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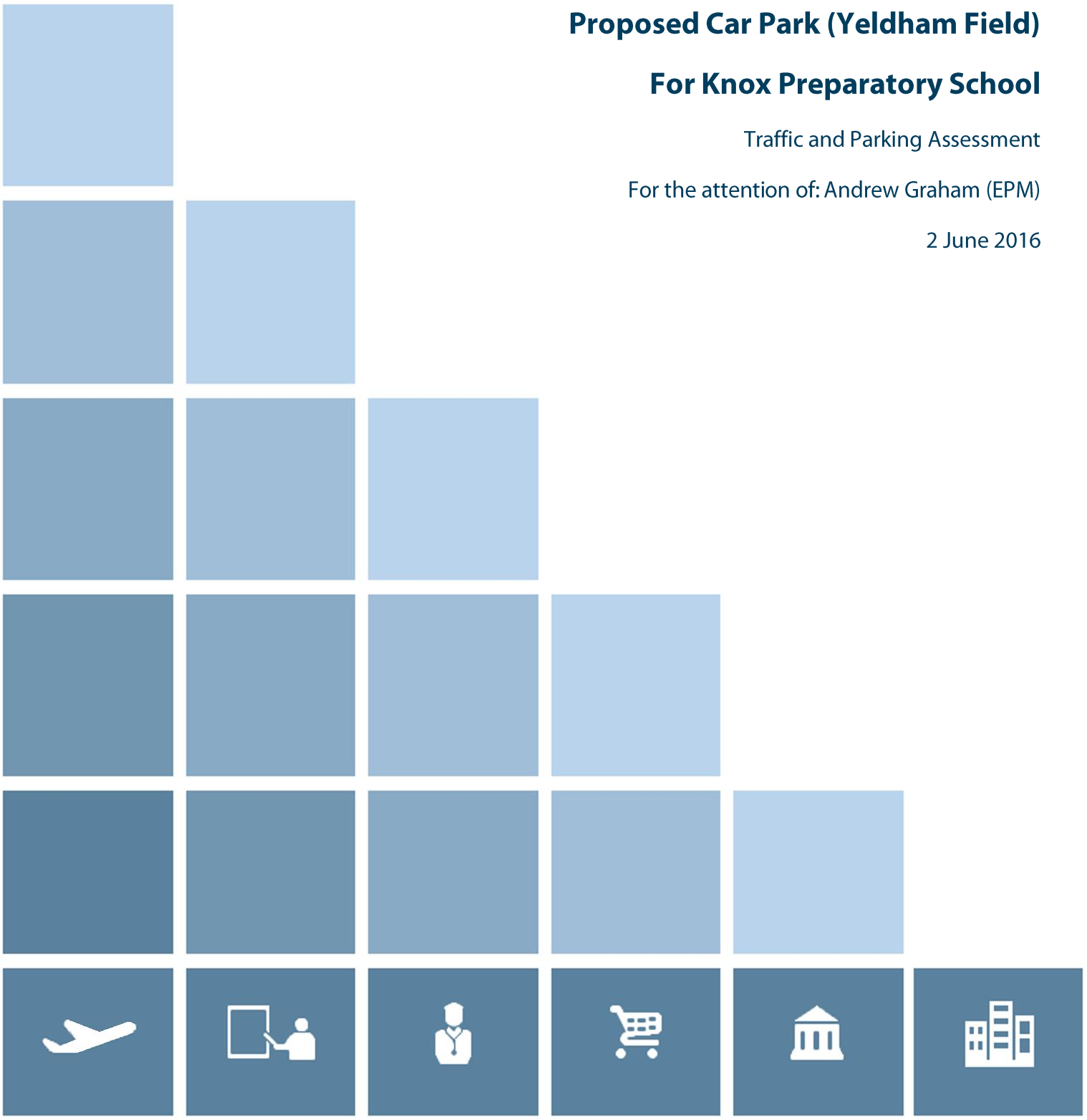
Proposed Car Park (Yeldham Field)

For Knox Preparatory School

Traffic and Parking Assessment

For the attention of: Andrew Graham (EPM)

2 June 2016



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Contents

1 Executive Summary

This report presents the Traffic and Parking Assessment associated with a proposal by Knox Grammar School to increase the student population to 840 students and construct a car park accommodating 85 parking spaces and a dedicated drop-off / pick-up facility comprising 22 spaces. The car park will be constructed beneath the existing Yeldham Field within the Knox Preparatory School campus.

The findings of this assessment are:

- The proposal will ensure that the school meets the minimum parking provision stipulated in the current planning requirements.
- The provision of a drop-off and pick-up facility within the campus will remove parking activity from the road frontages, which in turn reduces the impact of school activity on the road network.
- The removal of drop-off activity from the road network provides an opportunity to prohibit parking along the Cleveland Street frontage, which will allow two-way traffic flow resulting in improved traffic conditions.
- The current approval for the school permits a maximum population of 676 students, which involves 71 Full Time Equivalent (FTE) staff. At the time of preparing this assessment, the student population was 661 students, with 71 FTE. The proposed increase in the population over the current consent is 164 students and 19 FTE, although for the purposes of the traffic assessment, the increase has been measured against the current population (up to 179 additional students), as this directly relates to the current traffic volumes collected during the surveys.
- The addition of 179 students and 19 staff over the current population will result in an additional 87 vehicle movements during the morning peak, which is insufficient to cause any notable impact on the road network, and is within the daily variation of volumes on the road network. The operation of the road network will improve as a result of removing the existing drop-off and pick-up activity from the frontages of the school.
- The proposed car park layout and access driveway have been designed in accordance with the relevant Australian Standards and represent a best practice design having regard for the unique safety considerations associated with schools and the safe movement of children. The drop-off area has been designed so that no child is ever required to walk across the path of moving vehicles.
- The proposed driveway has been designed to accommodate only the left-in and left-out movements, which reduces the number of conflicting movements and assists in the traffic flow along Cleveland Street as no right turns are permitted.

2 Introduction

Parking & Traffic Consultants (PTC) has been engaged by Knox Grammar School (Knox) under the direction of EPM Projects to undertake a study to assess the traffic, parking and the road network related considerations associated with the following proposal:

- Intensification of use at an Existing Educational Establishment comprising an additional 164 Students and 19 staff, and
- Alterations and Additions including a new Synthetic Grass Playing Field Surface and Underground Car Park with access from Cleveland Street, together with ancillary Landscaping and Drainage works.

The works are proposed within Lot Nos. 271 and 272 in Deposited Plan No. 608835 Nos. 1-3 Billyard Avenue and No. 15 Cleveland Street, Wahroonga, which forms part of the Knox Preparatory School (the Prep School).

This report sets out the methodology and findings of the study and is intended to accompany a Development Application by Knox to Ku-ring-gai Council.

This study addresses the key topics related to traffic and parking impacts typically associated with schools, being:

- Traffic activity associated with students and the impact on the road network,
- Traffic activity associated with staff and the impact on the road network,
- On-campus parking provision and demand associated with staff,
- On-street parking availability and demand associated with staff,
- On-street parking and drop-off/pick-up activity associated with students and how this is to be managed,
- The safety of pedestrians, students and other road users in the vicinity of the Prep School,
- The warrants for providing additional traffic and/or parking facilities either within the road network or within the Prep School.

Approval under Section 138 of the Roads Act 1993 is required for proposed works in Cleveland Street. However, Section 7 of the Roads Act 1993 indicates that Ku-ring-Gai Council is the 'Roads Authority' in this instance. Section 91(3) of the Environmental Planning and Assessment Act 1979, provides that:

I.) "Development is not integrated development in respect of the consent required under section 138 of the Roads Act 1993 if, in order for the development to be carried out, it requires the development consent of a council and the approval of the same council."

Consequently, despite the required approval under Section 138 of the Roads Act 1993, the proposal is not 'Integrated Development' for the purposes of Section 91 of the Environmental Planning and Assessment Act 1979.

Notwithstanding, the proposal will still be referred to the NSW Roads and Maritime Services (RMS) (formerly RTA) for comment as the proposal constitutes 'Traffic Generating Development' under Clause 104 and Schedule 3 of State Environmental Planning Policy (Infrastructure) 2007 given that the proposal involves greater than 50 students associated with an educational establishment.

3 Knox Grammar School

3.1 General Background

Knox comprises two campuses in Wahroonga, approximately 22 kilometres north of Sydney CBD. The Prep School is the subject of this study, and is located on the eastern side of the North Shore railway line, bounded by Cleveland Street, Billyard Avenue and Sutherland Avenue.

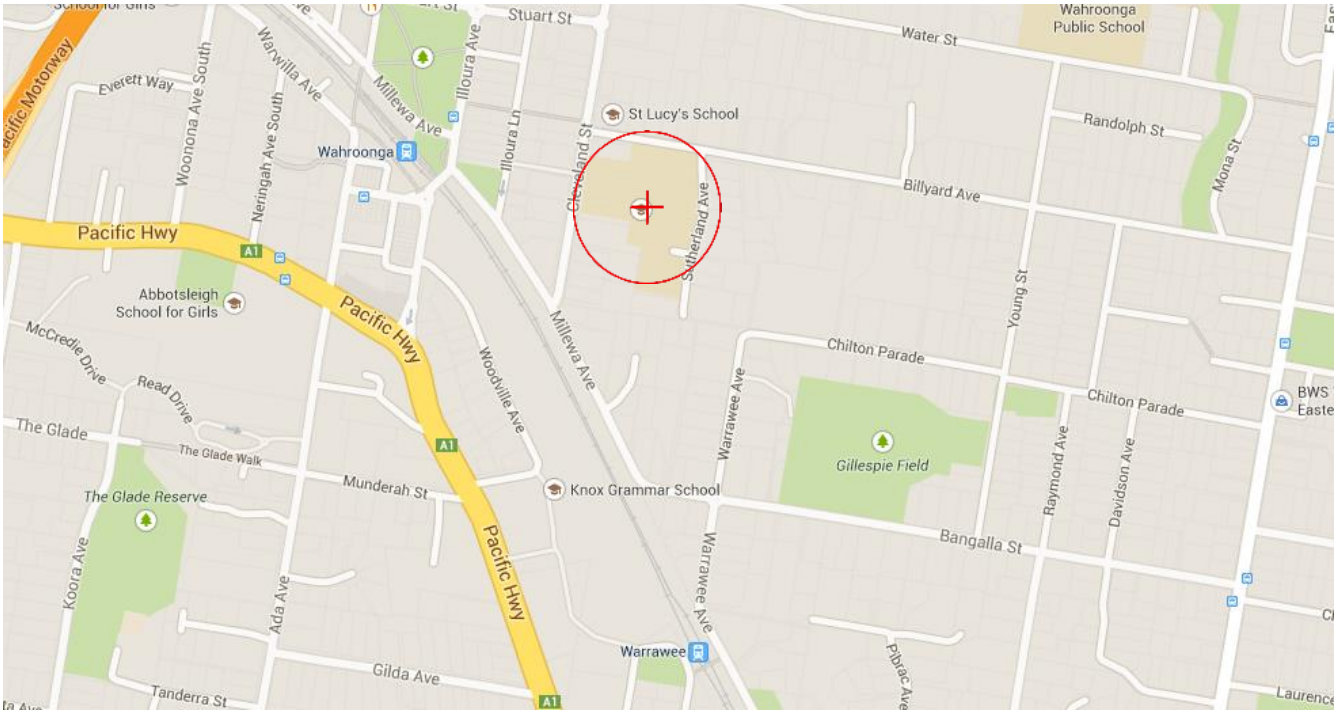


Figure 1 - Knox Preparatory Campus Location

Knox was established in 1924 by the Presbyterian Church of Australia as an all-boys school. Named after John Knox, the school has grown to approximately 1,760 senior students (located at the Senior School Campus on the Pacific Highway, Wahroonga) and 661 junior school students (located at the Prep School).

3.2 Prep School Campus

The Prep School is attended by approximately 661 students in Kindergarten and years 1 to 6 and involves 71 full time staff and 29 part time staff (being 16.76 Full Time Equivalent staff (FTE)). The Prep School accommodates a range of different types of buildings and facilities that are used for curricular and non-curricular activities and after school care.

The Prep School is located within a predominantly residential area comprising large established dwellings. St Lucy's School for children with a disability is located on the north-east corner of Cleveland Street and Billyard Avenue, opposite and to the north of the Prep School.

The following aerial photograph provides an overview of the area and context in relation to the surrounding land uses, while the Prep School map presented overleaf summarises the location of facilities within the Prep School.

Figure 2 - Knox Preparatory Campus Context

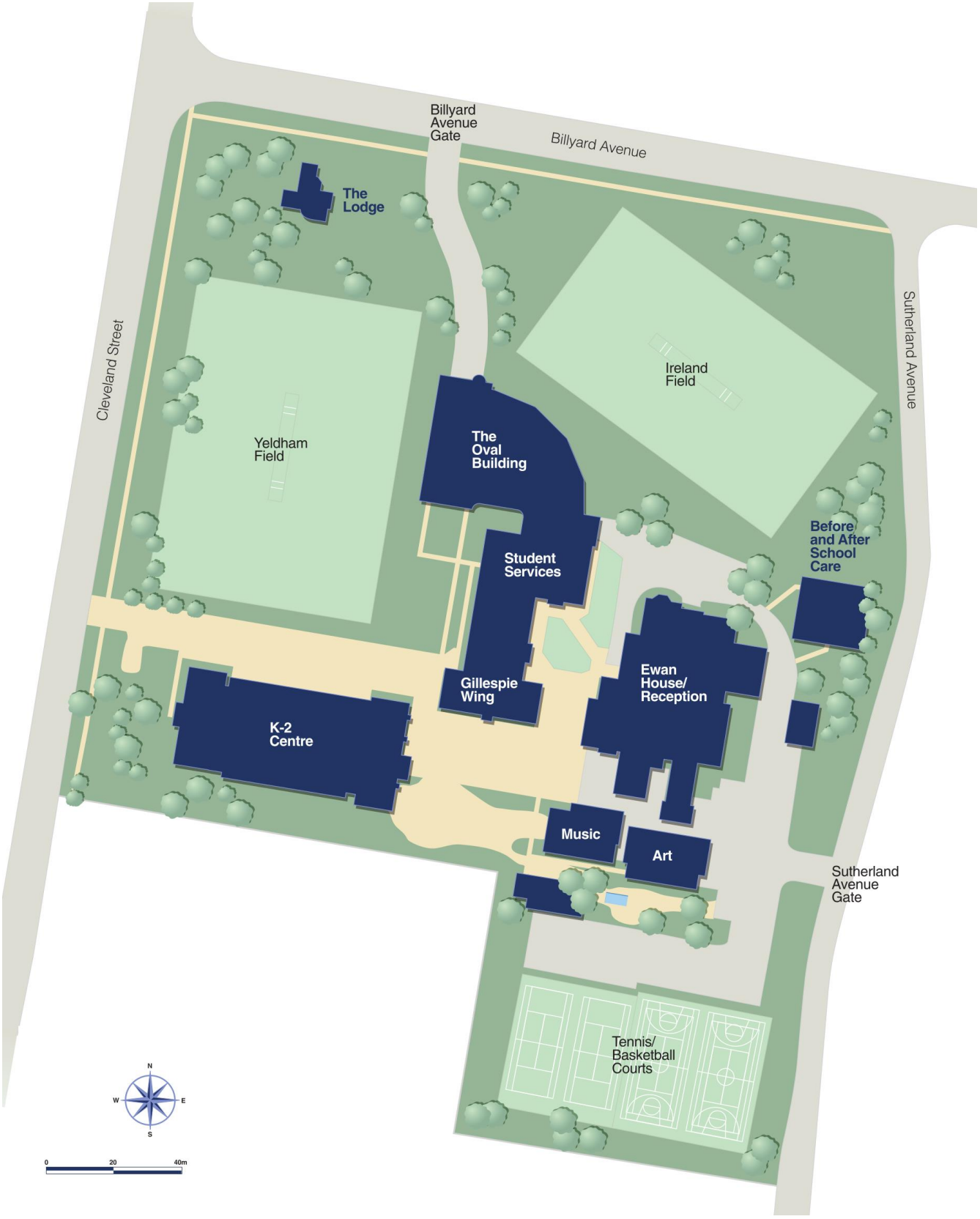


Figure 3 - Knox Preparatory School Campus Map

The Prep School population by year group comprises:

Year	Number of Students
K	52
1	51
2	54
3	81
4	102
5	145
6	176
Total	**661**

Table 1 - Prep School population by year group

These figures are important in relation to the travel surveys described in section 5 of this report.

3.3 Current School Traffic Arrangements

The Prep School benefits from three road frontages comprising Cleveland Street, Billyard Avenue and Sutherland Avenue. Vehicular access is currently available from Billyard Avenue and Sutherland Avenue. The Prep School cannot be accessed from Cleveland Street. Each of these roads is classified as a "local road" according to the RMS Road Classification map and residential in character.

A complete on-street parking inventory is presented in Section 3.5 of this report, however the primary on-street drop-off and pick-up area is provided along the Billyard Avenue and Cleveland Street frontages (by way of 'No Parking' signage), while no specific provisions for drop-off and pick-up are provided on Sutherland Avenue. There are limited areas of unrestricted parking within the Cleveland Street frontage.

All roads in the vicinity of the Prep School are subject to the School Zone 40kph speed limit controls associated with both St Lucy's and the Prep School. Marked pedestrian crossings are located at the intersection of Cleveland Street and Billyard Avenue. A commentary on these facilities and their effect on safety and traffic flow is presented in Section 4.2 of this report.

3.4 Current Parking Supply on Prep School

The current parking provision within the Prep School comprises 71 spaces in the newly completed car park adjacent to the Tennis Courts located on Sutherland Avenue. Following completion of the proposed Yeldham Field Car Park, 26 of the 71 spaces available at the Sutherland Avenue car park will remain in use for day to day operations of the Prep School. The remaining 45 spaces will be retained for over-flow parking or as required for parking beyond day to day staff parking requirements.

There are currently no parking spaces or drop-off/pick-up areas for parents within the Prep School.

3.5 Current On-Street Parking Controls

The Prep School has three road frontages; Cleveland Street, Billyard Avenue and Sutherland Avenue, each providing some areas of on-street parking. The on-street parking provision is subject to time restrictions and 'No Stopping' restrictions. The various parking controls are presented in Figure 4 (overleaf), which comprise

either unrestricted parking, 'No Parking', or 'No Parking during student drop-off and pick-up periods' ('No Parking' permits a driver to stop for up to 2 minutes, but they must remain with the vehicle).

The study observed that the majority of the parking provision was utilised during student arrival and departure periods. The student and staff survey questionnaires referenced in Section 5 confirm the parking demand arising out of the Prep School, which informs the measures required to manage the peak activity.

Figure 4 - Existing On-Street Parking Controls

4 Transport Environment

4.1 Road Network

The Prep School is located in Wahroonga to the east of the northern line railway and the Pacific Highway and in this regard has reasonably good connections to the north shore arterial road network. However, connections to the west are somewhat limited by the North Shore Railway line, which acts as a barrier through the area.

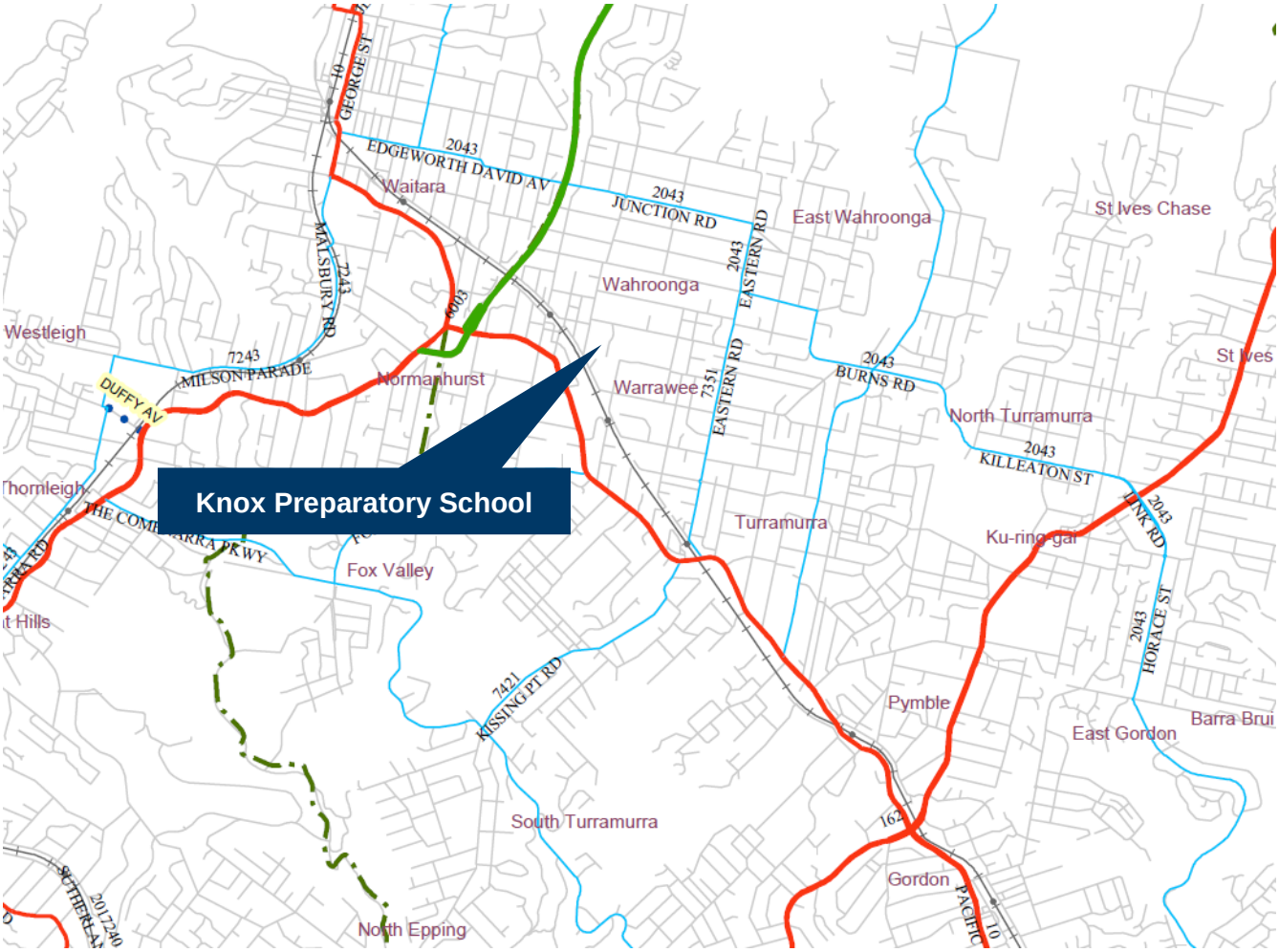


Figure 5 - Road Hierarchy Map

The NSW administrative road hierarchy comprises the following road classifications, which align with the generic road hierarchy as follows:

State Roads - Freeways and Primary Arterials (RMS Managed)

Regional Roads - Secondary or sub arterials (Council Managed, Part funded by the State)

Local Roads - Collector and local access roads (Council Managed)

The road network servicing the Prep School includes:

The Pacific Highway, which is classified as a State Road and follows a north–south alignment. Within the suburb of Wahroonga, the carriageway accommodates three traffic lanes in each direction with auxiliary turning lanes at major intersections. During peak periods, clearway restrictions are implemented and a 40Kph School Zone is applied in addition to the normal 60Kph speed limit.

Eastern Road, which is classified as a Regional Road and provides a connection to the East Wahroonga Area and Junction Road, which provides an important alternative connection to Hornsby.

Cleveland Street, which is a local road providing access between Millewa Avenue (along the northern side of the railway) and Burns Road. Cleveland Street provides strategic access to the school frontage and connects with the expansive residential area to the north of the Prep School, as well as providing the most convenient crossing over the railway, via Millewa Avenue. In the vicinity of the Prep School the carriageway accommodates parking along both sides, with an undivided roadway able to accommodate two-way vehicles at low speed.

Billyard Avenue, which is a local road providing access between Eastern Road and Cleveland Street. Billyard Avenue is also a strategic access road to the Prep School as it connects directly with the Eastern Road, Burns Road and Junction Road regional route from the south (which is an alternative to the Pacific Highway). In the vicinity of the Prep School the carriageway accommodates two marked traffic lanes in each direction, with parking along both sides.

Sutherland Avenue, which is a local access road and cul-de-sac providing access to the residential properties located along the eastern side of the Prep School.

4.2 Traffic Controls

The traffic controls in the vicinity of the Prep School comprise a general 50kph speed limit and a 40Kph school zone applicable to Cleveland Street, Billyard Avenue and Sutherland Avenue. Other controls include two pedestrian crossings located on the northern and eastern approaches to the Cleveland Street and Billyard Avenue intersection. The intersection is not subject to any STOP or GIVE WAY control, although it is clear to drivers that Cleveland Street has priority over traffic on Billyard Avenue.

The existing parking controls are described in Section 3.5 of this report.

4.3 Public Transport

The Prep School is reasonably well served by both train and bus services operating on the North Shore line and the 576 bus route along Cleveland Street.

4.3.1 Rail

Wahroonga Station is located approximately 400m walking distance from the Billyard Avenue entrance to the Prep School (see Figure 7) and is situated on the North Shore Line, providing access to the Prep School from Northern, Southern and Western suburbs (via interchange at Sydney CBD stations).

Rail Route	From	To	Frequency on Weekdays (approx.)
Northern Line (Southbound)	Berowra/Hornsby	Parramatta (via Central)	Arrive every 15 minutes (morning peak and afternoon school peak)
Northern Line (Northbound)	Parramatta (via Central)	Hornsby/Berowra	Arrive every 6-9 minutes (morning peak) Depart Every 6-9 minutes (afternoon school peak)

Table 2 - Rail Services

Services via the North Shore/Northern Line are frequent and provide excellent availability throughout the day, especially during peak hours.

4.3.2 Knox Buses

Knox also provides the option of a private bus charter which operates on four different routes. This service is available for students who are charged a fee per term.

The buses operates four routes as follows:

- Route 1: Newport, Mona Vale, Ingleside, Terrey Hills
- Route 2: Seaforth, Wakehurst Parkway, Belrose, Forest Way, St Ives
- Route 3: Cammeray, Northbridge, Castlecrag, Middle Cove, Castle Cove, Roseville Chase, Killara
- Route 4: Longueville, Lane Cove, Boronia Park, North Ryde

Figure 6 - Knox Bus Routes Map

The pedestrian routes connecting between the Billyard Avenue entrance and public transport services are indicated in Figure 7, which demonstrate that there is no conflict between pedestrian activity and the proposed car park driveway within the Cleveland Street frontage.

Figure 7 - Pedestrian Routes to Public Transport

5 Prep School Travel Characteristics

In order to assess the current and projected traffic activity associated with the Prep School, it is important to understand the current travel characteristics, such as the transport mode split, car occupancy rates, locations of drop-off or parking etc.

This information has been collected through the use of an online questionnaire survey of Prep School students and staff. The online surveys were administered by Knox and sought separate responses from students and staff as the travel characteristic of these two groups is quite different. It should be noted that the students within the Prep School are all below the legal driving age, therefore there are no self-drive results and there is no all-day parking demand associated with students.

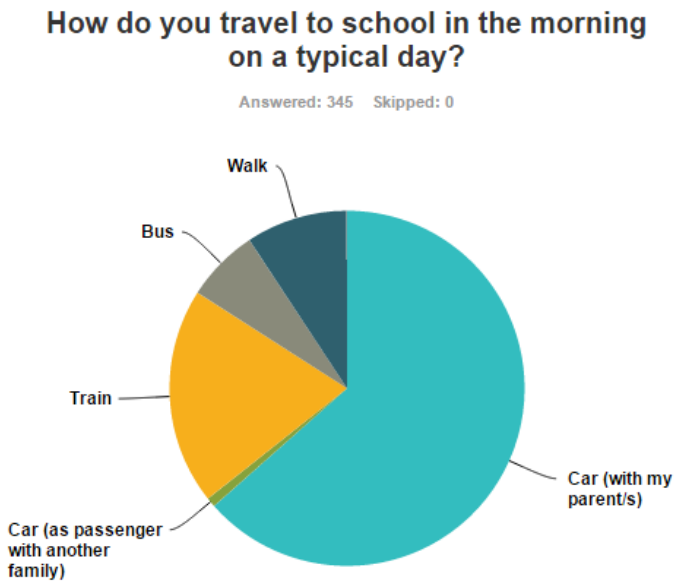
The key findings from the survey results are:

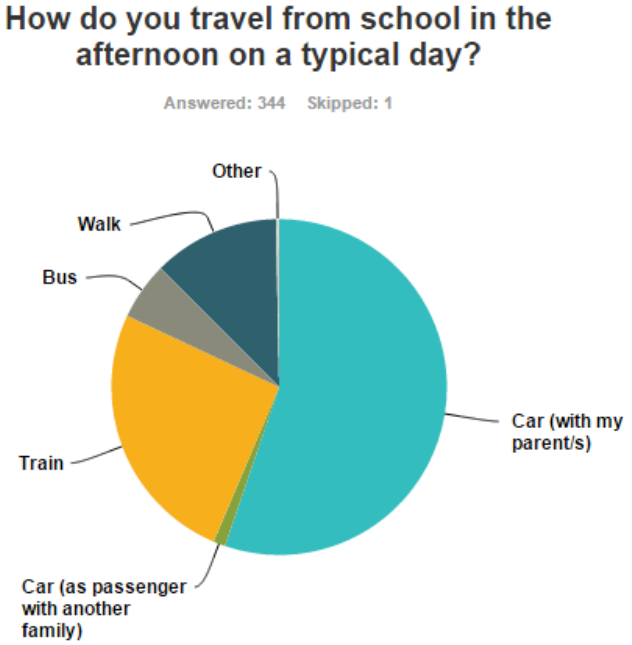
- 64.3% of students arrive by car and are dropped-off;
- the remaining 35.7% travel by other means, with Train being the most popular alternative at 19.6%.

The afternoon departure figures are slightly different in that:

- the pick-up value drops to 56.4% (versus 64.3% drop-off);
- all other forms of transport increase to 43.6%, including Train use at 25.72%. Anecdotally, this is likely to be a result of parents who work and are able to drop-off in the morning but not pick-up in the afternoon.

The travel mode splits are summarised in the following pie charts:





In relation to staff, the surveys indicate that:

- 85.4% of staff drive to Knox and park;
- of those who drive, 72.2% have allocated parking spaces within the Prep School while the remaining 27.8% don't;
- of the staff who drive, 33.3% indicated that they park on nearby streets.

5.1 Student Survey and Results

The student survey comprised the following questions.

Q1. What year group are you in?

Q2. How do you travel to school in the morning on a typical day?

Q3. How do you travel from school in the afternoon on a typical day?

Q4. If by car, how many other students travel with you?

Q5. If you travel by car, why is this your preferred method of transport to and from school?

Q6. If you travel by car, where are you dropped-off in the morning?

Q7. If you travel by car, where are you picked-up in the afternoon?

Q8. If you park and walk to the school, which street do you generally park in?

Q9. What is the postcode of where you live?

Q10. Are there any parts of your journey that you feel are difficult or cause you concern?

The student surveys were undertaken within the school environment, therefore the response rate is reasonably high compared to typical surveys undertaken in more public / open forums. However the response rate varied according to year group and therefore the results need to be assessed in this context. Also, as each school year involves slightly different travel characteristics the adjustments to the results has been applied to each year separately as presented in the following table:

Year	Number of students	Responses	Percentage
K	52	40	77%
1	51	33	65%
2	54	30	56%
3	81	47	58%
4	102	55	54%
5	145	66	46%
6	176	76	43%
	661	**347**	**52.5%**

Table 3 - Student Survey Results Adjustment factors

The ultimate aim of the study is to determine the parking demand and traffic activity associated with the Prep School and to assess the demand for drop-off and pick-up spaces following an increase in the student population from the current 661 students to 840 students.

The second question within the survey establishes the travel mode split, which provides an outline snapshot of the vehicle trip generation (per student), the overall parking demand and the demand for drop-off/pick-up spaces.

5.2 Existing Student Traffic Generation

The traffic generation associated with students is calculated by multiplying the car usage figures by the correction rates and then by applying the car occupancy rate, i.e. those students who travel with another student travel by car, but do not result in an additional vehicle trip.

Number of students	% Driven	# Driven	Car Occupancy	Number of Cars	Trips per Student
661	64.3%	425	1.67	255	0.39

Table 4 - Student Morning Trip Generation

Number of students	% Driven	# Driven	Car Occupancy	Number of Cars	Trips per Student
661	56.4%	373	1.67	223	0.34

Table 5 - Student Afternoon Trip Generation

On the assumption that the mode split doesn't dramatically change over coming years, the surveys provide a reliable traffic generation figure of 0.39 trips per student during the morning arrival period and 0.34 trips per student during the afternoon departure period. These figures are useful in predicting future traffic impacts associated with the proposed increase in the student and staff population.

5.3 Student Parking Demand

5.3.1 Drop-off and Pick-Up Demand

The majority of schools in Sydney provide limited on-site parking, typically reserved for staff, while drop-off and pick-up areas are provided for students on and off site. At the Prep School, the current drop-off and pick-up activity occurs on Billyard Avenue and Cleveland Street, which have a combined total capacity for approximately 40 vehicles (17 on Billyard Avenue and 23 on Cleveland Street). In order to assess the demand for the drop-off and pick-up spaces, video surveys were undertaken during a typical term week during the morning arrival and afternoon departure periods. The results of the surveys enable determination of not only the demand, but also the average dwell time of vehicles (how long they are stationary at the kerb) and how often, and to what extent, queuing occurred beyond the capacity of the area.

The video surveys recorded a drop-off activity comprising 202 vehicles during the morning and a pick-up activity comprising 88 vehicles. The difference between the video survey results and the questionnaire results is indicative of parking activity taking place beyond the combined capacity of Billyard Avenue and Cleveland Street. This is particularly noticeable during the afternoon period, whereby many more parents park in the unrestricted parking areas rather than relying on the short-term pick-up areas. This is consistent with our findings at other schools, and is driven mainly by the longer dwell time required (i.e. parents arriving prior to the end of school and waiting).

The video surveys enable the recording of the arrival and departure time of each vehicle, allowing an accurate average dwell time to be established. The average dwell time during the morning period was recorded as 2 minutes 18 seconds (138 seconds). The afternoon pick up dwell time is two and a half time longer at an average of 5 minutes and 43 seconds (343 seconds), although the impact of this is somewhat offset because fewer students travel home by car than travel to school by car. This was evident in that the maximum recorded accumulation of vehicles on Billyard Avenue was 4 cars during the morning period and 5 cars during the afternoon period.

5.3.2 Future Drop-off and Pick-Up Demand

Knox proposes to construct a dedicated student drop-off and pick-up facility within the Prep School. Several options have been identified and investigated as to their ability to accommodate the demand arising out of the proposed student population of 840 students and impact on the surrounding road network.

A purpose-built student drop-off and pick-up facility requires careful design to avoid interaction between students and moving vehicles and requires dedicated management whilst in operation in order to maintain safe and efficient throughput. Any proposal should be assessed based on the safety of students as a priority over efficiency or use of space.

The existing student population of 661 students typically results in 425 students being dropped off at the Prep School in the morning via 255 vehicles that generally do not park. In the afternoon 373 students are picked up at the Prep School via 223 vehicles, however unlike in the morning, vehicles are more likely to park on the street and wait. A purpose-built well operated drop-off and pick-up facility within the Prep School would encourage an increase in on-time pick-up rather than parking. Based on the survey data, the proposed student population of 840 would increase the number of vehicles dropping off students in the morning by 69 to 324, and picking up students in the afternoon by 60 to 283.

The assessment of traffic activity associated with land-uses typically involves a 60 minute period referred to as the peak hour and generally a weekday morning peak hour and an afternoon peak hour is assessed. In relation to schools, the peak traffic activity is typically confined to a 30 minute period.

A benefit of a dedicated, properly sized and well managed student drop-off and pick-up facility is that it makes the process and timing of dropping of and picking up a student more predictable for all involved (student, driver and staff) and thereby reduces the reliance on extended parking. Under managed arrangements the pick-up dwell time is dramatically reduced and it is likely that a dwell time of less than 1 minute can be achieved. Based on surveys of other schools where the drop-off and pick-up activity is managed by staff and the driver stays within the vehicle at all times (i.e. kiss-and-go, not park-and-escort), the dwell time is approximately 45 seconds.

5.4 Staff Parking Survey and Results

The staff survey comprised the following questions:

Q1. How do you travel to and from school on a typical day?

Q2. Do you have allocated parking?

Q3. If you travel by car, why is this your preferred method of transport to and from the school?

Q4. If you drive, where do you typically park?

Q5. In a typical week, how many times do you:

a. Come to work at school?

b. Arrive at school at or before 7:50am

c. Arrive at school after 8:20am

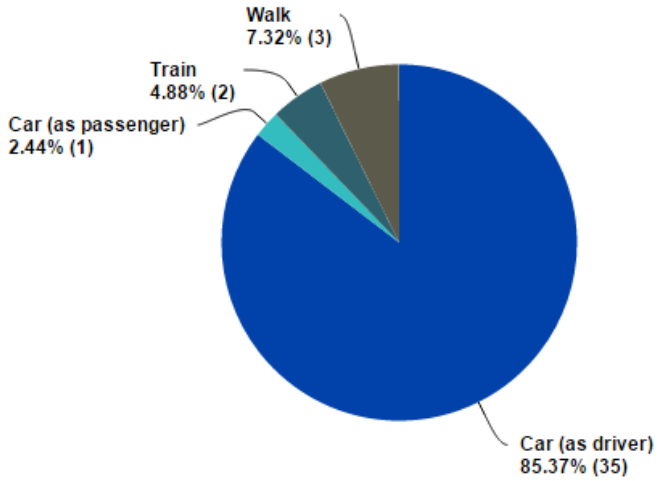
d. Depart school before 2:50pm

e. Depart school after 3:30 but before 5:00pm

f. Depart school after 5:00pm

5.5 Staff Parking Demand

A separate online survey was undertaken specifically to record the staff travel and parking characteristics, which are quite different to that of students. The travel model split is presented in the following pie chart, which confirms that a high proportion of staff arrive by car as a driver or passenger and therefore generate some form of parking demand.



The survey response comprised 41 members of staff and while the mode split provides a useful tool in relation to traffic generation calculations it is important to consider the characteristics of the parking demand, based on the likely staff attendance and parking turnover. The following table presents the parking demand associated with the staff.

	Number of staff (typical term time week)	FTE	Arrived by Car (as Driver)	Type of Parking	Turnover	Parking Demand
Full time	70	70	60	All-Day	1	60
Part time	35	20	17	All-Day	1	77
Total	**105**	**90**	**77**			**77**

Table 6 - The staff population and predicted Parking Demand

The proposal includes the provision of 85 parking spaces (plus 22 drop-off spaces) within a proposed car park beneath Yeldham Field, in addition to the existing parking provision.

The current parking provision within the Prep School comprises 71 spaces in the newly completed car park adjacent to the Tennis Courts located on Sutherland Avenue. Following completion of the proposed Yeldham Field Car Park, 26 of the 71 spaces available at the Sutherland Avenue car park will remain in use for day to day operations of the Prep School. The remaining 45 spaces will be retained for "over-spill" car parking or as required for parking beyond day to day staff parking requirements.

The proposed and existing car parking will accommodate 111 parking spaces for daily use, 45 overflow spaces, and 22 drop-off / pick-up spaces.

5.6 Planning Policy Requirements

The relevant planning policy applicable to the development is the Ku-ring-gai DCP 2015, and Part 23 stipulates the following parking provisions for schools:

- 1 space per full time equivalent (FTE) employee;
- 1 space per 8 year 12 students;
- Provision for on-site set down / pick up of students and a set down / pick up management plan is required.

There are no Year 12 students at the Prep School. Consequently the DCP requires the provision of 90 car parking spaces within the Prep School to accommodate 90 staff.

It is evident that the DCP makes the assumption that all staff drive to work at a car usage ratio of 1:1, whereas the survey results discussed at Section 5.5 above indicate that only 85% of staff drive to the Prep School (77 cars) and therefore the actual parking demand is in fact less than that contemplated by the DCP. The proposed parking provision is described in the following section.

6 Proposed Improvements

In order to facilitate an increase in the approved student population, it is evident that the parking provision within the Prep School and/or the drop-off/pick-up arrangements should be upgraded. It is also evident that certain areas of the road network surrounding the school are not operating at the potential capacity because of drop-off and pick-up activity.

It is proposed to construct a car park and dedicated student drop-off/pick-up facility beneath Yeldham Field, which is located within the Prep School on the corner of Cleveland Street and Billyard Avenue.

This proposal will improve the existing situation by:

- removing all drop-off and pick-up activity from the local road network,
- accommodating all staff parking within the site,
- accommodating the additional activity associated with the proposed increase in the student population,
- accommodating parking associated with out-of-hours activities.

6.1 Proposed Parking Provision

The proposed car park will accommodate 85 parking spaces for staff and visitors and 22 drop-off/pick-up spaces. The combined provision of 107 spaces would be available for use in relation to out-of-hours activity (sports etc.).

The current parking provision within the Prep School comprises 71 spaces in the newly completed car park adjacent to the Tennis Courts located on Sutherland Avenue. Following completion of the proposed Yeldham Field Car Park, 26 of the 71 spaces available at the Sutherland Avenue car park will remain in use for day to day operations of the Prep School. The remaining 45 spaces will be retained for over-flow car parking or as required for parking beyond day to day staff parking requirements.

In relation to the DCP requirements, the provision of 111 spaces (85 within the Yeldham car park and 26 within the Sutherland Avenue car park) satisfies the minimum requirement for 90 FTE staff.

It is not intended to dedicate the parking to any particular user group, however it is evident that based on the car usage rate of 85%, only 77 spaces would be used by staff. Assuming that the Sutherland Avenue car park is used only be staff and to its capacity of 26 spaces, this would create a demand for 51 spaces within the Yeldham car park, leaving 34 spaces for visitors and/or parents wishing to park and escort students (e.g. to collect large items, musical instruments etc.) rather than using the drop-off spaces.

The overall parking provision is summarised in the following table:

Location	Type of parking	Number of Spaces	Daily Staff Demand	Parking for Visitors / Parents	Events
Sutherland Avenue	Permeant	26	26	0	26
	Over-flow	45	0	0	45
Yeldham Field	Permanent	85	51	34	85
	Drop-off/Pick-up	22	0	0	22
Total		**178**	**77**	**34**	**178**

Details of the proposal are presented in the architectural drawings prepared by Drew Dickson Architects and those illustrating overall car parking arrangement are included as Attachment 1.

6.2 Vehicular Access

Access to the proposed carpark will be from Cleveland Street towards the northern side of the car park, while being approximately 40 metres south of the Billyard Avenue intersection. This location has been selected due to the limited impact on student pedestrian movements and its isolation from the existing Bus Zone, located on Billyard Avenue, where students disembark and board the school buses.

The proposal also involves the closure of other existing driveways serving the Prep School. Two driveways located on the Billyard Avenue frontage will be closed, although the eastern entrance will remain open to pedestrians. The removal of these driveways removes all vehicle activity across the footpath along the Billyard Avenue frontage.

6.2.1 Geometry

The driveway servicing the proposed new underground carpark has been designed in accordance with the requirements of AS2890.1 having regard for the road frontage type and the size and class of parking facility. According to AS2890.1, the car park will represent a User Class 1 facility, and the driveway will serve 107 parking spaces. In this regard, according to Table 3.1 of As2890.1, the driveway will represent a Category 2 driveway, which according to Table 3.2 requires a combined width of 6.0 – 9.0 metres.

In accordance with the Standard, the proposed driveway comprises a width of 9.0 metres, and is proposed to be divided, providing two 4.2 metre wide lanes. The central island will be formed to prevent the right turn movements to and from the driveway, which will assist in limiting the impact on through movements along Cleveland Street. This means that only the left-in and left-out movements will be available so that all traffic associated with the car park will need to approach and depart in a southbound direction. This has been incorporated into the projected traffic modelling.

6.2.2 Sight Distance

The sight distance requirements are described in Section 3.2 of AS2890.1 and are prescribed on the basis of the sign posted speed limit or 85th percentile vehicle speeds along the frontage road. Cleveland Street has a posted speed limit of 50kph (outside the School Zone periods) and according to the Standard requires a desirable visibility distance of 69 metres and a minimum distance of 45 metres.

The proposed driveway is located along a straight section of Cleveland Street, where unobstructed visibility is available.

In relation to pedestrian sight distances, Figure 3.3 of the standard requires a splay of 2.0 metres (along the frontage) by 2.5 metres (into the property) so that drivers can observe pedestrians adjacent to the driveway, when exiting the car park. These splay requirements have been incorporated into the proposed driveway.

6.3 Carpark Arrangement

The proposed carpark arrangement and internal circulation have been designed in accordance with the requirements of Section 2 of AS2890.1.

Table 1.1 of AS2890.1 presents a number of classifications applicable to different land-uses. According to the Table, the most appropriate car park classification applicable to the subject car park will be a Class 1 facility, which is suitable for "Residential, domestic and employee parking".

The parking space dimensions and associated aisle widths for each classification are presented in Table 2.2, and accordingly, a Class 1 facility requires parking space dimensions of 2.4 x 5.4 metres with an access aisle width of 6.2 metres.

The proposed car park has been designed to provide compliant parking space widths of 2.5 metres and aisle widths in excess of 5.8 metres. An assessment of all elements of the car park has been undertaken including column locations, aisle extensions and in this regard, the car park design complies with the requirements of AS2890.1.

The perimeter aisle of the car park serves a drop-off and pick-up area along three side of the car park. This area has the capacity to accommodate up to 22 cars in a parallel parking arrangement.

7 Traffic Assessment

7.1 Existing Traffic Conditions

In order to determine the existing traffic conditions within the road network serving the Prep School, traffic count surveys were undertaken at the following intersections:

- Cleveland Street and Billyard Avenue
- Cleveland Street and Millewa Avenue
- Billyard Avenue and Sutherland Avenue

In addition to the intersection surveys, video surveys were undertaken along the frontages of the Prep School to determine the extent of drop-off and pick-up activity to assess the parking demand, but also the associated impact on traffic flows.

The results of the intersection surveys are illustrated in the following figures:

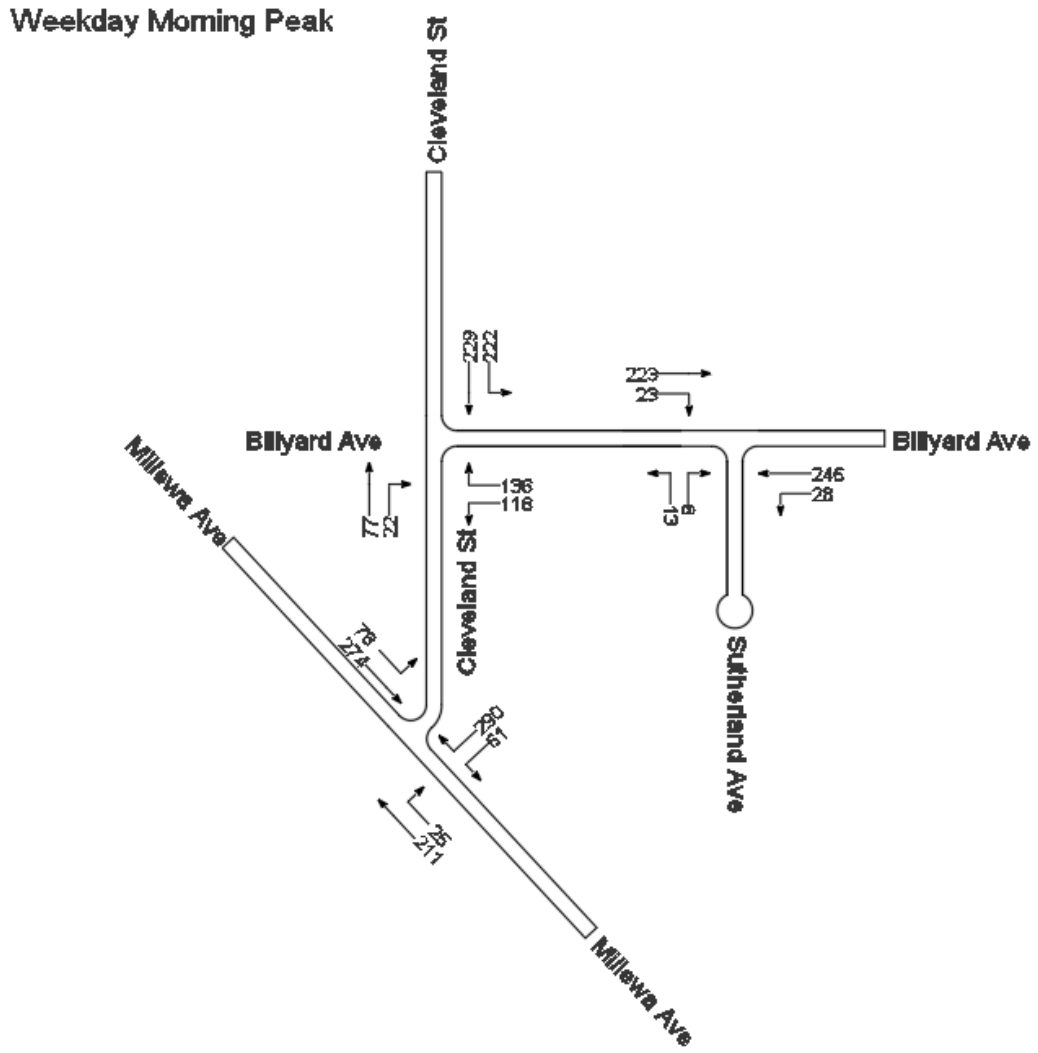


Figure 8 - Existing Morning Peak Traffic Volumes

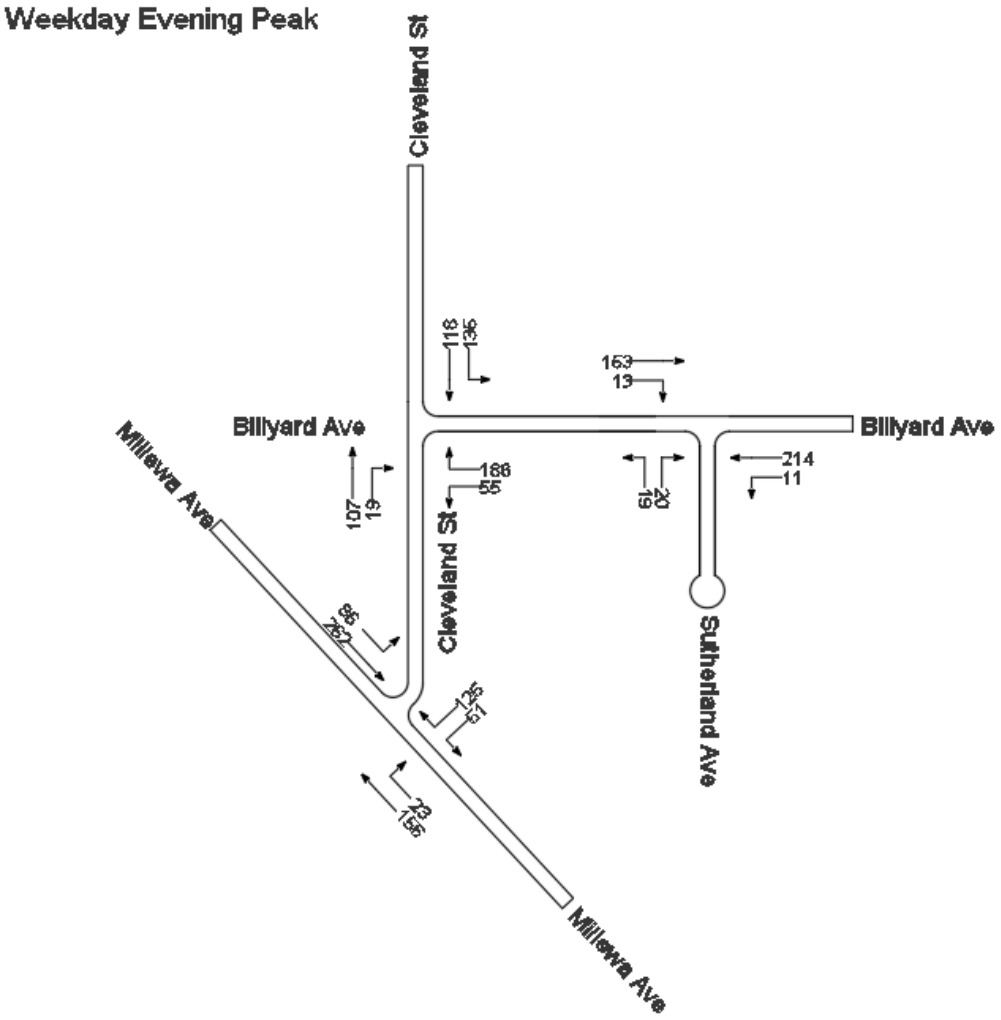


Figure 9 - Existing Evening Peak Traffic Volumes

7.2 Traffic Generation

The traffic generation associated with land-uses is typically established through reference to Section 3 of the RTA Guide to Traffic Generating Developments. However, where an expansion of an existing facility is proposed, it is more appropriate to collect data that is specific to the operation. In relation to the Prep School, this has been achieved through on-line surveys, which have enabled the establishment of the traffic generation per student and per staff.

The student surveys determined a trip generation rate of 0.39 cars per student during the morning peak and 0.34 cars per student during the afternoon peak.

The staff surveys recorded that 85% of staff drive to the school, resulting in a trip generation of 0.85 cars per staff member.

The increase of 179 students will therefore result in 70 additional morning trips and 61 additional afternoon trips. It should be noted that all vehicles arrive and depart within the same one-hour period and this has been incorporated into the projected traffic modelling.

It is proposed that the increase in the student population will involve up to 90 staff, representing an increase of 19 staff, and 17 vehicle trips.

While the projected increase of 87 additional trips is not sufficient to cause any detrimental impact on the road network, it is important to note that the proposed car park will result in the redirection of trips in the vicinity of the Prep School. This has been incorporated into the project traffic modelling and traffic distribution.

The traffic generation and comparison figures are summarised in the following table:

	Current Consent*	Diff.	Actual	Diff.	Proposed
Students	676	-15	661	+179	840
Student AM Trip Rate	0.39		0.39		0.39
Student AM Trips	264	-6	258	+70	328
Student PM Trip Rate	0.34		0.34		0.34
Student PM Trips	230	-5	225	+61	286
FTE	71	0	71	+19	90
FTE Trip Rate (AM and PM)	0.85		0.85		0.85
FTE Trips (AM and PM)	60	0	60	+17	77
Total AM Traffic Activity	324	-6	318	+87	405
Total PM Traffic Activity	290	-5	285	+78	363

* Potential population and traffic activity under the current consent

Table 7 - Summary of Traffic Generation

7.3 Traffic Distribution

It is proposed that the driveway to the proposed carpark will only accommodate left-in and left-out movements in order to limit the impact on the through traffic on Cleveland Street. Therefore, the distribution of the projected trips includes the following assumptions:

- all vehicles will approach the driveway from the north and depart to the south,
- all staff vehicles will arrive during the morning peak and depart during the evening peak (this provides a robust assessment as most staff do not leave within the same hour as the students),
- all parent vehicles will arrive and depart within the morning peak and the afternoon peak.

The traffic movements have been distributed at the neighbouring intersections according to the existing turning proportions recorded during the intersection surveys. The projected traffic volumes associated with the morning peak is illustrated in the following figure:

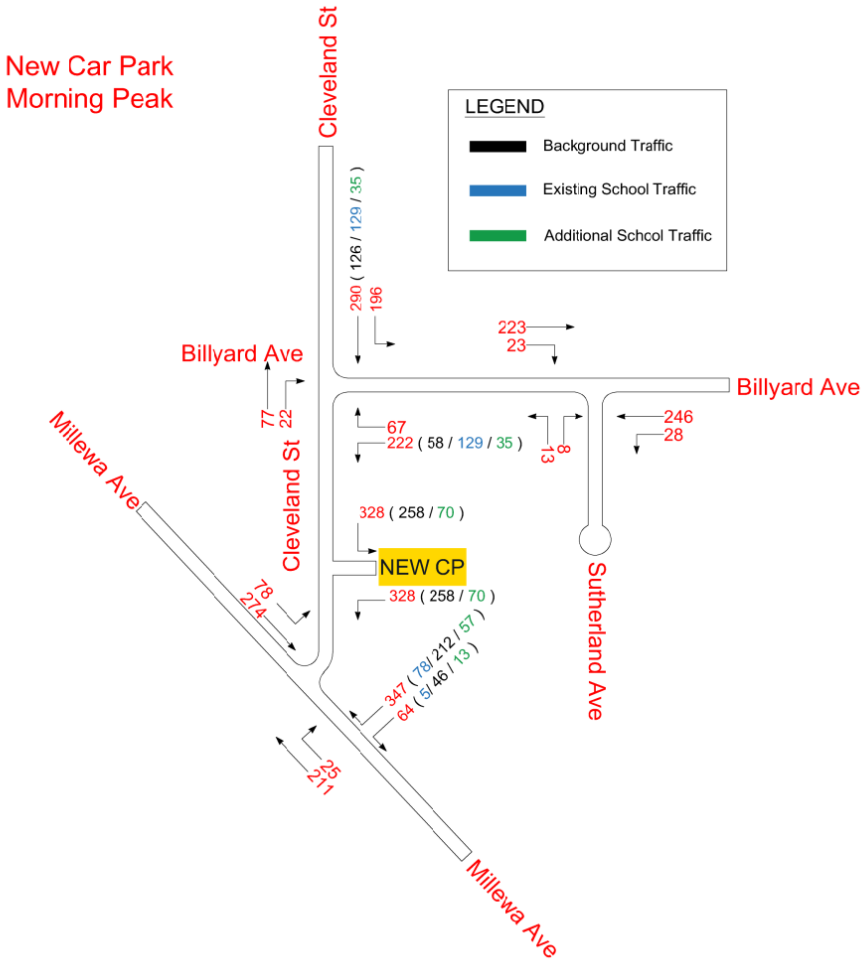


Figure 10 - Post Development Morning Peak Traffic Volumes

7.4 Intersection Modelling

In order to confirm the current operation of the intersection, an assessment has been undertaken using the Commuter Nano-simulation modelling software, which presents a range of performance indicators (Level of Service, Average Delay, etc.).

Typically there are three performance indicators used to summarise the performance of an intersection, being:

- Average Delay- The average delay encountered by all vehicles passing through the intersection. It is often important to review the average delay of each approach as a side road could have a long delay time, while the large free flowing major traffic will provide an overall low average delay.
- 95% Queue lengths (Q95) - is defined to be the queue length in metres that has only a 5-percent probability of being exceeded during the analysis time period. It transforms the average delay into measureable distance units.
- Level of Service (LoS) – This is a categorization of average delay, intended for simple reference. The RMS adopts the following bands:

Level of Service	Average Delay (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	<14	Good operation	
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity. At signals, incidents would cause excessive delays. Roundabouts require other control mode	At capacity, requires other control mode
F	>70	Extra capacity required	Extreme delay, major treatment required

Table 8 - Level of Service Criteria

The modelling includes the intersection of Cleveland Street / Billyard Avenue and the proposed driveway (within the future scenarios).

A summary of the modelling results are presented in the following table.

Intersection	Level of Service	Avg Delay	95% Back of Queue (Veh)
Cleveland St and Billyard Ave (Sign Control Intersection)	A	11.24	4.0

Table 9 - Commuter Modelling Results (Existing Situation)

To assess the impact of an additional 87 vehicles during the morning peaks including the redirection of vehicles to the proposed car park driveway the road network was modelled in Commuter. The results of this analysis are presented in the following table.

Intersection	Level of Service	Avg Delay	95% Back of Queue (Veh)
Cleveland St and Billyard Ave (Sign Control Intersection)	B	25.05	3.0
Prep School Entry	A	6.31	1.0

Table 10 - Commuter Modelling Results (Post Development Situation)

The findings indicate that the intersection of Cleveland Street / Billyard Avenue will continue to operate well within capacity following the increase of 87 vehicles, plus the redirection of traffic to the proposed car park.

Observations at the Prep School indicate that much of the delay experienced by drivers on Cleveland Street is the result of the limited carriageway width and the parking activity along both sides. This is particularly notable during the morning drop-off period, when the school frontage is used as a drop-off area. The video surveys of the drop-off activity reveal that not all vehicles pull up close/parallel to the kerb, further reducing the usable carriageway. While it is generally possible for two vehicles to pass while cars are parked on both sides, many drivers (particularly of larger cars) choose to wait, effectively converting a short section of Cleveland Street to a single lane carriageway. As part of the car park proposal it is proposed that the existing 'No Parking' controls along the school frontage be replaced with 'No Stopping', which would not permit a

vehicle to stop for any period of time. This would assist to maintain two-way traffic flow along this section of road. The Commuter modelling has shown the effects of this change show clearly that this proposal would increase the capacity of Cleveland Street and further reduce delays currently experienced.

In summary, the Cleveland Street and Billyard Avenue intersections will continue to provide an acceptable degree of saturation during the typical weekday peak period and the changes to Cleveland Street will increase the road capacity and solve an existing constraint. Therefore the proposal will have no detrimental impact on the adjacent road network and will likely have a net benefit.

8 Conclusion & Recommendations

This study has assessed the current and future parking demands associated with the Knox Grammar Prep School in the context of an application to increase the student population to 840 students and construct a new car park beneath Yeldham Field within the Prep School.

This assessment has concluded that the proposed increase in the student population will have an unnoticeable impact on the operation of the road network and the associated traffic movements are within the daily variation. The way in which Knox proposes to address potential impacts, by constructing a 85-space carpark and 22-space student drop-off and pick-up facility under Yeldham Field, will reduce traffic congestion from the current situation.

The proposed car park and access arrangement have been designed in accordance with AS2890.1 and provides a safe drop-off / pick-up arrangement whereby no students are required to cross a vehicle path.

The proposed driveway to the proposed underground carpark has been designed to accommodate only left-in and left-out movements in order to limit the delays on Cleveland Street associated with the right turn movement into the car park. The prohibition of the right turn out of the car park will limit queueing within the car park.

In summary, the proposed increase in the student population will have no detrimental impact on the road network, while the proposed car park and associated changes to the on-street parking controls will provide an improvement to the existing situation.

Attachment 1 - Architectural Drawings