North Sydney Marist College Masterplan

Transport and Accessibility Impact Assessment

Prepared for:

Sydney Catholic Schools

1 June 2022

The Transport Planning Partnership

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North Sydney Marist College Masterplan

Transport and Accessibility Impact Assessment

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1 Introduction

1.1 Background

This report supports a State Significant Development (SSD) Development Application (DA) for the expansion and redevelopment of Marist Catholic College North Shore, which is to be submitted to the Department of Planning, Industry and Environment (DPIE) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (the Act). Sydney Catholic Schools is the proponent of the SSD DA.

A 24-month study undertaken by Sydney Catholic Schools has identified a major deficiency in the provision of affordable, non-government education within the North Sydney Local Government Area (LGA).

The study also identified that the choice for families is extremely limited, as almost all of the schools in North Sydney provide single-sex education, with co-educational schools significantly underrepresented.

Sydney Catholic Schools, as operators of St Mary's Catholic Primary School and Marist College North Shore, is responding to this challenge and has identified a strategic response that can positively support the future of North Sydney.

This transport and accessibility impact assessment has been prepared having regard to the Secretary's Environmental Assessment Requirements issued for the project by DPIE, ref no SSD-10473 issued on 21 July 2020.

This report should be read in conjunction with the *Internal Traffic and Parking Assessment* report prepared by Colston Budd Rogers & Kafes (CBRK), which is attached in Appendix C.

1.2 Purpose of the Assessment

This report sets out an assessment of the anticipated transport implications of the proposed development including consideration of the following:

- existing traffic and parking conditions surrounding the site
- suitability of proposed parking in terms of quantum and layout
- the traffic generating characteristics of the proposed development
- suitability of proposed access arrangements for the site
- the transport impacts of the proposed development on the surrounding road network.

1.3 Secretary's Environmental Assessment Requirements

On 21 July 2020, the DPIE issued the Secretary's Environmental Assessment Requirements (SEARS) for SSD-10473. Specifically, a transport and accessibility impact assessment is required as part of the Environmental Impact Statement (EIS), in accordance with the SEARs for the proposed development.

The issues raised in the SEARs have been considered during the preparation of this report and are summarised in Table 1.1. Issues relating to internal access and parking arrangements have been addressed by CBRK (refer to Appendix C), which should be read in conjunction with this report. The relevant issues addressed by CBRK are noted in Table 1.1.

Table 1.1: Review of Compliance with SEARs

SEARS Transport, Traffic, Parking and Access	Report Reference
Transport and Accessibility Include a transport and accessibility impact assessment, which details, but not limited to the following:	
• accurate details of the current daily and peak hour vehicle, existing and future public transport networks and pedestrian and cycle movement provided on the road network located adjacent to the proposed development	Refer to Section 3.3 and 0
• details of estimated total daily and peak hour trips generated by the proposal, including vehicle, public transport, pedestrian and bicycle trips based on surveys of the existing and similar schools within the local area.	Refer to Section 0
• the adequacy of existing public transport or any future public transport infrastructure within the vicinity of the site, pedestrian and bicycle networks and associated infrastructure to meet the likely future demand of the proposed development.	Refer to Section 6
• measures to integrate the development with the existing/future public transport network	Refer to Section 4
• the impact of trips generated by the development on key intersections, with consideration of the cumulative impacts from other approved developments in the vicinity, and the need/associated funding for, and details of, upgrades or road improvement works, using appropriate network modelling tools in accordance with the requirements set out in the TfNSW Traffic Modelling Guidelines. These key intersections should include, but not limited to: o Falcon Street/Miller Street. o Miller Street/Carlow Street. o Miller Street/Ridge Street. o Miller Street/Berry Street. o Pacific Highway/Miller Street.	Refer to Section 6 and Section 7
• the traffic modelling, considering scenarios of year 2020, 2026 (or the year of completion, and 10 years plus year of completion of the development.	Refer to Section 7
• the identification of infrastructure required to address any impacts on traffic efficiency and road safety impacts associated with the proposed development, including details on improvements required to affected intersections, additional school bus routes along bus capable roads (i.e. minimum 3.5m wide travel lanes), additional bus stops or bus bays	Refer to Section 7
• details of travel demand management measures to minimise the impact on general traffic and bus operations, including details of a location-specific sustainable travel plan (Green Travel Plan and specific Workplace travel plan) and the provision of facilities to increase the non-car mode share for travel to and from the site	Refer to Section 10 and TTPP's Green Travel Plan

SEARS Transport, Traffic, Parking and Access	Report Reference
• the proposed walking and cycling access arrangements and connections to public transport services	Refer to Section 4
• the proposed access arrangements, including car and bus pick-up/drop-off facilities, and measures to mitigate any associated traffic impacts and impacts on public transport, pedestrian and bicycle networks, including pedestrian crossings and refuges and speed control devices and zones	Refer to Section 4
• proposed bicycle parking provision, including end of trip facilities, in secure, convenient, accessible areas close to main entries incorporating lighting and passive surveillance	Refer to Section 5.3
• proposed number of on-site car parking spaces for staff and visitors and corresponding compliance with existing parking codes and justification for the level of car parking provided on-site	Refer to Section 5
• an assessment of the cumulative on-street parking impacts of cars and bus pick-up/drop-off, staff parking and any other parking demands associated with the development	Refer to Section 5 and 6
• an assessment of road and pedestrian safety adjacent to the proposed development and the details of required road safety measures and personal safety in line with CPTED	Refer to Section 7
• emergency vehicle access, service vehicle access, delivery and loading arrangements and estimated service vehicle movements (including vehicle type and the likely arrival and departure times)	Refer to Section 4.5 and CBRK's report in Appendix C
• details of any pedestrian links and connections that improve the walkability with the precinct in consideration to Sydney Metro and how the connections align with the North Sydney Civic Precinct Planning Study.	Refer to Section 2.7, 4.6 and CBRK's report in Appendix C
• consideration to include a pedestrian connection between Ridge Lane and Carlow Street and associated details.	Refer to Section 2.7, 4.6 and CBRK's report in Appendix C
• the preparation of a preliminary Construction Traffic and Pedestrian Management Plan to demonstrate the proposed management of the impact in relation to construction traffic addressing the following: o assessment of cumulative impacts associated with other construction activities (if any). o an assessment of road safety at key intersection and locations subject to heavy vehicle construction traffic movements and high pedestrian activity. o details of construction program detailing the anticipated construction duration and highlighting significant and milestone stages and events during the construction process. o details of anticipated peak hour and daily construction vehicle movements to and from the site. o details of on-site car parking and access arrangements of o construction vehicles, construction workers to and from the site, emergency vehicles and service vehicle. o details of temporary cycling and pedestrian access during construction.	Refer to TTPP's Preliminary Construction Traffic and Pedestrian Management Plan

1.4 References

In preparing this report, reference has been made to the following:

- an inspection of the site and its surrounds
- Educational State Environmental Planning Policy
- North Sydney Development Control Plan
- Roads and Maritime Guide to Traffic Generating Developments 2002
- other documents as referenced in this report.

1.5 Report Structure

The remainder of this report is set out as follows:

- Chapter 2 examines the existing conditions surrounding the school
- Chapter 3 presents a summary of the existing travel and parking patterns of the school
- Chapter 4 outlines the proposed school expansion
- Chapter 5 assesses the parking implications of the proposal
- Chapter 6 assesses the transport implications arising from the proposed development
- Chapter 7 assesses the traffic implications of the proposed development using AIMSUN traffic modelling
- Chapter 8 assesses the traffic implications of the proposed development using SIDRA traffic modelling
- Chapter 9 details road safety and personal safety measures in line with CPTED
- Chapter 10 outlines travel demand management measures to minimise the impact on general traffic and bus operations
- Chapter 11 presents a summary of the traffic assessment and implications of the proposal.

2 Existing Conditions

2.1 Site Description

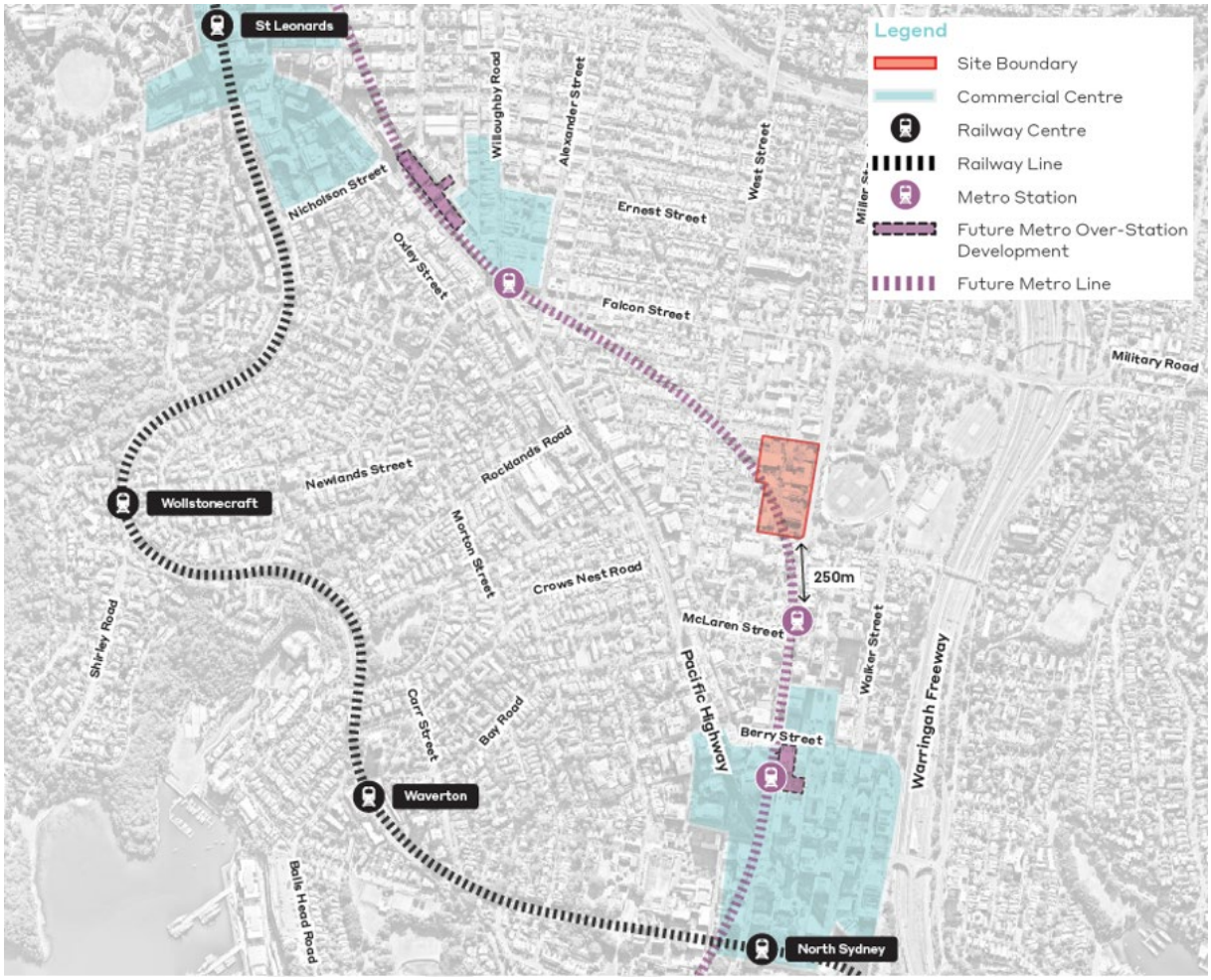
The site is located at 270 Miller Street, North Sydney within North Sydney LGA. It is bound by Carlow Street to the north, Ridge Street to the south, Miller Street to the east, and Ridge Lane to the west. It is surrounded by a mix of civic, residential and commercial uses.

It is approximately 700m north of the North Sydney CBD and located opposite St Leonards Park and North Sydney Oval. The site is strategically located between the Crows Nest and North Sydney, which will soon be connected by the Sydney Metro. The site is approximately 250m to the north of the future Sydney Metro Station at the corner of Miller and McLaren Streets.

Existing development on the site includes St Mary's Primary School, Marist College North Shore, St Mary's Church and Parish Centre, the former Presbytery and Monastery, as well as the two acquired terraces along Miller Street and a childcare centre known as the Jacaranda Centre.

The site comprises 26 lots and has a total area of 22,420m2. The locational context of the site is shown at Figure 2.1 and an aerial photograph of the site is shown at Figure 2.2.

Figure 2.1: Site Context



Source: Ethos Urban

Figure 2.2: Site Aerial

Source: Ethos Urban

2.2 Surrounding Road Network

The site is surrounded by a network of regional and local roads, including Miller Street, Carlow Street and Ridge Street along the east, north and south boundaries respectively. A brief description of these roads are provided below.

2.2.1 Miller Street

Miller Street is a regional road, aligned in a north-south direction between The Boulevarde and Blue Street. This road travels along the eastern boundary of the site. It is generally configured as a two-way road with three travel lanes and two kerbside parking lines, across a 15.4m wide road carriageway (kerb to kerb). The site is serviced by bus stops along this road.

The existing egress driveway to the site is provided off Miller Street. The road has a posted speed limit of 50km/h, with 40km/h school zone restrictions that apply between 8:00am and 9:30am and between 2:30pm and 4:00pm Monday to Friday.

2.2.2 Carlow Street

Carlow Street is a local road, aligned in an east-west direction between Miller Street and West Street. This road travels along the northern boundary of the site. It is generally configured as a two-way road with two traffic lanes and kerbside parking, across a 11.7m wide road carriageway (kerb to kerb).

It has a posted speed limit of 50km/h, with 40km/h school zone restrictions that apply between 8:00am and 9:30am and between 2:30pm and 4:00pm Monday to Friday.

2.2.3 Ridge Street

Ridge Street is a local road, aligned in an east-west direction between Miller Street and West Street. This road travels along the southern boundary of the site. It is configured as a two-way road with two travel lanes and kerbside parking, across a 9.3m wide road carriageway (kerb to kerb). In addition, a bidirectional separated cycleway is provided along the northern side of the road.

It has a posted speed limit of 50km/h, with 40km/h school zone restrictions that apply between 8:00am and 9:30am and between 2:30pm and 4:00pm Monday to Friday.

2.3 Public Transport Facilities

The site is generally serviced by bus services operated by Sydney Buses. The nearest railway station is North Sydney station which is located approximately 1.1km south of the site.

There are bus stops located on Miller Street and Pacific Highway within a 400m radius from the primary school and high school. Table 2.1 and

Table 2.2 indicate the public and school bus services that travel between these stops and the stops located in the Northern Shore and the Northern Beaches regions. The frequency of these services are generally every 10-30 minutes.

Table 2.1: Existing Public Bus Service and Associated Frequencies

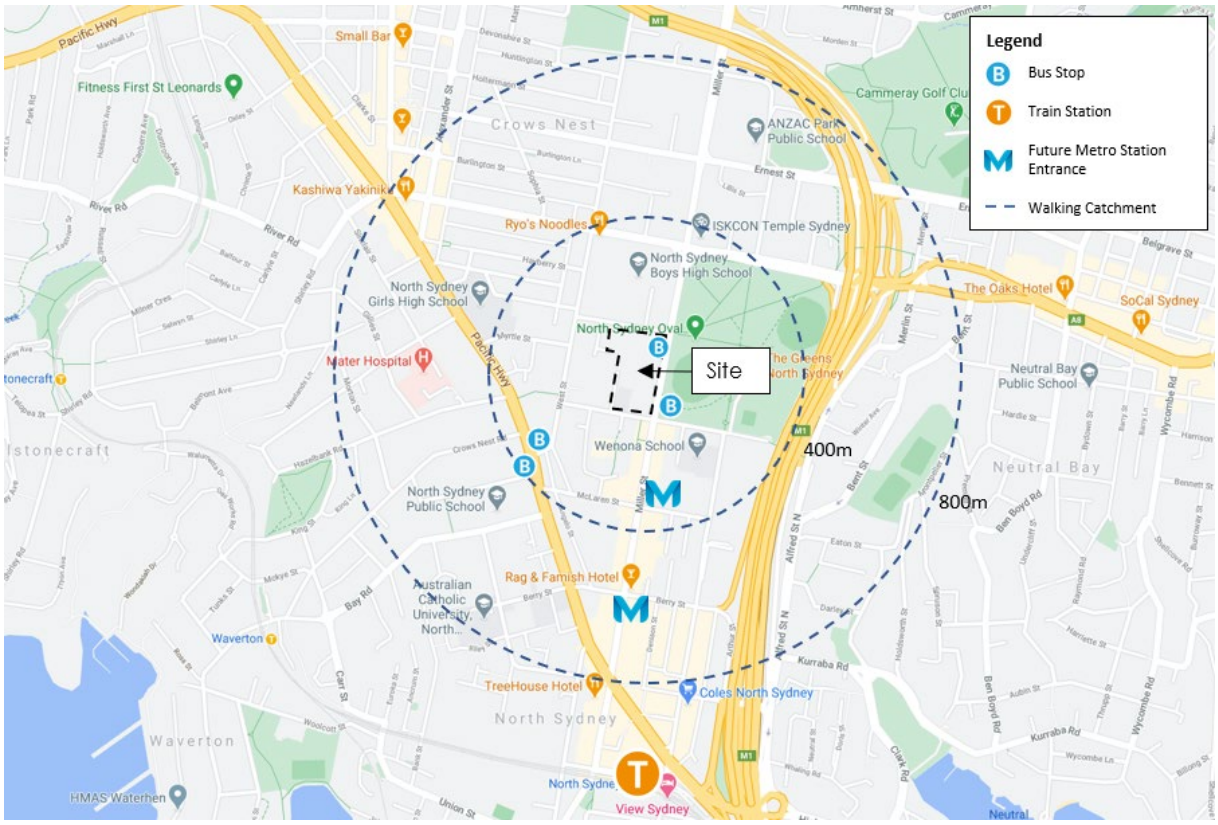
Route Number	Description	Bus Stop Location	Frequency
150X	Manly to Milsons Point (Express Service)	North Sydney Oval, Miller Street	Every 5-15 mins
154X	Dee Why to Milsons Point (Express Service)	North Sydney Oval, Miller Street	Every 5-10 mins (AM peak)
115	Chatswood to City Bridge St via North Sydney	Pacific Highway at West Street	Every 10-20 mins
200	Gore Hill to Bondi Junction	Pacific Highway at West Street	Every 20-30mins
202	Northbridge to City Bridge St via North Sydney	North Sydney Oval, Miller Street	Every 10-30 mins
203	Castlecrag to North Sydney	North Sydney Oval, Miller Street	Every 30-60 mins
207	East Lindfield to City Bridge St via North Sydney	North Sydney Oval, Miller Street	Every 10-30 mins
208	East Lindfield to City Bridge St via Northbridge & North Sydney	North Sydney Oval, Miller Street	Every 30 mins (PM)
209	East Lindfield to Milsons Point via North Sydney	North Sydney Oval, Miller Street	Every 2-15 mins (AM)
228	Clifton Gardens to Milsons Point	North Sydney Oval, Miller Street	2 services (AM)
229	Beauty Point to Milsons Point via Balmoral Heights	North Sydney Oval, Miller Street	2 services (AM) 3 services (PM)
230	Mosman Wharf to Milsons Point via North Sydney	North Sydney Oval, Miller Street	Every 5-30mins
252	Gladesville to City King Street Wharf via North Sydney	Pacific Highway at West Street	Every 20-30mins
254	Riverview to McMahons Point	Pacific Highway at West Street	Every 15-30 mins (AM Peak) Every 30-60mins (PM)
261	Lane Cove to City King Street Wharf via Longueville	Pacific Highway at West Street	Every 30 mins (Peak) Every 60 mins (Off-peak)
286	Denistone East to Milsons Point via St Leonards & North Sydney	Pacific Highway at West Street	5 services (AM)
287	Ryde to Milsons Point via St Leonards & North Sydney	Pacific Highway at West Street	6 services (AM)
290	Epping to City Erskine St via Macquarie University & North Sydney	Pacific Highway at West Street	4 services (AM) 1 service (PM)
291	Epping to McMahons Point	Pacific Highway at West Street	Every 20-30mins (Peak) Every 60mins (Off-peak)
320	Gore Hill to Mascot	Pacific Highway at West Street	Every 10 mins

Table 2.2: Existing School Bus Services and Associated Frequencies

Route Number	Description	Bus Stop Location	Frequency
639W	North Sydney Girls High to Castlecrag	Miller Street at Carlow Street	1 service (PM)
641W	North Sydney Girls High to East Lindfield	Miller Street at Carlow Street	1 service (PM)
645W	North Sydney Girls High to Chatswood Station	Miller Street at Carlow Street	1 service (PM)
646W	Denistone East to North Sydney Boys High	Miller Street at Carlow Street	1 service (AM)
647W	Epping Station to North Sydney Boys High	Miller Street at Carlow Street	1 service (AM)
651W	North Sydney Girls High to Lane Cove West	Miller Street at Carlow Street	1 service (PM)
653W	Lane Cove Shops to North Sydney Boys High	Miller Street at Carlow Street	1 service (AM)
793N	North Sydney Girls High to Manly Wharf	Miller Street at Carlow Street	1 service (PM)
794N	North Sydney Girls High to Manly Wharf	Miller Street at Carlow Street	1 service (PM)

Figure 2.3 presents a map of the key existing bus stops within a 400m radius of the site.

Figure 2.3: Bus services within Close Proximity of Site



Bus occupancy data has been obtained from Transport for NSW collected on Thursday, 20 February 2020 to understand existing capacities of buses arriving at the following bus stops within the immediate vicinity of the site during typical conditions (i.e. pre-COVID school term).

- Along Miller Street, in front of North Sydney Oval – Bus Stops 206049 and 206018
- Along Pacific Highway, north of West Street – Bus stops 206025 and 206029

The data indicate the occupancy of buses into ranges of 20%. The bus occupancy data collected from buses arriving at the above stops during peak school periods (i.e. 8:00am to 10:00am in AM peak and 2:00pm to 4:00pm in PM peak) have been used in this assessment.

Table 2.3: Bus Occupancy Data

Time Period	0% to 20% Occupancy	21% to 40% Occupancy	41% to 60% Occupancy
AM Period	59%	33%	8%
PM Period	76%	21%	3%

Source: Transport for NSW Bus Opal Assignment Model – data collected on 20 February 2020

Based on the bus occupancy data, existing bus loads within the immediate vicinity of the site currently operate below capacity, with maximum occupancy of 60%. The majority of the buses arriving at the selected stops have up to 20% occupancy. As such, the existing bus facilities within the immediate vicinity of the site currently have spare capacity for any additional bus trips generated by the school.

2.3.1 Future Transport Facilities

The NSW Government is implementing a new standalone, 66-kilometre railway line from Epping to Bankstown via Chatswood. The Sydney Metro City & Southwest rapid transit railway line was approved in January 2017 and is currently under construction.

It will include a new line between Epping to Sydenham via St Leonards, and will convert the existing railway line between Sydenham and Bankstown to Metro standards.

The Metro has an anticipated opening of 2024. Following opening, the Metro is anticipated to provide rail services every four minutes during the peak and 15 minutes off-peak.

Victoria Cross Station will be delivered as part of this project and will be located beneath Miller Street to the north of the Pacific Highway between McLaren Street and south of Berry Street. This is approximately 250 metres (a 3-minute walk) from the subject site and is expected to significantly add to the already provisioned public transport amenities in the area.

2.4 Pedestrian and Cyclist Infrastructure

Well established pedestrian facilities are provided within the immediate vicinity of the site. Sealed pedestrian footpaths are provided along the site frontage, with dedicated pedestrian facilities provided along Miller Street, Carlow Street and Ridge Street in the form of signalised crossings or pedestrian (zebra) crossings. At present, these pedestrian facilities are well utilised during school peak drop off and pick up times.

The existing pedestrian access gates and pedestrian facilities surrounding the site are shown in Figure 2.4.

Figure 2.4: Existing Pedestrian Facilities

2.5 Cyclist Infrastructure

The surrounding area is well serviced by cycling routes. Notably, a separated bidirectional cycleway is provided on Ridge Street, along the southern boundary of the site. The cycleway connects to a wider network of off-road and on-road cycle routes in the area.

West Street has been determined as a road with high bicycle use, and a potential future bicycle route is being considered. This will provide connectivity to a wider network in the area.

The existing and potential future cycle network is shown in Figure 2.5.

Figure 2.5: Cycle Paths within the Vicinity of the Site

Source: https://www.northsydney.nsw.gov.au/Transport_Parking/Cycling/Cycling_Map, accessed 25/11/2020

2.6 Car Share Facilities

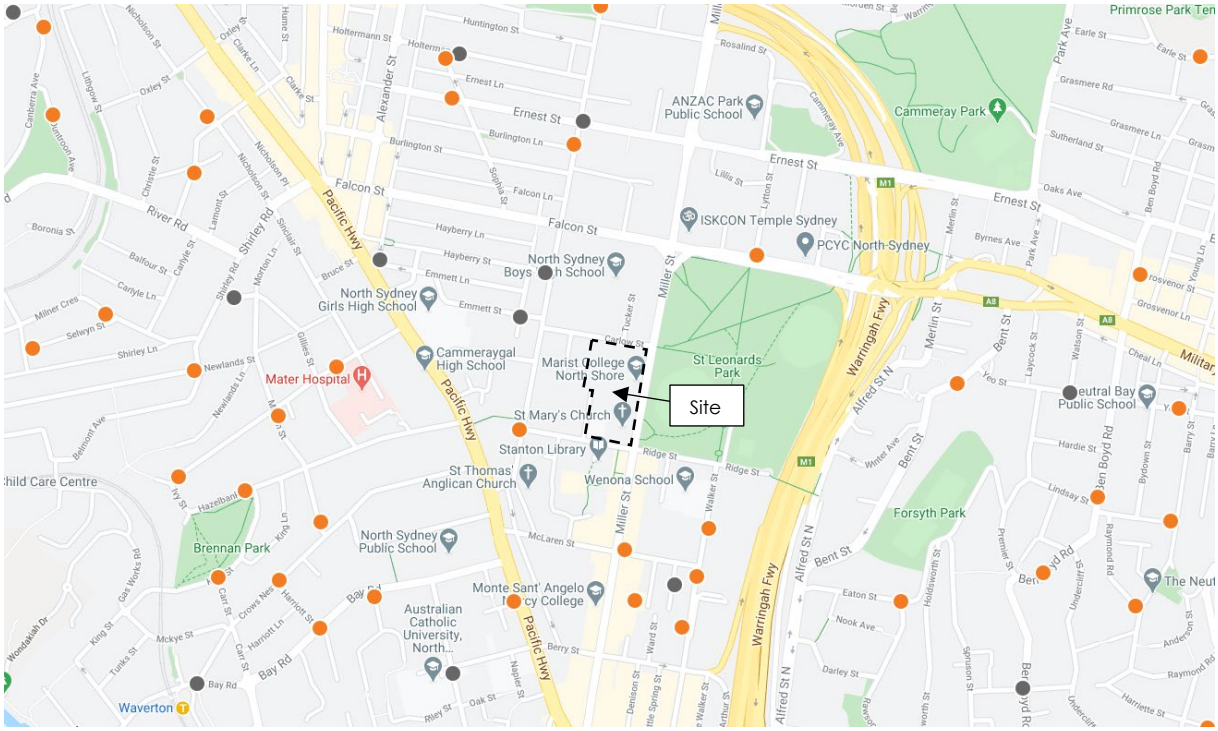
Car share schemes are a flexible, cost effective alternative to car ownership and is a convenient and reliable way for staff or students to use a car when they need one. GoGet is a car share company operated in Australia, with numerous vehicles positioned within the North Sydney area.

Car share is a concept by which members join a car ownership club, choose a rate plan and pay an annual fee. The fees cover fuel, insurance, maintenance and cleaning. The vehicles are mostly sedans, but also include SUVs and station wagons. Each vehicle has a home location, referred to as a "pod", either in a parking lot or on a street, typically in a highly populated urban neighbourhood. Members reserve a car by web or telephone and use a key card to access the vehicle.

Notably, the City of Sydney Council has reported that "a single car share vehicle can replace up to 12 private vehicles that would otherwise compete for local parking". As such, the provision of car sharing facilities or the promotion of using existing car sharing facilities in the vicinity should be able to reduce both the parking demand for the site and the traffic generated by it.

Figure 2.6 shows the location of the existing GoGet vehicles surrounding the site.

Figure 2.6: Location of Existing GoGet Vehicles



Source: https://www.goget.com.au/, accessed 25/11/2020

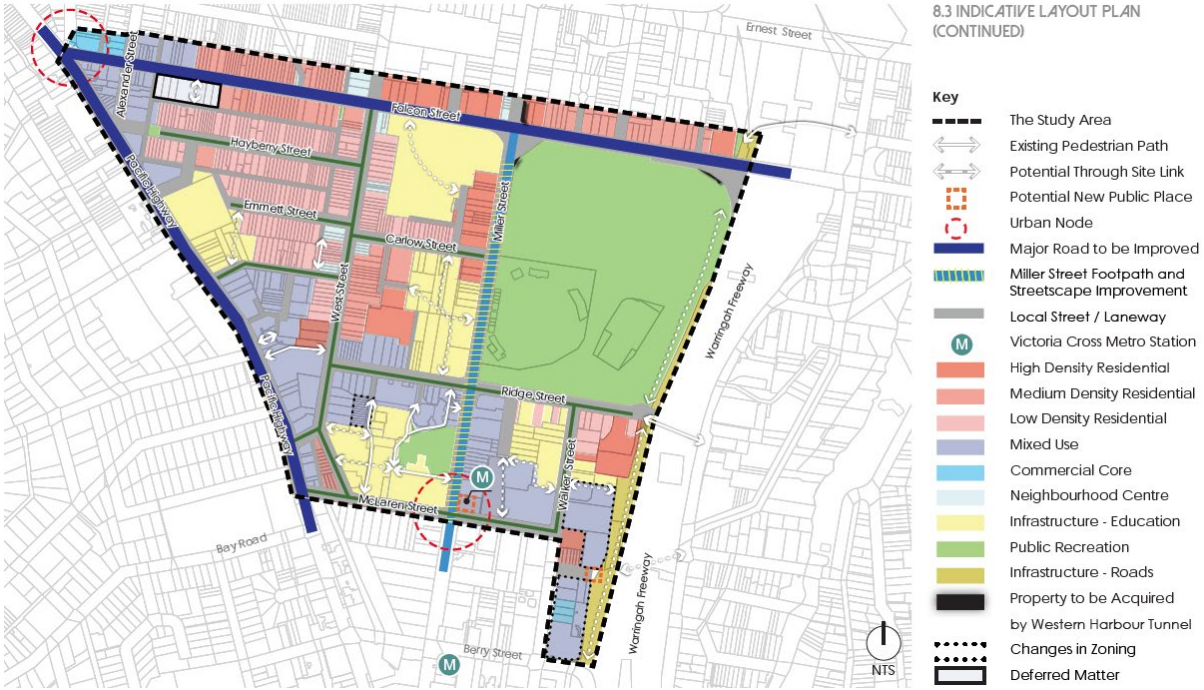
2.7 Strategic Planning

The site is located within the North Sydney Civic Precinct, which stretches between Crows Nest and North Sydney. North Sydney Council is preparing a framework for the Precinct to plan for its growth as a result of the new Metro Line.

The actions under the framework aim to create more jobs and housing projects, identify opportunities for improvements to access, pedestrian amenity and active transport and improve streetscapes.

Notably, the *Draft Civic Precinct and Surrounds Planning Study* has identified the subject site as a potential site for new pedestrian links, including a north south link between Carlow Street and Ridge Street and an east-west link between Cassins Avenue and Miller Street. The indicative plan from this study is shown in Figure 2.7.

Figure 2.7: Indicative Civic Precinct Layout Plan



Source: Draft Civic Precinct and Surrounds Planning Study

2.8 Existing Vehicle Access Arrangements

The existing site contains two access points, including an ingress driveway off Ridge Street and an egress driveway to Miller Street. The two access points connect and form a thoroughfare through the site that is used by parents and guardians of St Mary's Primary School to drop-off and pick-up their children. The driveway off Miller Street is secured by way of a boom gate which allows controlled access to the site and ensures egress movements are only permitted. The existing circulation through the site is shown in Figure 2.8.

Figure 2.8: Existing Vehicle Circulation through Site

Aerial Source: Nearmap

2.9 Traffic Survey Data

TTPP commissioned traffic and parking surveys on Thursday 17 September 2020, between the hours of 7:00am – 9:00am and 2:30pm – 5:00pm. The survey included a survey of the on-street parking and a traffic count of the site access points and six intersections comprising:

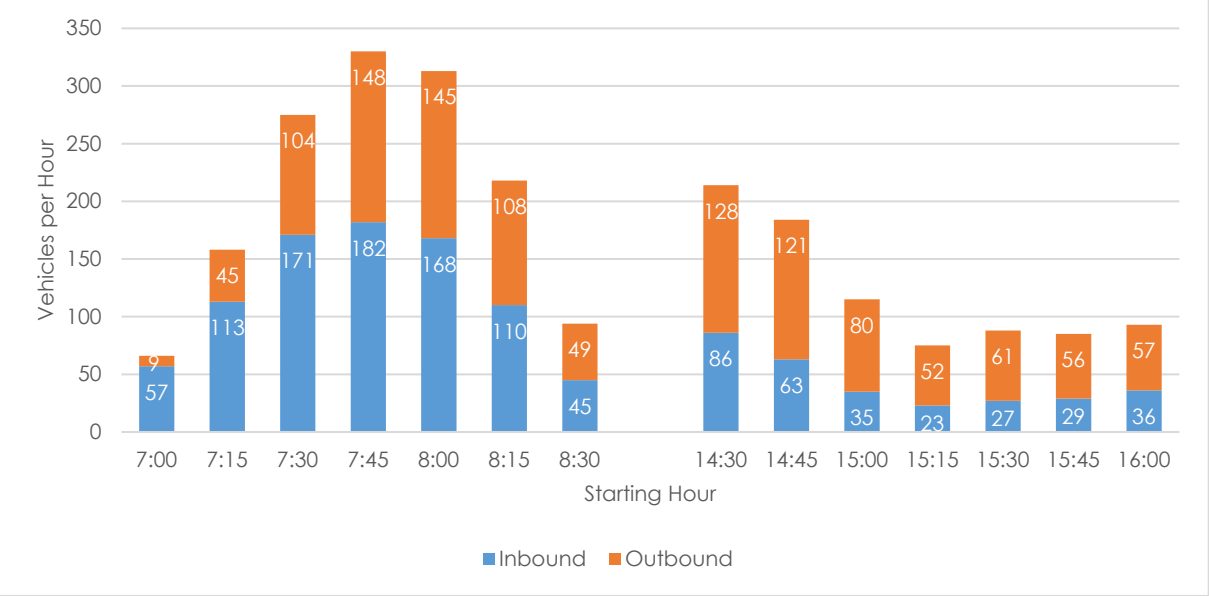
- Falcon Street – Miller Street
- Carlow Street – Miller Street
- Ridge Street – Miller Street
- McLaren Street – Miller Street
- Berry Street – Miller Street
- Pacific Highway – Berry Street.

The results of the surveys are presented below.

2.9.1 Site Traffic

A summary of the existing site traffic is summarised in Figure 2.9.

Figure 2.9: Existing Site Traffic



The data indicates that the site peaks in the morning, at 7:45am to 8:45am, when there is a traffic generation of 330 two-way vehicle movements per hour (182 vehicles entering and 148 vehicles exiting in the hour).

2.9.2 Parking Provision and Demand

The school currently provides 101 car spaces comprising the following:

- Unreserved parking – 38 spaces
- Unreserved accessible parking – 6 spaces
- Reserved (Parish/ North Sydney Jesuit Community) parking – 17 spaces
- Ron Dyer Centre car park – 40 spaces.

A spot count of the on-site parking demand was undertaken at the beginning and end of each traffic survey period (which were 7:00am - 9:30am and 2:30pm - 5:00pm). Based on this count, the parking demand profile of the site was determined and is summarised in Figure 2.10.

Figure 2.10: Parking Demand Profile

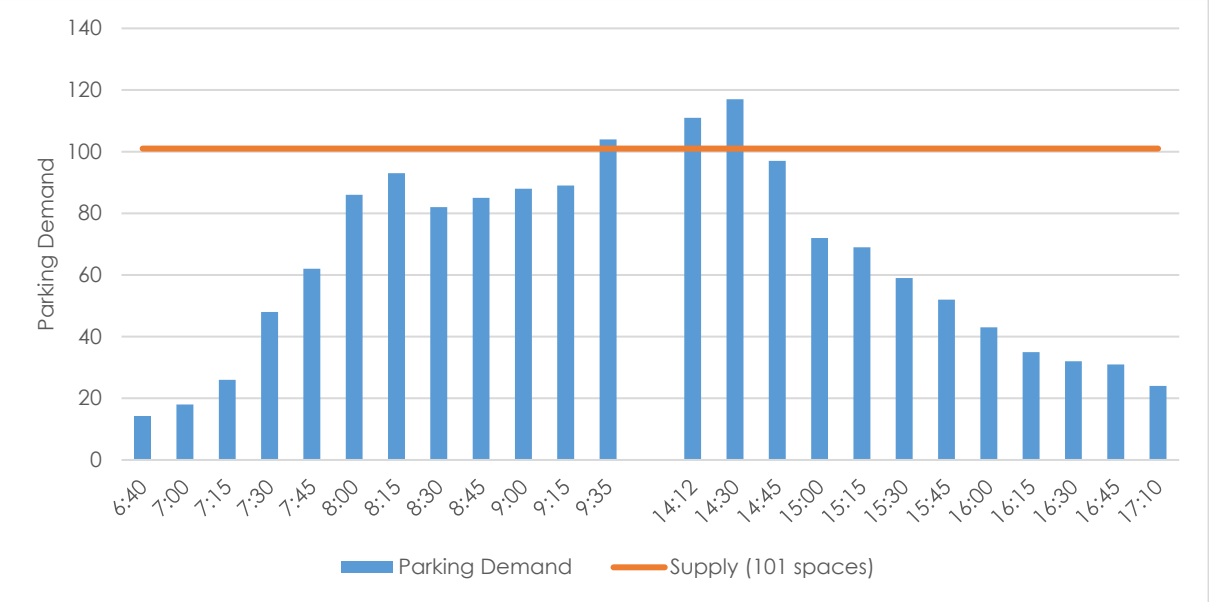


Figure 2.10 indicates that the peak parking demand was 104 cars in the morning peak (at 9:30am) and 117 cars in the afternoon peak (at 2:30pm).

In the morning peak, a number of 'no parking' areas are occupied by staff cars. Up to 19 informal/'no parking' spaces have been recorded. Notably, the exit driveway (off Miller Street) is commonly used for parallel parking, with the driveway being wide enough to accommodate one lane of traffic and parallel parking. The 19 informal spaces are considered permanent spaces used by staff. The informal parking is shown in Figure 2.11.

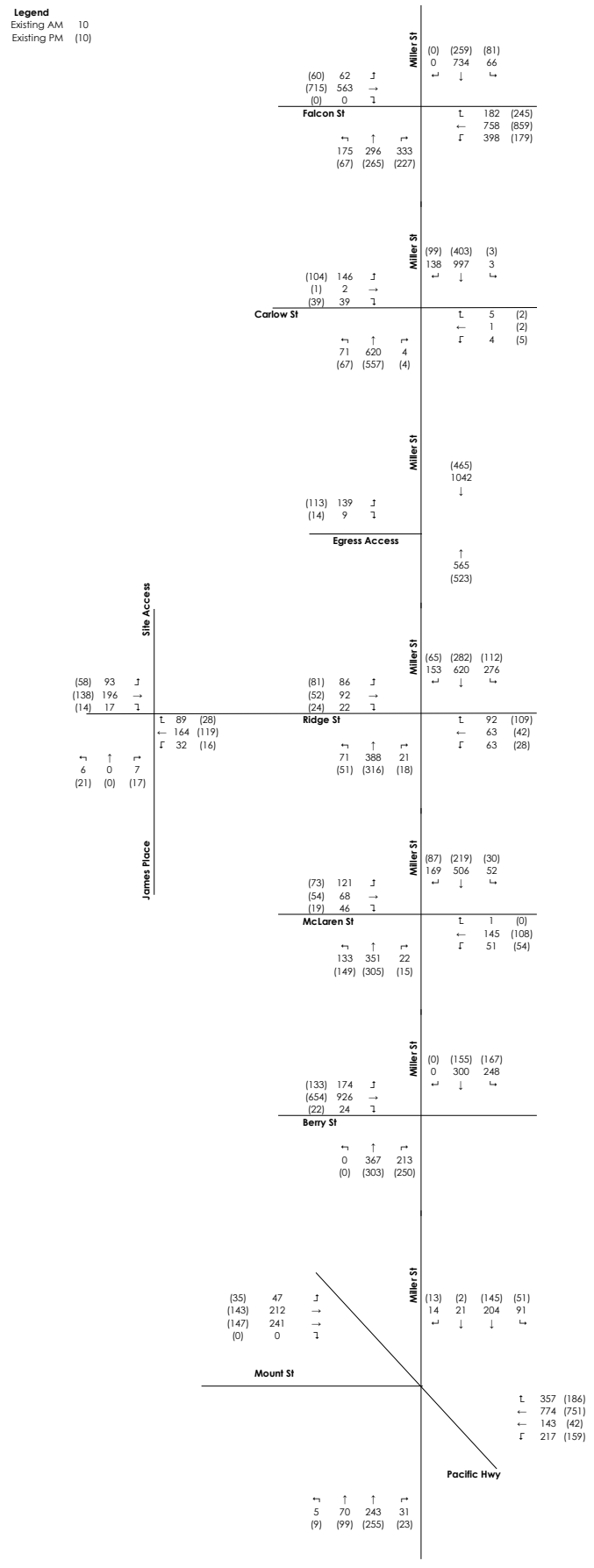
Figure 2.11: Staff Parking on Unmarked Areas

In the afternoon peak, the increase in parking demand is believed to reflect the vehicles driving through the site to undertake pick-up activity. The existing site would be able to accommodate a vehicle queue of 170m (28 vehicles) between the entry at Ridge Street and exit at Miller Street.

2.9.3 Intersection Counts

The intersection surveys included a count of six intersections plus the two site access points. The road network peak hours were recorded as being 7:45-8:45am in the morning period and 2:45-3:45pm. The turning volumes during these periods are presented in Figure 2.12.

Figure 2.12: Existing Traffic Volumes



2.9.4 Validation of traffic data

The COVID-19 pandemic has resulted in the year 2020 having atypical traffic flows. While traffic is understood to have generally normalised by October 2020, when the traffic surveys were undertaken, a comparison of the data with historical traffic counts have been undertaken to confirm the reliability of the data.

TTPP has compared the 2020 survey data from two sources of historical survey data:

- intersection count of Falcon Street and West Street on Thursday, 9th November 2017
- automatic tube count data on Carlow Street, near West Street between 11 May 2018 and 18 May 2018.

A comparison of traffic volumes along Falcon Street from these two data sets is provided in Table 2.4, with the raw survey data provided in **Appendix A**.

Table 2.4: Comparison of Survey Data along Falcon Street

Falcon Street Direction	AM Peak (7:30-8:30)			PM Peak (16:00-17:00)		
	2017	2020	Difference	2017	2020	Difference
Eastbound	754	642	-112	800	792	-8
Westbound	913	916	+3	889	938	+39
Two-Way Total	1,667	1,558	-109	1,689	1,730	+41

Table 2.4 indicates that there is an approximate difference of 40-100 vehicles between the 2017 and 2020 survey data of Falcon Street. Based on experience, this level of difference is minor and within the general variability of day to day traffic for a road with around 1,600 vehicles per hour.

A comparison of the peak average weekday traffic volume from the automatic tube count data from 2018, and the recent intersection count of Carlow Street, is provided in Table 2.5 with the raw survey data provided in **Appendix A**.

Table 2.5: Comparison of Survey Data along Carlow Street

Falcon Street Direction	AM Peak			PM Peak		
	2018[1]	2020	Difference	2018[1]	2020	Difference
Eastbound	171	187	+16	127	144	+17
Westbound	144	210	+66	105	167	+62
Two-Way Total	315	397	+100	232	311	+62

[1] Weekday average of the automatic tube count data

The current traffic volumes along Carlow Street appears to have increased compared to pre pandemic conditions with an increase of 100 vehicles per hour (two-way).

Based on the above, the 2020 traffic survey data collected for this project is considered to be reliable.

3 Existing Travel Patterns

3.1 Travel Questionnaires

Online questionnaires were distributed to school staff and primary school students via email in October 2020 and senior school students in March 2022 to determine their travel mode choice and behaviour to/from the school. A total of 1,169 surveys were completed by staff and students. The ratio of completed surveys in relation to the student and staff population is shown in Table 3.1. The sample size obtained is considered adequate for this study.

Table 3.1: Survey Response Rates

Group	Existing Population	Total Number of Surveys Completed	Ratio of Completion
St Marys Catholic Primary School Students (Kindergarten to Year 2)	466	199	79%
St Marys Catholic Primary School Students (Year 3 to Year 6)		167	
Marist College North Shore Students	826	713	86%
Staff	120	90	75%

3.2 Existing Travel Mode Splits

A summary of existing staff and student travel modes obtained from the survey results is provided in Table 3.2.

Table 3.2: Summary of Existing Staff and Student Travel Modes

Mode	Arrival (AM)			Departure (PM)		
	Primary School Students	High School Students	Staff	Primary School Students	High School Students	Staff
Car	72%	22%	90%	66%	9%	90%
Walk	16%	7%	2%	22%	11%	3%
Bus	5%	55%	1%	4%	60%	0%
Train	0%	3%	2%	1%	6%	2%
Train and Bus	1%	9%	0%	1%	11%	0%
Cycle	3%	0%	0%	3%	0%	0%
Other	3%	4%	4%	3%	3%	4%
Total	**100%**	**100%**	**99%**	**100%**	**100%**	**99%**

The results indicate a high dependency on car usage for staff (90%) and primary students (66%-72%), despite the site's proximity to a number of bus services. Notwithstanding, majority of the high school students travel to/from the school by public transport (66%-77%), mostly using public buses.

The car mode share for students is lower in the afternoon than in the morning due to parents being able to drop off their children on the way to work in the morning and while requiring the students to catch public transport in the afternoon. This pattern is typical at most schools.

A significant number of students also walk to travel between school and their place or residence. However, there is a minimal population who use bicycle to travel to/from the school.

3.3 Existing Mode Trip Generation

Based on the mode shares in Table 3.3 and the existing population numbers in Table 3.2, an estimate of the existing site traffic generation for each travel mode has been estimated and is detailed in Table 3.3.

Table 3.3: Estimated Existing Staff and Student Trips for each Travel Mode

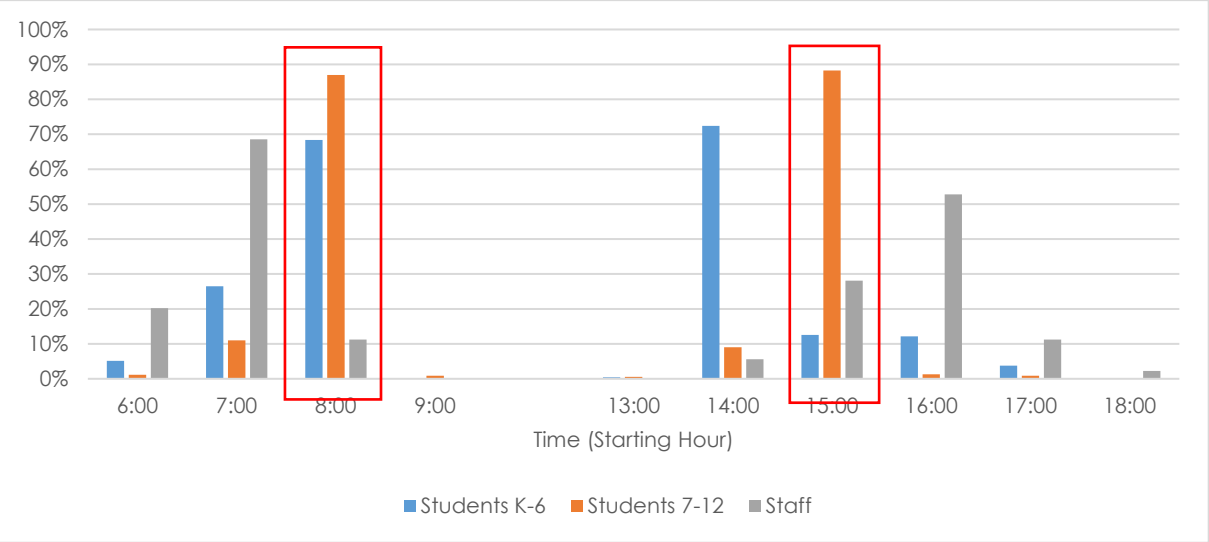
Mode	Arrival (AM)			Departure (PM)		
	Primary School Students	High School Students	Staff	Primary School Students	High School Students	Staff
Car	335	182	108	306	74	108
Walk	75	60	3	103	89	4
Bus	23	453	1	21	496	0
Train	1	21	3	2	52	3
Train and Bus	3	75	0	4	90	0
Cycle	15	1	0	15	1	0
Other	14	34	5	16	23	5
Total	**466**	**826**	**120**	**467**	**825**	**120**

The above arrival/ departure patterns span over a three to four hour period in both the morning and afternoon peak periods, as detailed in Section 3.4.

3.4 Arrival and Departure Patterns

A summary of the staff and student arrival and departure travel patterns is shown in Figure 3.1.

Figure 3.1: Arrival and Departure Times



Note: red box indicates the road network peak hour

The above travel patterns may have been affected by Out of School Hour (OOSH) care with currently accommodates 120 children. No changes to OOSH is proposed in the future.

It should be noted that Table 3.4 indicates the proportions of vehicles which arrive and depart in the peak hour, based on the information provided above in Figure 3.1.

Table 3.4: Peak Hour Vehicle Generation Proportions

Group	Arrival	Departure
Staff	11%	28%
Kindergarten – Year 6	68%	13%
Year 7 – Year 12	87%	88%

3.5 Car Occupancy

Based on the travel survey questionnaires, the following average car occupancy numbers were recorded:

- staff: 1.0 staff per vehicle
- students: 1.36 students per vehicle.

4 Proposed Development

4.1 Overview of Proposed Development

The SSD DA seeks approval for:

- Retention of key buildings including St Mary's Church and Parish Centre, the former Presbytery and Monastery, St Mary's Primary School and some existing buildings on the western boundary.
- Demolition of existing buildings along Miller Street and Carlow Street, including the childcare centre and terrace houses.
- Construction of a mixed-use education precinct comprising a high school and early learning centre, including:
  - adaptive reuse of the existing Presbytery, and alterations and additions to retained educational buildings;
  - construction of a multistorey educational building on the corner of Miller Street and Carlow Street;
  - construction of a multistorey mixed-use building along Miller Street, accommodating teaching facilities, an early learning centre and an auditorium.
  - construction of a new basement car park; and
  - provision of ancillary canteen/café uses.
- Landscaping and public domain works, including the creation of a new plaza along Miller Street, adjoining St Mary's Church.

4.1.1 School Population

A summary of the existing and proposed enrolments is provided in Table 4.1.

Table 4.1: Existing and Proposed Site Population

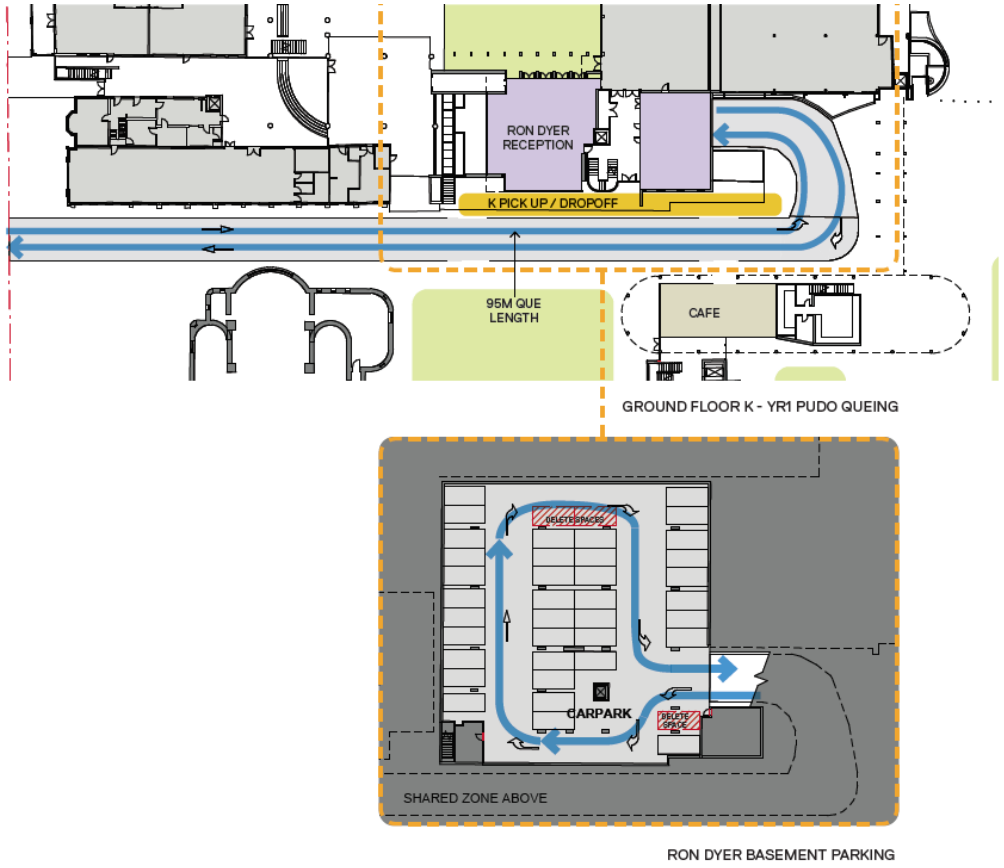
Group	Existing Population		Proposed Population		Proposed Increase	
	Students	Staff	Students	Staff	Students	Staff
Early Learning Centre (ELC) Children	50	7[1]	90	12[1]	+40	+5
Primary School Students (St Marys)	466	40	544	43	+78	+3
High School Students (Marist)	826	80	1,440	132	+614	+52
Total Students	**1,342**	**127**	**2,074**	**187**	**+732**	**+60**

[1] Childcare staff numbers are assumed, based on a ratio of 1 staff to 7 children as required by the National Quality Framework by ACECQA

4.2 Proposed Access Arrangements

The existing entrance off Ridge Street is to be retained. However, the connecting egress road to Miller Street would be removed. Consequently, the access off Ridge Street would be converted to a two-way driveway, permitting traffic to the Ron Dyer Centre (RDC) car park (i.e. Parish parking) and to the pick-up/drop-off area for Kindergarten to year 1 students. The drop-off area is located along the RDC frontage as shown in Figure 4.1.

Figure 4.1: Ridge Street Access



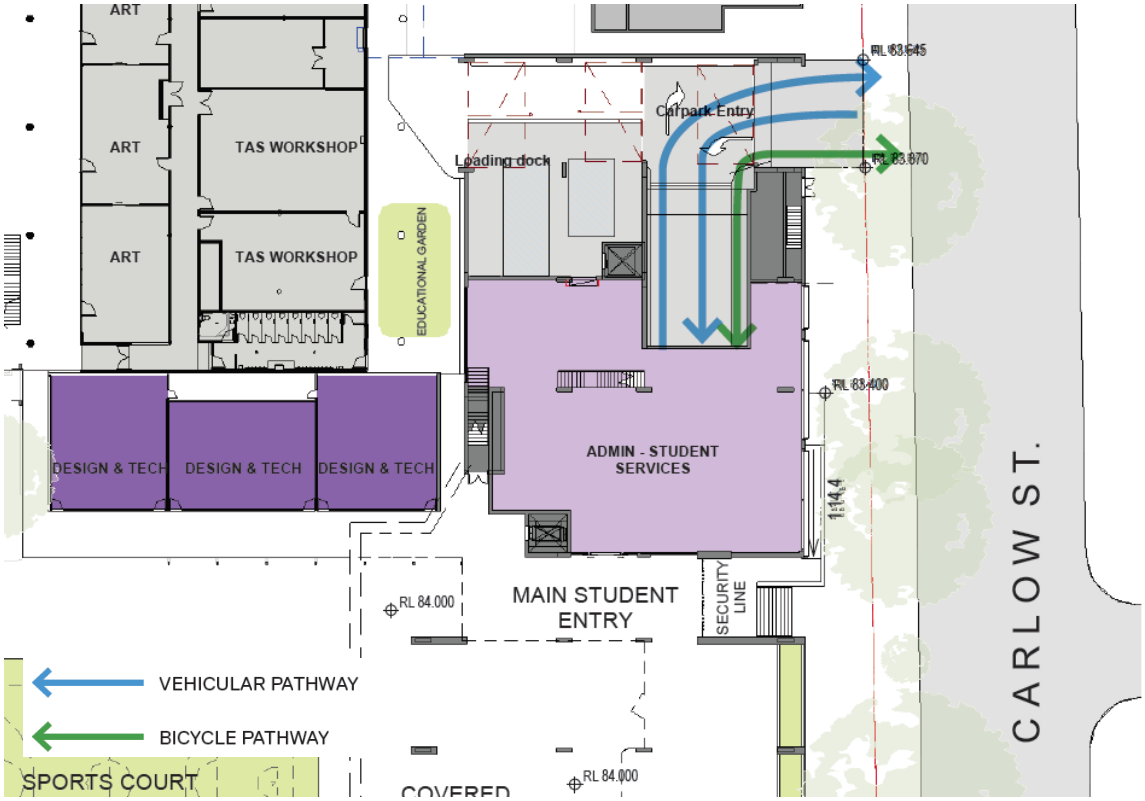
Source: WMK Architecture, September 2020

The access off Ridge Street is also to be redeveloped as a shared zone to improve pedestrian amenity in the area.

The existing access off Miller Street will not be reinstated based on the advice from Transport for NSW (TfNSW) and in accordance with the Infrastructure SEPP, which states that the "consent authority must not grant consent to development on land that has a frontage to a classified road unless it is satisfied that (a) where practicable and safe, vehicular access to the land is provided by a road other than the classified road…".

On this basis, a new access is proposed off Carlow Street which is a local road, to the new Carlow Street car park and loading dock as shown in Figure 4.2.

Figure 4.2: Carlow Street Access



Source: WMK Architecture, September 2020

The Carlow Street car park would provide car parking for staff as well as drop-off spaces for Year 2 to 12 students, and designated parking for the childcare centre. In addition, a secure bicycle parking facility is provided for staff and students, with cycling access to be provided off the same ramp to the car park.

4.3 Proposed Parking Provision

The existing site contains 101 car spaces. Of this, 43 spaces are to be retained including:

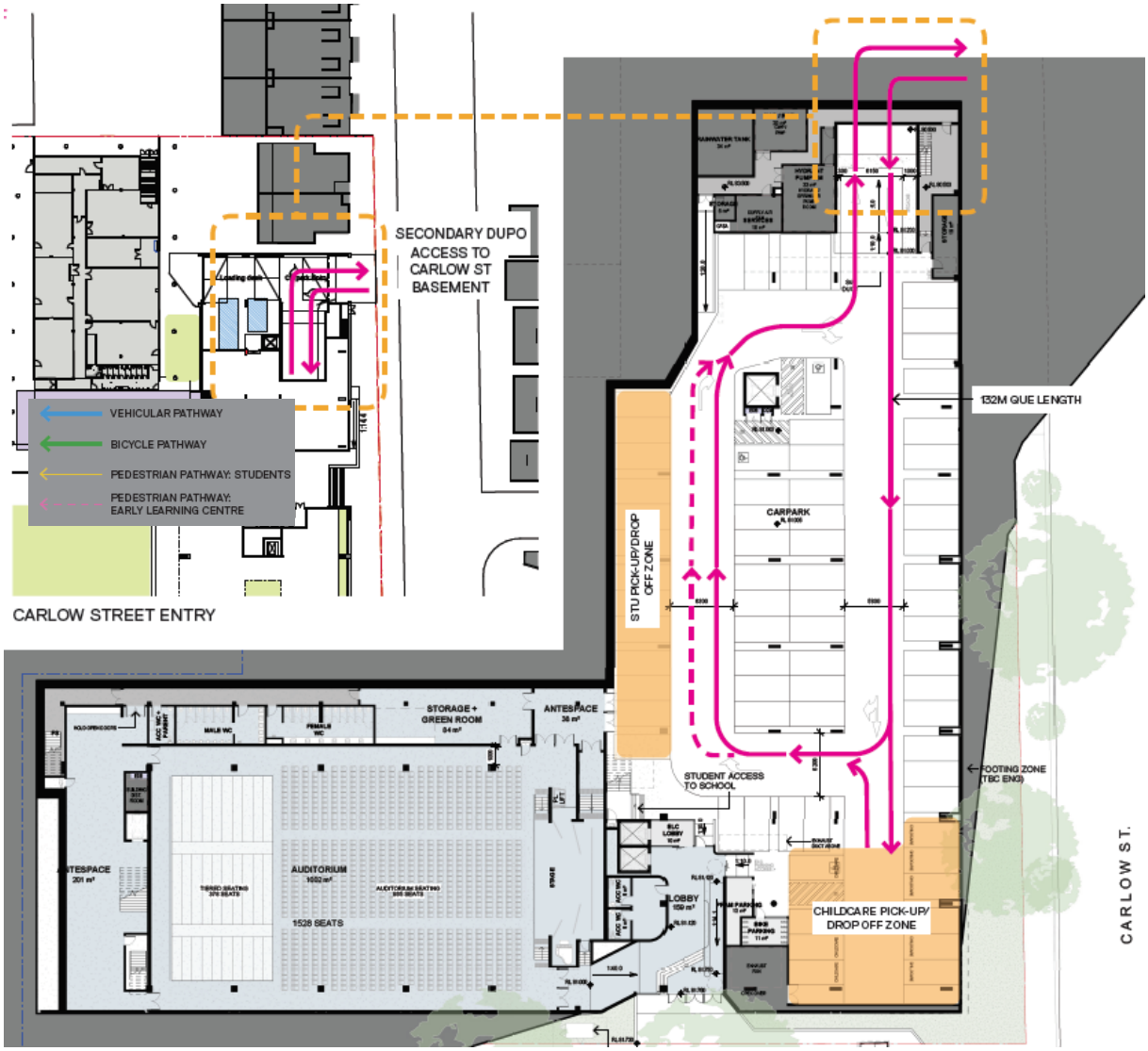
- 37 car spaces in the RDC car park for the Parish Centre and St Mary's Church,
- 6 accessible car spaces located along the internal roadway, adjacent to St Marys Church.

The existing at-grade car park adjacent to St Mary's Church with 44 spaces, is to be removed and replaced with the Carlow Street car park, with a provision of 71 new car spaces, including:

- 13 spaces that available for use by staff and visitors outside of drop-off/pick-up activities for Year 2-12 students (further discussed in Section 6.5.2)
- 10 spaces for the childcare centre
- 48 spaces for staff parking.

Therefore, the proposed site is to have a total provision of 114 car spaces. The site car parks are shown in Figure 4.3.

Figure 4.3: Basement Car Park Circulation



Source: WMK Architecture, September 2020

The Carlow Street car park would also be used as an overflow parking area for the Parish and St Marys Church, outside of school hours, and would be open on the weekends for regular use by parishioners.

4.4 Proposed Drop-off and Pick-up Arrangements

As noted above, the proposed site would have separate pick up and drop off zones, including:

- along the access off Ridge Street (as per existing conditions) for Kindergarten to Year 1 students
- at the new basement car park off Carlow Street, for Year 2 to 12 students
- the childcare centre would have separate parking for visitors to park at the Carlow Street basement.

The separate pick-up and drop-off zones ensures that the traffic is split into different areas to reduce vehicle queues.

An analysis of the queueing impact has been addressed in Section 6.5.

Kindergarten to Year 1 students would be dropped off along the frontage of the RDC centre, and vehicles would circulate out through the existing RDC car park in a one-way clockwise circulation and exit to Ridge Street in a forward direction.

Vehicles would circulate the Carlow Street car park in a one-way clockwise direction, utilising the designated childcare centre spaces or the drop off zone for Years 2 to 12. The circulation arrangements are shown in Figure 4.3.

The childcare centre is designated parking spaces as parents/guardians are required to park and leave their car to drop off and pick up their children, where years 2-12 may be dropped off or picked up without leaving their vehicles, allowing for efficient circulation through the site.

All proposed drop off/ pick up areas are to be operated under a management plan which will include staff managing student and vehicle movements. Additionally, the childcare centre is to be staggered with the school to manage vehicle movements.

4.5 Service and Emergency Vehicles

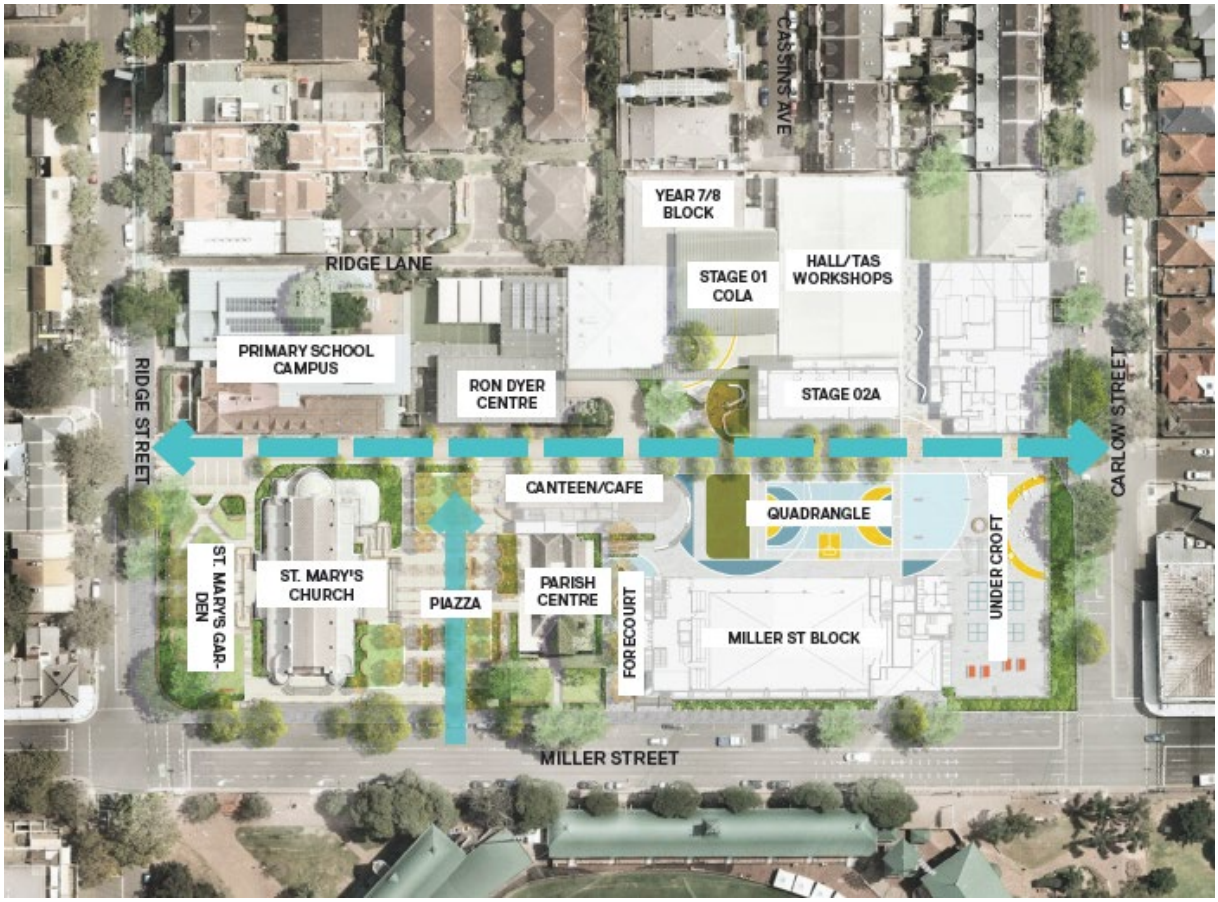
Servicing for the site is to be consolidated into one new loading dock, accessed via the new driveway off Carlow Street and to the south of the ramp into the basement car park. The loading dock would accommodate two bays, including one Small Rigid Vehicle (SRV) bay and one Medium Rigid Vehicle (MRV) bay.

Emergency services would continue to obtain access via the existing driveway off Ridge Street and would be able to gain access from the basement car park off Carlow Street.

4.6 Pedestrian Connectivity

The proposed site would include improved permeability for pedestrians as shown in Figure 4.4.

Figure 4.4: Pedestrian Connectivity



4.7 Internal Traffic and Parking

The internal operation of the car park is considered in more detail in the *Internal Traffic and Parking Assessment* report prepared by Colston Budd Rogers & Kafes (CBRK), which is attached in Appendix C.

5 Parking Assessment

5.1 Parking Requirements for Educational Establishments

5.1.1 State Environmental Planning Policy (Educational Establishments)

There is no specific car parking rate under the Educational State Environmental Planning Policy (Educational SEPP). However, generally, any car parking must not reduce the number of car parking spaces provided and/or must not contravene any existing condition of the most recent development consent relating to car parking (where applicable).

5.1.2 North Sydney Development Control Plan

The North Sydney Development Control Plan (DCP) specifies parking rates for both Child Care Centres and Educational Establishment.

The DCP recommends parking be provided at the following rates:

- Child care centres:
  - Staff – 1 space per 2 employees with a max. of 3 spaces
  - Parents – 2 spaces for < 24 places and 3 spaces for ≥ 24 places.
- Educational establishments: Maximum of 1 space per 6 staff.

On this basis, the proposed ELC with 90 children is permitted a maximum of six car spaces and will provide ten car spaces. The existing childcare centre does not provide parking.

The proposed primary and secondary schools with a total of 175 staff members, is permitted a maximum of 29 car spaces. Comparatively, the existing schools with 120 staff members is permitted a maximum of 20 car spaces. The existing site provides 44 unreserved car spaces (excluding the 19 informal spaces) that can be used by school staff, which exceeds the DCP maximum requirement by 24 spaces. The proposed site includes a provision of 48 car spaces for staff which exceeds the DCP requirement by 21 spaces.

5.1.3 Child Care Planning Guidelines

State Significant Developments are not required to comply with DCP provisions. As such it is considered appropriate to review other guidelines to determine the parking provision for the site.

Notably, the *Child Care Planning Guideline* prepared by the NSW Department of Planning & Environment (August 2017), recommends a provision of 1 space per 10 children plus 1 space per 2 staff at sites located within 400m of a metropolitan train station (e.g. the proposed

Victoria Cross Metro Station). The proposed site with 90 children and 12 staff is therefore recommended a provision of 15 car spaces.

The proposed development includes a provision of ten spaces, which is in between the DCP requirement and Child Care Planning Guideline. The proposed provision is considered satisfactory.

5.1.4 RMS Parking Requirement

The *Guide to Traffic Generating Developments* (2002) does not provide parking provisions for schools. RMS conducted a more recent study of traffic and parking generation associated with schools, namely, *Trip Generation Study for Schools Analysis Report (2014)*. This Study stipulates peak parking demand for schools in metropolitan areas as an average of 0.11 spaces per student.

According to RMS' parking provisions, the proposed development would be required to provide on-site parking as 218 spaces for 1,984 students in the primary and secondary schools.

5.1.5 'First Principles' Parking Requirement

The existing site accommodates 101 car spaces including 57 car spaces dedicated to St Mary's Church and the Parish Office (i.e. Ron Dyer Centre). The remaining 44 spaces are believed to be occupied by school staff. Based on the parking survey data, an additional 19 informal spaces are used for parking, indicating an on-site parking demand of 63 spaces from the schools.

However, the travel questionnaire data as detailed in Table 3.2, indicates that 90% of staff drive to work. Based on 120 staff employed at the site, 108 staff members are expected to currently drive to the school. Of this, it's understood that 84% are full time staff members i.e. 90 drivers that travel to the school every day.

The data indicates that some 27-45 staff members are parking off-site in the surrounding parking facilities. Noting that on-street parking surrounding the site is generally time restricted as short-stay parking, it is anticipated that staff are parking at nearby off-street car parks e.g. the Ridge Street Carpark.

The proposed increase in 55 staff members, may increase the parking demand by 50 spaces based on the existing modal split of 90% of car drivers. Allowing for the proposed modal shift of 5% resulting from the school's travel plan (as discussed in Section 10), an increase of 47 spaces could be expected.

However, parking demand is also influenced by the availability of parking. Noting the limited availability of parking on-site and in the surrounding area, where on-street parking is time

restricted and off-street car parks charge fees, the opportunity for future staff to drive will be limited.

The character of the surrounding area justifies the maximum rates in the DCP, which aims to limit parking and associated traffic to the area. On that note, there may not be opportunity for parking demand to increase as a result of the development and the associated increase in staff numbers.

5.1.6 Parking Provision Adequacy

The proposed Carlow Street car park would provide 48 spaces proposed for staff. With the inclusion of the existing accessible spaces on Ridge Lane that would be retained, gives the proposed development a total parking provision of 54 spaces.

This compares to an existing provision of 63 unreserved spaces available to school staff, including 44 formal spaces and 19 informal spaces.

A comparative summary of the existing and proposed provisions is detailed in Table 5.1.

Table 5.1: Parking Provision Comparison

Type of Parking	Existing	Proposed
Ridge Lane Accessible Spaces	6	6
Unreserved Spaces	38 [1]	48 [2]
Informal Spaces	19	0
Sub-Total	***63***	***54***
Reserved At Grade Spaces	17 [1]	0
Ron Dyer Centre	40	37
Childcare Centre Drop Off	On-Street [3]	10
Senior Drop Off/ Visitor Parking	On-Street [3]	13 [4]
Total (Staff + Drop Off + Parish)	***120***	***114***

[1] Existing at-grade parking, to be removed
[2] Proposed Carlow Street Car Park which is to replace all existing at-grade car parking spaces, except the Ridge Lane accessible spaces which are to be retained. The Carlow Street car park would include another three accessible spaces.
[3] Carlow Street has P10 restrictions for about 4-5 car spaces, from 8:30am to 10am and 4pm to 6pm, which are believed to used by parents to drop off and pick up.
[4] These 13 car spaces would only be available for use outside of pick-up/drop-off periods, when they are blocked off for Year 2 to 12 pick-up/drop-off activities.

On the above basis, it is proposed to generally reinstate the existing parking supply as permitted by the Educational SEPP, with an estimated increase of only six spaces for staff.

The proposed development would also retain 37 spaces for use by St Mary's Church and the Parish Office. This is 20 spaces less than the existing provision for the Parish and Church, however, the Carlow Street car park is to be available to Parish visitors outside of school hours

(e.g., weekends when services are typically run) and would accommodate the reduced provision.

In addition, 10 car spaces are proposed for the new childcare centre (as discussed in Section 5.1.3). Outside of pick-up/drop-off periods, there would also be 13 additional spaces within the Carlow Street car park that would be available to visitors and late arrivals of staff. During pick-up/drop-off periods, these spaces are unavailable for access and are used for Year 2 to 12 pick-up/drop-off activities. The new pick-up/drop-off area would displace existing on-street parking activities (i.e. within the P10 spaces on Carlow Street) during the drop off and pick up periods.

5.2 Accessible Parking Requirements

The DCP requires that "1-2% of all non-residential parking spaces are to be designated for use by the disabled".

Additionally, the Disability (Access to Premises — Buildings) Standards 2010 requires accessible car parking spaces to be provided for school developments at a rate of one space for every 100 car parking spaces or part thereof.

Based on the proposed additional provision of 71 new car parking spaces, the proposal would require at least one space designed as an accessible space. It is proposed to provide three accessible spaces, which complies with above requirements.

5.3 Bicycle Parking Requirements

The DCP specifies a bicycle parking requirement for childcare centres, however, do not specify a bicycle parking requirement for primary or secondary educational facilities.

On this basis, the bicycle parking requirement for primary and secondary school has been sourced from the *NSW Planning Guidelines for Walking and Cycling*, which suggests bicycle parking at a rate of 3-5% of staff and 5-10% of students.

A rate of 5% is applied to the proposed primary and high school population of 1,984 students, noting that high school students are more likely to cycle to school than primary school students who are typically escorted by their parents. Therefore, 99 bike parking spaces are proposed for students.

In addition, based on a rate of 5% of all staff (187), 10 bicycle spaces are proposed for staff.

A total provision of 109 spaces is proposed and is considered adequate for the site. It is noted that the existing site does not contain any bicycle parking.

6 Transport Assessment

This section outlines the traffic assessment associated with the proposed development in future stages.

The travel demand strategies proposed to be implemented at the school, as detailed in Section 10 of this report and the separate Green Travel Plan, aim to influence the way people move to/from the school to encourage sustainable travel and reduce traffic and parking impacts within communities. Such measures facilitate a modal shift away from car and an increased uptake in more sustainable transport options. Additionally, the proposed Victoria Cross Metro Station will likely result in a substantial shift in mode to travel by train.

Therefore, the additional traffic associated with the proposed development has been estimated assuming that there would be 5% modal shift away from car, as proposed by the Green Travel Plan.

6.1 Proposed Mode Share Targets

A summary of the existing and projected modal splits for each user type is provided in Table 6.1 and Table 6.2. These proposed modal split targets are considered realistic based on our previous experience at similar developments, subject to the implementation of green travel strategies and initiatives.

Table 6.1: Existing and Projected Modal Splits – AM Arrivals

Mode	Existing Arrival (AM) Modal Splits			Proposed Arrival (AM) Modal Splits		
	Primary School Students	High School Students	Staff	Primary School Students	High School Students	Staff
Car	72%	22%	90%	67%	17%	85%
Walk	16%	7%	2%	17%	8%	3%
Bus	5%	55%	1%	6%	56%	3%
Train	0%	3%	2%	1%	4%	4%
Train and Bus	1%	9%	0%	2%	10%	0%
Cycle	3%	0%	0%	4%	1%	0%
Other	3%	4%	5%	3%	4%	5%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Note: Red = reduced mode share, green = increased mode share

Table 6.2: Existing and Projected Modal Splits – PM Departures

Mode	Existing Departure Modal Splits			Proposed Departure Modal Splits		
	Primary School Students	High School Students	Staff	Primary School Students	High School Students	Staff
Car	66%	9%	90%	61%	4%	85%
Walk	22%	11%	3%	23%	12%	4%
Bus	4%	60%	0%	5%	61%	2%
Train	1%	6%	2%	2%	7%	4%
Train and Bus	1%	11%	0%	2%	12%	0%
Cycle	3%	0%	0%	4%	1%	0%
Other	3%	3%	5%	3%	3%	5%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Note: Red = reduced mode share, green = increased mode share

6.2 Proposed Trip Generation by Mode

Table 6.3 summarises the anticipated net additional site traffic generation for each mode associated with the proposed College redevelopment under the proposed mode share targets (as outlined in Table 6.1 and Table 6.2). These additional figures are based upon the net increase in the school population i.e. 78 primary school students, 614 high school students and 60 staff members (including childcare centre staff).

Table 6.3: Estimated Person Trips for Each Mode

Mode	Arrivals			Departures		
	Primary School Students	High School Students	Staff	Primary School Students	High School Students	Staff
Car	52	105	51	47	24	51
Walk	13	51	2	18	72	3
Bus	5	343	2	4	375	1
Train	1	22	3	1	45	3
Train and Bus	1	62	0	1	73	0
Cycle	3	7	0	3	7	0
Other	2	25	3	3	17	3
Total	**+78**	**+614**	**+60**	**+78**	**+614**	**+60**

6.3 Vehicle Trip Generation

6.3.1 Childcare Centre

The traffic generation of the childcare centre has been based on the rates provided in the *Roads and Maritime Services Guide to Traffic Generating Developments 2002* (the Guide). The Guide provides the following rates for a long day care centre:

- 0.8 trips per child in the morning (7:00-9:00am)
- 0.3 trips per child in the early afternoon (2:30-4:00pm).

Therefore, the proposed increase in 40 children (from 50 to 90 children), would generate an increase of 32 trips in the morning and 12 trips in the afternoon.

6.3.2 School

Based on the number of people travelling by car (as detailed in Table 6.3) and the car occupancy rates provided in Section 3.5 and the peak hour arrival and departure patterns detailed in Table 3.4, the vehicle generation of the proposed increase in student and staff population has been determined. The traffic generation estimate is summarised in Table 6.4.

Table 6.4: Vehicle Generation

User	Peak Hour Proportions		Peak Hour Vehicles		Peak Hour Trips (Two-way)	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Childcare	-	-	16	6	32	12
Years K-6	11%	28%	4	10	8	20
Years 7-12	68%	13%	52	2	105	5
Staff	76%	90%	39	46	78	92
Total			111	64	223	129

This traffic generation estimate is based on a "business as usual" approach with a 5% mode shift from site specific travel demand management measures only. With the introduction of the Metro it would be anticipated that the mode shift would be much higher than 5% compared to existing. However, a 5% shift is adopted to enable a conservative traffic modelling approach.

6.4 Public Transport Impact

The proposed mode share targets involve an increase in the public transport mode share by 3%. Table 6.3 indicates that this would result in 415 to 438 students and staff catching the bus or train over an approximately three-hour period. Based on the peak hour proportions in Table 3.4, it is expected that up to 294 persons per hour would be catching public transport,

with majority (up to 200 persons) catching a bus. This is estimated to equate to around six persons per bus, allowing for around 30 public buses being serviced per hour by the nearby stops. Table 2.3 (bus occupancy data) indicates that the existing bus services has substantial capacity to accommodate additional patronage.

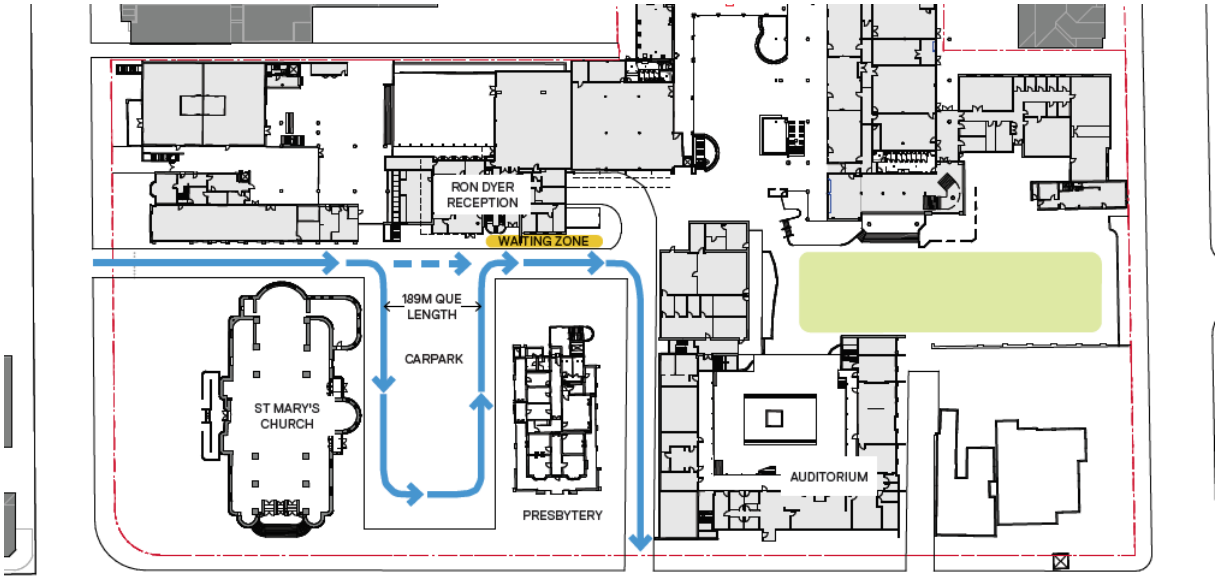
Nonetheless, as part of future GTP measures, investigations should be undertaken to assess the capacity of the buses and increase the number of bus services if required. However, it is also expected that the mode shares would change with the introduction of the Victoria Cross Metro Station, which would shift patronage from buses to train, not just from the site, but from the surrounding area. On that basis, it is considered that both bus and train capacity would substantially increase by 2024 (when the Metro Station is due for opening). On this basis, the public transport impact from the increase in students and staff numbers is expected to be manageable.

6.5 PUDO Queueing Impacts

6.5.1 Existing PUDO Operations

The site's existing pick up and drop off (PUDO) zone is located adjacent to the Ron Dyer Centre, with entry from Ridge Street and exit on to Miller Street. The existing location (labelled as a waiting zone) is shown in Figure 6.1. The existing PUDO zone is approximately 20m long and accommodates around three vehicles.

Figure 6.1: Existing PUDO Circulation



Staff are present to manage movement and queueing of vehicles accessing the PUDO zone. The management procedure involves directing vehicles through the car park aisles, rather than proceeding straight into the PUDO zone, in order to hold the vehicle within the site and minimise queues overflowing on to Ridge Street. This circulation arrangement allows for an on-site queue of 189m from the entry at Ridge Street to the PUDO zone, and a queue of 70m to the exit at Miller Street.

Queues are generally contained on-site as shown in Figure 6.2. However, queues occasionally overflow onto Ridge Street.

Figure 6.2: Ridge Street access during PM PUDO

Queues are caused by two factors. Delay from vehicles giving way to through traffic on Miller Street on exit and parents parking their vehicles to assist with child drop offs.

All vehicles using this PUDO area is observed to be primary school students. As noted in Section 3.2, the car mode share of primary school students is high with 66-71% travelling by car.

On the other hand, high school students have a car mode share of 9-22% and are typically dropped off on-street.

6.5.2 Proposed PUDO Operation

6.5.2.1 Existing PUDO Zone off Ridge Street

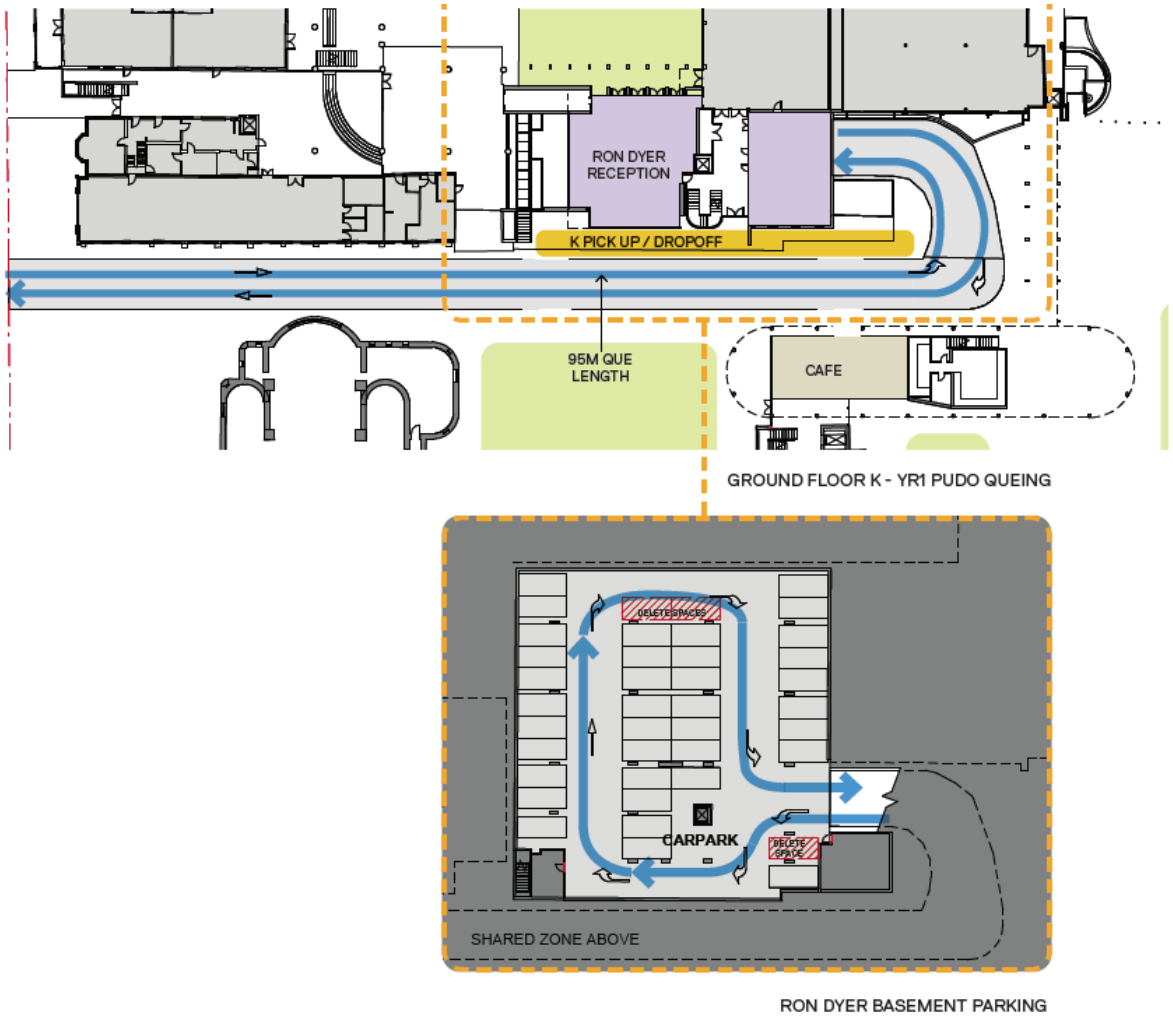
As part of the redevelopment, it is proposed to reduce vehicle queue lengths to the existing PUDO zone, by splitting the primary school traffic into two PUDO zones. The existing zone is to be extended in length from 20m to 40m (capacity for around 6 vehicles) and retained for kindergarten to year 1 students only.

Kindergarten to Year 1 students encompasses the year groups with the longest delays and associated queueing during pick up and drop off periods. Above Year 1, delays are shorter with parents able to drop their children off, without requiring them to park and alight from their vehicles.

The proposed PUDO zone, accessed from Ridge Street, allows for a 95m queue to the PUDO zone and an approximately 160m queue from the PUDO zone to the exit at Ridge Street, via the Ron Dyer car park.

The increased vehicle queuing capacity on exit would assist with ensuring exiting queues to be contained on-site. Notwithstanding, delays to exiting vehicles is anticipated to reduce with, Ridge Street containing lower traffic volumes and vehicle speeds than Miller Street, where the current site egress is located. The proposed PUDO circulation arrangement is shown in Figure 6.3.

Figure 6.3: Proposed K-Yr 1 Circulation



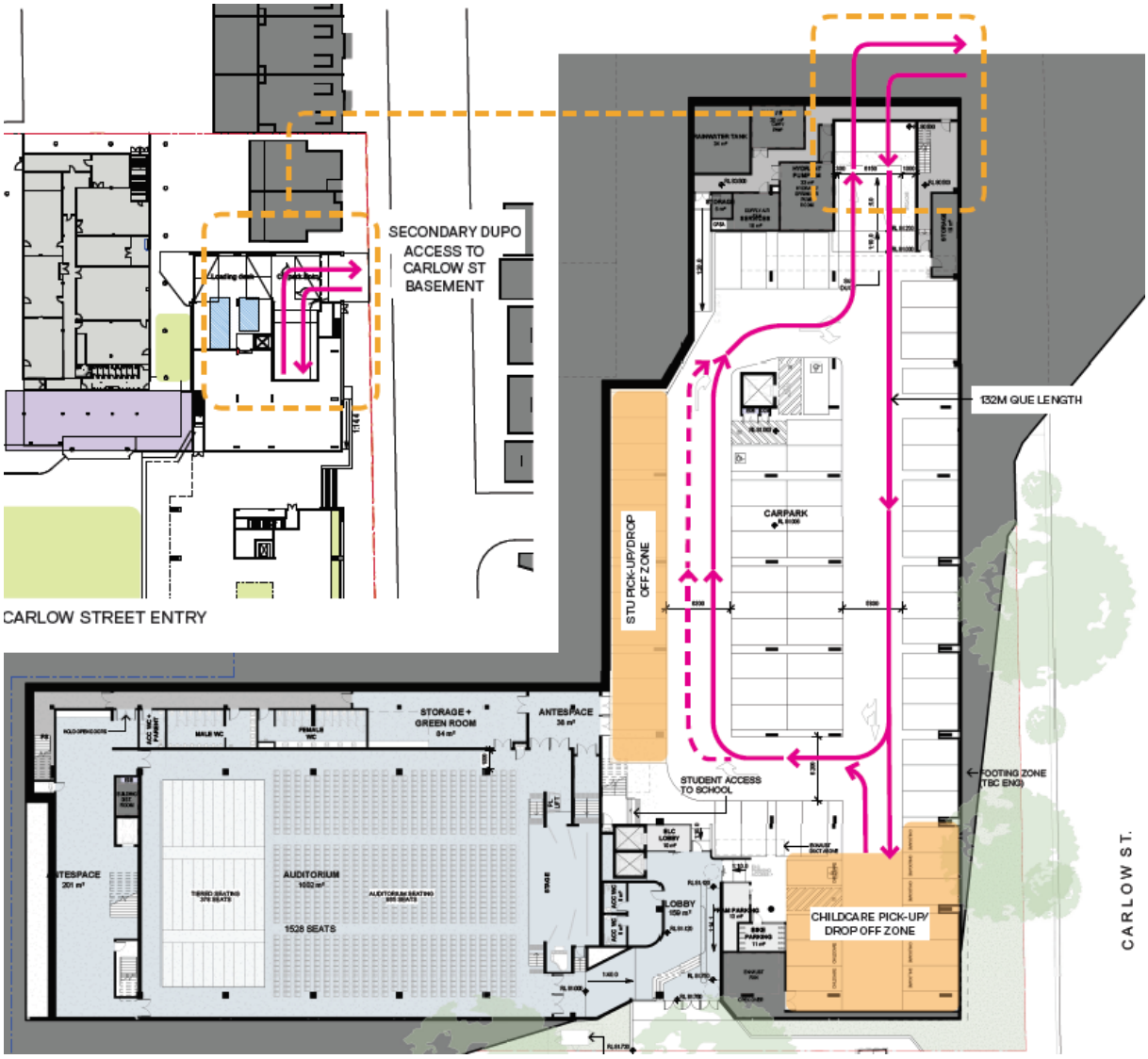
Staff are to be present at the Ridge Street access and PUDO zones, to manage traffic flow and ensure traffic is moving with minimal conflicts.

6.5.2.2 Carlow Street PUDO Zone

The remaining primary school students arriving by car are to be displaced to the Carlow Street car park. The new Carlow Street PUDO facility would also be accessed by high school students.

The PUDO facility at the Carlow Street car park provides a 30m long PUDO area for Years 2 to 12, which enables around 4 vehicles to stop and pick up/ drop off students. The adjoining 13 car spaces are to be used as a pedestrian area during PUDO, with vehicles stopping within the aisle to pick up/ drop off. Outside of PUDO periods, visitors and staff will be permitted to access the spaces for parking. The aisle at this point is 6.3m wide and is wide enough to permit vehicles from the childcare drop off to pass vehicles parked at the Year 2-12 PUDO zone. The circulation arrangement is shown in Figure 6.4.

Figure 6.4: Proposed Yr 2 – Yr 12 PUDO



The Carlow Street car park provides a circulation length/ vehicle queuing capacity of 132m from the bottom of the access ramp and back around.

Consequently, the PUDO capacity of the site as increased substantially, from a single zone with a capacity of 3 vehicles, to two PUDO zones with a total capacity of 10-12 vehicles.

Additionally, the on-site vehicle queueing capacity has increased substantially, from an existing 260m to a total of 392m in the proposed development (i.e. 260m from Ridge Street plus 132m from Carlow Street).

The increase in student numbers is much lower than the increase in PUDO capacity. Table 6.3 indicates an increase of 56 vehicles per hour which is largely related to high school students, who are more efficient in PUDO activities, and are likely to be dropped off in the surrounding

streets and car parks, out of convenience for parents and guardians which is similar to existing conditions.

6.5.3 Operational Traffic Management Plan

As noted above, the existing site is managed by staff acting as traffic controllers during PUDO periods.

The proposed site's traffic management plan will at the minimum, include personnel to manage traffic at the access point from the road and at the PUDO zone itself. The objective of the traffic management personnel would be to ensure that that the PUDO traffic is continuously flowing, that parents/ guardians are not parking along the roadway/ un-designated zones (e.g. ensuring that aisle at the Year 2-12 zone is split in to two lanes), are not undertaking manoeuvres that disrupt traffic and are assisting students in and out of vehicles where required, to reduce potential delays at the PUDO zone.

At present, primary and secondary start and finish times are staggered in the afternoon based on the travel questionnaire data. However, it may be desirable to further stagger both start and finish times for multiple year groups. This would be determined later, as travel behaviour and surrounding transport conditions may change by the time the proposed development has completed construction.

It is envisaged that that any consent of the approval would require a commitment to prepare an Operational Transport Management Plan prior to Construction Certificate to outline the detailed proposed traffic management measures.

7 AIMSUN Traffic Modelling

7.1 Overview

To address the SEARs requirement for the assessment, an Aimsun micro-simulation model was developed for the Miller Street corridor. The model was required to test the 2026 and 2036 years as the year of opening and 10 years past. Traffic forecasts were requested from TfNSW from the Sydney Transport Model (STM) and these were provided for 2021, 2026, and 2036 to be applied to the model.

The following section summarises the modelling that was undertaken.

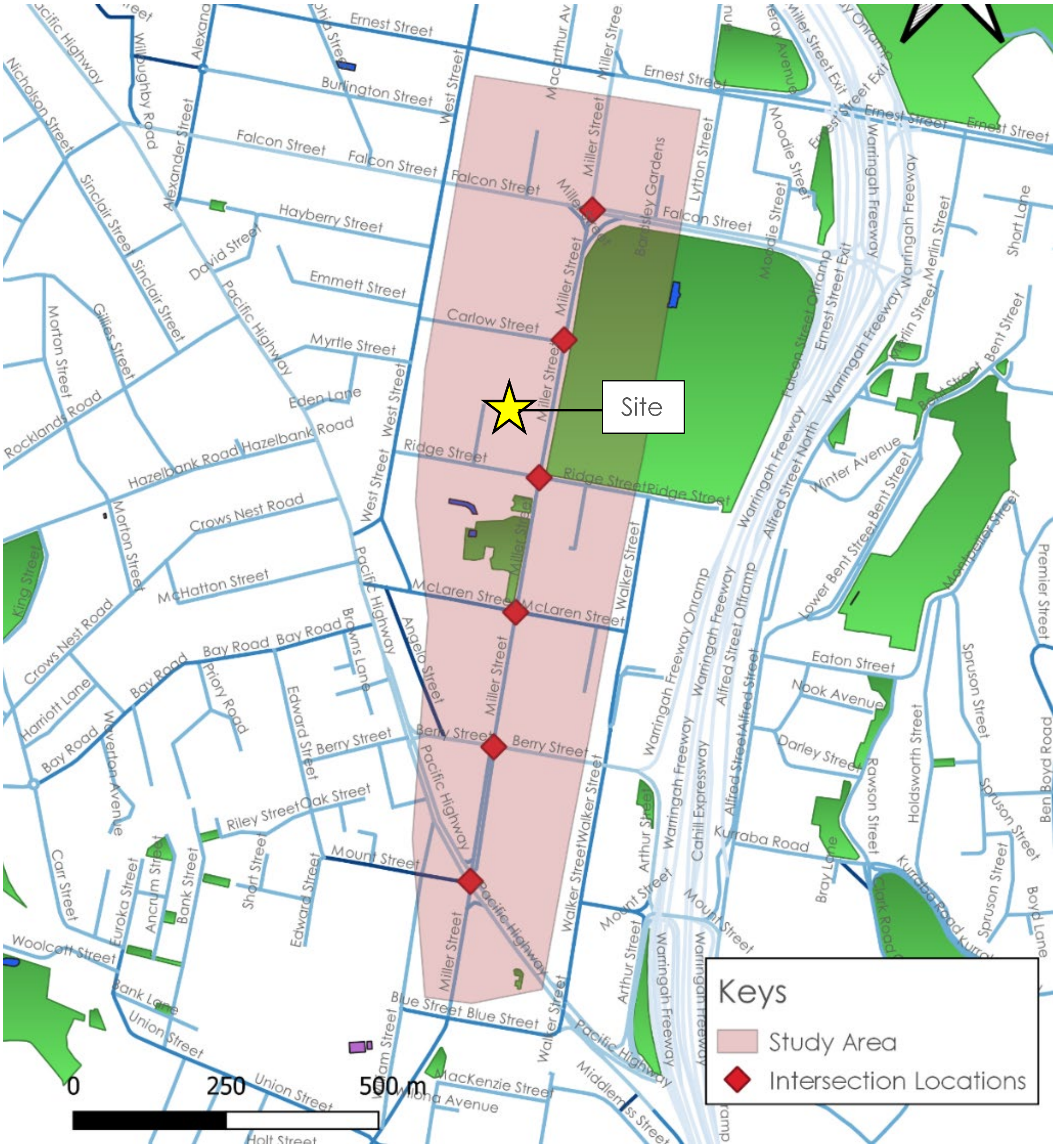
7.2 Base Model Development

The traffic impact of the proposed masterplan development has been assessed using the AIMSUN micro-simulation modelling software (Version 8.4.0).

A 2020 existing conditions model has been developed, calibrated and validated for a morning peak (7:30am-9:30am) and an evening peak (2:30pm-4:30pm). A summary of the key features of the base model is detailed in the following, with full details of the calibration method provided in the "Model Calibration Report' in Appendix B.

The model area covers the corridor of Miller Street from Falcon Street to Pacific Highway (Victoria Cross), as shown in Figure 7.1. The core area of the model has been identified as from Ridge Street to Falcon Street. The core area has been coded to a higher standard of calibration.

Figure 7.1: Model Area



The following is a summary of key inputs that was used to develop the model:

- Classified turn counts as undertaken on 17th September 2020
- Travel time surveys as undertaken on 17th September 2020
- Bus route and timetable data using General Transit Feed Specification from TfNSW's public transport data base
- SCATS History data including phase and cycle times, as obtained from TfNSW.

7.3 Model Scenarios

The following scenarios have been modelled in AIMSUN:

1. **2020 Base model** – existing conditions based on 2020 survey data
2. **2026 Do Minimum** – future year 2026 with no school development
3. **2036 Do Minimum** – future year 2036 with no school development
4. **2026 Do Minimum + School Demands** – future year 2026 with development
5. **2036 Do Minimum + School Demands** – future year 2036 with development
6. **2036 Do Minimum + School Demands** – future year 2036 with development and Western Harbour Tunnel EIS upgrades

7.4 Future Demand Development

The future traffic growth and demand has been developed from the subarea matrices from the Sydney Transport Model (STM), obtained from TfNSW.

The net growth from 2021-2026 and 2021-2036 was adopted for the 2026 and 2036 base models respectively and applied to the 15-minute traffic profiles of the Year 2020 base model.

Table 7.1: AM Peak Intersection Operation – Year 2026

Period	2020	2026		2031	
		Trips	Growth	Trips	Delay (s)
Morning Peak	14865	17369	17%	21868	47%
Evening Peak	14004	16575	18%	22107	58%

The 2036 future matrices from the STM data indicates significant growth. Year 2036 STM model includes a new link to the Western Harbour Tunnel/Beaches Link that has resulted in significant growth on surrounding roads, notably, Ridge Street is indicated to have a 2000% increase in growth between 2021 and 2036.

Difference plots from the Strategic model were requested from TfNSW between the years 2021 and 2036. The difference plots showed the net increase in traffic between the selected years as two hour volumes. The Difference plot for the morning peak period is shown in Figure 7.2.

Figure 7.2: Morning Peak Difference Plot 7:00am – 9:00am

The difference plot shows a significant increase in traffic on Ridge Street and Miller Street as a result of a new link from Ridge Street to the Western Harbour Tunnel. Likewise, the evening peak plot is shown in Figure 7.3

Figure 7.3: Evening Peak Difference Plot 4:00pm – 6:00pm

The new link from Ridge Street increases the volumes on Ridge Street by 2396 vehicles over the two hours. Transport for NSW confirmed that this link from Ridge Street is supposed to be in the model however, no reference to this link could be found in the Western Harbour Tunnel EIS documents which does not show such a link as existing.

7.5 Road Network Upgrades

7.5.1 Western Harbour Tunnel and Beaches Link

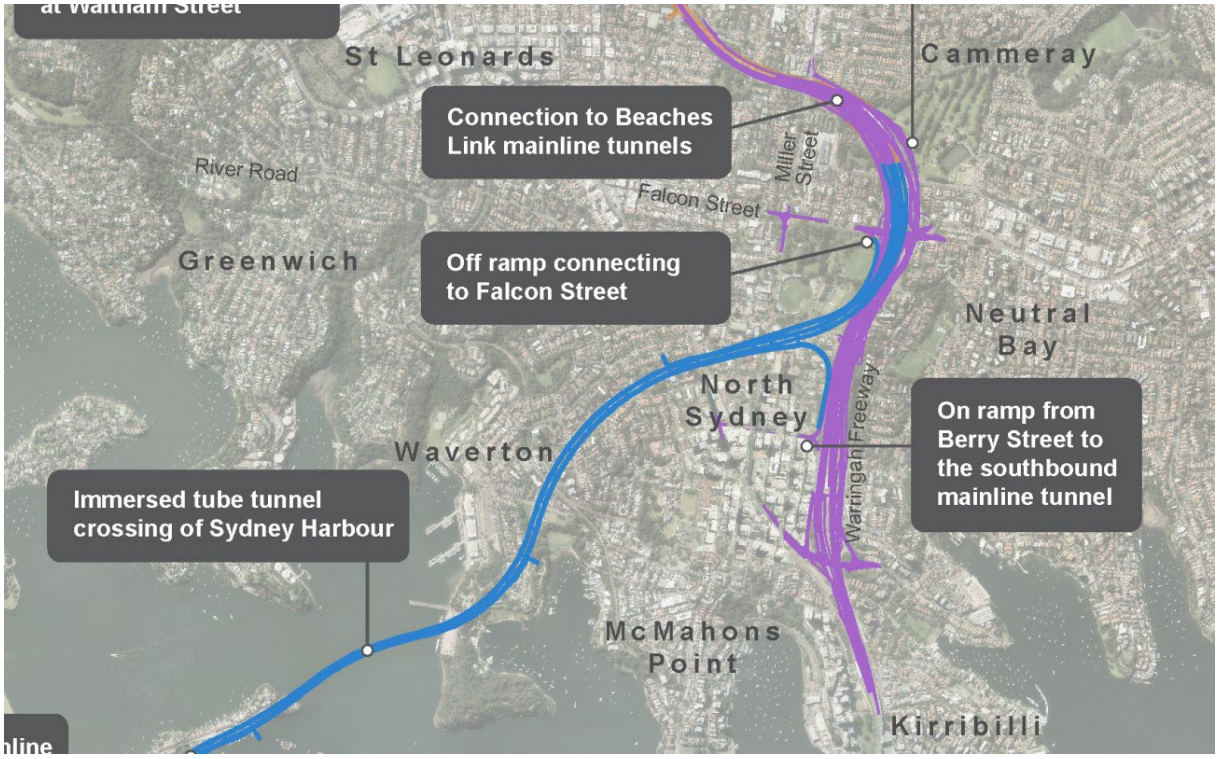
The NSW Government is to develop new motorway connections as part of the 'Western Harbour Tunnel and Beaches Link' Project, that include:

- a new motorway tunnel connection across Sydney Harbour, which run between M4-M5 link at Rozelle to the Warringah Freeway at North Sydney (identified as the Western Harbour Tunnel)

- a new motorway tunnel connection across Middle Harbour from Warringah Freeway and Gore Hill Freeway, to the Burnt Bridge Creek Deviation at Balgowlah and Wakehurst Parkway at Killarney Heights (identified as the Beaches Link).

The Western Harbour Tunnel connection at North Sydney will involve new links to the motorway including an off-ramp connecting to Falcon Street and on-ramp at Berry Street, as shown in Figure 7.4.

Figure 7.4: Western Harbour Tunnel at North Sydney



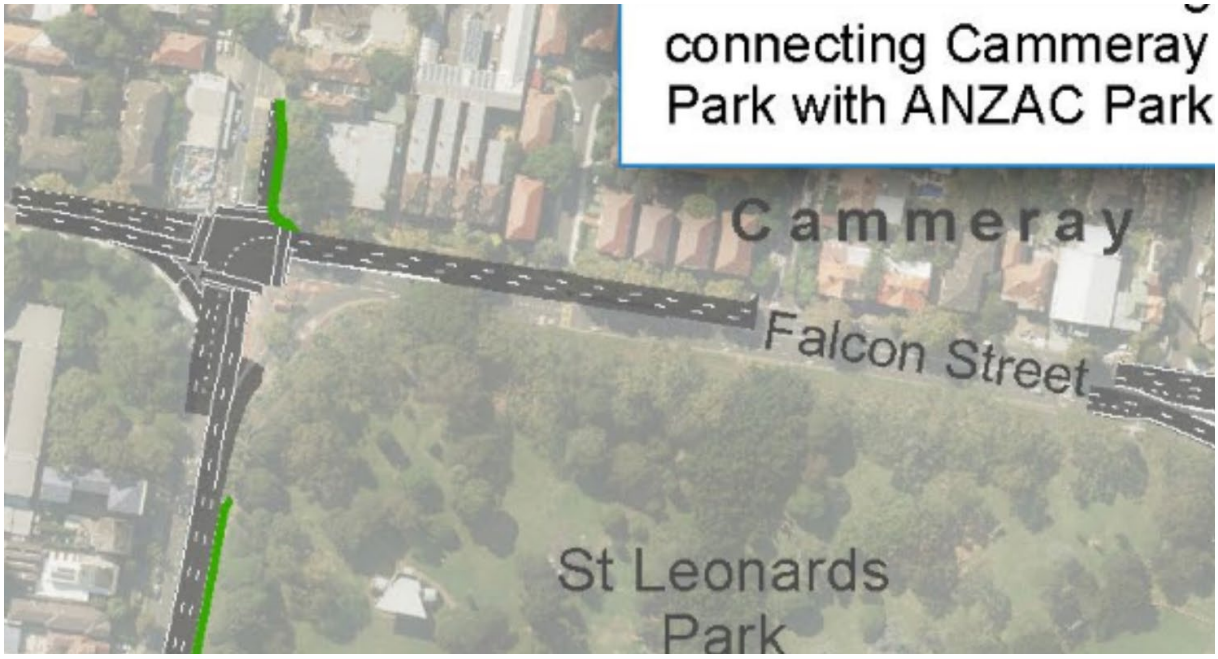
Source: Western Harbour Tunnel and Warringah Freeway Upgrade Environmental Impact Assessment, January 2020

In addition, to accommodate forecasted traffic growth to the new links, an upgrade of the Miller Street and Falcon Street intersection is proposed including:

- a new shared left turn and through movement short lane provided on the eastbound approach of Falcon Street
- a new left turn short lane provided on the Miller Street southbound approach
- the shared through and right turn traffic lane would be converted to a right turn only lane on the Miller Street northbound approach
- Falcon Street would be widened to provide three eastbound travel lanes on the east leg of the intersection.

The upgraded intersection is shown in Figure 7.5.

Figure 7.5: Falcon Street – Miller Street Upgrades



Source: Western Harbour Tunnel and Warringah Freeway Upgrade Environmental Impact Assessment, January 2020

The above upgrades have been applied to the 2036 Do Minimum and 2036 Do Minimum + School Demand scenarios.

7.5.2 Other upgrades

To accommodate forecasted traffic growth, the removal of on street parking in both directions on Miller Street will be required and has been applied to the year 2036 models. No upgrades are proposed to the year 2026 models.

7.6 Modelling Results

7.6.1 Overview

The results of the AIMSUN modelling is assessed based on the following key features:

1. intersection performance and level of service
2. travel times along Miller Street, between Falcon Street and Pacific Highway
3. network statistics based on:
   - vehicle hours travelled (VHT) in the network
   - vehicle kilometres travelled (VKT) in the network
   - unreleased vehicles – vehicles which were unable to enter the network during the modelled period.

The modelling results based on the above features are detailed in the following sections.

7.6.2 Levels of Service

The commonly used measure of intersection performance, as defined by the Roads and Maritime, is vehicle delay. The AIMSUN model determines the average delay (seconds per vehicle) that vehicles encounter and provides a measure of the level of service (LoS). At priority controlled (give-way and stop controlled) and roundabout intersection, the LoS is based on the modelled delay for the most delayed movement.

Table 7.2 shows the criteria that is adopted in assessing the LoS of intersections.

Table 7.2: Level of Service Criteria for Intersection Operation

Level of Service	Average Delay (seconds per 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 traffic signals, incidents will cause excessive delays, roundabouts require other control mode	At capacity, requires other control mode
F	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: Roads and Maritime Guide to Traffic Generating Developments, 2002

Based on the above, the intersection operation for the year 2020 and 2026, with and without the proposed school development, is presented in Table 7.3 (AM Peak) and Table 7.4 (PM Peak).

Table 7.3: AM Peak Intersection Operation – Year 2026

Intersection	2020 Base		2026 Do Minimum		2026 Do Minimum + School Demand	
	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)
1. Falcon Street / Miller Street	D	45	F	114	F	122
2. Carlow Street / Miller Street	A	8	A	12	B	14
3. Ridge Street / Miller Street	C	31	C	41	C	36
4. McLaren Street / Miller Street	A	10	A	11	A	9
5. Berry Street / Miller Street	C	42	C	35	C	35
6. Pacific Highway / Miller Street	B	22	B	18	B	16

Table 7.4: PM Peak Intersection Operation – Year 2026

Intersection	2020 Base		2026 Do Minimum		2026 Do Minimum + School Demand	
	LoS	Delay (s)	LoS	LoS	LoS	Delay (s)
1. Falcon Street / Miller Street	C	33	E	61	E	61
2. Carlow Street / Miller Street	A	4	A	5	A	6
3. Ridge Street / Miller Street	B	16	B	20	B	22
4. McLaren Street / Miller Street	A	9	A	10	A	9
5. Berry Street / Miller Street	A	11	A	12	A	11
6. Pacific Highway / Miller Street	C	31	B	21	B	19

Table 7.3 and Table 7.4 indicates the existing intersection of Falcon Street and Miller Street is nearing capacity under existing conditions in the morning peak period, while the remaining network is operating well. The forecasted traffic growth to the year 2026 would result in this intersection being at capacity (LoS F) in the AM peak period.

The proposed school traffic would not increase the delay at Falcon Street or to the road network along Miller Street.

The intersection operation for the year 2020 and 2036, with and without the proposed school development, is presented in Table 7.5 (AM Peak) and Table 7.6 (PM Peak).

Table 7.5: AM Peak Intersection Operation – Year 2036

Intersection	2020 Base		2036 Do Minimum		2036 Do Minimum + School Demand	
	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)
1. Falcon Street / Miller Street	D	45	F	190	F	201
2. Carlow Street / Miller Street	A	8	B	20	B	24
3. Ridge Street / Miller Street	C	31	F	114	F	142
4. McLaren Street / Miller Street	A	10	C	40	D	43
5. Berry Street / Miller Street	C	42	D	44	C	39
6. Pacific Highway / Miller Street	B	22	C	33	C	32

Table 7.6: PM Peak Intersection Operation – Year 2036

Intersection	2020 Base		2036 Do Minimum		2036 Do Minimum + School Demand	
	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)
1. Falcon Street / Miller Street	C	33	F	94	F	103
2. Carlow Street / Miller Street	A	4	A	13	A	14
3. Ridge Street / Miller Street	B	16	F	93	F	97
4. McLaren Street / Miller Street	A	9	B	16	A	13
5. Berry Street / Miller Street	A	11	B	28	B	25
6. Pacific Highway / Miller Street	C	31	C	30	C	30

The results of the modelling including the proposed upgrades for 2036 are shown in Table 7.7 and Table 7.8 for the morning and evening peak respectively.

Table 7.7: AM Peak Intersection Operation – Year 2036 With Upgrades

Intersection	2020 Base		2036 Do Minimum		2036 Do Minimum + School Demand	
	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)
1. Falcon Street / Miller Street	D	46	F	210	F	222
2. Carlow Street / Miller Street	A	7	C	29	B	27
3. Ridge Street / Miller Street	B	26	F	147	F	123
4. McLaren Street / Miller Street	A	8	D	43	C	41
5. Berry Street / Miller Street	B	15	C	37	D	46
6. Pacific Highway / Miller Street	B	24	C	29	C	36

Table 7.8: PM Peak Intersection Operation – Year 2036 With Upgrades

Intersection	2020 Base		2036 Do Minimum		2036 Do Minimum + School Demand	
	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)
1. Falcon Street / Miller Street	C	36	F	123	F	133
2. Carlow Street / Miller Street	A	3	A	14	A	13
3. Ridge Street / Miller Street	B	15	F	93	F	94
4. McLaren Street / Miller Street	A	8	A	13	A	12
5. Berry Street / Miller Street	A	10	C	28	C	28
6. Pacific Highway / Miller Street	B	21	C	30	C	30

Table 7.7 and Table 7.8 indicate that background traffic growth to the year 2036 would result in two intersections along Miller Street (at Falcon Street, Ridge Street) while the rest of the network would not be significantly affected.

The addition of the school development traffic would result in minor impact to delays, except at the intersection of Miller Street and Falcon Street and at Miller Street and Ridge Street.

Notwithstanding, the above results indicate that the school development will have a minor impact in comparison to the substantial changes expected to the road network as a result of background growth and development.

7.6.3 Travel Times

7.6.3.1 AM Peak Travel Times

The total travel times along Miller Street between Pacific Highway and Falcon Street have been extrapolated and presented in Table 7.9 for the northbound direction and Table 7.10 for the southbound direction, for each scenario in the morning peak.

Table 7.9: Northbound Travel Time – Morning

Check Point along Miller Street	Distance (m)	Cumulative Travel Time (min:sec)						
		2020 Base	2026	2036	2036 + Upgrades	2026 + School	2036 + School	2036 + School + Upgrades
Pacific Highway	0	0:00	0:00	0:00	0:00	0:00	0:00	0:00
Berry Street	224	0:28	0:25	0:33	0:41	0:26	0:36	0:35
McLaren Street	459	1:04	1:01	1:12	1:24	1:00	1:15	1:12
Ridge Street	676	1:48	1:52	1:45	2:00	1:38	1:49	1:43
Carlow Street	909	2:27	2:33	4:17	3:12	2:29	2:38	3:10
Falcon Street	1,119	3:34	5:05	8:12	5:54	4:30	4:44	5:21

Table 7.10: Southbound Travel Time – Morning

Check Point along Miller Street	Distance (m)	Cumulative Travel Time (min:sec)						
		2020 Base	2026	2036	2036 + Upgrades	2026 + School	2036 + School	2036 + School + Upgrades
Falcon Street	0	0:00	0:00	0:00	0:00	0:00	0:00	0:00
Carlow Street	219	0:47	0:44	1:37	1:47	0:55	1:42	1:52
Ridge Street	438	1:10	1:12	3:26	3:23	1:23	3:42	3:24
McLaren Street	665	1:41	1:48	6:32	6:10	1:51	7:01	6:21
Berry Street	879	2:29	2:35	9:06	8:16	2:42	9:10	8:33
Pacific Highway	1,116	3:26	3:16	9:57	9:06	3:20	9:53	9:31

The data in Table 7.9 and Table 7.10 indicates that the school would have little impact on the travel time results. It was noted that in the 2036 scenario without the school development that the northbound travel times increased by some 3 minutes compared to the scenario with road upgrades. This appears to be an outlier due to the congested nature of the forecasts making the models more unstable. For example if a different seed value is chosen (that is other than the median seed based on travel time) the result would be 6 m and 18 seconds which is two minutes quicker. The Southbound travel times are more consistent.

The southbound travel times increase significantly under the 2036 scenarios and this is due to the increase in traffic turning left from Miller Street to Berry Street which causes queuing back in the models.

The travel time results for the Morning peak period are also shown in Figure 7.6 to Figure 7.9.

Figure 7.6: 2026 Northbound Travel Time – Morning Peak 8:00am – 9:00am

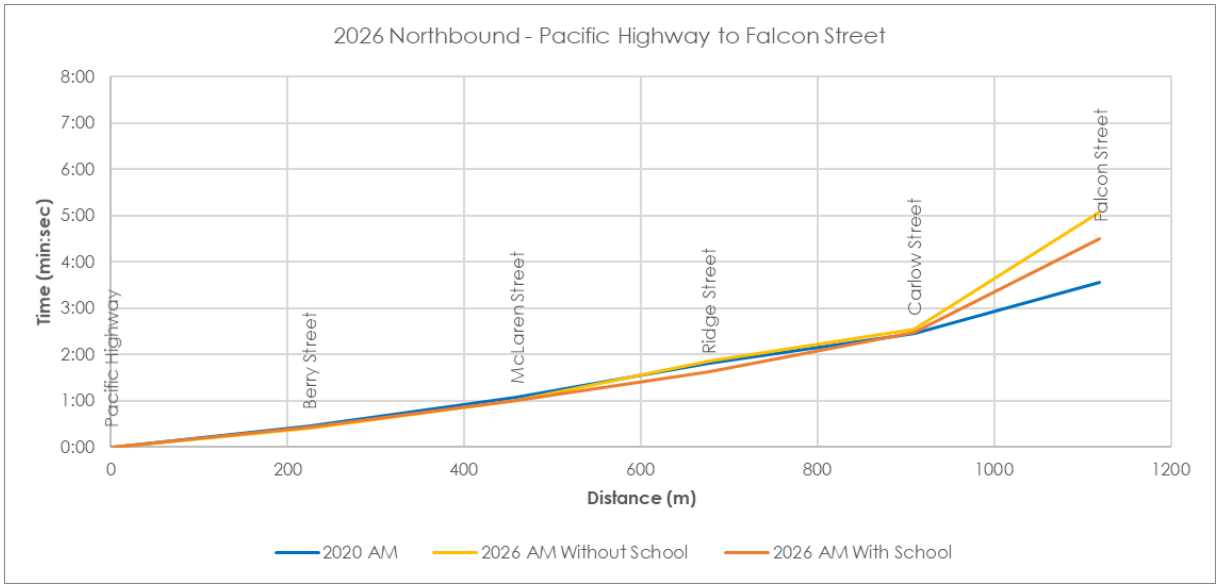


Figure 7.7: 2026 Southbound Travel Time – Morning Peak 8:00am – 9:00am

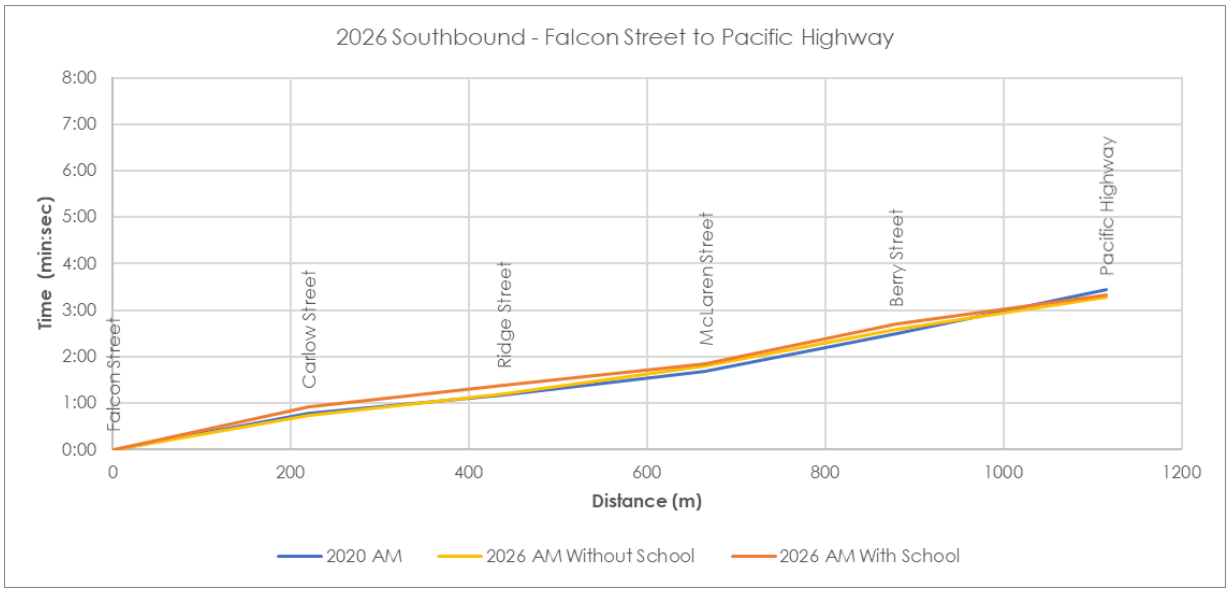


Figure 7.8: 2036 Northbound Travel Time – Morning Peak 8:00am – 9:00am

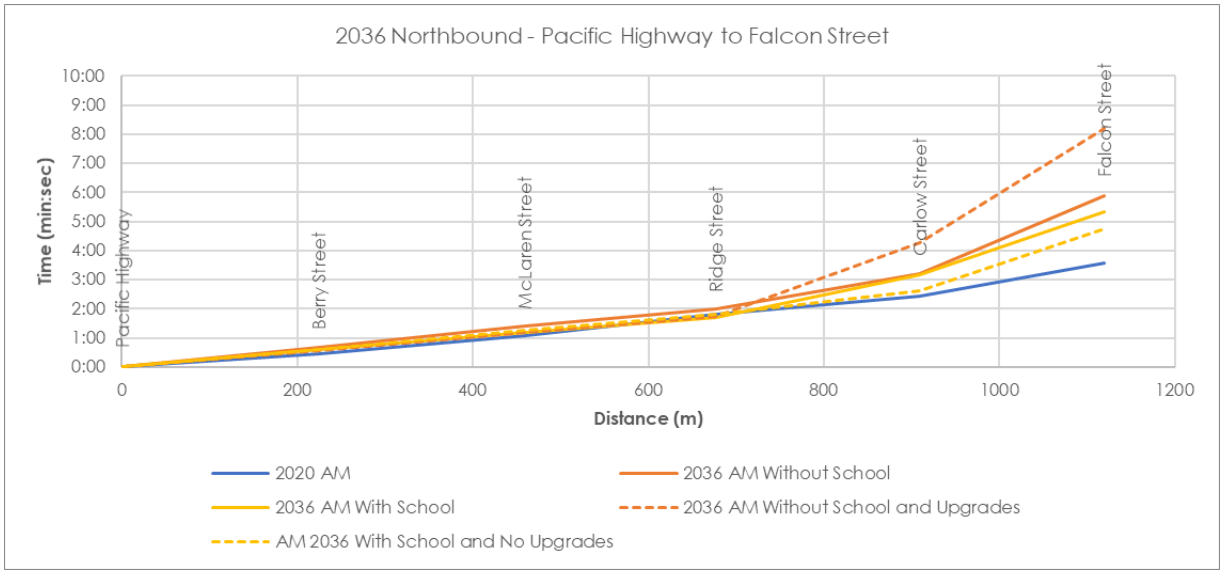
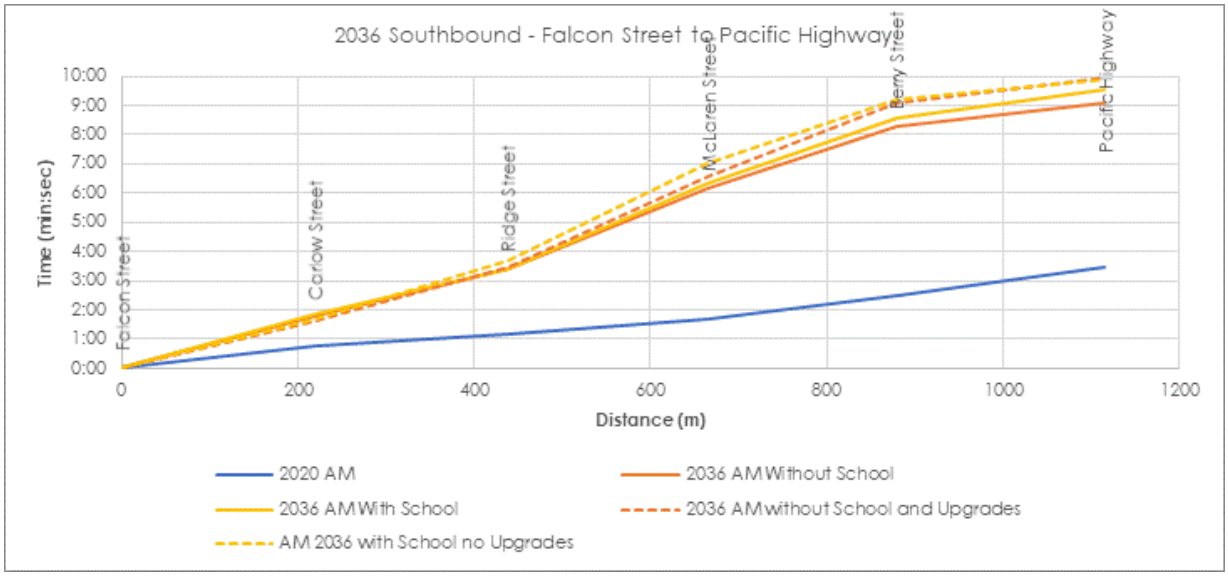


Figure 7.9: 2036 Southbound Travel Time – Morning Peak 8:00am – 9:00am



7.6.3.2 PM Peak Travel Times

The total travel times along Miller Street between Pacific Highway and Falcon Street have been extrapolated and presented in Table 7.11 for the northbound direction and Table 7.12 for the southbound direction, for each scenario in the afternoon peak.

Table 7.11: Northbound Travel Time – Evening Peak

Check Point along Miller Street	Distance (m)	Cumulative Travel Time (min:sec)						
		2020 Base	2026	2036	2036 + Upgrades	2026 + School	2036 + School	2036 + School + Upgrades
Pacific Highway	0	0:00	0:00	0:00	0:00	0:00	0:00	0:00
Berry Street	224	0:54	0:50	0:49	0:47	0:47	0:48	0:51
McLaren Street	459	1:26	1:24	1:32	1:31	1:18	1:30	1:32
Ridge Street	676	1:56	1:54	2:03	2:03	1:46	2:01	2:02
Carlow Street	909	2:19	2:23	2:33	2:32	2:14	2:38	2:31
Falcon Street	1,119	3:29	3:45	4:18	4:06	2:59	4:36	4:34

Table 7.12: Southbound Travel Time – Evening Peak

Check Point along Miller Street	Vehicles	Cumulative Travel Time (min:sec)						
		2020 Base	2026	2036	2036 + Upgrades	2026 + School	2036 + School	2036 + School + Upgrades
Falcon Street	0	0:00	0:00	0:00	0:00	0:00	0:00	0:00
Carlow Street	219	0:30	0:34	1:42	1:42	0:38	1:32	1:55
Ridge Street	438	1:06	1:16	2:33	2:33	1:18	2:31	2:28
McLaren Street	665	1:41	1:53	2:59	3:06	2:01	2:56	2:55
Berry Street	879	2:50	2:53	4:16	4:04	3:12	3:58	3:59
Pacific Highway	1,116	3:40	3:34	4:56	4:45	3:47	4:47	4:47

The data in Table 7.11 and Table 7.12 indicate that the school development would have little impact on travel times in the afternoon peak with most of the travel times within the normal variability of the models.

The travel time results for the PM peak period are also shown in Figure 7.10 to Figure 7.13.

Figure 7.10: 2026 Northbound Travel Time – Evening Peak 3:00pm – 4:00pm

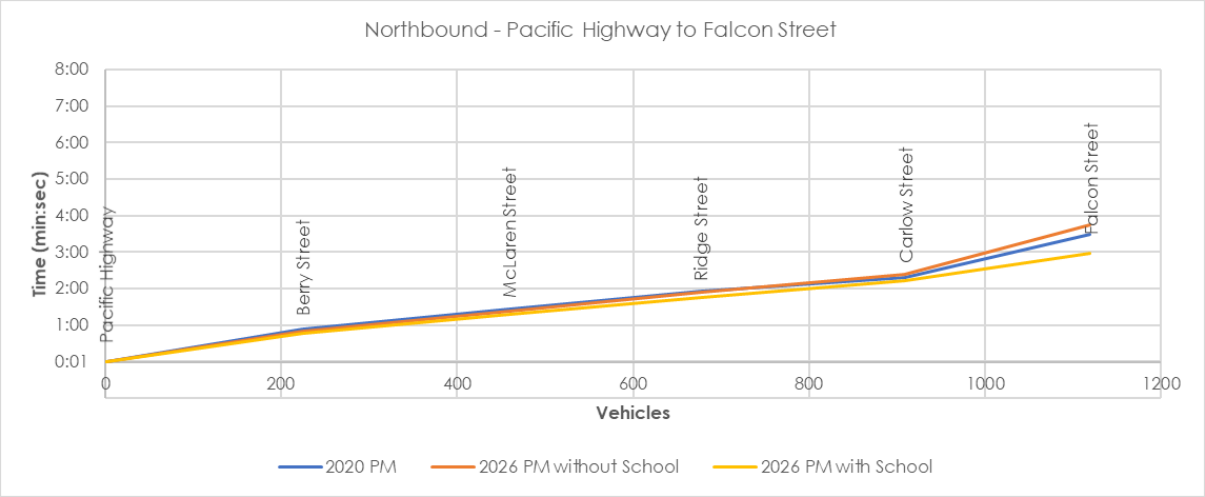


Figure 7.11: 2026 Southbound Travel Time – Evening Peak 3:00pm – 4:00pm

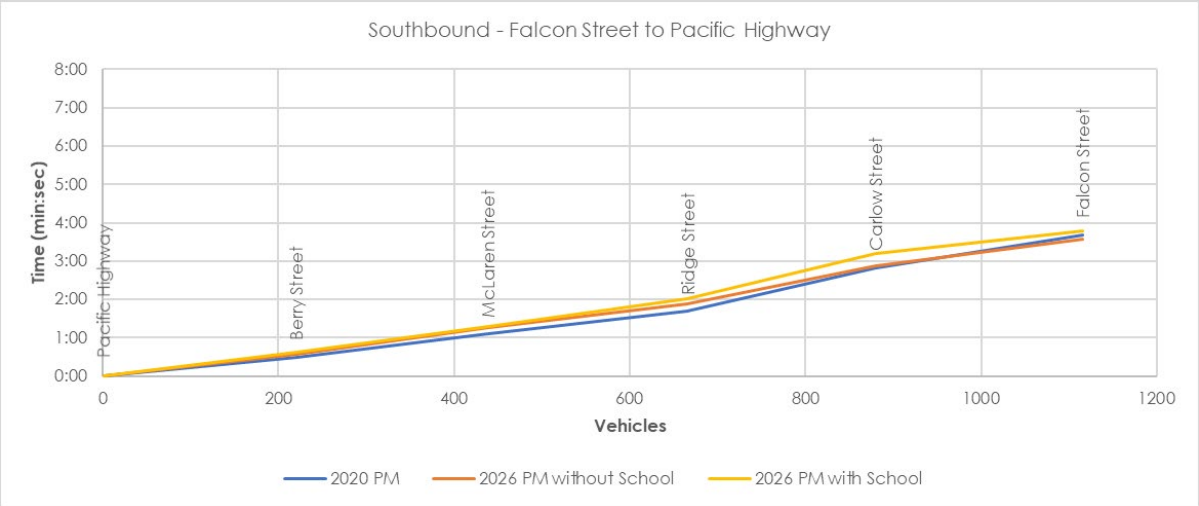


Figure 7.12: 2036 Northbound Travel Time – Evening Peak 3:00pm – 4:00pm

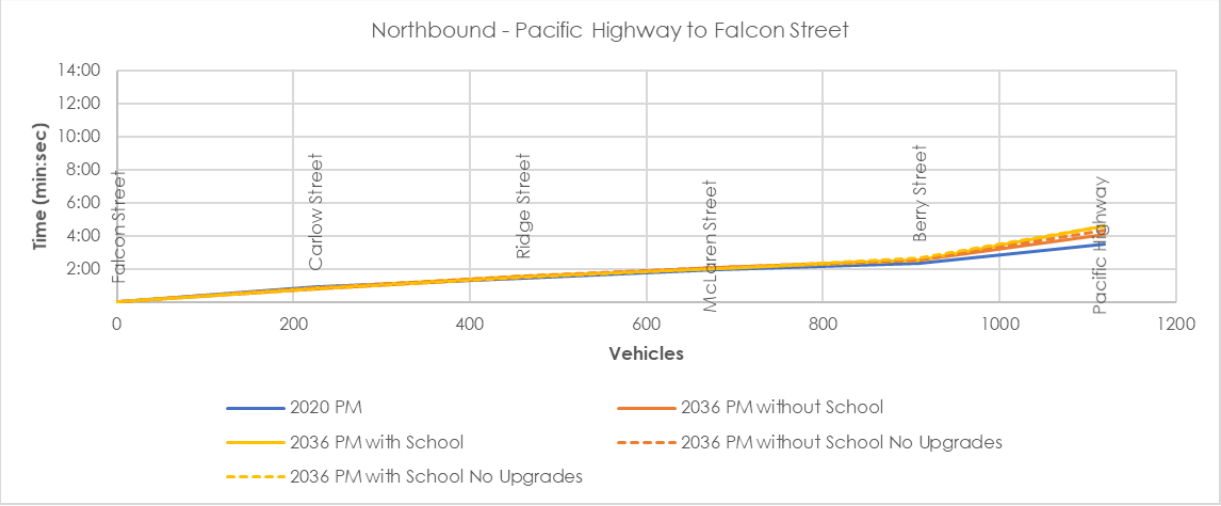
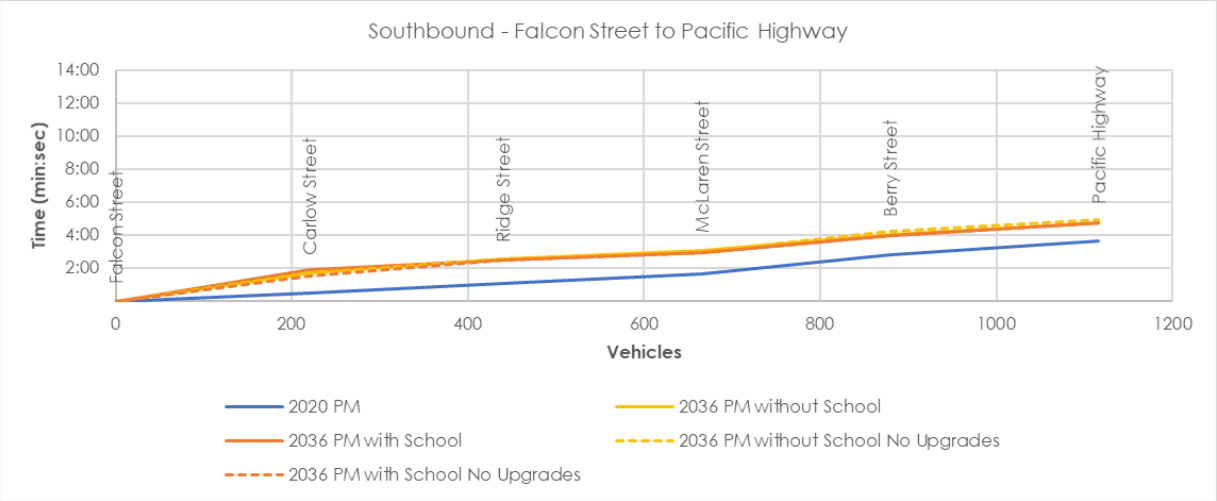


Figure 7.13: 2036 Southbound Travel Time – Evening Peak 3:00pm – 4:00pm



7.6.4 Network Statistics

The performance of the network during the Morning peak and Evening peak is indicated in Table 7.13 and Table 7.14 respectively. The network statistics include:

- VKT – Vehicle Kilometres Travelled, the total distance travelled by all vehicles in kilometres.
- VHT – Vehicle Hours Travelled – the total number of hours travelled in the model.
- Trips are a comparison of the demands. An increase in the number of trips will increase the VHT and VKT.
- Unreleased Vehicles are waiting to enter the network because congestion in the model has prevented them entering the model. Unreleased vehicles can reduce VKT and VHT as their trips will not be recorded.

Table 7.13: Network Performance Results – Morning Peak

Network Metric	2020 Base	2026			2036		
		No School	With School	% Change	No School	With School	% Change
Total vehicle kilometres travelled (VKT) (km)	8957	10293	10314	>1%	12166	12012	>1%
Total Vehicle Travel Time (VHT) (hr)	534	719	769	7%	1341	1327	>1%
Total Traffic (vehicles)	14865	17385	17508	2%	21868	22231	2%
Vehicles Waiting to Enter (Unreleased)	1*	0	0	0%	1269	1503	18%

*1 bus didn't enter the model under this seed value run.

In the morning peak the 2026 models have low volumes of unreleased vehicles. The increase in VHT and VKT are in part due to the increase in vehicles - however some of the increase in hours travelled would be a result of the additional delay at the intersection of the Miller Street and Falcon Street.

Table 7.14: Network Performance Results – Evening Peak

Network Metric	2020 Base	2026			2036		
		No School	With School	% Change	No School	With School	% Change
Total vehicle kilometres travelled (VKT) (km)	7771	9079	9098	>1%	12058	11974	>1%
Total Vehicle Travel Time (VHT) (hr)	373	483	484	>1%	974	956	>1%
Total Traffic (vehicles)	14004	16575	16705	1%	22107	22237	1%
Vehicles Waiting to Enter (Unreleased)	1	1	0	>1%	1332	1368	3%

The findings from Table 7.13 and Table 7.14 are indicated below:

- The VKT and VHT will increase substantially for the 2026 and 2036 base scenarios (i.e. without the school), compared to the 2020 base scenario, with:
  - VHT increasing by 30-35% in 2026 and 151-162% in 2036, and
  - VKT increasing by 15-17% in 2026 and 36-55% in 2036.
- With the inclusion of school traffic, there would be less than 7% difference in VHT and 1% difference in VKT in the AM peak period and less than 1% difference in the PM peak period compared to the 2026.
- In 2036 the school would have negligible impact on VKT and VHT.
- There were no unreleased vehicles in the 2026 scenarios.
- There some 1300 unreleased in the 2036 morning and afternoon peak scenarios. Although the model shows more unreleased in the 2036 morning peak this is more probably due to model randomness as all the school traffic is released by the end of the period.

Generally, the above results indicate that the school development will have a minor impact over the whole network when compared to the impact of the forecast traffic volumes.

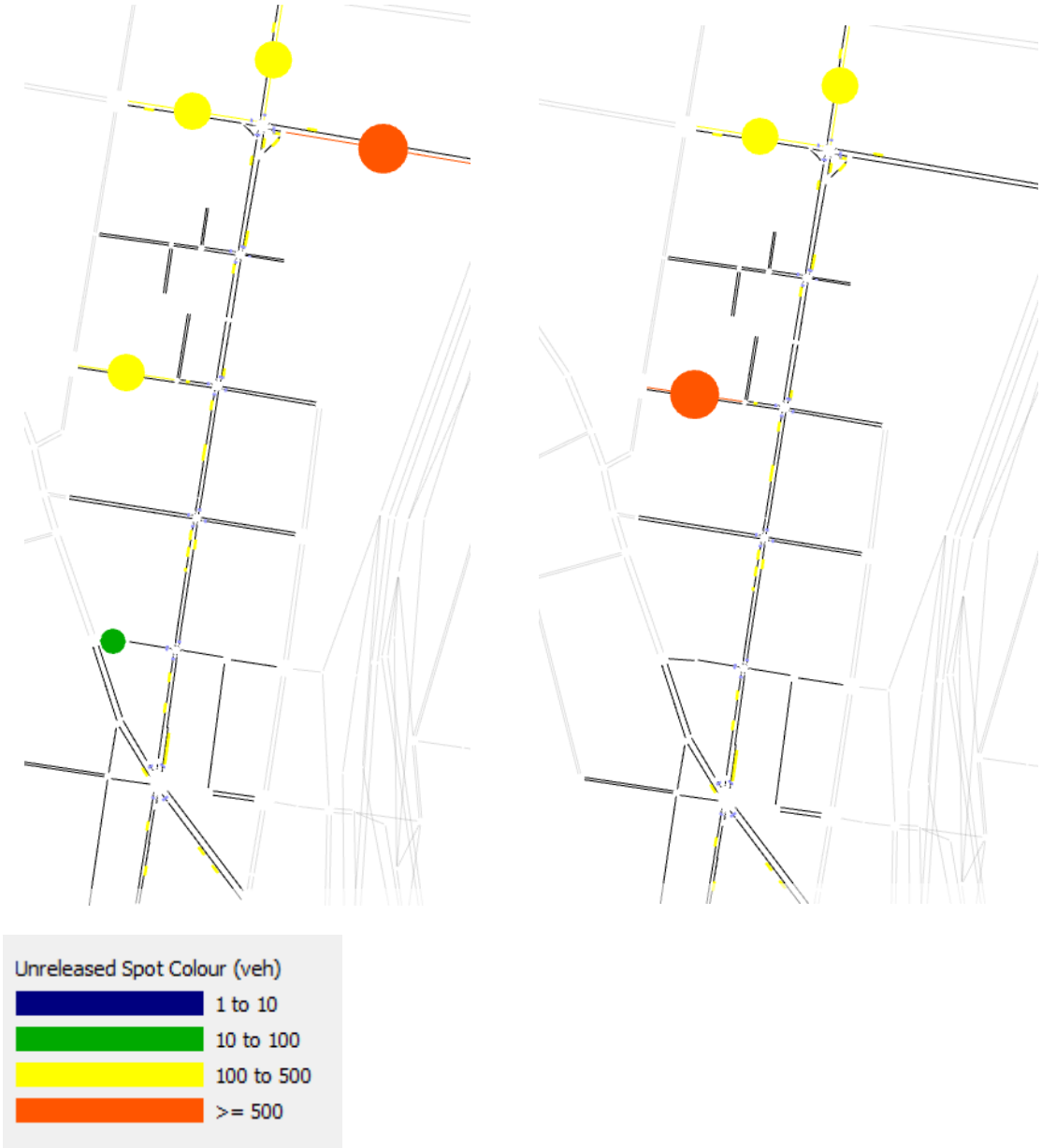
7.7 Unreleased Vehicles

Unreleased vehicles are vehicles that are queued outside the model area awaiting to enter the model. In the 2026 scenarios there were virtually no unreleased vehicles, though for transparency the models report 1 vehicle not being able to enter the network.

By 2036 the TfNSW forecasts are so high that there is not enough capacity on the road network to manage the increase in traffic. The locations where vehicles were unreleased are shown in Figure 7.14.

Figure 7.14: 2036 Unreleased Vehicle Locations (With School)

Morning Peak *Evening Peak*



In the morning peak vehicles were unreleased from Falcon Street, Miller Street North and Ridge Street. As discussed previously the forecast volumes for Ridge Street increase significantly due to a connection to the Beaches Link included in the forecast models from Ridge Street.

In the afternoon peak there are unreleased vehicles from Falcon Street (west), Miller Street north and Ridge Street. No vehicles are unreleased from the School and the unreleased is consistent between the school scenarios and the non-school scenarios.

7.8 Observations

The following section provides a discussion of the observations from the models.

7.8.1 2026 Observations

In the morning peak there was some additional congestion around the Falcon Street and Miller Street intersection. A comparison of the models with and without the school are shown in Figure 7.15. It shows some additional queueing at the intersection.

Figure 7.15: 2026 Morning Peak 8:30am

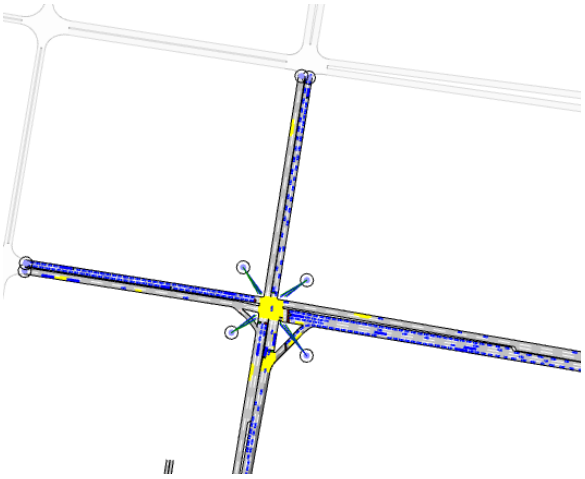
Without School Development

With School Development

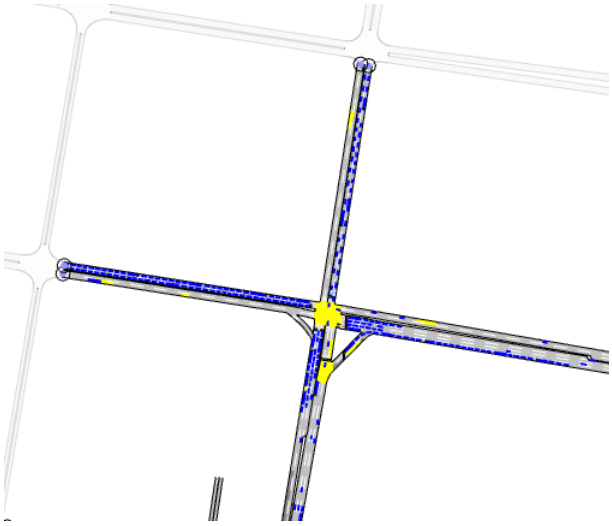
The congestion is localised to the period from 8:15 – 8:45 when the traffic volumes are the highest. By 9:00am the issues at the intersection significantly reduce with queues clearing each cycle of the traffic signals. Images from the model are shown in Figure 7.16.

Figure 7.16: 2026 Morning Peak 9:00am

Without School Development



With School Development



South of Falcon Street, Miller Street remains relatively free flow. A queue to turn right from Miller Street to Carlow Street develops in the 15 minutes from 8:15 – 8:30. This turn is currently a filter turn however it may benefit in the future from a controlled right turn.

Figure 7.17: 2026 Morning Peak 8:30am (with School Development)

7.8.2 2036 Observations

In the morning peak, there were high levels of traffic congestion around the Falcon Street and Miller Street Intersection. Most of the congestion was in the northern section of the model. The High volumes forecast for Ridge Street created long queues with vehicles queued beyond the boundary of the model. This is shown in Figure 7.18 and was consistent between the options with the school and without the school.

Figure 7.18: 2036 Model Observations Morning Peak

7.9 Modelling Conclusions

The above modelling results indicate that the surrounding road network would be significantly changed as a result of background growth and development alone. Comparatively, the proposed school development generates a minor volume of traffic. The intersection of Falcon Street and Miller Street if forecast to be at capacity in the future. Upgrades to the intersection as part of the Western Harbour Tunnel works are not forecast to create a significant increase in capacity at this intersection.

8 SIDRA Traffic Modelling

8.1 Overview

As requested by Transport for NSW, Sidra network traffic modelling has been undertaken using SIDRA 9.0 network software for the Miller Street corridor. The model included all signalised intersections along Miller Street from Falcon Street to Pacific Highway. Similarly to the Aimsun micro-simulation model, the Sidra model tested the 2026 and 2036 years as the year of opening and 10 years past with and without future road upgrades. The 2026 and 2036 future traffic forecast volumes were extracted using a static assignment obtained from the respective calibrated Aimsun micro-simulation models.

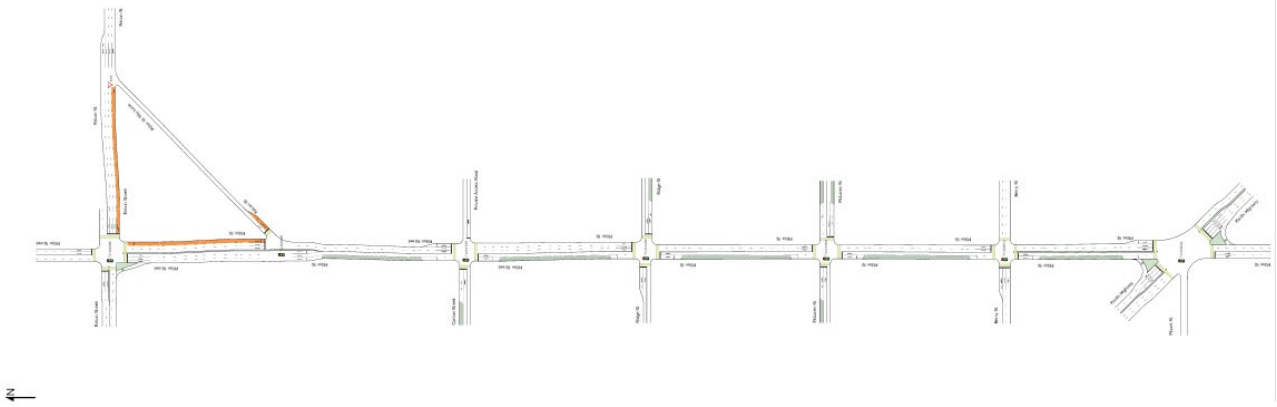
The following section summarises the Sidra modelling that was undertaken.

8.2 Base Model Development

8.2.1 Coding of the Network

The geometric coding of the network was based on nearmap aerial photography and TCS signal plans of the key intersections. The 'bus jump' on the south leg of Miller Street-Falcon Street was coded as a separate signalised site. In addition, the Falcon Street left turn slip-lane (east approach) coded as a separate approach to the site. The modelled area is shown in Figure 8.1.

Figure 8.1: Base Model Layout



8.2.1.1 SCATS History Files

The SCATS history files provide data recorded on the phase times and cycle times that were taken from the same day that the intersection counts were recorded. The hourly averages were used to calibrate the fixed user given phase times in the existing base model.

8.2.1.2 LX files and Offsets

LX files provide Subsystem (SS) and Link Plan (LP) data which were used to determine the signal coordination and offsets between coordinated traffic control sites. It is noted that not all intersections in the modelled area are coordinated e.g. Falcon Street-Miller Street and Berry Street-Miller Street signals – these signals are coordinated with a signalised intersection located outside of the study area.

8.2.1.3 TCS Signal Plans

These plans provide the geometric details of the intersection including the gradients layout for lanes. They also provide details on the phasing arrangements and additional information about how the intersection operates.

8.2.1.4 Travel Time Surveys

Travel time surveys were undertaken on the same day as the traffic surveys were undertaken. The travel time surveys were undertaken for the northbound and southbound route along Miller Street between Falcon Street and Pacific Highway. Model calibration was based on the travel time surveys.

8.2.2 Base Model Calibration and Validation

The 2020 existing conditions model has been developed for the morning peak hour (7:45am-8:45am) and evening peak hour (2:45pm-3:45pm).

In the absence of queue length survey data, the Sidra model has been calibrated to travel time surveys that were recorded during the intersection surveys in 2020. The observed and modelled Sidra route travel times for the AM peak hour and PM peak hour are summarised in Table 8.1 and Table 8.2.

Table 8.1: Northbound Route Travel Time

Check Point along Miller Street	Distance (m)	AM Peak (7:45am-8:45am)		PM Peak (2:45pm-3:45pm)	
		Observed	Modelled	Observed	Modelled
Pacific Highway	0.0	0:00	0:00	0:00	0:00
Berry Street	198.0	0:33	0:45	0:37	0:38
McLaren Street	414.1	1:14	1:23	1:14	1:11
Ridge Street	627.5	1:48	1:51	1:43	1:36
Carlow Street	840.8	2:15	2:35	2:11	2:02
Falcon Street	1015.8	3:38	3:29	3:11	3:09

Table 8.2: Southbound Route Travel Time

Check Point along Miller Street	Distance (m)	AM Peak (7:45am-8:45am)		PM Peak (2:45pm-3:45pm)	
		Observed	Modelled	Observed	Modelled
Falcon Street	0.0	0:00	0:00	0:00	0:00
Carlow Street	213.3	0:38	0:30	0:34	0:28
Ridge Street	426.6	1:05	1:00	1:11	0:55
McLaren Street	642.6	1:34	1:40	1:42	1:22
Berry Street	856.3	2:52	2:46	2:50	2:17
Pacific Highway	1253.2	4:14	3:34	3:43	3:24

A comparison of the observed and modelled travel time routes of the modelled networks are shown in Figure 8.2 to Figure 8.5. The results indicate the validity of the model calibration to the existing conditions. Additionally, for a comparison to the Aimsun micro-simulation results refer to Figure 5.10 to Figure 5.17 provided in "Model Calibration Report' in Appendix B.

Figure 8.2: Morning Peak Travel Time Northbound (7:45am-8:45am)

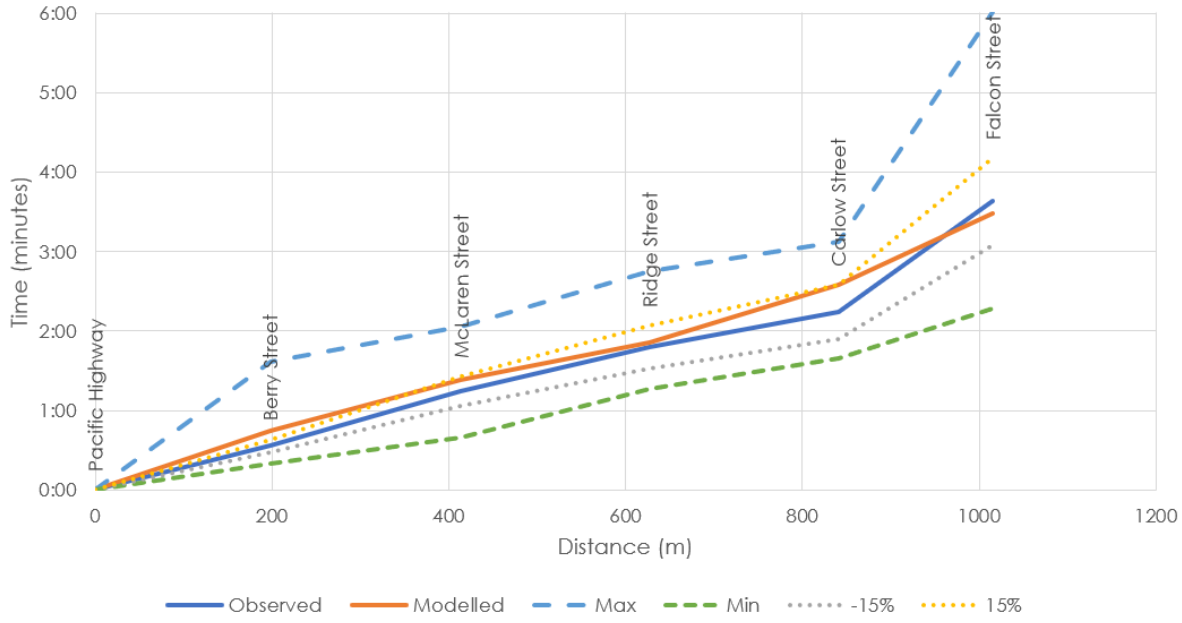


Figure 8.3: Morning Peak Travel Time Southbound (7:45am-8:45am)

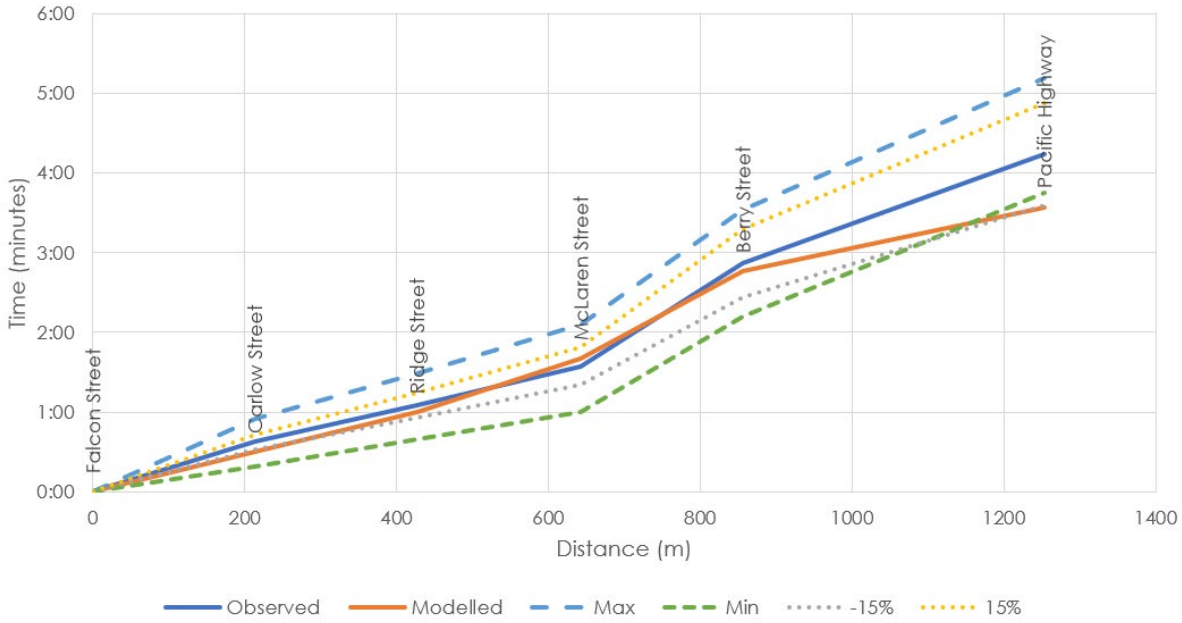


Figure 8.4: Evening Peak Travel Time Northbound (2:45pm-3:45pm)

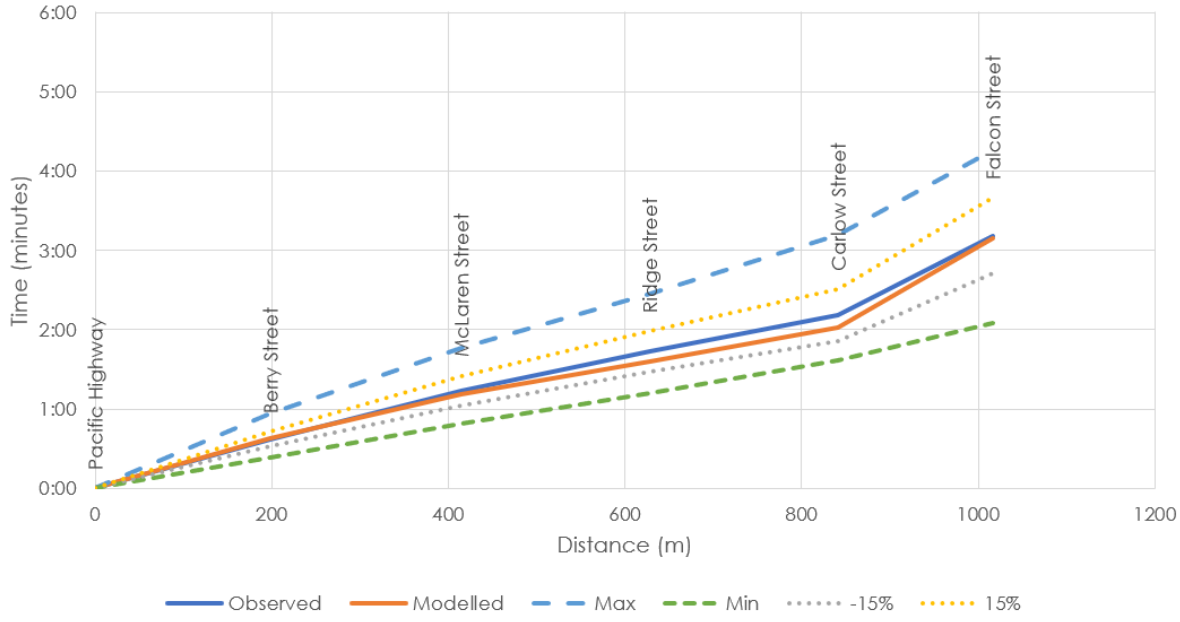
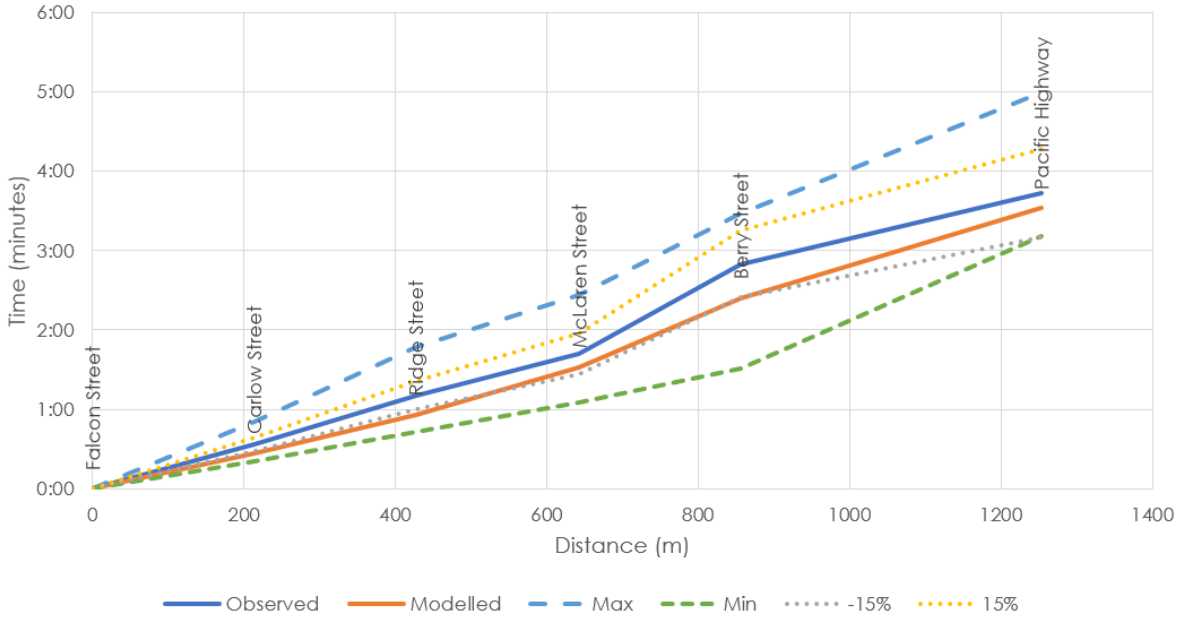


Figure 8.5: Evening Peak Travel Time Southbound (2:45pm-3:45pm)



8.3 Modelled Scenarios

The following scenarios have been modelled in Sidra 9.0 Network:

1. **2020 Base model** – existing conditions based on 2020 survey data.
2. **2026 Do Minimum** – future year 2026 with no school development.
3. **2026 Do Minimum + School Demands** – future year 2026 with school development.

4. **2026 Do Minimum + Road Upgrade** – future year 2026 with road upgrades but no school development.
5. **2026 Do Minimum + School Demands + Road Upgrade** – future year 2026 with road upgrades plus school development.
6. **2036 Do Minimum** – future year 2036 with no school development.
7. **2036 Do Minimum + School Demands** – future year 2036 with school development.
8. **2036 Do Minimum + Road Upgrade** – future year 2036 with road upgrades but no school development.
9. **2036 Do Minimum + School Demands + Road Upgrade** – future year 2036 with road upgrades plus school development.
10. **2036 Do Minimum + Road Upgrade + Parking Restrictions** – future year 2036 with road upgrades and Miller Street parking restrictions but no school development.
11. **2036 Do Minimum + School Demands + Road Upgrade + Parking Restrictions** – future year 2036 with road upgrades and Miller Street parking restrictions plus school development.

Table 8.3 provides a comparison of each modelled scenario.

Table 8.3: Modelled Scenario Comparison

	2020	2026				2036					
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9	Scenario 10	Scenario 11
Existing 2020 Demand	✓										
Future 2026 Base Demand		✓	✓	✓	✓						
Future 2036 Base Demand						✓	✓	✓	✓	✓	✓
School Demand			✓		✓		✓		✓		✓
Road Upgrades (Falcon Street)				✓	✓			✓	✓	✓	✓
Parking Restrictions (Miller Street)										✓	✓

8.4 Future Demand Development

The future base traffic growth and demand (2026 and 2036) has been obtained from the calibrated Aimsun micro-simulation model discussed in Section 7. A static assignment was undertaken for the 2026 and 2036 future base Aimsun models to extract the traffic volumes for input into the respective Sidra models.

8.5 Road Network Upgrades

As discussed in Section 7.5, there are proposed upgrades to the Falcon Street-Miller Street intersection as part of the Western Harbour Tunnel and Beaches Link project. Additionally, other upgrades include new parking restrictions along Miller Street in both directions. These road upgrades have been applied to the 2026 and 2036 scenarios as per Table 8.3 above.

8.6 Model Results

Based on the above, the intersection operation for the year 2020 and 2026, with and without the proposed school development and with and without road upgrades, is presented in Table 8.4 (AM Peak) and Table 8.5 (PM Peak).

Table 8.4: AM Peak Intersection Operation – Year 2026

Intersection	S1 – 2020 Base		S2 – 2026 Do Minimum		S3 – 2026 Do Minimum + School Demand		S4 – 2026 Do Minimum + Road Upgrade		S5 – Do Minimum + Road Upgrade + School Demand	
	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)
Falcon Street / Miller Street	D	49	F	120	F	211	F	123	F	138
Carlow Street / Miller Street	A	14	B	15	B	17	B	15	B	17
Ridge Street / Miller Street	B	18	B	19	B	17	B	19	B	16
McLaren Street / Miller Street	B	26	B	24	B	21	B	23	B	21
Berry Street / Miller Street	C	42.5	C	40	C	40	C	41	C	41
Pacific Highway / Miller Street	C	35	C	39	C	39	C	38	C	40

Table 8.5: PM Peak Intersection Operation – Year 2026

Intersection	S1 – 2020 Base		S2 – 2026 Do Minimum		S3 – 2026 Do Minimum + School Demand		S4 – 2026 Do Minimum + Road Upgrade		S5 – Do Minimum + Road Upgrade + School Demand	
	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)
Falcon Street / Miller Street	D	44	E	66	D	50	D	45	C	41
Carlow Street / Miller Street	A	11	A	13	A	14	A	13	A	14
Ridge Street / Miller Street	B	15	B	17	B	20	B	17	B	20
McLaren Street / Miller Street	B	16	B	16	B	16	B	16	B	16
Berry Street / Miller Street	B	28	C	30	C	30	C	30	C	30
Pacific Highway / Miller Street	B	27	C	29	C	30	C	29	C	29

Table 8.4 and Table 8.5 indicates the existing intersection of Falcon Street and Miller Street is nearing capacity (LoS D) under existing conditions in the morning peak period, while the remaining network is operating well. The forecasted traffic growth to the year 2026 would result in this intersection being at capacity (LoS F) in the AM peak period and LoS E in the PM peak period (Scenario 2).

The proposed school traffic would increase the delays at Falcon Street to the network in the morning peak (Scenario 3) while the PM peak LoS would improve slightly compared to the Do Minimum scenario.

Scenario 4 and Scenario 5 indicate that the proposed Falcon Street intersection upgrades would offer some intersection performance relief by reducing the average delay during the AM peak and PM peak. However, the Falcon Street intersection would continue to operate at LoS F during the AM peak while improving to LoS D/C during the PM peak.

The intersection operation for the year 2020 and 2036, with and without the proposed school development and with and without the Falcon Street intersection upgrades and Miller Street parking restrictions is presented in Table 8.6 (AM Peak) and Table 8.7 (PM Peak).

Table 8.6: AM Peak Intersection Operation – Year 2036

Intersection	S1 – 2020 Base		S6 – 2036 Do Minimum		S7 – 2036 Do Minimum + School Demand		S8 – 2036 Do Minimum + Road Upgrade		S9 – 2036 Do Minimum + Road Upgrade + School Demand		S10 – Do Minimum + Road Upgrade + Parking Restrictions		S11 – Do Minimum + Road Upgrade + Parking Restriction + School Demand	
	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)
Falcon Street / Miller Street	D	49	F	381	F	333	F	319	F	377	F	251	F	308
Carlow Street / Miller Street	A	14	B	17	C	39	B	17	B	23	B	16	B	21
Ridge Street / Miller Street	B	18	F	73	F	167	F	94	F	172	C	35	C	33
McLaren Street / Miller Street	B	26	F	133	F	221	F	143	F	234	B	22	B	21
Berry Street / Miller Street	C	42.5	F	107	F	118	F	107	F	113	C	37	C	36
Pacific Highway / Miller Street	C	35	F	149	F	172	F	147	F	124	C	40	C	41

Table 8.7: PM Peak Intersection Operation – Year 2036

Intersection	S1 – 2020 Base		S6 – 2036 Do Minimum		S7 – 2036 Do Minimum + School Demand		S8 – 2036 Do Minimum + Road Upgrade		S9 – 2036 Do Minimum + Road Upgrade + School Demand		S10 – Do Minimum + Road Upgrade + Parking Restrictions		S11 – Do Minimum + Road Upgrade + Parking Restriction + School Demand	
	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)
Falcon Street / Miller Street	D	44	F	189	F	219	F	124	F	149	F	124	F	150
Carlow Street / Miller Street	A	11	B	15	B	27	A	12	B	15	A	12	B	15
Ridge Street / Miller Street	B	15	F	132	F	130	F	118	F	110	E	60	E	57
McLaren Street / Miller Street	B	16	D	46	D	48	D	46	D	44	D	51	B	27
Berry Street / Miller Street	B	28	D	54	E	57	E	58	E	59	E	64	E	69
Pacific Highway / Miller Street	C	27	C	30	C	30	C	30	C	30	C	30	C	30

Table 8.6 indicates that background traffic growth to the year 2036 would result in a grid-lock situation during the AM peak period with majority of intersections along Miller Street (at Falcon Street, Ridge Street, McLaren Street, Berry Street and Pacific Highway) being at capacity. Average delays would be anticipated to be in the order of 100-200 seconds while Falcon Street would experience delays over 300 seconds.

Noting that any additional traffic (i.e. school development traffic) would result in Sidra LoS results to exponentially deteriorate (rather than linearly) the intersection performance in an already grid-locked network. The addition of the school development traffic would increase delays at the Carlow Street, Ridge Street, McLaren Street, Berry Street and Pacific Highway intersections.

The proposed Falcon Street intersection upgrade will provide some intersection performance improvements however notably the network would remain in a grid-lock scenario. The proposed parking restrictions along Miller Street in both directions would significantly improve intersection performance to LoS C or better at all intersections except for Falcon Street which would remain at LoS F. As previously noted above, the Falcon Street intersection is not coordinated with signals along the Miller Street corridor. The Falcon Street intersection is coordinated with the Falcon Street – Warringah Freeway intersection.

Table 8.7 indicates that background traffic growth to the year 2036 would result in two intersections along Miller Street (at Falcon Street and Ridge Street) being at capacity (LoS F) and two nearing capacity with LoS D (at McLaren Street and Berry Street) during the PM peak hour (Scenario 6). The addition of school traffic would result in minor impacts to average delays along the Miller Street corridor. The Falcon Street intersection would increase by 30 seconds however it is noted that this intersection would already fail (LoS F) in the Do Minimum (Scenario 6) case.

Some decreases in average delay could be expected at Ridge Street as a result of redistributed school traffic. Redistribution of school traffic would be due to the cumulative effects of the conversion of the existing one-way entry off Ridge Street to a proposed ingress and egress access, removal of Miller Street egress and provision of a new ingress and egress access off Carlow Street.

Similarly to the AM peak, the Falcon Street intersection upgrade would help improve intersection performance (Scenario 9) while the proposed Miller Street parking restrictions would also improve intersection performances within the network (Scenario 11).

The above results indicate that the school development will have a minor impact in comparison to the substantial changes expected to the road network as a result of background growth and development. This result is consistent with the results of the AIMSUN modelling.

9 Road and Personal Safety (CPTED Principles)

A number of potential design measures should be considered to maintain road and pedestrian safety in accordance with the Crime Prevention Through Environmental Design (CPTED) principles of surveillance, access control and space and activity management.

The following design measures should be considered as part of the proposed development:

- Ensure appropriate lighting is provided especially at pedestrian access points, parking areas and footpaths,
- Proposed safety signage in different languages around designated drop-off and pick-up areas to enhance awareness for a larger audience and thus mitigate the risk of any safety issues around the schools,
- Trim or remove foliage blocking sight lines and ensure there is minimal obstruction to lines of sight near key pedestrian facilities and pedestrian access points,
- Consider the implementation of Closed Circuit Television (CCTV) where practical to maximise surveillance opportunities out of school hours,
- Install boom gates, ticketed entry or other access control devices to regulate and restrict vehicle movements to/from the schools for authorised personnel only,
- Ensure security is provided at pedestrian access points to the school to reduce opportunities for perpetrators to enter the school undetected,
- Ensure regular maintenance is in place including rubbish removal, graffiti remove, repair of light fixtures, trimming of vegetation and/or regular patrols, where feasible, and
- All staff should undergo crime awareness training to identify any potential suspicious behaviour and reporting procedures within or near the schools.

10 Travel Demand Measures

10.1 Introduction

Travel demand management is a term for strategies to encourage a modal shift from single occupant private vehicle trips and influence the way people move to/from a site to deliver better environmental outcomes to encourage sustainable travel and reduce traffic and parking impacts within communities.

A key element of travel demand management is the preparation of a Green Travel Plan (GTP). The primary purpose of GTPs at schools is to encapsulate a strategy for managing travel demand that embraces the principles of sustainable transport whilst recognising the unique context of travel planning at education facilities. In its simplest form, GTPs encourage travel using transport modes that have low environmental impacts, for example active transport modes including walking, cycling, public transport, and encourages better management of car use.

In the case of GTPs for schools, this is of vital importance as schools are often located in local residential areas which can negatively impact local traffic and parking amenity during the concentrated peak periods of school pick up and drop off times. Furthermore, on-site car parking is often a luxury as schools cannot afford to apportion limited land resources due to teaching space and play space requirements.

Therefore, the implementation of a GTP would assist manage travel demand at the school, particularly with consideration to the future expansion of the school. It is expected that the GTP document would target staff and parents at the school.

10.2 School Feedback

10.2.1 Staff Feedback

As part of the online questionnaire survey, staff who travelled to site by car were asked if they drive the car by themselves, travelled other school staff or is being dropped off by someone who is not a staff. The data indicated that the majority of staff who travel by car drive to the site by themselves, with no passengers (90% to 93%). Only a small proportion of the staff drive or carpool to the site with another staff member.

Staff were also asked if they would consider alternative form of transport. The following feedback was received:

- 32% of the staff respondents would consider catching public transport to work if a school bus is provided to nearby suburbs and train stations
- 32% of the staff respondents would be willing to carpool with other staff

- 46% of the staff respondents would consider alternative form of transport, even occasionally

A summary of some of the key features that staff would like to see more to encourage walking, cycling, public transport and carpool is presented in Figure 3.3 to Figure 3.5.

Figure 10.1: Measures to Encourage Walking/Cycling – Staff Responses

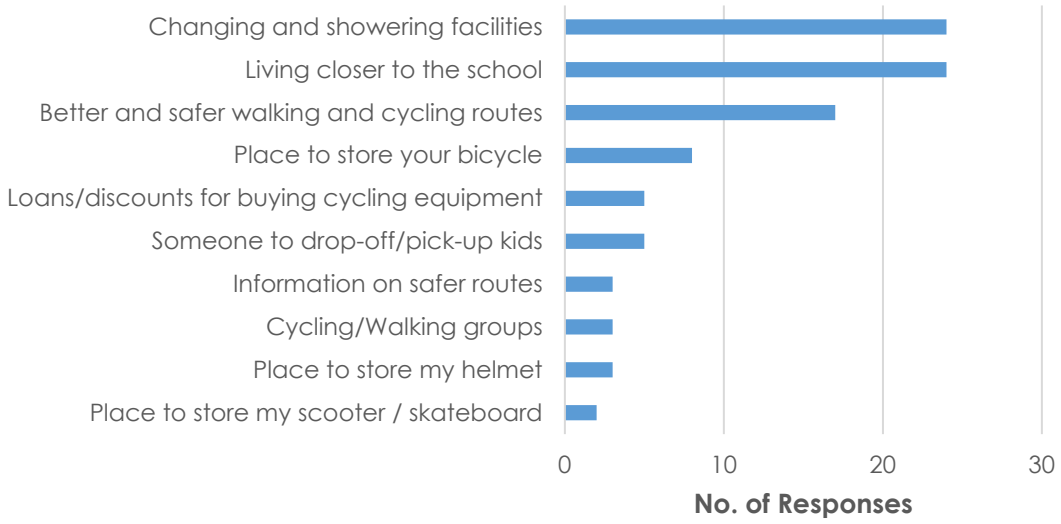


Figure 10.2: Measures to Encourage Public Transport Use – Staff Responses

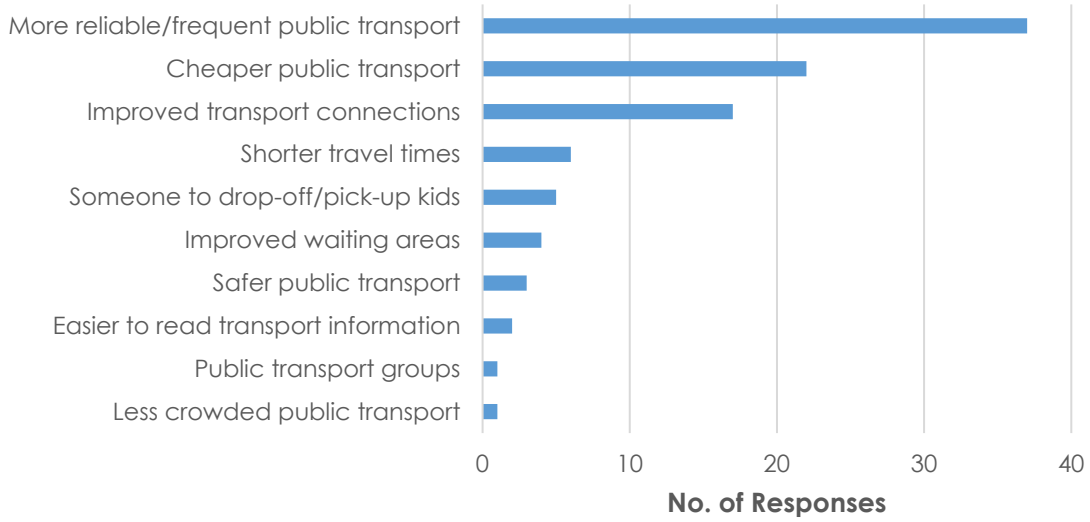


Figure 10.3: Measures to Encourage Carpooling – Staff Responses

10.2.2 Student Feedback

The following feedback are received from the student surveys:

- 60% of primary school students have a sibling that goes to the school
- 26% of high school students have a sibling that goes to the school
- 55% of primary school students who get dropped off/picked up travelled in a car with other Marist students
- 20% of high school students who get dropped off/picked up travelled in a car with other Marist students
- 27% of primary school students are not interested in changing their travel choices
- 33% of high school students are not interested in changing their travel choices

Students were also asked what would encourage them to use alternate mode of transport. A summary of some of the key features that students would like to see more to encourage walking, cycling and public transport and carpool is presented in Figure 3.6 and Figure 3.7

Figure 10.4: Measures to Encourage Walking/Cycling/Public Transport Use – Student Responses

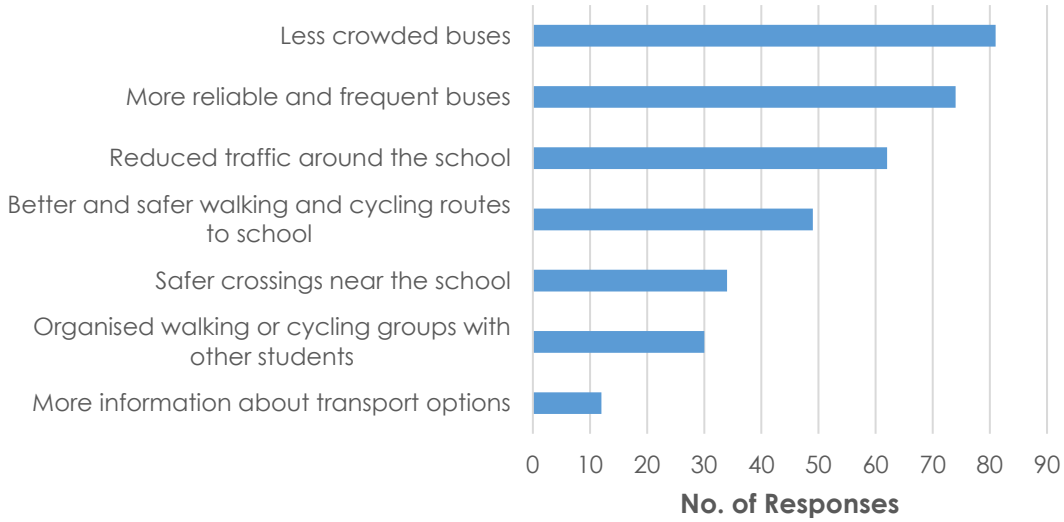
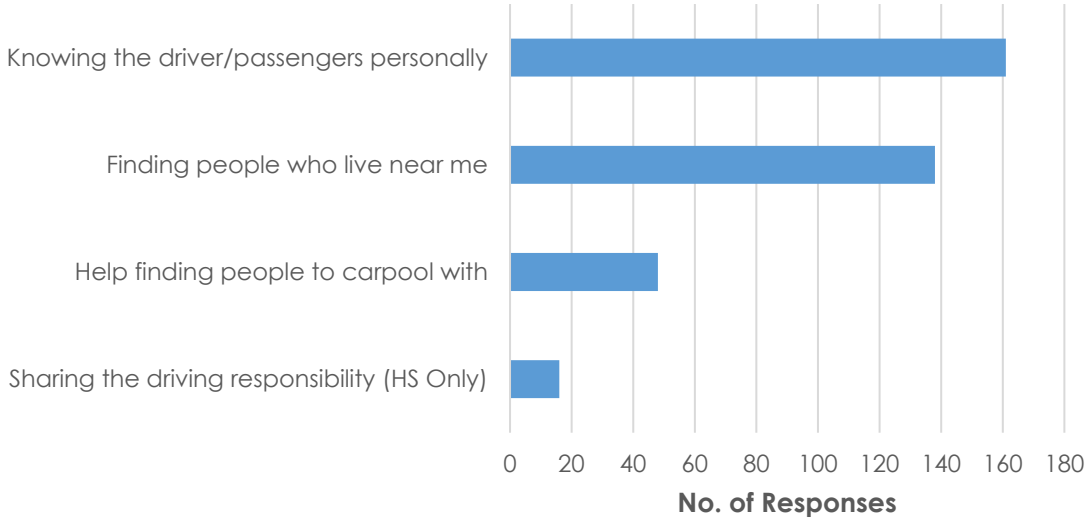


Figure 10.5: Measures to Encourage Carpooling – Student Responses



10.3 Green Travel Plan Initiatives

Based on the above, the following general travel strategies have been considered for implementation in the GTP to encourage more sustainable travel:

- Limit on-site car parking provision and introduce strict car parking policies to manage car parking allocation with the site
- Organise a carpool system/registry which could reduce single private vehicle car trips to and from the school. Currently, the car occupancy rate for staff is one staff member per vehicle therefore this is an opportunity to increase this rate. Promotion of carpooling

forums would need to be carried out as part of staff inductions. In addition to this, social events will go hand in hand with this approach to promote social interaction between the staff to reduce social barriers which may deter staff from carpooling with other staff members.

- Similarly, a carpooling forum could be developed on the student/ parent portal to encourage students to travel in groups. The forum will provide a platform for people travelling on the same route to site to find each other and form groups. Existence of the forum will be advertised on noticeboards within the School, via the school newsletter and social media, and/or on the School's Transport Access Guide (TAG).
- Provision of public transport timetable, car share vehicle locations and cycle maps on noticeboards to make staff more aware of alternative transport options
- Organise a walking/cycling group, or similar, to promote walking/use of bicycles of staff and students living in the same area
- Organise lessons to teach students and staff to ride a bike and learn road rules, and road safety
- Provision of appropriate uniform for students to ride to school
- Provision of bicycle parking and end-of-trip facilities including shower and changing rooms as well as bicycle infrastructure and bicycle repair tools
- Arrange activities and promotions to encourage staff and students to use public transport
  - hosting and participating on active travel events such as Ride2Work Day and National Bike Week
  - provision of Opal card or GoGet car share discounts or incentives
  - affiliation to local bicycle retailer and service centre to provide discounts for staff and students
- Develop or use a mobile application which can be used as a platform to communicate with parents and students regarding changes in travel plans and conditions. The school could utilise 'SkoolBag' app which is Australia's leading school communication app. An extension to the mobile app could include an instant messaging service for parents to facilitate quick trip-planning, real-time communication and real-time public transport information.

10.3.1 Staggering Arrival and Departure Times

At present, primary and secondary start and finish times are staggered in the afternoon based on the travel questionnaire data. However, it may be desirable to further stagger both start and finish times for multiple year groups. Staggering drop off and pick up times for school children can help alleviate congestion during peak periods. It is therefore recommended that

the start and finish times be amended for some year groups to assist distribute school related trips during school drop off and pick-up times.

In addition to this, schemes can also be easily implemented by the schools through the School News Bulletin (or similar) to provide parents with a general guideline as to what time they should drop off and pick up their child for each year group. This however may raise some concerns for parents who have more than one child in different year group at the school.

Further detailed consultation with staff and students/parents would need to be conducted to understand if amending the existing start and finish times are viable. It may become necessary that an "after class" room be established with a supervising teacher to accommodate any students who are waiting for their sibling in a different year group at the school.

A more detailed Green Travel Plan has been prepared as part of the SSD DA package of works. It is however envisaged that that any consent of the approval would require a commitment to prepare an Operational Transport Management Plan prior to Construction Certificate to outline the proposed traffic management measures to be implemented at the school, including mode share targets and proposed travel strategies to reduce private vehicle trips.

10.4 Monitoring of the GTP

For the GTP to be effective, it is recommended that the GTP be monitored on a regular basis, (e.g. yearly for a period of three years following completion), through travel surveys, staff meetings, parent consultations or similar. Travel surveys would show how staff, students and parents travel to/from the site and assist identify whether the proposed initiatives and measures outlined in the GTP are effective or are required to be replaced or modified to ensure that the best outcomes are achieved. Regular consultation with staff, students and parents would also be beneficial to help understand people's reasons for travelling the way they do and help identify any potential barriers to change their travel behaviours.

In order to ensure successful implementation of the GTP, a Travel Plan Coordinator (TPC) should be appointed to oversee the measures and resultant impacts of the GTP.

11 Conclusion

This study details our assessment of the traffic and transport implications associated with the proposed redevelopment of Marist Catholic College North Shore. The key findings of this report are presented below.

- The proposal seeks to develop a new education precinct containing primary and secondary students and an early learning centre. The redevelopment would result in an increase of 60 staff members, 692 primary and secondary students and 40 children at the early learning centre.
- New access and car parking arrangements are proposed, with a new car park located off Carlow Street, which provides access to staff parking and drop-off/pick-up facilities for year 2 to 12 students and the childcare centre. Kindergarten to year 1 students would continue to obtain access off Ridge Street. The existing access of Miller Street would be removed, in accordance with TfNSW requirements to reduce access off state roads.
- The proposal is estimated to generate an increase of 223 vehicle movements per hour in the morning and 129 vehicle movements per hour in the afternoon.
- AIMSUN and SIDRA network modelling has been undertaken along the Miller Street corridor, between Falcon Street and Pacific Highway, to assess the impact of the additional traffic on the road network, for the years 2020, 2026 and 2036. The future scenario models include with and without planned road upgrades and with and without proposed Miller Street parking restrictions.
- Both the AIMSUN and SIDRA modelling results indicate that the surrounding road network would be substantially affected by background growth from development and the connection to the proposed Western Harbour Tunnel which would attract an increase of traffic to the local area by 2036.
- However, the traffic generated by the proposed school development would have a minor impact to the surrounding road network, relative to the substantial development and growth expected in the area.
- A Green Travel Plan and Workplace Travel Plan is to be implemented on-site with an aim to reduce car share as a mode of travel. A 5% shift in mode is proposed from car to sustainable transport modes such as public transport, walking and cycling. Measures proposed as part of the travel plan include:
  - Limiting car parking provision on-site to reduce the opportunity and convenience of driving
  - Organising a car pool system/registry to assist Staff and parents
  - Organising walking/ cycling groups to promote those living near each other's to walk and cycle together
  - Organising cycling classes to teach road safety and safe on-road cycling practices
  - Provision of secure bicycle parking facilities and end of trip facilities

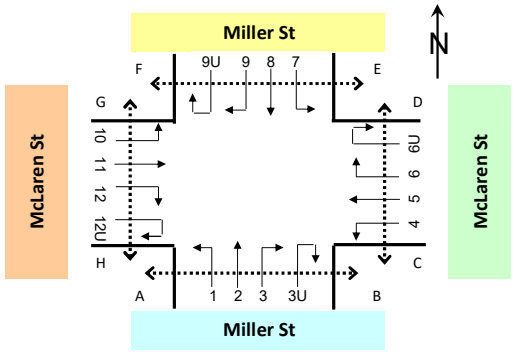
- Develop or use a mobile application which can be used as platform to communicate with parents and students regarding changes in travel plans and conditions e.g. the existing SkoolBag app.

Appendix A

Survey Data

Job No. : N5955
Client : TTPP
Suburb : North Sydney
Location : 1. McLaren St / Miller St

Day/Date : Thursday, 17th September 2020
Weather : Fine
Description : Classified Intersection Count
: Peak Hour Summary



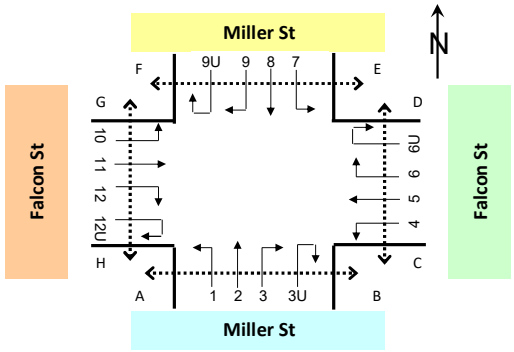
MATRIX Traffic and Transport Data

	Approach	Miller St					McLaren St					Miller St					McLaren St					Grand Total
	Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
AM	7:45 to 8:45	499	7	0	22	**528**	195	2	0	0	**197**	713	14	0	60	**787**	234	1	0	0	**235**	**1,747**
PM	14:45 to 15:45	450	19	0	59	**528**	157	5	0	0	**162**	329	7	0	23	**359**	143	3	0	0	**146**	**1,195**

Approach	Miller St					McLaren St					Miller St					McLaren St					Grand Total
Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
7:00 to 8:00	316	15	0	12	**343**	102	2	0	0	**104**	477	20	0	48	**545**	127	0	0	0	**127**	**1,119**
7:15 to 8:15	400	16	0	19	**435**	145	3	0	0	**148**	595	19	0	58	**672**	175	1	0	0	**176**	**1,431**
7:30 to 8:30	472	12	0	22	**506**	177	3	0	0	**180**	684	13	0	58	**755**	214	1	0	0	**215**	**1,656**
7:45 to 8:45	499	7	0	22	**528**	195	2	0	0	**197**	713	14	0	60	**787**	234	1	0	0	**235**	**1,747**
8:00 to 9:00	442	7	0	28	**477**	193	2	0	0	**195**	695	14	0	51	**760**	215	1	0	0	**216**	**1,648**
8:15 to 9:15	395	7	0	22	**424**	159	2	0	0	**161**	600	12	0	43	**655**	170	0	0	0	**170**	**1,410**
8:30 to 9:30	323	9	0	21	**353**	135	3	0	0	**138**	474	13	0	37	**524**	121	0	0	0	**121**	**1,136**
AM Totals	**919**	**29**	**0**	**48**	**996**	**350**	**6**	**0**	**0**	**356**	**1,343**	**36**	**0**	**112**	**1,491**	**387**	**1**	**0**	**0**	**388**	**3,231**
14:30 to 15:30	455	18	0	27	**500**	141	6	0	0	**147**	313	8	0	17	**338**	133	3	0	0	**136**	**1,121**
14:45 to 15:45	450	19	0	59	**528**	157	5	0	0	**162**	329	7	0	23	**359**	143	3	0	0	**146**	**1,195**
15:00 to 16:00	430	17	0	65	**512**	150	7	0	0	**157**	312	5	0	23	**340**	136	2	0	0	**138**	**1,147**
15:15 to 16:15	424	7	0	62	**493**	134	7	0	0	**141**	295	2	0	24	**321**	137	2	0	0	**139**	**1,094**
15:30 to 16:30	370	2	0	52	**424**	126	6	0	0	**132**	295	4	0	21	**320**	111	1	0	0	**112**	**988**
15:45 to 16:45	411	4	0	27	**442**	123	4	0	0	**127**	323	5	0	20	**348**	113	2	0	0	**115**	**1,032**
16:00 to 17:00	422	3	0	28	**453**	135	1	0	0	**136**	348	5	0	18	**371**	128	2	0	0	**130**	**1,090**
PM Totals	**1,048**	**23**	**0**	**97**	**1,168**	**338**	**12**	**0**	**0**	**350**	**800**	**15**	**0**	**47**	**862**	**310**	**5**	**0**	**0**	**315**	**2,695**

Job No. : N5955
Client : TTPP
Suburb : North Sydney
Location : 2. Falcon St / Miller St

Day/Date : Thursday, 17th September 2020
Weather : Fine
Description : Classified Intersection Count
: Peak Hour Summary



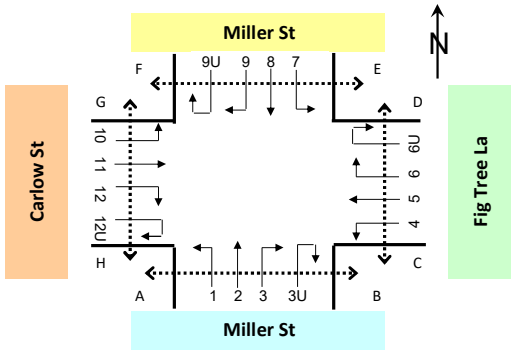
MATRIX Traffic and Transport Data

	Approach	Miller St					Falcon St					Miller St					Falcon St					Grand Total
	Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
AM	7:45 to 8:45	798	6	0	25	**829**	1,311	25	2	57	**1,395**	790	10	0	23	**823**	598	27	0	13	**638**	**3,685**
PM	16:00 to 17:00	555	4	0	28	**587**	1,267	16	0	24	**1,307**	335	5	0	12	**352**	770	5	0	17	**792**	**3,038**

Approach	Miller St					Falcon St					Miller St					Falcon St					Grand Total
Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
7:00 to 8:00	310	8	0	13	**331**	1,072	43	1	59	**1,175**	514	7	0	13	**534**	621	24	0	13	**658**	**2,698**
7:15 to 8:15	477	7	0	19	**503**	1,173	41	1	59	**1,274**	664	4	0	20	**688**	618	23	0	13	**654**	**3,119**
7:30 to 8:30	658	8	0	21	**687**	1,291	27	1	62	**1,381**	750	4	0	22	**776**	600	28	0	14	**642**	**3,486**
7:45 to 8:45	798	6	0	25	**829**	1,311	25	2	57	**1,395**	790	10	0	23	**823**	598	27	0	13	**638**	**3,685**
8:00 to 9:00	787	5	0	31	**823**	1,308	29	1	48	**1,386**	747	9	0	21	**777**	592	26	0	18	**636**	**3,622**
8:15 to 9:15	651	7	0	26	**684**	1,267	28	1	43	**1,339**	614	9	0	15	**638**	591	24	0	21	**636**	**3,297**
8:30 to 9:30	494	9	0	26	**529**	1,140	34	1	37	**1,212**	500	11	0	11	**522**	638	28	0	20	**686**	**2,949**
AM Totals	**1,264**	**21**	**0**	**52**	**1,337**	**2,897**	**89**	**2**	**123**	**3,111**	**1,443**	**20**	**0**	**39**	**1,502**	**1,539**	**65**	**0**	**38**	**1,642**	**7,592**
14:30 to 15:30	639	16	0	28	**683**	976	22	0	22	**1,020**	398	8	0	9	**415**	731	22	1	10	**764**	**2,882**
14:45 to 15:45	654	17	0	54	**725**	1,025	23	0	23	**1,071**	399	7	0	12	**418**	774	14	1	11	**800**	**3,014**
15:00 to 16:00	628	16	0	65	**709**	1,003	21	0	20	**1,044**	359	5	0	12	**376**	741	12	1	11	**765**	**2,894**
15:15 to 16:15	604	9	0	63	**676**	1,057	15	0	24	**1,096**	339	4	0	11	**354**	751	10	0	15	**776**	**2,902**
15:30 to 16:30	561	3	0	52	**616**	1,132	13	0	23	**1,168**	326	4	0	12	**342**	742	7	0	16	**765**	**2,891**
15:45 to 16:45	550	5	0	30	**585**	1,153	15	0	24	**1,192**	315	3	0	12	**330**	740	6	0	16	**762**	**2,869**
16:00 to 17:00	555	4	0	28	**587**	1,267	16	0	24	**1,307**	335	5	0	12	**352**	770	5	0	17	**792**	**3,038**
PM Totals	**1,476**	**23**	**0**	**98**	**1,597**	**2,754**	**46**	**0**	**57**	**2,857**	**898**	**15**	**0**	**27**	**940**	**1,868**	**30**	**1**	**33**	**1,932**	**7,326**

Job No. : N5955
Client : TTPP
Suburb : North Sydney
Location : 3. Carlow St / Miller St / Fig Tree La

Day/Date : Thursday, 17th September 2020
Weather : Fine
Description : Classified Intersection Count
: Peak Hour Summary



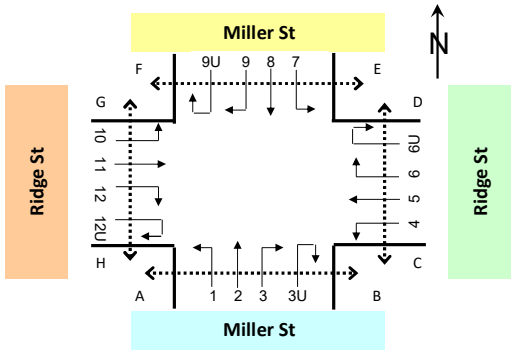
MATRIX Traffic and Transport Data

	Approach	Miller St					Fig Tree La					Miller St					Carlow St					Grand Total
	Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
AM	7:45 to 8:45	689	6	0	26	**721**	8	2	0	0	**10**	1,127	11	0	58	**1,196**	185	2	0	0	**187**	**2,114**
PM	14:45 to 15:45	613	15	0	51	**679**	4	5	0	0	**9**	498	7	0	20	**525**	139	5	0	3	**147**	**1,360**

Approach	Miller St					Fig Tree La					Miller St					Carlow St					Grand Total
Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
7:00 to 8:00	279	10	0	13	**302**	7	5	0	0	**12**	755	19	0	47	**821**	84	1	0	0	**85**	**1,220**
7:15 to 8:15	409	11	0	19	**439**	6	4	0	0	**10**	950	13	0	57	**1,020**	119	1	0	0	**120**	**1,589**
7:30 to 8:30	579	11	0	22	**612**	5	4	0	0	**9**	1,105	9	0	58	**1,172**	161	2	0	0	**163**	**1,956**
7:45 to 8:45	689	6	0	26	**721**	8	2	0	0	**10**	1,127	11	0	58	**1,196**	185	2	0	0	**187**	**2,114**
8:00 to 9:00	657	6	0	33	**696**	6	2	0	0	**8**	1,063	13	0	50	**1,126**	210	3	0	0	**213**	**2,043**
8:15 to 9:15	545	7	0	27	**579**	7	2	0	0	**9**	888	12	0	43	**943**	183	2	0	0	**185**	**1,716**
8:30 to 9:30	382	7	0	26	**415**	6	1	0	0	**7**	684	16	0	35	**735**	148	2	0	0	**150**	**1,307**
AM Totals	**1,061**	**22**	**0**	**53**	**1,136**	**15**	**7**	**0**	**0**	**22**	**2,066**	**37**	**0**	**111**	**2,214**	**333**	**5**	**0**	**0**	**338**	**3,710**
14:30 to 15:30	612	14	0	26	**652**	6	5	0	0	**11**	526	8	0	17	**551**	132	4	0	1	**137**	**1,351**
14:45 to 15:45	613	15	0	51	**679**	4	5	0	0	**9**	498	7	0	20	**525**	139	5	0	3	**147**	**1,360**
15:00 to 16:00	545	16	0	62	**623**	9	4	0	0	**13**	452	4	0	18	**474**	144	2	0	3	**149**	**1,259**
15:15 to 16:15	525	10	0	61	**596**	8	2	0	0	**10**	430	4	0	18	**452**	138	1	0	2	**141**	**1,199**
15:30 to 16:30	493	5	0	50	**548**	8	0	0	0	**8**	415	4	0	16	**435**	110	1	0	2	**113**	**1,104**
15:45 to 16:45	503	8	0	31	**542**	8	0	0	0	**8**	419	4	0	18	**441**	101	0	0	0	**101**	**1,092**
16:00 to 17:00	510	5	0	28	**543**	1	0	0	0	**1**	449	5	0	21	**475**	99	1	0	0	**100**	**1,119**
PM Totals	**1,353**	**24**	**0**	**94**	**1,471**	**14**	**5**	**0**	**0**	**19**	**1,167**	**15**	**0**	**45**	**1,227**	**296**	**6**	**0**	**3**	**305**	**3,022**

Job No. : N5955
Client : TTPP
Suburb : North Sydney
Location : 4. Ridge St / Miller St

Day/Date : Thursday, 17 September 2020
Weather : Fine
Description : Classified Intersection Count
: Peak Hour Summary



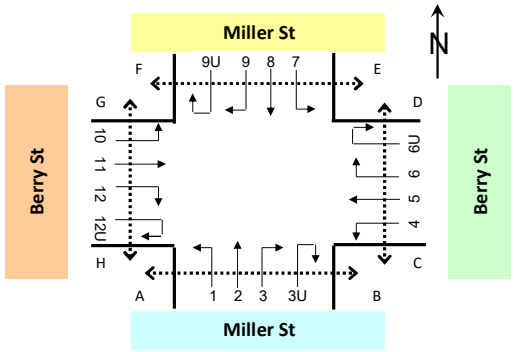
MATRIX Traffic and Transport Data

	Approach	Miller St					Ridge St					Miller St					Ridge St					Grand Total
	Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
AM	7:45 to 8:45	473	7	0	22	**502**	215	3	0	0	**218**	1,035	14	0	58	**1,107**	199	1	0	5	**205**	**2,032**
PM	14:45 to 15:45	369	16	0	51	**436**	177	2	0	4	**183**	452	7	0	21	**480**	157	0	0	1	**158**	**1,257**

Approach	Miller St					Ridge St					Miller St					Ridge St					Grand Total
Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
7:00 to 8:00	254	10	0	12	**276**	116	3	0	0	**119**	676	18	0	47	**741**	105	0	0	5	**110**	**1,246**
7:15 to 8:15	336	14	0	18	**368**	165	4	0	0	**169**	866	18	0	55	**939**	136	1	0	6	**143**	**1,619**
7:30 to 8:30	438	11	0	22	**471**	196	4	0	0	**200**	1,028	13	0	57	**1,098**	170	1	0	6	**177**	**1,946**
7:45 to 8:45	473	7	0	22	**502**	215	3	0	0	**218**	1,035	14	0	58	**1,107**	199	1	0	5	**205**	**2,032**
8:00 to 9:00	422	7	0	28	**457**	195	2	0	2	**199**	967	15	0	50	**1,032**	179	1	0	2	**182**	**1,870**
8:15 to 9:15	344	6	0	23	**373**	161	1	0	2	**164**	808	12	0	44	**864**	161	0	0	1	**162**	**1,563**
8:30 to 9:30	254	7	0	21	**282**	111	1	0	2	**114**	602	12	0	36	**650**	127	0	0	1	**128**	**1,174**
AM Totals	**788**	**23**	**0**	**48**	**859**	**354**	**5**	**0**	**2**	**361**	**1,865**	**35**	**0**	**111**	**2,011**	**326**	**1**	**0**	**7**	**334**	**3,565**
14:30 to 15:30	368	15	0	25	**408**	180	4	0	0	**184**	473	7	0	18	**498**	154	0	0	1	**155**	**1,245**
14:45 to 15:45	369	16	0	51	**436**	177	2	0	4	**183**	452	7	0	21	**480**	157	0	0	1	**158**	**1,257**
15:00 to 16:00	347	14	0	61	**422**	169	2	1	5	**177**	419	4	0	18	**441**	150	1	0	1	**152**	**1,192**
15:15 to 16:15	343	7	0	59	**409**	180	1	1	5	**187**	385	1	0	18	**404**	152	1	0	1	**154**	**1,154**
15:30 to 16:30	306	2	0	50	**358**	175	1	1	5	**182**	374	3	0	16	**393**	148	1	0	0	**149**	**1,082**
15:45 to 16:45	325	4	0	30	**359**	187	2	1	1	**191**	382	4	0	18	**404**	146	2	0	0	**148**	**1,102**
16:00 to 17:00	339	3	0	28	**370**	196	2	0	0	**198**	392	5	0	21	**418**	145	1	0	0	**146**	**1,132**
PM Totals	**850**	**20**	**0**	**93**	**963**	**443**	**7**	**1**	**5**	**456**	**1,043**	**13**	**0**	**46**	**1,102**	**365**	**2**	**0**	**1**	**368**	**2,889**

Job No. : N5955
Client : TTPP
Suburb : North Sydney
Location : 5. Berry St / Miller St

Day/Date : Thursday, 17th September 2020
Weather : Fine
Description : Classified Intersection Count
: Peak Hour Summary



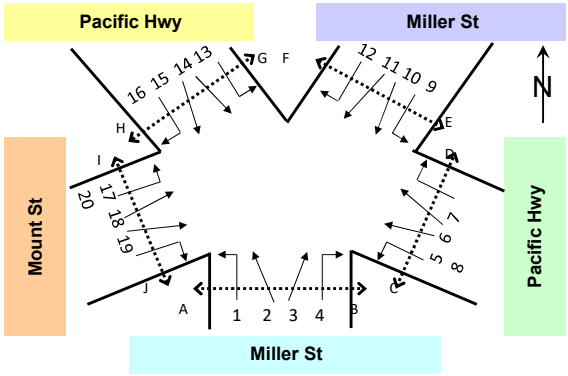
MATRIX Traffic and Transport Data

	Approach	Miller St					Berry St					Miller St					Berry St					Grand Total
	Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
AM	7:45 to 8:45	563	17	0	24	**604**	0	0	0	0	**0**	535	13	0	58	**606**	1,106	18	0	34	**1,158**	**2,368**
PM	14:45 to 15:45	534	19	0	57	**610**	0	0	0	0	**0**	314	8	0	18	**340**	799	10	0	34	**843**	**1,793**

Approach	Miller St					Berry St					Miller St					Berry St					Grand Total
Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
7:00 to 8:00	417	15	0	16	**448**	0	0	0	0	**0**	353	11	1	40	**405**	817	30	0	30	**877**	**1,730**
7:15 to 8:15	479	17	0	23	**519**	0	0	0	0	**0**	430	12	1	50	**493**	1,012	28	0	31	**1,071**	**2,083**
7:30 to 8:30	536	17	0	24	**577**	0	0	0	0	**0**	492	8	1	54	**555**	1,117	19	0	36	**1,172**	**2,304**
7:45 to 8:45	563	17	0	24	**604**	0	0	0	0	**0**	535	13	0	58	**606**	1,106	18	0	34	**1,158**	**2,368**
8:00 to 9:00	518	15	0	29	**562**	0	0	0	0	**0**	551	14	0	53	**618**	1,061	14	0	36	**1,111**	**2,291**
8:15 to 9:15	499	19	0	24	**542**	0	0	0	0	**0**	496	14	0	47	**557**	936	14	0	35	**985**	**2,084**
8:30 to 9:30	443	20	0	24	**487**	0	0	0	0	**0**	417	16	0	40	**473**	803	17	0	31	**851**	**1,811**
AM Totals	**1,154**	**43**	**0**	**55**	**1,252**	**0**	**0**	**0**	**0**	**0**	**1,064**	**29**	**1**	**107**	**1,201**	**2,230**	**53**	**0**	**82**	**2,365**	**4,818**
14:30 to 15:30	555	19	0	31	**605**	0	0	0	0	**0**	301	10	0	16	**327**	761	13	0	28	**802**	**1,734**
14:45 to 15:45	534	19	0	57	**610**	0	0	0	0	**0**	314	8	0	18	**340**	799	10	0	34	**843**	**1,793**
15:00 to 16:00	505	17	0	61	**583**	0	0	0	0	**0**	318	8	0	19	**345**	799	11	0	40	**850**	**1,778**
15:15 to 16:15	456	9	0	56	**521**	0	0	0	0	**0**	305	5	0	19	**329**	796	9	0	33	**838**	**1,688**
15:30 to 16:30	399	2	0	46	**447**	0	0	0	0	**0**	320	5	0	17	**342**	756	6	0	31	**793**	**1,582**
15:45 to 16:45	439	5	0	28	**472**	0	0	0	0	**0**	340	5	0	19	**364**	757	8	0	25	**790**	**1,626**
16:00 to 17:00	464	4	0	29	**497**	0	0	0	0	**0**	346	4	0	18	**368**	791	7	0	24	**822**	**1,687**
PM Totals	**1,209**	**25**	**0**	**94**	**1,328**	**0**	**0**	**0**	**0**	**0**	**808**	**18**	**0**	**42**	**868**	**1,897**	**22**	**0**	**72**	**1,991**	**4,187**

Job No. : N5955
Client : TTPP
Suburb : North Sydney
Location : 6. Pacific Hwy / Miller St / Mount St

Day/Date : Thursday, 17th September 2020
Weather : Fine
Description : Classified Intersection Count
: Peak Hour Summary



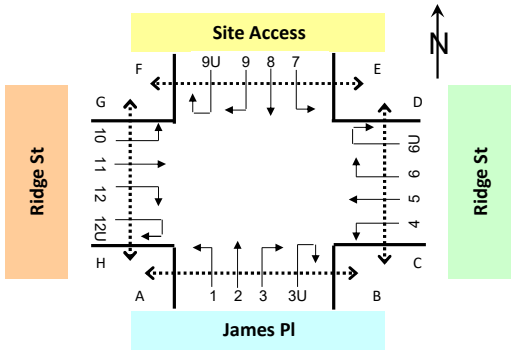
MATRIX Traffic and Transport Data

	Approach	Miller St					Pacific Hwy					Miller St					Pacific Hwy					Mount St					Grand Total
	Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
AM	7:45 to 8:45	338	11	0	41	**390**	1,448	37	6	17	**1,508**	322	8	0	94	**424**	485	15	0	18	**518**	0	0	0	0	**0**	**2,840**
PM	16:00 to 17:00	379	7	0	52	**438**	1,129	9	0	22	**1,160**	209	2	0	41	**252**	323	2	0	5	**330**	0	0	0	0	**0**	**2,180**

Approach	Miller St					Pacific Hwy					Miller St					Pacific Hwy					Mount St					Grand Total
Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
7:00 to 8:00	220	7	0	32	**259**	1,193	32	5	11	**1,241**	250	7	0	75	**332**	320	8	0	12	**340**	0	0	0	0	**0**	**2,172**
7:15 to 8:15	275	8	0	39	**322**	1,286	33	5	17	**1,341**	291	6	0	86	**383**	380	9	0	16	**405**	0	0	0	0	**0**	**2,451**
7:30 to 8:30	327	9	0	39	**375**	1,351	30	7	16	**1,404**	326	4	0	92	**422**	445	10	0	18	**473**	0	0	0	0	**0**	**2,674**
7:45 to 8:45	338	11	0	41	**390**	1,448	37	6	17	**1,508**	322	8	0	94	**424**	485	15	0	18	**518**	0	0	0	0	**0**	**2,840**
8:00 to 9:00	335	10	0	46	**391**	1,381	36	6	21	**1,444**	326	7	0	88	**421**	451	20	0	17	**488**	0	0	0	0	**0**	**2,744**
8:15 to 9:15	315	13	0	41	**369**	1,334	38	4	19	**1,395**	291	8	0	78	**377**	413	19	1	15	**448**	0	0	0	0	**0**	**2,589**
8:30 to 9:30	280	18	0	44	**342**	1,216	38	2	18	**1,274**	242	11	0	72	**325**	370	17	1	12	**400**	0	0	0	0	**0**	**2,341**
AM Totals	**693**	**29**	**0**	**98**	**820**	**3,108**	**85**	**11**	**39**	**3,243**	**678**	**19**	**0**	**193**	**890**	**946**	**33**	**1**	**34**	**1,014**	**0**	**0**	**0**	**0**	**0**	**5,967**
14:30 to 15:30	456	18	0	49	**523**	990	19	3	27	**1,039**	178	7	0	34	**219**	286	7	0	6	**299**	0	0	0	0	**0**	**2,080**
14:45 to 15:45	421	15	0	76	**512**	995	9	2	29	**1,035**	176	5	0	36	**217**	282	5	0	8	**295**	0	0	0	0	**0**	**2,059**
15:00 to 16:00	393	15	0	80	**488**	937	10	2	30	**979**	171	5	0	40	**216**	266	6	0	6	**278**	0	0	0	0	**0**	**1,961**
15:15 to 16:15	338	13	0	77	**428**	982	13	1	29	**1,025**	146	4	0	40	**190**	262	4	0	7	**273**	0	0	0	0	**0**	**1,916**
15:30 to 16:30	314	7	0	70	**391**	969	10	0	21	**1,000**	177	3	0	40	**220**	282	2	0	3	**287**	0	0	0	0	**0**	**1,898**
15:45 to 16:45	350	9	0	52	**411**	1,035	11	0	22	**1,068**	187	2	0	39	**228**	300	3	0	5	**308**	0	0	0	0	**0**	**2,015**
16:00 to 17:00	379	7	0	52	**438**	1,129	9	0	22	**1,160**	209	2	0	41	**252**	323	2	0	5	**330**	0	0	0	0	**0**	**2,180**
PM Totals	**967**	**28**	**0**	**146**	**1,141**	**2,566**	**31**	**3**	**58**	**2,658**	**469**	**12**	**0**	**95**	**576**	**726**	**10**	**0**	**13**	**749**	**0**	**0**	**0**	**0**	**0**	**5,124**

Job No. : N5955
Client : TTPP
Suburb : North Sydney
Location : 7. Ridge St / Site Access / James Pl

Day/Date : Thursday, 17th September 2020
Weather : Fine
Description : Classified Intersection Count
: Peak Hour Summary



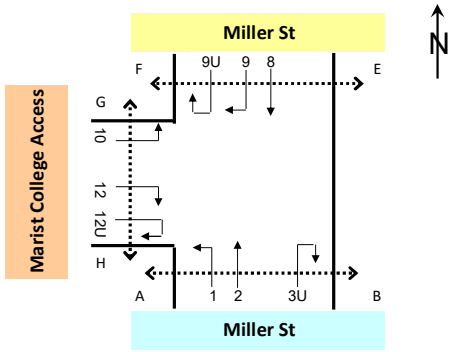
MATRIX Traffic and Transport Data

	Approach	James Pl					Ridge St					Site Access					Ridge St					Grand Total
	Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
AM	7:45 to 8:45	13	0	0	0	**13**	283	2	0	0	**285**	0	0	0	0	**0**	304	2	0	5	**311**	**609**
PM	14:30 to 15:30	38	0	0	0	**38**	160	4	0	0	**164**	1	0	0	0	**1**	211	0	0	1	**212**	**415**

Approach	James Pl					Ridge St					Site Access					Ridge St					Grand Total
Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
7:00 to 8:00	1	1	0	0	**2**	156	1	0	0	**157**	0	0	0	0	**0**	157	2	0	5	**164**	**323**
7:15 to 8:15	3	0	0	0	**3**	200	3	0	0	**203**	0	0	0	0	**0**	225	2	0	6	**233**	**439**
7:30 to 8:30	6	0	0	0	**6**	260	3	0	0	**263**	0	0	0	0	**0**	287	2	0	6	**295**	**564**
7:45 to 8:45	13	0	0	0	**13**	283	2	0	0	**285**	0	0	0	0	**0**	304	2	0	5	**311**	**609**
8:00 to 9:00	16	0	0	0	**16**	271	2	0	0	**273**	0	0	0	0	**0**	282	1	0	2	**285**	**574**
8:15 to 9:15	16	0	0	0	**16**	234	0	0	0	**234**	0	0	0	0	**0**	227	0	0	1	**228**	**478**
8:30 to 9:30	18	0	0	0	**18**	162	0	0	0	**162**	0	0	0	0	**0**	148	0	0	1	**149**	**329**
AM Totals	**24**	**1**	**0**	**0**	**25**	**482**	**3**	**0**	**0**	**485**	**0**	**0**	**0**	**0**	**0**	**484**	**3**	**0**	**7**	**494**	**1,004**
14:30 to 15:30	38	0	0	0	**38**	160	4	0	0	**164**	1	0	0	0	**1**	211	0	0	1	**212**	**415**
14:45 to 15:45	37	0	0	0	**37**	154	4	0	0	**158**	0	0	0	0	**0**	192	0	0	1	**193**	**388**
15:00 to 16:00	43	0	0	0	**43**	119	2	0	0	**121**	0	0	0	0	**0**	149	1	0	1	**151**	**315**
15:15 to 16:15	43	0	0	0	**43**	112	1	0	0	**113**	0	0	0	0	**0**	138	1	0	1	**140**	**296**
15:30 to 16:30	42	0	0	0	**42**	98	0	0	0	**98**	1	0	0	0	**1**	124	1	0	0	**125**	**266**
15:45 to 16:45	52	0	0	0	**52**	100	0	0	0	**100**	1	0	0	0	**1**	116	2	0	0	**118**	**271**
16:00 to 17:00	43	0	0	0	**43**	110	0	0	0	**110**	1	0	0	0	**1**	127	1	0	0	**128**	**282**
PM Totals	**103**	**0**	**0**	**0**	**103**	**315**	**4**	**0**	**0**	**319**	**2**	**0**	**0**	**0**	**2**	**390**	**2**	**0**	**1**	**393**	**817**

Job No. : N5955
Client : TTPP
Suburb : North Sydney
Location : 8. Marist College access / Carlow St

Day/Date : Thursday, 17th September 2020
Weather : Fine
Description : Classified Intersection Count
: Peak Hour Summary



MATRIX Traffic and Transport Data

	Approach	Miller St					Miller St					Marist College Access					Grand Total
	Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
AM	7:45 to 8:45	559	7	0	25	**591**	1,028	13	1	57	**1,099**	148	0	0	0	**148**	**1,838**
PM	14:30 to 15:30	509	15	0	26	**550**	457	8	0	17	**482**	127	0	0	0	**127**	**1,159**

Approach	Miller St					Miller St					Marist College Access					Grand Total
Time Period	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	Lights	Rigid Trucks	Articulated Trucks	Buses	Total	
7:00 to 8:00	283	8	0	13	**304**	693	15	3	47	**758**	9	0	0	0	**9**	**1,071**
7:15 to 8:15	380	11	0	20	**411**	885	14	3	56	**958**	45	0	0	0	**45**	**1,414**
7:30 to 8:30	490	11	0	25	**526**	1,036	12	1	57	**1,106**	104	0	0	0	**104**	**1,736**
7:45 to 8:45	559	7	0	25	**591**	1,028	13	1	57	**1,099**	148	0	0	0	**148**	**1,838**
8:00 to 9:00	518	7	0	33	**558**	961	12	3	49	**1,025**	145	0	0	0	**145**	**1,728**
8:15 to 9:15	440	7	0	27	**474**	791	9	3	43	**846**	108	0	0	0	**108**	**1,428**
8:30 to 9:30	338	7	0	23	**368**	596	9	3	35	**643**	49	0	0	0	**49**	**1,060**
AM Totals	**930**	**21**	**0**	**53**	1,004	**1,880**	**29**	**6**	**110**	2,025	**154**	**0**	**0**	**0**	154	3,183
14:30 to 15:30	509	15	0	26	**550**	457	8	0	17	**482**	127	0	0	0	**127**	**1,159**
14:45 to 15:45	504	15	0	51	**570**	431	8	0	20	**459**	121	0	0	0	**121**	**1,150**
15:00 to 16:00	485	16	0	62	**563**	399	3	0	18	**420**	80	0	0	0	**80**	**1,063**
15:15 to 16:15	486	9	0	60	**555**	380	2	0	18	**400**	52	0	0	0	**52**	**1,007**
15:30 to 16:30	441	4	0	50	**495**	367	3	0	16	**386**	60	0	0	0	**60**	**941**
15:45 to 16:45	458	8	0	31	**497**	375	4	0	18	**397**	55	0	0	0	**55**	**949**
16:00 to 17:00	460	5	0	28	**493**	382	5	0	21	**408**	56	0	0	0	**56**	**957**
PM Totals	**1,178**	**24**	**0**	**94**	1,296	**1,012**	**14**	**0**	**45**	1,071	**211**	**0**	**0**	**0**	211	2,578

Automatic Tube Counter - Carlow Street, near West Street

Start Time	11/05/2018 13:26
Finish Time	18/05/2018 15:32
Direction	Eastbound

	Total Vehicles								
Time	**11th Fri**	**12th Sat**	**13th Sun**	**14th Mon**	**15th Tue**	**16th Wed**	**17th Thu**	**18th Fri**	**Ave Wkd**
0000		5	3	1	1	4	1	3	2
0100		3	5	0	2	3	2	1	2
0200		2	2	1	0	0	2	1	1
0300		0	5	0	2	2	0	0	1
0400		1	0	4	4	2	3	2	3
0500		6	5	11	11	19	13	19	15
0600		13	5	32	29	37	44	36	36
0700		21	19	104	114	126	118	99	112
0800		48	46	194	167	162	169	163	171
0900		64	69	96	83	90	88	125	96
1000		79	76	69	86	76	79	89	80
1100		71	85	65	71	66	77	94	75
1200		60	59	70	69	79	68	82	74
1300		62	49	54	79	66	70	102	74
1400	59	79	39	88	97	78	90	45	80
1500	145	45	43	126	117	117	129		127
1600	102	65	45	94	107	109	89		100
1700	116	57	58	95	158	118	155		128
1800	79	49	41	75	108	86	105		91
1900	57	21	25	50	42	34	50		47
2000	29	18	24	24	42	36	45		35
2100	18	8	9	30	25	24	29		25
2200	18	14	7	13	10	8	15		13
2300	11	23	5	2	5	7	6		6
00-00	**634**	**814**	**724**	**1298**	**1429**	**1349**	**1447**	**861**	**1392**

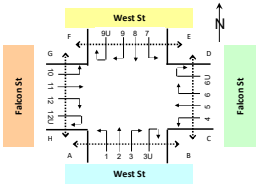
Automatic Tube Counter - Carlow Street, near West Street

Start Time	11/05/2018 13:26
Finish Time	18/05/2018 15:32
Direction	Westbound

	Total Vehicles								
Time	**11th Fri**	**12th Sat**	**13th Sun**	**14th Mon**	**15th Tue**	**16th Wed**	**17th Thu**	**18th Fri**	**Ave Wkd**
0000		6	4	0	1	0	0	4	1
0100		3	5	1	1	2	2	3	1.8
0200		2	1	0	1	0	0	1	0.4
0300		0	1	0	0	0	1	0	0.2
0400		1	2	1	0	2	1	4	1.6
0500		2	6	11	9	15	10	19	12.8
0600		13	10	44	41	41	48	38	42.4
0700		25	21	92	91	95	98	100	95.2
0800		54	35	138	142	144	155	143	144.4
0900		49	51	110	102	97	104	138	110.2
1000		64	65	62	68	64	55	80	65.8
1100		65	69	49	65	61	66	85	65.2
1200		65	54	60	78	51	69	77	67
1300		59	63	54	66	56	66	66	61.6
1400	49	56	45	81	81	66	90	51	73.8
1500	112	49	38	90	118	104	100		104.8
1600	79	50	44	73	76	75	64		73.4
1700	85	51	41	90	106	100	107		97.6
1800	52	41	54	68	80	63	84		69.4
1900	52	28	28	29	53	42	33		41.8
2000	29	18	24	34	44	27	36		34
2100	17	17	14	19	31	16	30		22.6
2200	16	15	5	21	10	15	9		14.2
2300	10	16	8	9	5	8	10		8.4
00-00	**501**	**749**	**688**	**1136**	**1269**	**1144**	**1238**	**809**	**1209.6**

Job No. : N3723
Client : TTPP
Suburb : Crows Nest
Location : C. Falcon St / West St

Day/Date : Thu, 9th November 2017
Weather : Fine
Description : Classified Intersection Count
: Hourly Summary



MATRIX Traffic and Transport Data

Approach	West St																Falcon St															
Direction	Direction 1 (Left Turn)				Direction 2 (Through)				Direction 3 (Right Turn)				Direction 3U (U Turn)				Direction 4 (Left Turn)				Direction 5 (Through)				Direction 6 (Right Turn)				Direction 6U (U Turn)			
Time Period	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total
6:00 to 7:00	25	1	0	**26**	36	4	6	**46**	0	0	0	**0**	0	0	0	**0**	34	1	0	**35**	429	21	1	**451**	61	1	2	**64**	0	0	0	**0**
6:15 to 7:15	33	1	0	**34**	53	4	8	**65**	0	0	0	**0**	0	0	0	**0**	46	0	1	**47**	481	27	2	**510**	76	1	9	**86**	0	0	0	**0**
6:30 to 7:30	43	1	0	**44**	72	4	7	**83**	0	0	0	**0**	0	0	0	**0**	53	0	1	**54**	537	31	2	**570**	92	3	9	**104**	0	0	0	**0**
6:45 to 7:45	49	1	0	**50**	93	5	9	**107**	0	0	0	**0**	0	0	0	**0**	63	0	1	**64**	565	41	3	**609**	106	3	9	**118**	0	0	0	**0**
7:00 to 8:00	66	2	0	**68**	110	3	11	**124**	0	0	0	**0**	0	0	0	**0**	77	0	1	**78**	603	36	2	**641**	105	3	8	**116**	0	0	0	**0**
7:15 to 8:15	72	2	0	**74**	126	4	14	**144**	0	0	0	**0**	0	0	0	**0**	83	1	0	**84**	643	37	1	**681**	109	3	1	**113**	0	0	0	**0**
7:30 to 8:30	76	2	0	**78**	142	4	18	**164**	0	0	0	**0**	0	0	0	**0**	99	2	0	**101**	640	38	2	**680**	131	1	0	**132**	0	0	0	**0**
7:45 to 8:45	80	3	0	**83**	168	4	16	**188**	0	0	0	**0**	0	0	0	**0**	107	3	0	**110**	627	38	2	**667**	154	2	0	**156**	0	0	0	**0**
8:00 to 9:00	82	2	0	**84**	184	3	11	**198**	0	0	0	**0**	0	0	0	**0**	96	3	0	**99**	593	44	2	**639**	191	3	0	**194**	0	0	0	**0**
AM Totals	**173**	**5**	**0**	**178**	**330**	**10**	**28**	**368**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**207**	**4**	**1**	**212**	**1,625**	**101**	**5**	**1,731**	**357**	**7**	**10**	**374**	**0**	**0**	**0**	**0**
15:00 to 16:00	89	1	0	**90**	214	0	5	**219**	0	0	0	**0**	0	0	0	**0**	50	4	0	**54**	585	33	1	**619**	137	3	0	**140**	0	0	0	**0**
15:15 to 16:15	96	1	0	**97**	231	0	8	**239**	0	0	0	**0**	0	0	0	**0**	58	4	0	**62**	635	33	1	**669**	142	1	0	**143**	0	0	0	**0**
15:30 to 16:30	79	1	0	**80**	207	0	7	**214**	0	0	0	**0**	0	0	0	**0**	59	2	0	**61**	664	33	0	**697**	141	1	0	**142**	0	0	0	**0**
15:45 to 16:45	77	2	0	**79**	191	0	16	**207**	0	0	0	**0**	0	0	0	**0**	61	0	0	**61**	651	31	0	**682**	130	1	0	**131**	0	0	0	**0**
16:00 to 17:00	81	1	0	**82**	201	0	29	**230**	0	0	0	**0**	0	0	0	**0**	65	0	0	**65**	660	25	0	**685**	137	1	1	**139**	0	0	0	**0**
16:15 to 17:15	82	1	0	**83**	196	0	39	**235**	0	0	0	**0**	0	0	0	**0**	61	0	0	**61**	640	21	2	**663**	140	1	1	**142**	0	0	0	**0**
16:30 to 17:30	84	1	0	**85**	207	0	57	**264**	0	0	0	**0**	0	0	0	**0**	57	1	0	**58**	629	21	2	**652**	145	2	2	**149**	0	0	0	**0**
16:45 to 17:45	104	0	0	**104**	224	0	81	**305**	0	0	0	**0**	0	0	0	**0**	52	1	0	**53**	604	21	3	**628**	144	2	2	**148**	0	0	0	**0**
17:00 to 18:00	109	1	0	**110**	219	0	100	**319**	0	0	0	**0**	0	0	0	**0**	58	2	0	**60**	611	19	4	**634**	143	1	1	**145**	0	0	0	**0**
17:15 to 18:15	108	1	0	**109**	220	1	126	**347**	0	0	0	**0**	0	0	0	**0**	58	2	0	**60**	589	19	2	**610**	138	1	1	**140**	0	0	0	**0**
17:30 to 18:30	97	1	0	**98**	204	1	130	**335**	0	0	0	**0**	0	0	0	**0**	67	1	0	**68**	633	13	2	**648**	143	0	0	**143**	0	0	0	**0**
17:45 to 18:45	86	1	0	**87**	182	1	108	**291**	0	0	0	**0**	0	0	0	**0**	67	1	0	**68**	612	13	1	**626**	145	0	0	**145**	0	0	0	**0**
18:00 to 19:00	80	0	0	**80**	167	1	86	**254**	0	0	0	**0**	0	0	0	**0**	65	0	0	**65**	580	12	0	**592**	138	0	0	**138**	0	0	0	**0**
PM Totals	**359**	**3**	**0**	**362**	**801**	**1**	**220**	**1,022**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**238**	**6**	**0**	**244**	**2,436**	**89**	**5**	**2,530**	**555**	**5**	**2**	**562**	**0**	**0**	**0**	**0**

Approach	West St																Falcon St																Crossing Pedestrians																							
Direction	Direction 7 (Left Turn)				Direction 8 (Through)				Direction 9 (Right Turn)				Direction 9U (U Turn)				Direction 10 (Left Turn)				Direction 11 (Through)				Direction 12 (Right Turn)				Direction 12U (U Turn)				A			B			C			D			E			F			G			H		
Time Period	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Lights	Heavies	Cyclists	Total	Peds	Cyclists	Total	Peds	Cyclists	Total	Peds	Cyclists	Total	Peds	Cyclists	Total	Peds	Cyclists	Total	Peds	Cyclists	Total	Peds	Cyclists	Total	Peds	Cyclists	Total
6:00 to 7:00	28	2	0	**30**	94	4	24	**122**	67	2	0	**69**	0	0	0	**0**	53	1	2	**56**	536	32	1	**569**	0	0	0	**0**	0	0	0	**0**	4	0	**4**	5	0	**5**	15	0	**15**	4	0	**4**	13	1	**14**	14	0	**14**	10	0	**10**	22	0	**22**
6:15 to 7:15	32	1	0	**33**	120	2	39	**161**	87	2	0	**89**	0	0	0	**0**	61	1	2	**64**	573	29	0	**602**	0	0	0	**0**	0	0	0	**0**	5	0	**5**	5	0	**5**	18	0	**18**	10	0	**10**	14	1	**15**	14	0	**14**	19	0	**19**	23	0	**23**
6:30 to 7:30	49	0	0	**49**	151	3	68	**222**	111	2	0	**113**	0	0	0	**0**	75	2	2	**79**	601	34	1	**636**	1	0	0	**1**	0	0	0	**0**	7	0	**7**	8	0	**8**	22	0	**22**	11	0	**11**	16	1	**17**	15	0	**15**	22	0	**22**	22	0	**22**
6:45 to 7:45	55	0	0	**55**	194	2	94	**290**	129	1	0	**130**	0	0	0	**0**	76	2	2	**80**	616	37	2	**655**	1	0	0	**1**	0	0	0	**0**	11	0	**11**	19	0	**19**	23	0	**23**	15	0	**15**	22	0	**22**	19	0	**19**	25	0	**25**	36	0	**36**
7:00 to 8:00	49	0	0	**49**	264	2	109	**375**	127	2	0	**129**	0	0	0	**0**	80	2	1	**83**	630	53	2	**685**	1	0	0	**1**	0	0	0	**0**	11	0	**11**	22	0	**22**	41	0	**41**	19	1	**20**	37	0	**37**	23	1	**24**	20	0	**20**	36	0	**36**
7:15 to 8:15	59	1	0	**60**	342	2	115	**459**	130	3	0	**133**	0	0	0	**0**	80	2	0	**82**	634	55	2	**691**	1	0	0	**1**	0	0	0	**0**	11	0	**11**	23	0	**23**	65	0	**65**	16	1	**17**	54	0	**54**	24	1	**25**	15	0	**15**	70	0	**70**
7:30 to 8:30	54	1	0	**55**	401	0	93	**494**	116	3	0	**119**	0	0	0	**0**	82	1	0	**83**	642	56	1	**699**	0	0	0	**0**	0	0	0	**0**	11	0	**11**	58	0	**58**	77	0	**77**	14	2	**16**	65	0	**65**	26	1	**27**	19	0	**19**	99	0	**99**
7:45 to 8:45	57	1	0	**58**	426	1	72	**499**	100	3	0	**103**	0	0	0	**0**	77	1	0	**78**	602	58	1	**661**	0	0	0	**0**	0	0	0	**0**	10	0	**10**	140	0	**140**	114	0	**114**	14	2	**16**	94	0	**94**	27	1	**28**	18	0	**18**	185	1	**186**
8:00 to 9:00	65	1	0	**66**	416	2	56	**474**	97	2	0	**99**	0	0	0	**0**	80	0	0	**80**	568	50	1	**619**	0	0	0	**0**	0	0	0	**0**	12	0	**12**	227	0	**227**	106	0	**106**	12	1	**13**	85	0	**85**	25	0	**25**	25	0	**25**	245	1	**246**
AM Totals	**142**	**3**	**0**	**145**	**774**	**8**	**189**	**971**	**291**	**6**	**0**	**297**	**0**	**0**	**0**	**0**	**213**	**3**	**3**	**219**	**1,734**	**135**	**4**	**1,873**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**27**	**0**	**27**	**254**	**0**	**254**	**162**	**0**	**162**	**35**	**2**	**37**	**135**	**1**	**136**	**62**	**1**	**63**	**55**	**0**	**55**	**303**	**1**	**304**
15:00 to 16:00	69	4	0	**73**	195	16	4	**215**	145	4	0	**149**	0	0	0	**0**	76	3	0	**79**	739	32	0	**771**	0	1	0	**1**	0	0	0	**0**	57	0	**57**	19	0	**19**	12	0	**12**	44	1	**45**	16	0	**16**	33	1	**34**	19	0	**19**	21	0	**21**
15:15 to 16:15	72	3	0	**75**	185	14	5	**204**	146	2	0	**148**	0	0	0	**0**	82	2	0	**84**	728	36	0	**764**	0	0	0	**0**	0	0	0	**0**	60	0	**60**	19	0	**19**	13	0	**13**	43	1	**44**	12	0	**12**	39	1	**40**	22	0	**22**	26	0	**26**
15:30 to 16:30	69	3	0	**72**	190	5	4	**199**	139	3	0	**142**	0	0	0	**0**	88	2	0	**90**	763	34	0	**797**	0	0	0	**0**	0	0	0	**0**	23	0	**23**	18	0	**18**	14	0	**14**	29	1	**30**	12	0	**12**	22	1	**23**	17	0	**17**	27	0	**27**
15:45 to 16:45	71	1	0	**72**	194	3	5	**202**	142	1	0	**143**	0	0	0	**0**	81	1	0	**82**	741	32	1	**774**	0	0	0	**0**	0	0	0	**0**	23	1	**24**	14	0	**14**	17	0	**17**	25	0	**25**	9	0	**9**	18	0	**18**	25	1	**26**	24	1	**25**
16:00 to 17:00	74	0	0	**74**	210	1	10	**221**	147	1	1	**149**	0	0	0	**0**	75	0	0	**75**	696	28	2	**726**	0	0	0	**0**	1	0	0	**1**	23	1	**24**	16	0	**16**	18	0	**18**	24	0	**24**	13	0	**13**	21	0	**21**	27	1	**28**	24	1	**25**
16:15 to 17:15	75	0	0	**75**	205	1	10	**216**	168	3	1	**172**	0	0	0	**0**	82	0	0	**82**	728	26	2	**756**	0	0	0	**0**	1	0	0	**1**	19	1	**20**	16	0	**16**	15	0	**15**	25	0	**25**	14	0	**14**	17	0	**17**	27	1	**28**	20	1	**21**
16:30 to 17:30	81	0	0	**81**	222	0	15	**237**	171	2	1	**174**	0	0	0	**0**	83	0	0	**83**	740	25	3	**768**	0	0	0	**0**	1	0	0	**1**	20	1	**21**	17	0	**17**	21	0	**21**	29	1	**30**	20	0	**20**	19	0	**19**	42	1	**43**	19	1	**20**
16:45 to 17:45	84	0	1	**85**	224	1	16	**241**	167	3	1	**171**	0	0	0	**0**	91	0	0	**91**	740	29	2	**771**	0	0	0	**0**	1	0	0	**1**	16	0	**16**	18	0	**18**	23	0	**23**	34	1	**35**	37	0	**37**	32	0	**32**	41	0	**41**	17	0	**17**
17:00 to 18:00	102	0	2	**104**	225	1	15	**241**	158	3	0	**161**	0	0	0	**0**	98	0	0	**98**	784	28	2	**814**	1	0	0	**1**	0	0	0	**0**	19	0	**19**	19	0	**19**	27	0	**27**	37	1	**38**	44	1	**45**	33	0	**33**	41	0	**41**	19	0	**19**
17:15 to 18:15	99	0	2	**101**	255	1	16	**272**	140	1	0	**141**	0	0	0	**0**	95	0	0	**95**	759	26	2	**787**	1	0	0	**1**	0	0	0	**0**	24	0	**24**	26	0	**26**	35	0	**35**	42	1	**43**	53	1	**54**	40	0	**40**	44	0	**44**	23	0	**23**
17:30 to 18:30	107	0	2	**109**	243	2	11	**256**	121	1	0	**122**	0	0	0	**0**	96	0	0	**96**	733	25	1	**759**	1	0	0	**1**	0	0	0	**0**	28	0	**28**	33	0	**33**	33	0	**33**	39	0	**39**	54	1	**55**	44	0	**44**	38	0	**38**	33	0	**33**
17:45 to 18:45	101	0	1	**102**	231	1	9	**241**	114	0	0	**114**	0	0	0	**0**	94	0	0	**94**	801	23	1	**825**	1	0	0	**1**	0	0	0	**0**	28	0	**28**	38	0	**38**	30	0	**30**	34	0	**34**	41	1	**42**	33	0	**33**	34	0	**34**	33	0	**33**
18:00 to 19:00	79	0	0	**79**	209	1	8	**218**	115	0	0	**115**	0	0	0	**0**	90	0	0	**90**	784	23	1	**808**	0	0	0	**0**	0	0	0	**0**	29	0	**29**	36	0	**36**	28	0	**28**	45	0	**45**	45	0	**45**	43	0	**43**	36	0	**36**	31	0	**31**
PM Totals	**324**	**4**	**2**	**330**	**839**	**19**	**37**	**895**	**565**	**8**	**1**	**574**	**0**	**0**	**0**	**0**	**339**	**3**	**0**	**342**	**3,003**	**111**	**5**	**3,119**	**1**	**1**	**0**	**2**	**1**	**0**	**0**	**1**	**128**	**1**	**129**	**90**	**0**	**90**	**85**	**0**	**85**	**150**	**2**	**152**	**118**	**1**	**119**	**130**	**1**	**131**	**123**	**1**	**124**	**95**	**1**	**96**

Appendix B

Model Calibration Report

Marist College North Sydney
Model Development Report

Prepared for:

Sydney Catholic Schools

22 December 2020

The Transport Planning Partnership

E: info@ttpp.net.au

Marist College North Sydney
Model Development Report

Client: Sydney Catholic Schools

Version: 01

Date: 22 December 2020

TTPP Reference: 16241

Quality Record

Version	Date	Prepared by	Reviewed by	Approved by	Signature
01	22/12/2020	S.Read	K.Hollyoak	Ken Hollyoak	

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APPENDICES

1 Introduction

The Transport Planning Partnership (TTPP) has been commissioned by Sydney Catholic Schools to undertake Aimsun Micro-simulation modelling for the Marist College North Sydney. The modelling has been undertaken to test the future increase in student numbers at the school and to meet the requirements of the SEARs. This report presents the model development, calibration and validation of the models.

1.1 Background

Marist College North Sydney is located on Miller Street, North Sydney between Ridge Street and Carlow Street.

A 24-month study undertaken by Sydney Catholic Schools has identified a major deficiency in the provision of affordable, non-government education within the North Sydney Local Government Area (LGA).

The study also identified that the choice for families is extremely limited, as almost all of the schools in North Sydney provide single-sex education, with co-educational schools significantly underrepresented.

Sydney Catholic Schools, as operators of St Mary's Catholic Primary School and Marist College North Shore, is responding to this challenge and has identified a strategic response that can positively support the future of North Sydney.

The SSD DA seeks approval for:

- Retention of key buildings including St Mary's Church and Parish Centre, the former Presbytery and Monastery, St Mary's Primary School and some existing buildings on the western boundary.
- Demolition of existing buildings along Miller Street and Carlow Street, including the childcare centre and terrace houses.
- Construction of a mixed-use education precinct comprising a high school and early learning centre, including:
  - adaptive reuse of the existing Presbytery, and alterations and additions to retained educational buildings;
  - construction of a multistorey educational building on the corner of Miller Street and Carlow Street;
  - construction of a multistorey mixed-use building along Miller Street, accommodating teaching facilities, an early learning centre and an auditorium.
  - construction of a new basement car park; and

- provision of ancillary canteen/café uses.

- Landscaping and public domain works, including the creation of a new plaza along Miller Street, adjoining St Mary's Church.

A summary of the existing and proposed enrolments is provided in Table 1.1.

Table 1.1: Existing and Proposed Site Population

Group	Existing Population		Proposed Population		Proposed Increase	
	Students	Staff	Students	Staff	Students	Staff
Early Learning Centre (ELC) Children	50	7[1]	90	12[1]	+40	+5
Primary School Students (St Marys)	466	40	544	43	+78	+3
High School Students (Marist)	826	80	1,440	132	+614	+52
Total Students	**1,342**	**127**	**2,074**	**187**	**+732**	**+60**

[1] Childcare staff numbers are assumed, based on a ratio of 1 staff to 7 children as required by the National Quality Framework by ACECQA

1.2 Project Objective

The objective of the modelling is to test the impacts on the road network of the traffic associated with the uplift in school activity. This is to meet the requirements of the SEARs.

1.3 Scope of Work

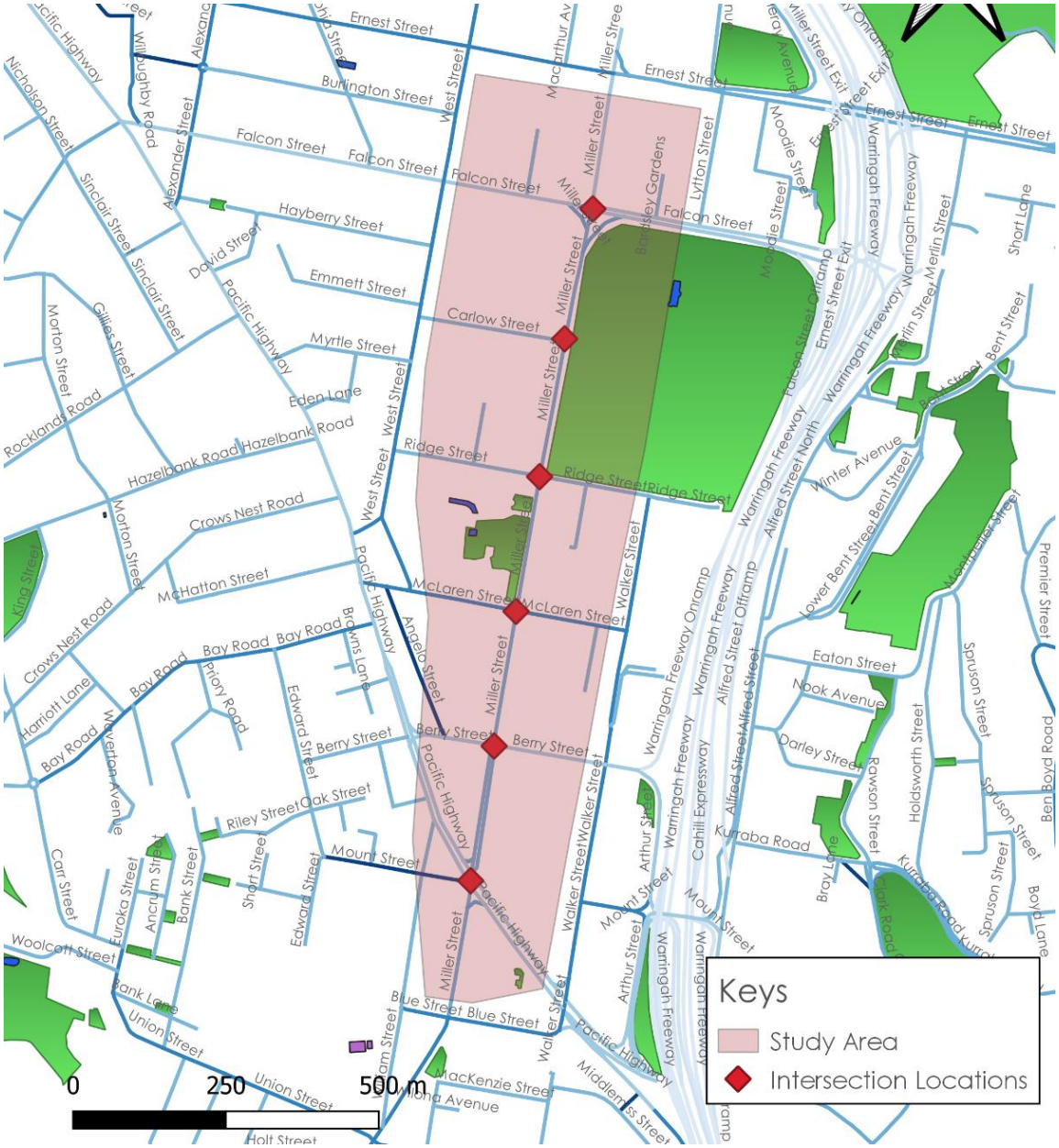
The model has been developed to test the impacts of the school on the traffic network. The scope of the modelling covers:

- Morning Peak from 7:30am – 9:30am
- Evening Peak from 2:30pm – 4:30pm
- Includes light vehicles, heavy vehicles and buses

1.4 Study Area

The model area covers the corridor of Miller Street from Falcon Street to the Pacific Highway (Victoria Cross)I as shown in Figure 1.1.

Figure 1.1: Model Area



The core area of the model has been identified as from Ridge Street to Falcon Street. The core area has been coded to a higher standard of calibration.

1.5 Report Outline

This report has been prepared in accordance with the Roads and Maritime technical direction for Operational Modelling Reporting Structure (TDT 2017/001). The report is structured as follows:

Section 2 – Existing Conditions – background information about the study area.

Section 3 – Model Assumptions – the modelling assumptions, settings and calibration and validation targets.

Section 4 – Calibration Results – presents the calibration and validation results for the model and the core area.

Section 4 – Model Limitations – sets out the limitations for using this model.

Section 5 – Conclusion

2 Existing Conditions

2.1 Traffic Surveys

The primary data used for the calibration and validation of the model includes:

- Classified Turn Counts – 17 September 2020
- Travel Time Surveys – 17 September 2020

2.1.1 Intersection counts

Classified intersections were undertaken at:

- Falcon Street / Miller Street
- Carlo Street / Miller Street
- Ridge Street / Miller Street
- McLaren Street / Miller Street
- Berry Street / Miller Street
- Victoria Cross (Pacific Highway / Miller Street / Mount Street)

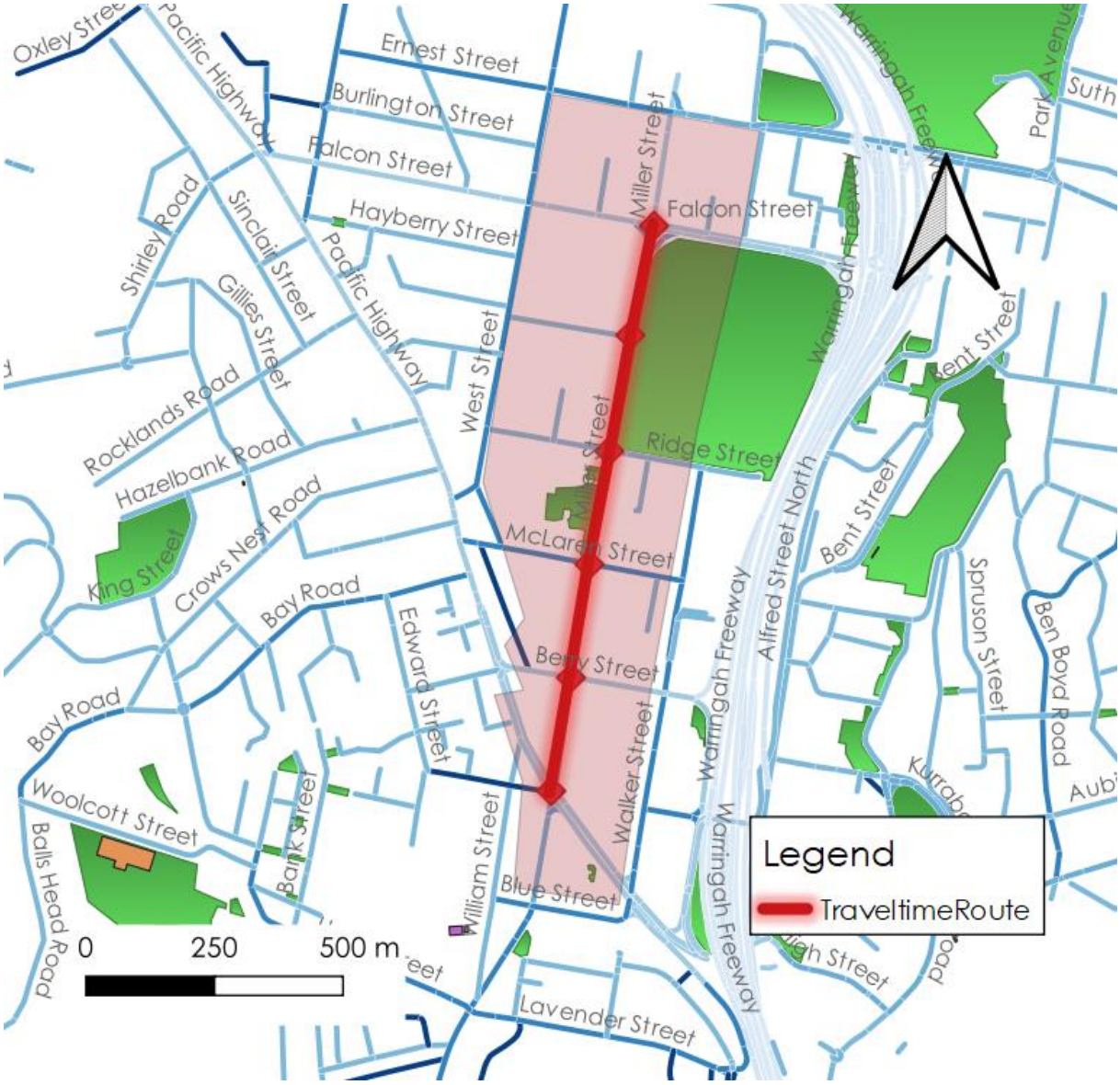
The counts were undertaken from:

- 7:00am – 9:30am Morning Peak
- 2:30pm – 5:00pm Evening School Peak

2.1.2 Travel Time Surveys

Travel time surveys were undertaken along Miller Street from 7:00am – 9:30am and 2:30pm – 5:00pm to cover the school peaks. The travel time route and associated waypoints are shown in Figure 2.1.

Figure 2.1: Travel Time Survey Route



2.2 Supporting Data

2.2.1 Bus Route Data

Bus route and timetable data was imported from the TfNSW public transport data base. This was the current timetable as at September 2020.

2.2.2 Traffic Signal Timing

SCATS History data was obtained from RMS and used for the traffic signal timing in the model. Data was obtained for every signalised intersection within the model. The data obtained covered the periods that that traffic surveys were undertaken.

2.2.3 Aerial Photography

Road geometry and intersection layouts were based on aerial photography from nearmap.

2.3 Congestion Locations

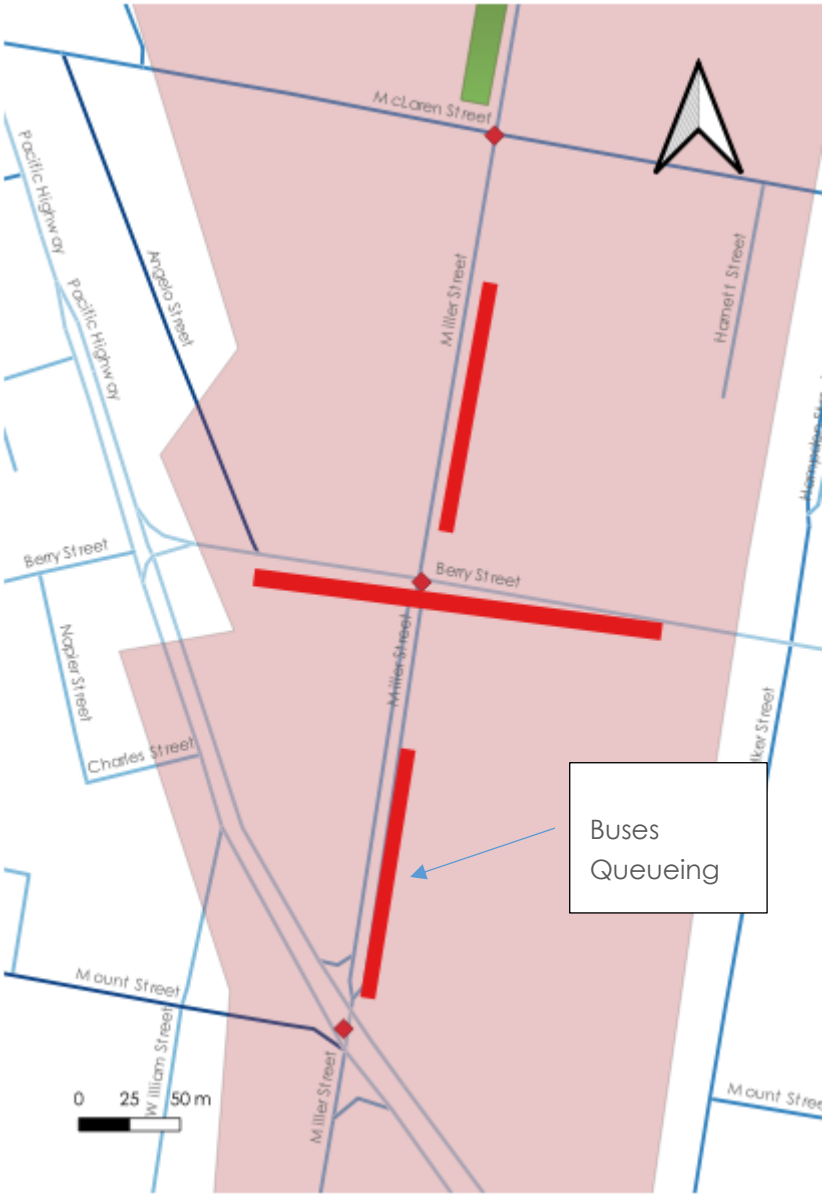
Generally, Miller Street operates with relatively low levels of congestion. This is reflected in the travel times on Miller Street roughly tracking at close to the 40km/h for most of its length.

In the morning peak there is some congestion on the approach to the Pacific Highway as a result of the number of buses attempting to use bus stops that interchange with North Sydney Train Station. This tends to affect the kerb side and middle lanes.

Southbound on Miller Street on approach to Miller Street also experiences some queuing however these queues typically dissipate each cycle. Berry Street also can be congested at times but likewise the queues tend to dissipate each cycle.

In the evening school peak there can be some congestion associated with the bus stops on Miller Street approach to Berry Street but traffic volumes are generally lower than the morning peak and clearways mean that there is low congestion during the afternoon school period.

Figure 2.2: Weekday Morning Congestion



2.4 Road Network

The key roads in the study are:

Miller Street

Miller Street is the main corridor running north-south through North Sydney. The southern portion from Mclaren Street to Blues Street is part of the North Sydney high pedestrian activity area (HPAA) and has a speed limit of 40km/h. The rest of Miller Street has a 50km/h speed limit out of school hours but has 40km/h school zones for most of its length. Miller Street is a regional road within the study area becoming a state road north of Falcon Street. It is generally two lanes in each direction with parking allowed out side peak hours and clearways in the peak directions (southbound in the morning and northbound in the afternoons). Miller Street is used as a trunk route for a number of buses connecting to North Sydney.

Falcon Street

Falcon Street is a state road connecting Crows Nest to Neutral Bay it features an interchange with the Warringah Freeway at its eastern end.

Ridge Street

Ridge Street is a local road that is also a cycle route. It includes access to Council car parks and a driveway access to the Marist College school.

Berry Street

Berry Street is a State Road that connects the Pacific Highway to the Bradfield Motorway and Warringah freeway at the Mount Street ramps. It is a one-way road eastbound.

Pacific Highway

The Pacific Highway is a major arterial road that travels north through Sydney from North Sydney to Hornsby and beyond. It is generally three lanes in each direction but often includes additional lanes and turning lanes at intersections.

3 Model Assumptions

3.1 Overview

The model is a micro-simulation corridor model of Miller Street from Falcon Street to the Pacific Highway.

3.2 Modelling Platform

The models have been developed in Aimsun Version 8.4.0 using the micro-simulations.

3.3 Time Period

Time periods from:

- 7:30am – 9:30am
- 2:30pm – 4:30pm

For both the morning and evening models a 30 minute warmup period has been applied.

3.4 Assignment Type

There is limited path assignment in the model as it is a corridor. The models have therefore been run as 'One shot' stochastic route choice.

3.5 Vehicle Types

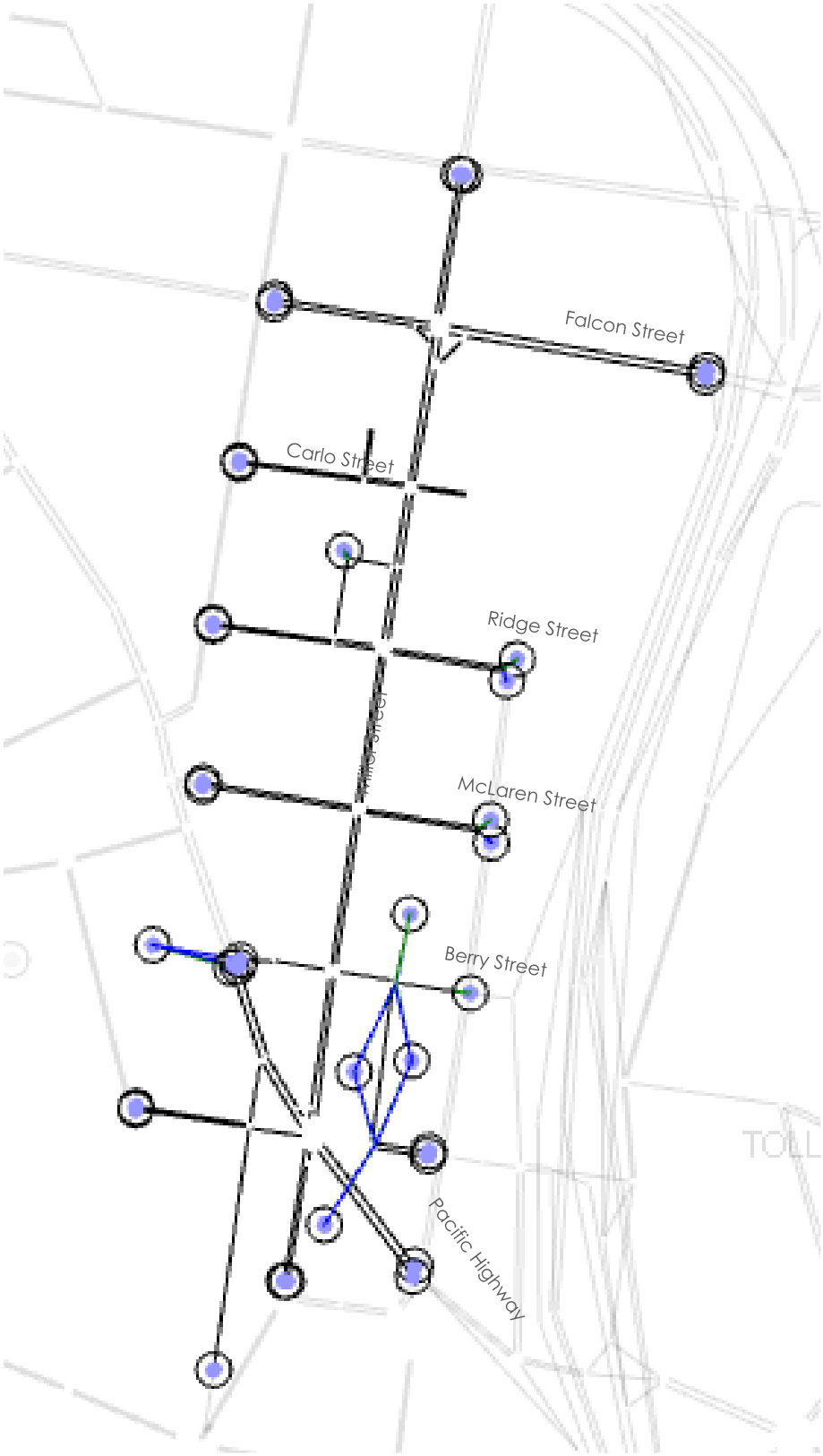
The vehicle types have been adopted from the Greater Sydney Aimsun model with no changes. This includes:

- Cars
- Heavy Vehicles
- Buses

3.6 Traffic Zones / Inputs

The centroid configuration has been based on a subarea cut of the Greater Sydney Aimsun model. The centroid locations are shown in Figure 3.1

Figure 3.1: Centroid Locations



3.7 Road Types

The road types have not been changed from the Greater Sydney Aimsun Model. The road types are shown in Figure 3.2.

Figure 3.2: Road Types

3.8 Speed Profiles

The speed profiles have been adopted from the Greater Sydney Aimsun Model with no changes.

Light Vehicles

	Mean	Deviation	Minimum	Maximum
Max Acceleration	3.00 m/s2	0.20 m/s2	2.60 m/s2	3.40 m/s2
Normal Deceleration	4.00 m/s2	0.25 m/s2	3.50 m/s2	4.50 m/s2
Max. Deceleration	6.00 m/s2	0.50 m/s2	5.00 m/s2	7.00 m/s2
Safety Margin Factor	1.00	0.00	1.00	1.00

Heavy Vehicles

	Mean	Deviation	Minimum	Maximum
Max Acceleration	0.80 m/s2	0.25 m/s2	0.60 m/s2	1.00 m/s2
Normal Deceleration	2.00 m/s2	0.50 m/s2	2.00 m/s2	4.00 m/s2
Max. Deceleration	3.50 m/s2	0.30 m/s2	3.20 m/s2	3.80 m/s2
Safety Margin Factor	1.00	0.00	1.00	1.00

3.9 School Zones

A 40km per hour speed limit has been applied on Miller Street to correspond to the timing of school zones which are:

- 8:00am – 9:30am
- 2:30pm – 4:00pm

School zones have been applied using a school zone policy for the morning and afternoon peak periods. For most of the model time periods Miller Street effectively has a speed limit of 40km/h.

3.10 Traffic Signals

Traffic signals timing has been based on SCATS History file data that was obtained from Transport for NSW of the time period corresponding to the periods of the model. The intersection of the Pacific Highway and Miller Street (Victoria Cross) has been coded as an actuated signals in order to model the diamond overlap phasing.

3.11 Public Transport

Public transport routes (specifically bus routes) have been sourced using General Transit Feed Specification (GTFS) data as provided by https://opendata.transport.nsw.gov.au/dataset/timetables-complete-gtfs.

The data indicates the routes, frequencies and stop locations of services which run through the specified model area. The data provided also indicates school bus routes which run through the area and their respective stop locations, noting that certain services stop at locations not accessible to public bus services.

3.12 Demand Assumptions

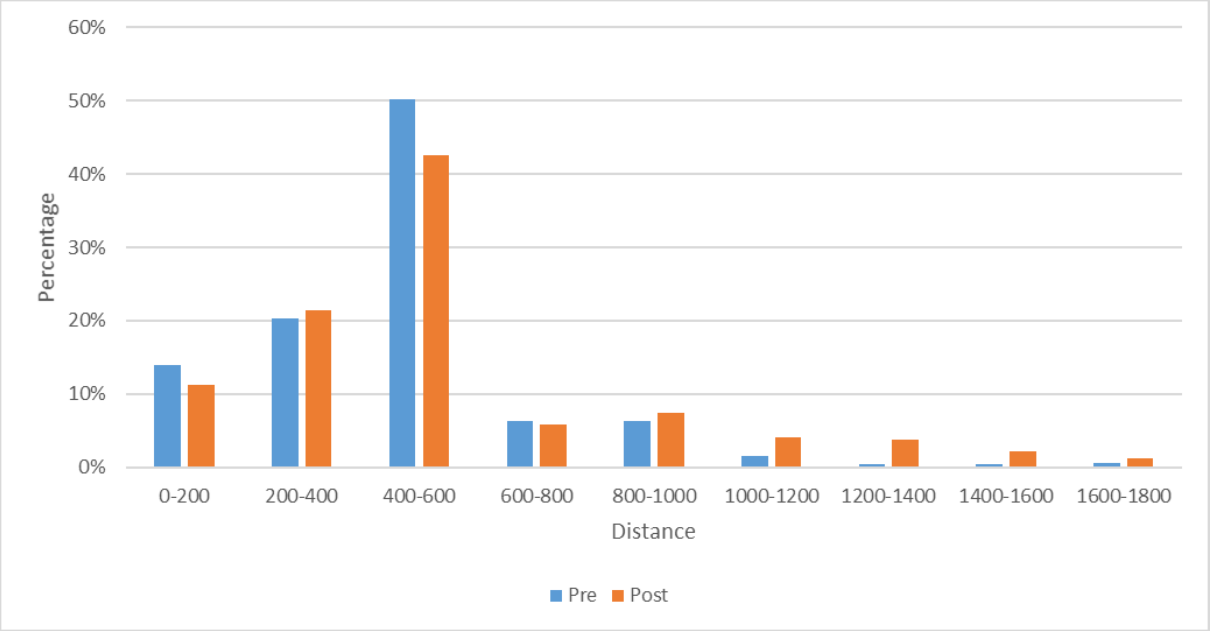
Traffic demands were developed from a subarea traversal for the study area from the STFM model. This subarea matrix was then used as the basis for a departure adjustment to intersection count data.

3.13 Trip Length Distribution

The trip length distribution is the number of trips that travel certain distances in the model. The matrix estimation process can sometime distort this trip length by filling in shorter trips in place of longer trips or vice versa. This may effect some behaviours in the model and the network statistics.

The models trip length distribution has been compared between the raw seed matrices from the strategic model and the results of the departure adjustment. The comparison of the morning peak is shown in Figure 3.3.

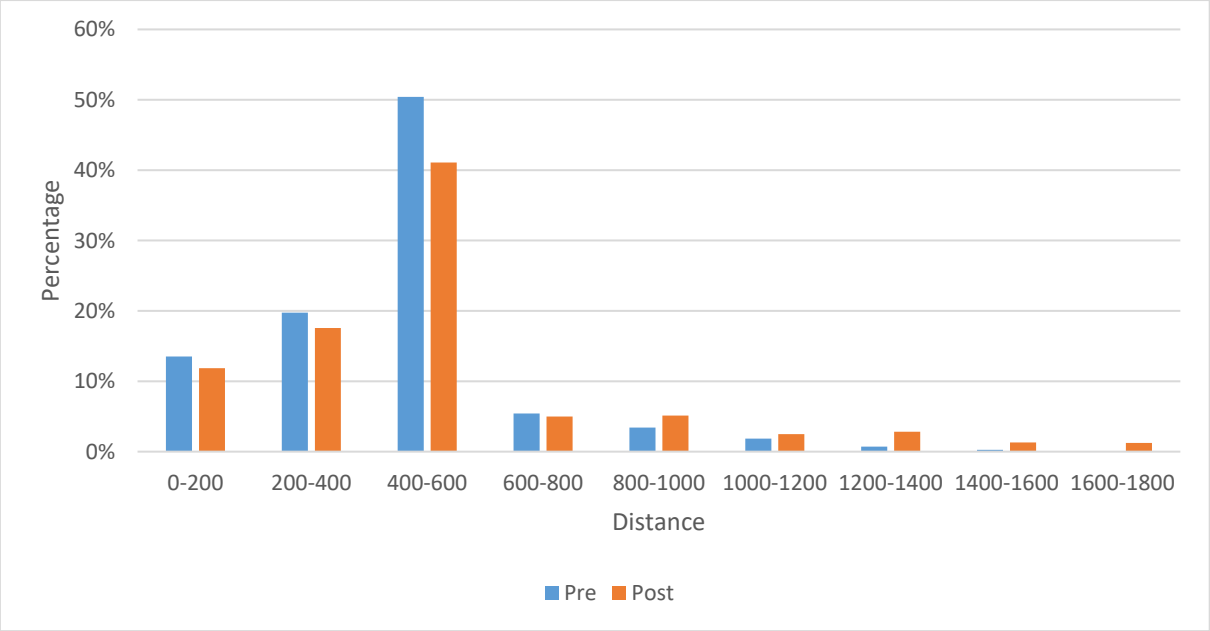
Figure 3.3: Morning Peak Period Trip Length Distribution



The data shows that after the departure adjustment the matrix retains a similar shape to the original matrix.

The evening peak period trip length distribution is shown in Figure 3.4.

Figure 3.4: Evening Peak Period Trip Length Distribution



The evening peak trip length distribution also shows that the trip patterns not been significantly distorted by the matrix estimation process.

The trip length distribution shows that the models reflect the outputs from the strategic models.

3.14 Traffic Profiles

The models have 15 minute time slices. These time slices create the profile of traffic based on the traffic count data. The profiles for the morning and evening peaks are shown in Figure 3.5 and Figure 3.6 for the morning and evening peak respectively.

Figure 3.5: Morning Peak Traffic Profiles

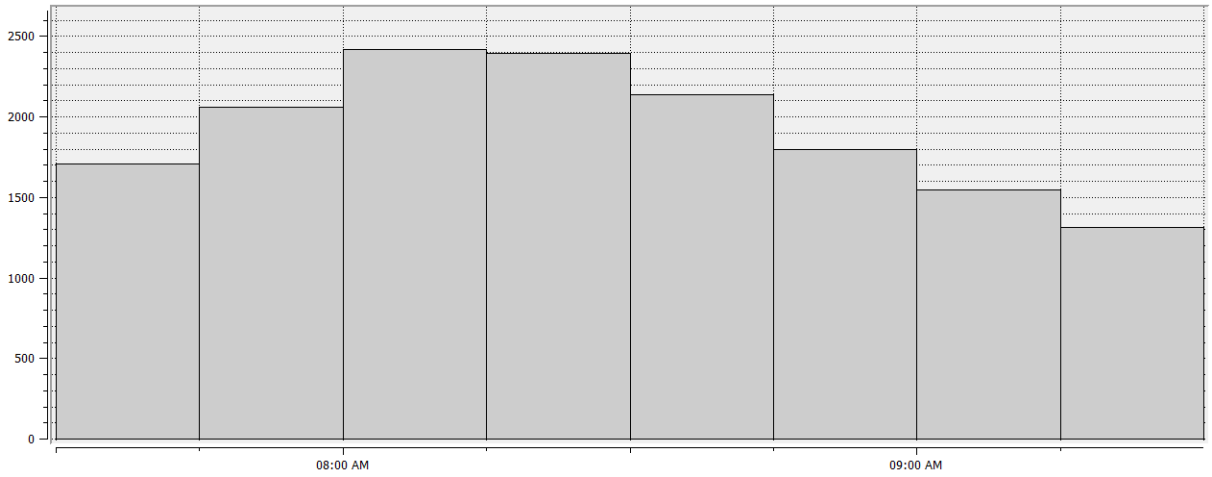
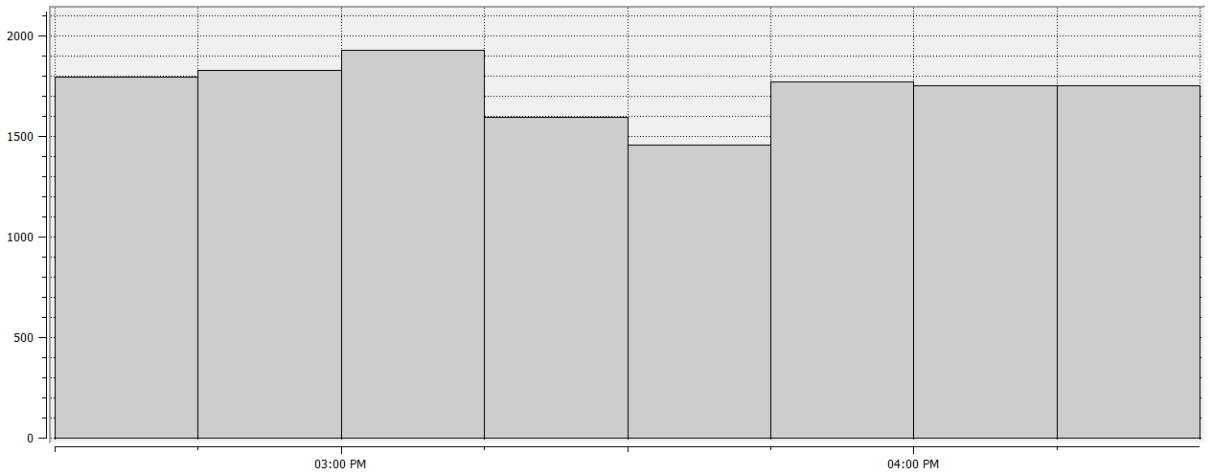


Figure 3.6: Evening Peak Traffic Profiles



The morning peak reflects the morning commuter peak at 8:30 with traffic volumes dropping away after this time.

The evening peak shows a peak after 3:00pm corresponding to the school's peak with traffic remaining relatively level in the period from 3:45pm – 4:30pm.

3.15 Calibration and Validation Targets

The following sets out the calibration and validation targets that have been adopted.

3.15.1 Calibration

The calibration criteria have been based on the RMS Modelling guidelines for micro-simulation models.

Calibration of the base model has adopted the following targets from the guidelines:

- 85% of all turns with a GEH of less than 5
- 100% of all turns with a GEH of less than 10
- Linear regression R^2 value > 0.9

The GEH statistic is a measure of goodness of fit used by traffic modellers. Using the GEH Statistic avoids some problems that occur when using simple percentages to compare two sets of volumes. This is because the traffic volumes vary over a wide range. For example, the mainline of a freeway/motorway might carry 5000 vehicles per hour, while one of the on-ramps leading to the freeway might carry only 50 vehicles per hour (in that situation it would not be possible to select a single percentage of variation that is acceptable for both volumes). The equation for GEH is an empirical formula:

$$GEH = \sqrt{\frac{2(M-C)^2}{M+2}}$$

Where:

M = the modelled traffic flow for one hour

C = the observed traffic flow for one hour

The lower the GEH is the closer the model is to the observed traffic flows.

3.15.2 Core Area Calibration

The calibration of a core area has been used to ensure the model is more robust in the area that would be directly impacted by the development.

The core area calibration targets from the Roads and Maritime Services Guidelines is:

- Flows < 99 – to be within 10 vehicles or the observed value

- Flows 100 – 999 – to be within 10% of the observed flows
- Flows 1000 to 1999 to be within 100 vehicles of observed value
- Flows > 2000 to be within 5 % of observed values
- 100% percent of observations to be within tolerance limits

3.15.3 Validation

Validation of the models has been based on travel times on Church Street and Parramatta Road. The target for travel time validation is +/- 15% of the observed travel times.

4 Model Stability

To ensure that the models have not been biased and to take into account random variation the models have been run for 5 random seed values as prescribed by Transport for NSW. These random seed values are:

- 560
- 28
- 7771
- 86524
- 2849

Seed numbers begin the sequence of random numbers that is used to generate the release patterns from the centroids. Model stability has been assessed based on the model Vehicle Hours Travelled (VHT). The median VHT has been adopted as the representative result on which the calibration results have been based.

The morning peak model stability is shown in Table 4.1.

Table 4.1: Morning Peak Model Stability

Seed Value	VHT
560	432
28	433
2849	432
86429	445
7771	441
Median	433 (seed 28)
Standard Deviation	**6.09**

The median seed value was seed 28 and the standard deviation was 6.09.

The evening peak stability is shown in Table 4.2.

Table 4.2: Evening Peak Model Stability

Seed Value	VHT
560	333
28	334
2849	335
86429	339
7771	344
Median	335 (seed 2849)
Standard Deviation	**4.34**

The median seed value for the evening peak is 2849 and standard deviation of 3.34.

5 Calibration and Validation Results

5.1 Overview

The following section presents the model calibration and validation in accordance with the TfNSW guidelines to the targets that have been described in Section 3.

5.2 Model Calibration

5.2.1 Model Calibration All Turns GEH Statistic

The model as a whole has been calibrated to turn counts for the whole model. There were 75 turn counts used in the model. The results of the turn calibration are shown in Table 5.1

Table 5.1: Model Calibration GEH Statistic

Time Period	GEH < 5	GEH > 10
Morning Peak Period		
7:30am – 8:30am	92%	100%
8:30am – 9:30am	97%	100%
Evening Peak Period		
4:00pm – 5:00pm	97%	100%
5:00pm – 6:00pm	99%	100%

In all time periods the model exceeds the calibration criteria.

The observed flows have been plotted against the modelled flows and a trend line added with an intercept of 0. The plots for the morning peak are shown in Figure 5.1 and Figure 5.2.

Figure 5.1: Morning Peak Volume Plot (7:30am – 8:30am)

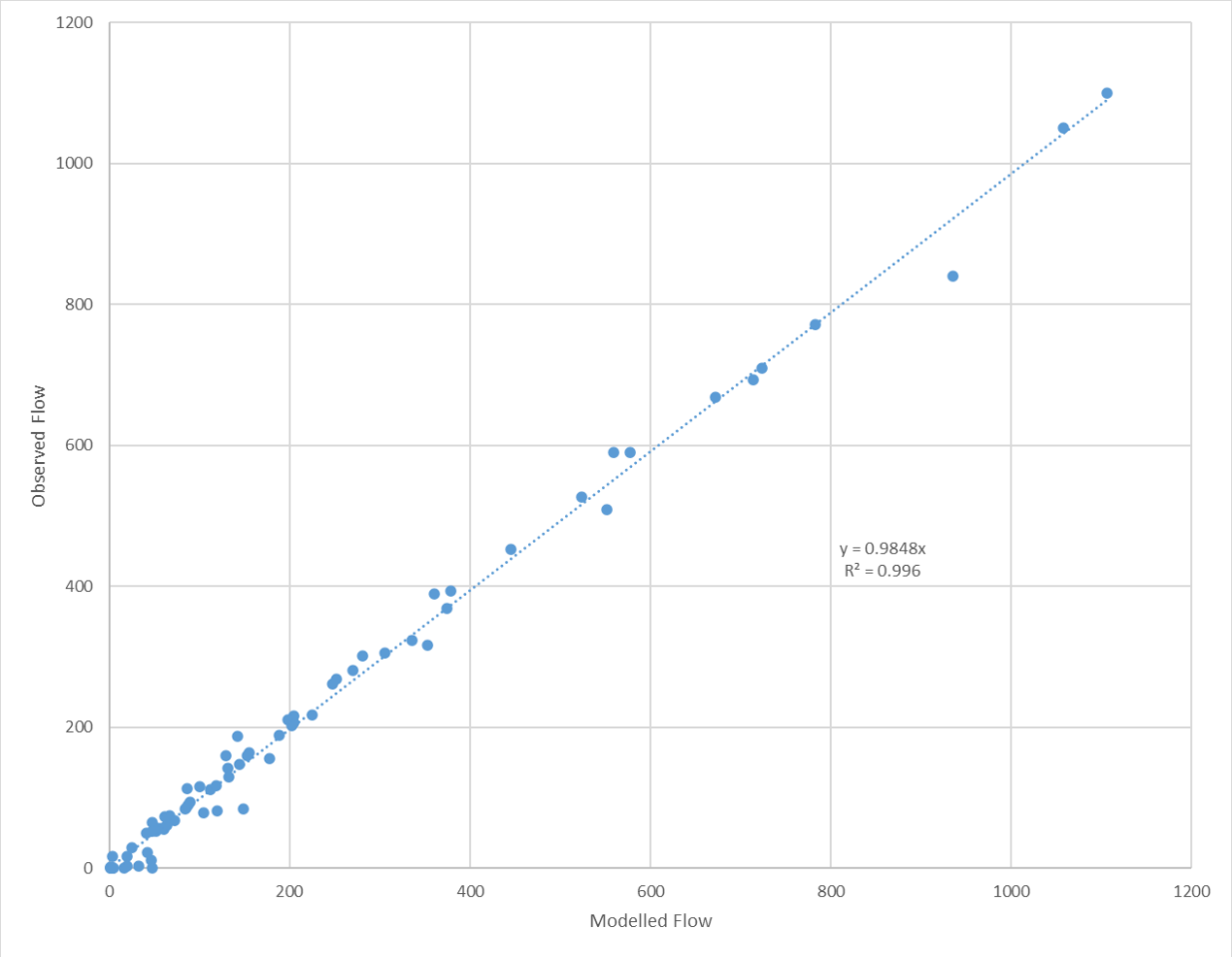
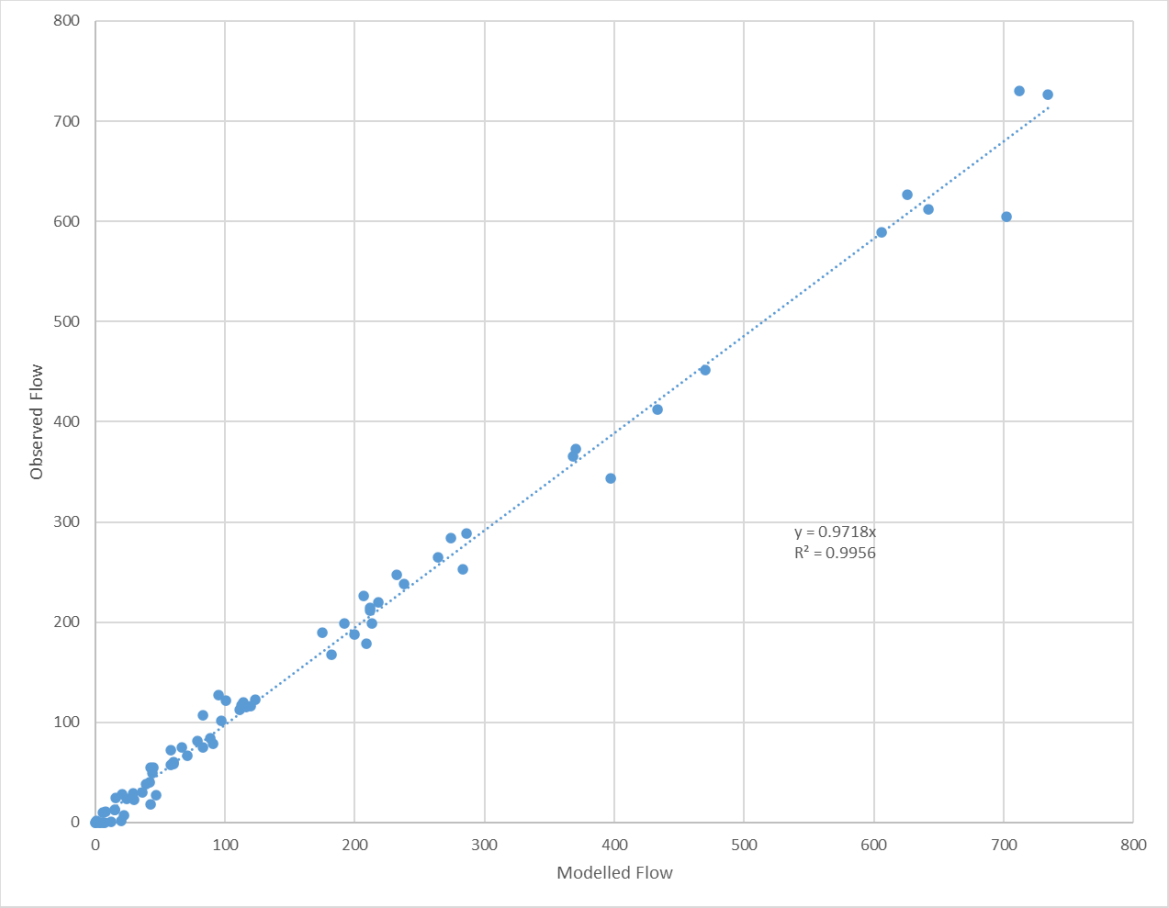


Figure 5.2: Morning Peak Volume Plot (8:30am – 9:30am)



In both the morning peak periods the model shows a strong correlation with the observed traffic flows and exceeds the calibration criteria for both $R^2 > 0.9$ and the slope close to 1.

The evening peak period graphs are shown in Figure 5.3 and Figure 5.4 for the hours starting 4:00pm and 5:00pm respectively.

Figure 5.3: Evening Peak Volume Plot (2:30pm – 3:30pm)

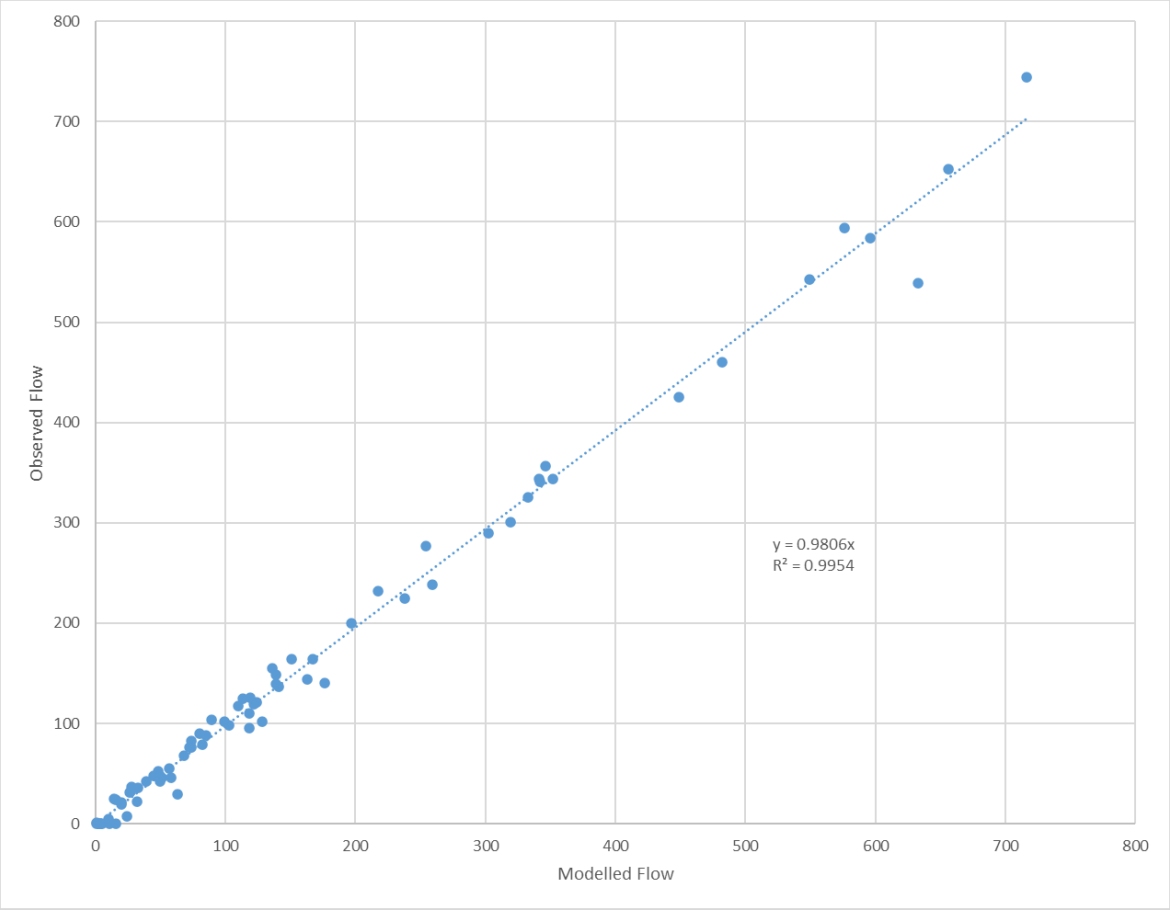
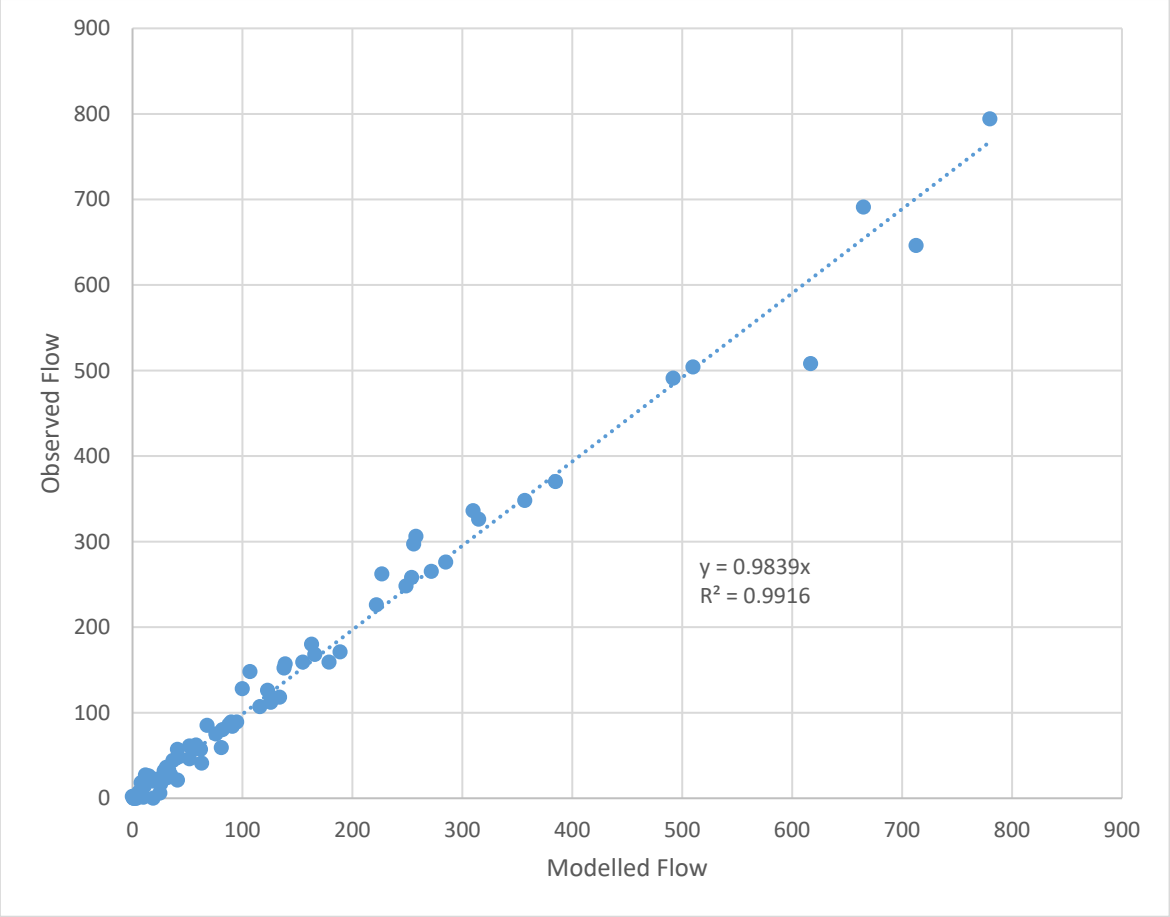


Figure 5.4: Evening Peak Volume Plot (3:30pm – 4:30pm)



In the evening peak model the calibration exceeds the criteria for $R^2 > 0.9$ and the slope is close to 1.

The overall model is considered to be calibrated and exceeds the relevant targets for the model as whole.

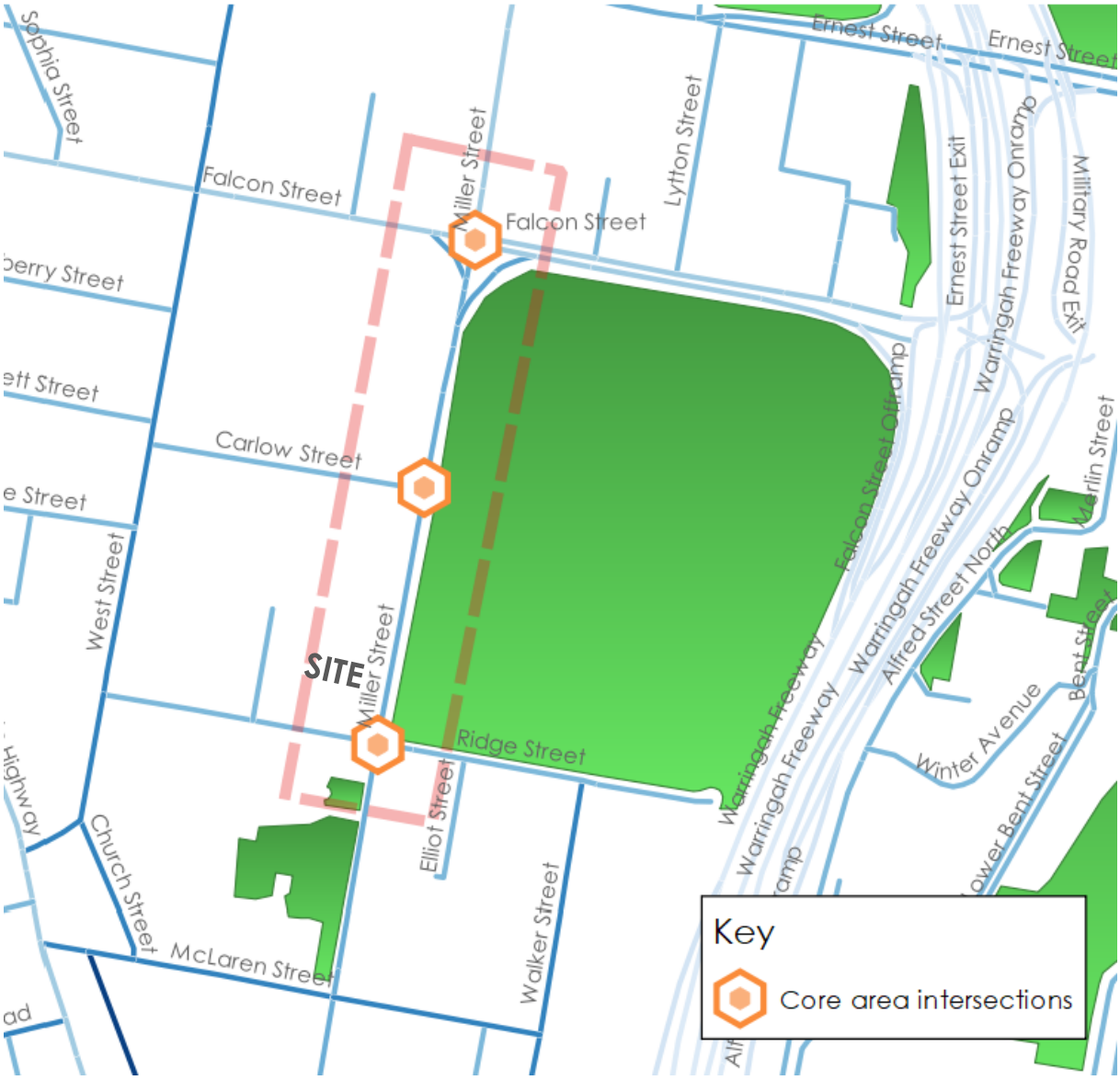
5.2.2 Model Core Area Calibration

The model has been calibrated in more detail for a core area. The purpose of the model is to test the impacts the Crescent Parklands and therefore the core area has been adopted to include the intersections of:

- Falcon Street / Miller Street (intersection 1)
- Carlow Street / Miller Street (intersection 2)
- Ridge Street / Miller Street (intersection 3)

This core area is shown in Figure 5.5.

Figure 5.5: Core Area



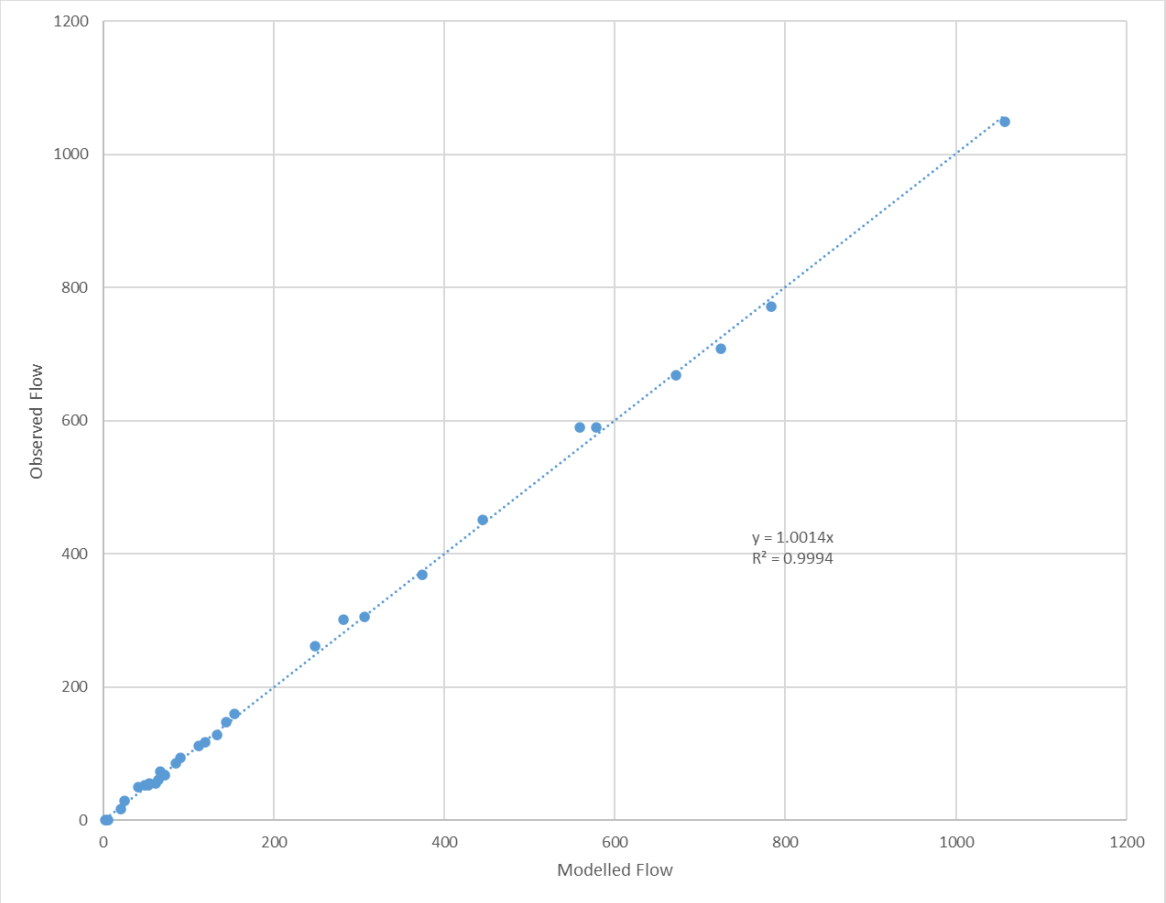
The comparison of turn counts between the modelled and the observed is shown in Table 5.2.

Table 5.2: Morning Peak Core Area Model Calibration (7:30am – 8:30am)

	Turn	Observed	Modelled	Difference	% Difference`	Meets Criteria
Intersection 1	EB Falcon St Left	64	61	3	5%	TRUE
	EB Falcon St Through	578	590	12	2%	TRUE
	SB Miller Street Through	724	709	15	2%	TRUE
	SB Miller Street Left	52	53	1	2%	TRUE
	WB Falcon Street Right	153	160	7	5%	TRUE
	WB Falcon Street Through	783	772	11	1%	TRUE
	WB Falcon Street Left	445	452	7	2%	TRUE
	NB Miller Street Left	133	129	4	3%	TRUE
	NB Miller Street Through	248	262	14	6%	TRUE
	NB Miller Street Right	306	305	1	0%	TRUE
Intersection 2	EB Carlow Street Left	119	117	2	2%	TRUE
	EB Carlow Street Through	3	0	3	100%	TRUE
	EB Carlow Street Right	41	50	9	22%	TRUE
	SB Miller Street Right	112	112	0	0%	TRUE
	SB Miller Street Through	1058	1050	8	1%	TRUE
	SB Miller Street Left	2	0	2	100%	TRUE
	NB Miller Street Right	5	0	5	100%	TRUE
	NB Miller Street Through	559	590	31	6%	TRUE
	NB Miller Street Left	48	53	5	10%	TRUE
In t	EB Ridge Street Left	67	74	7	10%	True
	EB Ridge Street Through	90	94	4	4%	True
	EB Ridge Street Right	20	17	3	15%	True
	SB Miller Street Left	281	302	21	7%	True
	SB Miller Street Through	672	668	4	1%	TRUE
	SB Miller Street Right	144	148	4	3%	TRUE
	WB Ridge Street Right	85	86	1	1%	TRUE
	WB Ridge Street Through	54	56	2	4%	TRUE
	WB Ridge Street Left	61	55	6	10%	TRUE
	NB Miller Street Left	72	68	4	6%	TRUE
	NB Miller Street Through	374	369	5	1%	TRUE
	NB Miller Street Right	25	29	4	16%	TRUE

In the first hour, 7:30am – 8:30am, all of the turns meet the criteria. The volume plot is shown in Figure 5.6.

Figure 5.6: Core Area Volume Plot (7:30am – 8:30am)



The R^2 for the first hour exceeds the 0.95 target and the slope is close to 1.

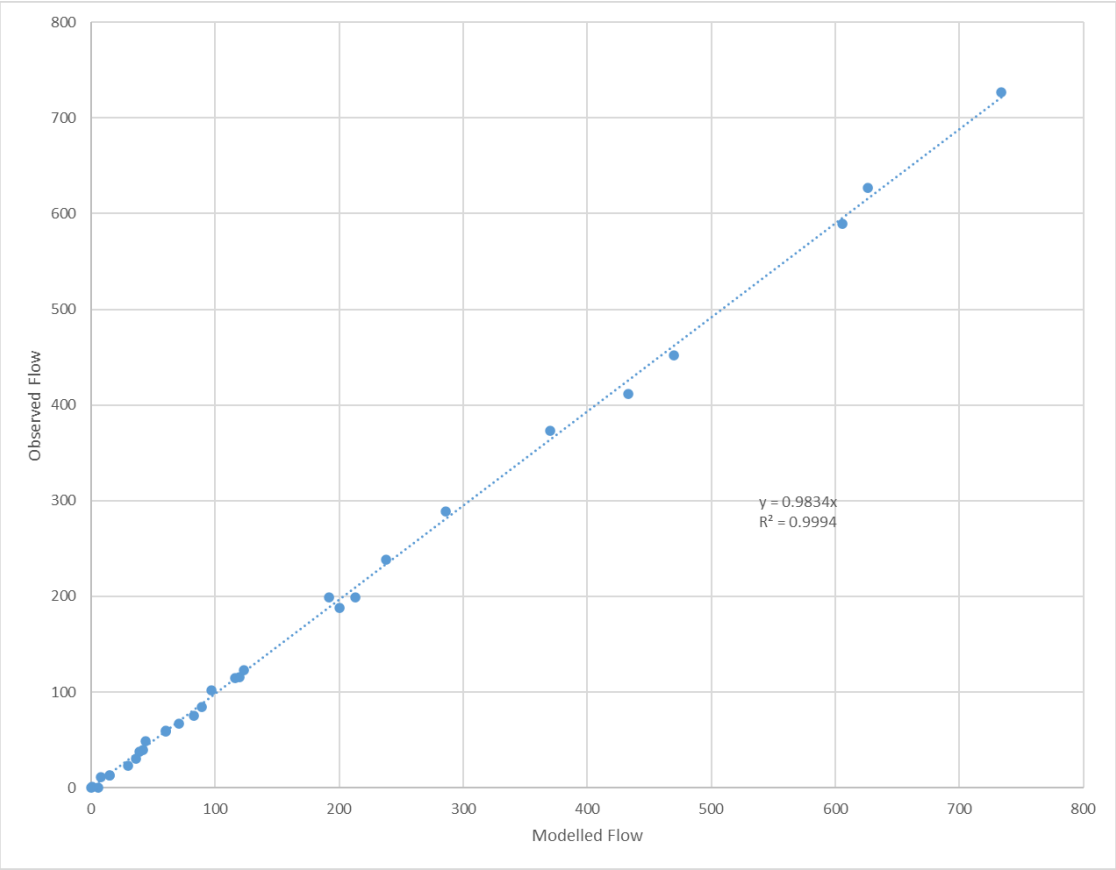
The results for the second hour are shown in Table 5.3.

Table 5.3: Morning Peak Core Area Model Calibration (8:30am – 9:30am)

	Turn	Observed	Modelled	Difference	% Difference`	Meets Criteria
Intersection 1	EB Falcon St Left	60	60	0	0%	TRUE
	EB Falcon St Through	626	627	1	0%	TRUE
	SB Miller Street Through	433	412	21	5%	TRUE
	SB Miller Street Left	89	84	5	6%	TRUE
	WB Falcon Street Right	192	199	7	4%	TRUE
	WB Falcon Street Through	734	727	7	1%	TRUE
	WB Falcon Street Left	286	289	3	1%	TRUE
	NB Miller Street Left	116	115	1	1%	TRUE
	NB Miller Street Through	200	188	12	6%	TRUE
	NB Miller Street Right	213	199	14	7%	TRUE
Intersection 2	EB Carlow Street Left	120	116	4	3%	TRUE
	EB Carlow Street Through	0	0	0	0%	TRUE
	EB Carlow Street Right	30	23	7	23%	TRUE
	SB Miller Street Right	123	123	0	0%	TRUE
	SB Miller Street Through	606	589	17	3%	TRUE
	SB Miller Street Left	6	0	6	100%	TRUE
	NB Miller Street Right	1	1	0	0%	TRUE
	NB Miller Street Through	370	373	3	1%	TRUE
	NB Miller Street Left	44	49	5	11%	TRUE
Intersection 3	EB Ridge Street Left	71	67	4	6%	True
	EB Ridge Street Through	42	40	2	5%	True
	EB Ridge Street Right	15	13	2	13%	True
	SB Miller Street Left	97	102	5	5%	True
	SB Miller Street Through	470	452	18	4%	TRUE
	SB Miller Street Right	83	75	8	10%	TRUE
	WB Ridge Street Right	60	59	1	2%	TRUE
	WB Ridge Street Through	39	38	1	3%	TRUE
	WB Ridge Street Left	15	13	2	13%	TRUE
	NB Miller Street Left	36	30	6	17%	TRUE
	NB Miller Street Through	238	238	0	0%	TRUE
	NB Miller Street Right	8	11	3	38%	TRUE

In the second hour each of the turns in the core area satisfy the core area calibration requirements. The volume plot is shown in Figure 5.6.

Figure 5.7: Core Area Volume Plot (8:30am – 9:30am)



The R^2 for the second hour exceeds the 0.95 criteria.

The model meets the core area calibration requirement in both hours of the model and is considered to be well calibrated.

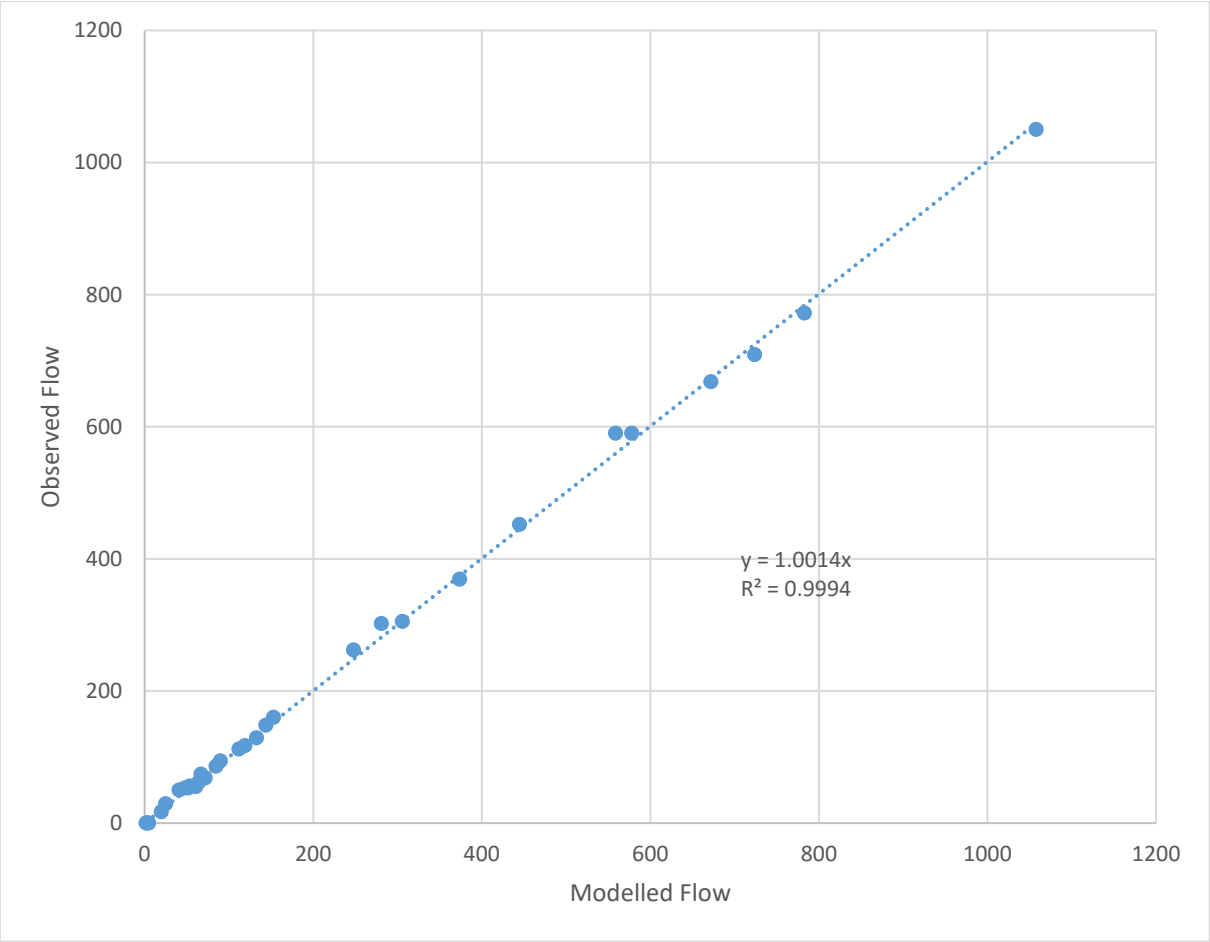
The results for the evening peak first hour are shown in Table 5.4.

Table 5.4: Evening Peak Core Area Model Calibration (2:30pm – 3:30pm)

	Turn	Observed	Modelled	Difference	% Difference`	Meets Criteria
Intersection 1	EB Falcon St Left	48	48	0	0%	TRUE
	EB Falcon St Through	716	744	28	4%	TRUE
	SB Miller Street Through	333	325	8	2%	TRUE
	SB Miller Street Left	82	79	3	4%	TRUE
	WB Falcon Street Right	167	164	3	2%	TRUE
	WB Falcon Street Through	656	653	3	0%	TRUE
	WB Falcon Street Left	197	200	3	2%	TRUE
	NB Miller Street Left	110	117	7	6%	TRUE
	NB Miller Street Through	254	277	23	9%	TRUE
	NB Miller Street Right	319	301	18	6%	TRUE
Intersection 2	EB Carlow Street Left	103	98	5	5%	TRUE
	EB Carlow Street Through	1	0	1	100%	TRUE
	EB Carlow Street Right	33	36	3	9%	TRUE
	SB Miller Street Right	99	102	3	3%	TRUE
	SB Miller Street Through	449	425	24	5%	TRUE
	SB Miller Street Left	3	0	3	100%	TRUE
	NB Miller Street Right	4	0	4	100%	TRUE
	NB Miller Street Through	576	594	18	3%	TRUE
	NB Miller Street Left	72	76	4	6%	TRUE
Intersection 3	EB Ridge Street Left	85	88	3	4%	True
	EB Ridge Street Through	50	42	8	16%	True
	EB Ridge Street Right	20	19	1	5%	True
	SB Miller Street Left	122	119	3	2%	True
	SB Miller Street Through	302	290	12	4%	TRUE
	SB Miller Street Right	74	76	2	3%	TRUE
	WB Ridge Street Right	118	110	8	7%	TRUE
	WB Ridge Street Through	39	42	3	8%	TRUE
	WB Ridge Street Left	27	32	5	19%	TRUE
	NB Miller Street Left	51	46	5	10%	TRUE
	NB Miller Street Through	341	344	3	1%	TRUE
	NB Miller Street Right	16	24	8	50%	TRUE

The first hour of the evening peak meets the targets for the core area calibration. The observed and modelled flows have been plotted and are shown in Figure 5.8.

Figure 5.8: Core Area Volume Plot (2:30pm – 3:30pm)



The plot shows that the R^2 exceeds 0.95 target.

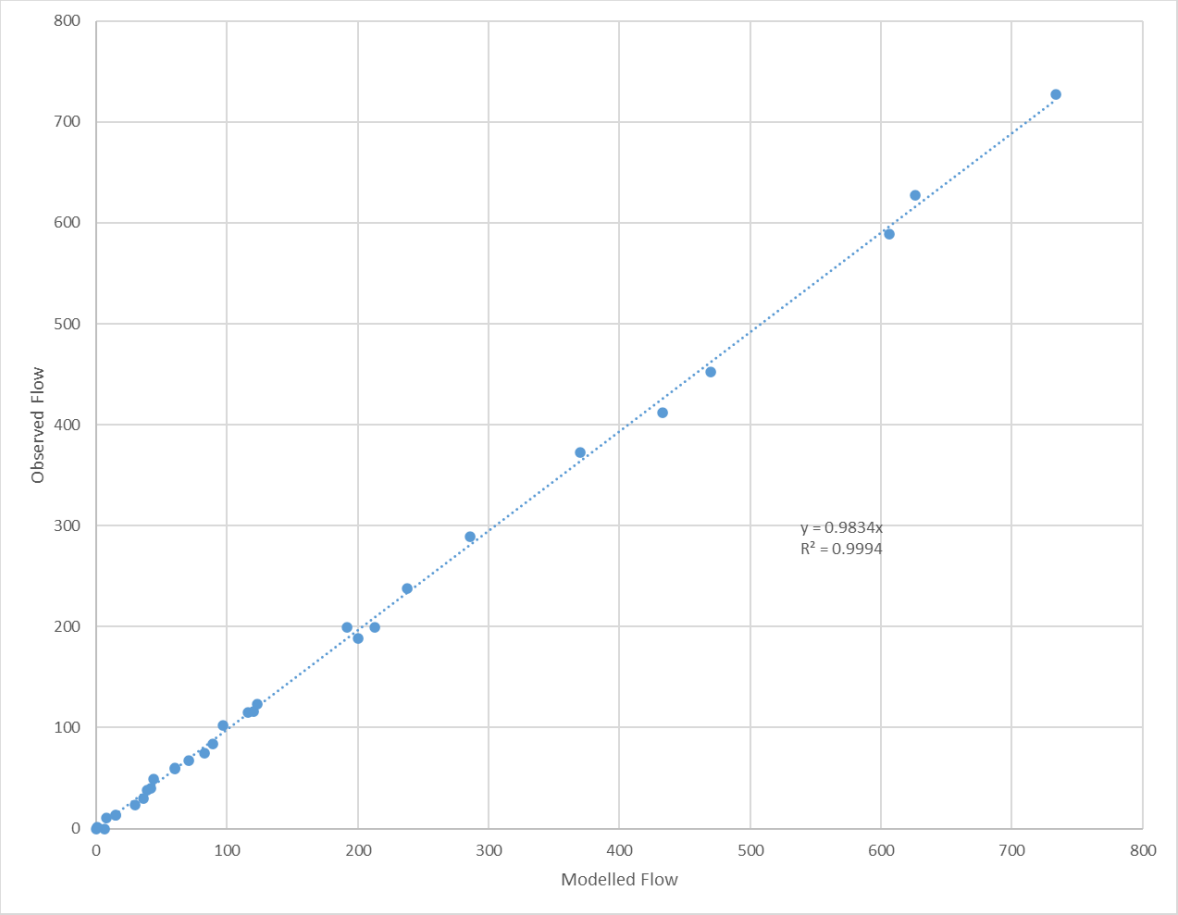
The second hour core area results are shown in Table 5.5.

Table 5.5: Evening Peak Core Area Model Calibration (3:30pm – 4:30pm)

	Turn	Observed	Modelled	Difference	% Difference`	Meets Criteria
Intersection 1	EB Falcon St Left	52	46	6	12%	TRUE
	EB Falcon St Through	713	646	67	9%	TRUE
	SB Miller Street Through	254	258	4	2%	TRUE
	SB Miller Street Left	88	86	2	2%	TRUE
	WB Falcon Street Right	222	226	4	2%	TRUE
	WB Falcon Street Through	780	794	14	2%	TRUE
	WB Falon Street Left	166	168	2	1%	TRUE
	NB Miller Street Left	82	80	2	2%	TRUE
	NB Miller Street Through	249	248	1	0%	TRUE
	NB Miller Street Right	285	276	9	3%	TRUE
Intersection 2	EB Carlow Street Left	90	87	3	3%	TRUE
	EB Carlow Street Through	1	0	1	100%	TRUE
	EB Carlow Street Right	22	22	0	0%	TRUE
	SB Miller Street Right	76	75	1	1%	TRUE
	SB Miller Street Through	357	348	9	3%	TRUE
	SB Miller Street Left	2	0	2	100%	TRUE
	NB Miller Street Right	1	2	1	100%	TRUE
	NB Miller Street Through	510	504	6	1%	TRUE
	NB Miller Street Left	37	44	7	19%	TRUE
Intersection 3	EB Ridge Street Left	58	58	0	0%	True
	EB Ridge Street Through	62	57	5	8%	True
	EB Ridge Street Right	29	32	3	10%	True
	SB Miller Street Left	90	89	1	1%	True
	SB Miller Street Through	272	265	7	3%	TRUE
	SB Miller Street Right	31	36	5	16%	TRUE
	WB Ridge Street Right	116	107	9	8%	TRUE
	WB Ridge Street Through	33	25	8	24%	TRUE
	WB Ridge Street Left	33	33	0	0%	TRUE
	NB Miller Street Left	32	24	8	25%	TRUE
	NB Miller Street Through	315	326	11	3%	TRUE
	NB Miller Street Right	11	14	3	27%	TRUE

The model meets the targets for the core area in the second hour of the evening peak. The volumes for the second hour are plotted in Figure 5.9.

Figure 5.9: Core Area Volume Plot (4:30pm – 5:30pm)



The R^2 for the second hour also meets the target of 0.95.

In each of the hours modelled the core area has been calibrated to exceed the targets set out by Transport for NSW. The model is considered to be well calibrated for the core area that has been adopted.

5.3 Model Validation Travel Time

The model validation has been based on travel times on Miller Street. The results for the morning peak periods are shown in Figure 5.10, Figure 5.11, Figure 5.12 and Figure 5.13. The graphs show the average observed travel times with 15% variability as well as the fastest and slowest recorded travel times. In each hour the travel time falls within the 15% of the average observed travel times.

Figure 5.10: Morning Peak Travel Time Northbound (7:30am – 8:30am)

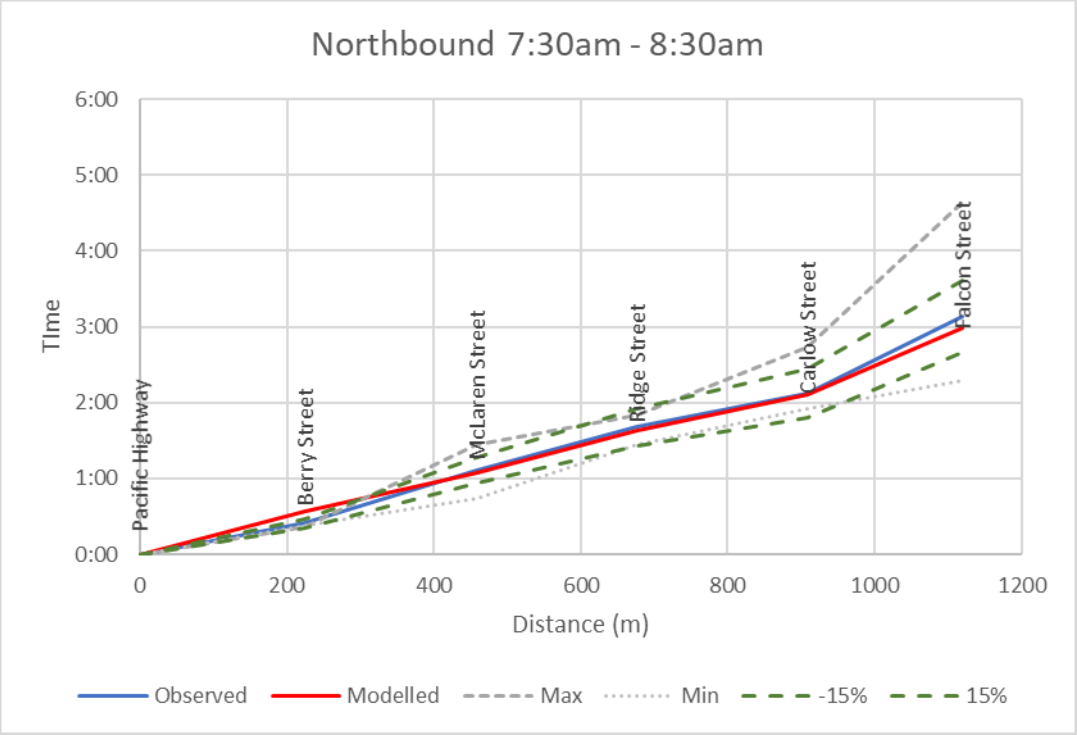


Figure 5.11: Morning Peak Travel Time Northbound (8:30am – 9:30am)

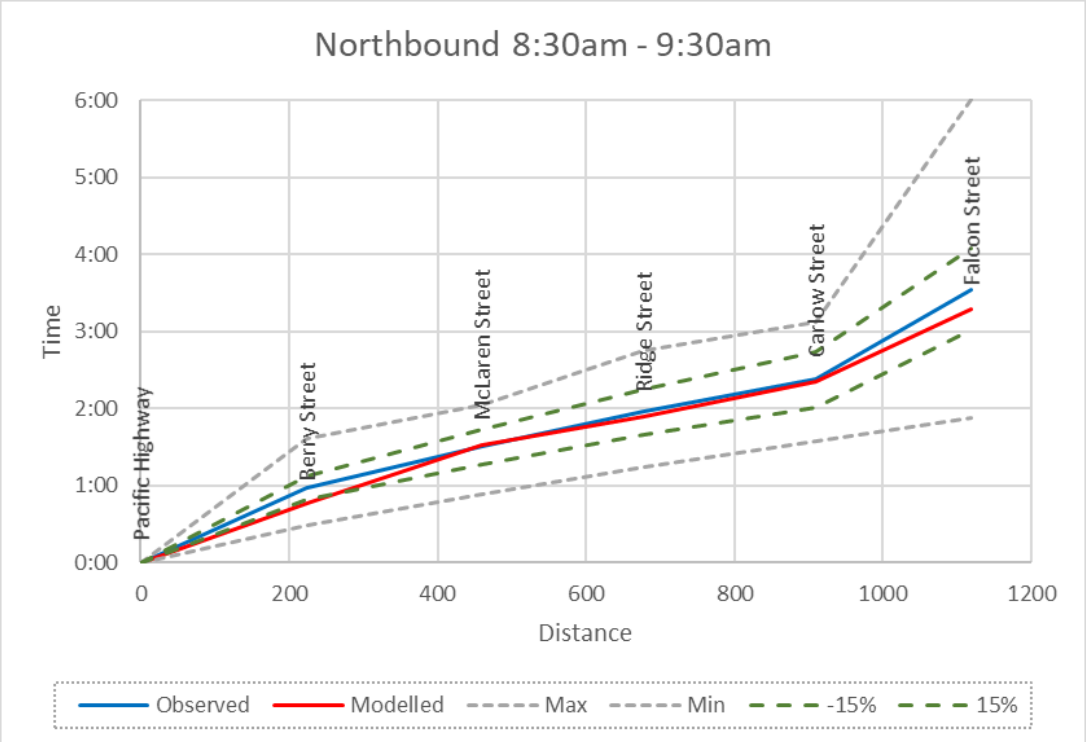


Figure 5.12: Morning Peak Travel Time Southbound (7:30am – 8:30am)

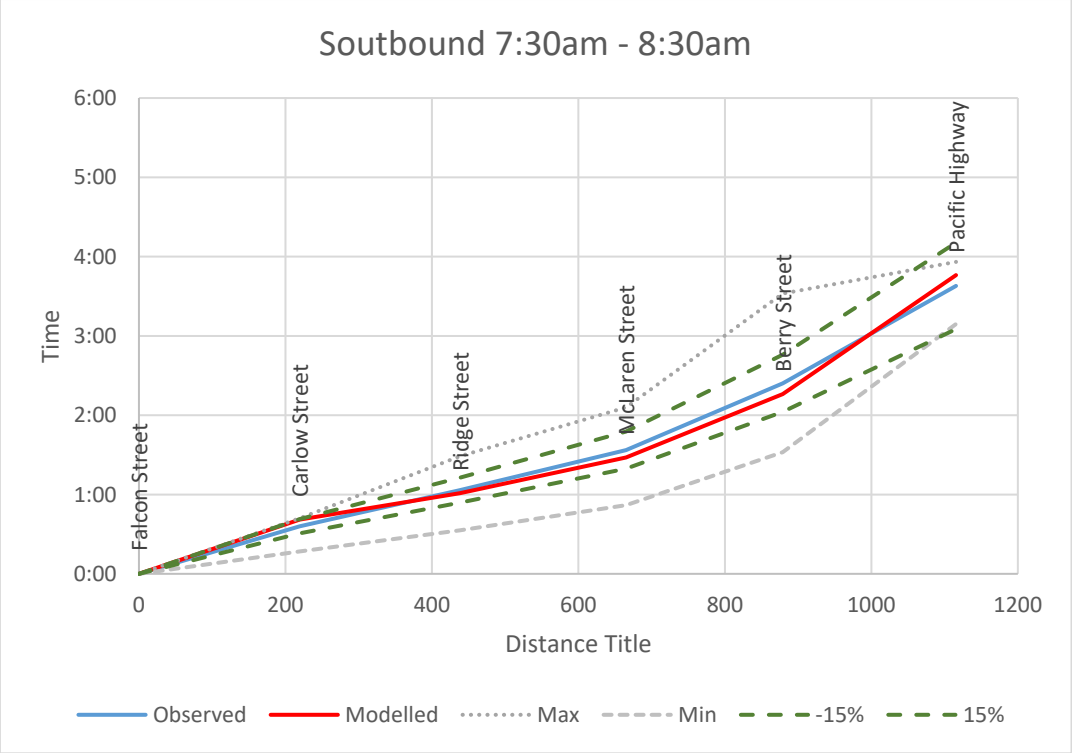
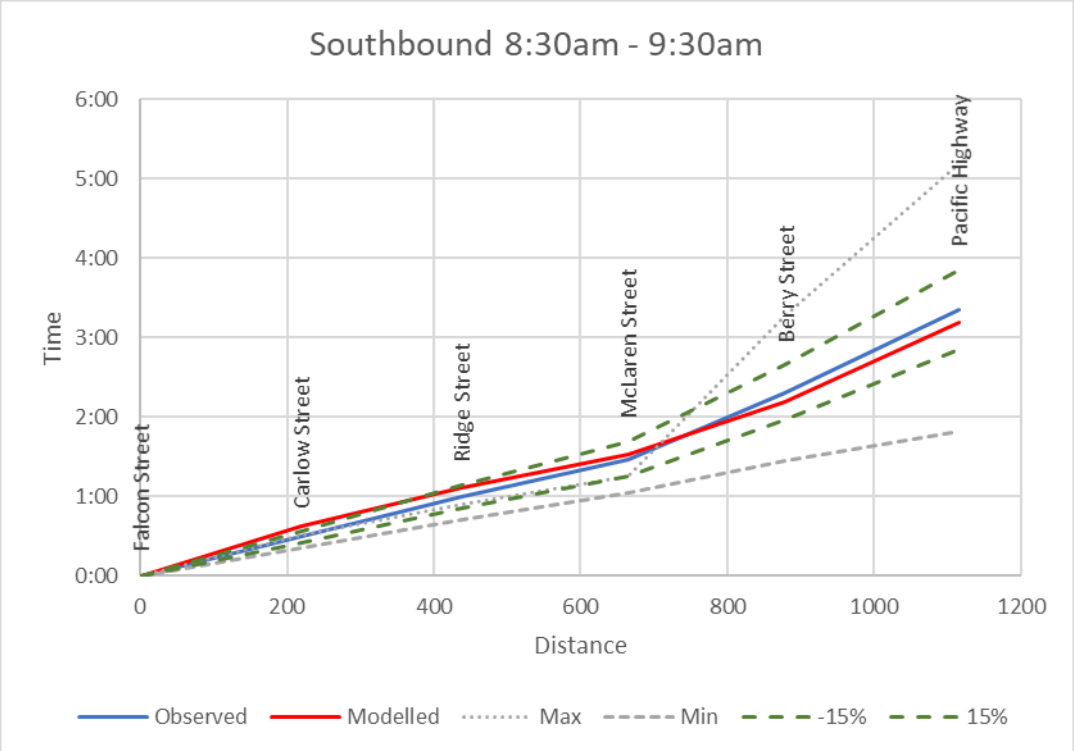


Figure 5.13: Morning Peak Travel Time Southbound (8:30am – 9:30am)



In the Morning peak the modelled travel times reflect the observed travel times and are completed withing the 15% of the observed travel time for all hours.

The evening peak travel times are shown in Figure 5.14, Figure 5.15, Figure 5.16 and Figure 5.17.

Figure 5.14: Evening Peak Travel Time Eastbound (2:30pm – 3:30pm)

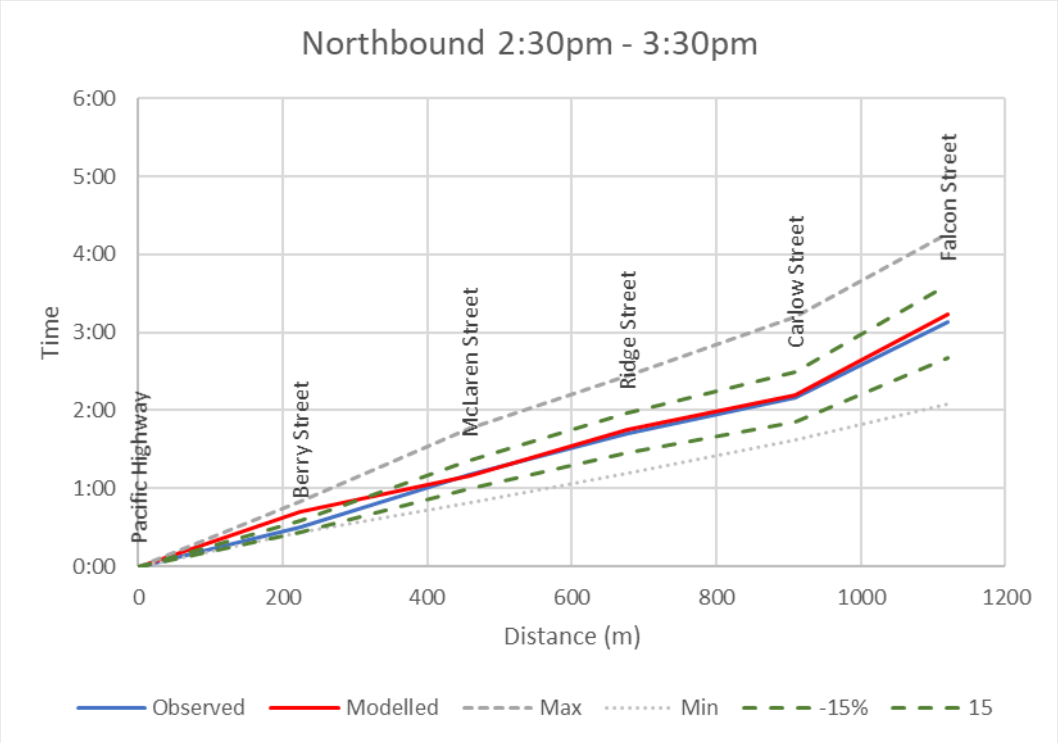


Figure 5.15: Evening Peak Travel Time Eastbound (3:30pm – 4:30pm)

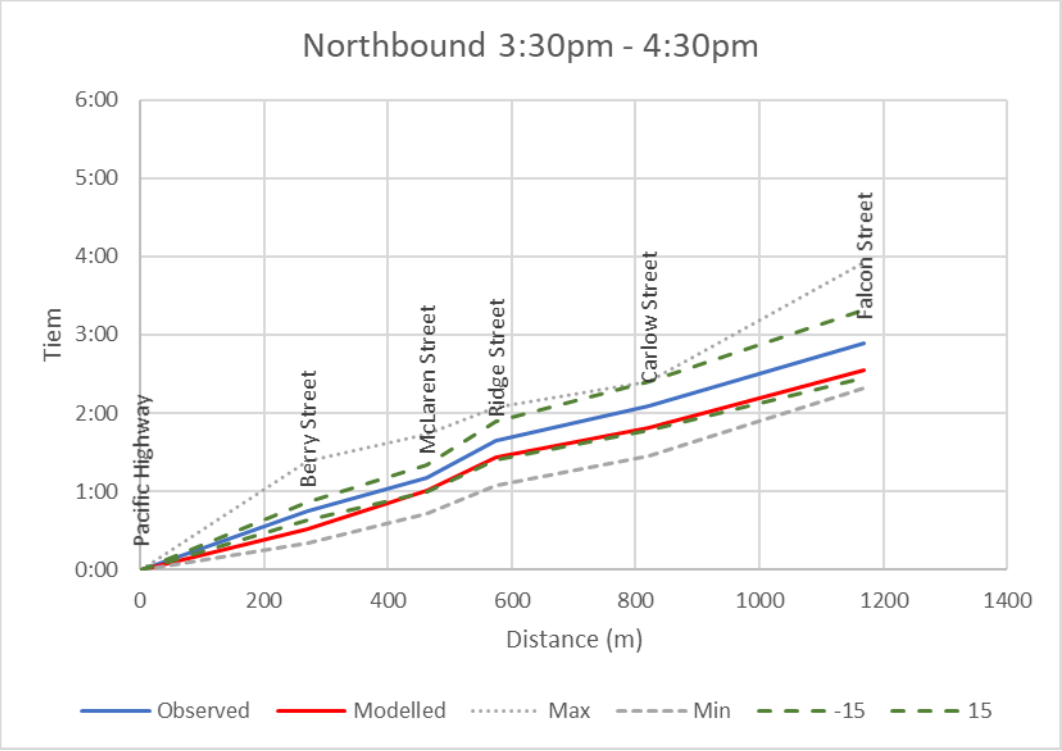


Figure 5.16: Evening Peak Travel Time Eastbound (2:30pm – 3:30pm)

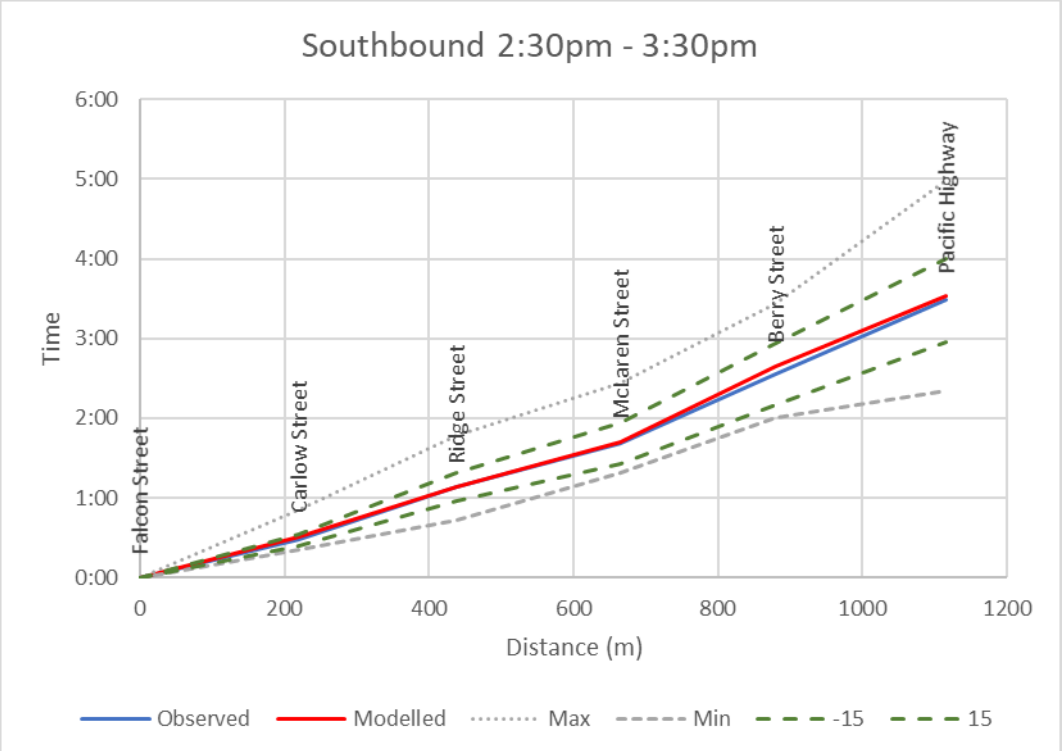
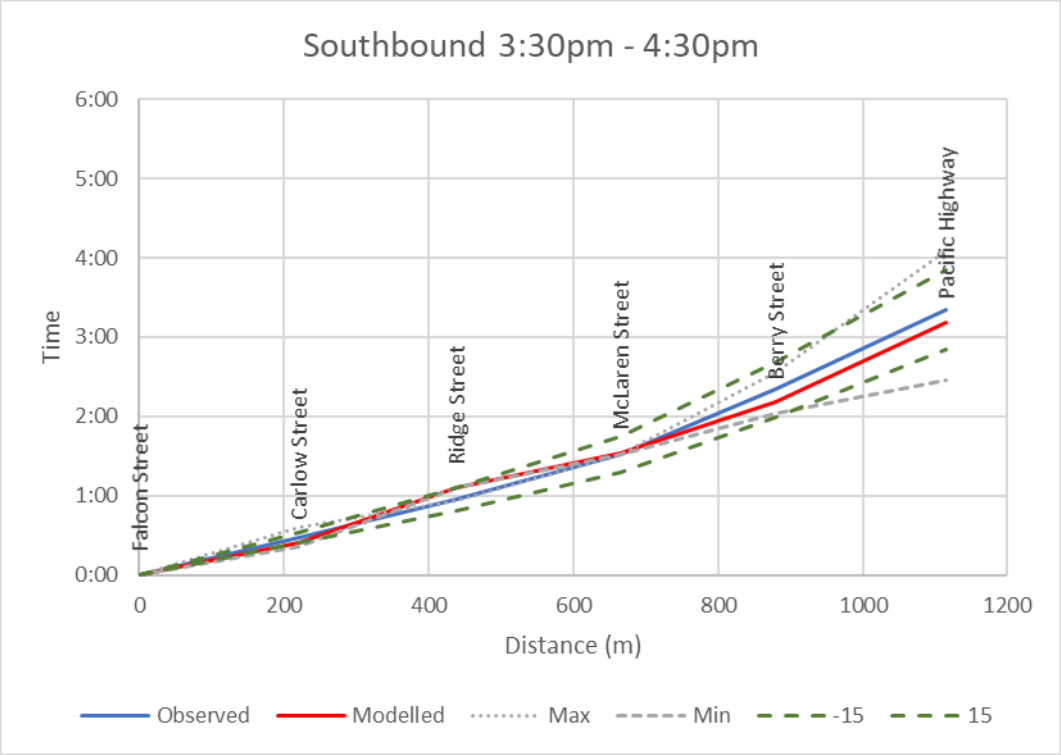


Figure 5.17: Evening Peak Travel Time Eastbound (3:30pm – 4:30pm)



Evening peak validation falls within the 15% tolerance for the end of the trip. It is noted that the second hour which is the peak has a very close replication of the observed travel times.

The model is considered to be validated for both the morning and evening peak periods replicating the congestion and travel times that were observed in the travel time surveys.

5.4 Calibration and Validation Conclusion

The model calibration and validation results meet the criteria and show that the model is able to replicate the exiting traffic conditions and can be used for testing of future scenarios.

6 Model Limitations

The model has been calibrated for the purpose of testing the impacts of the Marist College North Sydney School. The core area of the model in the immediate vicinity of the school however the boarder model is calibrated to the RMS Standards.

7 Conclusion

TTPP has calibrated and validated a micro-simulation model of the Miller Street corridor from Falcon Street to the Pacific Highway. The model was calibrated and validated based on the Roads and Maritime Services (now TfNSW) modelling guidelines.

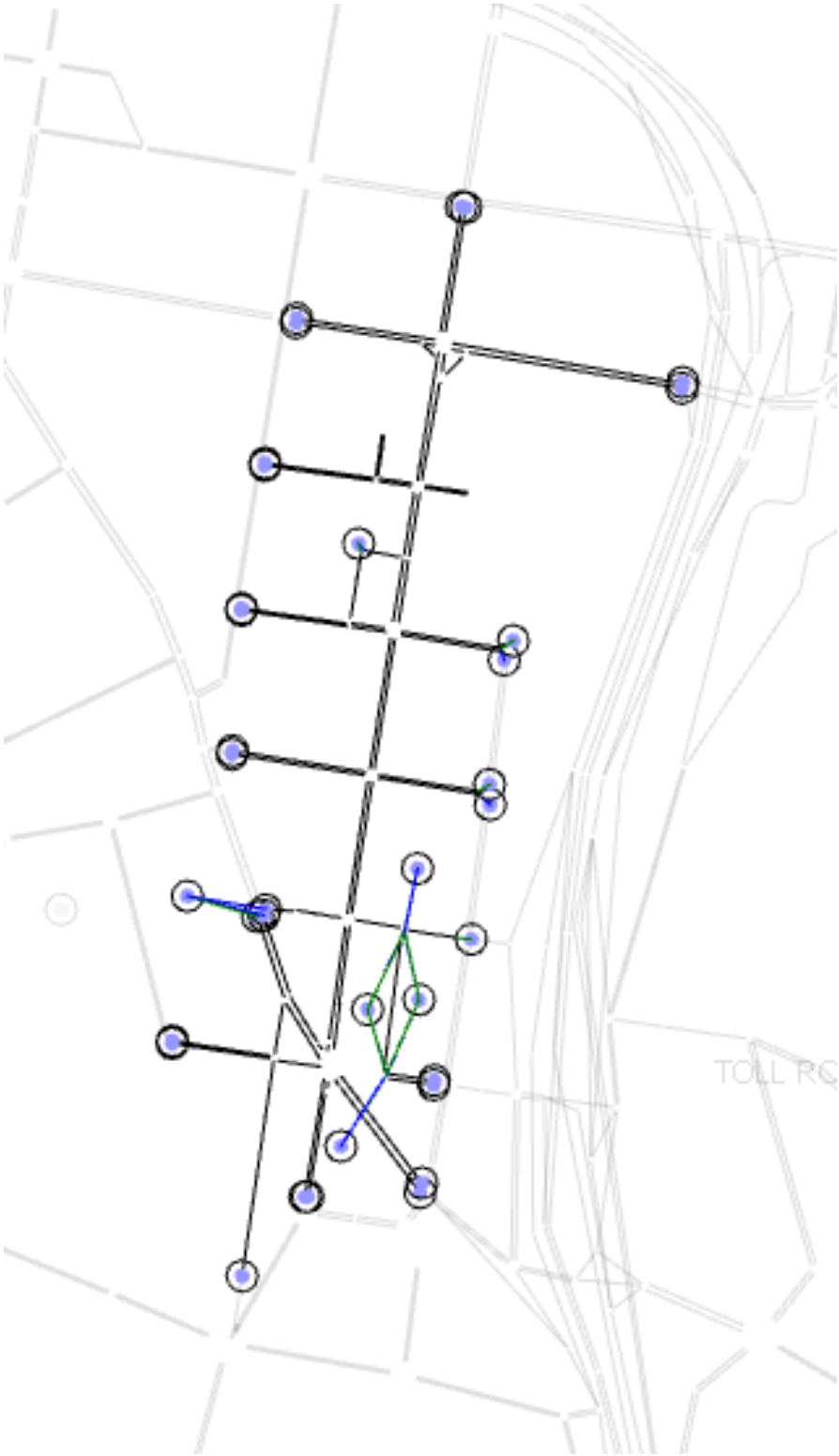
The model has been run for 5 random seeds in both the morning and evening peak periods and results presented here are based on the median run.

The model has been calibrated to achieve the criteria for GEH and R^2 for turns and a core area has been calibrated which meets core area requirements. Validation of the model has been undertaken based on travel times. The model shows a strong correlation with the travel times.

The model is considered well calibrated and suitable for the purpose of modelling the impacts of the Marist College North Sydney traffic impacts.

Appendix A

Model Plot


TOLL RC

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Appendix C

Internal Traffic and Parking Assessment, CBRK, 2020

SYDNEY CATHOLIC SCHOOLS

MARIST CATHOLIC COLLEGE NORTH SHORE REDEVELOPMENT

INTERNAL TRAFFIC AND PARKING ASSESSMENT

Date of Report:
17 DECEMBER 2020

COLSTON BUDD ROGERS & KAFES PTY LTD
ACN 002 334 296
Level 18 Tower A
Zenith Centre
821 Pacific Highway
CHATSWOOD NSW 2067

Telephone: (02) 9411 2411
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REF: 11110

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Colston Budd Rogers and Kafes Pty Ltd has been commissioned by Sydney Catholic Schools to prepare a report on the internal traffic and parking aspects of the proposed expansion and redevelopment of Marist Catholic College North Shore. This report in conjunction with the external traffic assessment and green travel plan prepared by TTPP for the transport and accessibility impact assessment, to support the State Significant Development (SSD) Development Application (DA) for the proposed expansion and redevelopment of the college.

Background

1.2 A 24 month study undertaken by Sydney Catholic Schools has identified a major deficiency in the provision of affordable, non-government education within the North Sydney Local Government Area (LGA).

1.3 The study also identified that the choice for families is extremely limited, as almost all of the schools in North Sydney provide single-sex education, with co-educational schools significantly underrepresented.

1.4 Sydney Catholic Schools, as operators of St Mary's Catholic Primary School and Marist College North Shore, is responding to this challenge and has identified a strategic response that can positively support the future of North Sydney.

Site Description

1.5 The site is located at 270 Miller Street, North Sydney within North Sydney LGA. It is bound by Carlow Street to the north, Ridge Street to the south, Miller Street to the east, and Ridge Lane to the west. It is surrounded by a mix of civic, residential and commercial uses.

1.6 It is approximately 700m north of the North Sydney CBD and located opposite St Leonards Park and North Sydney Oval. The site is strategically located between Crows Nest and North Sydney, which will soon be connected by the Sydney Metro. The site is approximately 250m to the north of the future Sydney Metro Station at the corner of Miller Street and McLaren Street.

1.7 Existing development on the site includes St Mary's Primary School, Marist College North Shore, St Mary's Church and Parish Centre, the former Presbytery and Monastery, as well as the two acquired terraces along Miller Street and a childcare centre known as the Jacaranda Centre.

1.8 The site comprises 26 lots and has a total area of 22,420m^2. The locational context of the site is shown on Figure 1 and an aerial photograph of the site is shown on Figure 2.

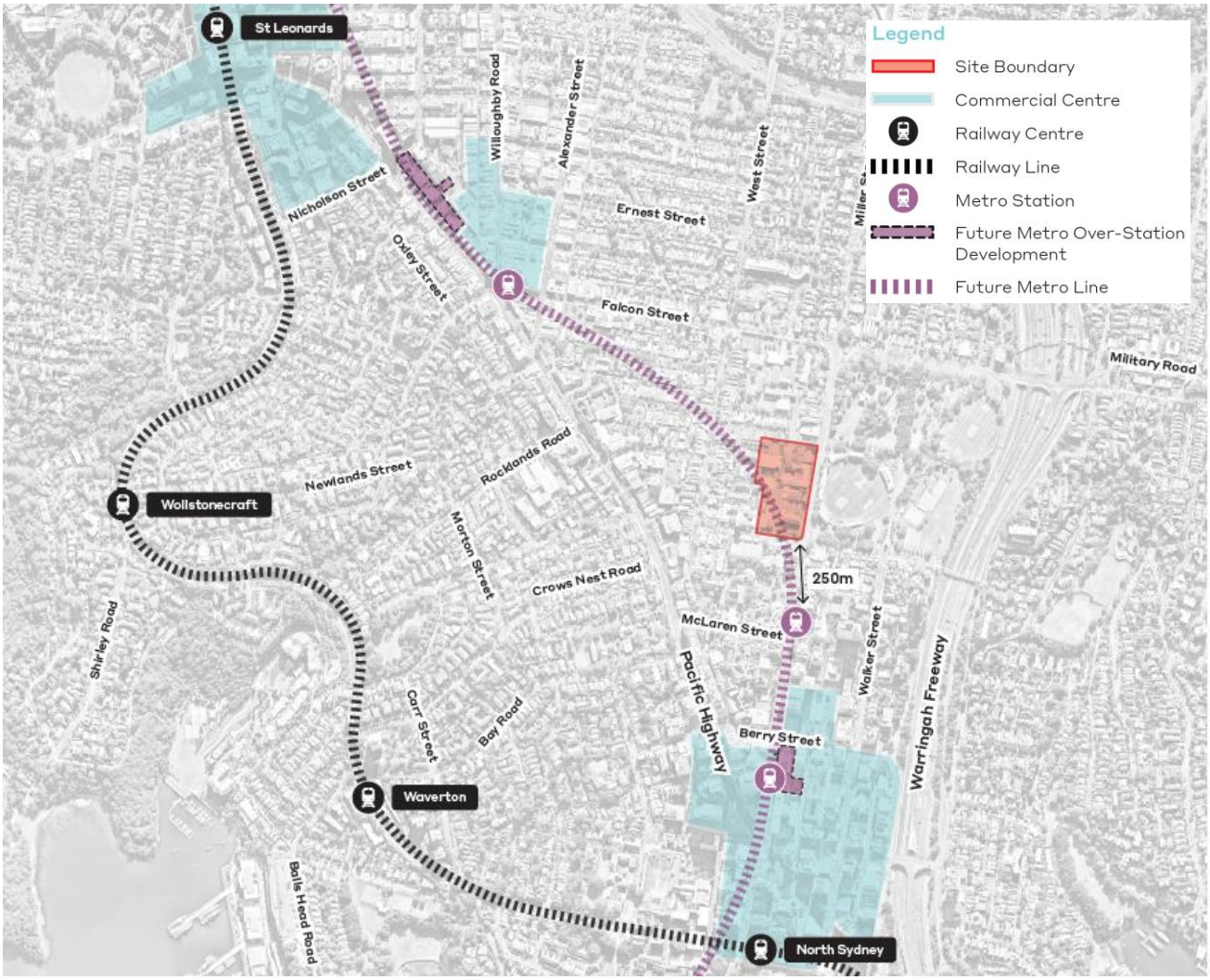

Figure 1 Site Context

Source: Ethos Urban

Figure 2 Site Aerial

Source: Ethos Urban

Proposed Development

1.9 The SSD DA seeks approval for:

- retention of key buildings including St Mary's Church and Parish Centre, the former Presbytery and Monastery, St Mary's Primary School and some existing buildings on the western boundary;

- demolition of existing buildings along Miller Street and Carlow Street, including the childcare centre and terrace houses;

- construction of a mixed-use education precinct comprising a high school and early learning centre, including:

  - adaptive reuse of the existing Presbytery, and alterations and additions to retained educational buildings;
  - construction of a multistorey educational building on the corner of Miller Street and Carlow Street;
  - construction of a multistorey mixed-use building along Miller Street, accommodating teaching facilities, an early learning centre and an auditorium;
  - construction of a new basement car park; and
  - provision of ancillary canteen/café uses

- landscaping and public domain works, including the creation of a new plaza along Miller Street, adjoining St Mary's Church.

Secretary's Environmental Assessment Requirements

1.10 DPIE has issued Secretary's Environmental Assessment Requirements (SEARs) for the proposed development, including the following traffic and parking matters:

SEARS Transport, Traffic, Parking and Access	Report Reference
Transport and Accessibility Include a transport and accessibility impact assessment, which details, but not limited to the following	
• accurate details of the current daily and peak hour vehicle, existing and future public transport networks and pedestrian and cycle movement provided on the road network located adjacent to the proposed development.	Refer to Section 3.3 and 6.2 of TTPP TAI report
• details of estimated total daily and peak hour trips generated by the proposal, including vehicle, public transport, pedestrian and bicycle trips based on surveys of the existing and similar schools within the local area.	Refer to Section 6.2 of TTPP TAI report
• the adequacy of existing public transport or any future public transport infrastructure within the vicinity of the site, pedestrian and bicycle networks and associated infrastructure to meet the likely future demand of the proposed development.	Refer to Section 6 of TTPP TAI report
• measure to integrate the development with the existing/ future public transport network.	Refer to Section 4 of TTPP's TAI report
• the impact of trips generated by the development on key intersections, with consideration of the cumulative impacts of other approved developments in the vicinity, and the need/associated funding for, and details of, upgrades or road improvement works, using appropriate network modelling tools in accordance with the requirements set out in the TfNSW Traffic Modelling Guidelines. These key intersections should include, but not limited to: o Falcon Street/Miller Street. o Miller Street/Carlow Street. o Miller Street/Ridge Street. o Miller Street/Berry Street. o Pacific Highway/Miller Street.	Refer to Section 6 of TTPP TAI report
• the traffic modelling, considering scenarios of years 2020, 2026 (or year of completion), and 10 years plus year of completion of the development.	Refer to Section 6 of TTPP TAI report
• the identification of infrastructure required to ameliorate any impacts on traffic efficiency and road safety impacts associated with the proposed development, including details on improvements required to affected	Refer to Section 6 of TTPP TAI report

	intersections, additional school bus routes along bus capable roads (i.e. minimum 3.5m wide travel lanes), additional bus stops rf bus bays.	
•	details of travel demand management measures to minimise the impact on general traffic and bus operations, including details of a location-specific sustainable travel plan (Green Travel Plan and specific Workplace Travel Plan) and the provision of facilities to increase the non-car mode share for travel to and from the site.	Refer to Section 8 of TTPP's TAI report and TTPP GTP
•	the proposed walking and cycling access arrangements and connections to public transport service.	Refer to Section 4 of TTPP TAI report
•	the proposed access arrangements, including car and bus pick-up/drop off facilities, and measures to mitigate any associated traffic impacts and impacts on public transport, pedestrian and bicycle networks, including pedestrian crossings and refuges and speed control devices and zones.	With regards access arrangements refer to Section 2 of CBRK report. With regards to student pick-up/drop-off facilities refer to Section 3 of CBRK report. With regards to public transport, pedestrian and bicycle network refer to Section 4 of TTPP TAI report
•	proposed bicycle parking provision, including end of trip facilities, in secure, convenient, accessible areas close to main entries incorporating lighting and passive surveillance.	Refer to Section 5.3 of TTPP TAI report
•	proposed number of on-site car parking spaces for teaching staff and visitors and corresponding compliance with existing parking codes and justification for the level of car parking provided on-site.	Refer to Section 5 of TTPP TAI report
•	an assessment of the cumulative on-street parking impacts of cars and bus pick-up/drop-off, staff parking and any other parking demands associated with the development.	Refer to Section 5 and 6 of TTPP TAI report
•	an assessment of road and pedestrian safety adjacent to the proposed development and the details of required road safety measures and personal safety in line with CPTED.	Refer to Section 7 of TTPP TAI report

• emergency vehicle access, service vehicle access, delivery and loading arrangements and estimated service vehicle movements (including vehicle type and the likely arrival and departure times).	Refer to Section 2 of CBRK report
• details of any pedestrian links and connections that improve the walkability within the precinct in consideration to Sydney Metro and how the connections align with the North Sydney Civic Precinct Planning Study.	Refer to Section 2.7 and 4.6 of TTPP TAI report
• consideration to include a pedestrian connection between Ridge Lane and Carlow Street and associated details.	Refer to Section 2.7 and 4.6 of TTPP TAI report
• the preparation of a preliminary Construction Traffic and Pedestrian Management Plan to demonstrate the proposed management of the impact in relation to construction traffic addressing the following: - assessment of cumulative impacts associated with other construction activities (if any). - an assessment of road safety at key intersection and locations subject to heavy vehicle construction traffic movements and high pedestrian activity. - details of construction program detailing the anticipated construction duration and highlighting significant and milestone stages and events during the construction process. - details of anticipated peak hour and daily construction vehicle movements to and from the site. - details on on-site car parking and access arrangements of construction vehicles, construction workers to and from the site, emergency vehicles and service vehicles. - details of temporary cycling and pedestrian access during construction.	Refer to TTPP CTPMP report

1.11 This report assesses the SEARs relating to the internal traffic and parking aspects of the proposed development. In conjunction with the external traffic assessment and green travel plan prepared by TTPP the reports form the transport and accessibility impact assessment, to support the State Significant Development

(SSD) Development Application (DA) for the proposed expansion and redevelopment of the college.

Report Structure

1.12 The internal traffic and parking aspects of the proposed development are assessed through the following chapters:

- Chapter 2 – description of access arrangements, car park layout, internal circulation and servicing; and
- Chapter 3 – pedestrian access and student set-down/pick-up arrangements.

1.13 The external traffic impact assessment report and green travel plan, prepared by TTPP, are provided under separate cover.

2. VEHICULAR ACCESS, CAR PARK LAYOUT, CIRCULATION AND SERVICING

2.1 The site is located at 270 Miller Street, North Sydney within North Sydney LGA. It is bound by Carlow Street to the north, Ridge Street to the south, Miller Street to the east, and Ridge Lane to the west, as shown on Figure 2. It is surrounded by a mix of civic, residential and commercial uses.

2.2 Existing development on the site includes St Mary's Primary School, Marist College North Shore, St Mary's Church and Parish Centre, the former Presbytery and Monastery, as well as two acquired terraces along Miller Street and a childcare centre (Jacaranda Centre).

2.3 The primary school (K-Y6) provides for some 466 students, Marist College (Y7 to Y12) provides for some 826 students and the childcare centre provides for some 50 children. The combined facility has a total of some 70 full-time equivalent (FTE) staff.

2.4 Vehicular access to the site by car, service vehicle and emergency vehicle is currently provided at two access points, including an entry driveway from Ridge Street and an exit driveway onto Miller Street. An internal access road (Ridge Lane) connects the two driveways and provides access to on-site parking and student set-down/pick-up facilities. The driveway off Miller Street is controlled by a boom gate which allows controlled exit from the site and ensures that vehicles do not entry the campus from Miller Street.

2.5 An existing loading area is located at the eastern end of Cassins Avenue. Service vehicle access to the site is provided from this loading area and from the internal access road passing through the site.

2.6 The site currently provides on-site parking for some 110 vehicles for the primary school, senior school, childcare centre, church and parish centre. The main parking areas include at-grade parking between the church and presbytery (some 55 spaces, including 17 spaces reserved for the Parish Centre), and basement car parking beneath the Ron Dyer Centre (some 40 spaces). Six accessible parking spaces are located on the internal access road adjacent to the church. In addition, some informal off-street parking is available along the internal access road on approach to the Miller Street exit driveway.

Vehicular Access Arrangements

2.7 In association with the proposed development, vehicular access to the site will be modified. The existing access driveway onto Ridge Street will be retained and the exit driveway onto Miller Street will be closed. The Ridge Street access driveway will be widened, and the internal access road modified to provide for two-way traffic flow.

2.8 The at-grade parking area adjacent to the church and presbytery will be relocated to a new basement car park beneath the Carlow Street building. The Ridge Street access driveway will provide access to basement parking beneath the Ron Dyer Centre (some 40 spaces) and to the reconfigured on-site student set-down/pick-up area on the eastern side of the Ron Dyer Centre. The access from Ridge Street and the internal access road adjacent to the primary school will be

developed into a shared zone to improve pedestrian amenity and to create a safe environment for students.

2.9 A new driveway crossing onto Carlow Street will provide access to the new basement car park and loading dock beneath the Carlow Street building. The basement car park will provide parking for some 70 vehicles (including 50 staff parking spaces, 12 student set-down/pick-up spaces and nine childcare parking spaces).

2.10 The access driveways to the site will be provided in accordance with the Australian Standard for Parking Facilities (Part 1: Off-street car parking and Part 2: Off-street commercial vehicle facilities), AS 2890.1:2004 and AS 2890.2 – 2002, to cater for two-way traffic flow, as well as car and service vehicle swept paths.

Car Park Layout and Internal Circulation

2.11 In association with the proposed development, the at-grade parking area adjacent to the church and presbytery (comprising some 55 parking spaces) will be relocated to a new basement car park beneath the Carlow Street building. Access to the basement car park will be provided by a ramp with a maximum grade of 1 in 5, with appropriate transitions at the top and bottom of the ramp, located adjacent to the northern boundary of the site. A section of 1 in 20 grade will be provided for the first six metres at the top of the ramp and appropriate sight lines will be provided for exiting vehicles to observe pedestrians walking adjacent to the driveway along Carlow Street.

2.12 Car parking arrangements and internal circulation within the basement car park will be designed to comply with the Australian Standards AS 2890.1-2004 with

regards to parking bay dimensions, aisle widths, grades and height clearances. Parking bays will be a minimum of 2.5 metres wide by 5.4 metres long. Columns will be set back 750mm from the front of the space. Parking spaces located adjacent to structure will be additional 300mm wider to provide an appropriate door opening clearance. Circulation aisles will be a minimum of 5.8 metres wide with parking on both sides of the aisle or 6.1 metres wide with parking on one side and structure on the other.

2.13 Disabled parking spaces will be provided in accordance with the Australian Standard for Parking Facilities Part 6: Off-street parking for people with disabilities (AS2890.6-2009). These spaces will be 2.4 metres wide by 5.4 metres long with an adjacent shared zone of 2.4 metres wide for wheelchair access. Height clearance will be 2.5 metres above disabled parking spaces and 2.2 metres elsewhere within the car parking areas.

2.14 The new student set-down/pick-up area (comprising 12 parking spaces) will be located on the southern side of the basement car park. A signposted one-way traffic flow through the car park will provide convenient circulation for parents setting down and picking up students.

2.15 Some nine parking spaces within the car park will be allocated for the childcare set-down and pick-up. These spaces will be located at the eastern end of the basement car park, with direct access via lifts to the new childcare facility. Parents dropping off and picking up children at the childcare will not be required to mix with the student set-down and pick-up operation.

2.16 The proposed car parking arrangements are considered appropriate, being in accordance with AS 2890.1:2004 and AS 2890.6:2009.

2.17 In addition to the above, the existing basement car park beneath the Ron Dyer Centre will be maintained. However, several parking spaces will be removed to improve car park circulation. The car park will provide some 37 parking spaces (including 17 spaces reserved for the Parish Centre).

2.18 The Ron Dyer Centre basement car park and the Carlow Street basement car park would be available for the Parish and St Mary's Church, outside of school hours. The car parks would also be available on weekends for regular use by parishioners.

Servicing

2.19 Service vehicles to the development would include garbage collection and deliveries. A loading and waste collection area will be provided beneath the Carlow Street building with access to and from Carlow Street. The loading area will provide for service vehicles ranging from small commercial vehicles to medium rigid trucks to enter the site, circulate and exit in a forward direction. The access driveway, loading and manoeuvring area will be provided to accommodate the swept paths of these vehicles, in accordance with AS 2890.2 – 2002. Swept paths of vehicles accessing the basement car park and loading dock are shown in Figures 3 to 5.

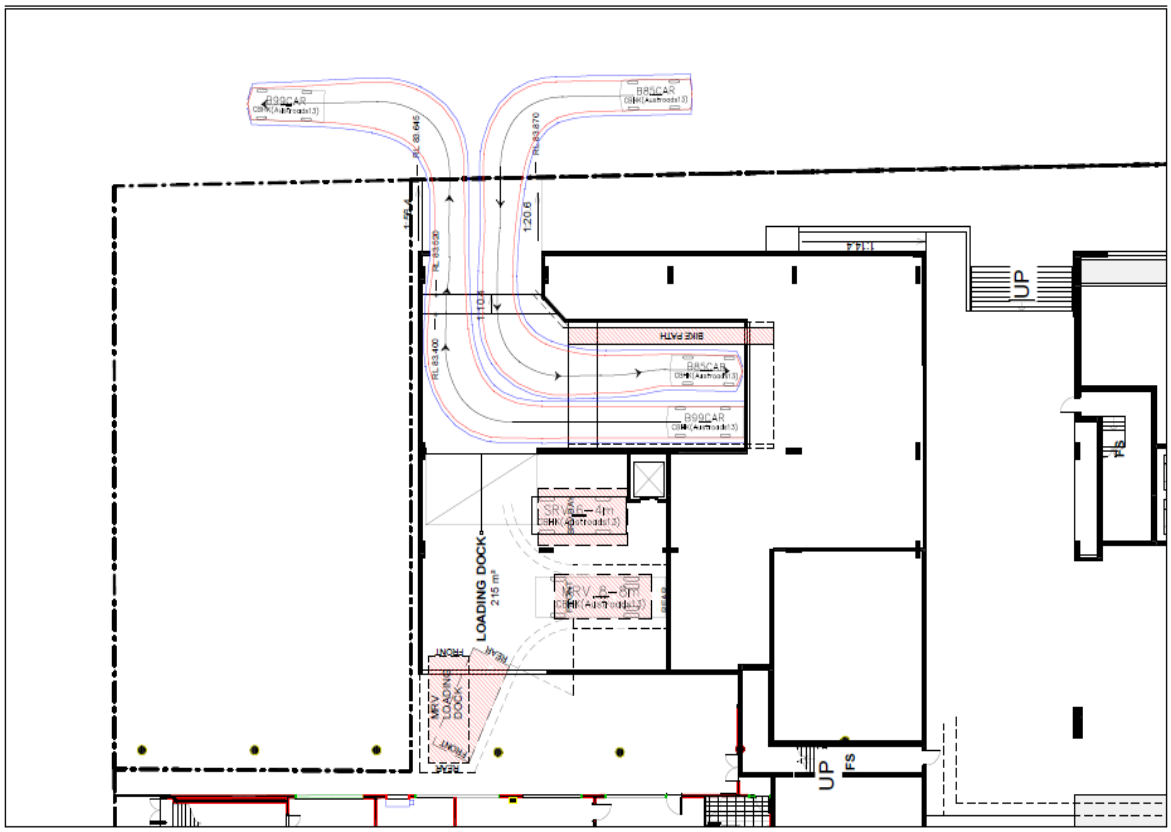

Figure 3 B85 and B99 Vehicle Swept Paths

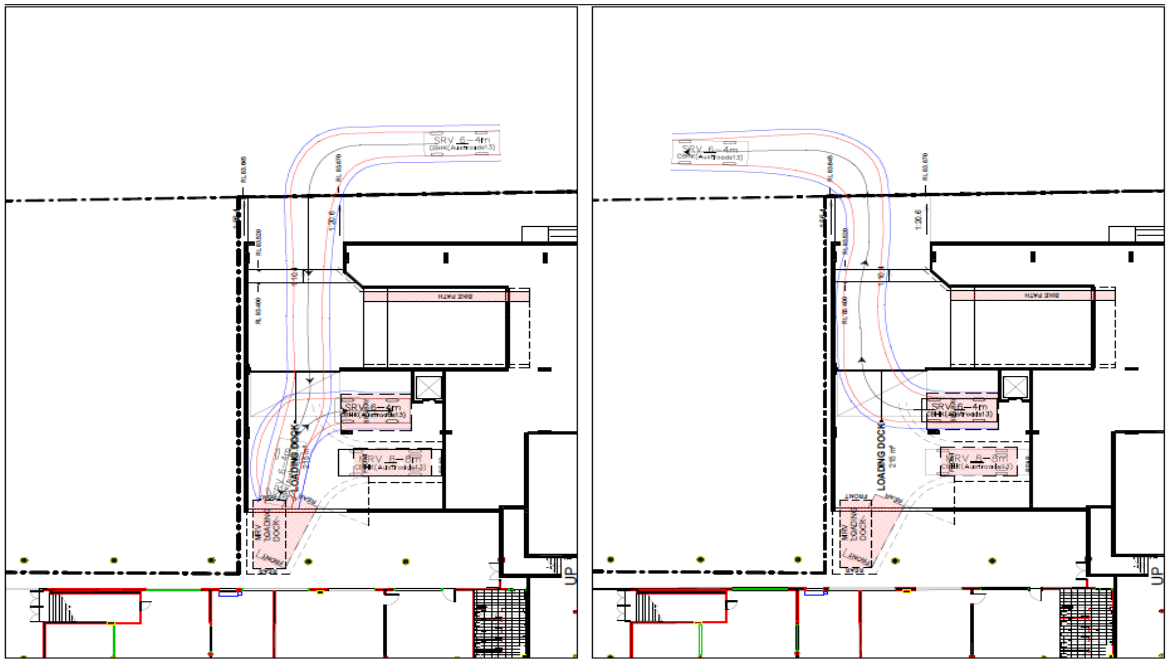

Figure 4 6.4 metre Small Rigid Truck Swept Path

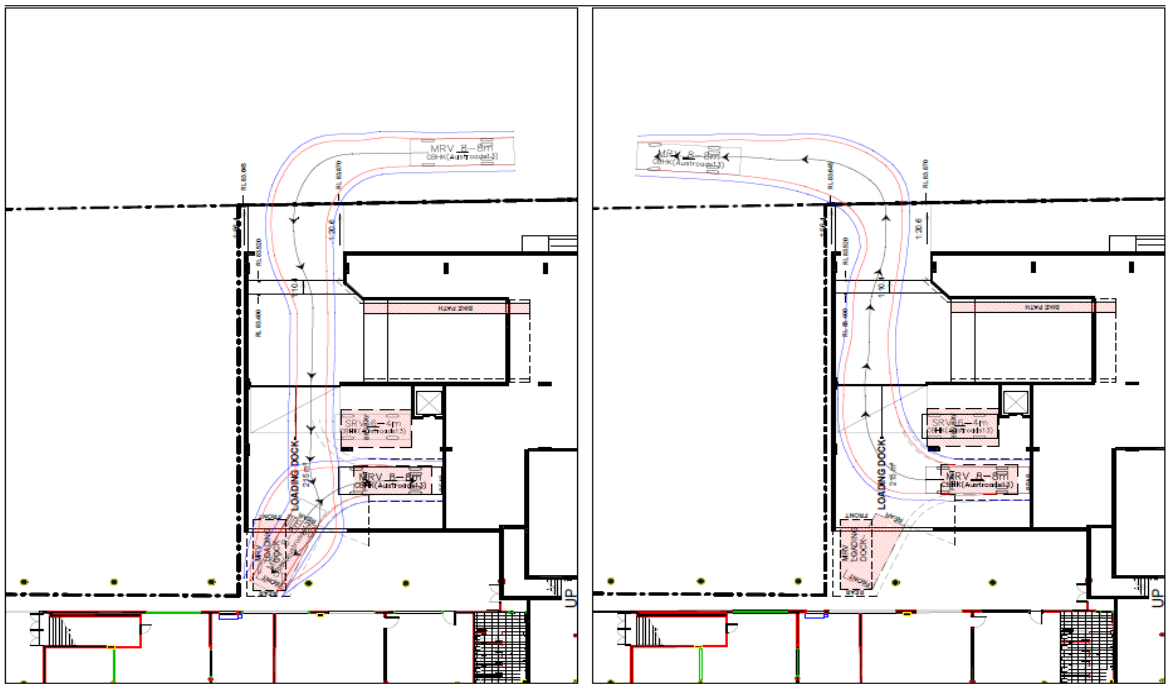

Figure 5 8.8 metre Medium Rigid Truck Swept Path

2.20 Service vehicles will be restricted to 3.8 metre height clearance, with waste collection being undertaken by private contractors with appropriate collection vehicles. The driveway will provide appropriate height restrictions, in accordance with the Australian Standard, and the loading dock will be managed to ensure that all service vehicles comply with this requirement.

2.21 Emergency vehicle access to the site would be provided from the existing access driveway onto Ridge Street and the internal access road passing through the site. Emergency vehicles would also be able to access the loading dock and basement car park beneath the Carlow Street building.

3. PEDESTRIAN ACCESS AND SET-DOWN/PICK-UP ARRANGEMENTS

Pedestrian Access

3.1 The school is located adjacent to a well established pedestrian network within North Sydney. Convenient access for students and staff within the school grounds and along the adjacent road network include the following:

- pedestrian footpaths along the site frontage, including Miller Street, Ridge Street and Carlow Street;
- marked pedestrian crossings in Ridge Street and West Street;
- dedicated pedestrian facilities at the signalised intersections of Miller Street/Ridge Street and Miller Street/Carlow Street;
- pedestrian connections within the school grounds, including pedestrian access to Ridge Street, via a dedicated footpath adjacent to the primary school and pedestrian access to Miller Street, at a number of locations.

3.2 These pedestrian facilities are well utilised by students during the morning and afternoon school peak periods, providing convenient access to rail services at North Sydney railway station, bus services on Miller Street, Pacific Highway and Falcon Street and future access to the Victoria Cross Metro station.

3.3 The proposed expansion and redevelopment of the school is close to existing and future public transport services and will therefore be readily accessible by public transport.

3.4 In association with the redevelopment of the school, a pedestrian shared zone will be developed along the central internal access road within the school. Safe and convenient pedestrian access for students and staff will be provided onto the surrounding road network and access to student set-down/pick-up areas within the school.

3.5 Pedestrian access for the school will be consistent with North Sydney Council's Walking Strategy and planned walking infrastructure for the local area. These measures are consistent with NSW Government planning guidelines for Walking and Cycling.

Student Set-Down/Pick-Up Arrangements

3.6 In association with the redevelopment of the school, a new on-site student set-down/pick-up area will be provided within the new basement car park beneath the Carlow Street building. The existing student set-down/pick-up operation adjacent to the Ron Dyer Centre will be maintained, with access to and from Ridge Street.

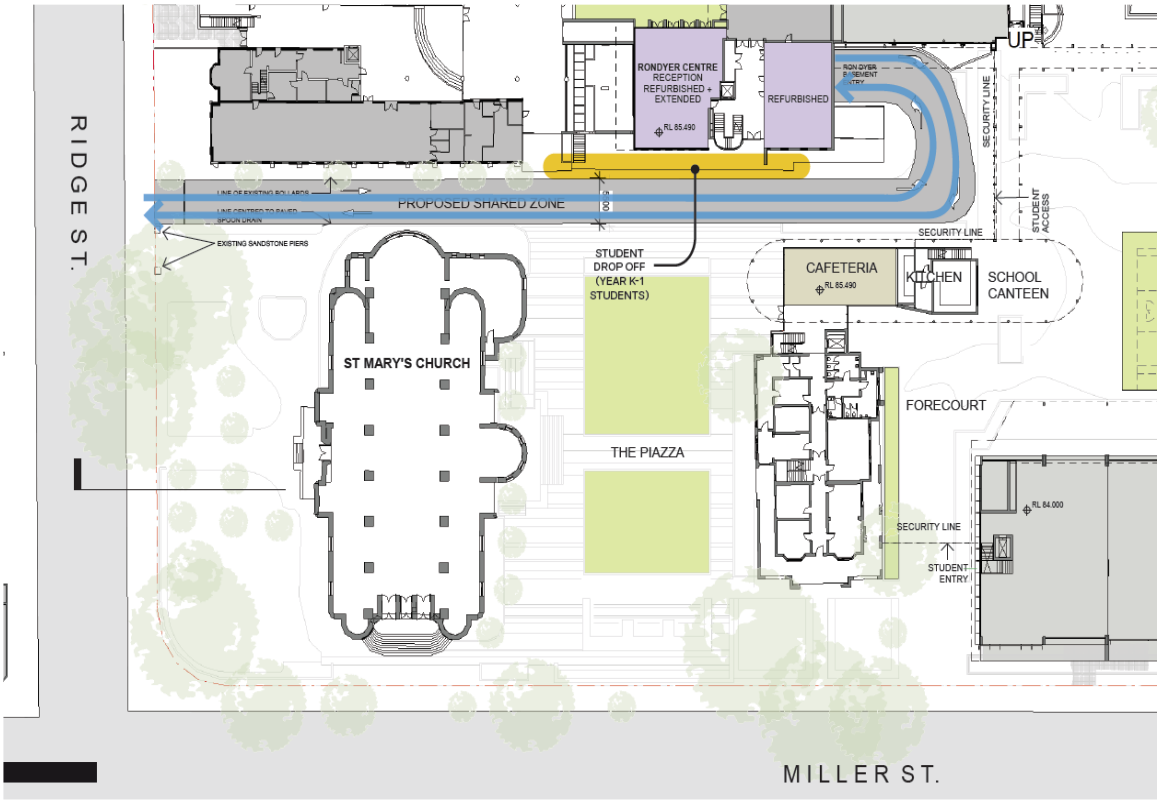

Figure 6 Ron Dyer Centre – student set-down/pick-up facility

Source: WMK Architecture, September 2020

3.7 During the morning and afternoon peak periods, to better manage student movements, the school will split the student set-down/pick-up operation between the two facilities. Kindergarten to Year 3 students would be dropped off and picked up from the internal access road along the frontage of the Ron Dyer Centre. Years 4 to 12 students would be dropped off and picked up from the new student set-down/pick-up facility that will be provided within the new basement car park beneath the Carlow Street building.

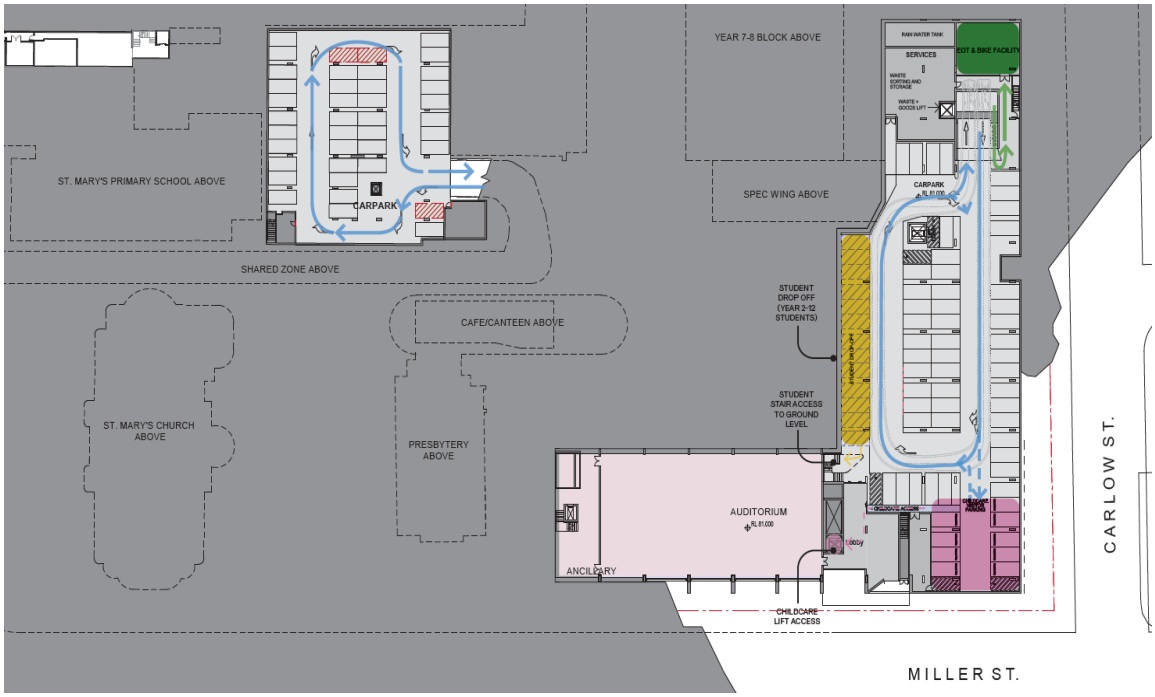

Figure 7 Carlow Street Basement Car Park – student set-down/pick-up facility

Source: WMK Architecture, September 2020

3.8 In addition to the student set-down/pick-up facilities, some nine parking spaces within the Carlow Street basement car park will be allocated for the childcare centre. These spaces will be located at the eastern end of the basement car park, with parents/carers required to park and leave their car to drop off and pick up children at the childcare. The set-down/pick-up operation for the childcare will be staggered with the school to better manage student movements.

3.9 The set-down/pick-up operation will be managed in accordance with an approved operational management plan to be prepared by the school. The plan would include:

- on-site student set-down/pick-up and vehicle movements to be managed by staff/personnel;

- stagger the start and finish times of the primary and senior schools and the childcare centre;

- encourage older students and staff to use public transport to travel to and from school;

- develop an online student and parent platform to encourage students to travel in groups with other students that live in the same area;

- encourage car pooling to increase the number of students per car;

- provide public transport information, maps and public transport timetables to students and staff;

- introduce a buddy system at the school where younger students are partnered with senior students that live in the same area and can travel together on public transport;

- increase awareness of the health benefits of walking and cycling (including maps showing walking and cycling routes through North Sydney;

- encourage cycling by providing safe and secure bicycle parking, including the provision of lockers and change facilities.

3.10 The proposed student set-down/pick-up facilities at the school are considered appropriate to manage student movements during the morning and afternoon peak periods.

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