Traffic Impact Assessment

Educational Establishment at Seventeenth Avenue Austral NSW

Prepared for

AL Mabarat Benevolent Society

March 2017

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	Name	Signature	Date
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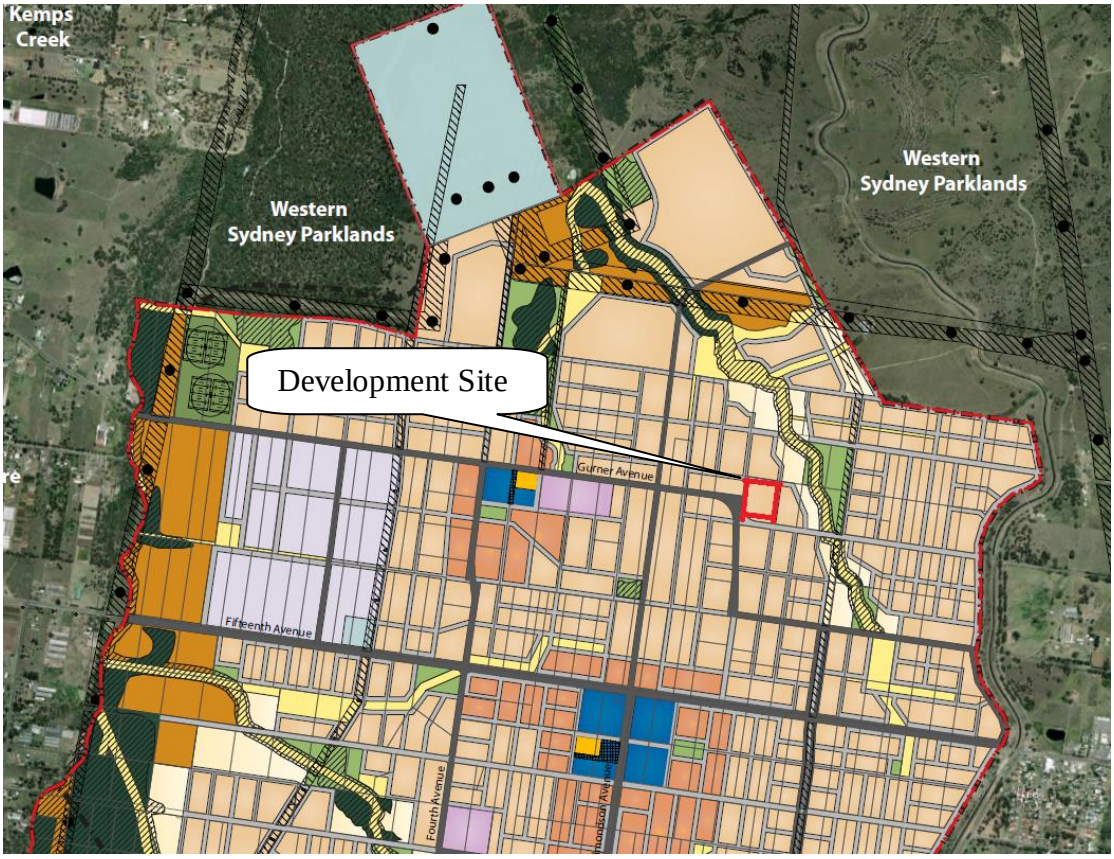
1. Introduction

This report has been prepared for Liverpool City Council in support of a development application for a school proposed at the corner of Seventeenth Avenue and Craik Avenue, Austral, NSW. The purpose of this study is to assess the parking and access requirements of the site and determine the impacts of the proposed development, on the surrounding road network. This report will focus on traffic generation and the potential impacts of the additional traffic associated with the proposed development, on the existing and the proposed road network, the suitability of the proposed parking on site, both in terms of the number of spaces and the lay out of the parking areas.

2. Locality map

The following plan shows the location of the proposed development in the context of the surrounding existing road network.

The following plan shows the location of the proposed development in the context of the proposed road network as per the indicative layout plan for Austral and Leppington North Precinct.



3. Scope of works

The scope of this report is outlined below:

- Assessment of the traffic generation of the proposed development and its cumulative impact on surrounding street network. Especially at the intersection of Craik Avenue and Seventeenth Avenue.
- Assessment of the parking requirement of the proposed development in accordance with relevant Development Control Plan for the subject area.
- Assessment of the design of the proposed parking layout in accordance with Australian Standard AS2890.1 and AS2890.6.
- Assessment of the access driveways in accordance with AS2890.1.
- Assessment of the overall traffic circulation within and surrounding the site.

4. Proposed development

It is proposed to undertake a staged development of a school providing for Kindergarten - Year 12. The development involves the demolition of the existing buildings on the site and the construction of several buildings containing classrooms, a separate administration building, an assembly building, external play areas, car parking areas accessed from Seventeenth Avenue and associated landscaping. The school buildings have been sufficiently setback from the site frontage to Seventeenth Avenue and the corner of Craik and Gurner Avenue. Separation has also been provided from the adjoining property boundaries to accommodate landscaping. The proposed development seeks approval for the following:

- Demolition of two (2) existing dwellings and associated outbuildings on the site.
- Removal of trees and shrubs located centrally on the site.
- Staged development of a school providing for kindergarten – Year 12 for up to 800 students including 60 Y12 students to be achieved by 2029.
- Construction of an Administration and Chapel building.
- Construction of buildings associated with the primary and secondary school.
- Construction of a school assembly building.
- Provision of 51 car parking spaces for staff and visitors.
- Provision of a 12 bay pick-up/drop –off area.
- On-street indented parking bays surrounding the site.
- Provision of two bus parking area.
- Provision for external play areas.
- Before and after school services for up to 40 school aged children.

The development master plan has been shown in **Appendix A**.

5. Existing traffic

The proposed development site is located at the north-east corner of the T-intersection of Craik Avenue and Seventeenth Avenue. Currently there are two residential dwellings at the site.

a Former RTA's "*Guide to Traffic Generating Developments -2002*" has been used to calculate the trip generation of the existing development at the site as shown in Table-1 and 2 below.

Table-1: Trip Generation Rate

Use	Rate/ Peak Hour	Rate/Day
Dwelling houses	0.85 trips per dwelling	9 trips per dwelling per day

Table-2: Existing Site Trip Generation

Use	Number of dwellings	Rate/ Peak Hour	Rate/Day
Dwelling houses	2	2 trips	18 trips per day

However, the proposed development site is subject to rezoning under Austral and Leppington North (ALN) precincts. In the Indicative Layout Plan for the precinct Craik Avenue is classified as Collector Road and Seventeenth Avenue is classified as local road. The following table-3 has been extracted form Austral and Leppington North (ALN) Precincts Transport Assessment Post-Exhibition Traffic Report (Addendum) prepared by AECOM. Table-3 shows the predicted year 2036 mid-block traffic volume and the classification of the roads within the precinct.

Table: 3: Future background traffic Austral and Leppington Precinct

3.7 Road network analysis and classification (road hierarchy)

(In response to Submission ID 599293 – Transport for NSW, changes to Table 8)

Table 8: Forecast 2036 peak hour flows for proposed road network

Location	Direction	AM Peak	PM Peak	AADT	Classification
Bringelly Road (W of Dickson Road)	Eastbound	3,430	1,230	46,100	Principal Arterial
	Westbound	940	3,380		
Bringelly Road (E of Dickson Road)	Eastbound	3,240	810	40,800	Principal Arterial
	Westbound	630	3,270		
Bringelly Road (E of Cowpasture Road)	Eastbound	3,890	1,440	55,000	Principal Arterial
	Westbound	1,270	4,060		
Fifteenth Avenue (E of Fourth Avenue)	Eastbound	1,230	810	22,100	Transit Boulevard
	Westbound	740	1,400		
Fifteenth Avenue (E of Craik Avenue)	Eastbound	2,040	570	27,300	Transit Boulevard
	Westbound	690	2,110		
Fourth Avenue (N of Bringelly Road)	Northbound	240	650	11,400	Sub-Arterial
	Southbound	560	490		
Fourth Avenue (N of Seventh Avenue)	Northbound	270	330	7,400	Collector Road
	Southbound	400	410		
Fourth Avenue (N of Tenth Avenue)	Northbound	410	250	8,400	Collector Road
	Southbound	260	590		
Fourth Avenue (S of Fifteenth Avenue)	Northbound	490	300	9,300	Collector Road
	Southbound	300	630		
Edmondson Avenue (N of Bringelly Road)	Northbound	880	830	16,500	Transit Boulevard
	Southbound	660	820		
Edmondson Avenue (N of Seventh Avenue)	Northbound	600	560	12,300	Transit Boulevard
	Southbound	430	670		
Edmondson Avenue (N of Tenth Avenue)	Northbound	1,020	480	15,000	Transit Boulevard
	Southbound	480	1,000		

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Revision D - 04 July 2012

The predicted year 2036 traffic volumes in Table-3 above is considered the future background traffic for the purpose of this study and has been used to predict the traffic volume on Craik Avenue in the proceeding sections.

Seventeenth Avenue is classified as local road and estimated to have low traffic volumes and generally have volumes less than 1500 to 2000 vehicles per day and 200 vehicles in the peak hour.

6. Proposed development trip generation

RTA's "*Guide to Traffic Generating Developments -2002*" makes no reference to the trip generation rate for school or similar developments.

Therefore the following information supplied by the applicant has been used to calculate the trip generation for the proposed school using first hand principle:

Total number of students:

- Approximately 800 students

Number of teachers and staffs:

- Approximately 36 teachers and staff in total

Hours of operation:

- 7am- 9am and 3pm – 6pm (Outside School Ours Care Services [OOSH]) 40 Children Maximum
- 8.30 am – 3.30pm (Normal school hours)

Likely arrival and departure period for the staffs and teachers:

- Staff and Teachers arrival 8.00am
- Staff and Teachers departure 4.00pm

Likely arrival and departure period for the students and visitors:

- Likely arrival is estimated to be between 8.00am and 8.30am
- Likely departure is estimated to be 3.00pm Primary School Students
- Likely departure is estimated to be 3.30pm Secondary School Students

Modes of students transport (Car or bus):

- It is expected that 60% of students arrive by bus and 40% by car

Modes of staff transport (Car or bus):

- It is expected that 90% of staff will drive whilst 10% are expected to travel using alternative transportation.

Capacity of a designated bus:

- Company contracted 11.1m bus with seating capacity of 53 children *(Maximum)*
- Privatized medium 21 seater busses *(External School Bus Run)*

- Privatized 12 Seater Hiaces or equivalent *(External School Bus Run*)

Frequency of arrival and departure of the buses:

- Busses are estimated to arrive every 10 minutes from 8am to 8.45am and 3.00pm to 4.00pm.

Likely catchment area for the students:

- The schools catchment area is will be a combination of local and regional enrolments. The school will be open for student enrolments outside of the schools immediate district.

The following additional assumptions have been made in estimating the trip generation of the proposed school:

1. A vehicle occupancy rate of 2 students per vehicle has been assumed given the nature of the school where enrolments of siblings are common.

2. The proposed before and after school facility will be used by the school students. Hence no additional trips will be generated by this facility apart from the student trips that has been calculated in Table-4.

Table: 4: Estimated trip generation of the proposed school

	Trip Generation		
Total Students		800	
Staff		36	
Students bus transport @	60%	480	
Students car transport @	40%	320	
Student car occupancy @	2		
Number of vehicles transporting student		160	
Morning Peak Hour	8:00am-9:00am		
		Incoming	Outgoing
Staff		36	0
Students		160	160
Total Morning Peak hour trips		196	160
Total combined trips in the peak hour			356
Through intersection of Craik and Seventeenth Ave	80%	157	128
Total development Traffic			285

7. Development impact

7.1 Traffic Distribution

Craik Avenue in the vicinity of the proposed development site has been classified as a collector road and Seventeenth Avenue as a local road in the Indicative Layout Plan for the Austral and Leppington North Precinct. A fourth leg has been proposed at this intersection as part of the precinct plan street network.

As no truing volumes at the intersections have been shown in the traffic and transport study for Austral and Leppington North Precinct prepared by AECOM, the following assumptions have been made in order to estimate the traffic distribution at the intersection of Craik Avenue and Seventeenth Avenue for the purpose of this study:

1. The highest predicted mid-block volumes for a collector road as stipulated in Table-3 have been assumed to be the mid-block volumes for Craik Avenue in the year 2036.

2. The mid-block peak hour volume for Seventeenth Avenue assumed to be 200 vehicles in the peak hour given that it is classified as a local road. This equates to 2000 vehicles daily.

3. The morning peak has been considered to be most critical compared to evening peak, as the commuter peak (4pm-6pm) do not coincide with school afternoon peak (2pm-4pm).

4. It is reasonable to assume that majority of the precinct traffic (80%) will be leaving the precinct via collector roads and 20% of the trips will be within the precinct.

5. In order to test the worst-case-scenario it is also assumed that 80% of the proposed school traffic will arrive and depart via the intersection of Craik Avenue and Seventeenth Avenue and the remaining 20% will be via Seventeenth Avenue East.

The following Figure-1 shows the individual approach distribution of future background traffic at the intersection of Craik Avenue and Seventeenth Avenue that has been estimated considering the above assumptions.

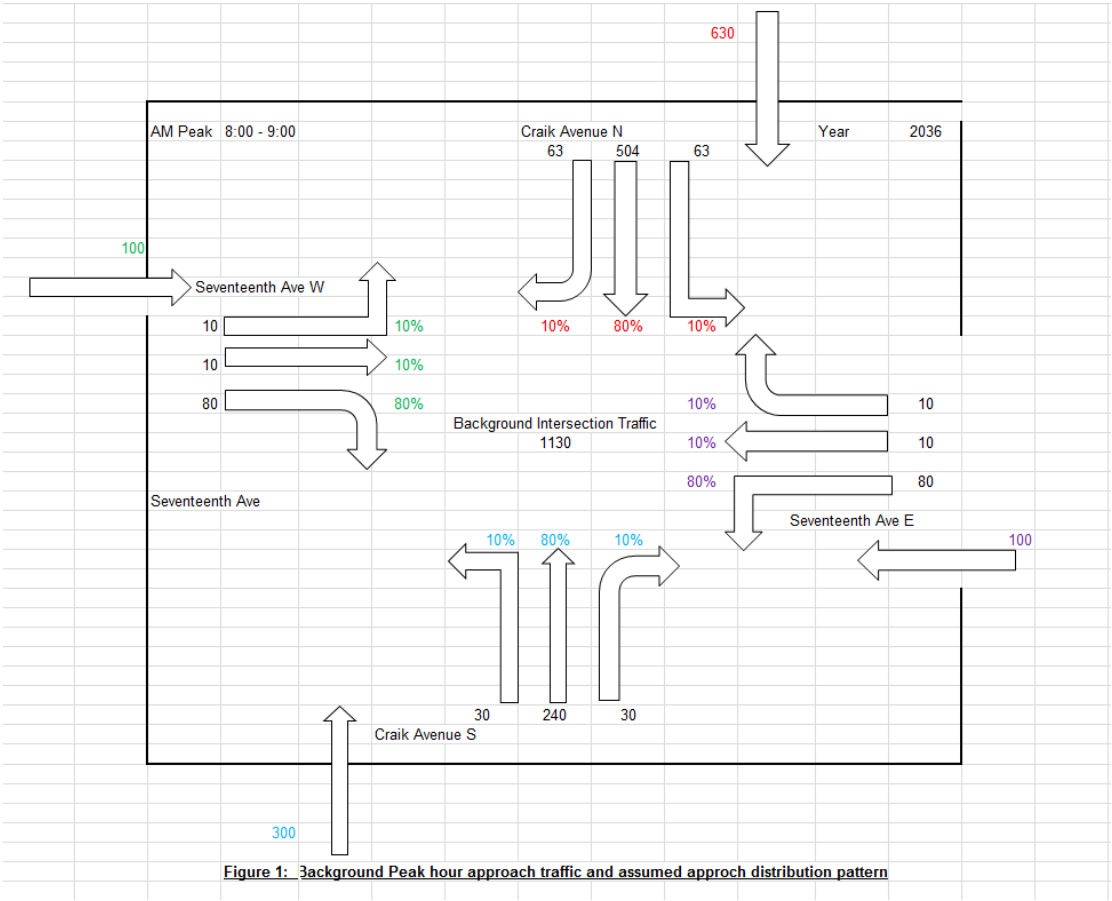


Figure 1: Background Peak hour approach traffic and assumed approch distribution pattern

Figure -2 is showing the distribution of traffic in respect to the total intersection traffic

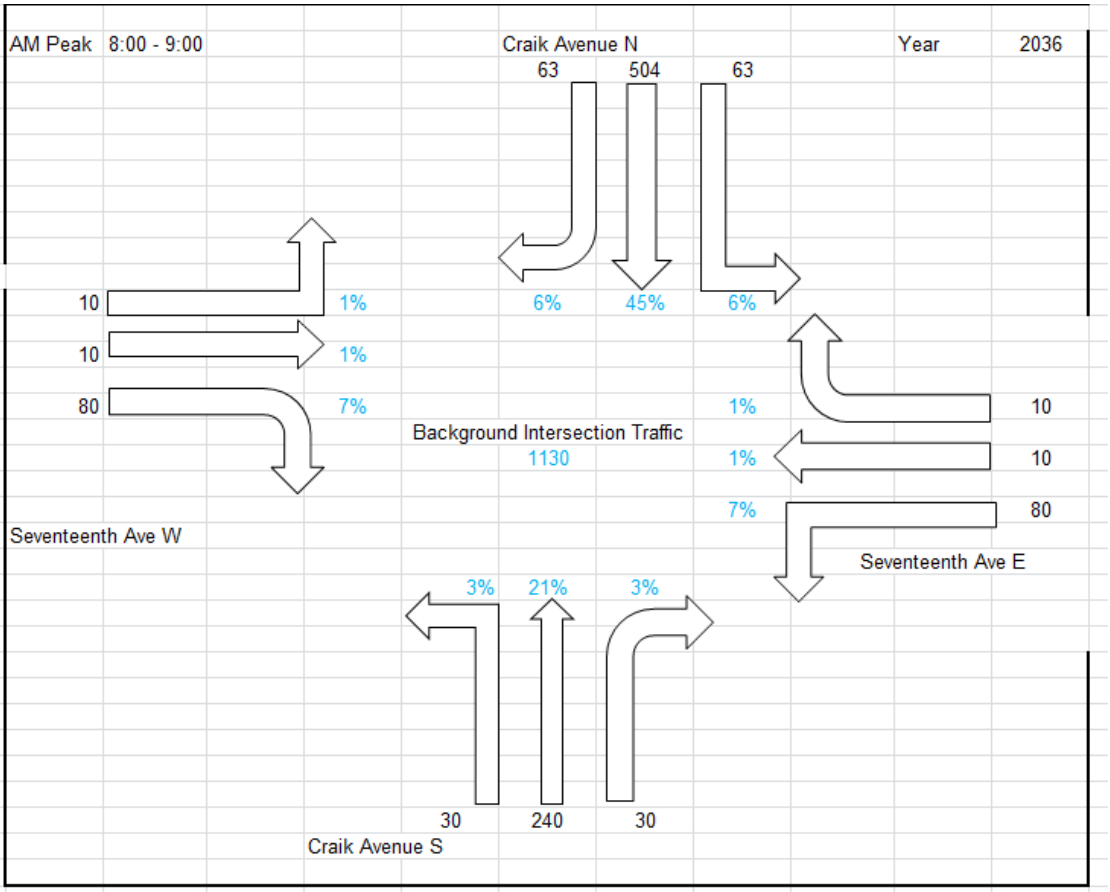


Figure2: Background Peak hour intersection traffic distribution pattern

80% of the total school trips from Table- 4 have been distributed at the intersection of Craik Avenue and Seventeenth Avenue applying the same distribution pattern in Figure-2 and shown in Figure-3.

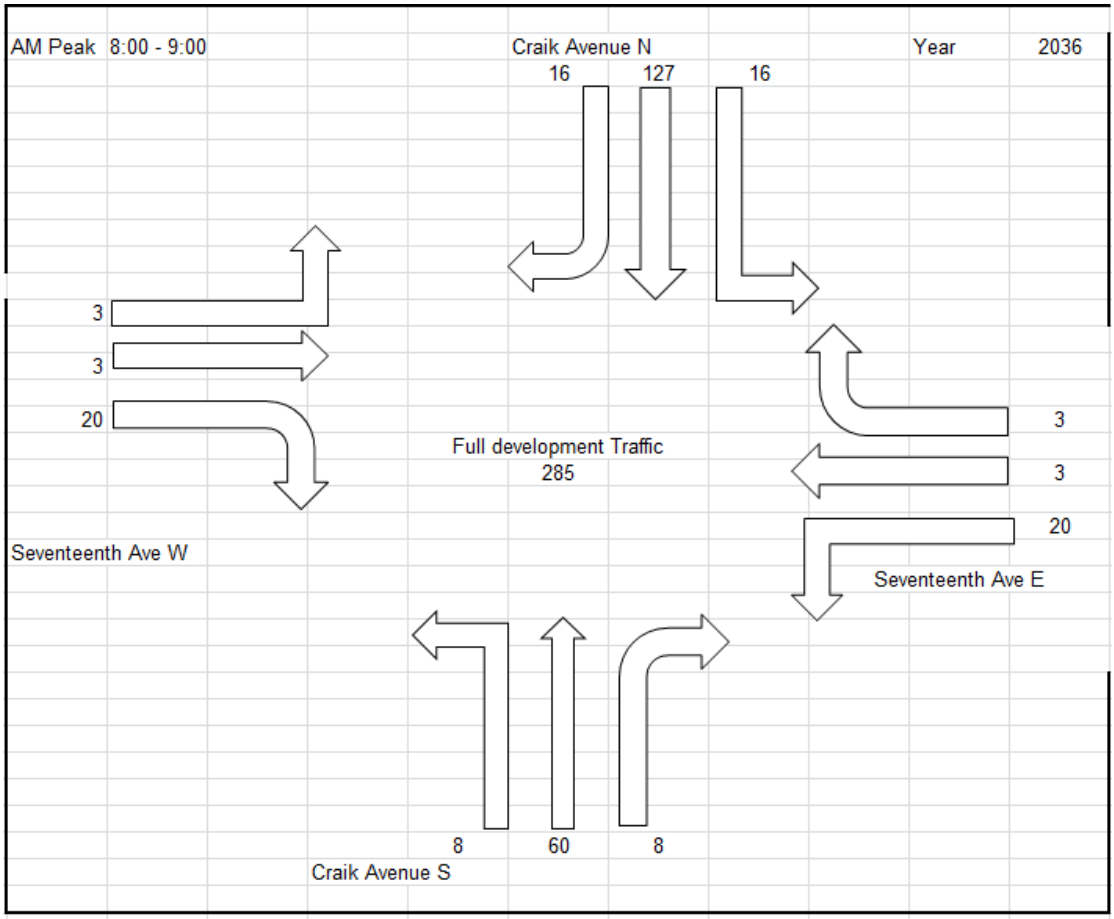


Figure 3: Peak hour development traffic distribution

Figure-4 below is showing the background and the development traffic distribution at the intersection of Craik Avenue and Seventeenth Avenue.

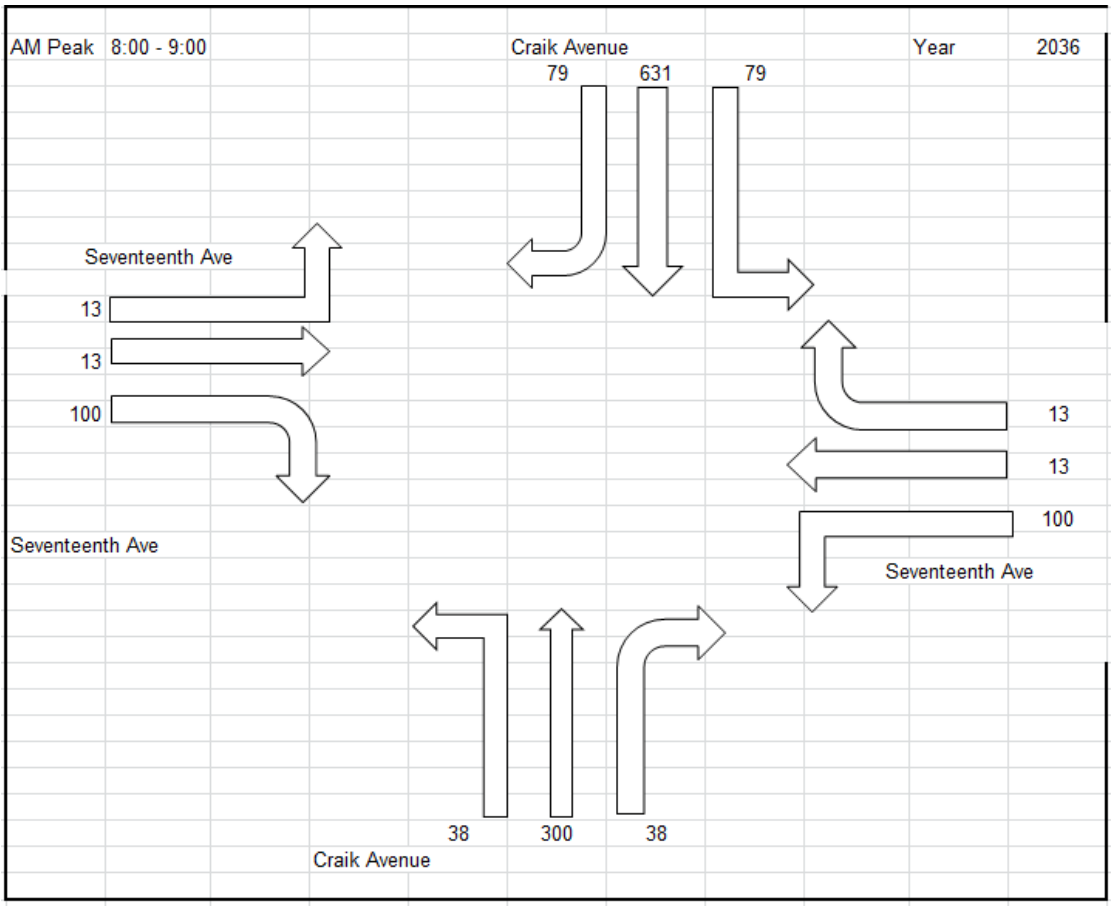


Figure 4 : Background + development Peak hour traffic distribution

An intersection count has been undertaken at the intersection of Craik Avenue and Seventeenth Avenue which is currently a T-intersection in order to capture the traffic generated form the existing school at 88 Gurner Avenue that have been using this intersection. The details of the survey can be found in Appendix C. The summary of the survey results have been shown in Figure -5.

Currently there are approximately 188 students enrolled in the existing school in Gurner Avenue. The current approval is for 350 students. The surveyed traffic volume in Figure-5 with respect to 188 students have been extrapolated for the current approval of 350 students and shown in Figure-6.

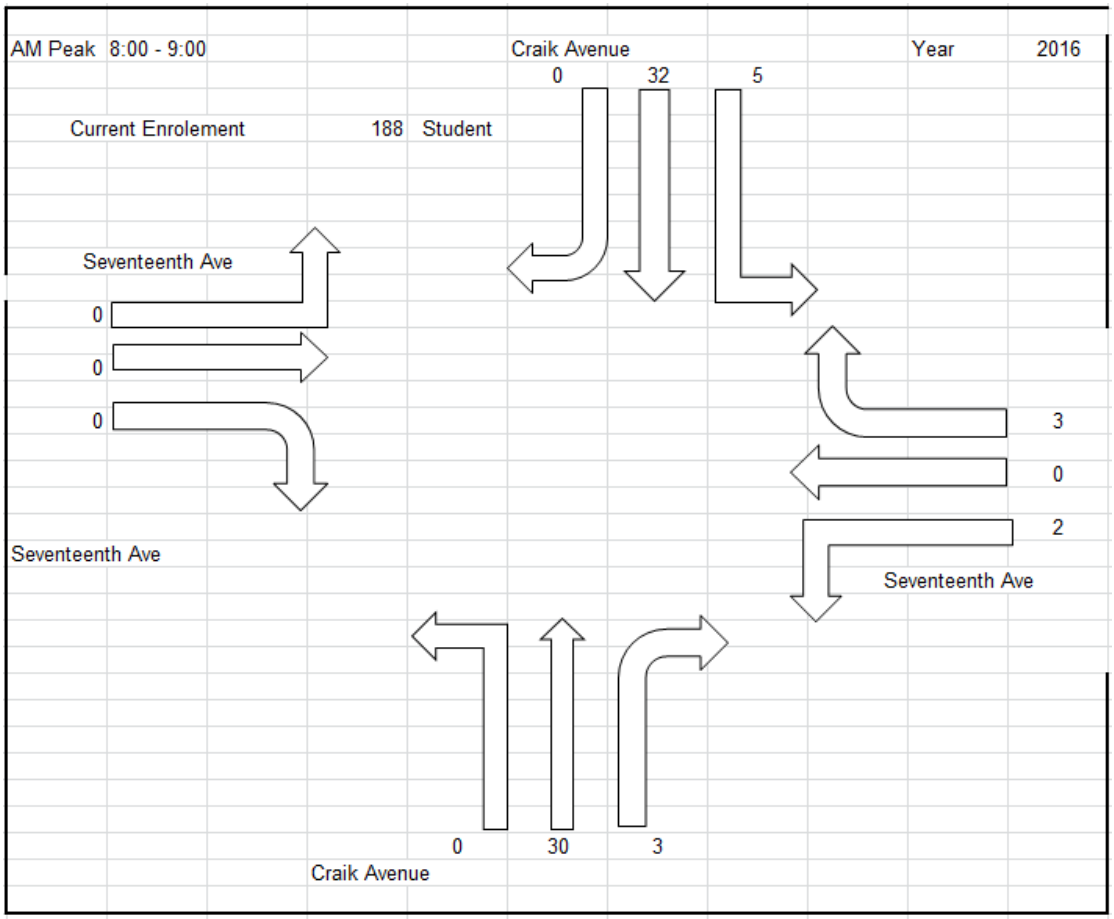


Figure 5 : Surveyed existing school peak hour traffic

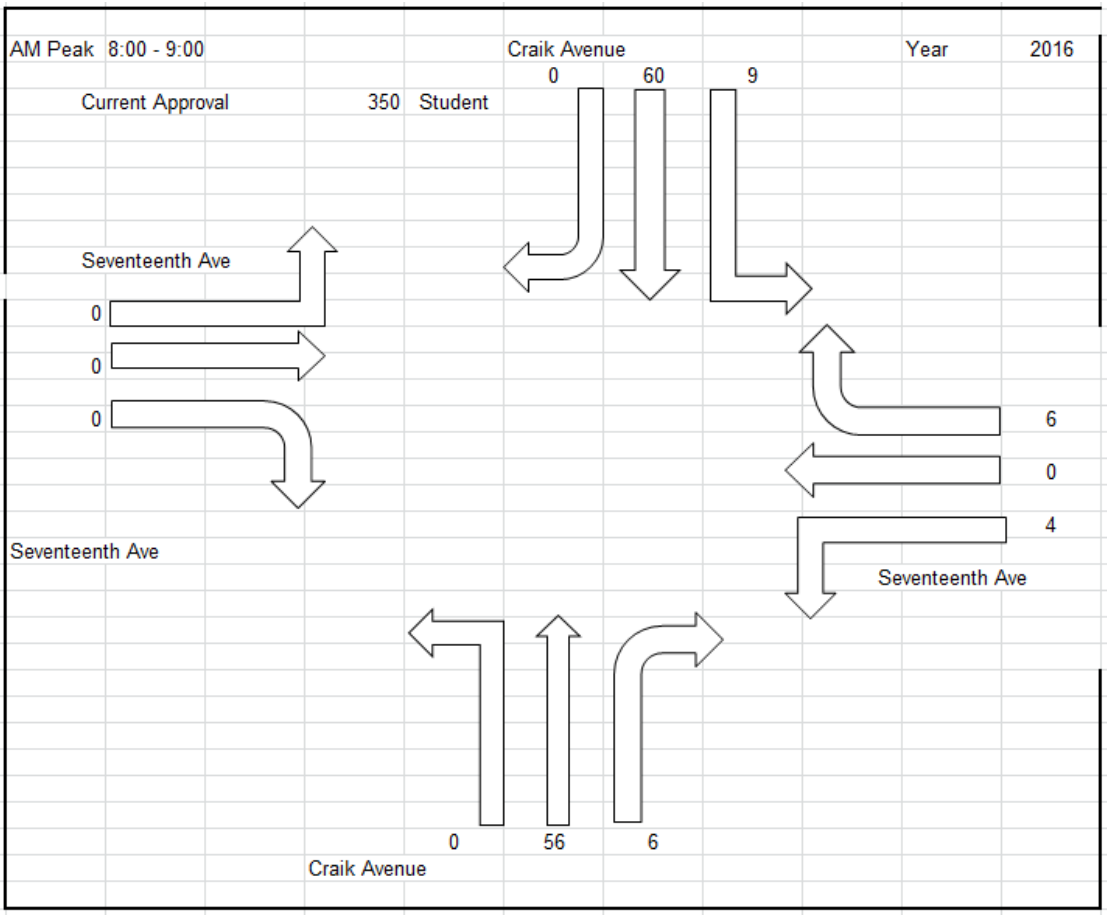


Figure 6 : existing school peak hour traffic extrapolated for 350 students

In order to identify the cumulative impact of the proposed development, the existing school and the future precinct traffic, the existing school traffic that have been utilising the intersection of Craik Avenue and Seventeenth Avenue has been added to the future background precinct traffic and the proposed development traffic and shown in Figure-7.

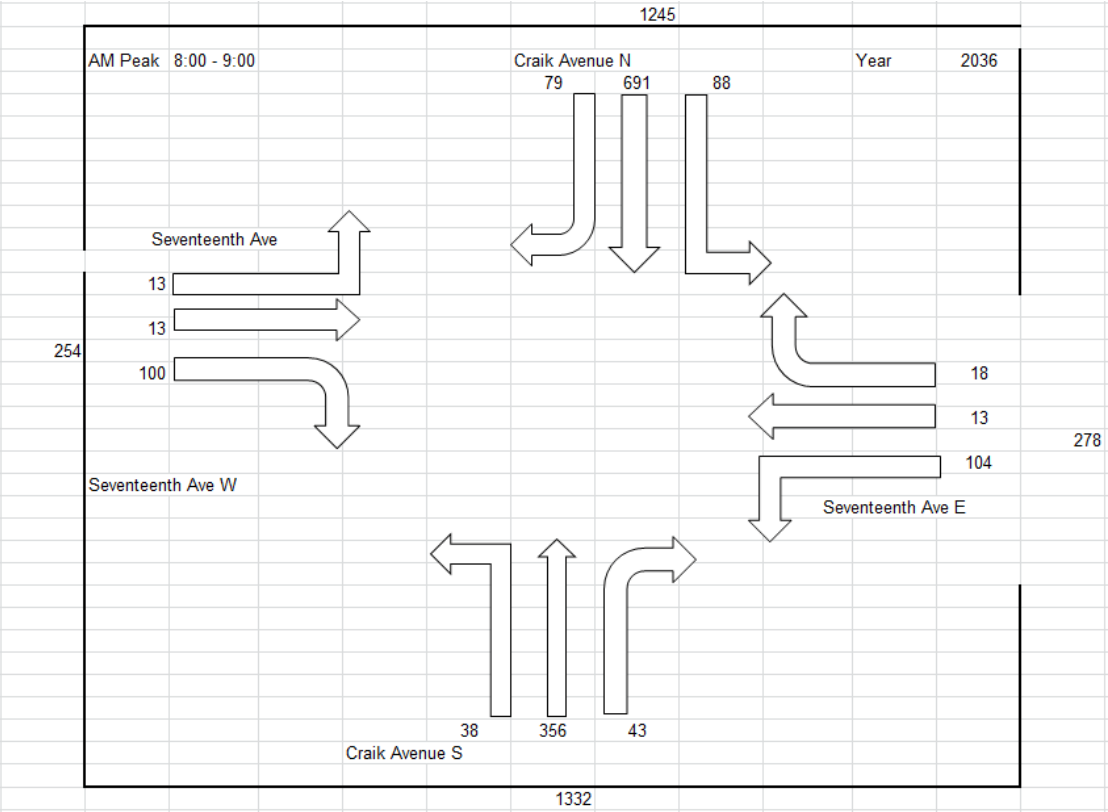


Figure 7 : Total cumulative peak hour traffic

7.2 Mid-Block Impact

The forecasted cumulative mid-block traffic volume in the peak hour has been calculated form the Figure-6 for both Craik Avenue and Seventeenth Avenue and shown in Table-5.

Table-5: Forecasted cumulative peak hour volume

Road	Peak hour volume (both direction) (veh/hr)
Craik Avenue South	1430
Craik Avenue North	1304
Seventeenth Avenue East	332
Seventeenth Avenue West	254

The midblock capacity of an urban road and its relation with the level of service has been identified in Table 4.4 of former RTA's "*Guide to Traffic Generating Developments -2002*" and stipulated below:

Table-6: Urban road peak hour flows per direction

Level of Service	One Lane (veh/hr)	Two Lane (veh/hr)
A	200	900
B	380	1400
C	600	1800
D	900	2200
E	1400	2800

Source: Table 4.4: RTA's "*Guide to Traffic Generating Developments -2002*"

In reference to **Table 5**, the corresponding level of service for the forecasted cumulative traffic volumes on Craik Avenue, indicated to be 'C'. Similarly the corresponding level of service for the forecasted cumulative traffic volumes on Seventeenth Avenue, indicated to be 'A'. Therefore, the resulting future mid-block level of service on both Craik Avenue and Seventeenth are predicted to be within the acceptable level with the proposed school development, the future Austral Leppingon precinct and the existing school development in Gurner Avenue.

7.3 Intersection of Craik Avenue and Seventeenth Avenue

The intersection of Craik Avenue and Seventeenth Avenue, Austral has been modelled using computer based micro-simulation software 'SIDRA Intersection' to analyse various traffic parameters of the intersection for the future scenario.

SIDRA Intersection calculates the amount of delay experienced by vehicles using an intersection, and gives a Level of Service rating which indicates the relative performance of that intersection with regard to the average delay (seconds per vehicle) experienced by vehicles at the intersection. The average delay reported for signalised intersections is taken over all movements, while for unsignalised intersections the average delay is reported for the worst movement only.

The Level of Service criteria set by the RTA is outlined in **Table-6**

Table- 7: Level of Service Criteria (LoS)

Level of Service	Average Delay (seconds/vehicle)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents will cause excessive delays	At capacity, requires other control mode
F	More than 70	Roundabouts require other control mode	

Source: Guide to Traffic Generating Developments, RTA 2002.

The traffic volumes in Figure-7 have been used as input volumes in the micro-simulation software 'SIDRA Intersection' in order to test the cumulative impact of the proposed school development. The intersection has been modelled as a 'Give Way' sign controlled intersection.

The results of the SIDRA analysis of the intersection of Craik Avenue and Seventeenth Avenue under the estimated traffic volume in the year 2036 are shown in **Table-8** below.

Table-8: Intersection operation Craik Avenue/Seventeenth Avenue Austral (Morning peak)

Intersection	*Scenario*	*Year*	*Worst Approach AM Peak*	
			LoS	Average Delay (Seconds)
Craik Ave/ Seventeenth Ave	Future Cumulative	2036	B	26.3

The results of the analysis show that the worst approach of the intersection is operating at a Level of Service (LoS) of 'B' in the morning peak hour under the estimated traffic volumes in the year 2036. This includes the cumulative traffic of the proposed school development, existing school in Gurner Avenue and the Austral Precinct traffic in the year 2036. Therefore modelling results of the intersection indicated that the intersection will be operating at a satisfactory level as a sign controlled intersection and there will be spare

capacity for growth such as growth in the existing school in Gurner Avenue. Detailed SIDRA outputs of the model can be found in **Appendix-D**.

8. ILP road pattern

As part of this development new roads have been proposed to be constructed on the eastern and northern boundary of the development site as indicated in the Indicative Layout Plan (ILP) for this area. The proposed roads have been configured as per the typical local street configuration as indicated in the ILP, with additional indentation within the development site boundary for on-street parking bays and bus bays as shown in the attached site plan in Appendix A.

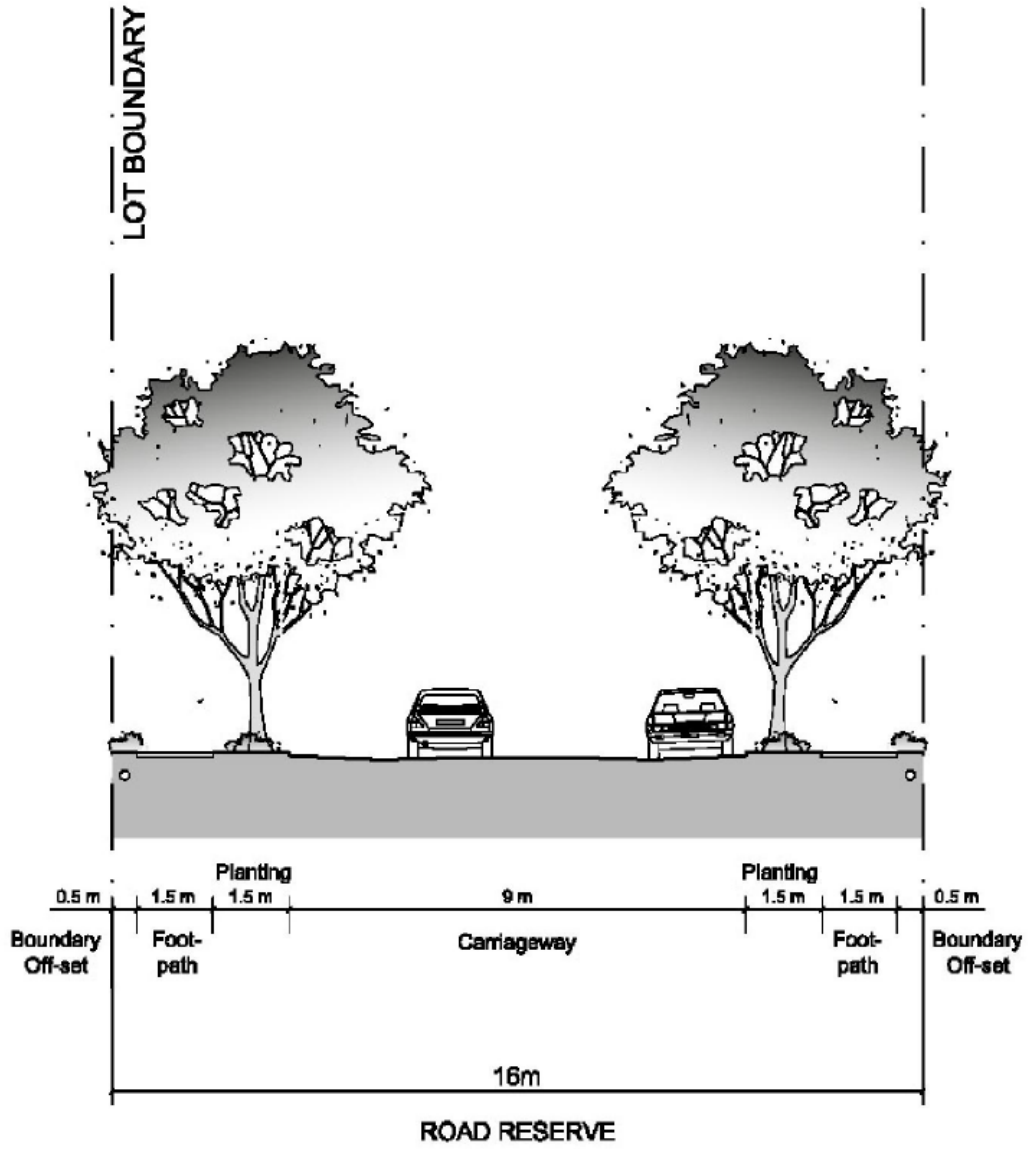


Figure 3-13: Typical local street

9. DCP parking requirement

The following table has been extracted from the Liverpool Growth Centre Precinct DCP that is relevant to the proposed school development.

Table 1-11: Car parking requirements for places of public worship and educational establishments

Land use	Parking requirement
Places of Public Worship	1 space per 6 seats, plus 1 bicycle and 1 motorcycle space per 25 car parking spaces in excess of the first 25 car parking spaces
Schools	1 space per staff member Plus 1 space per 100 students Plus 1 space per 5 students in Yr 12 (based on estimated capacity for year 12 students to be specified in the Development Application) A pick up / drop off facility of sufficient size to accommodate the forecast demand identified through a traffic and parking report. The resultant layout of the facility to be to the satisfaction of Council.
Tertiary and Adult Educational Establishments	1 space per 5 seats Or 1 space per 10m² of floor area (whichever is greater)

Parking requirements for the proposed development have been calculated as per the DCP requirement and shown in Table 8.

Table-8: DCP off-street parking requirements (educational establishment)

Category	Formula	Number of staff and students	Required Parking Spaces
Staff	1 space per staff member	36 staff	36 spaces
Visitor	1 space per 100 students	800 students	8 spaces
Year 12 Students	1 space per 5 year 12 students	60 students	12 Spaces
Drop-off/Pick-up facility	Sufficient size to accommodate the forecast demand		12 Spaces proposed
	Total		**68 spaces**

A total of 63 off-street parking spaces have been proposed onsite including 12 drop-off /pick-up spaces. It is expected that some of the staff/secondary school student will be using available public transport in the area. Moreover there are approximately 22 on-street indented parking spaces have been proposed abutting the school boundary along the proposed north-south and east-west local roads.

9.1 Pick-up/Drop-off facility

The proposed development is aiming for a total of 800 student ranging k-12. This includes 60 year 12 students. The year 12 students have been discounted from the total number as the required parking spaces for the year 12 students have been proposed to be provided. Also a further 40 students have been discounted given that the students enrolled in the before and after school care will arrive and depart the school outside the normal school drop-off/pick-up period. Therefore in an ultimate scenario a total of 700 students will need to be transported to the school in the peak hours. It is expected that approximately 60% of the students will be using the public bus services as well as services provided by the school. This equates to a total 280 students will need to be dropped off by cars.

Assuming a vehicle student occupancy rate of 2 students/veh (Given that enrolments of siblings are common in this type of establishment) a total of 140 cars will be arriving at the school during drop-off period.

A car drop-off/pick-up area has been proposed on the northern boundary of the site accessed off the proposed north-south road and exit onto the proposed east-west road as a one-way traffic circulation aisle. A total of 12 formalised car drop-off/pick-up spaces have been proposed. Therefore the number of drop-off cycle needed to service 140 vehicles (140/12 = 11.66) is 11.66. Assuming the peak drop-off period will be for 30 minutes between 8:00am-8:30am. This will allow each car an average servicing time of (30/11.66= 3.2) 2.6 minutes. This is considered reasonable given that approximately 50% of the students will be secondary students and the drop-off time for these students may be less than a minute. On the other hand the primary students may need more than the estimated 2.6 minutes.

The pick-up period is not considered critical as the departure time for the primary and the secondary students does not overlap with each other.

Therefore the proposed 12 drop-off/pick-up spaces are considered to be sufficient to cater for the demand of the proposed school development.

Moreover, the proposed visitor spaces within the site can also be used during drop-off period for the secondary school children if needed. Also there will be ample on-street parking spaces surrounding the school site abutting the school boundary once the proposed ILP roads are constructed. These on-street spaces can be used for drop-off and pick-up. The impact on the residential developments along these future roads will be minimal; especially with the additional indentation beyond the typical road reserve width will ensure efficient traffic movements along these roads.

Two indented bus bays have been proposed, one in Seventeenth Avenue and the other in the proposed north-south local road. The bus bay in Seventeenth Avenue will be designated for the company contracted regular local school bus runs. The bus bay in the north-south local road will be used by the other private external school bus runs.

10. Assessment of parking design

10.1 Dimensions:

Dimensions of the proposed parking spaces and aisle widths have been shown in the site plan in **Appendix A**. The parking spaces are 2.5m wide and 5.4m deep which comply with the requirement of a 90^0 angle parking bay in accordance with Australian Standard for off-street parking AS/NZS2890.1.2004 and comply with Council's DCP requirement. The aisle widths for the parking bays have been proposed to be of 6.0m wide which are also in excess of the requirement of both Australian Standard and Council's DCP. The proposed parallel parking bays comply with the standard requirement of AS2890.1.2004.

10.2 Gradient

The maximum gradients within a parking module shall be as follows in accordance with section 2.4.6.1 of AS/NZS 2990.1.2004:

a) Measured parallel to the angle of parking- 1:20

b) Measured in any other direction- 1:16

The proposed parking modules should comply with the gradient requirement above in line with AS/NZS 2890.1.2004.

11. Assessment of proposed driveways

Two combined, one 'entry only' and one 'exit only' driveways have been proposed as part of the proposed development. A 7.0m wide combined driveway is proposed at the southern boundary of site off Seventeenth Avenue, a 6.0m wide combined entry/exit driveway on the eastern boundary close to Seventeenth Avenue. A 6.0m wide 'entry only' driveway is proposed off-the eastern boundary road for the drop-off area. A 6.0m wide 'exit only' driveway has been proposed off the east-west local road at the northern boundary of the site as shown in the plan in **Appendix A**.

11.1 Driveway widths

The user class of the proposed parking facility as part of the proposed development at Seventeenth Avenue is determined to be user class 2 from the Table 1.1 of AS/NZS 2890.1.200 as shown below.

TABLE 1.1

CLASSIFICATION OF OFF-STREET CAR PARKING FACILITIES

User class	Required door opening	Required aisle width	Examples of uses (Note 1)
1	Front door, first stop	Minimum for single manoeuvre entry and exit	Employee and commuter parking (generally, all-day parking)
1A	Front door, first stop	Three-point turn entry and exit into 90° parking spaces only, otherwise as for User Class 1	Residential, domestic and employee parking
2	Full opening, all doors	Minimum for single manoeuvre entry and exit	Long-term city and town centre parking, sports facilities, entertainment centres, hotels, motels, airport visitors (generally medium-term parking)
3	Full opening, all doors	Minimum for single manoeuvre entry and exit	Short-term city and town centre parking, parking stations, hospital and medical centres
3A	Full opening, all doors	Additional allowance above minimum single manoeuvre width to facilitate entry and exit	Short term, high turnover parking at shopping centres
4	Size requirements are specified in AS/NZS 2890.6 (Note 2)		Parking for people with disabilities

Seventeenth Avenue and the proposed future roads along the eastern and northern boundary of the site are classified as local roads. A total of 63 off-street parking spaces have been proposed as part of the proposed development. Based on the user class of the proposed parking facility, type of frontage road and number of parking spaces proposed, the access facility category of the proposed driveways are determined from table 3.1 of AS/NZS 2890.1.2004 as shown below. The categories of the proposed driveways are determined to be category 2 in accordance with Table 3.1 below:

TABLE 3.1

SELECTION OF ACCESS FACILITY CATEGORY

Class of parking facility (see Table 1.1)	Frontage road type	Access facility category				
		Number of parking spaces (Note 1)				
		<25	25 to 100	101 to 300	301 to 600	>600
1,1A	Arterial	1	2	3	4	5
	Local	1	1	2	3	4
2	Arterial	2	2	3	4	5
	Local	1	2	3	4	4
3,3A	Arterial	2	3	4	4	5
	Local	1	2	3	4	4

Therefore the minimum width requirement for the entry and the exit only driveway of the proposed parking facility is 3.0m and for the combined entry

and exit driveway is 6.0m as shown below in the table 3.2 of AS/NZS 2890.1.2004.

TABLE 3.2

ACCESS DRIVEWAY WIDTHS

metres

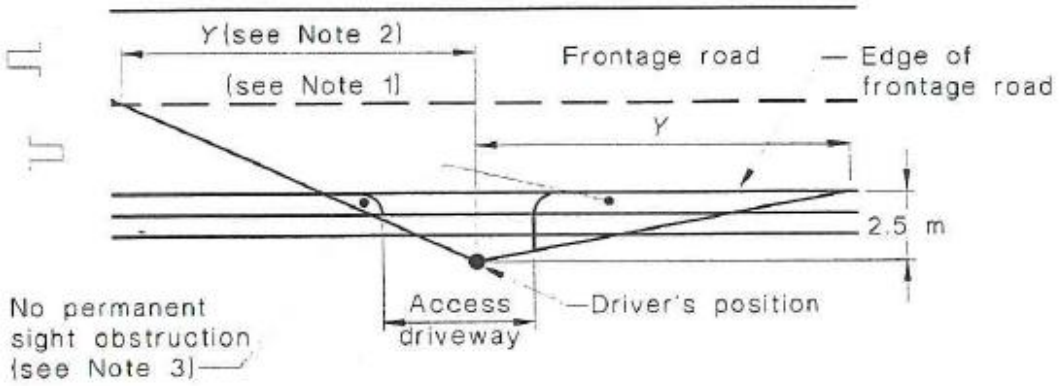
Category	Entry width	Exit width	Separation of driveways
1	3.0 to 5.5	(Combined) (see Note)	N/A
2	6.0 to 9.0	(Combined) (see Note)	N/A
3	6.0	4.0 to 6.0	1 to 3
4	6.0 to 8.0	6.0 to 8.0	1 to 3
5	To be provided as an intersection. not an access driveway. see Clause 3.1.1.		

NOTE: Driveways are normally combined. but if separate, both entry and exit widths should be 3.0 m min.

Therefore, the proposed widths for all four driveways comply with the minimum standard requirement for this class of parking facilities.

11.2 Sight distance

The proposed ILP roads surrounding the site are classified as local roads in an urbanised area. Therefore default speed limit of 50km/h would apply to the proposed roads at the frontage of the proposed school site. The minimum sight distance requirement at a driveway with a frontage road of 50km/h speed limit can be determined from figure 3.2 of AS/NZS 2890.1.2004 below. From figure 3.2 below the sight distance requirement at the proposed combined entry/exit driveway is 45m minimum and 69m desirable.



Frontage road speed (Note 4) km/h	Distance (Y) along frontage road m		
	Access driveways other than domestic (Note 5)		Domestic property access (Note 6)
	Desirable 5 s gap	Minimum SSD	
40	55	35	30
50	69	45	40
60	83	65	55
70	97	85	70
80	111	105	95
90	125	130	Use values from 2nd and 3rd columns
100	139	160	
110	153	190	

FIGURE 3.2 SIGHT DISTANCE REQUIREMENTS AT ACCESS DRIVEWAYS

The proposed development is located at a relatively straight section of the proposed future roads along the eastern and northern boundary. It is apparent that available sightlines on both directions at the proposed combined entry/exit driveways will exceed the minimum requirements. The available sight distances at the proposed exit only driveway are likely to exceed the desirable requirement of AS/NZS2890.1.2004.

11.3 Gradient

In accordance with Section 3.3 of AS/NZS 2890.1.2004, the maximum gradient requirement between the edge of the road and the property line, building line or pedestrian path, and for at least the first 6m into the car park, is 1:20. The maximum grade across the property line shall remain at 1:20.

The proposed parking modules should comply with the gradient requirement above in line with AS/NZS 2890.1.2004.

12. Traffic circulation and pedestrian safety

A one-way circulation has been proposed through the 'entry only' driveway at the eastern boundary of the site and exiting on to the proposed road that run along the northern boundary of the site as shown in the plan in **Appendix A.**

The drop-off and pick-up area has been located on the northern boundary of the site. A total of 12 parallel parking spaces have been proposed for drop-off and pick up as shown in the plan in **Appendix A**.

A contentious network of footpath has been proposed throughout the car park and located off the trafficable area for pedestrian safety. A pedestrian path link has been provided for the proposed on-street bus bays.

Vehicle swept paths have been checked for these areas to assess the manoeuvrability requirements of appropriate design vehicle using AUTOTRACK computer aided software. The swept path diagrams are shown in **Appendix B**.

13. Servicing of the site

Servicing of the site has been proposed to occur at the cal-de-sac head accessed off Seventeenth Avenue**.** The site is designed to allow manoeuvring of a Medium Rigid Vehicle (MRV). The servicing of the site will take place in the off-peak when there will be no student or visitor activity within the site, as a result there will be no conflicts between service vehicle and general traffic within the site. The swept path diagram for a MRV has been shown in **Appendix B**.

14. Conclusion

The proposed school development at the corner of Seventeenth Avenue and Craik Avenue, Austral has been assessed in terms of, trip generation and its impact on public street network, off-street parking demand and supply, design of the proposed parking layout, access driveway requirement, pedestrian safety, pick-up and drop-off facility of the site and the following conclusions are made:

1. The proposed development will have minimal impact on the traffic capacity of surrounding street network.

2. Intersection of Craik Avenue and Seventeenth Avenue can accommodate the additional traffic generated from the proposed development site as well as the future precinct traffic including existing

school in Gurner Avenue while operating as a sign controlled intersection.

3. The proposed parking provisions meet the requirements of Council's Development Control Plan. It is anticipated that there will be minimal impact on the existing on-street parking supply in the area due to the proposed development.

4. Proposed number of pick-up and drop-off spaces is likely to cater for the demand of the proposed number of students.

5. The proposed parking layout both off-street and on-street complies with the Australian Standard AS2890.1, AS2890.6 and AS2890.5 in terms of dimensions and manoeuvrability requirements.

6. The proposed driveways meet the requirements of Australian Standard AS2890.1 in terms of widths and sight distance requirement.

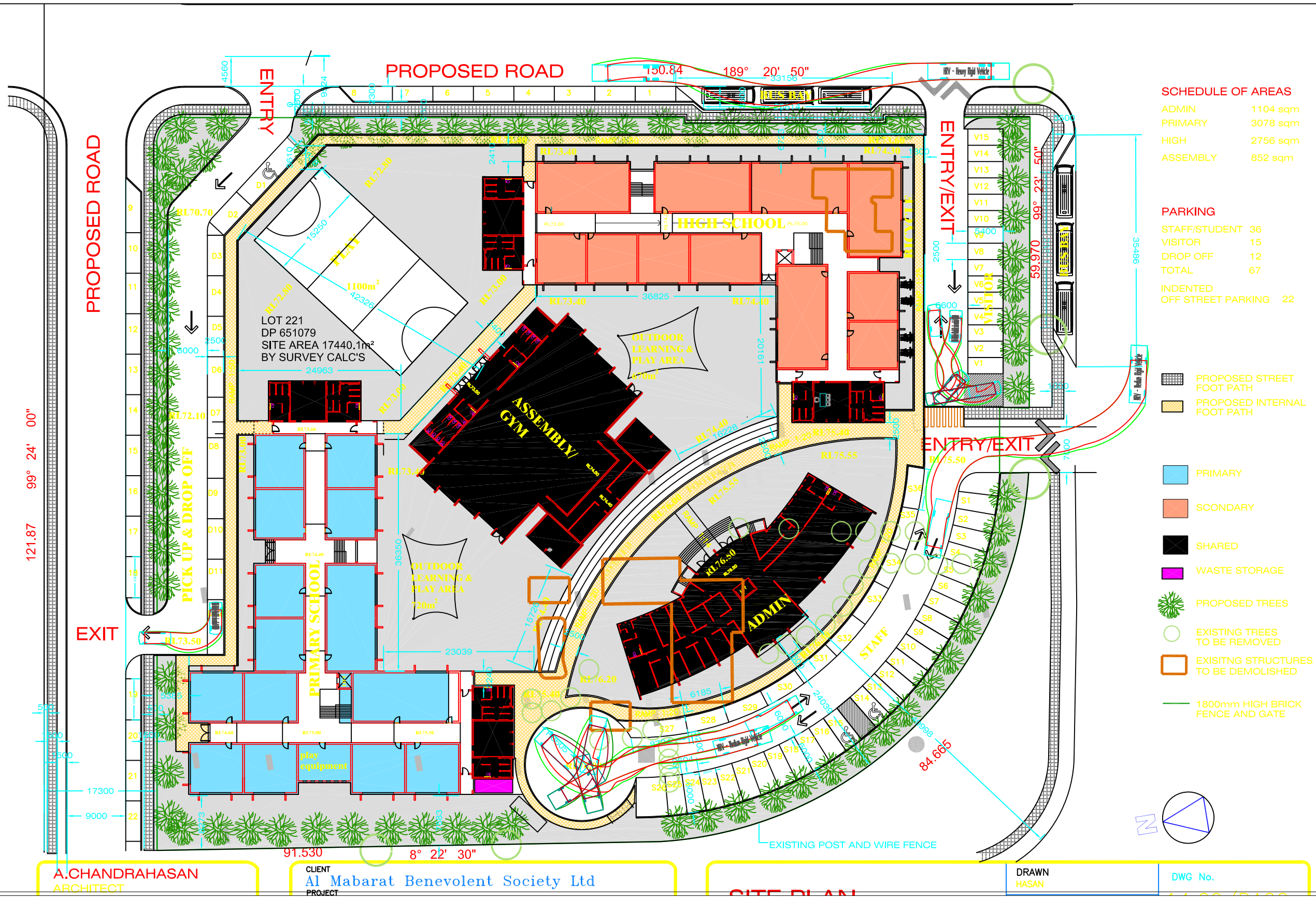
7. No reverse in and out vehicular movements from and on to the public roads have been proposed.

8. Minimal impact on the amenity of the surrounding development has been anticipated from traffic management point of view.

Based on the findings of this report, the proposed school development in Seventeenth Avenue, Austral could be supported, given that the development is unlikely to have any significant adverse impact on the traffic and parking environment in the surrounding area.

Appendix A

SITE MASTER PLAN



Express Traffic Engineering Solutions

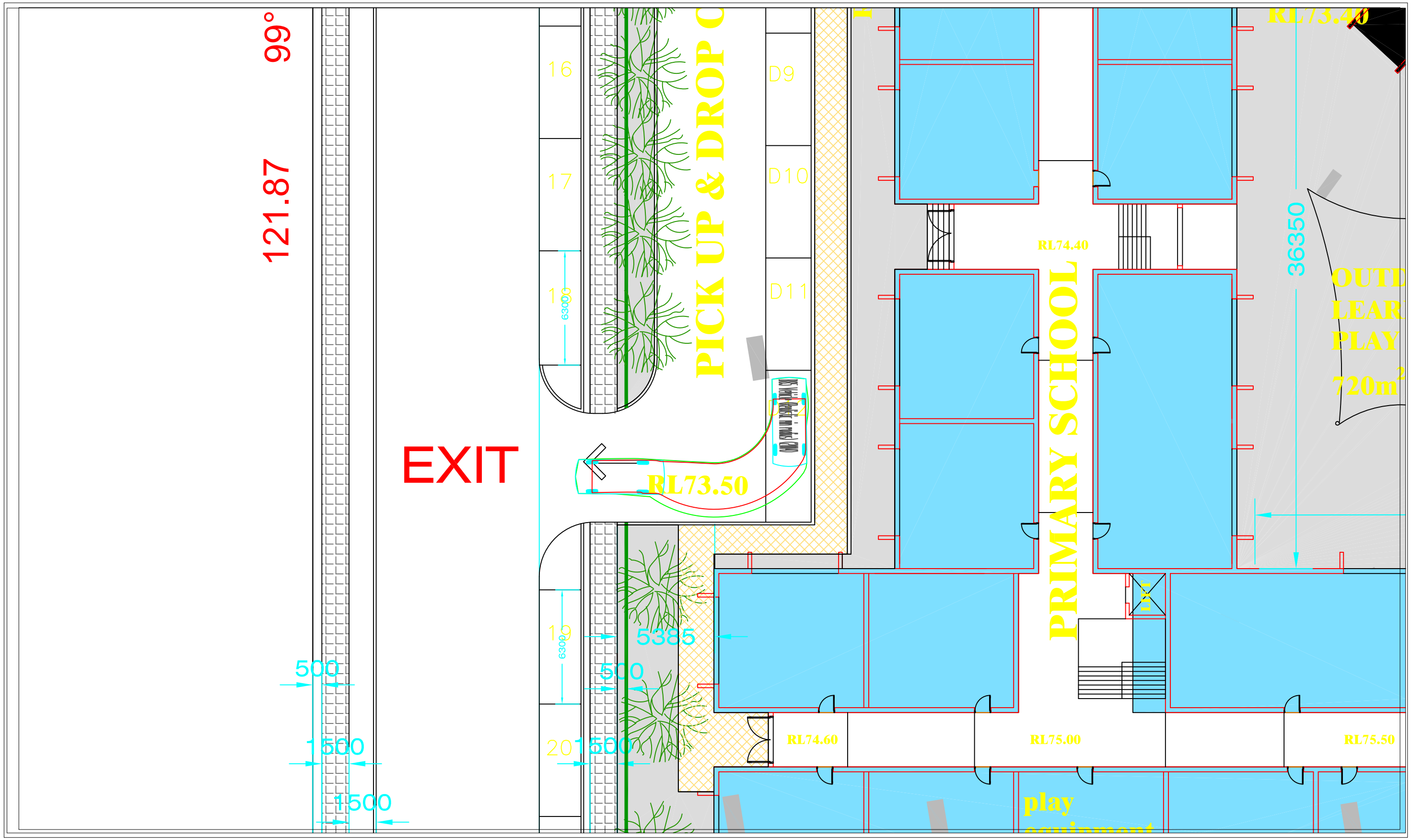
Seventeenth Avenue Austral

Site Plan

Scale: 1:600

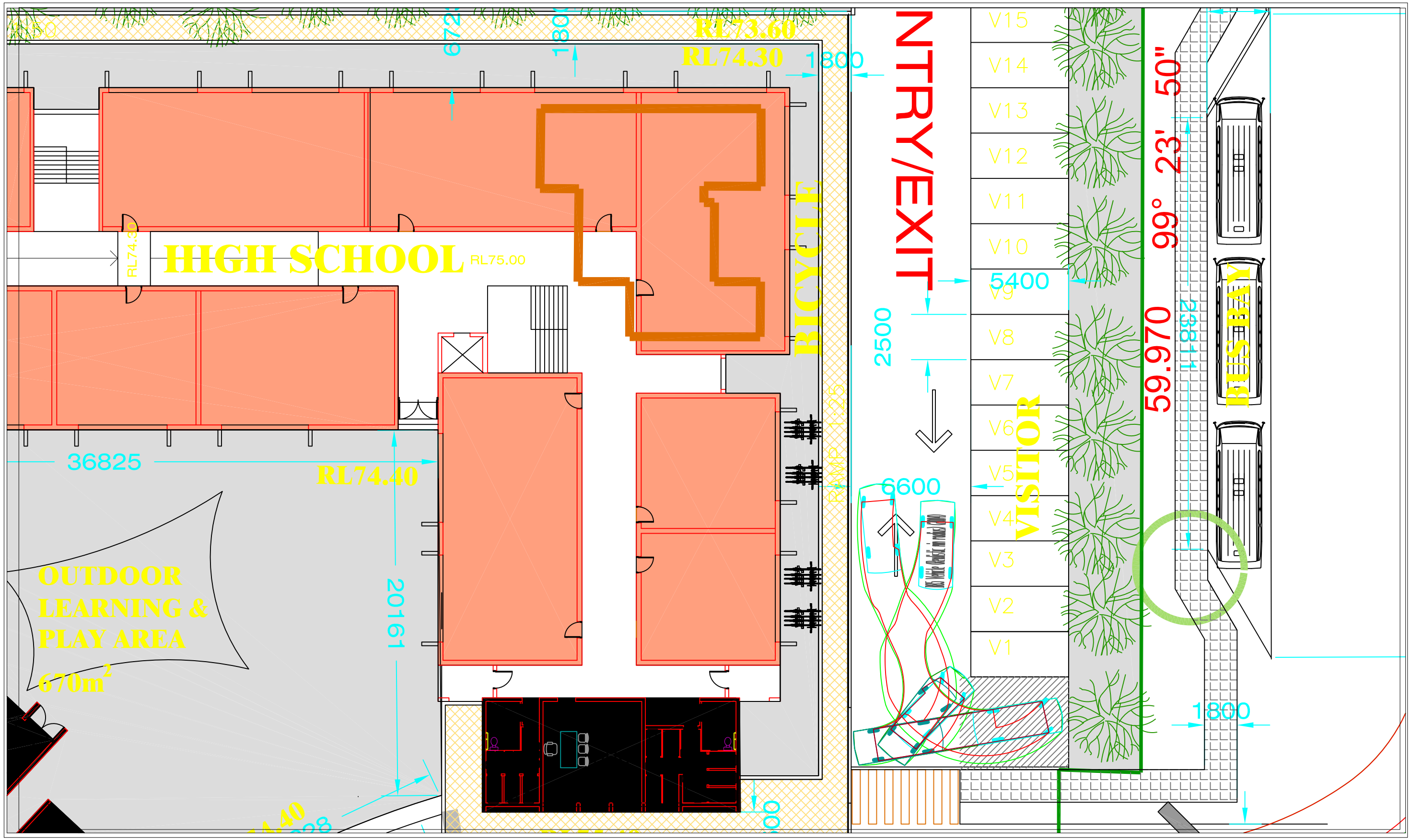
Appendix B

SWEPT PATH DIAGRAMS



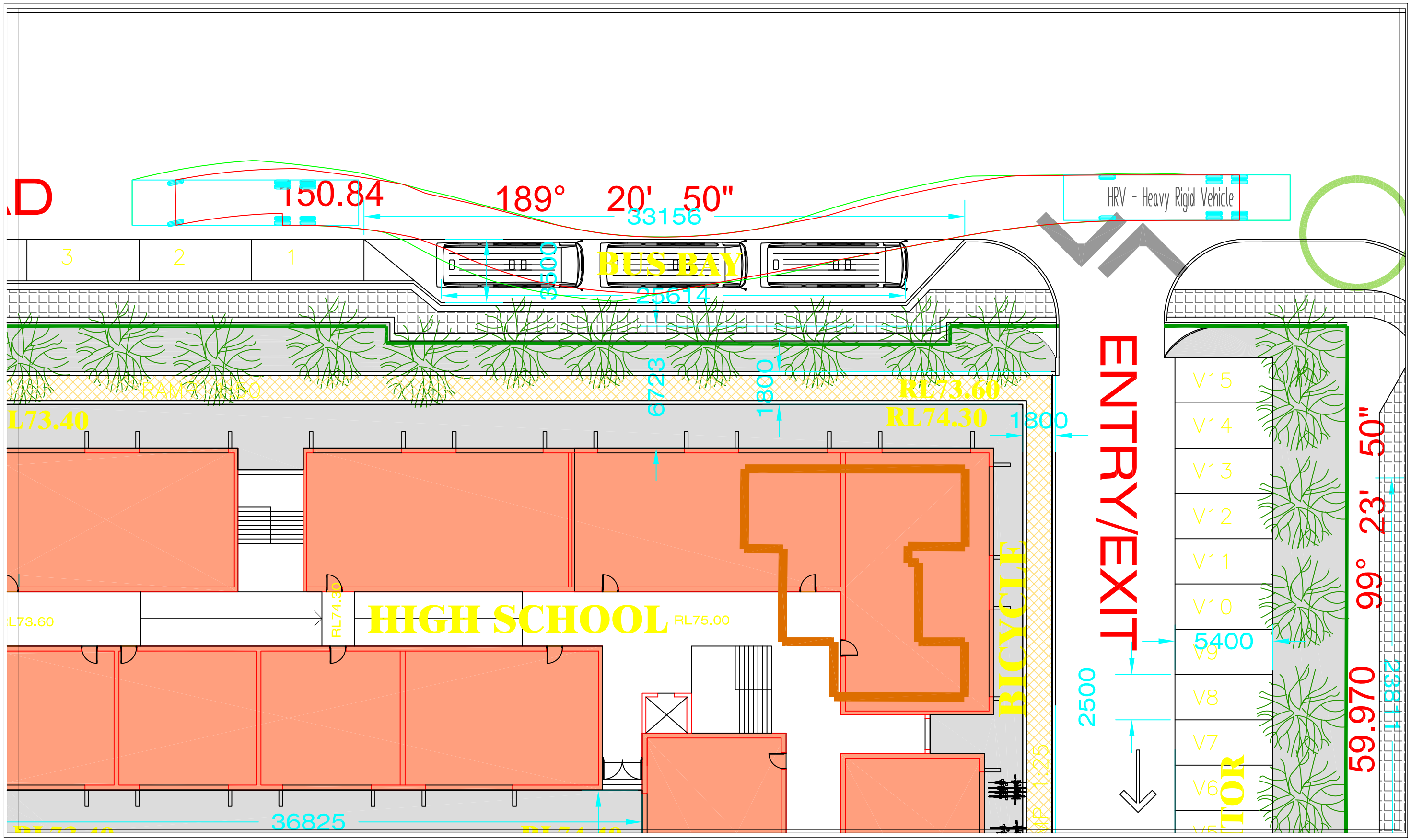
Express Traffic Engineering Solutions

				Seventeenth Avenue Austral
				Swept Path Diagram B85 Vehicle(AS2890.1)
				Scale: 1:200



Express Traffic Engineering Solutions

				Seventeenth Avenue Austral	
				Swept Path Diagram B85 Vehicle(AS2890.1)	N
				Scale: 1:200	



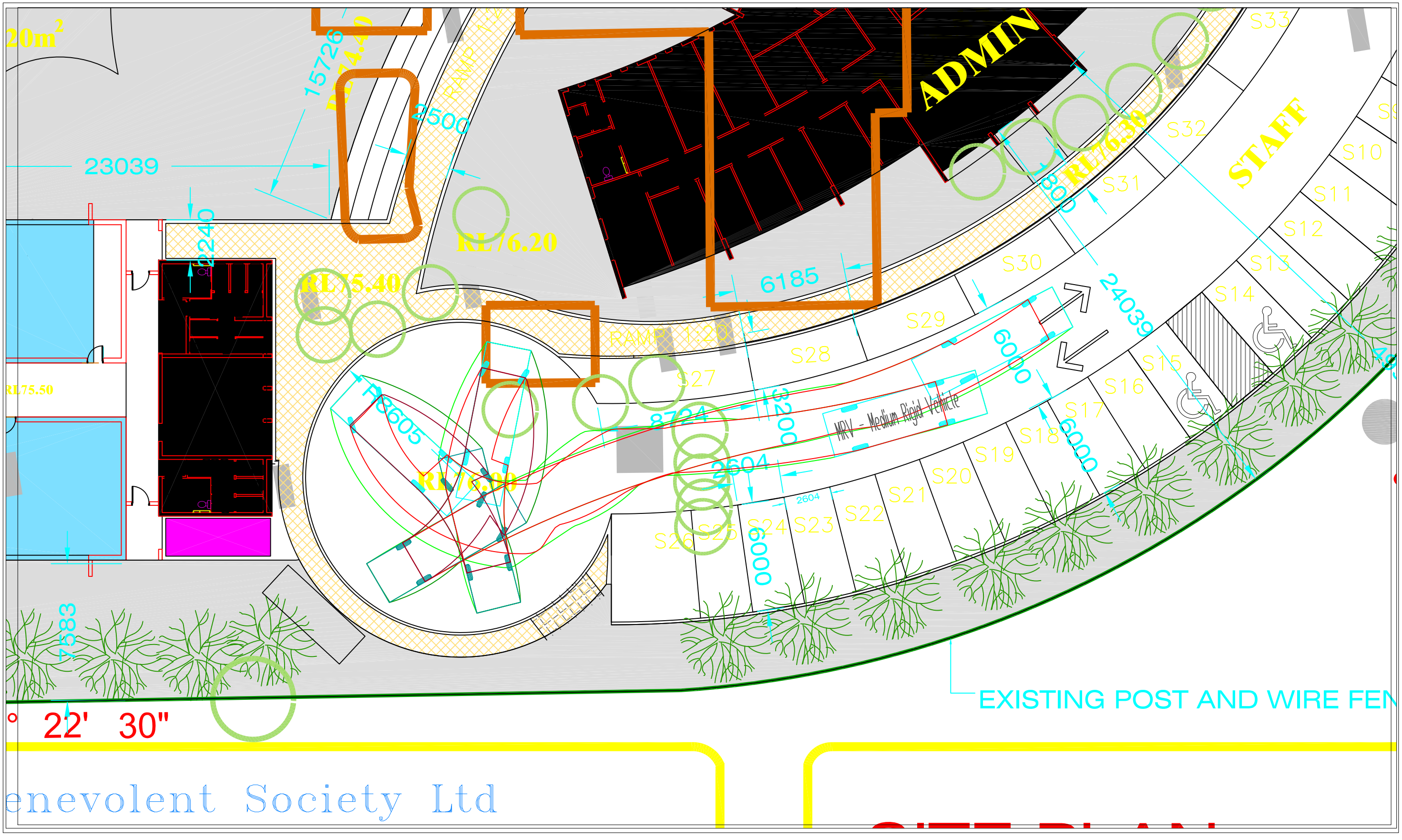
Express Traffic Engineering Solutions

Seventeenth Avenue Austral

Swept Path Diagram Heavy Rigid Bus HRV(AS2890.2)

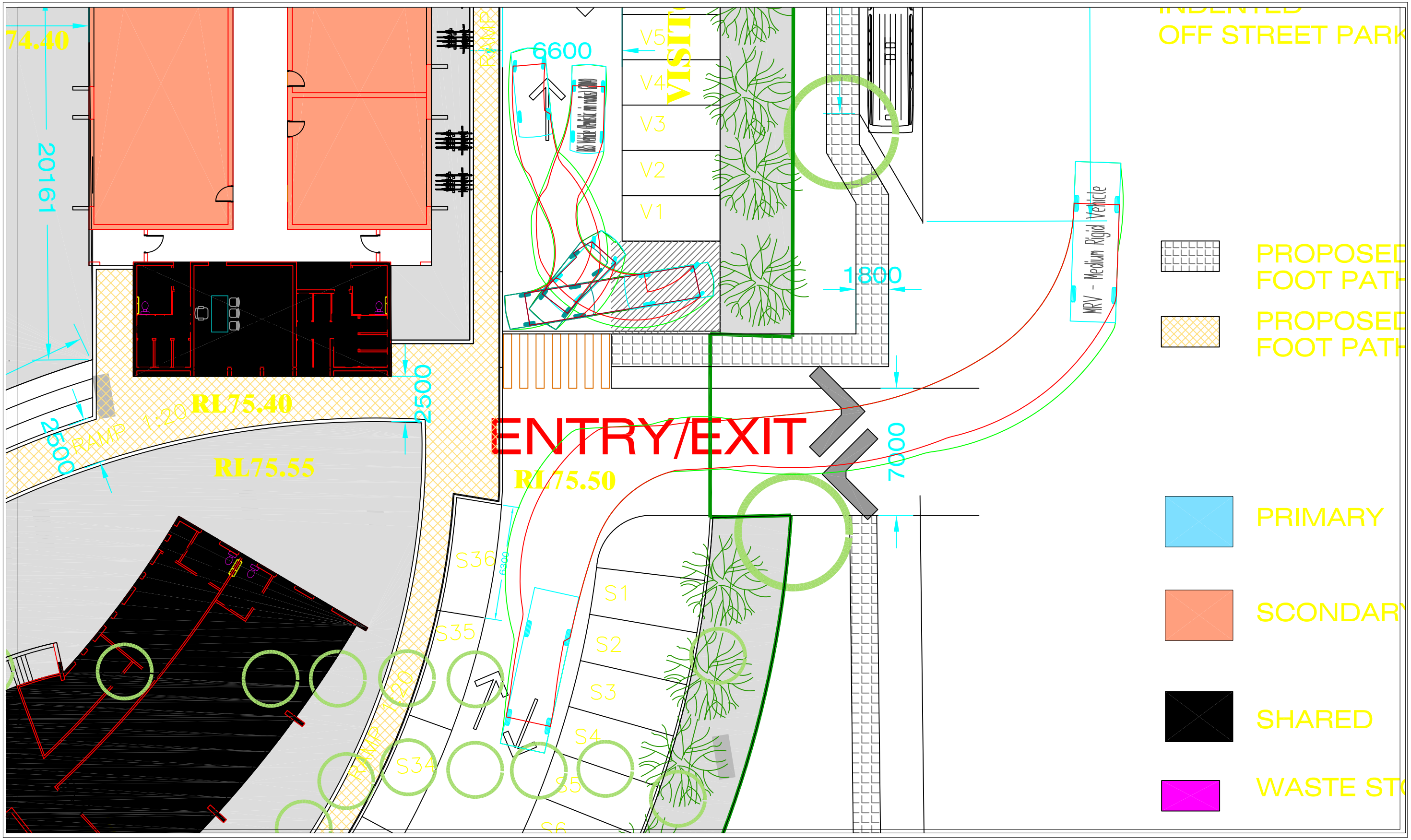
Scale: 1:200

N



Express Traffic Engineering Solutions

				Seventeenth Avenue Austral	
				Swept Path Diagram MRV(AS2890.2)	N
				Scale: 1:200	



Express Traffic Engineering Solutions

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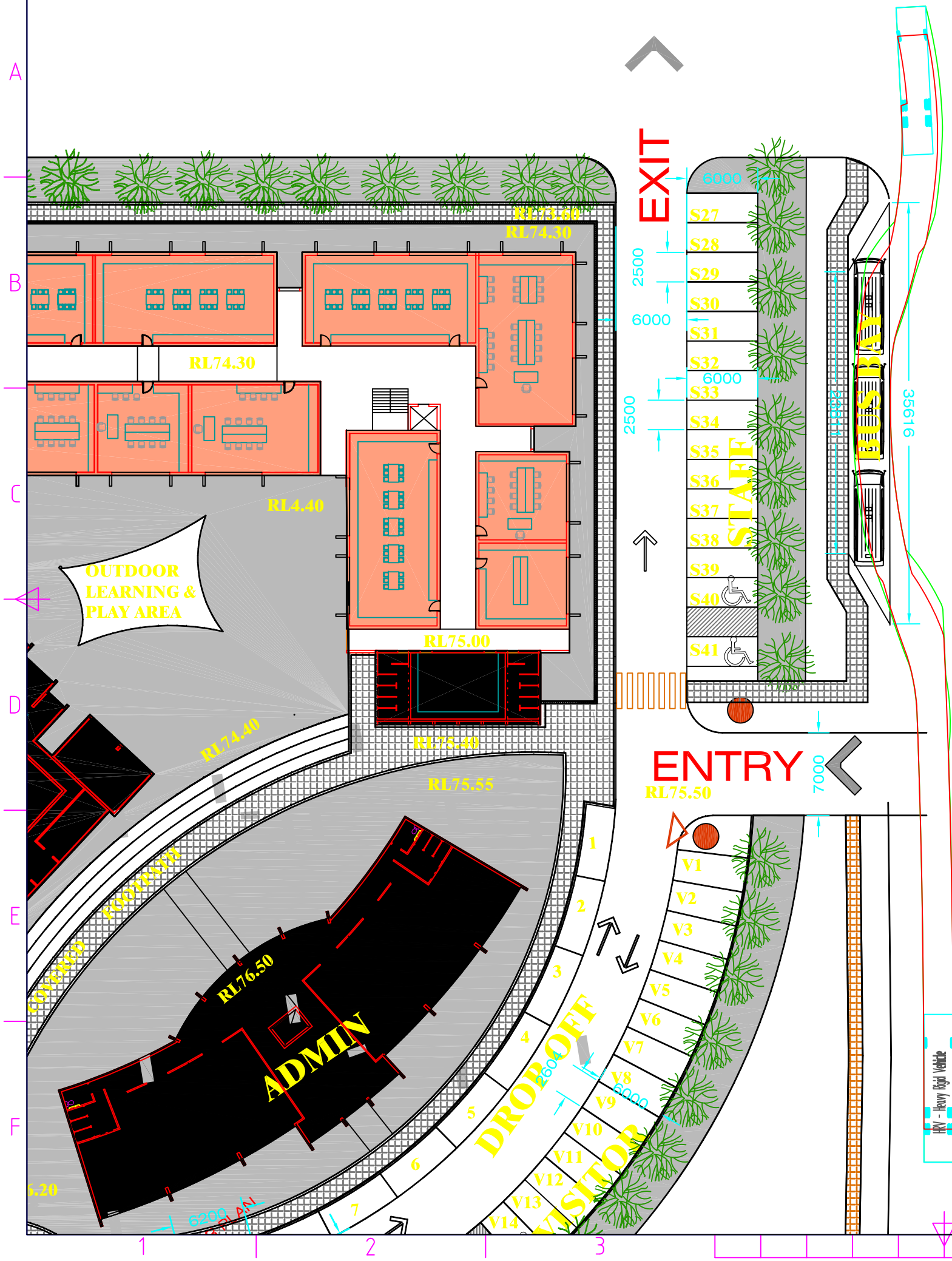
				Swept Path Diagram MRV(AS2890.2)	N
				Scale: 1:200	

RevNo	Revision note	Date	Signature	Checked



Itemref	Quantity	Title/Name, designation, material, dimension etc		Article No./Reference	
Designed by XXX		Checked by XXX	Approved by - date XXX - 00/00/00	File name XXX	Date 00/00/00	Scale 1:1
Heavy Rigid Bus		Swept Path Diagram			
		School Bus		Edition 0	Sheet 1/1

Appendix C

TRAFFIC COUNT DATA

SeventeenthAve@CraikAve_Austral_2016

INTERSECTION COUNT

Craik Avenue @ Seventeenth Avenue, Austral (2016)

	A	B	C	D	E	F	G	H	I	J	K	L	W		X		Y		Z	
	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	School	Others	School	Others	School	Others	School	Others
7:30 - 7:45	9	0	0	1	2	5							-	-	-		-	-	-	-
7:45 - 8:00	7	2	2	0	0	8							-	-	-	-	-	-	-	-
8:00 - 8:15	5	1	0	1	1	8							-	-	-	-	-	-	-	
8:15 - 8:30	9	0	0	1	2	11							-	-	-	-	-	-	-	
TOTAL	30	3	2	3	5	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 - 8:45	10	1	0	0	0	14														
8:45 - 9:00	4	1	2	1	2	4														
9:00 - 9:15	3	0	1	0	0	5														
9:15 - 9:30	5	2	1	2	2	5														
TOTAL	22	4	4	3	4	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	School	Others	School	Others	School	Others	School	Others
12:00 - 12:15																				
12:15 - 12:30																				
12:30 - 12:45																				
12:45 - 1:00																				
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	School	Others	School	Others	School	Others	School	Others
4:00 - 4:15																				
4:15 - 4:30																				
4:30 - 4:45																				
4:45 - 5:00																				
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 - 5:15																				
5:15 - 5:30																				
5:30 - 5:45																				
5:45 - 6:00																				
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Count by:
Date: 29/01/2016
Note:

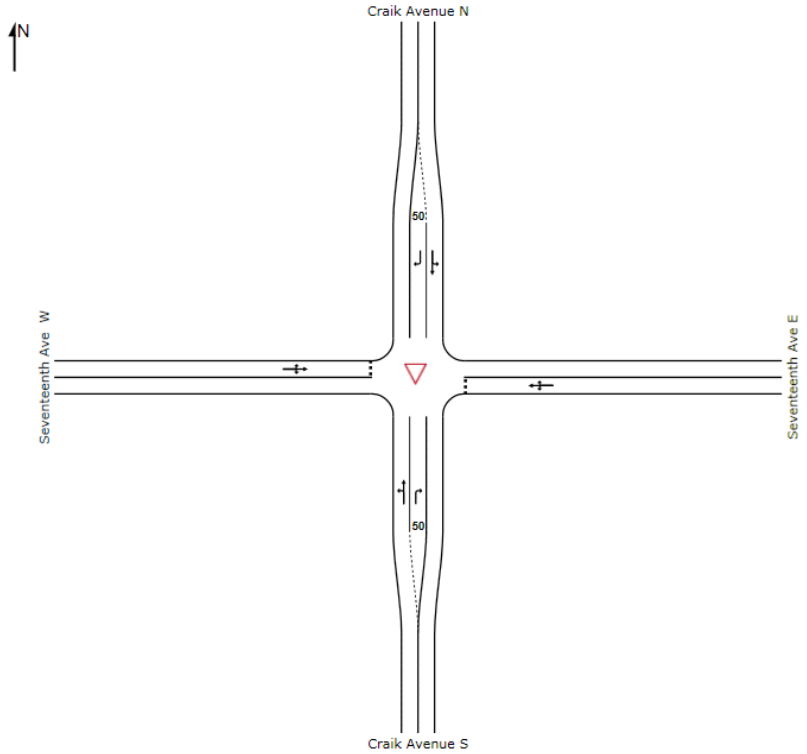
Appendix D

SIDRA OUTPUTS

SITE LAYOUT

▽ Site: AM PEAK-GIVE WAY

Craik Avenue/Seventeenth Avenue
Giveway / Yield (Two-Way)



LANE SUMMARY

▽ Site: AM PEAK-GIVE WAY

Craik Avenue/Seventeenth Avenue
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Craik Avenue S													
Lane 1	415	1.0	1928	0.215	100	0.6	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2	45	1.0	663	0.068	100	10.0	LOS A	0.3	1.8	Short	50	0.0	0.0
Approach	460	1.0		0.215		1.5	NA	0.3	1.8				
East: Seventeenth Ave E													
Lane 1	142	1.0	594	0.239	100	11.2	LOS A	0.9	6.5	Full	500	0.0	0.0
Approach	142	1.0		0.239		11.2	LOS A	0.9	6.5				
North: Craik Avenue N													
Lane 1	820	1.0	1926	0.426	100	0.7	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2	83	1.0	1187	0.070	100	7.0	LOS A	0.3	2.1	Short	50	0.0	0.0
Approach	903	1.0		0.426		1.3	NA	0.3	2.1				
West: Seventeenth Ave W													
Lane 1	133	1.0	250	0.531	100	26.3	LOS B	2.2	15.5	Full	500	0.0	0.0
Approach	133	1.0		0.531		26.3	LOS B	2.2	15.5				
Intersection	1638	1.0		0.531		4.2	NA	2.2	15.5				

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

DELAY (CONTROL)

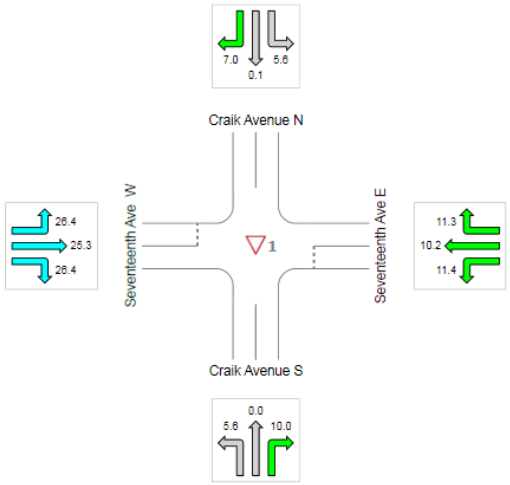
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: AM PEAK-GIVE WAY

Craik Avenue/Seventeenth Avenue
Giveway / Yield (Two-Way)

All Movement Classes

	South	East	North	West	Intersection
	1.5	11.2	1.3	26.3	4.2
LOS	NA	A	NA	B	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F | Continuous

Level of Service Method: Delay (RTA NSW)
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

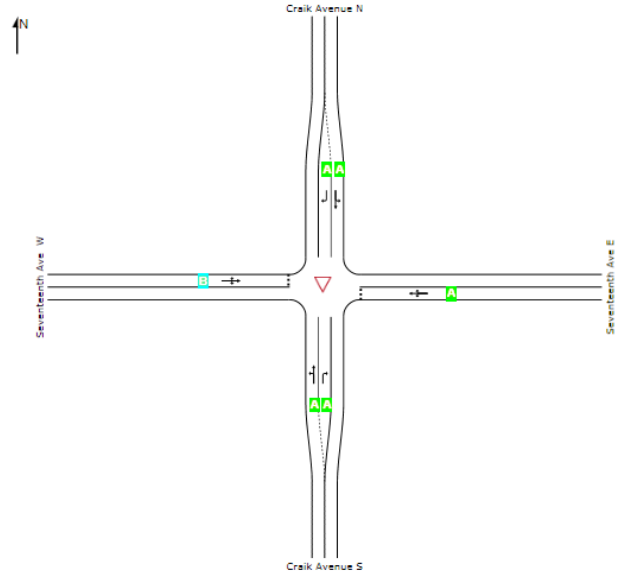
LEVEL OF SERVICE

Site: AM PEAK-GIVE WAY

Craik Avenue/Seventeenth Avenue
Giveway / Yield (Two-Way)

All Movement Classes

	South	East	North	West	Intersection
LOS	NA	A	NA	B	NA



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