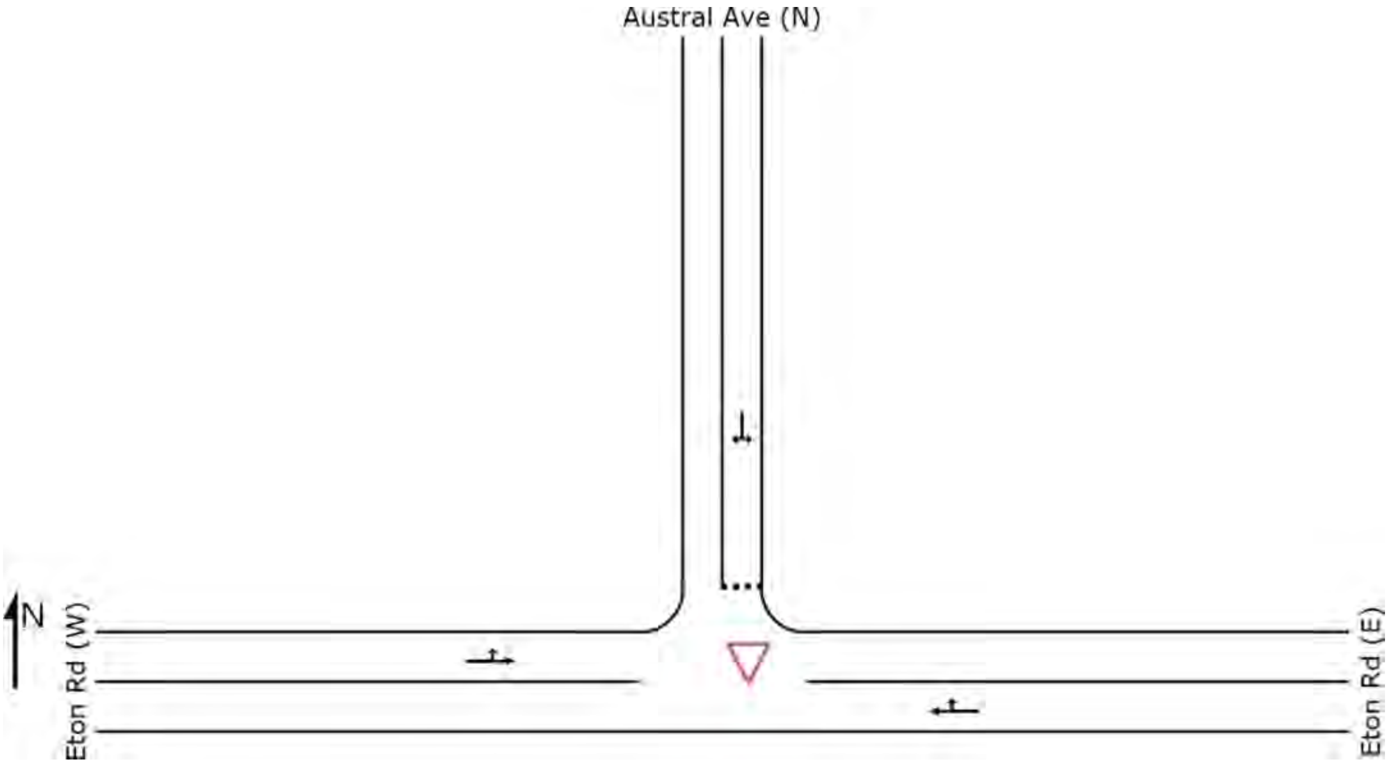
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	233	3.8	1169	0.199	100	8.4	LOS A	3.4	24.6	Full	500	0.0	0.0
Lane 2	847	3.8	1118	0.757	100	21.0	LOS B	40.0	289.2	Full	500	0.0	0.0
Lane 3	847	3.8	1118	0.757	100	21.0	LOS B	40.0	289.2	Full	500	0.0	0.0
Approach	1927	3.8		0.757		19.5	LOS B	40.0	289.2				
East: Burleigh St (E)													
Lane 1	72	3.8	74	0.972	100	102.7	LOS F	6.0	43.6	Full	100	0.0	0.0
Approach	72	3.8		0.972		102.7	LOS F	6.0	43.6				
North: Pacific Hwy (N)													
Lane 1	383	3.8	1384	0.277	100	6.0	LOS A	8.0	57.9	Full	500	0.0	0.0
Lane 2	383	3.8	1384	0.277	100	6.0	LOS A	8.0	57.9	Full	500	0.0	0.0
Lane 3	383	3.8	1384	0.277	100	6.0	LOS A	8.0	57.9	Full	500	0.0	0.0
Lane 4	84	3.8	173	0.486	100	67.4	LOS E	5.4	39.0	Short	70	0.0	NA
Approach	1234	3.8		0.486		10.2	LOS A	8.0	57.9				
West: Grosvenor Rd (W)													
Lane 1	93	3.8	154	0.606	100	69.7	LOS E	6.2	44.5	Full	500	0.0	0.0
Lane 2	121	3.8	199	0.606	100	66.5	LOS E	7.8	56.2	Short	60	0.0	NA
Approach	214	3.8		0.606		67.9	LOS E	7.8	56.2				
Intersection	3447	3.8		0.972		20.9	LOS B	40.0	289.2				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

SITE LAYOUT

▽ Site: 04_Eton Road_Austral Avenue Existing AM

Giveway / Yield (Two-Way)



LANE SUMMARY

▽ Site: 04_Eton Road_Austral Avenue Existing AM

Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Eton Rd (E)													
Lane 1	88	3.5	1668	0.053	100	4.9	LOS A	0.2	1.8	Full	500	0.0	0.0
Approach	88	3.5		0.053		4.9	NA	0.2	1.8				
North: Austral Ave (N)													
Lane 1	57	3.5	1166	0.049	100	6.0	LOS A	0.2	1.2	Full	100	0.0	0.0
Approach	57	3.5		0.049		6.0	LOS A	0.2	1.2				
West: Eton Rd (W)													
Lane 1	105	3.5	2007	0.052	100	3.6	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	105	3.5		0.052		3.6	NA	0.0	0.0				
Intersection	250	3.5		0.053		4.6	NA	0.2	1.8				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

▽ Site: 04_Eton Road_Austral Avenue Existing PM

Giveway / Yield (Two-Way)

Lane Use and Performance														
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Eton Rd (E)													
Lane 1	121	3.5	1855	0.065	100	2.4	LOS A	0.3	1.9	Full	500	0.0	0.0
Approach	121	3.5		0.065		2.4	NA	0.3	1.9				
North: Austral Ave (N)													
Lane 1	114	3.5	1155	0.099	100	6.1	LOS A	0.3	2.5	Full	100	0.0	0.0
Approach	114	3.5		0.099		6.1	LOS A	0.3	2.5				
West: Eton Rd (W)													
Lane 1	82	3.5	1998	0.041	100	4.2	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	82	3.5		0.041		4.2	NA	0.0	0.0				
Intersection	317	3.5		0.099		4.2	NA	0.3	2.5				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

Site: 04_Eton Road_Austral Avenue Existing School

Giveway / Yield (Two-Way)

Lane Use and Performance														
	Demand Flows		Cap.	Deg.	Lane	Average	Level of	95% Back of Queue		Lane	Lane	Cap.	Prob.
	Total veh/h	HV %	veh/h	Satn v/c	Util. %	Delay sec	Service	Veh	Dist m	Config	Length m	Adj. %	Block. %
East: Eton Rd (E)													
Lane 1	92	3.5	1740	0.053	100	4.2	LOS A	0.3	1.8	Full	500	0.0	0.0
Approach	92	3.5		0.053		4.2	NA	0.3	1.8				
North: Austral Ave (N)													
Lane 1	64	3.5	1219	0.052	100	5.9	LOS A	0.2	1.3	Full	100	0.0	0.0
Approach	64	3.5		0.052		5.9	LOS A	0.2	1.3				
West: Eton Rd (W)													
Lane 1	75	3.5	1999	0.038	100	4.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	75	3.5		0.038		4.1	NA	0.0	0.0				
Intersection	231	3.5		0.053		4.6	NA	0.3	1.8				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

Site: 01_Grosvenor Road_Lady Game Drive Future AM

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Lady Game Dr (S)													
Lane 1[d]	389	0.8	989	0.393	100	9.7	LOS A	2.7	19.2	Full	500	0.0	0.0
Approach	389	0.8		0.393		9.7	LOS A	2.7	19.2				
East: Grosvenor Rd (E)													
Lane 1[d]	513	0.8	1129	0.454	100	7.2	LOS A	3.8	26.4	Full	500	0.0	0.0
Approach	513	0.8		0.454		7.2	LOS A	3.8	26.4				
North: Lady Game Dr (N)													
Lane 1[d]	449	0.8	303	1.479	100	941.4	LOS F	208.4	1469.1	Full	500	-32.5	100.0
Approach	449	0.8		1.479		941.4	LOS F	208.4	1469.1				
Intersection	1351	0.8		1.479		318.4	LOS F	208.4	1469.1				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 01_Grosvenor Road_Lady Game Drive Future PM

New Site
Roundabout

Lane Use and Performance	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Lady Game Dr (S)													
Lane 1[d]	982	0.1	1085	0.905	100	18.9	LOS B	22.9	160.3	Full	500	0.0	0.0
Approach	982	0.1		0.905		18.9	LOS B	22.9	160.3				
East: Grosvenor Rd (E)													
Lane 1[d]	443	0.1	1267	0.350	100	6.7	LOS A	2.7	19.1	Full	500	0.0	0.0
Approach	443	0.1		0.350		6.7	LOS A	2.7	19.1				
North: Lady Game Dr (N)													
Lane 1[d]	378	0.1	403	0.939	100	44.3	LOS D	18.5	129.5	Full	500	0.0	0.0
Approach	378	0.1		0.939		44.3	LOS D	18.5	129.5				
Intersection	1803	0.1		0.939		21.2	LOS B	22.9	160.3				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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LANE SUMMARY

Site: 01_Grosvenor Road_Lady Game Drive Future School

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Lady Game Dr (S)													
Lane 1 [d]	583	1.9	945	0.617	100	10.6	LOS A	6.1	43.4	Full	500	0.0	0.0
Approach	583	1.9		0.617		10.6	LOS A	6.1	43.4				
East: Grosvenor Rd (E)													
Lane 1 [d]	689	1.9	1215	0.567	100	6.7	LOS A	5.6	39.6	Full	500	0.0	0.0
Approach	689	1.9		0.567		6.7	LOS A	5.6	39.6				
North: Lady Game Dr (N)													
Lane 1 [d]	478	1.9	471	1.015	100	89.4	LOS F	41.2	293.2	Full	500	0.0	0.0
Approach	478	1.9		1.015		89.4	LOS F	41.2	293.2				
Intersection	1750	1.9		1.015		30.6	LOS C	41.2	293.2				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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LANE SUMMARY

Site: 02_Grosvenor Road_Austral Avenue Future AM

Roundabout

Lane Use and Performance														
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Austral Ave (S)													
Lane 1[d]	910	1.1	1091	0.834	100	12.1	LOS A	15.2	107.3	Full	100	0.0	7.1
Approach	910	1.1		0.834		12.1	LOS A	15.2	107.3				
East: Grosvenor Rd (E)													
Lane 1[d]	693	1.1	1030	0.673	100	7.3	LOS A	7.6	54.0	Full	500	0.0	0.0
Approach	693	1.1		0.673		7.3	LOS A	7.6	54.0				
West: Grosvenor Rd (W)													
Lane 1[d]	434	1.1	635	0.683	100	15.8	LOS B	7.6	53.4	Full	500	0.0	0.0
Approach	434	1.1		0.683		15.8	LOS B	7.6	53.4				
Intersection	2037	1.1		0.834		11.2	LOS A	15.2	107.3				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 02_Grosvenor Road_Austral Avenue Future PM

Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Austral Ave (S)													
Lane 1[d]	348	0.8	969	0.359	100	7.3	LOS A	2.4	16.7	Full	100	0.0	0.0
Approach	348	0.8		0.359		7.3	LOS A	2.4	16.7				
East: Grosvenor Rd (E)													
Lane 1[d]	389	0.8	1032	0.377	100	5.6	LOS A	2.5	18.0	Full	500	0.0	0.0
Approach	389	0.8		0.377		5.6	LOS A	2.5	18.0				
West: Grosvenor Rd (W)													
Lane 1[d]	531	0.8	1166	0.456	100	6.3	LOS A	3.6	25.0	Full	500	0.0	0.0
Approach	531	0.8		0.456		6.3	LOS A	3.6	25.0				
Intersection	1268	0.8		0.456		6.3	LOS A	3.6	25.0				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 02_Grosvenor Road_Austral Avenue Future School

Roundabout

Lane Use and Performance														
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Austral Ave (S)													
Lane 1[d]	801	2.8	1003	0.799	100	12.5	LOS A	12.6	90.4	Full	100	0.0	2.1
Approach	801	2.8		0.799		12.5	LOS A	12.6	90.4				
East: Grosvenor Rd (E)													
Lane 1[d]	486	2.8	1060	0.458	100	5.6	LOS A	3.6	25.5	Full	500	0.0	0.0
Approach	486	2.8		0.458		5.6	LOS A	3.6	25.5				
West: Grosvenor Rd (W)													
Lane 1[d]	396	2.8	849	0.466	100	8.2	LOS A	3.5	25.1	Full	500	0.0	0.0
Approach	396	2.8		0.466		8.2	LOS A	3.5	25.1				
Intersection	1683	2.8		0.799		9.5	LOS A	12.6	90.4				

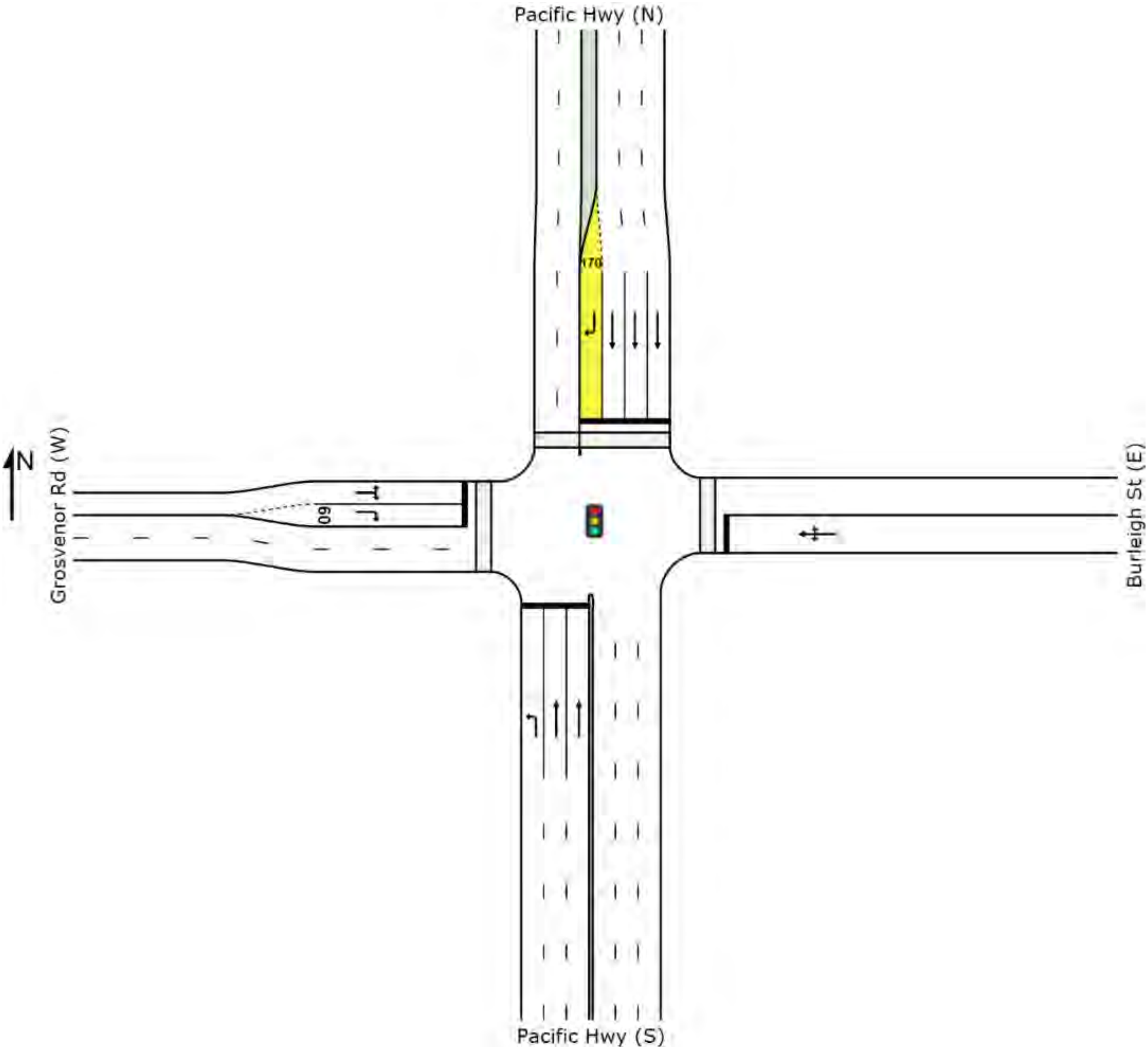
Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SITE LAYOUT

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future AM Upgrades2+Diverted

Signals - Fixed Time Isolated



PHASING SUMMARY

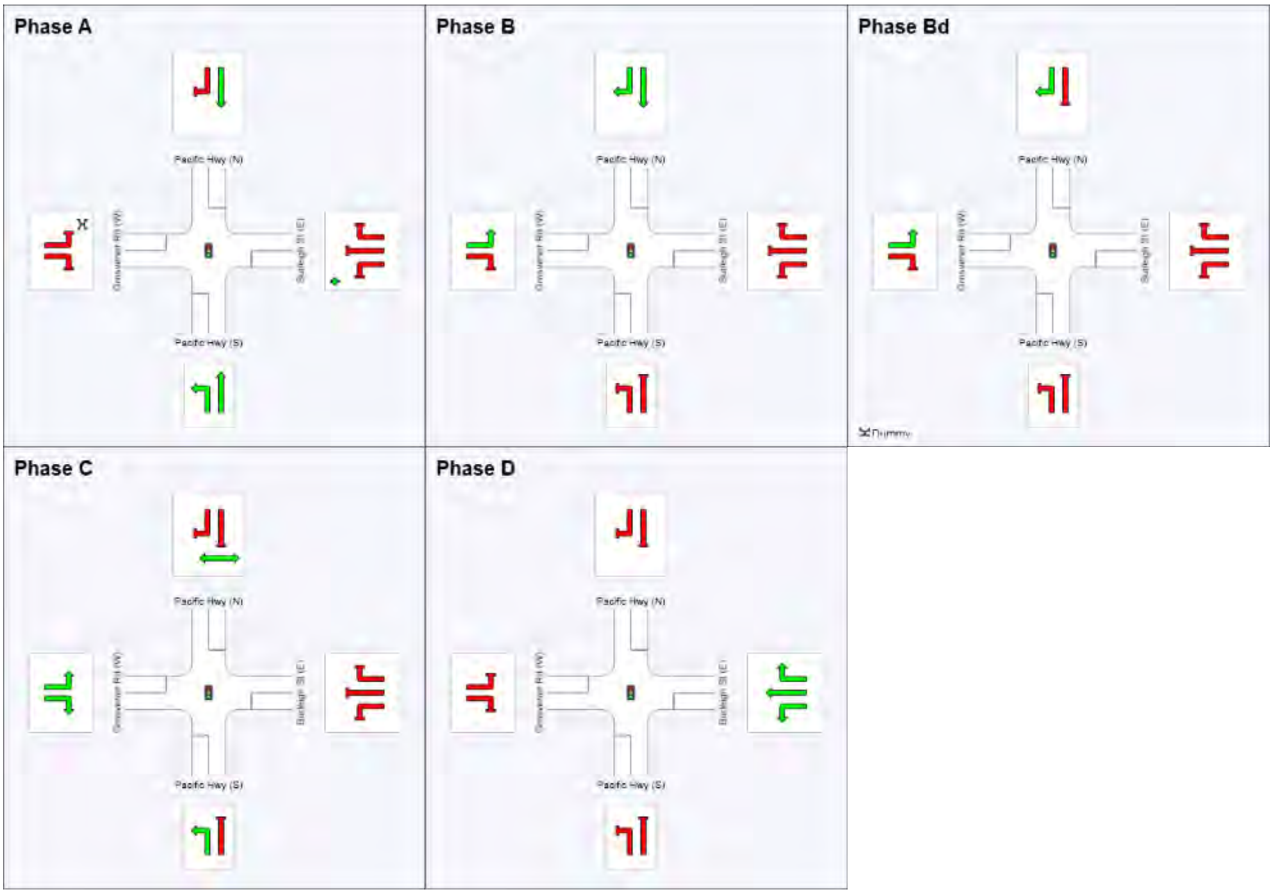
Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future AM Upgrades2+Diverted

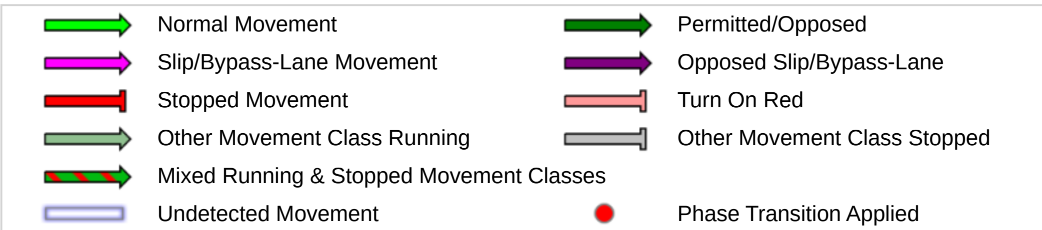
Signals - Fixed Time Isolated   Cycle Time = 150 seconds (User-Given Cycle Time)

Phase times determined by the program
Sequence: Video AM Upgrades
Movement Class: All Movement Classes
Input Sequence: A, B, Bd, C, D
Output Sequence: A, B, Bd, C, D

Phase Timing Results

Phase	A	B	Bd	C	D
Reference Phase	Yes	No	No	No	No
Phase Change Time (sec)	0	67	95	111	137
Green Time (sec)	64	22	10	20	7
Yellow Time (sec)	4	4	4	4	2
All-Red Time (sec)	2	2	2	2	1
Phase Time (sec)	70	28	16	26	10
Phase Split	47 %	19 %	11 %	17 %	7 %





PHASING SUMMARY

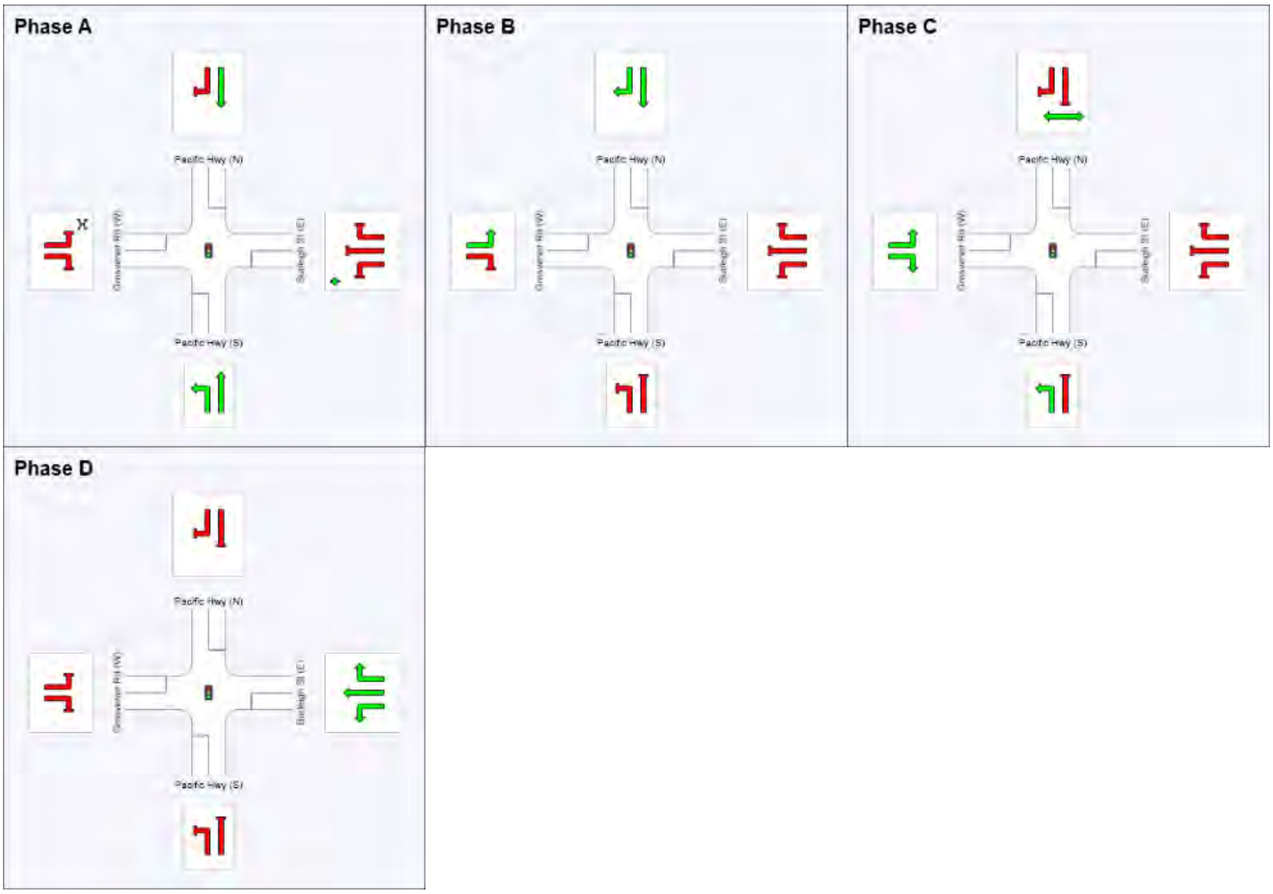
Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future PM Upgrades2+Diverted

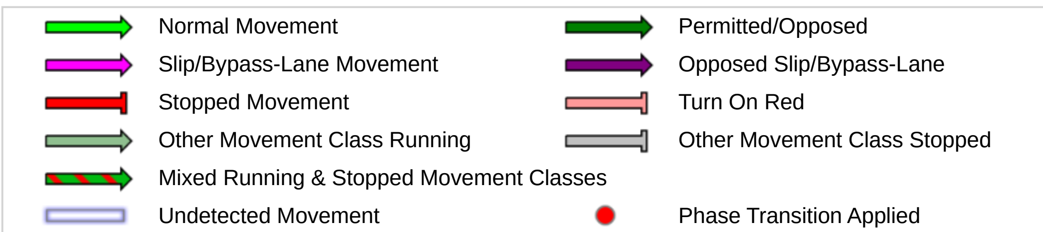
Signals - Fixed Time Isolated   Cycle Time = 150 seconds (User-Given Cycle Time)

Phase times determined by the program
Sequence: Video AM Upgrades
Movement Class: All Movement Classes
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	Yes	No	No	No
Phase Change Time (sec)	0	93	115	141
Green Time (sec)	90	16	20	3
Yellow Time (sec)	4	4	4	2
All-Red Time (sec)	2	2	2	1
Phase Time (sec)	96	22	26	6
Phase Split	64 %	15 %	17 %	4 %





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PHASING SUMMARY

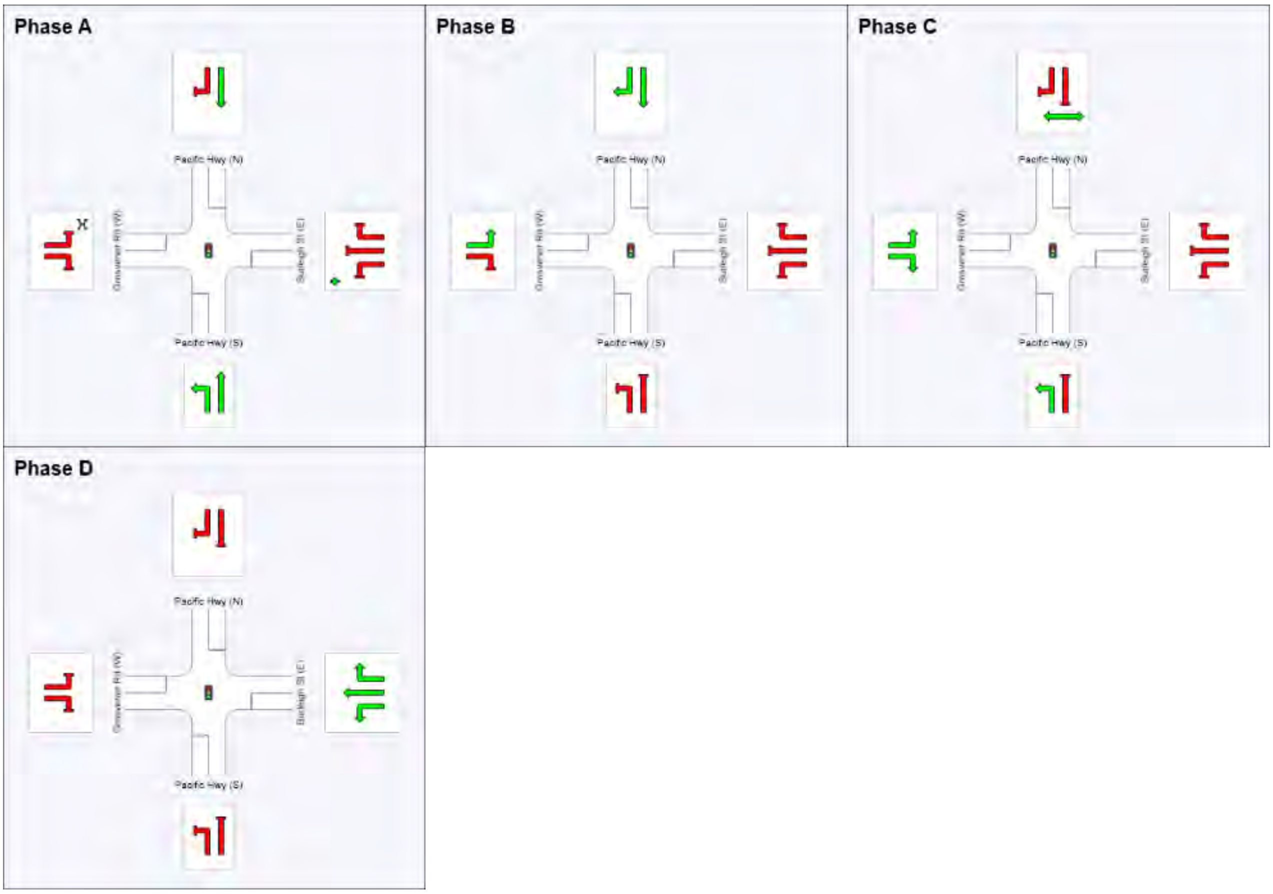
Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future School Upgrades2+Diverted

Signals - Fixed Time Isolated   Cycle Time = 150 seconds (User-Given Cycle Time)

Phase times determined by the program
Sequence: Video AM Upgrades
Movement Class: All Movement Classes
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	Yes	No	No	No
Phase Change Time (sec)	0	88	111	137
Green Time (sec)	85	17	20	7
Yellow Time (sec)	4	4	4	2
All-Red Time (sec)	2	2	2	1
Phase Time (sec)	91	23	26	10
Phase Split	61 %	15 %	17 %	7 %



Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class Running	Other Movement Class Stopped
Mixed Running & Stopped Movement Classes	
Undetected Movement	Phase Transition Applied

LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future AM Diverted

Signals - Fixed Time Isolated   Cycle Time = 150 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	117	4.2	805	0.145	100	19.0	LOS B	3.7	26.5	Full	500	0.0	0.0
Lane 2	673	4.2	673	1.001	100	124.3	LOS F	77.4	561.3	Full	500	0.0	15.5
Lane 3	673	4.2	673	1.001	100	124.3	LOS F	77.4	561.3	Full	500	0.0	15.5
Approach	1464	4.2		1.001		115.8	LOS F	77.4	561.3				
East: Burleigh St (E)													
Lane 1	77	4.2	79	0.973	100	112.9	LOS F	7.2	51.9	Full	100	0.0	0.0
Approach	77	4.2		0.973		112.9	LOS F	7.2	51.9				
North: Pacific Hwy (N)													
Lane 1	774	4.2	1134	0.683	100	20.9	LOS B	37.2	269.9	Full	500	0.0	0.0
Lane 2	774	4.2	1134	0.683	100	20.9	LOS B	37.2	269.9	Full	500	0.0	0.0
Lane 3	544	4.2	797[1]	0.683	100	17.2	LOS B	21.6	156.6	Full	500	0.0	0.0
Lane 4	372	4.2	368[1]	1.010	100	183.2	LOS F	46.5	337.1	Short	70	0.0	NA
Approach	2464	4.2		1.010		44.6	LOS D	46.5	337.1				
West: Grosvenor Rd (W)													
Lane 1	186	4.2	233	0.800	100	77.1	LOS F	14.2	102.7	Full	500	0.0	0.0
Lane 2	207	4.2	259[1]	0.800	100	75.4	LOS F	15.6	113.2	Short	60	0.0	NA
Approach	393	4.2		0.800		76.2	LOS F	15.6	113.2				
Intersection	4398	4.2		1.010		72.3	LOS F	77.4	561.3				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the adjacent full-length lanes. Some upstream delays at entry to short lanes are not included.

LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future PM Diverted

Signals - Fixed Time Isolated   Cycle Time = 145 seconds (User-Given Cycle Time)

Lane Use and Performance														
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	279	1.4	1236	0.226	100	8.2	LOS A	4.4	31.5	Full	500	0.0	0.0
Lane 2	1021	1.4	1102	0.926	100	44.0	LOS D	76.6	542.3	Full	500	0.0	12.3
Lane 3	1021	1.4	1102	0.926	100	44.0	LOS D	76.6	542.3	Full	500	0.0	12.3
Approach	2321	1.4		0.926		39.7	LOS C	76.6	542.3				
East: Burleigh St (E)													
Lane 1	17	1.4	42	0.401	100	85.2	LOS F	1.3	9.3	Full	100	0.0	0.0
Approach	17	1.4		0.401		85.2	LOS F	1.3	9.3				
North: Pacific Hwy (N)													
Lane 1	420	1.4	1378	0.305	100	7.4	LOS A	10.2	72.5	Full	500	0.0	0.0
Lane 2	420	1.4	1378	0.305	100	7.4	LOS A	10.2	72.5	Full	500	0.0	0.0
Lane 3	420	1.4	1378	0.305	100	7.4	LOS A	10.2	72.5	Full	500	0.0	0.0
Lane 4	165	1.4	187	0.881	100	84.8	LOS F	13.1	92.5	Short	70	0.0	NA
Approach	1426	1.4		0.881		16.4	LOS B	13.1	92.5				
West: Grosvenor Rd (W)													
Lane 1	165	1.4	237	0.696	100	70.7	LOS F	11.6	81.9	Full	500	0.0	0.0
Lane 2	191	1.4	275	0.696	100	68.0	LOS E	13.2	93.4	Short	60	0.0	NA
Approach	356	1.4		0.696		69.3	LOS E	13.2	93.4				
Intersection	4120	1.4		0.926		34.3	LOS C	76.6	542.3				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future School Diverted

Signals - Fixed Time Isolated   Cycle Time = 140 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	233	3.8	1157	0.201	100	8.8	LOS A	3.6	26.1	Full	500	0.0	0.0
Lane 2	866	3.8	1017	0.851	100	30.4	LOS C	50.7	366.2	Full	500	0.0	0.0
Lane 3	865	3.8	1017	0.851	100	30.4	LOS C	50.7	366.2	Full	500	0.0	0.0
Approach	1964	3.8		0.851		27.8	LOS B	50.7	366.2				
East: Burleigh St (E)													
Lane 1	72	3.8	85	0.847	100	84.3	LOS F	5.5	39.5	Full	100	0.0	0.0
Approach	72	3.8		0.847		84.3	LOS F	5.5	39.5				
North: Pacific Hwy (N)													
Lane 1	371	3.8	1298	0.286	100	8.6	LOS A	9.4	68.3	Full	500	0.0	0.0
Lane 2	371	3.8	1298	0.286	100	8.6	LOS A	9.4	68.3	Full	500	0.0	0.0
Lane 3	371	3.8	1298	0.286	100	8.6	LOS A	9.4	68.3	Full	500	0.0	0.0
Lane 4	158	3.8	191	0.828	100	77.2	LOS F	11.6	83.8	Short	70	0.0	NA
Approach	1271	3.8		0.828		17.2	LOS B	11.6	83.8				
West: Grosvenor Rd (W)													
Lane 1	135	3.8	247	0.547	100	64.8	LOS E	8.8	63.4	Full	500	0.0	0.0
Lane 2	153	3.8	280	0.547	100	62.9	LOS E	9.8	70.8	Short	60	0.0	NA
Approach	288	3.8		0.547		63.8	LOS E	9.8	70.8				
Intersection	3595	3.8		0.851		28.1	LOS B	50.7	366.2				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future AM Upgrades2+Diverted

Based on 43% driver rate and staggered start times
Signals - Fixed Time Isolated   Cycle Time = 150 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	117	4.2	899	0.130	100	15.4	LOS B	3.1	22.6	Full	500	0.0	0.0
Lane 2	678	4.2	797	0.851	100	44.9	LOS D	46.4	336.4	Full	500	0.0	0.0
Lane 3	678	4.2	797	0.851	100	44.9	LOS D	46.4	336.4	Full	500	0.0	0.0
Approach	1474	4.2		0.851		42.5	LOS D	46.4	336.4				
East: Burleigh St (E)													
Lane 1	77	4.2	92	0.834	100	88.5	LOS F	6.2	44.8	Full	100	0.0	0.0
Approach	77	4.2		0.834		88.5	LOS F	6.2	44.8				
North: Pacific Hwy (N)													
Lane 1	695	4.2	1146	0.606	100	18.8	LOS B	30.6	222.1	Full	500	0.0	0.0
Lane 2	695	4.2	1146	0.606	100	18.8	LOS B	30.6	222.1	Full	500	0.0	0.0
Lane 3	695	4.2	1146	0.606	100	18.8	LOS B	30.6	222.1	Full	500	0.0	0.0
Lane 4	385	4.2	450	0.856	100	69.1	LOS E	29.4	213.4	Short	170	0.0	NA
Approach	2470	4.2		0.856		26.6	LOS B	30.6	222.1				
West: Grosvenor Rd (W)													
Lane 1	204	4.2	246	0.826	100	78.1	LOS F	15.7	113.9	Full	500	0.0	0.0
Lane 2	195	4.2	237	0.826	100	78.8	LOS F	15.1	109.6	Short	60	0.0	NA
Approach	399	4.2		0.826		78.4	LOS F	15.7	113.9				
Intersection	4420	4.2		0.856		37.7	LOS C	46.4	336.4				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

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LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future PM Upgrades2+Diverted

Signals - Fixed Time Isolated   Cycle Time = 150 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	279	1.4	1243	0.224	100	8.2	LOS A	4.5	31.6	Full	500	0.0	0.0
Lane 2	1022	1.4	1154	0.885	100	28.9	LOS C	64.5	457.1	Full	500	0.0	0.0
Lane 3	1022	1.4	1154	0.885	100	28.9	LOS C	64.5	457.1	Full	500	0.0	0.0
Approach	2322	1.4		0.885		26.4	LOS B	64.5	457.1				
East: Burleigh St (E)													
Lane 1	17	1.4	41	0.415	100	88.2	LOS F	1.4	9.6	Full	100	0.0	0.0
Approach	17	1.4		0.415		88.2	LOS F	1.4	9.6				
North: Pacific Hwy (N)													
Lane 1	420	1.4	1420	0.296	100	6.5	LOS A	9.7	68.7	Full	500	0.0	0.0
Lane 2	420	1.4	1420	0.296	100	6.5	LOS A	9.7	68.7	Full	500	0.0	0.0
Lane 3	420	1.4	1420	0.296	100	6.5	LOS A	9.7	68.7	Full	500	0.0	0.0
Lane 4	157	1.4	181	0.867	100	86.0	LOS F	12.6	89.6	Short	170	0.0	NA
Approach	1417	1.4		0.867		15.3	LOS B	12.6	89.6				
West: Grosvenor Rd (W)													
Lane 1	184	1.4	256	0.719	100	71.7	LOS F	13.3	94.6	Full	500	0.0	0.0
Lane 2	174	1.4	241	0.719	100	73.2	LOS F	12.7	89.6	Short	60	0.0	NA
Approach	358	1.4		0.719		72.5	LOS F	13.3	94.6				
Intersection	4114	1.4		0.885		26.8	LOS B	64.5	457.1				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future School Upgrades2+Diverted

Signals - Fixed Time Isolated   Cycle Time = 150 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	233	3.8	1151	0.202	100	9.3	LOS A	3.9	28.1	Full	500	0.0	0.0
Lane 2	866	3.8	1062	0.816	100	27.7	LOS B	50.2	362.5	Full	500	0.0	0.0
Lane 3	866	3.8	1062	0.816	100	27.7	LOS B	50.2	362.5	Full	500	0.0	0.0
Approach	1966	3.8		0.816		25.5	LOS B	50.2	362.5				
East: Burleigh St (E)													
Lane 1	72	3.8	93	0.777	100	86.3	LOS F	5.7	41.0	Full	100	0.0	0.0
Approach	72	3.8		0.777		86.3	LOS F	5.7	41.0				
North: Pacific Hwy (N)													
Lane 1	370	3.8	1349	0.275	100	7.7	LOS A	9.2	66.4	Full	500	0.0	0.0
Lane 2	370	3.8	1349	0.275	100	7.7	LOS A	9.2	66.4	Full	500	0.0	0.0
Lane 3	370	3.8	1349	0.275	100	7.7	LOS A	9.2	66.4	Full	500	0.0	0.0
Lane 4	162	3.8	202	0.803	100	79.6	LOS F	12.4	89.9	Short	170	0.0	NA
Approach	1273	3.8		0.803		16.8	LOS B	12.4	89.9				
West: Grosvenor Rd (W)													
Lane 1	149	3.8	249	0.601	100	69.9	LOS E	10.5	75.6	Full	500	0.0	0.0
Lane 2	143	3.8	237	0.601	100	70.7	LOS F	10.0	72.6	Short	60	0.0	NA
Approach	292	3.8		0.601		70.3	LOS E	10.5	75.6				
Intersection	3603	3.8		0.816		27.3	LOS B	50.2	362.5				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

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LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future AM Upgrades2+Diverted + Worst Case

No Staggered times worst case
Signals - Fixed Time Isolated   Cycle Time = 150 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	117	4.2	864	0.135	100	16.8	LOS B	3.3	24.3	Full	500	0.0	0.0
Lane 2	714	4.2	735	0.971	100	92.4	LOS F	71.8	520.4	Full	500	0.0	8.6
Lane 3	714	4.2	735	0.971	100	92.4	LOS F	71.8	520.4	Full	500	0.0	8.6
Approach	1545	4.2		0.971		86.7	LOS F	71.8	520.4				
East: Burleigh St (E)													
Lane 1	77	4.2	79	0.973	100	112.9	LOS F	7.2	51.9	Full	100	0.0	0.0
Approach	77	4.2		0.973		112.9	LOS F	7.2	51.9				
North: Pacific Hwy (N)													
Lane 1	697	4.2	1034	0.674	100	25.2	LOS B	35.7	258.6	Full	500	0.0	0.0
Lane 2	697	4.2	1034	0.674	100	25.2	LOS B	35.7	258.6	Full	500	0.0	0.0
Lane 3	697	4.2	1034	0.674	100	25.2	LOS B	35.7	258.6	Full	500	0.0	0.0
Lane 4	480	4.2	497	0.966	100	103.0	LOS F	47.7	346.0	Short	170	0.0	NA
Approach	2572	4.2		0.966		39.7	LOS C	47.7	346.0				
West: Grosvenor Rd (W)													
Lane 1	226	4.2	243[1]	0.932	100	95.2	LOS F	20.0	144.7	Full	500	0.0	0.0
Lane 2	221	4.2	237[1]	0.932	100	95.4	LOS F	19.4	141.0	Short	60	0.0	NA
Approach	447	4.2		0.932		95.3	LOS F	20.0	144.7				
Intersection	4641	4.2		0.973		61.9	LOS E	71.8	520.4				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.
The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the adjacent full-length lanes. Some upstream delays at entry to short lanes are not included.

LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future PM Upgrades2+Diverted + Worst Case

Signals - Fixed Time Isolated   Cycle Time = 150 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	279	1.4	1231	0.227	100	8.5	LOS A	4.6	32.8	Full	500	0.0	0.0
Lane 2	1025	1.4	1141	0.898	100	32.6	LOS C	68.4	484.8	Full	500	0.0	2.2
Lane 3	1025	1.4	1141	0.898	100	32.6	LOS C	68.4	484.8	Full	500	0.0	2.2
Approach	2329	1.4		0.898		29.7	LOS C	68.4	484.8				
East: Burleigh St (E)													
Lane 1	17	1.4	41	0.415	100	88.2	LOS F	1.4	9.6	Full	100	0.0	0.0
Approach	17	1.4		0.415		88.2	LOS F	1.4	9.6				
North: Pacific Hwy (N)													
Lane 1	418	1.4	1420	0.294	100	6.4	LOS A	9.6	68.2	Full	500	0.0	0.0
Lane 2	418	1.4	1420	0.294	100	6.4	LOS A	9.6	68.2	Full	500	0.0	0.0
Lane 3	418	1.4	1420	0.294	100	6.4	LOS A	9.6	68.2	Full	500	0.0	0.0
Lane 4	171	1.4	193	0.886	100	87.6	LOS F	14.0	99.2	Short	170	0.0	NA
Approach	1424	1.4		0.886		16.2	LOS B	14.0	99.2				
West: Grosvenor Rd (W)													
Lane 1	191	1.4	256	0.749	100	72.9	LOS F	14.0	99.5	Full	500	0.0	0.0
Lane 2	181	1.4	241	0.749	100	74.3	LOS F	13.3	94.5	Short	60	0.0	NA
Approach	372	1.4		0.749		73.6	LOS F	14.0	99.5				
Intersection	4142	1.4		0.898		29.3	LOS C	68.4	484.8				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

LANE SUMMARY

Site: 03_Grosvenor Road_Pacific Highway_Burleigh_Street Future School Upgrades2+Diverted + Worst Case

Signals - Fixed Time Isolated   Cycle Time = 150 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Pacific Hwy (S)													
Lane 1	233	3.8	1115	0.209	100	10.1	LOS A	4.3	31.0	Full	500	0.0	0.0
Lane 2	875	3.8	1024	0.854	100	31.3	LOS C	54.1	390.9	Full	500	0.0	0.0
Lane 3	875	3.8	1024	0.854	100	31.3	LOS C	54.1	390.9	Full	500	0.0	0.0
Approach	1983	3.8		0.854		28.8	LOS C	54.1	390.9				
East: Burleigh St (E)													
Lane 1	72	3.8	93	0.777	100	86.3	LOS F	5.7	41.0	Full	100	0.0	0.0
Approach	72	3.8		0.777		86.3	LOS F	5.7	41.0				
North: Pacific Hwy (N)													
Lane 1	365	3.8	1349	0.270	100	7.6	LOS A	9.0	65.1	Full	500	0.0	0.0
Lane 2	365	3.8	1349	0.270	100	7.6	LOS A	9.0	65.1	Full	500	0.0	0.0
Lane 3	365	3.8	1349	0.270	100	7.6	LOS A	9.0	65.1	Full	500	0.0	0.0
Lane 4	196	3.8	237	0.826	100	78.8	LOS F	15.1	109.5	Short	170	0.0	NA
Approach	1290	3.8		0.826		18.4	LOS B	15.1	109.5				
West: Grosvenor Rd (W)													
Lane 1	166	3.8	247	0.673	100	71.1	LOS F	11.9	85.8	Full	500	0.0	0.0
Lane 2	160	3.8	237	0.673	100	72.0	LOS F	11.5	82.8	Short	60	0.0	NA
Approach	326	3.8		0.673		71.6	LOS F	11.9	85.8				
Intersection	3671	3.8		0.854		30.1	LOS C	54.1	390.9				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

LANE SUMMARY

▽ Site: 04_Eton Road_Austral Avenue Future AM

Giveway / Yield (Two-Way)

Lane Use and Performance														
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Eton Rd (E)													
Lane 1	304	3.5	1925	0.158	100	1.5	LOS A	0.5	3.5	Full	500	0.0	0.0
Approach	304	3.5		0.158		1.5	NA	0.5	3.5				
North: Austral Ave (N)													
Lane 1	57	3.5	964	0.059	100	6.9	LOS A	0.2	1.4	Full	100	0.0	0.0
Approach	57	3.5		0.059		6.9	LOS A	0.2	1.4				
West: Eton Rd (W)													
Lane 1	105	3.5	2007	0.052	100	3.6	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	105	3.5		0.052		3.6	NA	0.0	0.0				
Intersection	466	3.5		0.158		2.6	NA	0.5	3.5				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

Site: 04_Eton Road_Austral Avenue Future PM

Giveway / Yield (Two-Way)

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Eton Rd (E)													
Lane 1	181	3.5	1919	0.094	100	1.7	LOS A	0.3	2.2	Full	500	0.0	0.0
Approach	181	3.5		0.094		1.7	NA	0.3	2.2				
North: Austral Ave (N)													
Lane 1	114	3.5	1099	0.104	100	6.3	LOS A	0.4	2.6	Full	100	0.0	0.0
Approach	114	3.5		0.104		6.3	LOS A	0.4	2.6				
West: Eton Rd (W)													
Lane 1	82	3.5	1998	0.041	100	4.2	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	82	3.5		0.041		4.2	NA	0.0	0.0				
Intersection	377	3.5		0.104		3.6	NA	0.4	2.6				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

▽ Site: 04_Eton Road_Austral Avenue Future School

Giveway / Yield (Two-Way)

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Eton Rd (E)													
Lane 1	262	3.5	1933	0.136	100	1.5	LOS A	0.4	3.1	Full	500	0.0	0.0
Approach	262	3.5		0.136		1.5	NA	0.4	3.1				
North: Austral Ave (N)													
Lane 1	64	3.5	1067	0.060	100	6.5	LOS A	0.2	1.5	Full	100	0.0	0.0
Approach	64	3.5		0.060		6.5	LOS A	0.2	1.5				
West: Eton Rd (W)													
Lane 1	75	3.5	1999	0.038	100	4.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	75	3.5		0.038		4.1	NA	0.0	0.0				
Intersection	401	3.5		0.136		2.8	NA	0.4	3.1				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

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