

NSW Department of Education and
School Infrastructure NSW

**Lindfield Learning Village Phase
2 and 3**

Traffic and Transport Assessment
Response to Submissions

Issue | 11 September 2019

This report takes into account the particular
instructions and requirements of our client.

It is not intended for and should not be relied
upon by any third party and no responsibility
is undertaken to any third party.

Job number 251272

Arup Pty Ltd ABN 18 000 966 165

Arup
Level 5
151 Clarence Street
Sydney NSW 2000
Australia
www.arup.com

ARUP

Contents

	Page
1 Introduction	1
1.1 Overview	1
1.2 Arup Traffic and Transport Reports	2
1.3 Response to Submissions	2
1.4 Consultation	3
2 Agency comments	4
2.1 Roads & Maritime Services Comments	4
2.2 Transport for NSW Comments	6
2.3 Ku-ring-gai Council Comments	9
2.4 Department of Planning & Environment	14
2.5 Action for Public Transport	17
3 Phase 1 School	18
3.1 Drop-off and pick-up access	18
3.2 Pedestrians	22
3.3 Bus Facilities	23
3.4 Travel survey	23
3.5 Phase 1 school travel	25
3.6 Traffic surveys	26
3.7 Traffic distribution	29
3.8 Traffic modelling	30
4 Stage 2 and 3 School	32
4.1 School population	32
4.2 Car parking for school activity	32
4.3 After hours parking	33
4.4 School travel modes	35
4.5 Traffic analysis	38
5 Right turn bay on Pacific Highway at Grosvenor Street	45
5.1 Potential Strickland Avenue upgrades	48
6 Drop-off/ Pick-up Facilities	49
6.1 Bus facility	49
6.2 Private car facility	51
6.3 Loop road vehicle swept paths and management	51
7 Emergency vehicles	53

Appendices

Appendix A

Meeting Minutes

Appendix B

Turning paths for RFS

1 Introduction

1.1 Overview

This Traffic and Transport Assessment has been prepared by Arup on behalf of the NSW Department of Education and School Infrastructure NSW (the Applicant). It accompanies a Response to Submissions Report in support of State Significant Development Application (SSD 16_8114) for Lindfield Learning Village (the site).

On 24 October 2018 the Minister for Planning granted partial development consent to SSD 8114 for Phase 1 construction and operation of a new school for 350 students. The remainder of SSD 8114 (as originally proposed) has not yet been granted consent and has been subject to further investigation, assessment and engagement with the relevant agencies (DPE, RFS, OEH, RMS, TfNSW) and Council.

The Response to Submissions and supporting documents seek approval for the remainder of SSD 8114, being:

Phase 2(a):

- Minor internal works within the approved Phase 1 area to accommodate an additional 35 students.
- The additional 35 students (a total of 385 enrolled students) is needed for Day 1 Term 1 2020, prior to Phase 2(b) being completed.
- Phase 2(a) will occur immediately on approval to allow the additional students for Day 1 Term 1 2020.

Phase 2(b) of construction:

- Works to accommodate 1,050 students (including the approved 350).
- Repurposing of the Phase 1 area.
- A loop road around the southern portion of the site for emergency vehicles, buses and drop off and pick up vehicles.

Phase 3 of construction:

- Works to accommodate an additional 950 students in the western wing of the building.

Vegetation management will be required to achieve the necessary APZ. The SSD does not seek approval for vegetation management outside the site boundary.

The purpose of this Traffic and Transport Assessment is to

- describe the proposed access arrangements by all modes of travel
- confirm that the Phase 2 and 3 school populations can be accommodated by the proposed travel modes
- confirm that the proposed upgrade works are appropriate for the two stages of school expansion

1.2 Arup Traffic and Transport Reports

Arup submitted a report supporting the development SSD8114 titled “NSW Department of Education and Communities, Lindfield Learning Village, Traffic and Transport Assessment, Rev C, 13 June 2017”. This report will be referred to as “the TTA”.

Arup submitted a report supporting the Phase 1 school titled “Supplementary Traffic and Transport Assessment, Issue, 1 June 2018”. This report will be referred to as “the TTA Supplementary”.

1.3 Response to Submissions

This Traffic and Transport Assessment has considered the issues raised by agencies during exhibition of SSD 8114 and subsequent Response to Submissions for Phase 1.

Agency comments received on the TTA and the TTA Supplementary are summarised in Table 1. The following sections of this report provide responses to the comments.

Table 1: List of comments and organisations

Section	Date of submission	Organisation	Document name
SSD 8114			
2.1	14/08/2017	Roads & Maritime Services	Lindfield Learning Village - 100 Eton Road, Lindfield
2.2	11/08/2017	Transport for NSW comments	Lindfield Learning Village (SSD 8114) Notice of Exhibition
2.3	9/08/2017	Ku-ring-gai Council Comments	Proposed Lindfield Learning Village, UTS site 100 Eton Road, Lindfield
2.4	16/08/2017	Department of Planning & Environment	Lindfield Learning Village - 100 Eton Road, Lindfield (SSD 8114)
2.5	6/08/2017	Action for Public Transport (NSW) Inc. Department of Planning & Environment	Lindfield Learning Village Submission on EIS
Supplementary Traffic and Transport Assessment - Phase 1 School			

Section	Date of submission	Organisation	Document name
2.1	25/07/2018	Roads & Maritime Services	Lindfield Learning Village - 100 Eton Road, Lindfield
2.2	20/07/2018	Transport for NSW comments	Lindfield Learning Village (SSD 8114) Response to Submissions
2.3	17/07/2018	Ku-ring-gai Council Comments	Response to Submissions for Lindfield Learning Village (SSD 8114) - 100 Eton Road, Lindfield

1.4 Consultation

A number of meetings regarding the traffic and transport issues were held with representatives from Department of Planning and Environment, RMS, TfNSW, Ku-ring-gai Council, Schools Infrastructure, Arup, DesignInc and Savills. The meeting minutes for meetings held for the Stage 2 and 3 development are included in Appendix A.

2 Agency comments

2.1 Roads & Maritime Services Comments

Table 2: Roads & Maritime Services

R#	Comment	Arup response
SSD 8114 TTA		
R1	[1] Given the narrow nature of the Eton Road access to the campus/school grounds, Roads and Maritime requires clarification regarding emergency vehicle access in emergencies.	Discussed in section 7.
R2	[2] The existing bus bay/turnaround facility has inadequate holding capacity for the proposal as the proposed bus volumes will queue out onto Eton Road. Roads and Maritime does not consider the proposed bus bay appropriate for the following reasons:	The Eton Road bus bay will be used only for Route 565 Services.
R3	[2.1] The bus bay rank arrangement only allows for buses to arrive in a specific order to access their specific route rank. If buses arrive out of order, heavy delays will result from buses having to queue outside the bus bay. There are no opportunities available for buses to leap frog each other to get into the correct order before proceeding into the bus bay.	All school buses will utilise the new school loop road which provides good storage for buses. (Section 6.1)
R4	[2.2] Buses using the bus bay do not appear to have enough clearance to safely navigate the bus bay without rubbing up against concrete walls or pedestrian fences. The 600mm body clearance has not been achieved.	Only the route 565 bus service will continue to use the Eton Road bus bay.
R5	[2.3] Buses exiting the bus bay are required to mount the western kerb of Eton Road when turning right. This will damage the kerb as it is repeatedly run over by buses as well as increase the wear and tear of buses.	There will be no change to the existing operations of the Eton Road bus bay.
R6	[2.4] The existing bus bay cantilever structure was constructed to a single bus at the time. Roads and Maritime requires clarification that the existing structure can handle the extra 3 buses, passengers and kerb without failing.	There will be no change to the existing operations of the Eton Road bus bay.
R7	[3] Roads and Maritime will not support non-standard School Zone times.	A standard School Zone has been installed. Staggered finish times are with the standard school zone times.
R8	[4] Roads and Maritime require further information regarding mode share. The current submission assumes that 50% of	Lindfield Public School has been surveyed and discussed in section 6.1 of the TTA.

R#	Comment	Arup response
	kindergarten to Grade 6 students will use school buses to travel to school. Section 6 case studies provide no evidence that kinder to grade 6 children will use school buses when travelling to and from school, rather the evidence indicates that parents either drive to school or park nearby and walk children to school	A travel survey for the Phase 1 school with 350 students has identified the existing and potential bus users as: K-2 Existing 15%, potential 31% 3-6 Existing 40%, potential 60% 7-10 Existing 85%, potential 100% (Section 3.4.1)
R9	[5] Section 5.2.3 of the submission stipulates that it may take 14 mins for parents to drop their children off at school. This is an unacceptable delay that would result in driver frustration. The queue lengths, particularly on rainy days when more children will arrive by car, will likely have heavy impacts on local traffic.	Analysis updated in Section 6.2
R10	[6] It is unclear that the submitted modelling includes the 160 Staff for the proposed school. Furthermore it is understood a child care facility will be incorporated on site, Roads and Maritime requires more information regarding the impacts of the proposed child care centre.	Staff are included.
R11	[7] The foot paths along Eton Road are very narrow and hard up against the kerb. Roads and Maritime raises safety concerns over children accidentally falling onto the road shared with other traffic including buses due to the large volume children who are expected to use these facilities to walk to school.	Footpaths have been upgraded as described in Section 3.2.
R12	[8] It is not acceptable to remove the bus stop on Pacific Highway to facilitate right turn extension. Roads and Maritime requires further information regarding the impacts of extending the Pacific Highway right turn lane into Grosvenor Road without removing the existing bus stop:	A fully surveyed concept design of the right turn bay has been prepared. (Section 5) TfNSW has agreed that the bus stop can stay as an in lane stop. The Lady Game Drive route is heavily saturated and intersection works will not alleviate this issue.
R13	[8.1] A civil investigation incorporating the property impacts and a cost estimate of works (including utility relocation).	
R14	[8.2] The modelling assessment indicates that the proposed right turn bay extension to 170m is shorter than the future queue length of 200m. Roads and Maritime raises concerns that the queue will regularly block through traffic on the Pacific Highway and cause significant congestion.	
R15	[9] Roads and Maritime requests the applicant to investigate the following congestion alleviating upgrades:	

R#	Comment	Arup response
	<ul style="list-style-type: none"> Duplicate the Pacific Highway right turn bay into Grosvenor Road (including the entrance of Grosvenor Road) to accommodate the traffic generated by the proposed school. Upgrade the intersection of Lady Game Drive and Grosvenor Road to increase through put so that there will be an alternative access to the proposed school other than Pacific Highway. 	
TTA Supplementary		
R16	Bus turnaround facilities - Buses will be scheduled to arrive ahead of the pick-up time. Buses will therefore wait in order and depart at the same time. These arrangements should be provided to Council's satisfaction.	The route 565 bus is currently providing for student access to the Phase 1 school utilising the existing Eton Road bus facility.
R17	Footpaths on Eton Road - The footpaths on Eton Road are very narrow. In this regard, the footpath upgrades should be provided to the satisfaction of Council as stipulated in section 3.5.3 of the Traffic and Transport Assessment Report.	Footpath upgrades have been carried out by Ku-ring-gai Council.
R18	Intersection upgrades - The duplication of the right turn bay into Grosvenor Road and upgrading the intersection of Lady Game Drive and Grosvenor Road is required.	The Grosvenor Road upgrade will be required for Stages 2 and 3.

2.2 Transport for NSW Comments

Table 3: Transport for NSW

R#	Comment	Arup response
SSD 8114 TTA		
R19	<p>Comment</p> <p>The Transport Impact Assessment (TIA) (Arup, June 2017) has assessed that the Pacific Highway/ Grosvenor Road/ Burleigh Street intersection currently operates at a Level of Service (LOS) C. The future operation of this intersection has been assessed to operate at LOS F (overcapacity) in the absence of any improvements. A suggested intersection upgrade is provided which involves the extension of the southbound right-hand turning lane into Grosvenor Road and the removal of the northbound kerbside bus lane. TfNSW does not support this upgrade option as the kerbside bus lane is</p>	Please refer to the revised modelling discussed in Section 4.5 of this report.

R#	Comment	Arup response
	<p>currently being used. As such, alternative improvements should be investigated.</p> <p>Recommendation</p> <p>TfNSW requests that the proponent investigates alternative intersection improvements, in consultation with Roads and Maritime, which maintains the availability of the northbound kerbside bus lane.</p>	
R20	<p>Bus Stop Design</p> <p>Comment</p> <p>It is likely that a number of school buses would be using the proposed bus bay at the same time. Due to the curvature and dimensions of the current design, no buses will be able to overtake other buses and/or exit their respective bus bay if there were other buses stopped at any other stops. Furthermore, the curved design would potentially pose a safety risk for children and less mobile patrons as the bus doors would open directly onto the road rather than the footpath.</p> <p>Recommendation</p> <p>TfNSW requests that the proposed bus stop design is revised or relocated having regard for the above comments. TfNSW advises that the existing bus bay would potentially be more suited to a pick-up and dropoff location for motor vehicles.</p>	Refer to Section 6.1.
R21	<p>Cycling Access and Bicycle Parking Provision</p> <p>Comment</p> <p>The TIA assesses the requirement for 42 bicycle parking spaces and that the existing facility satisfies this requirement. The location of these spaces (existing and proposed) should be documented within the TIA and assessed for compliance with AS2890.3. Furthermore, the TIA should also identify potential cycle routes and assesses the safety of these routes.</p> <p>Recommendation</p> <ul style="list-style-type: none"> • The proponent clarifies the location, type and quantity of end-of-trip facilities to be provided; • The proposed bicycle facilities should be located in secure, convenient, accessible areas close to main entries, incorporating adequate lighting and passive surveillance 	<p>Future bicycle facilities on local streets will need to be coordinated through the Council Bike Plan.</p> <p>Shower facilities will be provided for staff as an end-of-trip facilities. Lockers for staff will also be considered.</p> <p>Bicycle facilities have been provided as part of the Phase 1 school and will be upgraded if demand warrants.</p>

R#	Comment	Arup response
	<p>and in accordance with Austroads guidelines;</p> <ul style="list-style-type: none"> • Separate end-of-trip facilities should be provided for staff and students; and • The proponent identifies potential cycle routes and assesses the safety of these routes. 	<p>Students will be able to use sports shower facilities</p> <p>New footpath facilities have been installed which allow for student cycling.</p>
R22	<p>Travel Plan</p> <p>Prior to commencement, the applicant is to submit a Green Travel Plan for the Secretary's approval, prepared by a suitably qualified person and addresses the following requirements:</p> <ul style="list-style-type: none"> • Measures and initiatives to promote and encourage cycling, walking, public transport and carpooling as alternative transport modes; • Provision of a travel access guide, which would be issued to new students, parents and staff; and • Methods to monitor the effectiveness and uptake of sustainable travel measures. <p>Road Safety Audit</p> <p>Prior to the issue of construction certificate, a Detailed Design Road Safety Audit (RSA) on the proposed bus stop design shall be undertaken and appropriate road safety measures should be implemented based on the outcomes of the RSA.</p> <p>Walking</p> <p>The proponent is to undertake a Pedestrian Accessibility and Mobility Plan (PAMP) (in consultation with Council/RMS, where relevant) to identify and assess the required pedestrian safety and accessibility improvements to accommodate the future use of the site. The improvements identified within the PAMP must be implemented prior to commencement to ensure that adequate walking infrastructure is available.</p> <p>Additional Bus Services</p> <p>The TIA assesses the need to increase the frequency of Bus Route 565 services based on increased patronage from students and teachers. TfNSW would consider the additional services of the current route; subject to the TfNSW Growth Services Initiative. This would also require further discussion and assessment with the proponent prior to any agreement.</p>	<p>Green Travel plan completed for Phase 1 school.</p> <p>Footpaths have been upgraded in consultation with Council.</p> <p>Transdev has recommended that additional Route 565 services be introduced in the peak periods.</p>

R#	Comment	Arup response
TTA Supplementary		
R23	Bus serviceability - Consult further with TfNSW to address operational requirements for remaining phases.	Transdev are developing school bus services with routes aligned with the catchment and to meet the staggered departure times.
R24	School bus plan for Phase 1 - Develop school bus plan in consultation with TfNSW prior to school commencement.	The catchment area information has been provided to Transdev and TfNSW so that they can develop the school bus routes.
R25	Cycling access and bicycle parking provision - Details required on location/type of EOTF for staff and students. Identify and assessment potential cycle routes.	Bicycle facilities have been provided as part of the Phase 1 school and will be upgraded if demand warrants. Shower facilities will be provided for staff as an end-of-trip facilities. Lockers for staff will also be considered.
R26	Changes to parking controls on Eton Road - May require approval from Council's Local traffic committee and should be undertaken as soon as possible.	Changes to parking controls have been installed by Council. Further changes will involve discussion with Transdev about bus operations along this route.

2.3 Ku-ring-gai Council Comments

Table 4: Ku-ring-gai Council

R#	Comment	Arup response
SSD 8114 TTA		
R27	[4.1.1] Catchment - In terms of the school catchment area, the assessment notes that the school would have a wider catchment but it is unclear whether this means wider than the 2km buffer shown in Figure 15 or some other parameter. This needs to be clarified.	The final catchment area is still being determined and will be submitted to Council at a later stage. It however, will not affect the traffic and transport assessment.
R28	[4.1.2] Drop-off and pick-up access - the proposed drop-off and pick-up areas are supported, but the times where it is proposed to implement "No Parking" and "5 Minute Parking" restrictions (to allow efficient turnover) do not align with the proposed staggered opening/closing times, and, as a result, the full capacity of the drop-off and pick-up areas may not be available prior to 8.30am. Also, given the location of the proposed drop-off and pick-up areas with respect to the school buildings, and the site topography, there is no identification of accessible paths of travel.	The Phase 1 school drop-off area is working satisfactorily and signage requirements are being monitored. Wayfinding signage is in place at all key locations for both motorists and pedestrians. This includes drop-off and pedestrian entrance locations as well as all required road safety requirements at key crossing locations.
R29	[4.1.3] Eton Road Bus Bay - the proposed widening of the footpath in the Eton Road	The Eton Road bus bay will be used only for Route 565 Services.

R#	Comment	Arup response
	<p>bus bay is supported, to cater for the expected numbers of students, although it should be clarified whether the proposed footpath width is adequate if the mode split to buses increases towards the levels currently experienced at Killara High School. There should also be a requirement to extend and widen the existing bus shelter/canopy to provide weather protection, and to provide adequate lighting in and around the shelters (for after-hours/evening events, so that dedicated shuttle bus services can be implemented if necessary).</p> <p>There is no identified path between the Eton Road bus bay and the main school building, which is expected to be the principal connection for students walking between the bus stop and the main school building. This path should be wide enough to cater for expected student movements and be adequately lit (for afterhours/evening events).</p>	All school buses will utilise the new school loop road which provides good storage for buses. (Section 6.1)
R30	[4.1.4] <i>Parking</i> - Given the history of the site and the on-going parking issues experienced by the nearby residents, there is an opportunity to address and contain the impacts to the site. Relying on surrounding on-street areas to accommodate spill over parking is not supported and parking generated by the proposal should be contained within the site as far as possible.	See Section 4.2.
R31	[4.1.5] Cycle routes and bicycle parking- The cycle routes shown in section 3.5.4 are fairly limited in terms of applicability to the site. There is a missing link from the site to the existing cycling facilities in Lane Cove National Park and most of the cycling network in the Ku-ring-gai LGA is largely absent. The north-south parallel route to Pacific Highway is probably too far from the site and not of a standard (on road/missed traffic) to allow primary school age children to cycle safely to school. In principle, the use of the existing bicycle parking facilities is supported, although further investigations should be undertaken to determine if they comply with the relevant Australian Standards in terms of location, type and class of facility and should be of a configuration such that bicycle parking facilities can be expanded if the demand for it increases.	It is agreed that existing cycle routes are limited. Council should investigate the possibility of upgrading key routes leading to the school.
R32	[4.1.6] The frequency of the existing 565 service operated by Transdev is not attractive enough to encourage commuters to use it to access Lindfield/Roseville	TfNSW would consider the additional services of the current route; subject to the TfNSW Growth Services Initiative. This would also require further discussion and

R#	Comment	Arup response
	<p>railway stations or employment areas in Macquarie Park/Chatswood. It is agreed that improvement to bus frequencies is required to make attractive connections to the nearby railway stations.</p> <p>Pedestrian infrastructure between the site and Lindfield railway station is either nonexistent or non-compliant at various points along the site and should be addressed before the Learning Village opens. The Assessment suggests that a Pedestrian Access and Mobility Plan (PAMP) should be prepared to assess pedestrian access and safety improvements, although it is our view that this should be prepared by the applicant and improvements be undertaken by the applicant.</p>	<p>assessment with the proponent prior to any agreement.</p> <p>Footpath upgrades have been completed by Council.</p>
R33	<p>[4.4.1] Traffic distribution - The assessment suggests that vehicles arriving in the morning peak to the site from Lady Game Drive (travelling southerly) would divert to Highfield Road, Pacific Highway and Grosvenor Road, due to congestion near the roundabout at Grosvenor Road. While it is agreed that vehicles would divert away from the intersection with Grosvenor Road, there are shorter alternatives to the Highfield Road/Pacific Highway/Grosvenor road route (i.e. Highfield Road/Primula Street/Polding Road/Bent Street/Grosvenor Road), which would be more attractive than entering and leaving Pacific Highway as suggested in the assessment. It is unclear what the effect would be on this alternative route when additional of 25% of the total site traffic generation is assigned to this route. This needs to be clarified.</p>	<p>Arup agrees with these findings with revised modelling discussed in Section 4.5 of this report.</p>
R34	<p>[4.4.2] Local road impacts The assessment notes that the Learning Village would perform at a similar level to the former UTS operation, and that local roads would experience higher peak hour traffic but lower off-peak traffic volumes. While this may be the case, the traffic volumes on some of the local roads (such as Eton Road north-east of Austral Avenue) had exceeded the 300 vehicles per hour maximum desirable environmental goal recommended for local roads (as per the RTA Guide to Traffic Generating Developments) when UTS was operating, and are likely to exceed this threshold again when the Learning Village commences operation. During the UTS operation, traffic probably increased in an</p>	<p>Traffic calming could be considered on the local access streets if traffic behaviour needs to be managed. The volume of traffic will be determined by the ultimate level of development in the precinct and the associated level of car use. Any traffic calming would need to be compatible with bus access.</p>

R#	Comment	Arup response
	incremental fashion and Council ultimately was not in a position to request traffic calming improvements from UTS. In this case though, the impacts of the proposal are known and the Learning Village should be required to contribute towards traffic calming and amenity improvements along those local roads where the environmental thresholds would be exceeded.	
R35	[4.4.3] Historical Traffic Volumes – 2007 - The comment is made that the desirable maximum of 2,000 vehicles per day for local roads assumes that the road services residential areas only, and that this would historically not apply to this area/proposal due to the presence of UTS Ku-ring-gai and Film Australia. This assumption is incorrect as the Film Australia site has since been rezoned for residential development, and the former UTS Ku-ring-gai site has partly also been rezoned for housing. Given that the whole length of Eton Road (with the exception of the southwestern-most end) is now a low density residential area, it would be unfair and inappropriate to apply this rationale and somehow avoid any ameliorative measures to the residents along Eton Road.	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.
R36	[4.5.1] Pacific Highway and Grosvenor Road - Ku-ring-gai's commuter road network model, prepared for the Lindfield local centre, suggests that the current operation of the intersection of Pacific Highway and Grosvenor Road is at capacity and future traffic increases will exacerbate this. This model has been submitted to Roads and Maritime Services for their eventual concurrence, and envisages (amongst other things) minor capacity improvements on the Grosvenor Road approach to the intersection, as well as new traffic signals at the intersection of Pacific Highway and Strickland Avenue.	Revised modelling discussed in Section 4.5 of this report.
R37	[4.5.2] Lady Game Drive - Planned upgrades identified by Council at 2 intersections on Lady Game Drive have been cited in the assessment. The proposal is likely to add pressure to these intersections and NSW DEC should be required to provide the suggested upgrades or at least contribute to them.	The Lady Game Drive congestion is an existing issue. Congestion is present despite the site being vacant. Southbound traffic along Lady Game Drive to the site will predominantly use the Lady Game Drive / Grosvenor Road roundabout, and not the Millwood Avenue intersection. The cause of the Lady Game Drive congestion is a result of downstream intersection inefficiencies at Lady Game Drive / Millwood Avenue and other intersections. Future traffic would not affect the critical downstream intersection performances.

R#	Comment	Arup response
		As such the learning village should not be required to provide upgrades or contribute to them.
R38	[4.6] The construction traffic vehicle routes shown in Figure 53 suggest Lady Game Drive would be an access route from the south-west. It should be noted that Lady Game Drive is a load limited road and due to its horizontal and vertical alignment is not suited to ongoing construction traffic, especially large rigid trucks and articulated heavy vehicles. Also, heavy construction vehicles travelling on Grosvenor Road may be subject to movement restrictions during School Zone times, to minimise conflicts with drop-offs and pick-ups associated with Lindfield Public School. Further consultation with Ku-ring-gai Council is recommended for the development of the construction routes.	Was incorporated into the Detailed Construction Management Plan.
TTA Supplementary		
R39	Private vehicles - How will pick up operation be achieved.	There is extensive queuing area on the site if parents do choose to come early. We are trying to spread the load by asking parents to arrive after the finish time so that students are ready to be picked up. A system of matching students to cars is being utilised to assist with efficient operations at pick-up time.
R40	Bicycle Parking - Comply with AS	The existing bicycle racks at the front door to the school are in good condition and will be used by students. Any additional racks needed to meet demand will comply with the standard.
R41	On-Street parking - any changes to parking restrictions on Eton Road need to be approved by Traffic committee.	Noted.
R42	No parking restrictions On both sides of Eton Road between Austral Ave and curve of Austral Ave is excessive. Only the southern side of Eton Road be considered for No Parking restrictions between (approximately) 76 Eton Road at the curve west of Austral Avenue, and on a part-time basis (7am-9.30am, 2.30pm-4.30pm, School Days only).	Southern side only as proposed by Council is likely to provide the desired outcome. This should be subject to ongoing monitoring by the bus company to ensure safe passage of vehicles.
R43	Pedestrian footpaths - Upgrading the footpath width to 2m would not be satisfactory for subsequent stages when student numbers are projected to reach 2,100. The location of the bicycle racks near the entrance to the main building suggests that the route of the upgraded footpath	Footpaths were widened to be as wide as can be accommodated within the constraints of the available verge and trees. Up to 2.5m was achieved between the back of kerb and the property boundary. This is a good outcome for pedestrian access with occasional use by shared bicycles in the first phase.

R#	Comment	Arup response
	(between the Eton Road bus stop and the bike racks) would likely be used by children riding bicycles to school, necessitating additional width and possibly some separation.	
R44	Pedestrian crossing within the site - The distance pedestrians need to cross is excessive, and should be reduced.	A reduced crossing distance was incorporated into the design which has now been implemented.
R45	Footpath upgrades on the local road network - Footpath works and facilities on the surrounding road network should be funded and implemented by the applicant prior to the commencement of Phase 1.	Footpath works on the local road system were completed by Ku-ring-gai Council.
R46	Bus facilities.	All school buses will utilise the new school loop road which provides good storage for buses. (Section 6.1)
R47	Transport strategies.	Transport strategy/ Green Travel Plan (GTP) are being developed and implemented for school operations. A framework GTP has been developed for use by the school.
R48	Stage 1 revised traffic distribution - Does not address potential impact/growth in traffic on certain local roads.	See Section 4.5.2.
R49	Stage 2 assessment - Various comments.	Updated assessment contained in this report.

2.4 Department of Planning & Environment

Table 5: Department of Planning & Environment

R#	Comment	Arup response
SSD 8114 TTA		
R50	[1.1] Road Network Upgrades	Please refer to the revised modelling discussed in Section 4.5.1 of this report.
R51	[1.2] The TTA (p.25) has assumed northbound traffic movements in proximity to the site to include up to 94 vehicle movements generated by the full completion of the surrounding Defence Housing Australia (DHA) sites. The Department supports the traffic assumptions made in relation to the DHA sites, however, the TTA has not considered additional traffic movements that would be generated by the future development of the former Screen Australia site, located on the corner of Eton Road and Shout Ridge. Further, the historic traffic volumes from 2007 outlined at Section 10.2.3 of the TTA does not provide an accurate indication of current traffic volumes, particularly given	The former screen Australia site is likely to consist of no more than 100 apartments. Applying a trip generation rate of 0.19 vehicles per unit in the peak hour would result in only 19 vehicles and is deemed negligible and arbitrary in the assessment. The modelling considers highly conservative volume assumption which more than compensates for the 19 vehicles.

R#	Comment	Arup response
	<p>the development of the surrounding area that has occurred in that time.</p> <p>The Department requests the traffic assumptions provided in the TTA (including traffic volumes and the performance of intersections) be updated to account for the future traffic volumes that would be generated by the development of the former Screen Australia site. The traffic assumptions should take into account the fact that this site, being zoned R1 General Residential, has the potential for multi-storey housing including residential flat buildings.</p>	
R52	<p>[1.3] The TTA primarily focuses on traffic impacts to higher-order roads and intersections, most notably the Pacific Highway, Lady Game Drive and Grosvenor Road. The TTA does not adequately assess the impact of increased traffic generated by the proposed school on local roads throughout the surrounding residential catchment. Further, the TTA (p.2) notes that the total daily traffic demand on local roads would perform at a similar or lower level than during 2 the site's operation as a university campus. The Department questions this assumption, particularly given the completion of several multi-storey residential housing sites in proximity to the site, post university operations.</p>	
R53	<p>[1.4] The TTA states that a staged opening of the proposed school is essential to reasonably allow for traffic impact monitoring and review of the final operating scale (p.3). The Department supports this recommendation, particularly in response to the uncertainty of the surrounding road network to accommodate the proposed development.</p> <p>The Department requests the Applicant consider a staged opening of school operations to allow for traffic impact monitoring and the implementation of suitable traffic management measures (should any future monitoring identify the need for such measures). The RtS should outline a proposed staged opening strategy for the proposed school.</p>	Phase 1 school operating for 350 students.
R54	<p>The TTA (p.19) notes the poor pedestrian accessibility to the site with several footpaths and key crossing facilities missing. The TTA recommends the missing footpath and pedestrian crossing</p>	See Section 3.2.

R#	Comment	Arup response
	<p>links be addressed to encourage walking and improve pedestrian safety, prior to opening of the school.</p> <p>The Department requests the RtS propose a suite of upgrades to the existing pedestrian footpath network and establishment of appropriate pedestrian crossing facilities in proximity to the proposed school. Figure 8 of the TTA (p.20) shows the location of potential footpath upgrades and pedestrian crossing locations which should be considered for any future works. Evidence of consultation with Council regarding future upgrade works should be provided as part of the RtS.</p>	

2.5 Action for Public Transport

Table 6: Action for Public Transport

R#	Comment	Arup response
SSD 8114 TTA		
R55	Don't have staggered starts.	The school will not have staggered start times.
R56	Allow buses onto campus.	A school bus loop is being provided on campus for stages 2 and 3.
R57	Operate a small fleet of dedicated buses. Offer long-day childcare only.	School buses services will be provided by Transdev to supplement the regular route service and school drop-off and pick-up times. The need for dedicated bus services for this school only will be considered as part of this service mix.
R58	Prohibit parent cars from campus at peak times with exceptions for mobility problems.	The drop-off/ pick-up arrangements on site are designed for efficient throughput. There is not room on the public road system for this activity to occur.
R59	Kindergarten drop-offs and pickups would have to be (say) 15 minutes after the morning peak and 15 minutes before afternoon peak respectively.	Separate car parking spaces will be allocated to accommodate kindergarten drop-off and pick-up.
R60	Provide drop-off and pick-up facilities at appropriate locations in Eton Road and either Abingdon Road or Westbourne Road. Some cover from rain might be appropriate.	It is not considered appropriate to formalise drop-off and pick-up facilities on public roads. There may be a small amount of informal activity with minimal impact expected.
R61	Devise tactics for deterring parent and other unessential traffic from Eton west of Austral and Abingdon west of Westbourne during school peak hours. Efficient shuttle services should be provided inside that area.	Eton Road is the primary access route to the school and served the site when it was occupied by UTS. It is expected that Eton Road and Grosvenor Road will be the key access routes from the Pacific Highway.
R62	Devise a procedure for controlling resident cars on campus in the event of any emergency	Emergency plans for fire and other events will include procedures for evacuation including any cars on the site.

3 Phase 1 School

Phase 1 of the school commenced in the 2019 school year and accommodates 350 students and 48 staff. There is a 45 place Out of School Hours Care (OOSH) available on site. The start and finish times are shown in Table 7.

Table 7: School start and finish times

	Start time	Finish time
OOSH	7.00am	-
Year K - 6	8.50am	2.50pm
Year 7 - 10	8.50am	3.10pm
Year 11 - 12	9.10am	3.30pm
OOSH	-	6.00pm

3.1 Drop-off and pick-up access

The drop-off and pick-up locations for the learning village are shown in Figure 1. The Eton Road bus bay is used by the Route 565 bus and the private vehicle drop-off/pick-up zone is within the site.

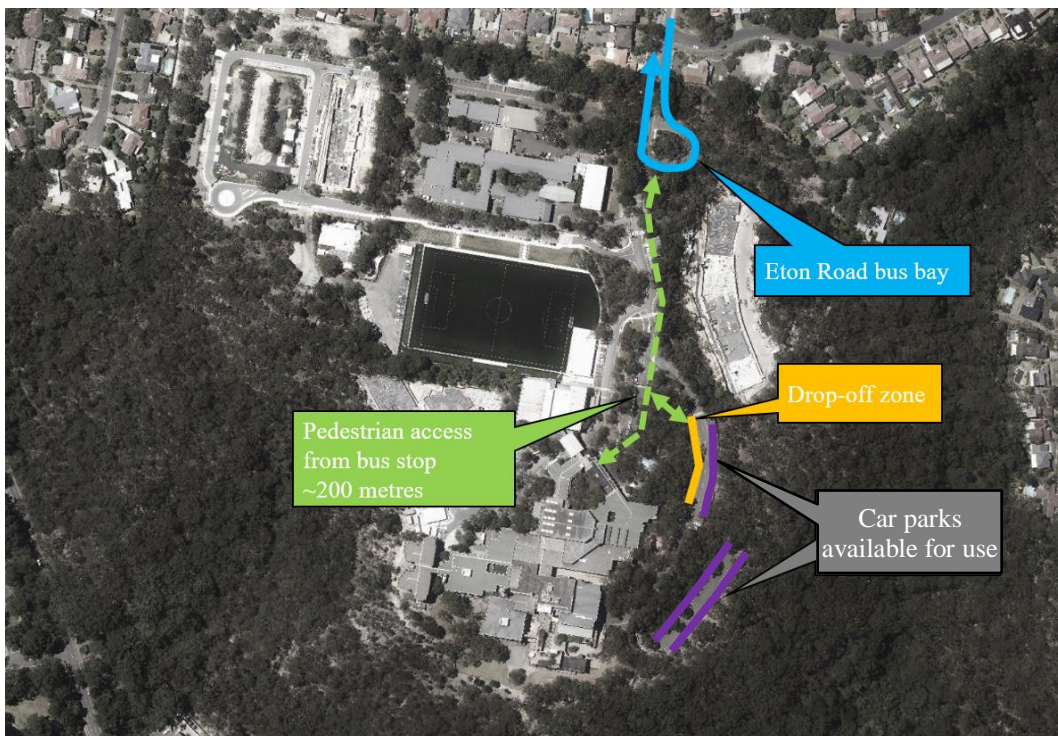


Figure 1: Bus pick-up and drop-off location

3.1.1 Private vehicles

The proposed drop-off and pick-up location is on the upper level car park, which consists of approximately 62 – 90 degree car spaces. A turning head has been installed to allow vehicles to make a U-turn to access the drop-off / pick-up bays.

The arrangement is shown in Figure 2, and allows for 10 vehicles to queue at the drop-off / pick-up bay at any one time. This requires the spaces on the western side to be converted into a car line during the school peak. These bays can then function as parking spaces for visitors, outside of the school peak hours.

Car parking spaces are available to allow parents with younger children to walk with their children from the car to the school building.

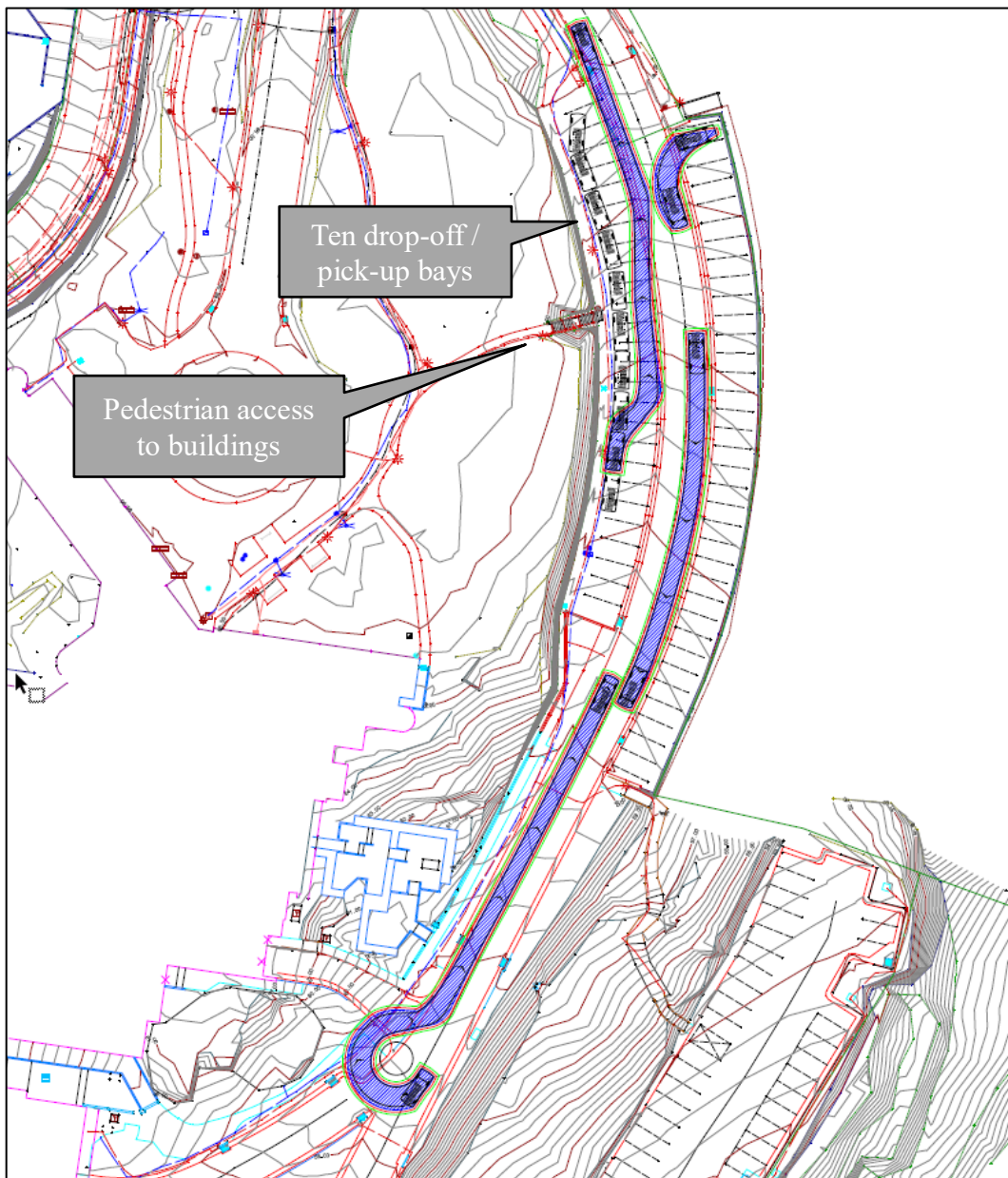


Figure 2: Drop-off / pick-up arrangement with the new turning head



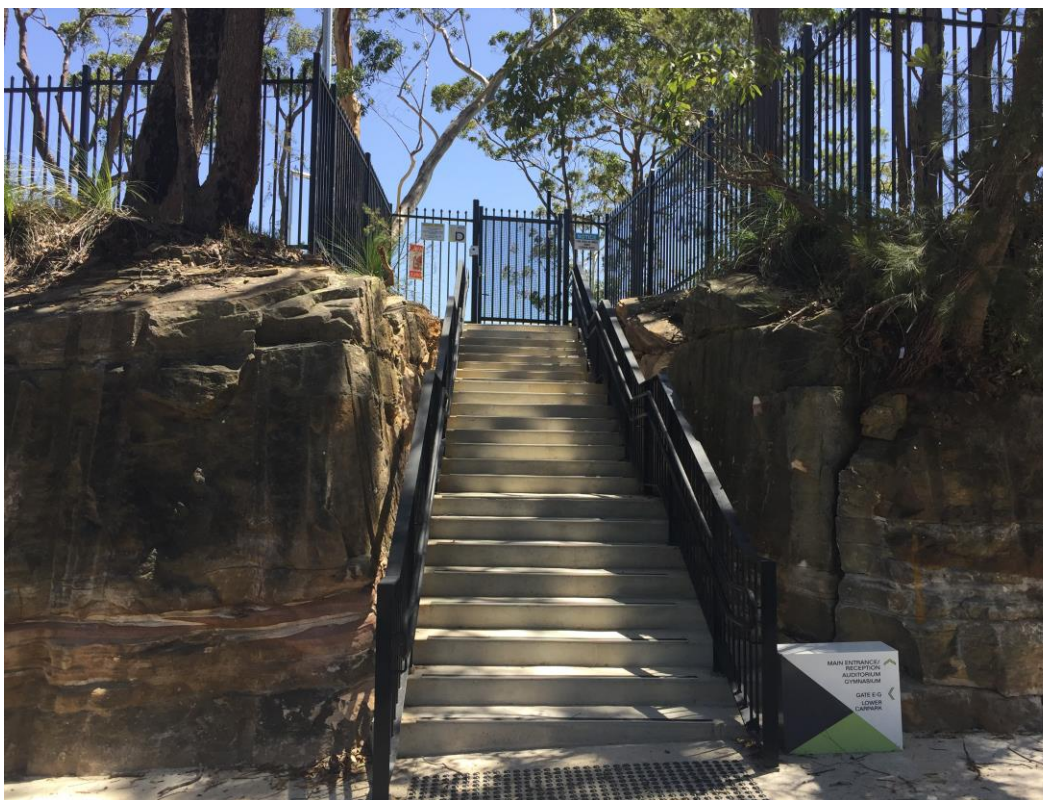
Entry to school – follow the yellow arrows



Approaching the drop-off / pick-up lane



The drop-off/ pick-up lane with removable bollards



Access stair down from student waiting area

3.2 Pedestrians

3.2.1 School Zones

A School Zone has been installed on all roads in the vicinity of the school in consultation with the Roads and Maritime Services.

3.2.2 Footpath upgrades at the school

Pedestrian infrastructure upgrades have been carried out for Phase 1 within the vicinity of the school boundary as shown in Figure 3.

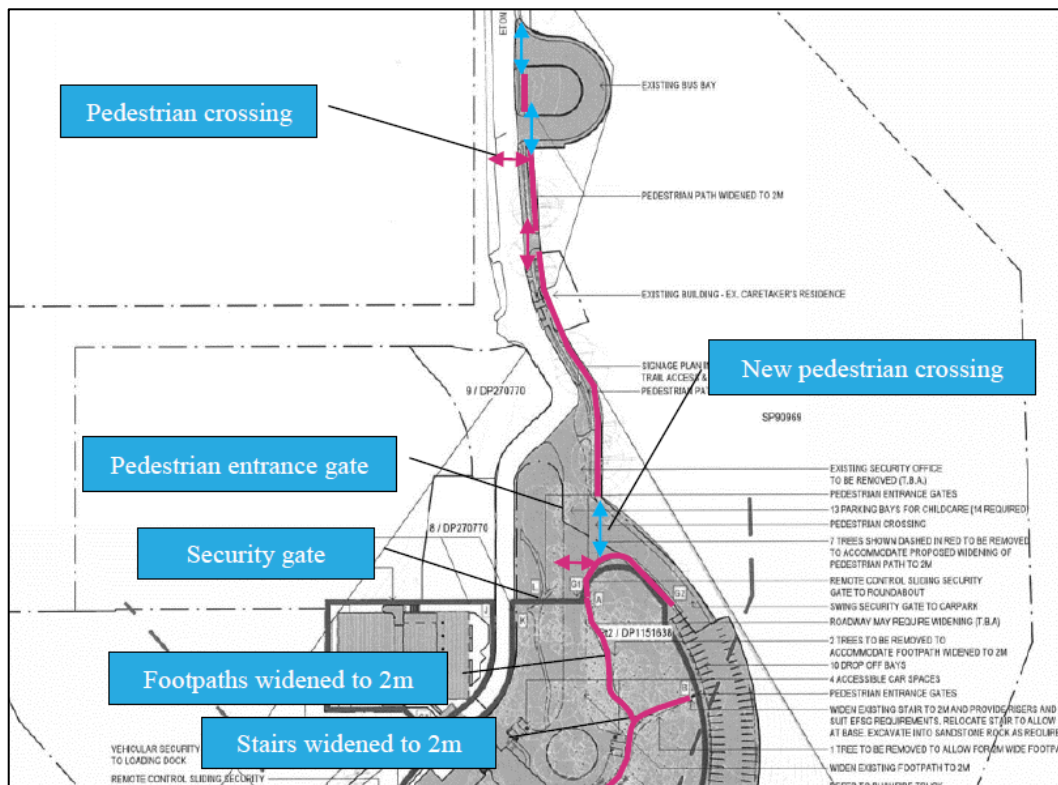


Figure 3: Pedestrian upgrades for Phase 1

3.2.3 Footpath upgrades on the local road network

Further upgrades to the wider local road network have also been undertaken by Ku-ring-gai Council to improve walkability to the school. A continuous footpath route from Lindfield Learning Village to Lindfield Public School and the Pacific Highway has been installed as a good spine route.

3.3 Bus Facilities

The closest bus stop to the site is located along Eton Road, shown in Figure 4. The Eton Road bus bay forms a loop, allowing buses to enter, exit and drop off passengers efficiently. The bus bay currently serves only the Route 565 bus. Students and staff would then walk 200 metres, approximately 2 minutes, to the school.

The bus route services key train stations which have high train frequencies such as Macquarie University, Chatswood, Lindfield and Roseville. Improving the public bus system would not only provide convenient access to the school, but also to existing and future residents living in the vicinity.



Figure 4: Eton Road Bus Bay

3.4 Travel survey

3.4.1 Student travel

A travel survey was undertaken between 27 February and 5 March 2019 by the school with 201 respondents representing 298 students. There was a good spread of respondents across all age groups as shown in Table 8.

Table 8: Comparison of survey respondents to enrolled students

Year	Enrolled students		Survey respondents	
	Number	%	Number	%
K-2	86	25%	81	27%
3-6	120	34%	98	33%
7-10	144	41%	119	40%
Total	350	100%	298	100%

The key reason for undertaking the travel survey was to determine the bus service requirements given that no new bus services were available at the start of the 2019 school year. As such, very detailed information on the use of existing bus services

and the potential for increased use of bus services when new services are provided was collected.

The route 565 bus provides the only current service to the school. The current and potential bus users are shown in Table 9.

Table 9: Existing and potential bus travel

Bus drop-off									
Year	Existing bus users						Potential bus users		
	From Lindfield			From Chatswood	Total bus users	% of year	New	total	% of year
	8:00	8:23	8:40	8:00					
K-2	3	3	2	4	12	15%	13	25	31%
3-6	4	24	2	9	39	40%	21	60	61%
7-10	15	45	14	27	101	85%	19	120	100%
Total	22	72	18	40	152			205	
Bus pick-up									
Year	To Lindfield		To Chatswood		Total bus users	% of year	New	total	% of year
	15:01	15:31	15:13	15:53					
K-2	4	2	6	2	14	17%	13	27	33%
3-6	17	7	18	0	42	43%	21	63	64%
7-10	0	35	63	2	100	84%	19	119	100%
Total	21	44	87	4	156			209	

Based on the findings of the travel survey, a high bus mode can be adopted. For the future stages of the school development, bus services should be planned to achieve the bus mode targets as shown in Table 10.

Table 10: Future bus mode target

Year	Bus mode
K-2	30%
3-6	60%
7-9	80%
10-12	90%

3.4.2 Staff Travel

There are 48 staff of which 90% are assumed to attend on any one day. There is currently a high car mode with car parking available on site. Approximately 40 cars are expected to arrive at the site over the morning peak period and depart after the afternoon school peak.

3.5 Phase 1 school travel

Based on the travel survey and observations during operation of the Phase 1 school, the current travel patterns have been determined.

Table 11: Current travel modes

	Year	Classes	Class size	Enrolled Students		Bus		Walk/cycle		Car Passenger	
						%	No	%	No	%	No
Primary	K	2	20	39	206	15%	6	5%	2	80%	31
	1	1	22	22		15%	3	5%	1	80%	18
	2	1	24	25		15%	4	5%	1	80%	20
	3	1	30	30		40%	12	5%	2	55%	17
	4	1	30	30		40%	12	5%	2	55%	17
	5	1	30	30		40%	12	5%	2	55%	17
	6	1	30	30		40%	12	5%	2	55%	17
Secondary	7	2	30	63	144	80%	50	5%	3	15%	9
	8	1	30	22		80%	18	5%	1	15%	3
	9	1	30	30		90%	27	5%	2	5%	2
	10	1	30	29		90%	26	5%	1	5%	1
	11	0	24	0		90%	0	5%	0	5%	0
	12	0	24	0		90%	0	5%	0	5%	0
Total					350		182		18		151

With an average car occupancy of 1.6 students/car, there are approximately 94 car movements generated for the car drop-off and pick-up. All 182 bus travellers use the Route 565 bus from the Eton Road bus bay. The walk cycle mode is currently low due to the wide spread of enrolments.

The timing of the drop-off and pick-up activity is shown in Table 12.

Table 12: Timing of drop-off and pick-up

Drop-off					Pick-up				
Start	OOSH (70%)	bus pass	car passenger	cars	Finish	OOSH (100%)	bus pass	car passenger	cars
7.00am	20	0	20	13					
8.50am	0	61	115	72	2.50pm	0	61	95	59
8.50am	0	121	16	10	3.10pm	0	121	16	10
9.10am	0	0	0	0	3.30pm	0	0	0	0
					6.00pm	40	0	40	25
Total	20	182	151	94		0	182	151	94

3.6 Traffic surveys

Update traffic surveys were undertaken in 2019:

- Seven day tube count was undertaken on Eton Road, south of Abingdom Road, from Wednesday 15 May to Tuesday 21 May 2019
- A turning movement count was undertaken at the Pacific Highway / Grosvenor Road intersection on Wednesday 15 May 2019

A comparison between the 2016 and 2019 data on Eton Road is provided in Table 13.

Table 13: Comparison of traffic flow on Eton Road between 2016 and 2019

Starting Time	Northbound			Southbound		
	2016	2019	change	2016	2019	change
0:00	1	1	0	0	2	2
1:00	0	2	2	1	4	3
2:00	0	0	0	0	0	0
3:00	1	1	0	0	1	1
4:00	5	3	-2	0	1	1
5:00	7	17	10	3	7	4
6:00	39	53	14	52	36	-16
7:00	70	114	44	24	78	54
8:00 (school peak)	81	224	143	36	150	114
9:00	48	70	22	39	55	16
10:00	40	47	7	30	41	11
11:00	32	43	11	30	34	4
12:00	37	46	9	35	43	8
13:00	40	37	-3	35	42	7
14:00	34	79	45	31	92	61
15:00 (school peak)	55	150	95	42	135	93
16:00	70	100	30	89	168	79
17:00	81	125	44	120	143	23
18:00	66	104	38	96	127	31
19:00	46	68	22	46	108	62
20:00	18	43	25	34	47	13
21:00	18	37	19	19	28	9
22:00	3	6	3	12	21	9
23:00	1	7	6	7	7	0
Total	793	1377	584	781	1370	589

The morning school and commuter peaks coincide at 8.00 – 9.00am. At this time there were an additional 114 vehicles entering the precinct comprising mostly school drop-off traffic with some local traffic and 143 vehicles leaving the precinct comprising new residents leaving for work, student drop-off traffic leaving and other local traffic. The school drop-off traffic of around 82 vehicles (Table 12) aligns well with this.

During the afternoon school peak at 2.30 - 3.30pm there are an approximately an additional 90 vehicles entering and exiting the precinct. This aligns well with the school pick-up traffic of around 69 vehicles (Table 12) with other local traffic.

A comparison of turning movements at the Grosvenor Road / Pacific Highway intersection between 2016 and 2019 is provided in Figure 5. As summarised in Table 14, the results show a very small change in total intersection movements for all peak periods. In all peak periods there have been increases in traffic flow on the right turn movement from Pacific Highway to Grosvenor Road and on the exit movement from Grosvenor Road onto the Pacific Highway.

Table 14: Peak period changes in traffic movements

Peak Period	Total intersection change	Right turn Pacific Hwy to Grosvenor Rd	Grosvenor Road exit
Morning	+1%	+16 veh	+21 veh
Afternoon	+2%	+44 veh	+67 veh
Evening	-1%	+27 veh	+57 veh

This increase in activity would be partially a result of the Phase 1 school in combination with other new residential traffic in the precinct.

Figure 5: Comparison of turning movements at the Grosvenor Road / Pacific Highway intersection between 2016 and 2019

3.7 Traffic distribution

Based on the school enrollments, a proportional split along the vehicular access routes has been derived as shown in Figure 6.

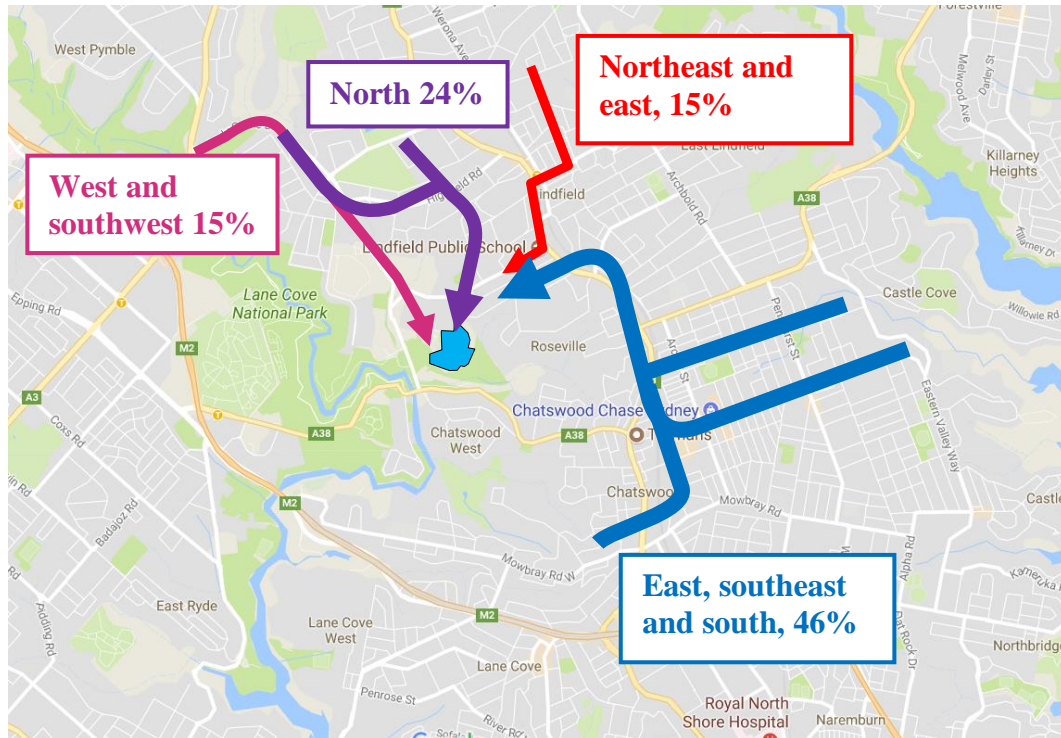


Figure 6: Approximate proportional splits of enrolments based on the school catchment

East, south and southeast (46%) – A majority of the enrolments and hence traffic arrive east and south of the school. Vehicles from the southeast area would make right turns onto the Pacific Highway via various intersections such as William Street, Ashley Street and Boundary Street. Vehicles located nearer to Clanville Road would use the right turn at the Pacific Highway / Clanville Road intersection, to get onto the Pacific Highway. All the vehicles would then turn left onto Eton Road or Westbourne Road from the Pacific Highway.

North (24%) – The next largest proportion of enrolments come from the north of the school, west of the Pacific Highway. Access to Grosvenor Road consists of a permeable local road network, using Bent Street, Highfield Road, Cook Road and Beaconsfield Parade. Most of the routes consist of priority controlled intersections and local roads with low levels of traffic.

West and southwest (15%) – Enrolments from the west and southwest are approximately 15%. These vehicles would use Lady Game Drive.

Northeast and East (15%) – Enrolments from the northeast and east are approximately 15%. Vehicles coming from this area would turn left from Strickland Avenue onto the Pacific Highway southbound. They would then proceed to utilise the right turn bay at the Pacific Highway / Grosvenor Road intersection.

3.8 Traffic modelling

3.8.1 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 15).

Table 15: 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.

3.8.2 Phase 1 traffic generation

For the Phase 1 school, peak traffic flows have been determined as:

- Morning peak entry – 82 student drop-off + 30 staff = 112 cars entering
- Morning peak exit – 82 student drop-off cars departing
- Afternoon peak entry – 69 student pick-up cars entering
- Afternoon peak exit – 69 student cars + 20 staff = 89 cars departing
- Evening peak entry – Nil
- Evening peak exit – 20 staff cars departing

The estimated traffic generation and distribution from each direction is shown in Figure 7.

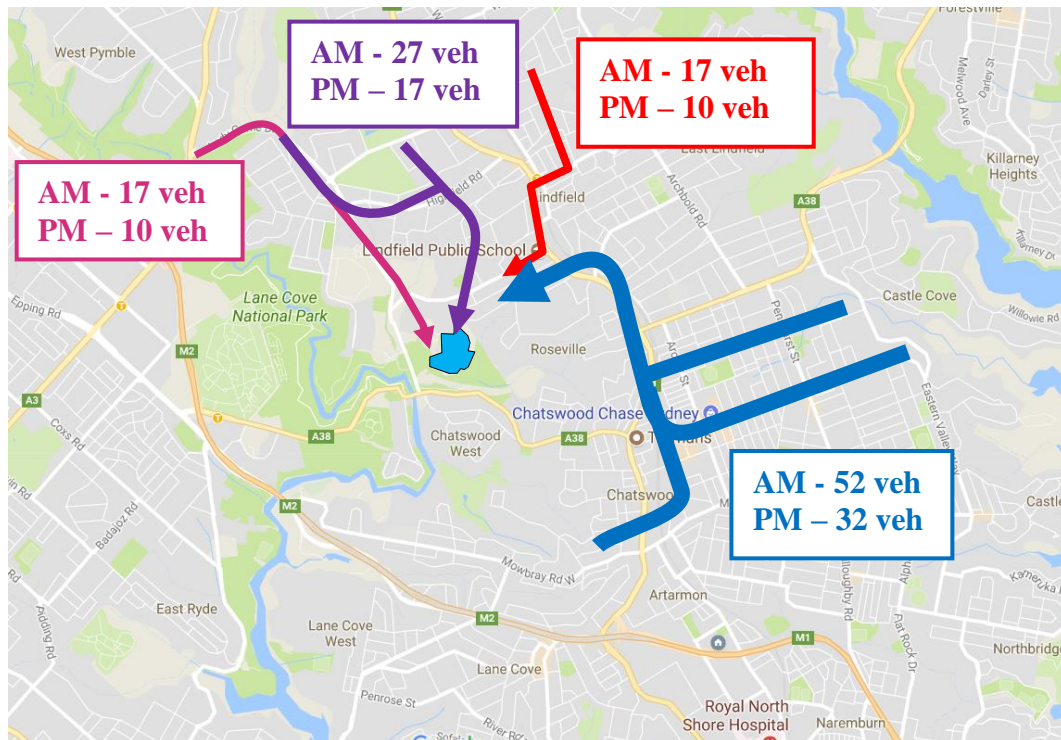


Figure 7: Approximate proportional splits of Phase 1 traffic generated based on the school catchment

Based on the school catchment and traffic generation numbers, the SIDRA results are shown in Table 16. It is assumed that vehicles entering would leave in the same direction within the same peak hour.

The modelling results for the Pacific Highway / Grosvenor Road / Burleigh Street intersection show that for Phase 1 of the school the intersection is operating satisfactorily at level of service C in the road peaks and B for the afternoon school peak. The 70 metre right turn bay from Pacific Highway into Grosvenor Road is fully utilised for the 95%ile queue in the morning and afternoon school peaks. This was observed on site. In the evening road peak the modelling shows a 95%ile queue slightly longer than the bay length indicating occasional spill out into the adjacent traffic lane.

Table 16: Pacific Highway / Grosvenor Road / Burleigh Street, SIDRA results

Peak	Deg. Saturation north approach	Average Delay (s)	Level of Service	95%ile q (m) of Pacific Highway Right turn bay
Existing (Stage 1) AM	0.698	29.4	C	65
Existing (Stage 1) PM (school)	0.747	23.0	B	68
Existing (Stage 1) PM	0.875	29.7	C	86

4 Stage 2 and 3 School

4.1 School population

The growth in student and staff numbers is shown in Table 17.

Table 17: School population for each stage

	Students	Staff			
		School Staff	OOSH staff (1 per 15 children)	Aurora Staff	Total
Stage 1	350	45	3	0	48
Stage 2	1,050	135	8	21	164
Stage 3	2,000	275	16	21	312

4.2 Car parking for school activity

No new car parking will be provided on the site due to the topography of the site and the sensitivity of utilising bushland space or impacting on it with additional structures. There are currently 166 marked car parking bays on the site as shown in Figure 8.

In the upper car park there are 27 parking bays on the western side which are converted to the drop-off and pick-up facility during school hours. This means that there are 139 car parking bays available for school staff use and parent pick-up and drop-off parking. Two (2) of the car bays are for accessible parking adjacent to the front door.

For Stage 2 with an allocation of 10 spaces for parent pick-up and drop-off parking there will be 127 staff parking spaces available. For 164 staff and assuming 90% in attendance on a typical day, this equates to a car mode of 85%. This is easily achieved with some staff travelling by public transport and others either car-pooling or being dropped off.

For Stage 3 with an allocation of 20 spaces for parent pick-up and drop-off parking there will be 117 staff parking spaces available. For 312 staff and assuming 90% in attendance on a typical day, this equates to a car mode of 42%. The primary way to achieve this low staff car mode is to promote alternative travel strategies identified in the Green Travel Plan. These focus on use of public transport, active transport and carpooling.

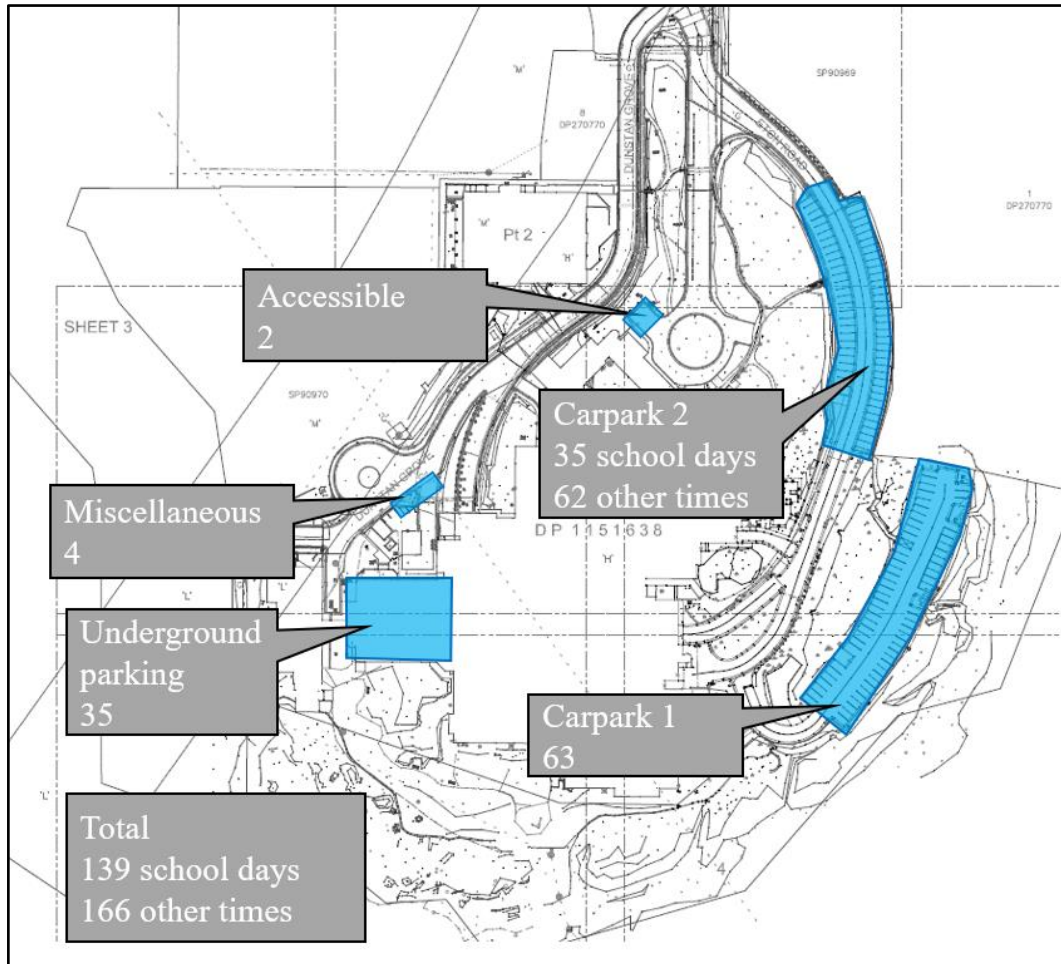


Figure 8: Current on-site car parking

4.3 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.

The Ku-ring-gai Development Control Plan 2015 (KDCP) provides parking guidelines for the minimum number of parking spaces required for each landuse. Table 18 outlines the car parking requirements.

Based on the KDCP, some 195 spaces would be required. There are 166 spaces available for use after hours. For larger events, additional spaces can be found throughout the learning village, for example at loading dock areas. There may also be some overflow onto local streets. If an overflow of up to 30 cars occurred on street, this equates to approximately 10% of on-street capacity in nearby streets.

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

Table 18: Proposed allocation of parking spaces for after hours use

School use	No. of people	KDCP Standards 2015 Minimum parking	KDCP Minimum	Proposed
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	

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

4.4 School travel modes

4.4.1 Stage 2 school travel

Based on the travel survey and observations during operation of the Phase 1 school, the Stage 2 travel patterns expected for 1,050 students has been determined.

Table 19: Stage 2 travel modes – 1,050 students

	Year	Classes	Class size	Enrolled Students		Bus		Walk/cycle		Car	
						%	No	%	No	%	No
Primary	K	3	20	60	558	30%	18	10%	6	60%	36
	1	3	22	66		30%	20	10%	7	60%	40
	2	3	24	72		30%	22	10%	7	60%	43
	3	3	30	90		60%	54	10%	9	30%	27
	4	3	30	90		60%	54	10%	9	30%	27
	5	3	30	90		60%	54	10%	9	30%	27
	6	3	30	90		60%	54	10%	9	30%	27
Secondary	7	3	30	90	504	80%	72	10%	9	10%	9
	8	3	30	90		80%	72	10%	9	10%	9
	9	3	30	90		80%	72	10%	9	10%	9
	10	3	30	90		90%	81	10%	9	0%	0
	11	3	24	72		90%	65	10%	7	0%	0
	12	3	24	72		90%	65	10%	7	0%	0
Total					1062		702		106		254

With an average car occupancy of 1.6 students/car, there are approximately 159 car movements generated for the car drop-off and pick-up.

Based on one additional Route 565 bus being scheduled during the peak periods (increase from 4 to 5 services) some 200 students are expected to use the public bus service. The remainder of bus travellers being 500 have been assigned to new school buses. Seven (7) new school buses are needed based on 75 students per school bus.

The timing of the drop-off and pick-up activity is shown in Table 20. With increased bus mode of travel there is predicted to be only a minor increase in car activity with 106 drop-off cars in the morning peak and 84 pick-up cars in the afternoon peak. This compares to 82 and 69 cars respectively for the Phase 1 school.

Based on the car parking allocation for staff described in Section 4.2, there could be approximately 95 staff cars arriving in the morning peak and 60 departing in the afternoon peak.

Table 20: Timing of drop-off and pick-up

Drop-off					Pick-up				
Start	OOSH (70%)	bus pass	car passenger	cars	Finish	OOSH (100%)	bus pass	car passenger	cars
7.00am	84	0	84	53					
8.50am	0	275	143	89	2.50pm	0	275	107	67
8.50am	0	297	247	17	3.10pm	0	297	27	17
9.10am	0	130	0	0	3.30pm	0	130	0	0
					6.00pm	120		120	75
Total	84	702	181	159		0	702	254	159

The resultant peak traffic generation is:

- Morning peak entry – 106 student drop-off + 95 staff + 7 buses
- Morning peak exit – 106 student drop-off cars departing + 7 buses
- Afternoon peak entry – 84 student pick-up cars entering + 7 buses
- Afternoon peak exit – 84 student cars + 60 staff + 7 buses
- Evening peak entry – Nil
- Evening peak exit – 60 staff cars departing

4.4.2 Stage 3 school travel

The Stage 3 travel patterns expected for 2,000 students have been extrapolated from the Stage 2 travel patterns adopting the same travel modes.

Table 21: Stage 3 travel modes – 2,000 students

	Year	Classes	Class size	Enrolled Students		Bus		Walk/cycle		Car	
						%	No	%	No	%	No
Primary	K	6	20	120	1,115	30%	36	10%	12	60%	72
	1	6	22	132		30%	40	10%	13	60%	79
	2	6	24	144		30%	43	10%	14	60%	86
	3	6	30	180		60%	108	10%	18	30%	54
	4	6	30	180		60%	108	10%	18	30%	54
	5	6	30	180		60%	108	10%	18	30%	54
	6	6	30	180		60%	108	10%	18	30%	54
Secondary	7	6	30	180	885	80%	144	10%	18	10%	18
	8	5.5	30	165		80%	132	10%	17	10%	17
	9	5	30	150		80%	120	10%	15	10%	15
	10	5	30	150		90%	135	10%	15	0%	0
	11	5	24	120		90%	108	10%	12	0%	0
	12	5	24	120		90%	108	10%	12	0%	0
Total					2,000		1,298		200		503

With an average car occupancy of 1.6 students/car, there are approximately 314 car movements generated for the car drop-off and pick-up.

Based on one additional Route 565 bus being scheduled during the peak periods (increase from 4 to 5 services), some 200 students are expected to use the public bus service. The remainder of bus travellers being 1100 have been assigned to new school buses. Fourteen (14) new school buses are needed based on 75 students per school bus.

The timing of the drop-off and pick-up activity is shown in Table 22. There is a doubling of car activity with 227 drop-off cars in the morning peak compared with 106 cars for Stage 2 and 165 pick-up cars in the afternoon peak compared with 84 cars for Stage 2.

Based on the car parking allocation for staff described in Section 4.2, there could be approximately 100 staff cars arriving in the morning peak and departing after the afternoon peak.

Table 22: Timing of drop-off and pick-up

Drop-off					Pick-up				
Start	OOSH (70%)	bus pass	car passenger	cars	Finish	OOSH (100%)	bus pass	car passenger	cars
7.00am	140	0	140	88					
8.50am	0	551	314	196	2.50pm	0	551	214	134
8.50am	0	531	50	31	3.10pm	0	531	50	31
9.10am	0	216	0	0	3.30pm	0	216	0	0
					6.00pm	240		240	150
Total	140	1,298	503	314		0	1,298	503	314

The resultant peak traffic generation is:

- Morning peak entry – 227 student drop-off + 95 staff + 14 buses
- Morning peak exit – 227 student drop-off cars departing + 14 buses
- Afternoon peak entry – 165 student pick-up cars entering + 14 buses
- Afternoon peak exit – 165 student cars + 60 staff + 14 buses
- Evening peak entry – Nil
- Evening peak exit – 60 staff cars departing

4.5 Traffic analysis

4.5.1 Pacific Highway / Grosvenor Road / Burleigh Street intersection

The traffic analysis for the Pacific Highway / Grosvenor Road / Burleigh Street intersection has been undertaken for Stage 2 and Stage 3 by adding the additional traffic to the existing situation modelled in Section 3.8. The Stage 2 and Stage 3 increases in traffic for each peak period at this intersection are shown Figure 9.

The right turn bay from the north has been extended to 100m in the SIDRA model to accommodate the 95th percentile queue lengths.

The modelling results for the Pacific Highway / Grosvenor Road / Burleigh Street intersection are shown in Table 23 indicate that for Stages 2 and 3 of the school the intersection continues to operate satisfactorily at level of service C in the road peaks and B for the afternoon school peak.

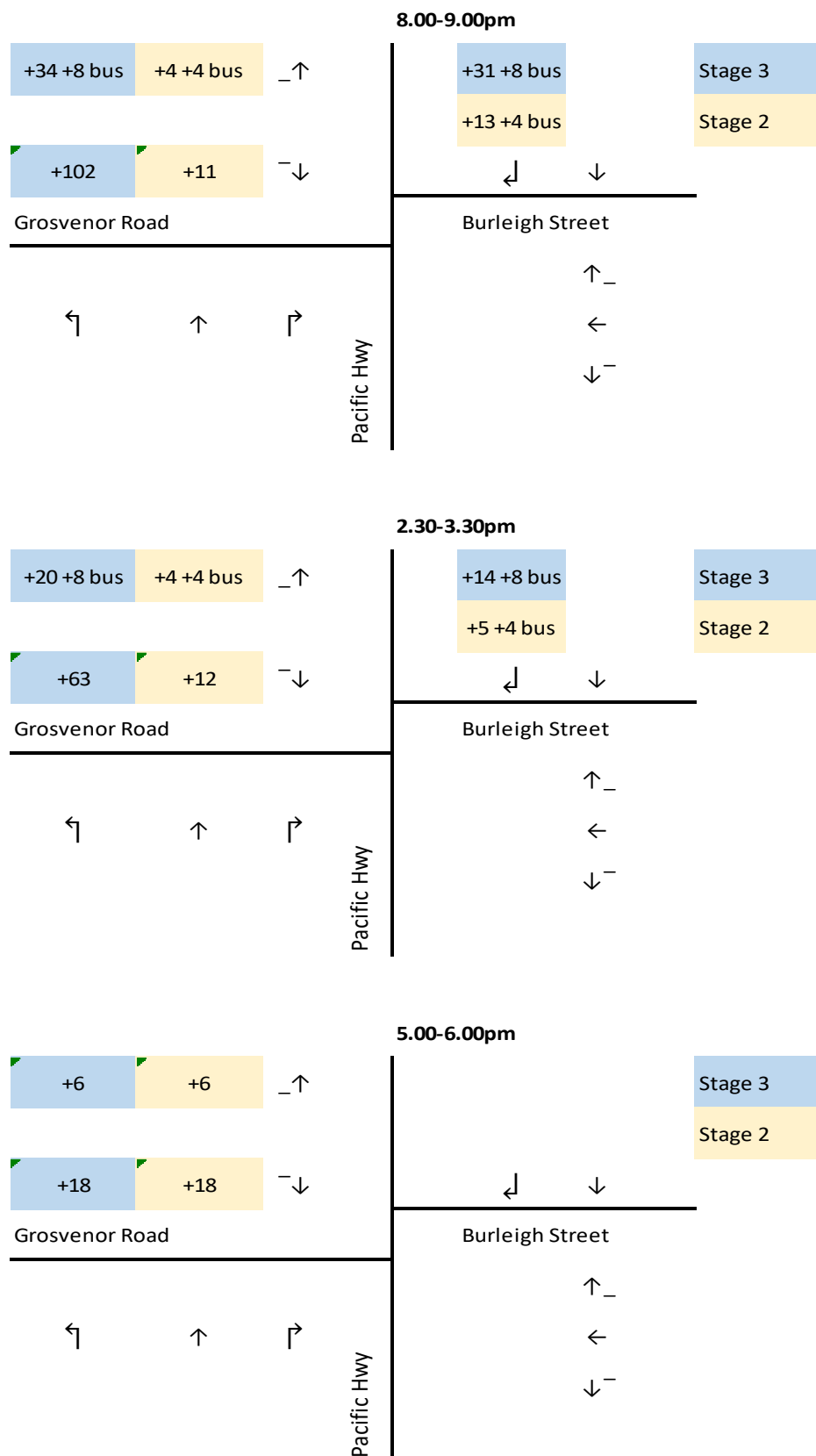


Figure 9: Stage 2 and Stage 3 increases in traffic for each peak period

Table 23: Pacific Highway / Grosvenor Road / Burleigh Street, Stage 2 and 3 Intersection results

Peak	Deg. Saturation north approach	Average Delay (s)	Level of Service	95%ile q (m) of Pacific Highway Right turn bay
Existing (Stage 1) AM	0.698	29.4	C	65
Stage 2 AM	0.697	30.3	C	74
Stage 3 AM	0.803	30.8	C	81
Existing (Stage 1) PM (school)	0.747	23.0	B	68
Stage 2 PM (school)	0.758	23.9	B	74
Stage 3 PM (school)	0.790	25.4	B	84
Existing (Stage 1) PM	0.875	29.7	C	86
Stage 2 PM	0.875	30.0	C	86
Stage 3 PM	0.875	30.0	C	86

4.5.2 Lady Game Drive

The Lady Game Drive / Grosvenor Road 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 10. Typical google traffic travel time metrics show slow rolling queues extending about 300 metres north of the intersection, shown in Figure 11.



Figure 10: Lady Game Drive / Grosvenor Road intersection

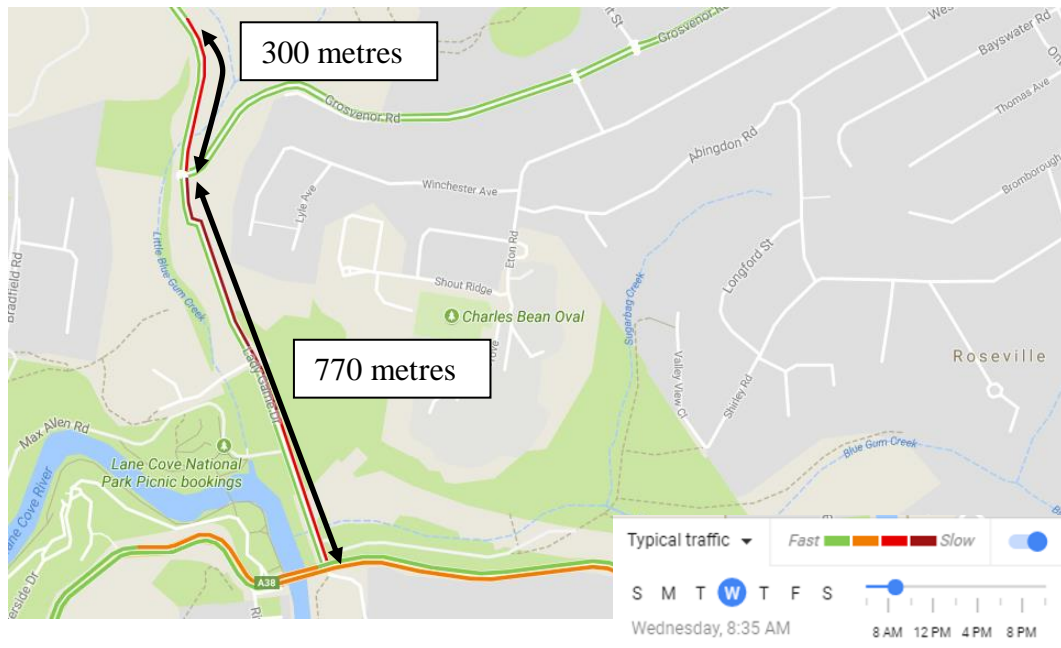


Figure 11: Google Maps Traffic, typical travel time on Wednesday 8:35am shown to be slow as observed on-site

Under current traffic conditions the Grosvenor Road / Lady Game Drive roundabout was found to be operating close to capacity during the AM peak. For the remainder of the day the Grosvenor Road / Lady Game Drive roundabout operates satisfactorily.

As discussed in Section 3.7, some 15% of drop-off and pick-up traffic is expected to approach on Lady Game Drive. In the morning peak there are 450 southbound vehicles/hour on Lady Game Drive approaching the Grosvenor Road intersection. At Stage 3 there is predicted to be 322 vehicles accessing the school in the morning peak with 48 (15%) expected to use Lady Game Drive.

Google traffic data shows the estimated travel time between two points by taking into account real-time or historical travel times. The quickest route from the west to the site as calculated by Google Maps for a typical Monday morning is shown in Figure 12. It shows that using Lady Game Drive to access the site from the west would be faster than using the Pacific Highway (Figure 13). This is despite the southbound congestion along Lady Game Drive. As such, traffic will choose to use the Lady Game Drive / Grosvenor Road intersection to access the site.

Many of these 48 vehicles may already be traveling on Lady Game Drive as a journey to work trip and hence would be classified as a diverted trip into the school to undertake the student drop-off. The level of increase is therefore expected to be much less at around 25 vehicles which is a 5% increase in southbound traffic. The roundabout can accommodate the additional cars however they will find themselves in the long vehicle queue before exiting into Grosvenor Road.

The priority for improvement works has been focused on the Pacific Highway right turn bay into Grosvenor Road. Roads and Maritime Services are reviewing the S-lane treatments along the Pacific Highway to improve through traffic capacity. This has the potential to attract traffic away from Lady Game Drive and onto the arterial road system

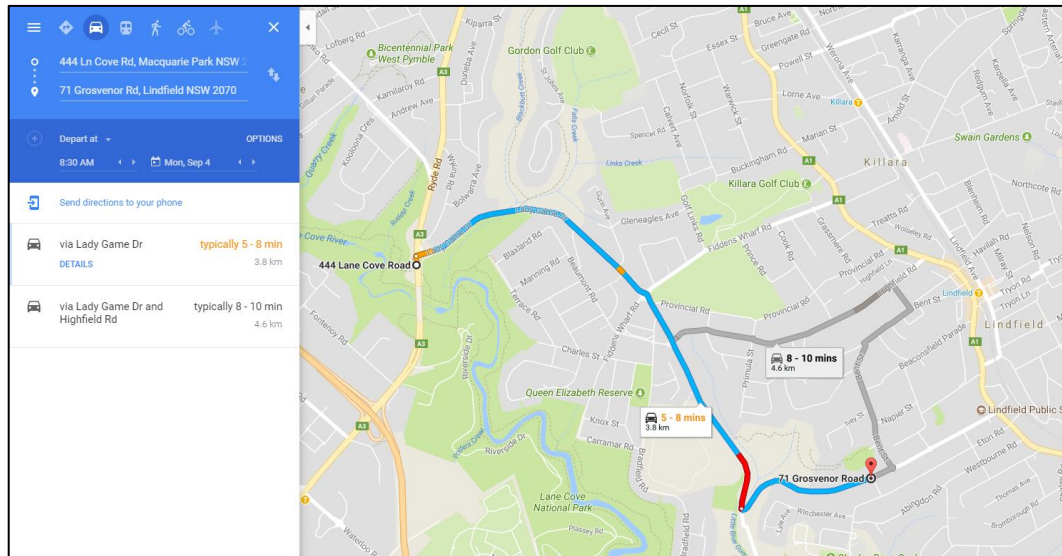


Figure 12: Fastest route to the site from the west shown by Google Maps

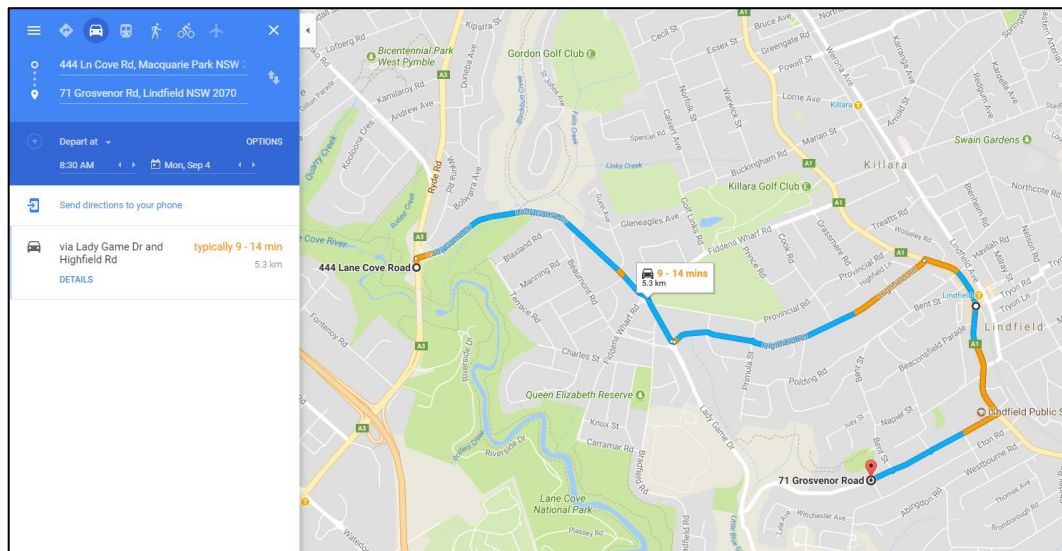


Figure 13: Alternate route via Pacific Highway shown by Google Maps found to be twice as long as Lady Game Drive option

4.5.3 Local road system

The estimated traffic generated by the school in Stages 2 and 3 during the morning peak are 307veh/hr and 549veh/hr respectively. Some local streets will see increases.

4.5.3.1 Bent Street

Bent Street north of Grosvenor Road will collect traffic from the north. Based on 24% arriving from this direction, an additional 132 vehicles (two-way) could be expected within a one hour period.

Council's 2010 traffic count indicates 237 veh/hour (two-way) on this section of road. An additional 132 vehicles will take this to 369 veh/hour, a 50% increase. For a local connector street such as Bent Street a traffic volume of between 300 and 500 veh/hour is provided by Roads and Maritime Services as a guideline for

local street environmental capacity. It should be noted that many cars on this route taking students to the school are residents who are already driving this route on their way to another school and onto work.



Figure 14: Local road routes converging from the north onto Bent Street.

4.5.3.2 Eton Road

On Eton Road on approach to the school, the additional traffic expected for the Stage 3 school is 193 veh/hour entering and 127 veh/hour exiting in the morning peak hour, the busiest hour of the day. This is an increase of 320 veh/hour on the existing two-way traffic volume of 374 veh/hour in the morning peak hour. A total two-way traffic flow of some 700 veh/hour in the morning peak, representing the busiest hour of the day, is consistent with a collector road function.

4.5.4 After hours traffic activity

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. As described in Section 4.3, 125 cars could be generated by full use of the auditorium and 70 cars could be generated by the gymnasium.

This level of activity on a weekday evening after the commuter peak would generate some 100-150 car movements in one hour on Eton Road. This level of activity is less than the predicted school peak traffic and can be accommodated on the local access road system.

5 Right turn bay on Pacific Highway at Grosvenor Street

As described in Section 4.5, the right turn bay needs to be extended to at least 100m to accommodate the predicted 95%ile queue. The existing right bay is 70m long as shown in Figure 15. To allow for future growth it is recommended that the right turn bay be extended to 120m as shown in Figure 16.

The extension is possible within the existing road reserve by utilising a partial lane along the western kerb line. There is a bus zone in this location which has no bus poles, wayfinding or bus shelter. There is no visual indication of a bus stop existing and as a result is likely underutilised as indicated by Opal data. In discussion with Transport for NSW it has been agreed that the bus zone can remain as an in lane stop given the low frequency of use.

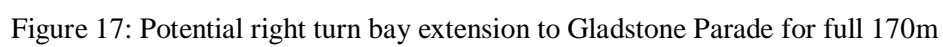
A land survey of the existing road conditions was commissioned by Schools Infrastructure to provide a base for a concept design of the right turn bay. The survey extended beyond Gladstone Parade to determine the full extent of right turn bay possible. As shown in Figure 17, a 170m long bay could be accommodated within the existing kerbed road space.



Figure 15: Existing right turn bay



Figure 16: Schematic of proposed right turn bay extension



5.1 Potential Strickland Avenue upgrades

Council has provided indicative plans (not part of the Lindfield Learning Village development) of the potential Strickland Avenue / Pacific Highway upgrades. The two indicative upgrade options are shown in Figure 18 and Figure 19. The extent of upgrades commence at Strickland Avenue and end at Llewellyn Street. Llewellyn Street is located some 150 metres north of the Pacific Highway / Grosvenor Road intersection. The proposed upgrades of the right turn bay to 120m would not affect the potential Strickland Avenue upgrades.

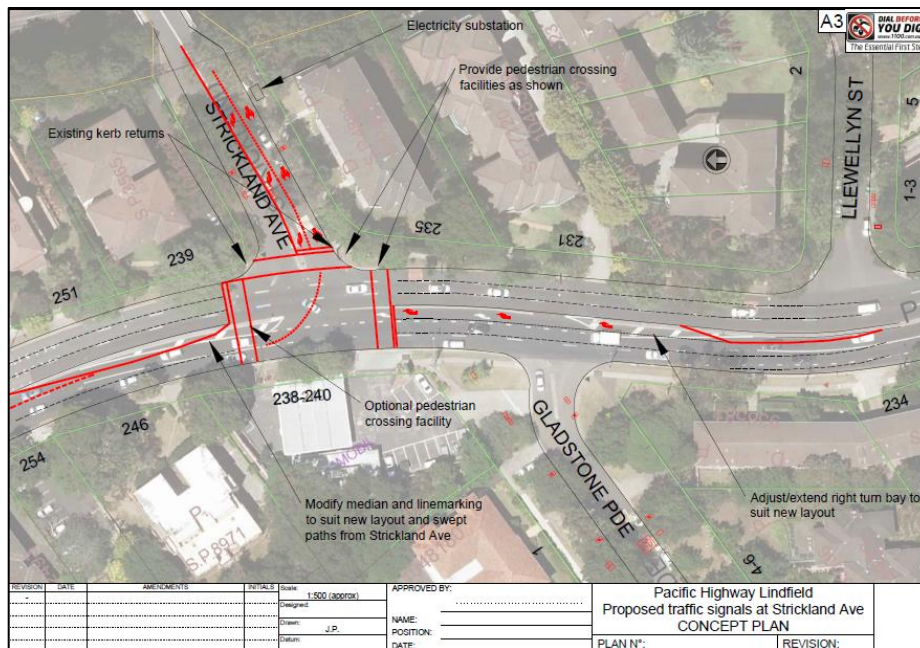


Figure 18: Proposed Strickland Avenue Concept Plan, with right turns

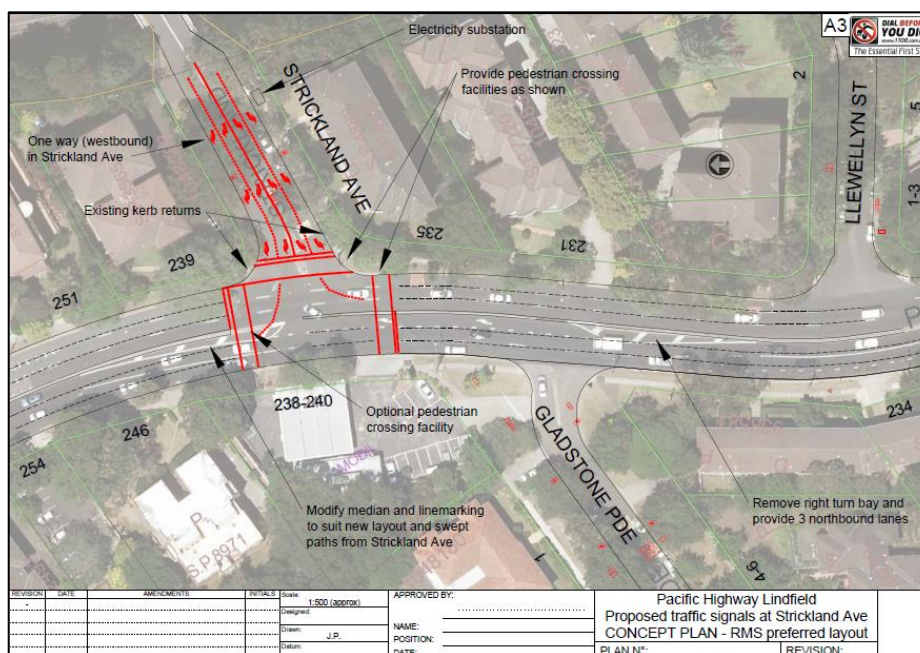


Figure 19: Proposed Strickland Avenue Concept Plan, no right turns

6 Drop-off/ Pick-up Facilities

6.1 Bus facility

A number of options have been considered for the provision of bus facilities for Lindfield Learning Village. The initial TTA contemplated improvements to the existing Eton Road turning loop and bus bay. However, given the constraints of that facility and the implications of sharing the facility between the Route 565 bus and school buses, it was determined that an alternative bus facility be developed.

The TTA Supplementary considered a number of options using the local streets system or a turning loop on the school grounds at the front entry area. After further consideration by the design team it has been determined that a one-way loop road through the site utilising the alignment of the fire access trail would provide an appropriate bus facility. There is a high bus mode target for the school with up to 7 school buses likely to be on the site at any one time during the pick-up period in Stage 3.

6.1.1 Description of the bus facility

The proposed bus loop enters the school grounds at the end of Dunstan Grove and traverses the lower portion of the site where the set-down / pick-up zone will be located as shown in Figure 20.

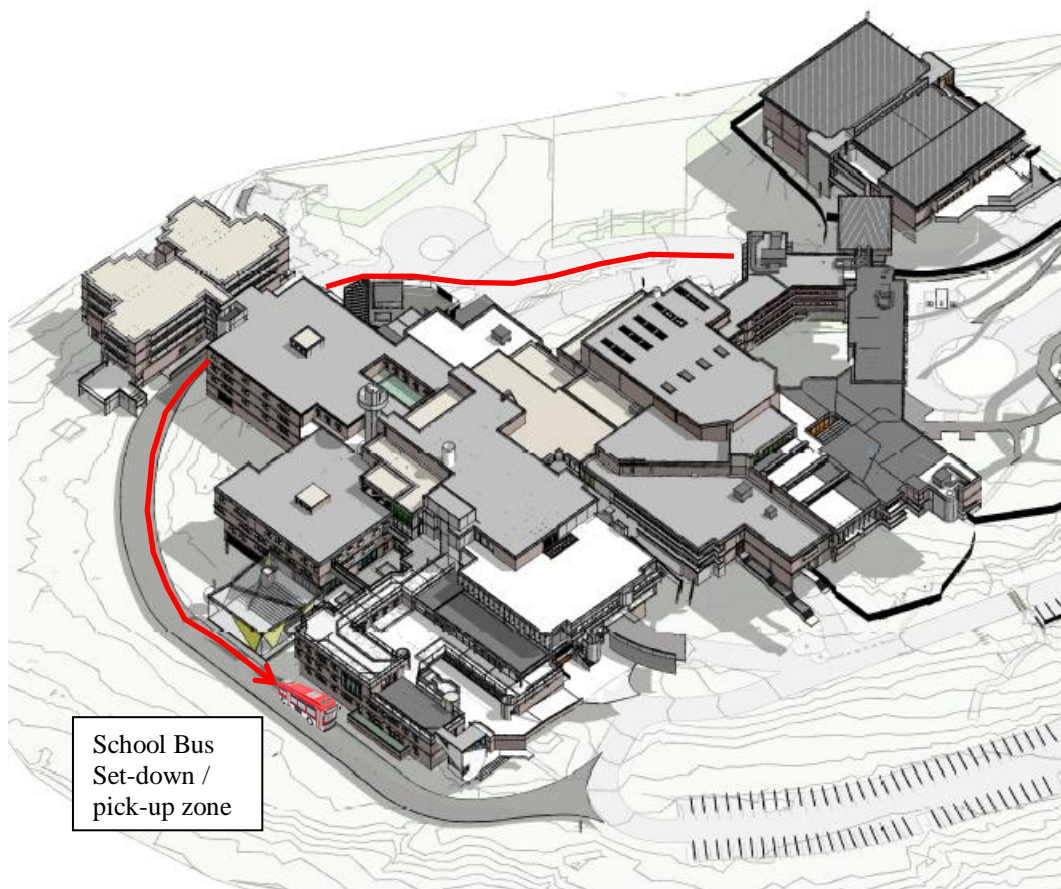


Figure 20: Location of bus loop and drop-off / pick-up zone

The bus loop will only be open for use during school drop-off and pick-up times. The roadway will be closed during the school day to allow students to fully utilise the lower campus grounds. An overall site plan showing the existing Eton Road bus bay for public buses and the proposed bus loop for school buses is shown in Figure 21.

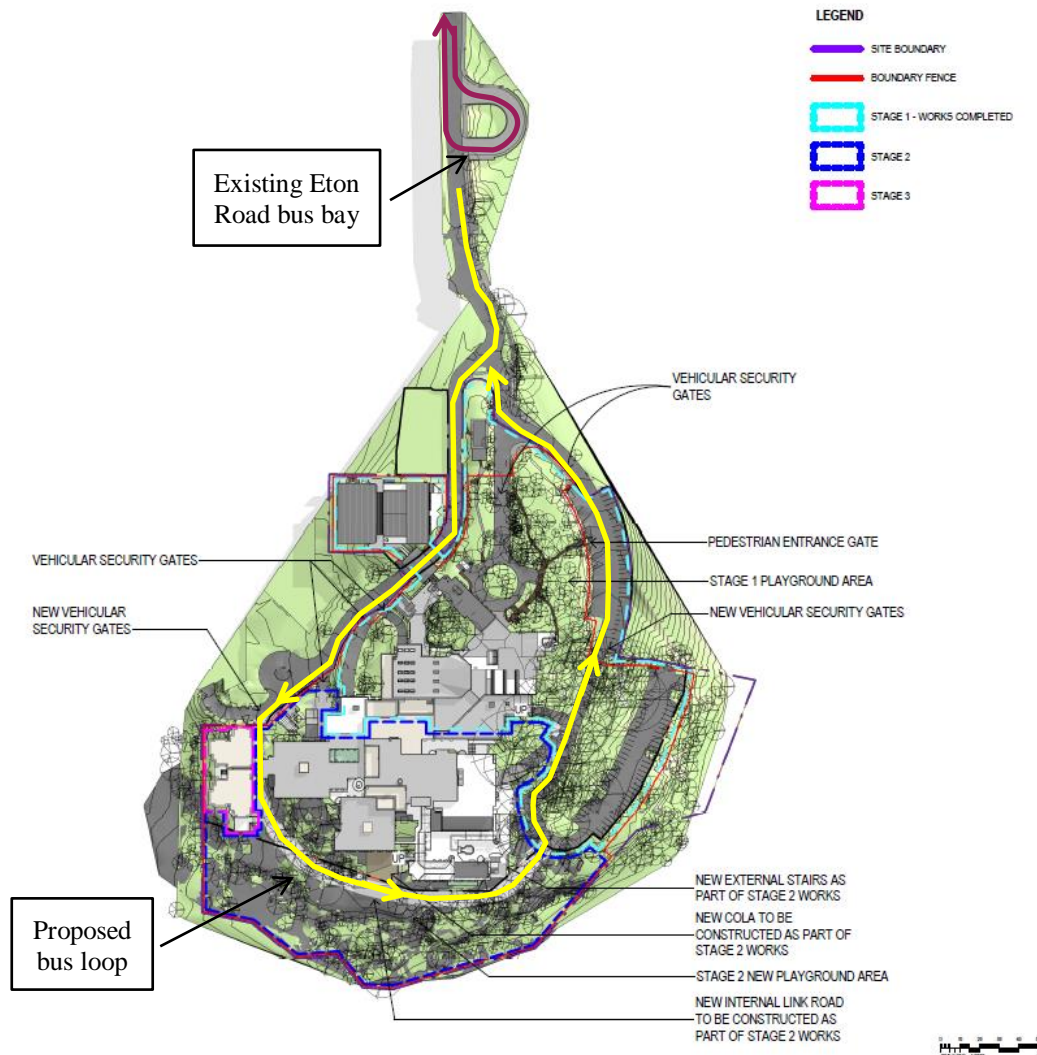


Figure 21: Overall site plan showing bus facilities

The configuration of the bus zone along the loop road is shown in Figure 22. It is envisaged that up to 5 buses could drop-off or pick-up at one time with room for a further 3 buses to queue to wait. A 12.5m standard bus has been used for setting out the bus zone with no allowance for independent movement given that buses are expected to load in batches.

A pedestrian fence will be located along the northern side of the road to control where students wait. A waiting area utilising the COLA provides covered protection for students that are waiting. A series of gates will enable students to access the bus loading area.

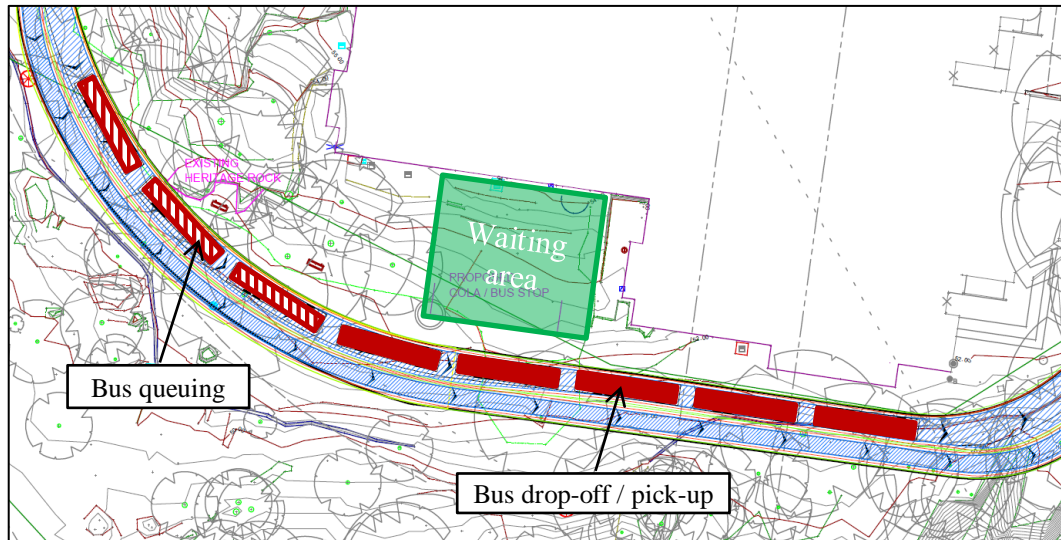


Figure 22: Bus zone (12.5m buses)

6.2 Private car facility

The existing drop-off / pick-up facility will continue to be used for the Stage 2 and 3 school as described in Section 3.1.1. The pick-up occurs over two periods with the primary school finishing at 2.50pm and the secondary school finishing at 3.10pm. The design peak occurs at Stage 3 when it is anticipated that there will be 134 cars picking up primary school students at 2.50pm. Based on 6 cars picking up students at one time in a 1 minute period, 20 minutes will be required. This will clear the majority of the pick-up zone ready for the secondary school pick-up.

Cars will utilise the one-way loop road travelling parallel with the buses, entering from Dunstan Grove and exiting to Eton Road.

6.3 Loop road vehicle swept paths and management

Management of the loop road is required for two operational modes throughout the day as shown in Figure 23.

Loop road open during drop-off / pick-up:

7.30 am to 9.30am

2.30pm to 5.00pm

Loop road closed during school hours and after hours:

9.30am – 2.30pm

5.00pm to 7.30am

When the loop road is open the school road system will operate as one-way for the full extent. When the loop road is closed, the school road system operates as two-way. A variable message sign will be located at the Eton Road entry to inform drivers of the current mode of operation as shown in Figure 24.



Figure 23: Management of loop road

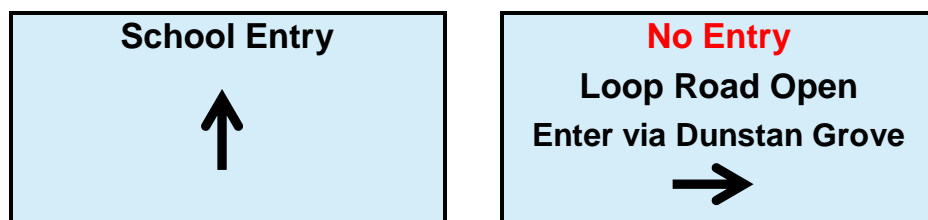


Figure 24: Variable message sign

When the loop road is in operation, buses and cars will share the road space. On the lower loop road, buses utilise the kerbside left lane and cars pass or queue on the outside lane as shown in Figure 25. When vehicles enter the upper school road, cars queue on the kerbside left lane on approach to the drop-off / pick-up zone and buses pass on the outside lane. A 14.5m bus has been used for the swept path analysis to accommodate coaches which may be used for school excursions.

The outcome provided by the loop road is containment of all bus and car queues on the site operating in a simple one-way system.

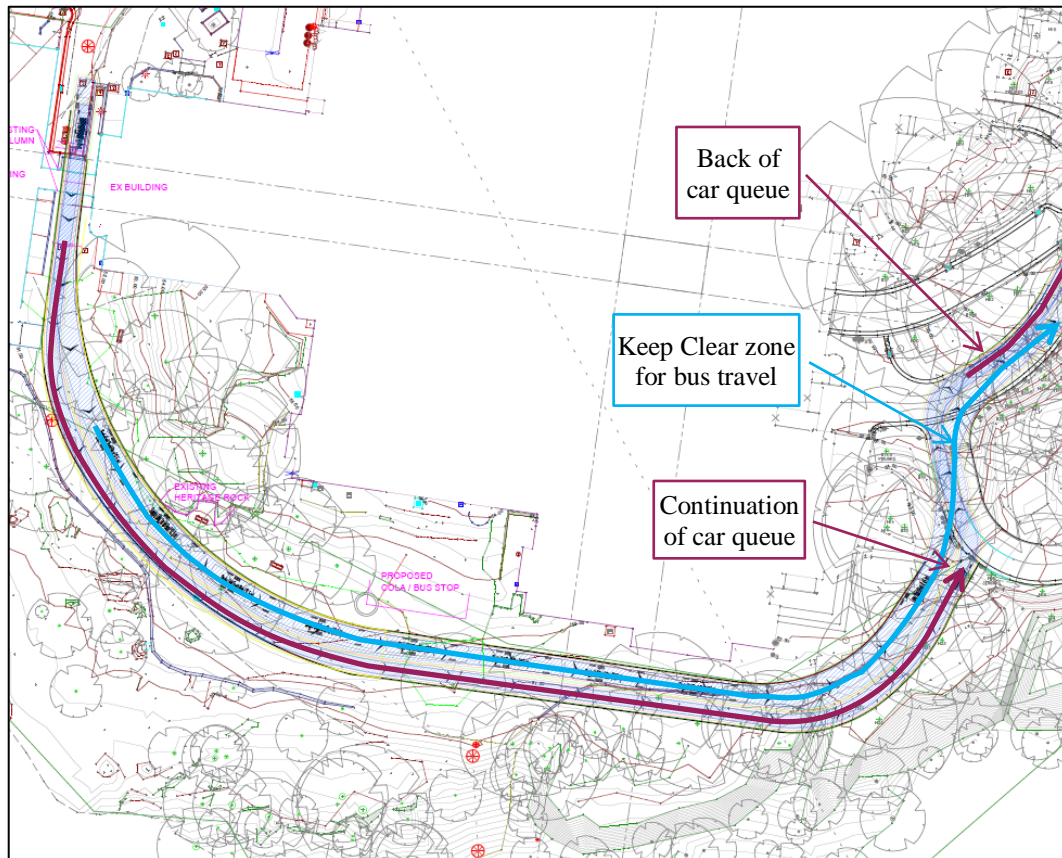


Figure 25: Bus (14.5m) and Car swept paths

7 Emergency vehicles

Emergency vehicle swept paths have been carried out for different areas of the site using MRV Fire Ladder 7.8 metre truck or a CAT 1 Tanker. The swept path analysis has indicated multiple opportunities for the truck to turnaround efficiently, attached in Appendix B.

The proposed loop road has been endorsed by RFS as a suitable access route for fire appliances.

Appendix A

Meeting Minutes

A1 TfNSW / Council / RMS – 10 April 2019

Attendees:

Ken Ho, TfNSW
Pahee Rathan, RMS
Mitchell Ryan, RMS
Allan Borge, TfNSW Bus service planner
Jospeh Piccoli, Ku-ring-gai Council
Andrew Hulse, Arup
Alaine Roff, Urbis
Jim Lewis, SINSW
Sandeep Amin, Design Inc
Tim Garry, Design Inc
Emma Viljoen, Savills

Agenda:

- School bus and public bus capacity for the expanded school
- Bus bay provision – discussion of available options
- Traffic capacity and right turn bay extension at Pacific Highway
- Student drop-off and pick-up on site

Arup presented bus requirements, bus options, student drop off and right turn improvement on the Highway.

We expressed our requirement to lodge the RtS with all agency items resolved prior, aiming for an approval end of June 2019.

Follow up meeting to be arranged for w/c 29/ 04.

Actions:

- Arup sent student enrolment addresses to TfNSW
- Arup follow up on highway upgrades program of works. Strickland Ave - additional investigations w RMS (Peter and Mitch) on upgrade works - Peter Grosvenor Rd works. Current right turn lane 70m and holds 10 cars.
- Arup provide markup and exact requirements for survey area on Pacific Highway for right turn bay. Arup to develop concept plans for right hand turn off high way.

- Ken Ho would come back to us on a proposal on how to move forward with buses, route and school. This may require additional info from the project team. He needs to understand priority for Transport for giving more 565 and or dedicated school services, discussions with Contracts Department. Extra buses - need data (attached)
- Arup Review RMS concern that people are queuing at the bus stop, step onto the Pacific Highway to move around pedestrian congestion.
- RMS still have concern of speed zone signage for staggered start times
- RMS have requested Arup utilise 51% as per current modes to utilise the bus in the RtS, as well as those projected percent's
- Noted bus bay for route and school buses would be an issue if no leap frogging option was available
- Noted bus solution on site was preferable.

Council comments:

- no traffic counts since the beginning of this year
- Parking issues around the sports field, not regarding traffic congestion. Pedestrian crossing request has come from Dunstan Grove residents.
- Pedestrian gate at main entry is restricted in width by fixed panel and less narrow than the footpath, might want to widen.
- Lady Game Drive – Council suggested given the current congestion means parents may avoid it. Might see improvements with mode share improvements.

Agreed key items to resolve:

- Pacific Highway Upgrade
- Bus availability
- Bus bay drop off pick up

A2 RMS – 5 June 2019

Attendees:

Mitchell Ryan, RMS

Peter Carruthers, RMS

Andrew Hulse, Arup

Jim Lewis, SINSW

Pablo Alvarez, DesignInc

Michael Grogan, Birzulis Associates

Emma Viljoen, Savills

Sasha Serrao, Savills

Agenda:

- Traffic capacity and right turn bay extension at Pacific Highway
- Bus loop proposal

Arup presented the concept design for the right turn improvement on the Highway based on the detail land survey. No kerb adjustments are required if existing lane widths are adopted. New traffic data has been collected indicating minimal increase in traffic since Phase 1 school opening.

DesignInc presented the bus loop proposal.

Discussion:

- RMS have a proposal for three northbound lanes in the vicinity of Grosvenor Road.
- The width of the traffic lanes will need to be agreed as suitable.

Actions:

- RMS to review the concept design against their proposed road works
- Arup to provide an updated traffic assessment based on the proposed Stage 2 and 3 school expansion in RtS.
- RMS noted they could undertake the design works and that the works, if no kerb to kerb adjustments required, could be undertaken in roughly a month.

Appendix B

Turning paths for RFS

A3

A

B

C

D

E

F

G

1

2

3

4

5

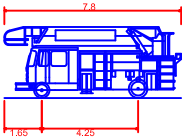
6

Do not scale

Legend

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

Design Vehicle(s)



Rural Fire Category 1 Isuzu
Overall Length 7.800m
Overall Width 2.400m
Overall Body Height 3.131m
Min Body Ground Clearance 0.215m
Max Track Width 2.365m
Lock-to-lock time 3.50s
Curb to Curb Turning Radius 8.850m

A	19/09/17	RWW	AMH	AMH
For Information				
Issue	Date	By	Chkd	Appd

ARUP

Arup, Level 10, 201 Kent St
Sydney, NSW, 2000
Tel +61(02)9320 9320 Fax +61(02)9320 9321
www.arup.com.au

Client
Department of Education

Job Title
Lindfield Learning Village

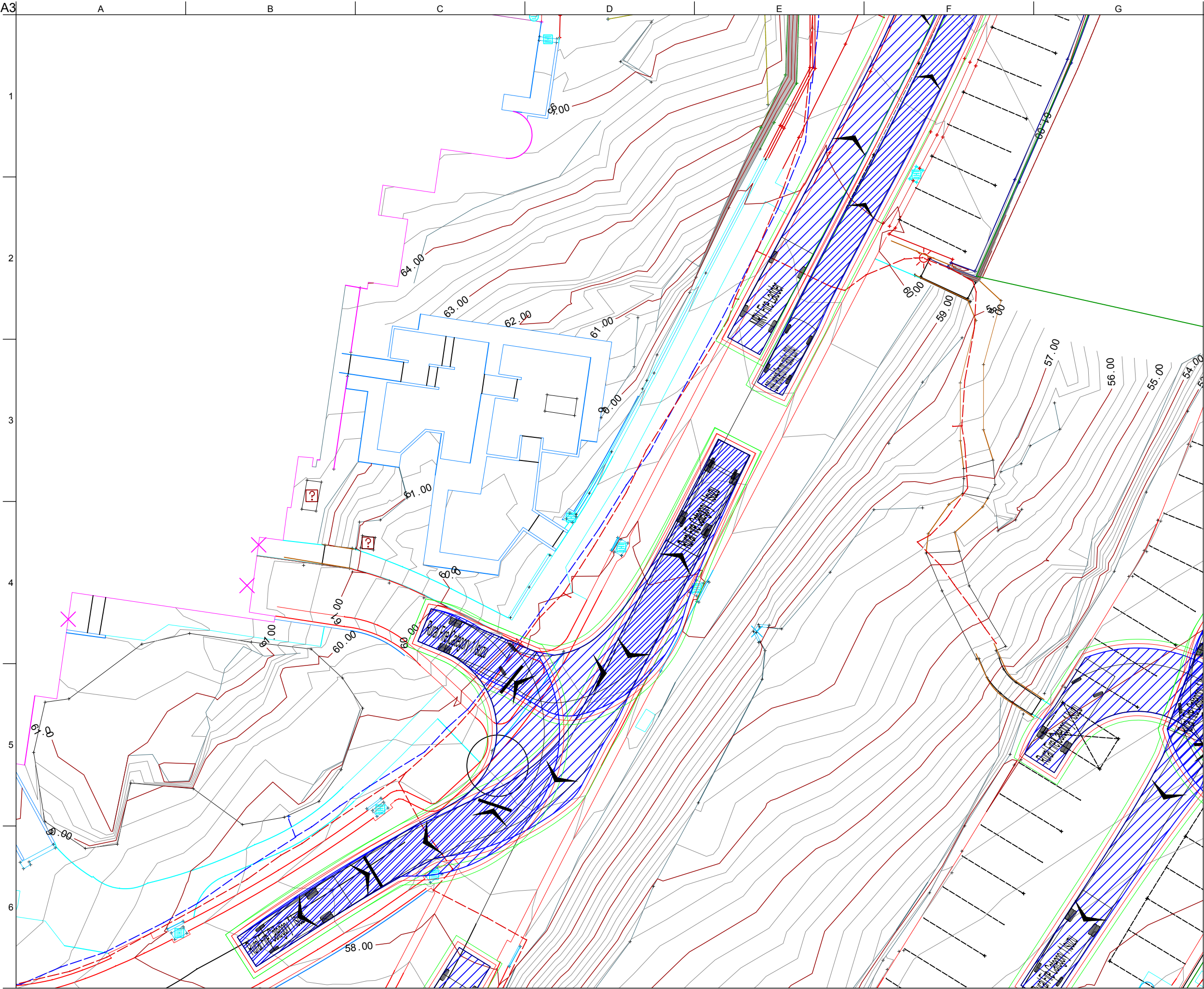
Drawing Title
Turning Paths
For Bushfire Cat 1 Tanker

Scale at A3

Discipline
Transport

Drawing Status
Draft

Job No 251272	Drawing No SKT005	Issue A
------------------	----------------------	------------



Legend

Body Envelope

300mm Envelope

Design Vehicle(s)

Rural Fire Category 1 Isuzu

Overall Length

Overall Width

Overall Body Height

Min Body Ground Clearance

Max Track Width

Lock-to-lock time

Curb to Curb Turning Radius

7.800m

2.400m

3.131m

0.215m

2.365m

3.50s

8.850m

B99 Vehicle (Realistic min radius) (2004)

Overall Length

Overall Width

Overall Body Height

Min Body Ground Clearance

Track Width

Lock to Lock Time

Curb to Curb Turning Radius

5.200m

1.940m

2.200m

0.312m

1.840m

4.00 sec

6.250m

A	19/09/17	RWW	AMH	AMH
For Information				
Issue	Date	By	Chkd	Appd

ARUP

Arup, Level 10, 201 Kent St
Sydney, NSW, 2000
Tel +61(02)9320 9320 Fax +61(02)9320 9321
www.arup.com.au

Client

Department of Education

Job Title

Lindfield Learning Village

Drawing Title

Turning Paths
For Bushfire Cat 1 Tanker

Scale at A3

Discipline

Transport

Drawing Status

Draft

Job No

251272

Drawing No

SKT006

Issue

A

A3

1

2

3

4

5

6

A

B

C

D

E

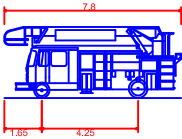
F

G

Legend

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

Design Vehicle(s)



Rural Fire Category 1 Isuzu
Overall Length 7.800m
Overall Width 2.400m
Overall Body Height 3.131m
Min Body Ground Clearance 0.215m
Max Track Width 2.365m
Lock-to-lock time 3.50s
Curb to Curb Turning Radius 8.850m

A	19/09/17	RWW	AMH	AMH
For Information				
Issue	Date	By	Chkd	Appd

ARUP

Arup, Level 10, 201 Kent St
Sydney, NSW, 2000
Tel +61(02)9320 9320 Fax +61(02)9320 9321
www.arup.com.au

Client
Department of Education

Job Title
Lindfield Learning Village

Drawing Title
Turning Paths
For Bushfire Cat 1 Tanker

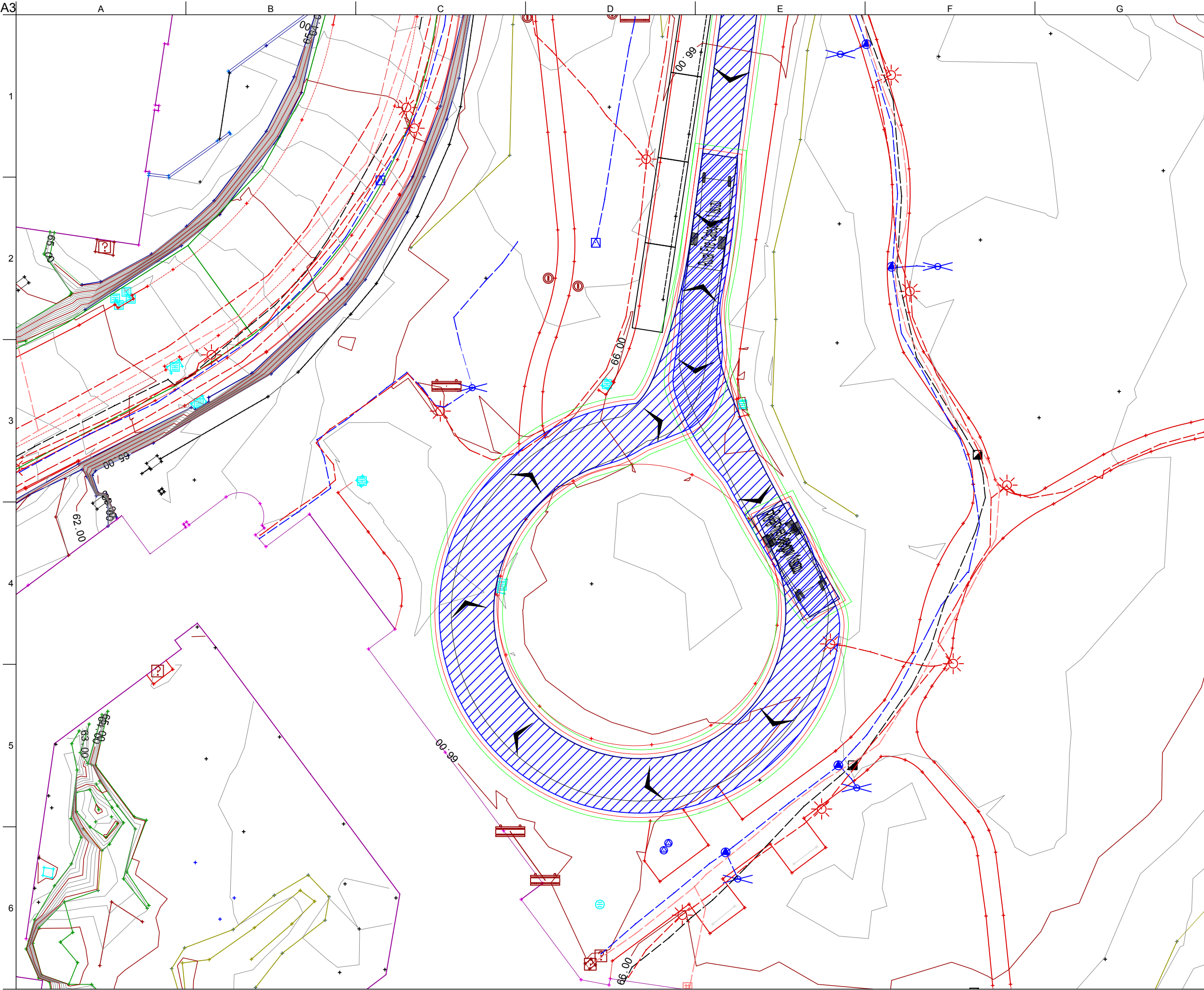
Scale at A3

Discipline
Transport

Drawing Status

Draft

Job No 251272	Drawing No SKT007	Issue A
------------------	----------------------	------------

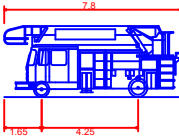


Do not scale

Legend

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

Design Vehicle(s)



Rural Fire Category 1 Isuzu
Overall Length 7.800m
Overall Width 2.400m
Overall Body Height 3.131m
Min Body Ground Clearance 0.215m
Max Track Width 2.365m
Lock-to-lock time 3.50s
Curb to Curb Turning Radius 8.850m

A	19/09/17	RWW	AMH	AMH
For Information				
Issue	Date	By	Chkd	Appd

ARUP

Arup, Level 10, 201 Kent St
Sydney, NSW, 2000
Tel +61(02)9320 9320 Fax +61(02)9320 9321
www.arup.com.au

Client
Department of Education

Job Title
Lindfield Learning Village

Drawing Title
Turning Paths
For Bushfire Cat 1 Tanker

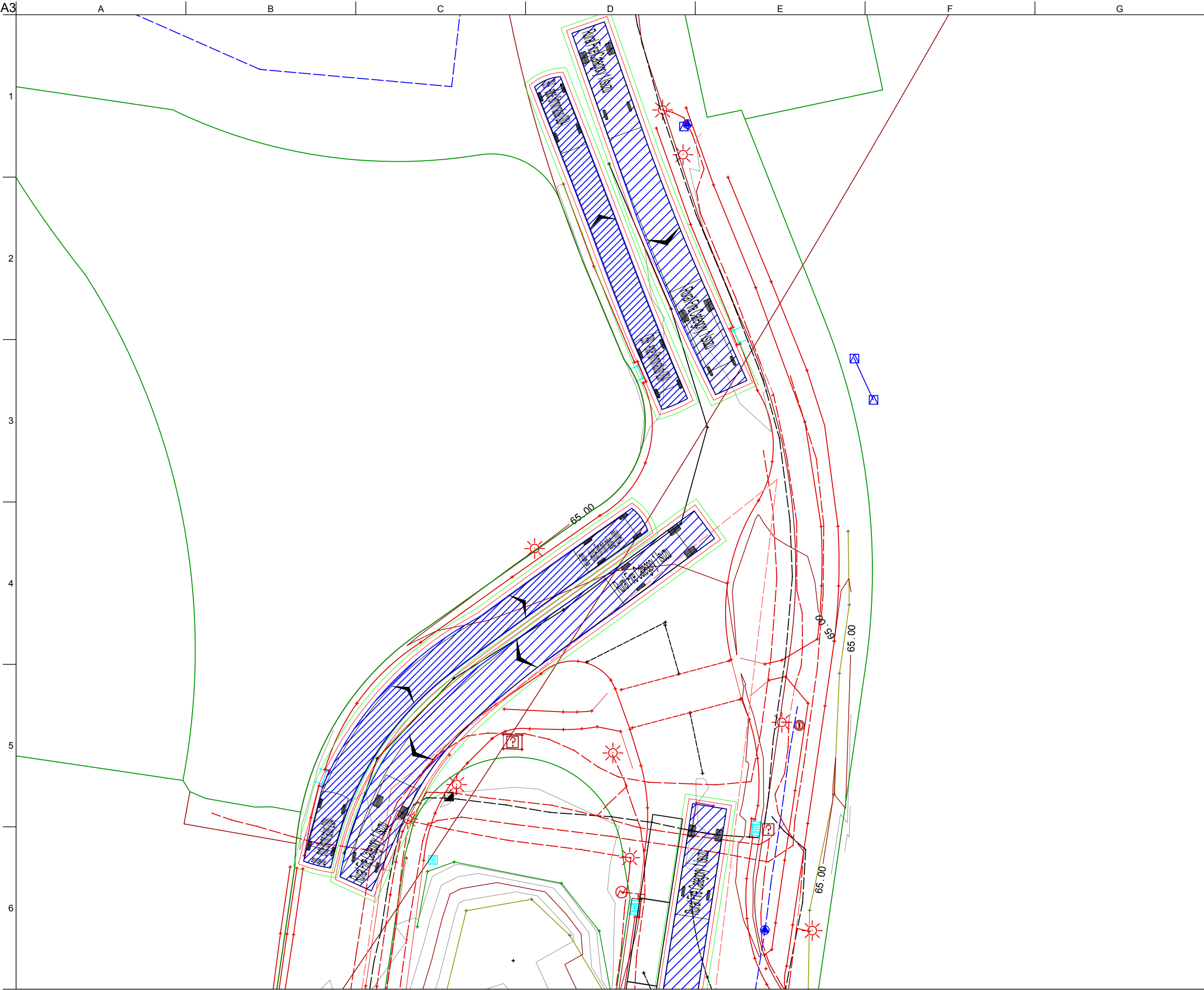
Scale at A3

Discipline
Transport

Drawing Status

Draft

Job No 251272	Drawing No SKT008	Issue A
------------------	----------------------	------------



Legend

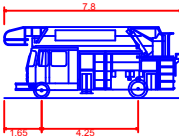
Body Envelope

300mm Envelope

600mm Envelope

Wheel Envelope

Design Vehicle(s)



Rural Fire Category 1 Isuzu

Overall Length

Overall Width

Overall Body Height

Min Body Ground Clearance

Max Track Width

Lock-to-lock time

Curb to Curb Turning Radius

7.800m

2.400m

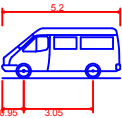
3.131m

0.215m

2.365m

3.50s

8.850m



B99 Vehicle (Realistic min radius) (2004)

Overall Length

Overall Width

Overall Body Height

Min Body Ground Clearance

Track Width

Lock to Lock Time

Curb to Curb Turning Radius

5.200m

1.940m

2.200m

0.312m

1.840m

4.00 sec

6.250m

A	19/09/17	RWW	AMH	AMH
For Information				
Issue	Date	By	Chkd	Appd

ARUP

Arup, Level 10, 201 Kent St

Sydney, NSW, 2000

Tel +61(02)9320 9320 Fax +61(02)9320 9321

www.arup.com.au

Client

Department of Education

Job Title

Lindfield Learning Village

Drawing Title

Turning Paths
For Bushfire Cat 1 Tanker

Scale at A3

Discipline

Transport

Drawing Status

Draft

Job No	Drawing No	Issue
251272	SKT009	A