Appendix 6 – Transport Impact Assessment

263 – 281 Pennant Hills Road, Carlingford
Transport Impact Assessment

Prepared for:

Meriton Group

20 October 2023

The Transport Planning Partnership

263 – 281 Pennant Hills Road, Carlingford
Transport Impact Assessment

Client: Meriton Group

Version: V03

Date: 20 October 2023

TTPP Reference: 21009

Quality Record

Version	Date	Prepared by	Reviewed by	Approved by	Signature
01	1/09/23	C Cheung, S Read	S Read	Ken Hollyoak	DRAFT
02	6/09/23	C Cheung, S Read	S Read	Ken Hollyoak	
03	19/10/23	C Cheung, S Read	S Read	Ken Hollyoak	

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1 Introduction

1.1 Background

A Planning Proposal (PP) is to be lodged with Parramatta City Council (Council) for a proposed residential development with ancillary retail and a childcare centre located at 18 Shirley Street and 263-273 and 277-281 Pennant Hills Road, Carlingford. A significant portion of the site benefits from Development Application approval (DA1103/2011/JP) for the construction of five residential apartment buildings ranging from 9-11 storeys comprising 450 units, but following acquisition and amalgamation of adjacent land, Meriton has worked with Council to submit a Planning Proposal for a cohesive development scheme.

The proposed development incorporates six apartment blocks with a total of 723 units, a 110-place childcare centre and a total of 2,600m^2 retail space. In addition to this, it is understood that Council have requested that a new Community Centre / Library (2,500m^2) also be provided on the subject site. The new facility would replace the existing Carlingford Branch Library (348m^2).

The Transport Planning Partnership (TTPP) was commissioned by Meriton to undertake a transport impact assessment for the proposed development.

1.2 Report Structure

The report assesses the traffic and parking implications of the proposed development and is set out as follows:

- Chapter 2 discusses the existing conditions including a description of the subject site.
- Chapter 3 provides a brief description of strategic context and applicable policies.
- Chapter 4 provides a brief description of the proposed development.
- Chapter 5 assesses the proposed on-site parking provision and internal layout.
- Chapter 6 examines the traffic generation and its impact.
- Chapter 7 details the traffic modelling assessment undertaken for the proposal.
- Chapter 8 presents the conclusions of the assessment.

2 Existing Conditions

2.1 Location

The subject site is located at 18 Shirley Street and 263-273 and 277-281 Pennant Hills Road, Carlingford. The site of approximately 27,987m^2 has a frontage of 323m to Pennant Hills Road, a northern frontage of 185m to Shirley Street and a collective western frontage of 120m to Shirley Street. The site is currently predominantly vacant, with the recently acquired land being a free-standing dwelling.

The subject site is situated within the R4 High Density Residential Zone under The Hills Local Environmental Plan 2012. The surrounding properties predominantly include residential and town centre uses, with Carlingford Village and Carlingford Court prominent in the neighbourhood landscape.

The location of the subject site and its surrounding environs is shown in Figure 2.1.

Figure 2.1: Site and Surrounding Environs

Source: Locality Plan, Fender Katsalidis

2.2 Transport Network

2.2.1 Road Hierarchy

Roads are classified according to the functions they perform. The main purpose of defining a road's functional class is to provide a basis for establishing the policies which guide the management of the road according to their intended service or qualities.

In terms of functional road classification, State roads are strategically important as they form the primary network used for the movement of people and goods between regions, and throughout the State. Transport for NSW (TfNSW) is responsible for funding, prioritising and carrying out works on State roads. State roads generally include roads classified as freeways, state highways, and main roads under the Roads Act 1993, and the regulation to manage the road system is stated in the Australian Road Rules, most recently amended on 19 March 2018.

TfNSW defines four levels in a typical functional road hierarchy, ranking from high mobility and low accessibility to high accessibility and low mobility. These road classes are:

Arterial Roads – Controlled by TfNSW, typically no limit in flow and designed to carry vehicles long distance between regional centres.

Sub-Arterial Roads – Managed by either Council or TfNSW under a joint agreement. Typically, their operating capacity ranges between 10,000 and 20,000 vehicles per day, and their aim is to carry through traffic between specific areas in a sub region or provide connectivity from arterial road routes (regional links).

Collector Roads – Provide connectivity between local sites and the sub-arterial road network, and typically carry between 2,000 and 10,000 vehicles per day.

Local Roads – Provide direct access to properties and the collector road system and typically carry between 500 and 4,000 vehicles per day.

2.2.2 Surrounding Road Network

A schedule of the surrounding road network is shown in Table 2.1.

Table 2.1: Road Schedule

Road name	Classification	Description
Pennant Hills Rd	Sub-Arterial Road	▪ East-west connector between Carlingford in the east and North Parramatta in the west ▪ Four-lane, bidirectional road ▪ 60km/h speed zoning
Marsden Rd	Sub-Arterial Road	▪ North-south connector between Carlingford in the north and Dundas Valley in the south ▪ Four-lane, bidirectional road ▪ 60km/h speed zoning
Jenkins Rd	Collector Road	▪ North-south connector between North Rocks Road and Pennant Hills Road, serving as the Carlingford suburban spine ▪ Primarily a four-lane, bidirectional road ▪ 50km/h speed zoning
Shirley St	Local Road	▪ Angled connector from Pennant Hills Road into Post Office St ▪ Two-lane, bidirectional road ▪ 50km/h speed zoning
Post Office St	Local Road	▪ North-south connector between North Rocks Road and Pennant Hills Road, serving as the Carlingford suburban spine ▪ Primarily a four-lane, bidirectional road ▪ 50km/h speed zoning

2.3 Public Transport

2.3.1 Bus Services

There are well-established public transport facilities available in the vicinity of the site. A review of the public transport available near the site is summarised in Table 2.2 and shown in Figure 2.2.

Table 2.2: Frequency of Bus Services

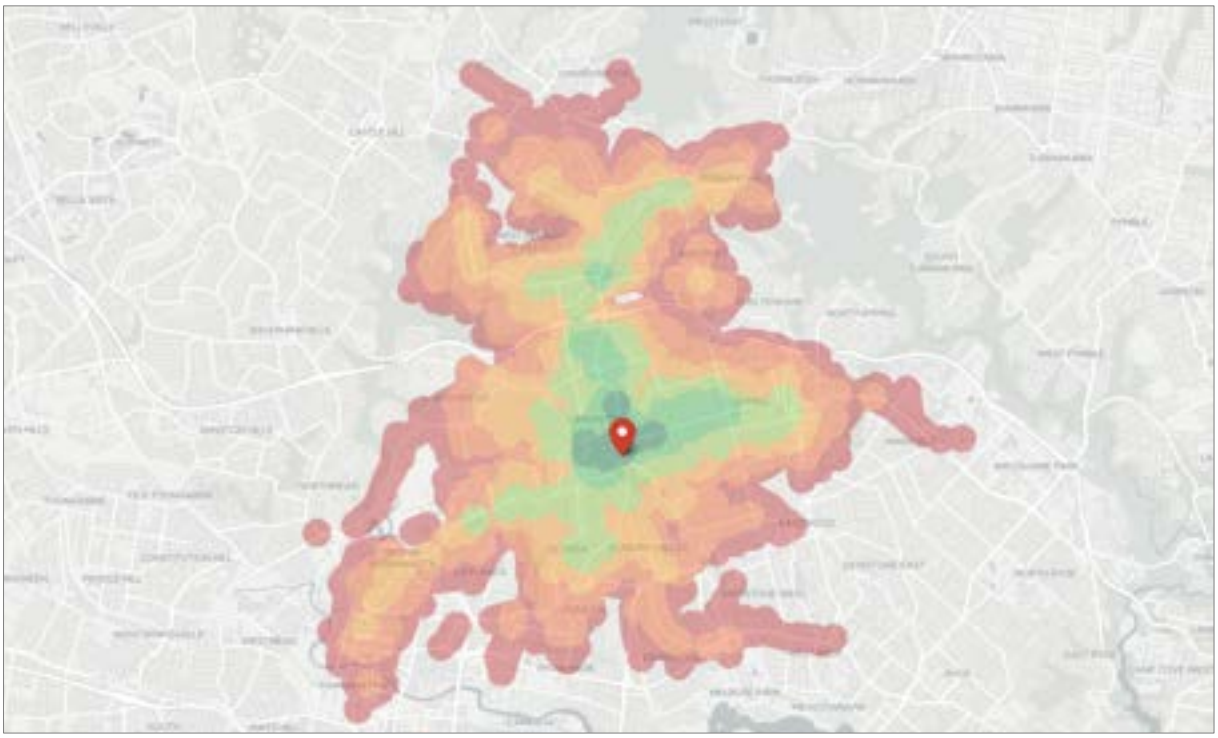
Mode	Route No.	Route Description	Weekday AM Peak Frequency	Weekday PM Peak Frequency	Weekend Midday Peak Frequency
Bus	550	Parramatta to Macquarie Park via Epping	1 per 10 minutes	1 per 10 minutes	1 per 20 minutes
	625	Parramatta to Pennant Hills	1 per 30 minutes	1 per 30 minutes	1 per hour
	546	Parramatta to Epping via Oatlands & North Rocks	1 per 30 minutes	1 per 25 minutes	1 per hour
	513	West Ryde to Carlingford	1 per 30 minutes	1 per 12 minutes	N/A

Figure 2.2: Bus Service Network Map

Reference: TfNSW Bus Maps

The site's transit travel time to key surrounding areas is shown in Figure 2.3.

Figure 2.3: 30-minute Catchment (Public Transit)



Reference: Targomo/ Route 360

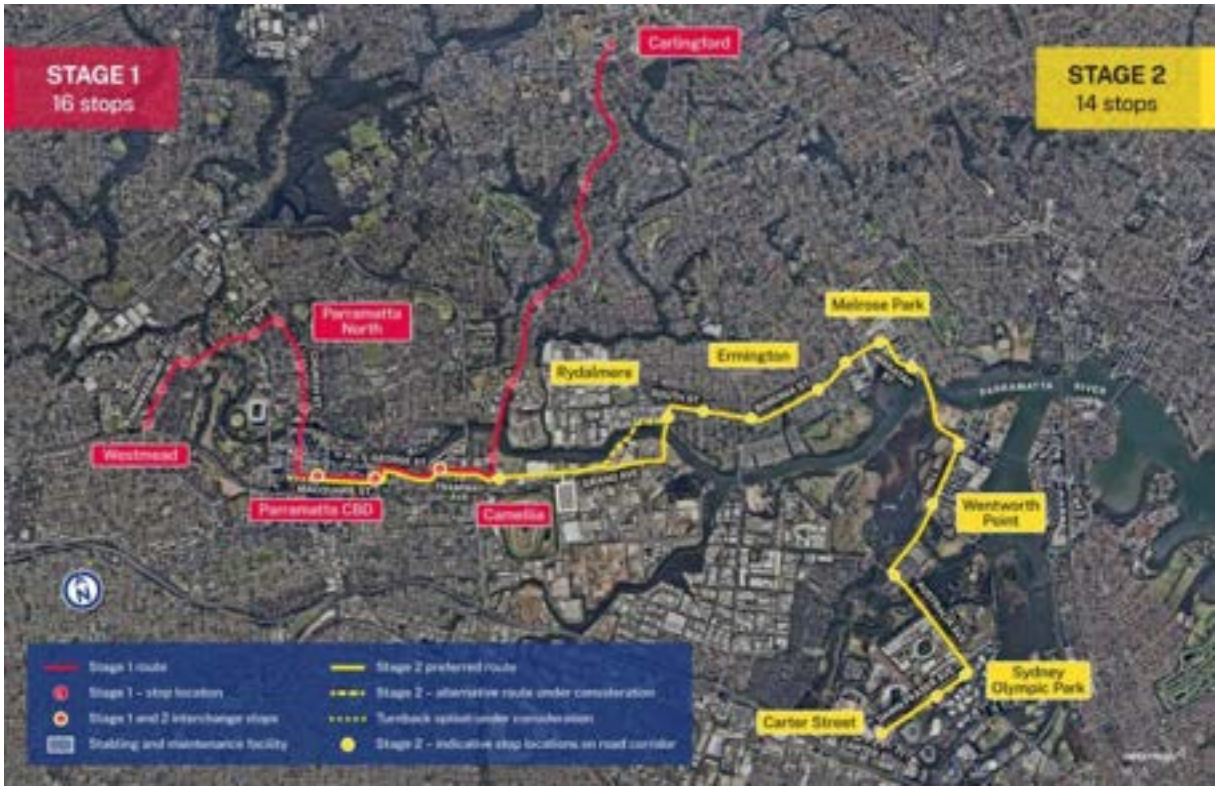
2.3.2 Parramatta Light Rail

The Parramatta Light Rail is a major public transport infrastructure project to provide high frequency light rail services to Parramatta, Westmead, Carlingford, Melrose Park and Sydney Olympic Park. The Parramatta Light Rail project will be constructed in two stages.

Stage 1 will connect Westmead to Carlingford via Parramatta CBD and Camellia with 16 stops along the route. It is noted that Stage 1 major construction is currently underway and is expected to operate in May 2024.

Stage 2 will further connect Parramatta CBD to Ermington, Melrose Park and Sydney Olympic Park. In October 2017, the NSW Government has announced the preferred route for Stage 2 which will provide an additional 10-12 stops. Figure 2.4 shows the preferred routes for both Stages 1 and 2 of the future Parramatta Light Rail service.

Figure 2.4: Parramatta Light Rail Preferred Route



Source: NSW Government

The T6 Carlingford-Clyde railway line has been permanently closed and will be converted to light rail by 2024. The 12km Parramatta Light Rail will connect Carlingford and Westmead via Parramatta CBD, passing through major town centres and universities.

The new light rail will increase connectivity to the surrounding suburbs and enhance access to public transport for residents. Carlingford is the first station in the line and is only 400m from the

site linked directly by a network of connections through the public open space. The light rail is designated to be a turn-up-and-go service, with a frequency of one tram every 7.5 minutes.

2.4 Walking and Cycling Infrastructure

Pedestrian paths are located as follows:

- Pennant Hills Road (both sides), providing access to the site
- Marsden Road (both sides)
- Shirley Street (north side).

Formalised crossing points are present on the south and east legs of the Pennant Hills Road/ Marsden Road intersection.

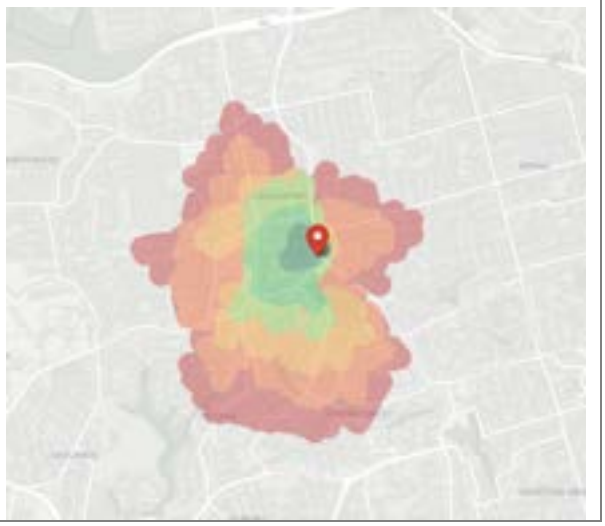
The surrounding cycling infrastructure is shown in Figure 2.5.

Figure 2.5: Surrounding Cycling Network

Reference: Cycling Parramatta, City of Parramatta Council 2020

The site's walking and cycling travel time to key surrounding areas is shown in Figure 2.6

Figure 2.6: 30-minute Catchment

Cycling	Walking
	

Reference: Targomo/ Route 360

2.5 Traffic Volumes

TTPP undertook traffic surveys which were conducted at key surrounding intersections on Thursday, 24 March 2022 during school term between 7:00am-9:00am and 4:00pm-6:30pm. The key intersections are as follows:

- Cumberland Hwy / Jenkins Road
- Pennant Hills Road / Coleman Avenue
- Pennant Hills Road / Evans Road
- Pennant Hills Road / Marsden Avenue
- Pennant Hills Road / Carlingford Road
- Cumberland Hwy / Moseley Street
- Jenkins Road / Post Office Street
- Post Office Street / Young Road
- Young Road / Moseley Street
- Jenkins Road / Moseley Street
- James Street / Jenkins Road
- Thallon Street / Post Office Street
- Shirley Street / Lloyds Avenue
- Lloyds Avenue / Coleman Avenue
- Shirley Street / Post Office Street

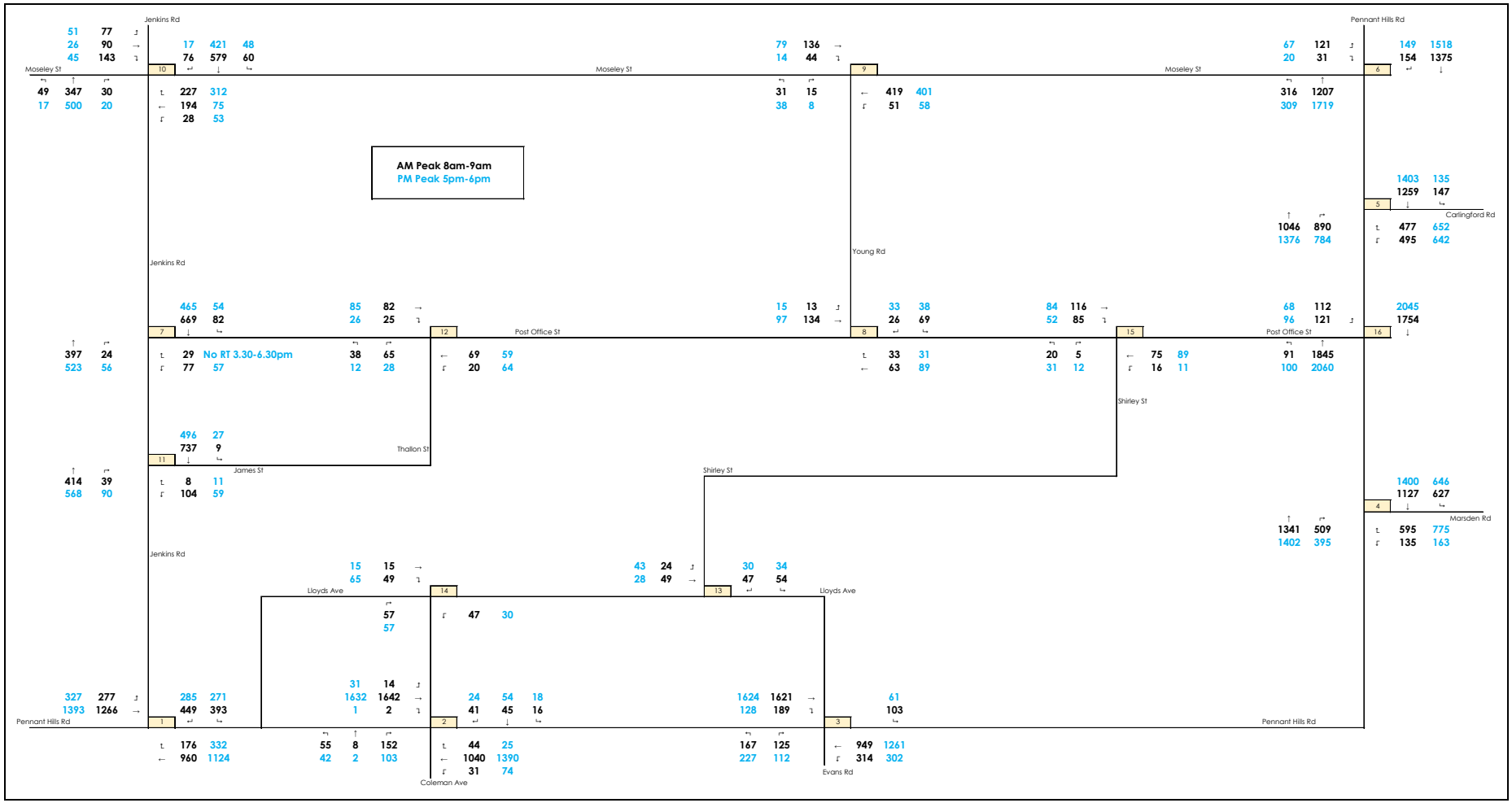
- Pennant Hills Road / Post Office Street

Based on the traffic surveys, the following peak hours were identified:

- morning peak: 8:00am-9:00am
- evening peak: 5:00pm-6:00pm

A summary of the network peak traffic flows surrounding the site is shown in Figure 2.7.

Figure 2.7: Existing Traffic Volumes



2.6 Method to Work

Method to Work (MTW) data from the Bureau of Transport Statistics (BTS), derived from the 2016 and 2021 Census, have been obtained to understand existing transportation modes to and from the subject site.

It is noted that in 2016, the Carlingford railway station was still in operation – Carlingford railway station was permanently closed in 2020 to be converted to Light Rail. As such, the 2016 MTW data would have captured existing mode share data including train patronage – this data would be key to appreciating future potential light rail patronage.

On the other hand, it is noted that the 2021 Census data was undertaken during the COVID-19 Pandemic and was notably undertaken during NSW lockdowns. Notwithstanding, a comparison of the 2016 and 2021 Census mode share data is provided in Table 2.3.

Figure 2.8 and Figure 2.9 illustrate the chosen SA1 Usual Residence (UR) and Place of Work (POW) Destination Zone (DZN) respectively.

Figure 2.8: SA1 Usual Residence

Figure 2.9: Place of Work Destination Zone

A summary of the existing mode splits of transportation is presented in Table 2.3.

Table 2.3: Existing Travel Mode Splits

Mode of Travel	Proportion (%)			
	2016 Census		2021 Census	
	where employed residents are travelling to (residential trips)	where employed people are coming from (non-residential trips)	where employed residents are travelling to (residential trips)	where employed people are coming from (non-residential trips)
Car (as driver or passenger)	67%	89%	84%	86%
Train	23%	6%	8%	4%
Bus	7%	2%	5%	0%
Motorcycle	1%	0%	0%	0%
Bicycle	0%	0%	0%	0%
Walked only	2%	3%	3%	10%
Total	**100%**	**100%**	**100%**	**100%**

Table 2.3 indicates that in 2016, residents living within the Carlingford area predominantly travel by car with 67% of residents travelling via car. Uptake of public transport (train or bus) is 30% for residents travelling to work. On the other hand, the majority of employed people travelling to the Carlingford area travel via private car (89%) while 8% travel via public transport.

Comparatively, the 2021 Census which was notably after the closure of Carlingford Railway Station and also during the COVID-19 pandemic travel restriction period, the uptake in private car travel was 84% - an increase of 17% to the 2016 Census data. Public transport usage decreased by more than half to 13% from 30% in 2016. The reduction in public transport usage is likely attributed to essential workers and social distancing restrictions with many opting for private vehicle travel over public transport.

Additionally, employees travelling to Carlingford for work decreased by 3% and 4% for private car and public transport respectively while 'walking only' increased by 7%. This is likely a result of travel restrictions imposed during Covid lockdowns such as the 5km radius.

Notwithstanding the above, it is considered that the 2016 Census would be key to appreciating future potential light rail patronage with the Carlingford to Westmead light rail line expected to be operational in 2024.

3 Strategic Context / Applicable Policies

3.1 Parramatta Local Strategic Planning Statement (LSPS)

The LSPS identifies Carlingford as a 'Local Centre'. A Local Centre is a focal point of neighbourhoods, are diverse, vary in size and provide essential access to day-to-day goods and services. The LSPS acknowledges that the role of local centres has been changing from a retail focus to a services focus, providing for basic needs and a place for local communities to gather and socialise in a quieter environment. However, it does suggest that a key challenge is for smaller centres to achieve enough vibrancy to attract customer traffic.

Key to the area of focus is developing robust public transport to connect local centres to the strategic cores (Epping and Parramatta).

3.2 City of Parramatta Community Infrastructure Strategy 2020

The City of Parramatta Community Infrastructure Strategy (Community Infrastructure Strategy) was adopted by Council in July 2020 and aims to provide long term direction for the provision of community infrastructure. The Community Infrastructure Strategy identifies contemporary challenges Council have for realising quality community infrastructure, and key opportunities and directions by asset type for City of Parramatta's 12 high growth areas including Carlingford.

As part of being identified as a high growth area, Carlingford has been identified as an area requiring high-density apartment developments to meet growth needs, and subsequent requirement for high-density transport infrastructure.

3.3 Planned Future Intersection Upgrade Works

Transport for NSW are proposing to upgrade the intersection of Pennant Hills Road and Carlingford Road to ease congestion, improve travel times and safety for all road users. Over 12,000 vehicles are using the intersection between Pennant Hills Road and Carlingford Road during the AM and PM peaks, resulting in congestion.

Transport for NSW proposes to improve traffic flow and safety at this intersection by widening sections of Pennant Hills Road and Carlingford Road to provide additional turning lanes at the intersection.

Key features of the proposed intersection upgrade include:

- provision of an additional westbound right turn lane from Carlingford Road onto Pennant Hills Road northbound

- conversion of the existing northbound bus lane on Pennant Hills Road to a general traffic left turn lane onto Moseley Street
- removal of the left slip lane replacing the existing left turn slip lane on the southbound approach along Pennant Hills Road with a dedicated left turn bay.
- road widening on the northern side of Carlingford Road to provide an additional right turn lane westbound on Carlingford Road
- road widening on the western side of Pennant Hills Road to provide three dedicated right lanes from Carlingford Road
- extension of the left turn only lane from Carlingford Road onto Pennant Hills Road southbound by 100 metres
- adjustment of existing bus shelters on Pennant Hills Road and Carlingford Road to suit new kerb alignment
- adjustment of utilities, street lighting, drainage, signage and road marking and footpaths.

The proposed upgrades are illustrated in Figure 3.1.

Figure 3.1: Proposed Intersection Upgrade of Pennant Hills Road and Carlingford Road

3.4 Known Proposed Developments within Carlingford Local Centre

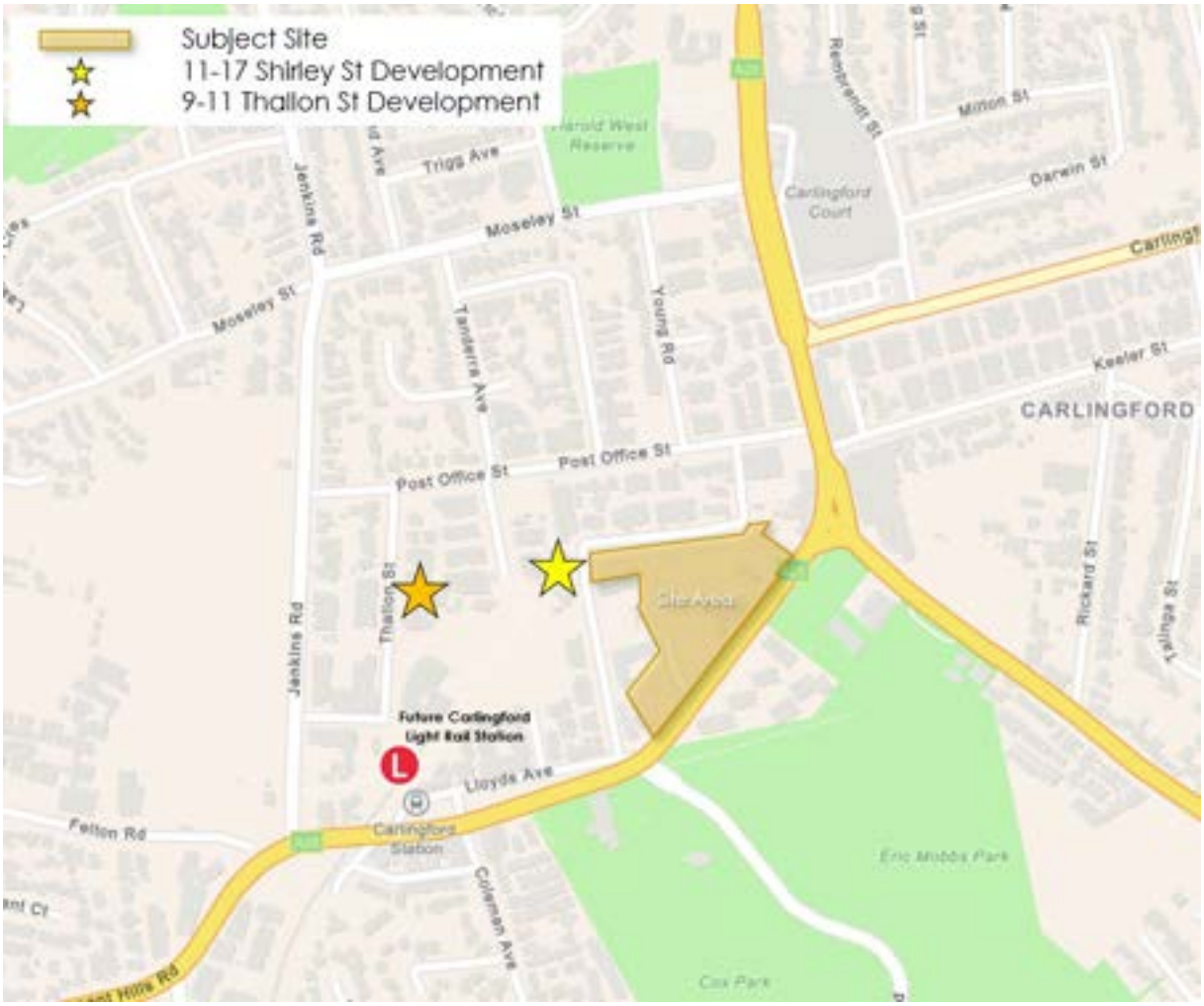
Two mixed-use developments are being proposed within the Carlingford Local Centre surrounding the future Carlingford light rail station and the subject site (this report). A breakdown of the proposed developments is as follows:

- 11-17 Shirley Street
  - 87 residential apartments
  - 75-place childcare centre and 13 staff
- 9-11 Thallon Street
  - 91 residential apartments
  - 60m^2 of retail space
  - 229m^2 of restaurant space

It is noted that the subject site (this report) currently has Development Application approval (DA1103/2011/JP) across the majority of the site for 450 residential units with an additional 100-120 units in the residual portion of the site not subject of the existing approval.

The locality of the above proposed developments is shown in Figure 3.2.

Figure 3.2: Surrounding Development Locality



4 Proposed Development

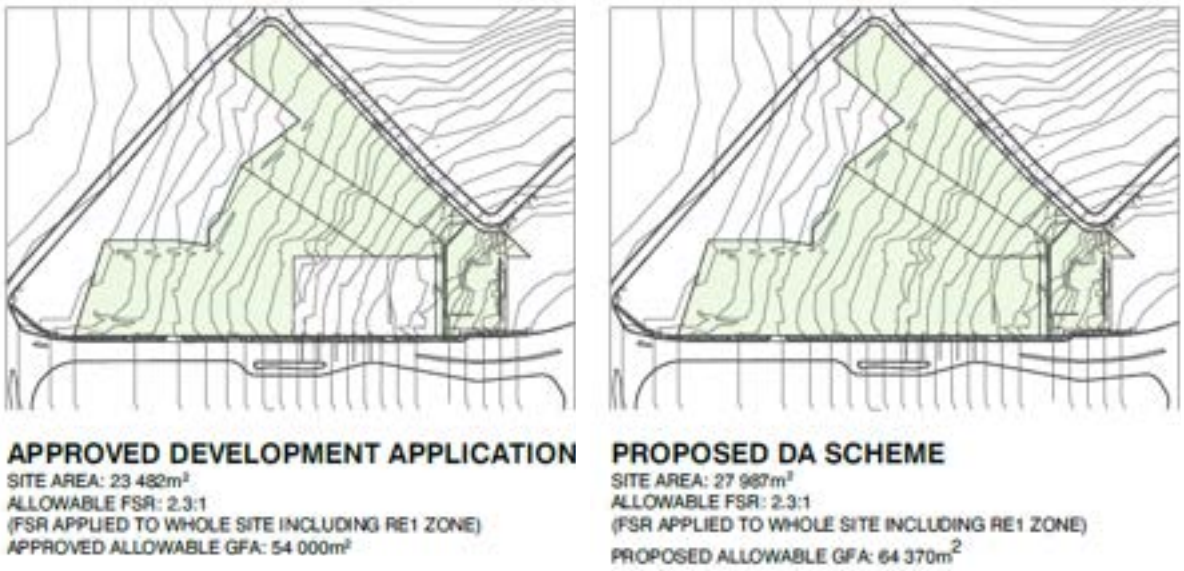
4.1 Approved Development

Planning Ingenuity's planning report notes that "*a significant portion of the site benefits from Development Application approval (DA1103/2011/JP) for the construction of five residential apartment buildings ranging from 9-11 storeys comprising 450 units. Since the approval of DA1103/2011/JP, the owners acquired the adjoining land along Pennant Hills Road, known as No. 263-273 Pennant Hills Road. These properties contain a site area of 4,471m², and under the existing planning controls, are permitted a GFA of 10,361m² (or 100 to 120 residential apartments). This would bring the overall existing (or approved/permitted) GFA of the site to 63,430m² or 550-570 residential apartments*".

Following acquisition and amalgamation of adjacent land, Meriton has worked with Council to submit a Planning Proposal for a cohesive development scheme.

This is shown in Figure 4.1 below.

Figure 4.1: Subject Site Area



Source: Fender Katsalidis,, Carlingford Apartments, Meriton, DA-470, Prelim., Dated 12.11.2021

4.2 Proposed Development

The proposal includes the construction of a primarily residential development, comprising:

- 723 residential units, including:
  - 145 one-bedroom units
  - 398 two-bedroom units

- 180 three+ bedroom units

- 2,600m^2 GFA of total retail space
- 755m^2 childcare centre with 110 children and 20 staff.
- 2,500m^2 community centre / library

It is noted that the inclusion of the community centre / library is at the request of Council. The proposed new community centre / library would replace the existing Carlingford Local Branch Library currently located at 17 Lloyds Avenue. It is also noted that the existing library relies on 15 on-street parking spaces and that the new proposed centre would require 20 parking spaces as agreed with Council.

The architectural layout plans (car park levels only) are enclosed in **Appendix A** and a site plan provided in Figure 4.2.

Figure 4.2: Proposed Site Plan

Reference: Site Plan, Fender Katsalidis, dated 23/08/2023

4.3 Proposed Vehicle Access

The proposed two-way internal roadway is approximately 7m in width, which connects to Shirley Street at two locations as shown in Figure 4.2. The proposed site locations are generally consistent with the previously approved DA.

Vehicular accesses to the basement car parks are provided via the internal roadway.

4.4 Proposed Servicing Arrangement

Waste collection for residential components will be undertaken by Council's 12.5m heavy rigid vehicle. The site will be serviced by various sized trucks ranging from 8.8m Medium Rigid Vehicle to 12.5m Heavy Rigid Vehicle.

5 Parking/ Loading Assessment

5.1 Car Parking

RTA Guide to Traffic Generating Developments 2002 and TDT 2013/ 04a

According to the State Environmental Planning Policy (SEPP) 65, a Development Application cannot be refused on account of parking provisions if car parking is provided to be equal to, or greater than the minimum about of car parking specified in Part 3J of the Apartment Design Guide.

The Guide defers to the TfNSW Guide to Traffic Generating Developments (GTGD) 2002 for developments within 800 metres of train stations (light rail and metro included). The GTGD 2002 rates for developments in metropolitan sub-regional areas are as follows:

- 0.6 spaces per 1 bedroom unit
- 0.9 spaces per 2 bedroom unit
- 1.40 spaces per 3 bedroom unit
- 1 space per 5 units (visitor parking).

Applying the rates specified, the development cannot be refused on grounds of car parking if the residential component provides the minimum GTGD 2002 prescription of 842 spaces.

Parramatta 'Harmonisation' Development Control Plan (DCP) 2023

In August 2023, Council adopted the Parramatta 'Harmonisation' DCP 2023. However, Council have accepted the application of the parking rates stipulated in the previous The Hills DCP 2012, prior to the Harmonisation DCP coming into effect.

The car parking requirements for different development are set out in The Hills DCP 2012, and the site-specific Carlingford DCP 2012.

The following Carlingford Precinct DCP 2012 car parking rates are adopted:

- Residential:
  - 0.8 spaces per 1 bedroom unit
  - 1.0 space per 2-bedroom unit
  - 1.3 spaces per 3-bedroom unit
  - 2 visitor spaces per 5 units
- Childcare:
  - 1 space per 1 employee, and
  - 1 space per 6 children

- Retail: 1 space per 18.5m^2 Gross Leasable Floor Area (GLFA).

No car parking rates are provided in the DCP for community centre / library uses. However, it is understood that Council requires 20 car spaces for the new facility.

A review of the car parking requirement rates and the floor area schedule results in a DCP 2012 car parking requirement for the proposed development as summarised in Table 5.1.

Table 5.1: DCP 2012 Car Parking Requirements

Land Use	Description	Size (no. units/ GFA)	Car Parking Rate	Car Parking Requirement
Residential	One-bedroom	145	0.8 spaces per 1-bedroom	116
	Two-bedroom	398	1.0 spaces per 2-bedroom	398
	Three-bedroom +	180	1.3 spaces per 3+-bedroom	234
	Visitor		2 spaces per 5 units	289
	Total	**723**		**1037**
Retail		2,600	1 space per 18.5m^2	141
Childcare	Children	110 (children)	1 space per 6 children	18
	Staff	20 (staff)	1 space per staff	20
Community Centre		2,500	Council agreed provision	20
Total				**1,236 spaces**

Based on SEPP 65/ ADG guidelines, the lesser of the TfNSW requirement and Council DCP requirement would be the determining factor for the residential component. Therefore, the minimum residential car parking requirement is 842 spaces in accordance with the GTTGD.

It is proposed to provide a total of 1,356 car parking spaces (including 1,189 car spaces for the residential component) which satisfies the both the TfNSW GTGD 2002 and DCP minimum car parking requirements.

The retail, childcare and community centre parking provisions would be provided at the rates stipulated in Table 5.1.

5.2 Accessible Parking

The Hills DCP 2012 Part C Section 1 outlines the accessible car parking rates for retail and childcare, being two percent and three percent of car parking spaces, respectively. Adaptable housing standard requires one accessible car parking space be provided for each adaptable unit.

The accessible parking requirements are summarised in Table 5.2.

Table 5.2: Accessible Parking Requirements

Land Use	Accessible Parking Rates
Residential Flat Building	1 space per adaptable unit
Retail	2% of spaces provided
Childcare	3% of spaces provided
Community Centre	4% of spaces provided

Note: Hills DCP Part D Section 12 – Carlingford Precinct – Section 4.31.3 states: 5% of units in any development of >20units, to be accessible units.

5.3 Bicycle Parking

The Hills DCP does not specify bicycle parking rates for residential, childcare or community centre/libraries. Therefore, recommended bicycle parking requirements have been sourced from Planning Guideline for Walking and Cycling which outlines the following recommended bicycle rates use as follows:

- Residential Flat Buildings:
  - 20-30% of units for residents, and
  - 5-10% of units for visitors.
- Childcare and Community Centre/Library:
  - Long-term/staff use: 3-5% of the number of staff, and
  - Short-term/customer use: 5-10% of the number of staff.

The Hills DCP 2012 Part C Section 1 Table 3 outlines the following bicycle rate for retail component:

- 2 spaces plus 5% of the total number of car spaces required where –
  New retail developments exceed GLFA of 5,000m^2 or
  Additions to existing developments that increase the size of the total development to greater than 5,000m^2 GLFA.

A summary of the bicycle parking requirements is provided in Table 5.3.

Table 5.3: Bicycle Parking Requirements

Land Use	Size/Yield	Reference/ Source	Parking Rate		Parking Requirement	
			Resident/Staff (Long-term use)	Customer/Visitor (short-term)	Resident/Staff (Long-term use)	Customer/Visitor (short-term)
Residential Flat Building	723 units	Planning Guideline for Walking and Cycling	20-30% * Units	5-10% * Units	145 – 217	36 – 72
Retail	108 total spaces required	Hills DCP Part C Section 1 - Car Parking	2 spaces plus 5% of total number of car spaces required		7	
Childcare	20 staff	Planning Guideline for Walking and Cycling	3-5% * Staff	5-10% * Staff	1	1-2
Community Centre / Library	5 staff				0	1
Total					**153-226**	**45-82**
					198 - 308	

Based on the above, the development is recommended to provide between 198-308 bicycle spaces.

5.4 Motorcycle Parking

The Hills DCP 2012 Part C Section 1 outlines a rate of one motorcycle space per 50 car spaces, or part thereof for all developments with more than 50 car spaces.

5.5 Car Wash Bay

The Hills DCP 2012 Part C Section 1 outlines a minimum provision of one designated carwash bay space per residential multi-unit development.

Hence, the proposed development is required to provide seven car wash bays for the proposed seven residential buildings. However, it is noted that buildings A, B, C, and G, and E and F share a basement and would naturally be able to share car wash bays. Building D would have its own separated basement levels to other development buildings.

5.6 Loading Requirements

Hills DCP 2012 Part C outlines the objectives of loading development controls, being:

- *To provide suitable access on-site for service vehicles for the purpose of loading and/ or delivering goods*
- *To ensure that types of loading and delivery areas are suited to the needs of the development*
- *To ensure that adequate numbers of loading and delivery areas are allocated for appropriate types of service vehicles*
- *To protect neighbourhood amenity and safety in the design and construction and operation of loading and service areas in accordance with Council's ESD objective 7.*

Moreover, rates for mixed shops and supermarkets have been specifically outlined.

For mixed small shops, loading bays are to be provided at a rate of:

- 2 for the first 465m^2
- 2 for the next 465m^2
- 1 for each extra 530m^2

For supermarkets, loading bays are to be provided at a rate of:

- 2 for the first 930m^2
- 2 for the next 930m^2
- 1 for each extra 930m^2

A total of seven (7) loading bays are proposed to accommodate service vehicle demand generated by the residential components such as waste collection vehicles, as well as the retail component.

5.7 Layout Design Review

The Australian Standard for Off-Street Car Parking (AS2890.1:2004) requires car parking spaces to be provided according to its use.

Residential, domestic and employee parking to be provided as Class 1A parking spaces. Short-term city and town centre parking, parking stations, hospital and medical centres are to be provided as Class 3. Whilst childcare centres are not specified in the Standard, car parking for childcare centres are generally designed as Class 3 facilities.

Table 5.4 summarises the minimum dimensions required for the parking spaces in the proposed development.

Table 5.4: Car Parking Dimensions

Uses	Class	Width	Length	Aisle Width
Residential/ Staff	1A	2.4m	5.4m	5.8m
Retail/ childcare	3	2.6m	5.4m	5.8m
Small car bay	-	2.3m	5.0m	5.8m

The proposed car park layout will comply with the above minimum requirements.

In summary, the car park and associated elements will generally comply with design requirements set out in the Australian Standards, namely AS2890.1:2004 and AS2890.6:2009. It is however, envisaged that a condition of consent would be imposed requiring compliance with these standards and as such, any minor amendments can be resolved prior to the issue of a Construction Certificate.

6 Traffic Assessment

6.1 Approved Traffic Generation

Traffic generation estimates for the proposed development have been sourced from the *TfNSW Guide to Traffic Generating Developments (GTGD) 2002* and *Technical Direction: Updated Traffic Surveys (TDT 2013/ 04a)*.

As indicated above, a significant portion of the site benefits from Development Application approval (DA1103/2011/JP) for the construction of five residential apartment buildings ranging from 9-11 storeys comprising 450 units. Since the approval of DA1103/2011/JP, the owners acquired the adjoining land along Pennant Hills Road, known as No. 263-273 Pennant Hills Road. These properties contain a site area of 4,471m^2, and under the existing planning controls, are permitted a GFA of 10,361m^2 (or 100 to 120 residential apartments). This would bring the overall existing (or approved/permitted) GFA of the site to 63,430m^2 or 550-570 residential apartments.

For the purpose of assessing residential component, it is noted that the TDT2013/ 04a have rates which more accurately reflect high-density residential apartments closer to large metropolitan / employment areas, noting the surveyed sites included areas such as Chatswood, St Leonards, Parramatta, Strathfield and Pyrmont – areas which provide railway station rather than light rail. On this basis, as a conservative approach, the vehicle trip rate per unit has been estimated from the mean of the PM peak Sydney Range. As a conservative measure this rate has also been adopted for the AM peak.

- AM Peak: 0.24 trips per unit
- PM Peak: 0.24 trips per unit

6.2 Proposed Traffic Generation

As compared with the approved DA1103/2011/JP for the site and the residual portion of the site, it is proposed to provide an additional 153 residential units (total 723 units), a 110-place childcare, a 2,600m^2 total retail floor space and a 3,525m^2 community centre / library facility.

Retail

For the purpose of assessing the retail component, the evening trip rate of 22.2 trips per 100m^2 per hour has been adopted from the "*Trip Generation Surveys – Small Suburban Shopping Centres Analysis Report*" (Bitzios Consulting, 2018). This trip rate has been recommended by TfNSW. However, the report stipulates that the morning peak would be 75% of the evening peak as the report is based on the development peak which is not coincidental with adjacent road network peaks. As the report notes, the development peaks occur 1 – 2 hours

after the road network peak. Therefore, we have adopted 50% of the evening peak to represent traffic at 8:00am – 9:00am in the morning.

A 'linked' trip rate of 25% has been adopted to represent drivers that are stopping at the supermarket on their way to another destination which is consistent with the Bitzios Consulting report (2018).

Additionally, a further reduction of 25% has been applied to account for the surrounding high-density mixed-use development at the subject site which is of a significantly different character to the supermarkets surveyed by Bitzios Consulting (2018).

The proposed supermarket has a significantly different character to the supermarkets surveyed in the Bitzios Consulting report. The supermarkets represented in the Bitzios Consulting report are all:

- Free standing supermarkets with at grade car parking.
- Located in low to medium density areas with the majority in low density areas.

Whereas the proposed supermarket is a metro style supermarket intended to primarily service the local residents and contain trips within the development. The supermarket will have a floor area of 1,100m^2 GFA (or 825m^2 GLFA). This combined with the small speciality shops that are distributed throughout the development for a total of 2,600m^2 GFA or 1,950m^2 GLFA. The supermarket will not have direct vehicular access from Pennant Hills Road and people driving to the supermarket would be required to enter the development via Shirley Street and the internal roads within the development to reach the car park.

Community Centre / Library

During the road network peak periods, it is expected that the library would generate minimal traffic, with staff members being the primary trip generators during this period. The existing Carlingford branch library opens from 9:30am-5pm Monday to Friday, except Wednesday which closes at 8pm. It is anticipated the new community centre/library facility would have similar opening hours.

Outside of peak periods, visitors would arrive sporadically throughout the day. Such visitors are likely to be undertaking other town centre functions such as shopping and visiting cafés and restaurants. Additionally, the library is expected to generate a large portion of walk-in visitors such as students from the nearby schools and colleges. Furthermore, noting that the new facility would replace the existing branch library it is not expected to generate additional trips to the road network.

The proposed community centre could be used for the occasional event.

There is no standard method for calculating the trip generation of functions, as they can vary depending on the type of event and how it is managed. However, it is anticipated that the community centre would be heavily used by local residents and would therefore generate a

large portion of walk-in visitors. Additionally, community centre events are typically held in the evening after the road network peak or on weekends.

In addition to the above, it is noted that Council has requested that 20 car parking spaces be provided for the new community centre / library consistent with the existing provision at the current Carlingford branch library. Therefore, this assumes that it does not expect heavy reliance on vehicle travel for users of the new facility.

Furthermore, the new community centre/library would be in an accessible area with public transport (Carlingford Light Rail), amenities, services and commercial/residential developments that visitors would originate from. Therefore, the site is capable of a higher public transport and walking mode share.

On the above basis, the proposed community centre/ library would not have any noticeable traffic impacts during the road network peak periods.

Estimates of net peak hour traffic volumes resulting from the proposal are set out in Table 6.1.

Table 6.1: Traffic Generation Estimates

Land Use	Size	Traffic Generation Rate (trips/ hr)		Traffic Generation Estimates (trips/ hr)	
		AM	PM	AM	PM
Approved Development Yield					
High-density residential [4]	570 units	0.24 trips per unit	0.24 trips per unit	137 trips	137 trips
Proposed Development Yield					
High-density residential [4]	723 units	0.24 trips per unit	0.24 trips per unit	174 trips	174 trips
Retail	2,600 m² GFA [1]	11.1 trips per 100m² GLFA [3]	22.2 trips per 100m² GLFA	108 trips [2]	216 trips [2]
Childcare	110 children	0.8 trips per child	0.7 trips per child	88 trips	77 trips
Total				**370 trips**	**467 trips**
Net Additional Trips				**+233 trips**	**+330 trips**

Note:
[1] Assuming that GLFA is approximately 75% of GFA
[2] Reduction factor of 50% has been applied to estimate "new trips"
[3] AM peak trip rate is assumed to be 50% of PM trip rate
[4] Trip rate calculated from the Mean of the PM peak Sydney Range

Based on Table 6.1, the approved/permitted development for the site was for up to 570 residential units, which is estimated to generate 137 trips in the AM peak and PM peak.

Hence, in comparison with the approved development, the net increase in traffic is expected to be 233 additional trips in the AM peak and 330 additional trips in the PM peak hour. This equates to four to six additional vehicles per minute spread across the entire road network.

Furthermore, it is anticipated that the trip generation of the proposed retail uses would be much lower than the vehicle trip rates specified in Table 6.1 due to the following reasons:

- Retail would primarily cater to the future residents within the precinct or in vicinity of the area.
- The majority of future residents within this site (and the surrounding areas) would take multi-purpose link trips (i.e., shopping after their work shifts prior to arriving home) so the trip to the retail is not additional.
- If there is no retail component within this precinct, then trips to retail developments beyond the site by the approved residential component would generate external trips to the road network to access other local retail centres.
- It is expected that there would be some diverted trips from traffic already using Pennant Hills Road/Cumberland Highway, which means the additional traffic on the main road network would be much less than the figures quoted in Table 6.1. This is particularly relevant given that the other retail offerings in the local area are on the opposite site of Pennant Hills Road.
- The site is within walking distance of the Carlingford Light Rail station and bus stops so it is anticipated that a large portion of the trips generated by the proposed retail component would be largely made up of trips arriving/departing by foot i.e. walking trips from public transport customers.
- The retail offering will sit within area of high amenity with high pedestrian/cycle activity which will provide opportunities for active travel and reduced car dependency.

6.3 Surrounding Developments

As detailed in Section 3.3, two proposed mixed-use developments are being proposed in the Carlingford Precinct within the vicinity of the site.

A summary of the estimated traffic generation is provided in Table 6.2.

Table 6.2: Surrounding Development Traffic Generation Estimates

Development Site	Proposed Land Use	Size	Traffic Generation Rate (trips/ hr)		Traffic Generation Estimates (trips/ hr)	
			AM	PM	AM	PM
11-17 Shirley Street	High-density residential	87 units	0.24 trips per unit	0.24 trips per unit	21 trips	21 trips
	Childcare	75 kids	0.8 trips per child	0.7 trips per child	60 trips	53 trips
	Total				**81 trips**	**74 trips**
9-11 Thallon Street	High-density residential	91 units	0.24 trips per unit	0.24 trips per unit	22 trips	22 trips
	Retail [1]	60m²	1 trip per parking space	1 trip per parking space	4 trips	4 trips
	Restaurant	229m²	2.5 trips per 100m² GFA [2]	5 trips per 100m² GFA	6 trips	11 trips
	Total				**28 trips**	**33 trips**
Total					**109 trips**	**107 trips**

[1] Assumed retail shop to service local/walk-in customers only, noting the small retail size.
[2] AM trip rate assumed as 50% of PM trip rate.

Based on Table 6.2, the surrounding developments will contribute a total of 109 trips and 107 trips in the Morning peak and evening peak respectively.

6.4 Trip Containment

The following discussion addresses the issue of trip containment within the local area. Although this is likely to significantly reduce the estimated traffic generation this has not been included in our assumptions for traffic generation as part of this assessment.

The provision of a small local supermarket and childcare are intended to reduce vehicle trips and reduce trip lengths. It is consistent with providing 15-minute neighbourhoods with local services within 15 minutes of peoples homes. It should also be made clear that the supermarket will not have access from Pennant Hills Road.

The adopted method for predicting traffic flow relies on traditional techniques where trip rates are identified and traffic generation is estimated based on them. However, this approach only considers the number of vehicle trips entering and exiting the car park, without taking into account the distance people have to travel or where they are coming from. This approach is overly cautious as it doesn't factor in trip containment which could decrease the number of trips leaving the area, or the possibility of shorter trip distances. Additionally, it disregards the fact that these trips would occur regardless of whether a supermarket is present at the development site.

The local residents, both present and future, require a supermarket to purchase groceries. If the proposed development does not include a supermarket, these individuals would have to

drive to Carlingford Shopping Centre or beyond using Pennant Hills Road. Moreover, outsiders would only make trips to the development if it was closer than going to Carlingford Shopping Centre. Thus, it can be argued that trips to the supermarket and childcare facilities should not be considered part of the broader road network since they are not new vehicle trips.

6.5 Trip Distribution

The inbound and outbound directional splits have been shown in Table 6.3.

Table 6.3: Directional Splits

Land Use	AM Peak		PM Peak	
	In	Out	In	Out
Residential	20%	80%	80%	20%
Retail	50%	50%	50%	50%
Child Care	50%	50%	50%	50%
Restaurant	50%	50%	50%	50%

Hence, the development trips with directional splits have been shown in Table 6.4.

Table 6.4: Development Trips

Land Use		AM			PM		
		In	Out	Total	In	Out	Total
Subject Site	Residential [1]	35	139	174	139	35	174
	Retail	54	54	108	108	108	216
	Child Care	44	44	88	39	39	77
	Total	**133**	**237**	**370**	**286**	**181**	**467**
Surrounding Sites	Residential	8	35	43	35	8	43
	Retail	3	1	4	1	3	4
	Child Care	30	30	60	26	26	52
	Restaurant	3	3	6	6	6	12
	Total	44	69	**113**	68	43	**111**
Network Total		**177**	**306**	**483**	**354**	**224**	**578**

[1] Includes full proposed yield (720 units)

Based on Table 6.4, the subject site would generate between 370-467 vehicle trips during the peak hour. The cumulative network traffic generation would be 483 vehicle trips in the AM peak and 578 vehicle trips in the PM peak.

In addition to this, the census data indicated that majority of residents travel to/from their POW being Sydney CBD (18%), Ryde/Hunters Hill (17%), Parramatta (9%) and 8% within Carlingford and the remaining spread across greater Sydney LGAs.

Meanwhile employed people coming to Carlingford (DZN) are travelling within Carlingford (26%) and from Baulkham Hills (12%), Ryde/Hunters Hill (7%), Parramatta (6%) and Pennant Hills/Epping (6%) and the remaining spread across greater Sydney LGAs.

Based on these locations, development traffic has been directionally distributed to/from the site onto the surrounding road network as summarised in Table 6.5. It is noted that the directional proportions indicate the route travelled inbound/outbound to/from the POW or DZN based on the fastest route from the respective site location and does not necessarily mean where the POW is located relative to the site.

Table 6.5: Existing Travel Patterns

Direction of Travel	Proportion (%)	
	Inbound Trips	Outbound Trips
North	38%	50%
East	13%	3%
South	20%	26%
West	29%	21%

Notes:
[1] North does not necessarily mean suburbs to the North only, but rather vehicles would require to travel north (towards M2 Motorway – the fastest route) to reach POW areas such as Chatswood, St Leonards, North Sydney and Sydney CBD. East indicates residents travel via Carlingford Road towards Epping, Macquarie Park, North Ryde etc.

The routes likely taken to/ from the subject site and each nominated direction have been shown in Figure 6.1 and Figure 6.2, while Figure 6.3 and Figure 6.4 illustrated the inbound and outbound route for the Thallon Street development. Note, the subject site and the proposed Shirley Street development would have similar inbound and outbound routes given they will both have vehicle accesses off Shirley Street.

Figure 6.1: Inbound Routes – Subject Site and Shirley Street Development

Figure 6.2: Outbound Routes – Subject Site and Shirley Street Development

Figure 6.3: Inbound Routes – Thallon Street Development

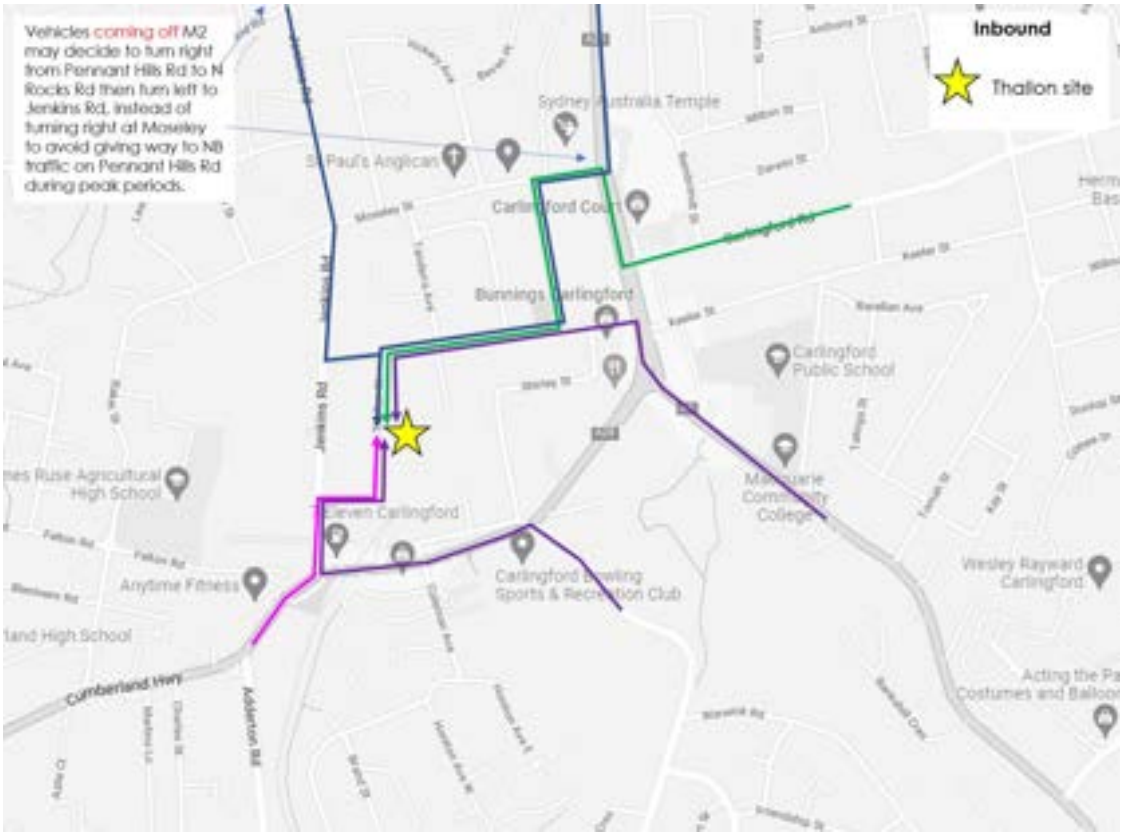
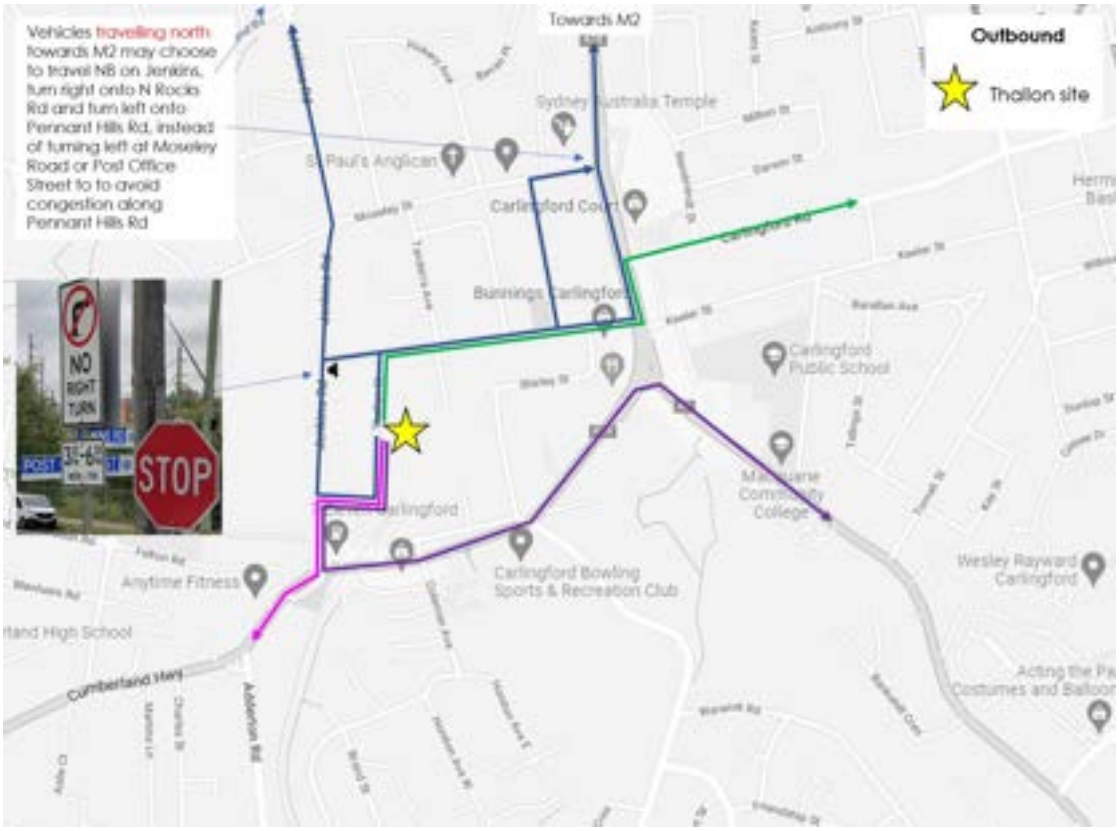


Figure 6.4: Outbound Routes – Thallon Street Development



In terms of vehicle turning movements, the distributed development trips from all developments (subject site plus surrounding developments) across the network are shown in Figure 6.5 (AM) and Figure 6.6 (PM).

Figure 6.5: Estimated Trips from All Development Sites (AM)

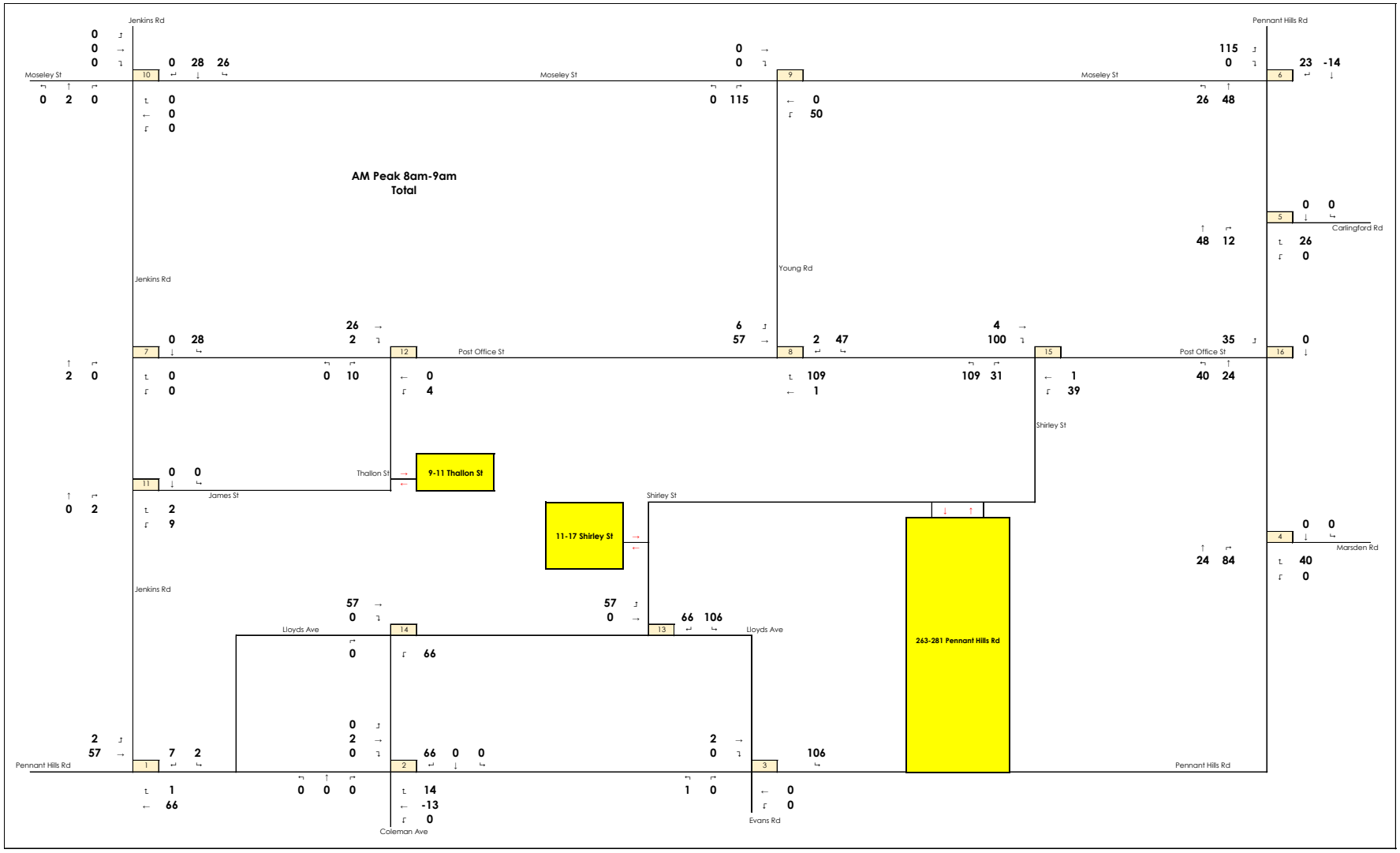


Figure 6.6: Estimated Trips from All Development Sites (PM)

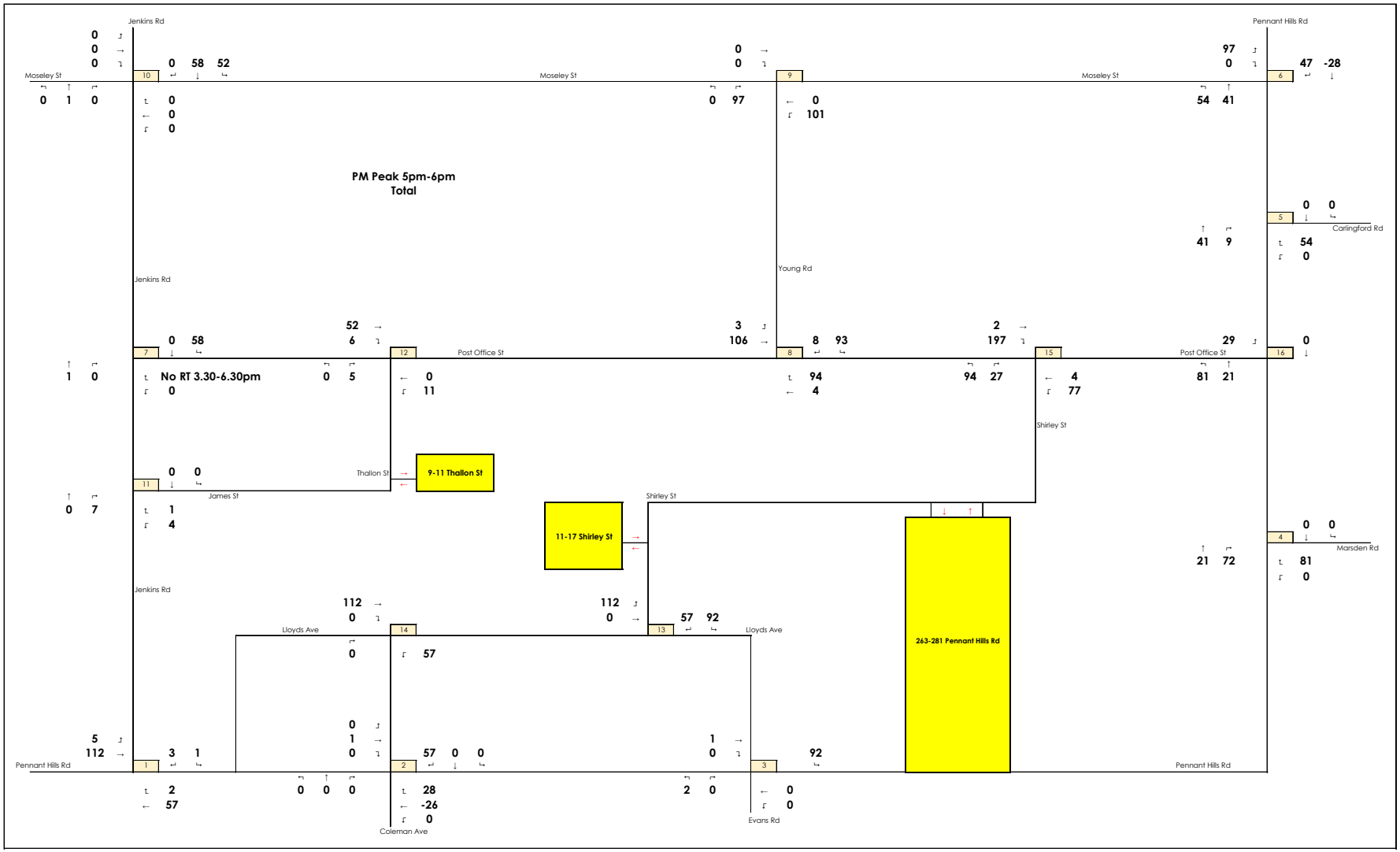


Table 6.6 shows the estimated two-way traffic volumes at key midblock locations for the 5-Year and 10-Year future, based on existing traffic volumes and STFM traffic growth data. Figures in parentheses present percentage of total cumulative additional traffic in comparison to the respective future base traffic volumes.

Table 6.6: Future Mid-Block Volume Comparison with Development Traffic

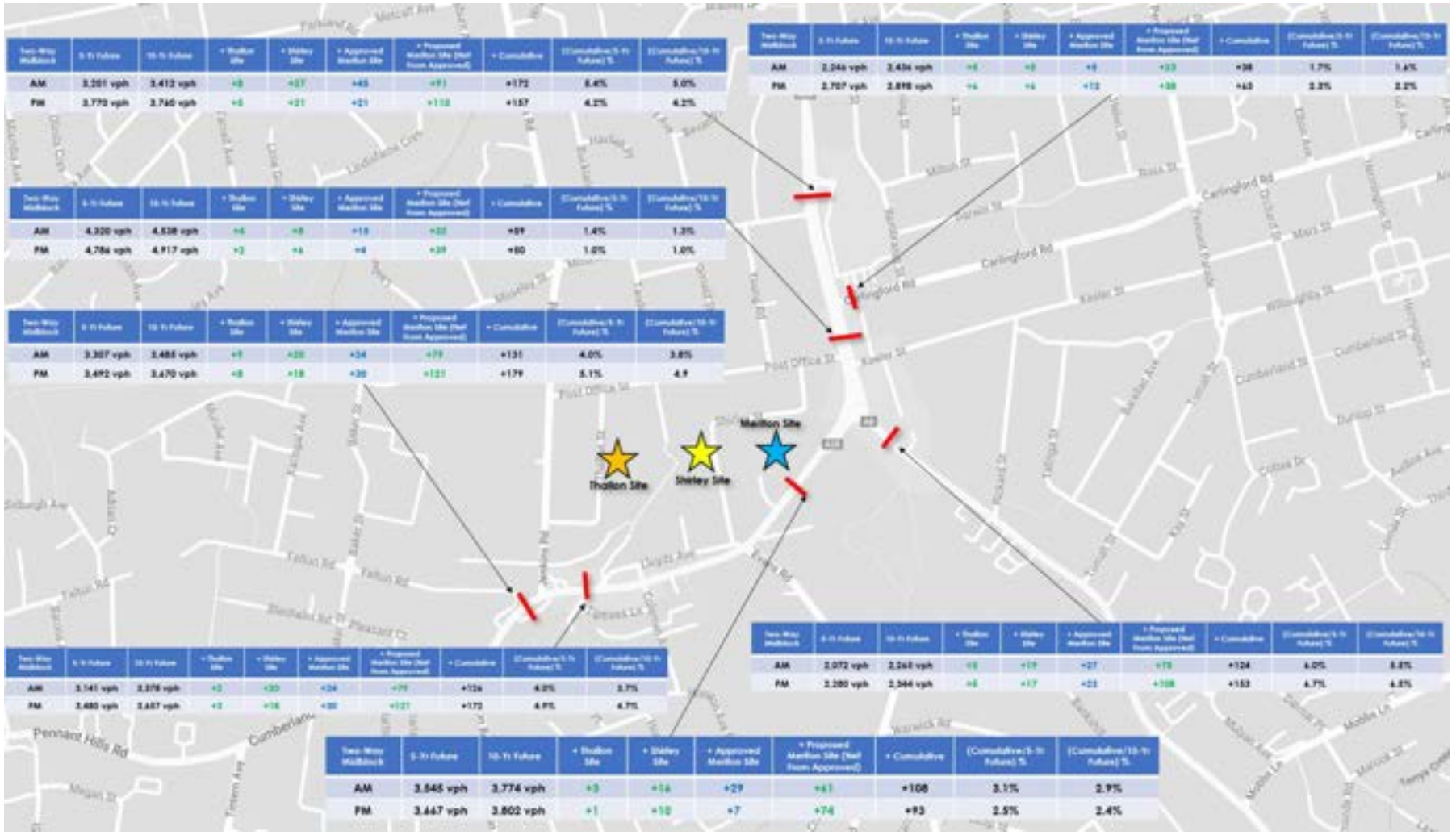
Locations	5 Year Future Base Two-Way Traffic Volume (vph)		10 Year Future Base Two-Way Traffic Volume (vph)	
	AM	PM	AM	PM
Pennant Hills Rd, west of Jenkins Rd	3,307 (+4%)	3,492 (+5.1%)	3,485 (+3.8%)	3,670 (+4.9%)
Pennant Hills Rd, east of Jenkins Rd	3,141 (+4%)	3,480 (+4.9%)	3,378 (+3.7%)	3,657 (+4.7%)
Pennant Hills Rd, between Coleman Avenue and Marsden Rd	3,545 (+3.1%)	3,667 (+2.5%)	3,774 (+2.9%)	3,802 (+2.4%)
Marsden Rd, east of Pennant Hills Rd	2,072 (+6%)	2,280 (+6.7%)	2,265 (+5.5%)	2,344 (+6.5%)
Pennant Hills Rd, south of Carlingford Rd	4,320 (+1.4%)	4,786 (+1%)	4,538 (+1.3%)	4,917 (+1%)
Carlingford Rd, east of Pennant Hills Rd	2,246 (+1.7%)	2,707 (+2.3%)	2,436 (+1.6%)	2,898 (+2.2%)
Pennant Hills Rd, north of Moseley St	3,201 (+5.4%)	3,770 (+4.2%)	3,412 (+5%)	3,760 (+4.2%)

As presented in Table 6.6, the additional traffic generated by all the proposed developments is likely to have minimal impact (i.e. up to 7% increase in traffic volume) at key locations and is likely to be less given the discussion points above.

Furthermore, the subject site alone would make up much less than 7% in total traffic, noting the proportion of traffic generation as compared with the surrounding developments (refer Table 6.6).

The midblock locations in Table 6.6 are illustrated in Figure 6.7 with values indicating the respective development traffic increase, including the cumulative increase at each key midblock location.

Figure 6.7: Future Mid-Block Volume Comparison with All Development Site Traffic



7 Traffic Modelling

7.1 Overview

As requested by Transport for NSW, SIDRA network traffic modelling has been undertaken using SIDRA 9.0 network software for the Carlingford study area as shown in Figure 7.1. The Sidra model tested the 5-Year and 10-Year futures with do-minimum road upgrades, and with/without known adjacent proposed developments. The 5-Year and 10-Year futures traffic forecast volumes were estimated based on TfNSW STFM data.

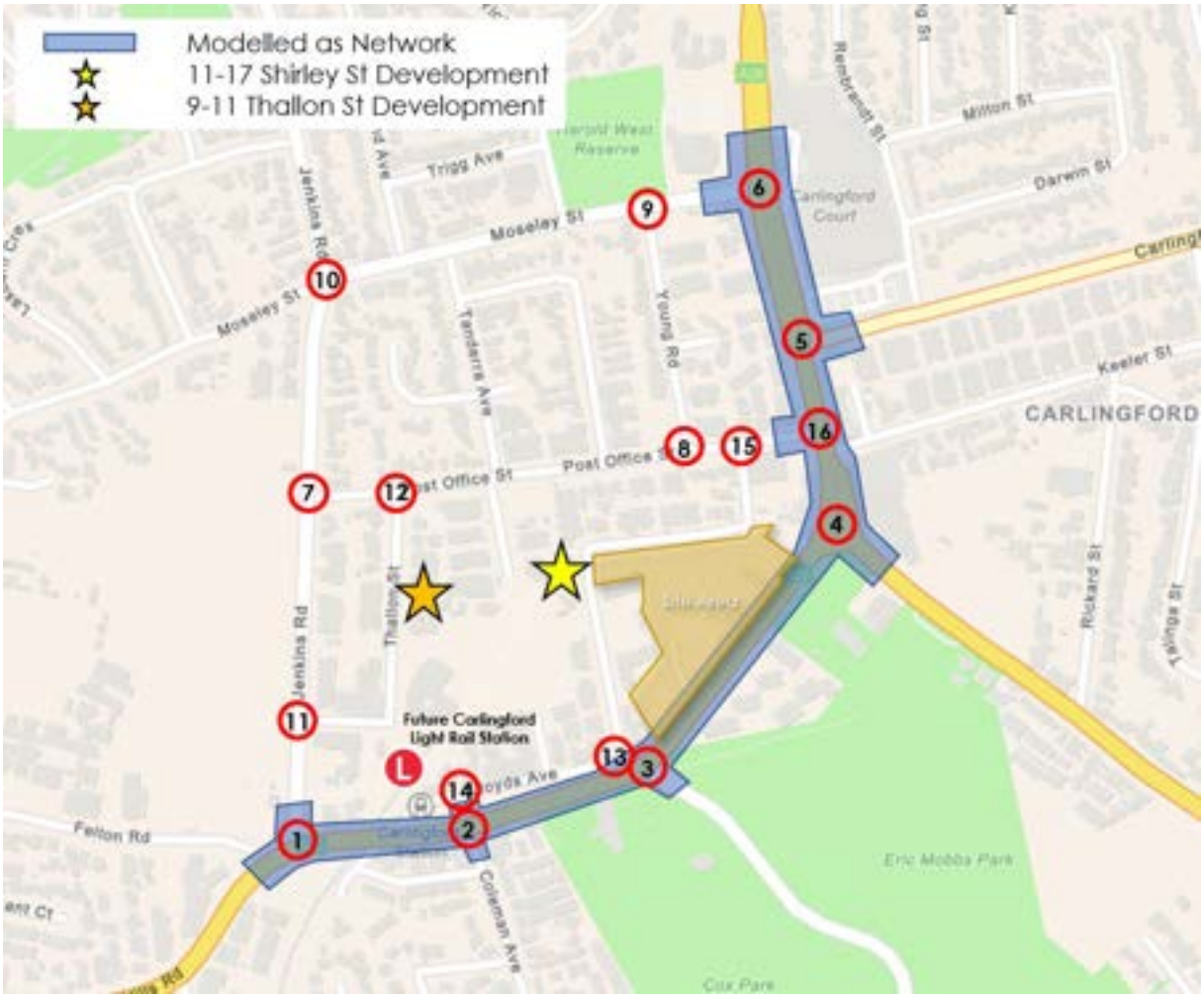
The following section summarises the Sidra modelling that was undertaken.

7.2 Model Development

7.2.1 Model Scope

The model scope includes the 16 key intersections as illustrated in Figure 2.7. The study area has been separated and modelled in two components: individual site intersections and a network corridor (Pennant Hills Road). The network model intersections include those highlighted in blue (i.e. intersection 1, 2, 3, 4, 5, 6 and 16) in Figure 7.1. The remaining sites have been modelled as individual sites. Additionally, Figure 7.1 illustrates the locality of known adjacent proposed developments that have been assessed.

Figure 7.1: Base Model Layout

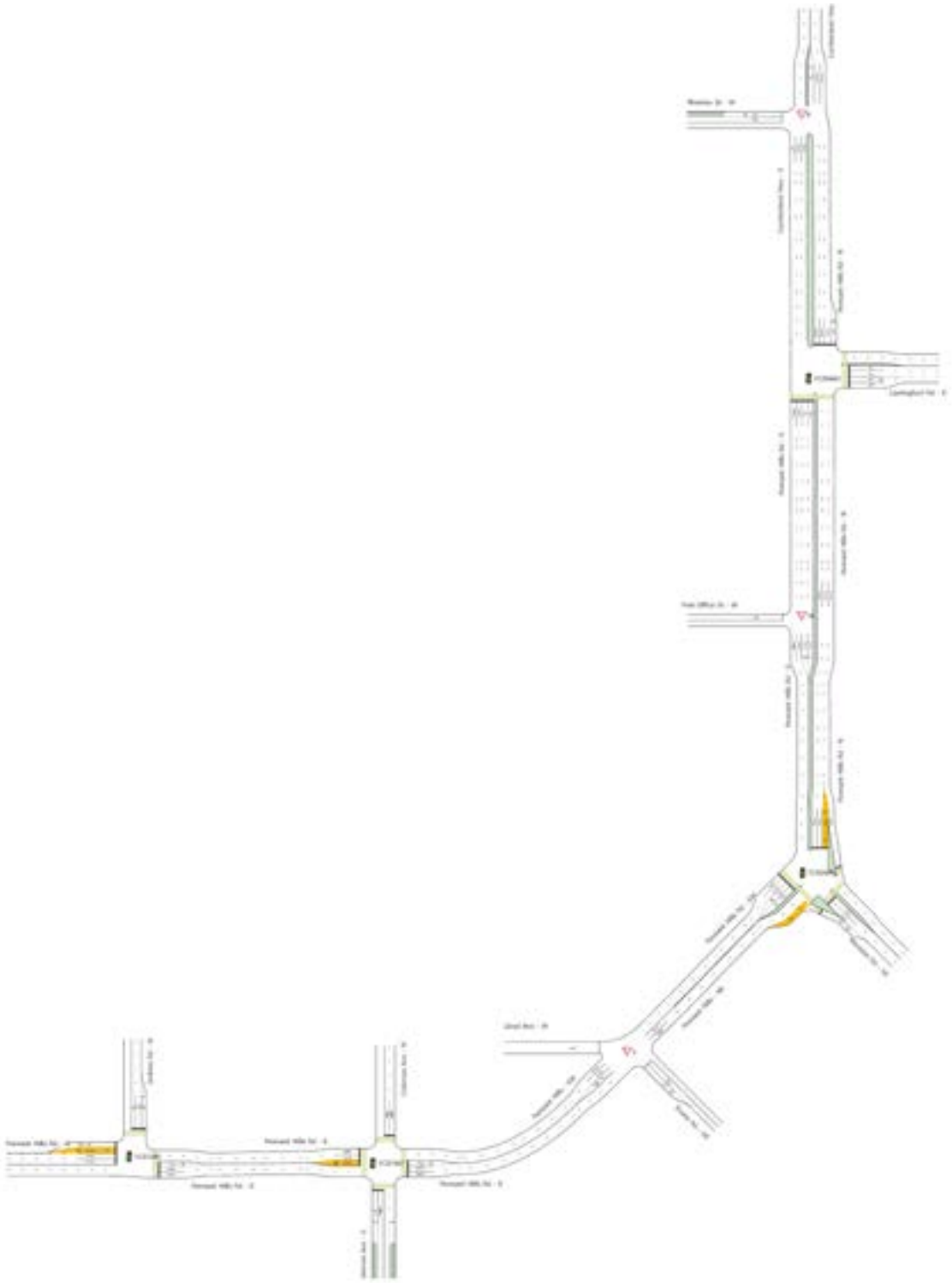


7.2.2 Coding of the Network

The geometric coding of the network was based on Nearmap aerial photography and TCS signal plans of the key intersections. Intersections 3, 6 and 16 are unsignalised intersections with Pennant Hills/Cumberland Highway being the major road. Intersection 16 has a left-in / left out layout with Post Office Street.

The modelled area is shown in Figure 7.2.

Figure 7.2: Base Model Layout



Intersection 3 is a four-legged unsignalized intersection. Lloyds Avenue (north leg) is a one-way approach and currently has a 'No Right Turn' restriction onto Pennant Hills Road. Notably however, through movements from Lloyds Avenue to Evans Road are un-restricted – i.e. no sign posts indicating such restriction. Notwithstanding, no vehicle movements were recorded

during the AM peak period while only 1 vehicle was recorded during the PM peak undertaking this movement.

However, for Sidra modelling purposes the through movement has not been coded as it has been reasonably assumed that motorists are highly unlikely to undertake this movement during AM and PM peak hours, noting the peak vehicle flows on Pennant Hills Road. The long delays for motorist would deter them from undertaking this movement during peak hour periods given there is opportunity to travel south via the signalised Intersection at Intersection 2. In addition to this, the movement is considered to be unsafe noting the poor sight distances to the east and west due to landscaping and the general road curvature of Pennant Hills Road at this location.

Intersections 3 and 6 were previously modelled as 'seagull' type intersections as detailed in the previous TIA report because preliminary base modelling showed extremely long delays for the right turns from the side streets at these intersections of over 2 hours.

Therefore, site inspections were undertaken during the peak traffic periods to observe the traffic behaviour. Site observations indicates that:

- Intersection 3: At Evans Road / Lloyds Avenue / Pennant Hills Road intersection, most right turning vehicles did not make turns like at a 'seagull' intersection. However, it was observed that traffic made the right turn from Evans Road using aggressive lane changing and relied on vehicles in Pennant Hills Road to give way to allow them into the traffic stream. This would suggest that right turn vehicles have a low gap acceptance tolerance as they currently struggle to find large, safe gaps in traffic streams on Pennant Hills Road.
- Intersection 6: At Mosely Street and Pennant Hills Road vehicles do use the central median as storage to make the right turn out similar to a 'seagull' intersection (see Figure 7.3). We also observed that some vehicles gave up trying to turn right after two minutes or so and turned left instead.

Figure 7.3: Right Turn Vehicles Waiting in Central Median Storage Area

Figure 7.4: Right Turn Vehicles from Evans Road to Pennant Hills Road

Although we observed that vehicles were turning using two movements at one of the intersections, we acknowledge that due to the limitations of Sidra we could not model the channelised right turn lanes acceptably for Transport for NSW. Therefore, we have recoded the models as standard 'Give Way' intersections with channelised right turns.

We have then adjusted the 'extra bunching' and 'gap acceptance' for the right turns in order to calibrate the models to the level of delay that we observed.

Without calibrating the gap acceptance, the model was showing delays greater than 2 hours on these turns. This is not what was observed and is not realistic. Previous methodology for modelling this as a two-stage right turn ('seagull') was rejected by Transport for NSW. Therefore, we adopted the method presented in the NSW modelling guidelines of adjusting gap acceptance.

The TfNSW modelling guidelines recommend that gap acceptance should be adjusted from the default values using appropriate judgement, as per below.

For two-way sign control and signalised intersections, SIDRA relies on user-specified critical gap and follow-up headways. SIDRA default values for all sign-controlled (stop-sign and give-way/yield sign) intersections are based on a two lane main road. Default values should be adjusted under different geometric arrangements. It should be noted that the capacity and performance of sign-controlled intersections are particularly sensitive to the values of these parameters. Therefore, gap-acceptance parameters applicable to particular intersection geometry and flow conditions should be selected by using good judgement and taking into account the local driver characteristics.

The default values of the gap-acceptance parameters for signalised intersections, roundabouts and sign-controlled intersections are given in Tables 12.2.5 of the SIDRA manual which are also attached in Appendix E to these guidelines. **Appropriate judgement is required while selecting the critical gap and follow-up headway values to suit the circumstances** considering grades, sight distance conditions, opposing movement speeds, number of lanes, and one-way or two-way conditions. Any changes to these values should be justified.

Source Traffic Modelling Guidelines, Roads and Maritime Services, 2013

Furthermore, the modelling guidelines do not provide a range of accepted values, it only states that these factors are adjusted to suit the circumstances.

As traffic turning right at these intersections is entering slow moving traffic, the gap acceptance was observed to be much lower than the default values. That is, vehicles were pushing into slow moving traffic flow. This is occurring on a daily basis. The gap acceptance factors were therefore adjusted to match what was observed and are justified based on the observed behaviours.

A comparison of the default SIDRA settings and calibrated (user input) settings is provided in Table 7.1 (Intersection 3) and Table 7.2 (Intersection 6).

Table 7.1: Pennant Hills Road – Evans Road – Lloyds Avenue

Pennant Hills Rd – Evans Rd – Lloyds Ave	Extra Bunching		Gap Acceptance					
	Default (SIDRA output based on program default settings [1])	Calibrated (User Input)	PHR Right Turn into Evans Rd			Right Turn from Evans Rd to PHR		
			Default		Calibrated (User Input)	Default		Calibrated (User Input)
AM Peak	NB approach: 13.7% SB approach: 9.5%	NB approach: 25% SB approach: 25%	Apply TWSC Calibration checkbox	Tick	-	Apply TWSC Calibration checkbox	Tick	Untick
			Critical Gap	4.5 sec	-	Critical Gap	7 sec	3 sec
			Follow-up Headway	2.5 sec	-	Follow-up Headway	4 sec	1.7 sec
PM Peak	NB approach: 7.9% SB approach: 13.3%	NB approach: 25% SB approach: 25%	Apply TWSC Calibration checkbox	Tick	-	Apply TWSC Calibration checkbox	Tick	Untick
			Critical Gap	4.5 sec	-	Critical Gap	7 sec	3 sec
			Follow-up Headway	2.5 sec	-	Follow-up Headway	4 sec	1.8 sec

TWSC = Two-Way Sign Control
[1] Extra Bunching calculated by SIDRA in 'Sign Control Analysis'.

Table 7.2: Pennant Hills Road – Moseley Street

Pennant Hills Rd – Moseley St	Extra Bunching		Gap Acceptance					
	Default (SIDRA output based on program default settings [1])	Calibrated (User Input)	PHR Right Turn into Evans Rd			Right Turn from Evans Rd to PHR		
			Default		Calibrated (User Input)	Default		Calibrated (User Input)
AM Peak	NB approach: 18.1% SB approach: 0%	Default SB approach: 5%	Apply TWSC Calibration checkbox	Tick	Untick	Apply TWSC Calibration checkbox	Tick	Untick
			Critical Gap	4.5 sec	-	Critical Gap	7 sec	3 sec
			Follow-up Headway	2.5 sec	-	Follow-up Headway	4 sec	1.8 sec
PM Peak	NB approach: 20.6% SB approach: 0%	Default SB approach: 15%	Apply TWSC Calibration checkbox	Tick	Untick	Apply TWSC Calibration checkbox	Tick	-
			Critical Gap	4.5 sec	4 sec	Critical Gap	7 sec	3 sec
			Follow-up Headway	2.5 sec	2.2 sec	Follow-up Headway	4 sec	1.7 sec

TWSC = Two-Way Sign Control
[1] Extra Bunching calculated by SIDRA in 'Sign Control Analysis'.

Based on the above coding and calibration inputs, the existing base model reflects the observed behaviour. Further detailed discussion of the model validation is discussed in Section 7.2.3 below.

7.2.2.1 Count Data

As detailed in Section 2.5, traffic surveys were undertaken on Thursday, 24 March 2022 during school term between 7:00am-9:00am and 4:00pm-6:30pm at the above 16 intersections.

7.2.2.2 Travel Time Data

Travel time surveys have been undertaken for the survey period from 7:00am – 9:00am and 4:00pm – 6:30pm along Pennant Hills Road from Jenkins Street to Moseley Street in both directions. The travel times have been recorded using the floating car survey method. The survey route was recorded 4 times in each direction in each model period. Model calibration was based on the travel time surveys.

7.2.2.3 TCS Signal Plans

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

7.2.2.4 SCATS History and LX Files

Traffic signals in the model are coded as actuated signals. The basic timing for the signalised intersections has been taken from the SCATS history files. In addition, offsets have been obtained from the SCATS LX files.

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.

7.2.3 Base Model Calibration and Validation

The 2022 existing conditions model has been developed for the morning peak hour (8:00am-9:00am) and evening peak hour (5:00pm-6:00pm).

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 2022. The model validation was undertaken based on travel time observations along Pennant Hills Road. Travel time validation was based on travel times within + or – 15% of the observed travel time for the whole route. Travel times have been reported by section and graphed of the cumulative travel time by distance.

The observed and modelled Sidra route travel times for the AM peak hour and PM peak hour are summarised in Table 7.3 and Table 7.4.

Table 7.3: Northbound Route Travel Time

Check Point along Pennant Hills Road	Distance (m)	AM Peak (8am-9am)		PM Peak (5pm-6pm)	
		Observed	Modelled	Observed	Modelled
Jenkins Road	0	00:00	00:00	00:00	00:00
Coleman Avenue	206.4	00:20	00:23	00:16	00:19
Shirley Street	431.4	00:36	00:37	00:30	00:33
Marsden Road	796	1:35	1:39	1:19	1:15
Carlingford Road	1,000.2	1:59	2:07	1:48	1:38
Moseley Street	1,693.4	2:13	2:49	2:02	2:20

Table 7.4: Southbound Route Travel Time

Check Point along Pennant Hills Road	Distance (m)	AM Peak (8am-9am)		PM Peak (5pm-6pm)	
		Observed	Modelled	Observed	Modelled
Moseley Street	0	00:00	00:00	00:00	00:00
Carlingford Road	264.4	1:21	1:34	00:51	00:57
Marsden Road	464.9	1:38	2:05	1:09	1:28
Shirley Street	828.5	2:05	2:27	1:34	1:51
Coleman Avenue	1,059.9	2:36	2:49	2:14	2:12
Jenkins Road	1,461.2	3:35	3:18	2:36	2:37

A comparison of the observed and modelled travel time routes of the modelled networks are shown in Figure 7.5 to Figure 7.8. The results indicate the validity of the model calibration to the existing conditions.

Figure 7.5: Morning Peak Travel Time Northbound (8am-9am)

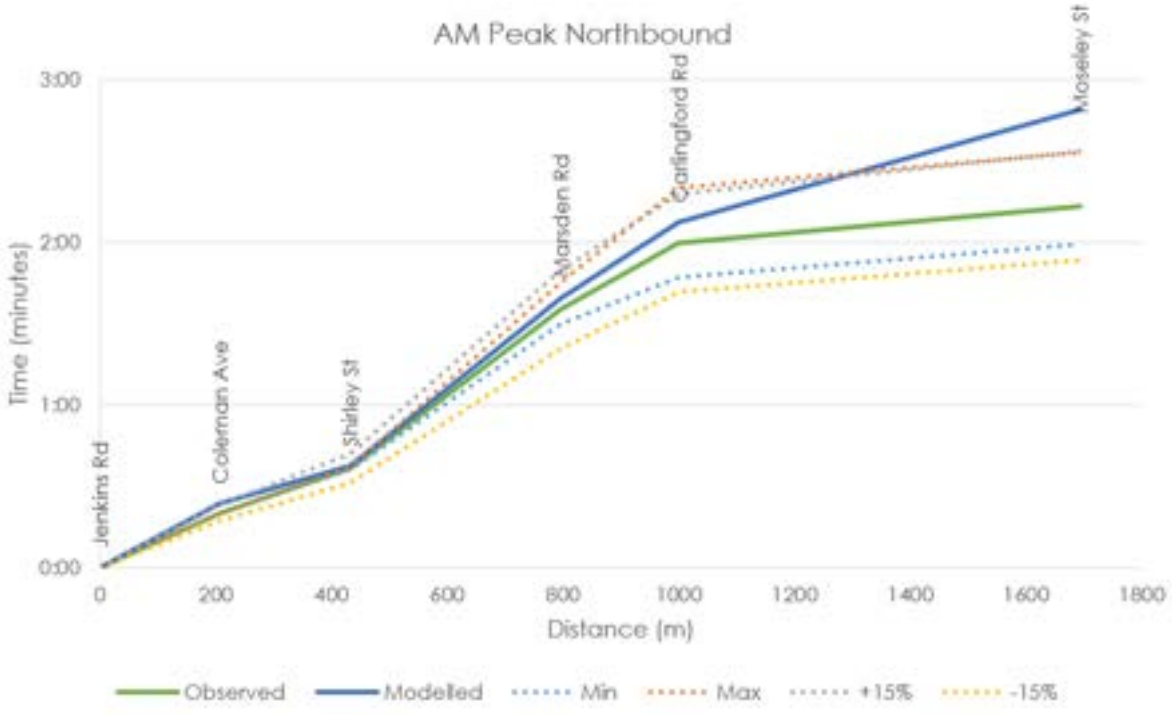


Figure 7.6: Morning Peak Travel Time Southbound (8am-9am)

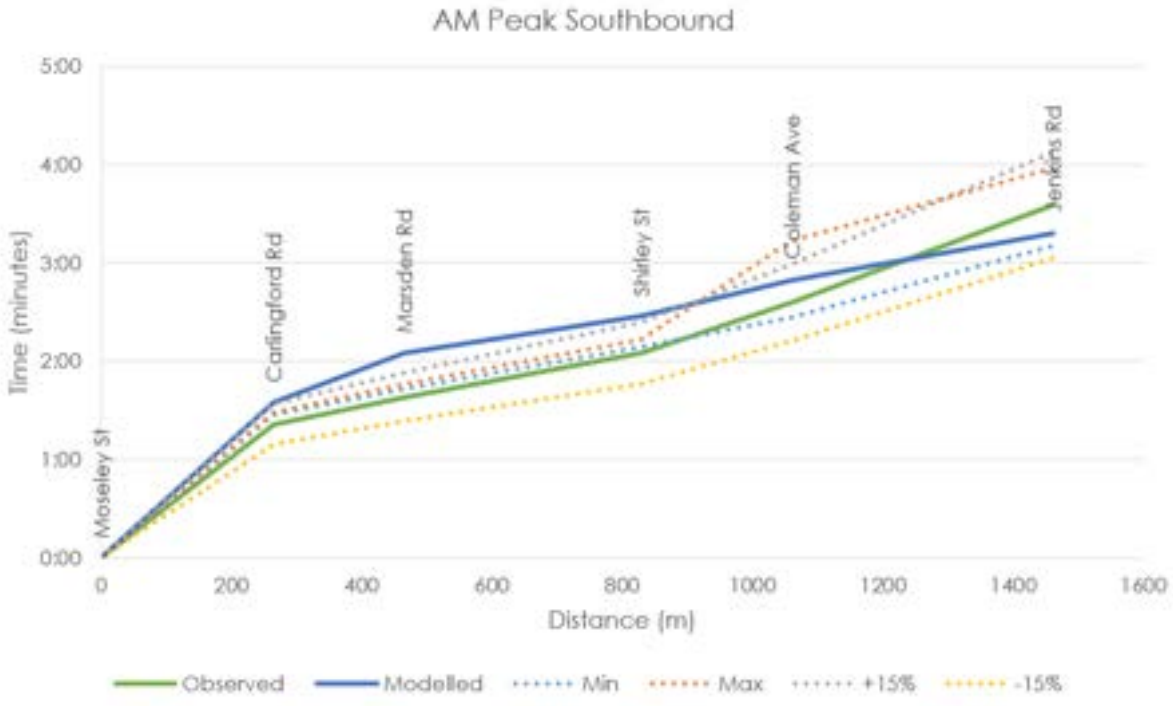


Figure 7.7: Evening Peak Travel Time Northbound (5pm-6pm)

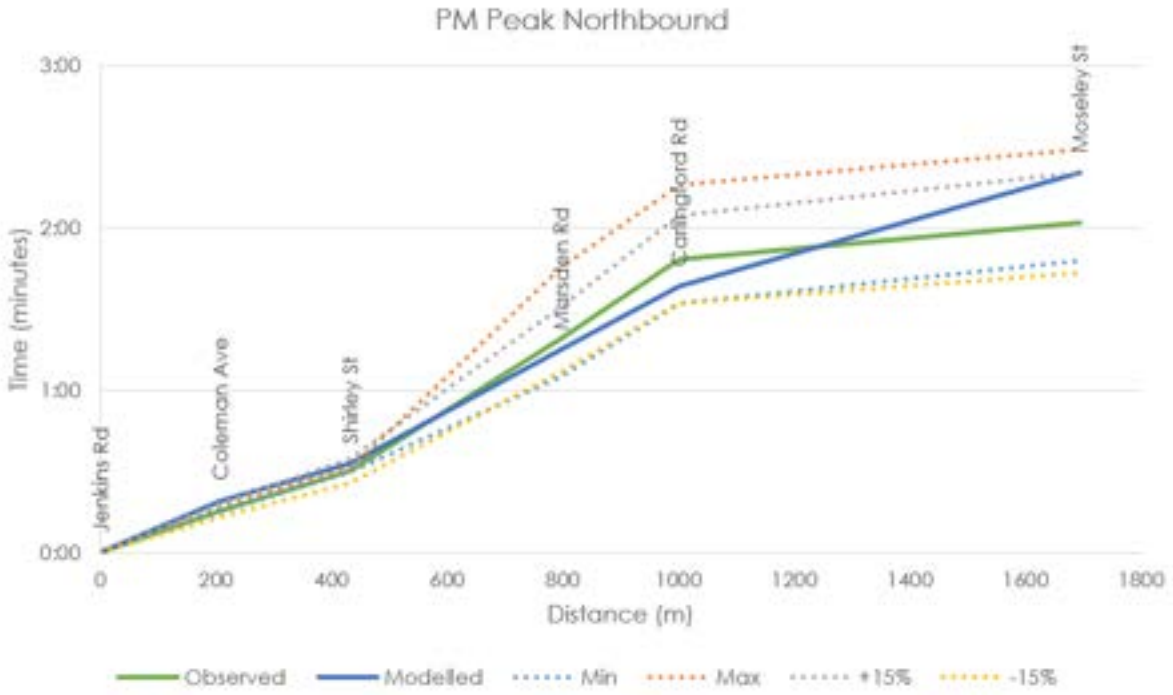
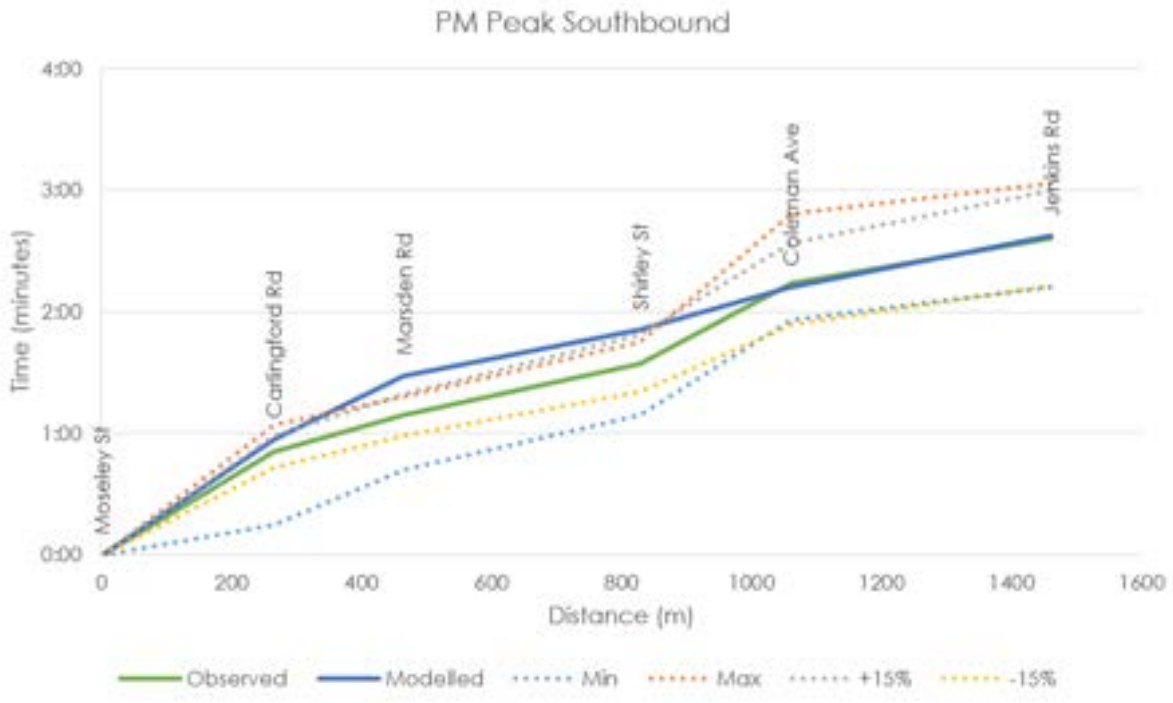


Figure 7.8: Evening Peak Travel Time Southbound (5pm-6pm)



7.3 Traffic Forecast Assumptions

Future traffic growth has been estimated based on the Sydney's Strategic Travel Forecast Model (STFM) provided by TfNSW in June 2022. The STFM is a strategic transport planning model that considers population and employment growths and is used for high level assessment of major infrastructure proposals, transport strategies and policy decision making.

The STFM provides future year traffic forecasts to determine the relative traffic growth from the baseline traffic to provide estimations for future year traffic conditions.

7.4 Modelling Scenarios

The proposed model scenarios for the morning and afternoon peak periods are shown in Table 7.5.

Table 7.5: Model Scenarios

Base Model
Scenario 1 – Base Model (two peak periods i.e., weekday AM & PM)
5 Year Model
Scenario 2 – 5-Year Future Do Minimum
Scenario 3 – 5-Year Future Do Minimum + 9-11 Thallon Street site development traffic
Scenario 4 – 5-Year Future Do Minimum + 11-17 Shirley Street site development traffic
Scenario 5 – 5-Year Future Do Minimum + Approved Meriton site development traffic
Scenario 6 – 5-Year Future Do Minimum + Proposed Meriton site development traffic
Scenario 7 – 5-Year Future Do Minimum + Cumulative sites
10 Year Model
Scenario 8 – 10-Year Future Do Minimum
Scenario 9 – 10-Year Future Do Minimum + 9-11 Thallon Street site development traffic
Scenario 10 – 10-Year Future Do Minimum + 11-17 Shirley Street site development traffic
Scenario 11 – 10-Year Future Do Minimum + Approved Meriton site development traffic
Scenario 12 – 10-Year Future Do Minimum + Proposed Meriton site development traffic
Scenario 13 – 10-Year Future Do Minimum + Cumulative sites

7.4.1 Do Minimum Road Network Upgrade

As discussed in Section 3.3, TfNSW are proposing to upgrade the intersection of Pennant Hills Road and Carlingford Road to ease congestion, improve travel times and safety for all road users. TfNSW proposes to improve traffic flow and safety at this intersection by widening sections of Pennant Hills Road and Carlingford Road to provide additional turning lanes at the intersection.

It is noted that the proposed layout which was provided by TfNSW is different to the proposed upgrade that is publicly available. The alternative layout features two left turn lanes and two right turn lanes on the Carlingford Road approach – the publicly available layout indicated a triple right turn and one left turn from Carlingford Road to Pennant Hills Road. The latest layout has been adopted in the modelling.

The existing signalised intersection is shown in Figure 7.9 while the proposed layout is shown in Figure 7.10.

Figure 7.9: Existing Pennant Hills Rd-Carlingford Rd Intersection

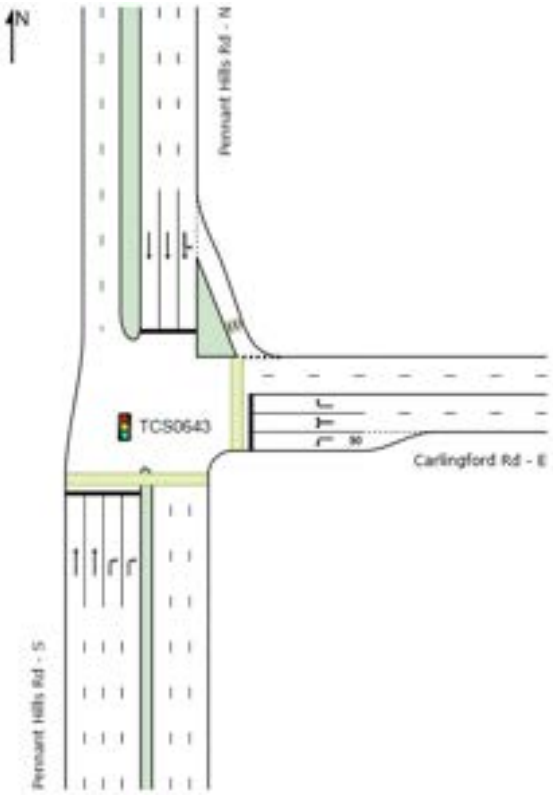
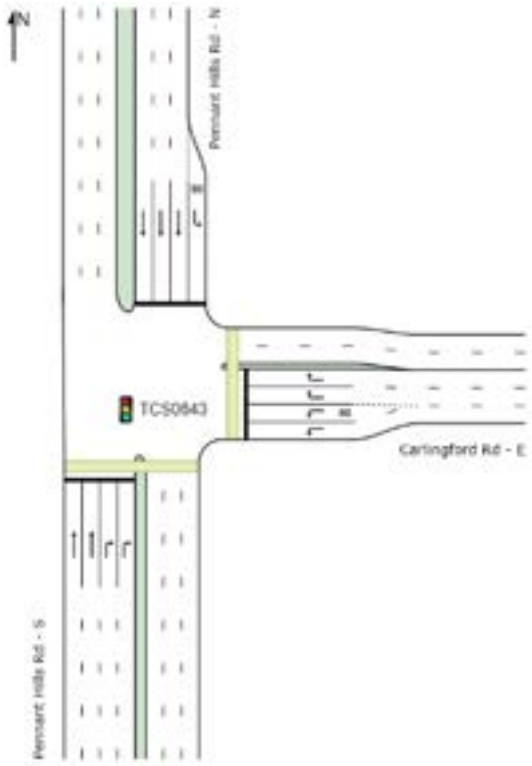


Figure 7.10: Proposed Pennant Hills Rd-Carlingford Rd Intersection



As shown in Figure 7.10, the following upgrades would be provided; dual right turn and dual left turn from Carlingford Road to Pennant Hills Road, a third departure lane on Pennant Hills Road (northern leg) – i.e. from the conversion of the existing bus lane to general traffic lane, extension of the left turn lane from Carlingford Road to Pennant Hills Road and removal of the existing southbound left turn slip lane to a dedicated short left turn bay.

7.5 Modelling Results

7.5.1 Level of Service Criteria

RMS uses the performance measure level of service to define how efficient an intersection is operating under given prevailing traffic conditions. Level of service is directly related to the delays experienced by traffic travelling the intersection. Level of service ranges from LoS A to LoS F. LoS A indicates the intersection is operating with spare capacity, while LoS F indicates the intersection is operating above capacity. LoS D is the long term desirable level of service.

At signalised intersections, the average delay is the volume weighted average of all movements. For roundabouts and priority (give way and stop sign) controlled intersections, the average delay relates to the worst movement.

Table 7.6 shows the criteria that SIDRA Intersection adopts in assessing the level of service.

Table 7.6: RMS Level of Service Criteria

Level of Service (LoS)	Average Delay per vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Sign
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	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity; at signals incidents will cause excessive delays. Roundabouts require other control mode	At capacity, requires other control mode.
F	Greater than 70	Unsatisfactory, requires additional capacity	Unsatisfactory, requires other control mode or major treatment

7.5.2 External Network (Pennant Hills Corridor) Capacity Analysis

A summary of the existing AM and PM peak traffic modelling results is provided in Table 7.7 while the future 5 and 10 year scenarios are summarised in Table 7.8 and Table 7.9, respectively.

Table 7.7: External Network (Pennant Hills Corridor) – Existing Base

Intersection	Control	AM		PM	
		Ave. Delay (s)	LoS	Ave. Delay (s)	LoS
1. Pennant Hills Rd - Jenkins Rd	Signal	45	D	38	C
2. Pennant Hills Rd - Coleman Ave	Signal	15	A	11	A
3. Pennant Hills Rd - Evans Rd - Lloyds Ave	Priority	252 [1]	F	246 [1]	F
4. Pennant Hills Rd - Marsden Rd	Signal	39	C	34	C
16. Pennant Hills Rd - Post Office St	Priority	6	A	8	A
5. Pennant Hills Rd - Carlingford Rd	Signal	54	D	45	D
6. Cumberland Hwy - Moseley St	Priority	30	C	91 [1]	F

[1] Worst movement: Right turn from minor road

Based on Table 7.7, during the AM peak the majority of the intersections currently operate satisfactorily with LoS C or better. Intersection 1 and 5 however are currently operating near capacity at LoS D. It is also noted that Intersection 5 is currently operating at a high-end LoS D

with 54s average delay. Furthermore, noting the existing control layout of intersection 3 (four-legged priority site), the right turn from Evans Road onto Pennant Hills Road currently experiences long delays as motorists would have to give-way to all traffic on Pennant Hills and find suitable gaps before turning.

During the PM peak the majority of intersections are operating satisfactorily with LoS C or better. Similarly, Intersection 5 however is currently operating near capacity at LoS D. Again, noting the existing control layout of intersection 3 and 6 (priority site with right turn from minor road permitted), the existing right turn movement experiences long delays.

It is noted that the delays for these right turn motorists would be exacerbated with the expected future background traffic growth on Pennant Hills Road.

Table 7.8: Pennant Hills Corridor – 5-Year Future

Intersection	Control	5 Year Base				5 Year + Thallon Development				5 Year + Shirley Development				5 Year + Meriton Development (Approved Yield)				5 Year + Meriton Development (Proposed Yield)				5 Year + Cumulative Development			
		Scenario 2				Scenario 3				Scenario 4				Scenario 5				Scenario 6				Scenario 7			
		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
		Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS
1. Pennant Hills Rd - Jenkins Rd	Signal	103	F	66	E	104	F	67	E	102	F	69	E	105	F	67	E	96	F	83	F	105	F	83	F
2. Pennant Hills Rd - Coleman Ave	Signal	16	B	16	B	16	B	16	B	16	B	16	B	17	B	16	B	17	B	18	B	17	B	18	B
3. Pennant Hills Rd - Evans Rd - Lloyds Ave	Priority	286	F	129	F	285	F	124	F	305	F	164	F	315	F	120	F	382	F	163	F	394	F	166	F
4. Pennant Hills Rd - Marsden Rd	Signal	77	F	115	F	77	F	110	F	80	F	117	F	80	F	113	F	87	F	135	F	86	F	138	F
16. Pennant Hills Rd - Post Office St	Priority	7	A	8	A	7	A	8	A	7	A	8	A	7	A	8	A	7	A	7	A	7	A	7	A
5. Pennant Hills Rd - Carlingford Rd	Signal	74	F	116	F	74	F	116	F	74	F	116	F	74	F	119	F	57	E	124	F	58	E	125	F

6. Cumberland Hwy - Moseley St	Priority	503	F	773	F	505	F	774	F	518	F	783	F	515	F	782	F	824	F	482	F	982	F	508	F

Table 7.9: Pennant Hills Corridor – 10-Year Future

Intersection	Control	10 Year Base				10 Year + Thallon Development				10 Year + Shirley Development				10 Year + Meriton Development (Approved Yield)				10 Year + Meriton Development (Proposed Yield)				10 Year + Cumulative Development			
		Scenario 8				Scenario 9				Scenario 10				Scenario 11				Scenario 12				Scenario 13			
		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
		Ave. Delay	LoS	Ave. Delay	LoS	Ave. Delay	LoS	Ave. Delay	LoS	Ave. Delay	LoS	Ave. Delay	LoS	Ave. Delay	LoS	Ave. Delay	LoS	Ave. Delay	LoS	Ave. Delay	LoS	Ave. Delay	LoS	Ave. Delay	LoS
1. Pennant Hills Rd - Jenkins Rd	Signal	154	F	79	F	154	F	80	F	168	F	80	F	162	F	84	F	162	F	98	F	166	F	107	F
2. Pennant Hills Rd - Coleman Ave	Signal	18	B	16	B	18	B	16	B	19	B	16	B	19	B	16	B	19	B	18	B	19	B	18	B
3. Pennant Hills Rd - Evans Rd - Lloyds Ave	Priority	324	F	222	F	323	F	211	F	278	F	275	F	305	F	188	F	365	F	421	F	405	F	380	F
4. Pennant Hills Rd - Marsden Rd	Signal	92	F	114	F	92	F	114	F	95	F	116	F	96	F	120	F	74	F	139	F	77	F	138	F
16. Pennant Hills Rd - Post Office St	Priority	7	A	8	A	7	A	8	A	7	A	8	A	7	A	8	A	7	A	7	A	7	A	7	A
5. Pennant Hills Rd -	Signal	84	F	138	F	84	F	139	F	85	F	140	F	84	F	141	F	64	E	145	F	64	E	148	F

Carlingford Rd																									
6. Cumberland Hwy - Moseley St	Priority	981	F	725	F	987	F	729	F	1,007	F	747	F	1,017	F	744	F	765	F	746	F	1,912	F	447	F

5-Year Future

Based on Table 7.8, the 5-year future base (S2) indicates that majority of signal-controlled sites would deteriorate to LoS F regardless of any development traffic. The average delays at the priority-controlled sites would increase further with the anticipated background traffic growth. Notably, Intersection 3 average delays (i.e. worst movement for priority intersection) would increase drastically as existing right turn movements from Evans Road (minor road) must give-way to increased number of through traffic from background growth in both directions on Pennant Hills Road. However notably, all other movements at this intersection would operate satisfactorily.

The site currently has an approved/permitted GFA for 570 residential units. Based on comparison of S5 and S6 results, the max increase from the net additional traffic is expected to be up to 7s at Intersection 4 signals. This increase is considered minor, noting the anticipated future LoS F in S2/S5. As such, the net additional trips from the proposed DA are anticipated to have minor traffic impacts above the approved development yield.

Overall, Scenarios 3-6 results indicate that there would be negligible traffic impacts from each of the individual developments and that the same LoS would be maintained, albeit at LoS F.

Scenario 7 indicates that based on the cumulative development traffic, a maximum increase of 23 seconds would be seen at the signalised intersections. However, as calculated in Table 6.6 the cumulative development traffic would make up a maximum of 6.7% increase in total traffic at any midblock location along the Pennant Hills Road corridor. On this basis, the proposed development alone would make up much less than 6.7% in total traffic, noting the level of traffic generation as compared with the surrounding developments (refer Table 6.4).

10-Year Future

Based on Table 7.9, the 10-year future base (S8) indicates that the signal-controlled sites would deteriorate further as compared with the 5-year future base (S2) with no development traffic and similarly for the priority-controlled sites.

Based on comparison of S11 and S12 results, the max increase from the net additional traffic is expected to be up to 19s at Intersection 4 signals. This increase is considered minor, noting the anticipated future LoS F in S8/S11. As such, the net additional trips from the proposed DA are anticipated to have minor traffic impacts above the approved development yield.

Overall, Scenarios 9-12 results indicate that there would be negligible traffic impacts from each of the individual developments and that the same LoS would be maintained, albeit at higher LoS F as compared with 5-year future scenarios.

Comparing S13 and S8, the max increase is expected to be up to 28s with the cumulative development traffic. This increase is considered minor, noting the anticipated future LoS F in

S8 and that the cumulative development traffic would make up a maximum of 6.5% increase in total traffic at any midblock location along the Pennant Hills Road corridor.

7.5.3 Internal Local Intersection Capacity Analysis

A summary of the existing AM and PM peak traffic modelling results is provided in Table 7.10 while the future 5 and 10 year scenarios are summarised in Table 7.11 and Table 7.12, respectively.

Table 7.10: Local Intersections – Existing Base

Intersection	Control	AM		PM	
		Ave. Delay (s)	LoS	Ave. Delay (s)	LoS
7. Jenkins Rd - Post Office St	Stop	27	B	8	A
8. Post Office St - Young Rd	Priority	6	A	5	A
9. Moseley St - Young Rd	Priority	8	A	8	A
10. Jenkins Rd - Moseley St	Signal	36	C	25	B
11. Jenkins Rd - James St	Priority	20	B	20	B
12. Post Office St - Thallon St	Priority	5	A	5	A
13. Lloyds Ave - Shirley St	Priority	5	A	5	A
14. Llyods Ave - Coleman Ave	Priority	8	A	8	A
15. Post Office St - Shirley St	Priority	6	A	5	A

Based on Table 7.10, all key intersections within the Carlingford model area currently operate at LoS C or better in both AM and PM peak period.

Table 7.11: Local Intersections – 5-Year Future

Intersection	Control	5 Year Base				5 Year + Thallon Development				5 Year + Shirley Development				5 Year + Meriton Development (Approved Yield)				5 Year + Meriton Development (Proposed Yield)				5 Year + Cumulative Development			
		Scenario 2				Scenario 3				Scenario 4				Scenario 5				Scenario 6				Scenario 7			
		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
		Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS
7. Jenkins Rd - Post Office St	Stop	34	C	10	A	34	C	10	A	34	C	10	A	34	C	10	A	35	C	11	A	35	C	11	A
8. Post Office St - Young Rd	Priority	6	A	5	A	6	A	6	A	6	A	6	A	6	A	6	A	6	A	6	A	7	A	7	A
9. Moseley St - Young Rd	Priority	11	A	9	A	11	A	9	A	11	A	9	A	11	A	9	A	12	A	10	A	13	A	11	A
10. Jenkins Rd - Moseley St	Signal	25	B	21	B	26	B	21	B	26	B	21	B	26	B	21	B	26	B	21	B	27	B	21	B
11. Jenkins Rd - James St	Priority	26	B	29	C	26	B	29	C	26	B	29	C	26	B	29	C	26	B	29	C	26	B	29	C
12. Post Office St - Thallon St	Priority	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	6	A	5	A	6	A
13. Lloyds Ave - Shirley St	Priority	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A
14. Llyods Ave - Coleman Ave	Priority	8	A	8	A	8	A	8	A	8	A	8	A	8	A	8	A	8	A	8	A	8	A	8	A

15. Post Office St - Shirley St	Priority	6	A	5	A	6	A	5	A	6	A	5	A	6	A	5	A	6	A	6	A	6	A	6	A

Table 7.12: Local Intersections – 10-Year Future

Intersection	Control	10 Year Base				10 Year + Thallon Development				10 Year + Shirley Development				10 Year + Meriton Development (Approved Yield)				10 Year + Meriton Development (Proposed Yield)				10 Year + Cumulative Development			
		Scenario 2				Scenario 3				Scenario 4				Scenario 5				Scenario 6				Scenario 7			
		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
		Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS	Ave. Delay (s)	LoS
7. Jenkins Rd - Post Office St	Stop	40	C	11	A	40	C	11	A	40	C	11	A	40	C	11	A	41	C	12	A	41	C	12	A
8. Post Office St - Young Rd	Priority	6	A	5	A	6	A	6	A	6	A	6	A	6	A	6	A	6	A	6	A	7	A	7	A
9. Moseley St - Young Rd	Priority	14	A	9	A	14	A	9	A	14	A	10	A	14	B	10	A	18	B	11	A	19	B	11	A
10. Jenkins Rd - Moseley St	Signal	39	C	21	B	29	C	21	B	29	C	21	B	29	C	21	B	31	C	21	B	33	C	21	B
11. Jenkins Rd - James St	Priority	31	C	34	C	31	C	35	C	31	C	34	C	31	C	34	C	31	C	34	C	31	C	35	C
12. Post Office St - Thallon St	Priority	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	6	A	5	A	6	A
13. Lloyds Ave - Shirley St	Priority	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A	5	A

14. Llyods Ave - Coleman Ave	Priority	8	A	8	A	8	A	8	A	8	A	8	A	8	A	8	A	8	A	8	A	8	A	8	A	8	A
15. Post Office St - Shirley St	Priority	6	A	5	A	6	A	5	A	6	A	5	A	6	A	5	A	6	A	6	A	6	A	6	A	6	A

Based on Table 7.11 and Table 7.12, all intersections are expected to operate satisfactorily in the 5-Year and 10-Year future with the cumulative developments at LoS C or better.

7.5.4 Additional Upgrades

The modelling shows that the existing road network is close to capacity. The estimated traffic generated by the subject site is relatively small compared to the background growth in traffic forecast by the STFM and the surrounding cumulative development traffic.

Notwithstanding, there are some further opportunities to improve the road network that may include signalising the intersection of Evans Street/Lloyds Avenue with Pennant Hills Road as well as Mosely Street and Pennant Hills Road. These intersections are currently priority intersections and side streets experience long delays. Signalising these intersections would provide better opportunities for vehicles to turn right onto and off Pennant Hills Road. Such an improvement would also improve pedestrian connectivity between the two sides of the road and provide better connections to the existing bus stops.

Transport for NSW are aware that the road network is constrained with few options for increasing capacity within the road network. There is already a proposed upgrade for Carlingford Road at Pennant Hills Road that uses all the available road reserve.

We note that in correspondence from 29 March 2022, Transport for NSW (Attached) that Transport for NSW are acquiring land along Pennant Hills Road for future road improvements which the developer would transfer to Transport for NSW. However, the nature of the upgrade of Pennant Hills Road that is being investigated has not been shared with the proponents.

Given the constraints on the road corridor the type of options available to increase capacity may include:

- Additional lanes on Pennant Hills Road requiring land acquisition along a 1 km front from Jenkins Road to Mosely Street.
- Creating a grade separated slot similar to the Warringah Road upgrade near the Northern Beaches Hospital.

Both these options would require significant expense disproportionate to the amount of traffic generated by the development. The proportion of traffic from the proposed development is shown in Figure 6.7. The cumulative impact of traffic is less than 2.5% of traffic at Carlingford Road and Pennant Hills Road.

Notwithstanding the above, signalisation of Evans Street/Lloyds Avenue with Pennant Hills Road has been tested for the AM/PM peak for the 10-Year Future Cumulative Development Scenario.

Signalisation of Evans Street/Lloyds Avenue intersection with Pennant Hills Road

The signalised layout for Intersection 3 is shown in Figure 7.11 while the phasing sequence for the proposed layout is shown in Figure 7.12. The phase sequence tested is ABCDE where B and E are variable phases.

Signalised pedestrian crossings have been applied to the north-east and south-east approaches only as there are currently no pedestrian connections between the west and south-west approaches.

The practical cycle time of 130 seconds has been set which is consistent with existing cycle times along Pennant Hills Road corridor.

Figure 7.11: Pennant Hills Road – Evans Street – Lloyds Avenue Signalisation

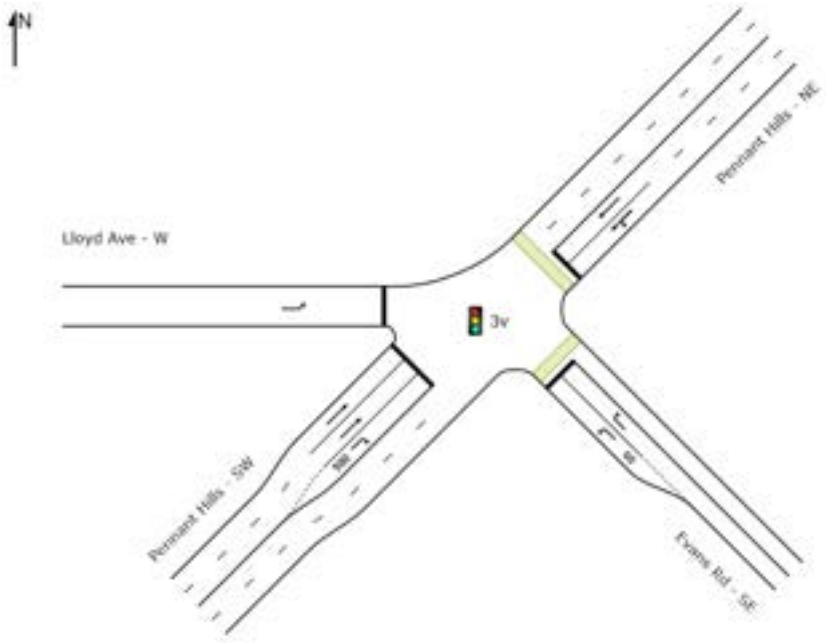
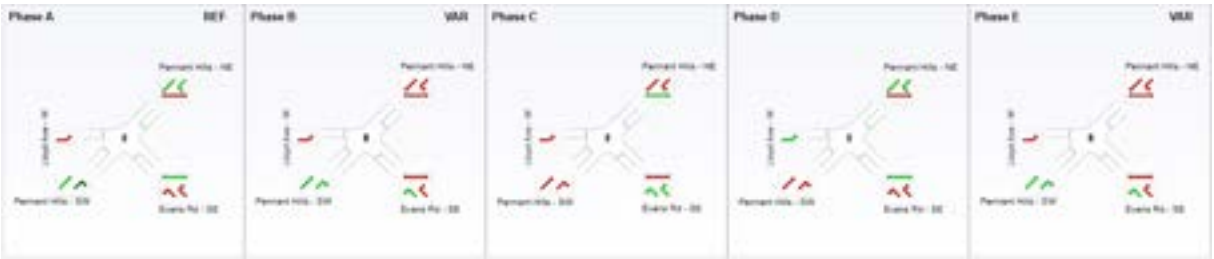


Figure 7.12: Pennant Hills Road – Evans Street – Lloyds Avenue Signalisation



Based on the above, the SIDRA results are shown in Table 7.13 for the 10-Year future cumulative development traffic scenario.

Table 7.13: Intersection 3 Signalisation with 10-Year Future Cumulative Development Traffic

Intersection	Control	AM		PM	
		Ave. Delay (s)	LoS	Ave. Delay (s)	LoS
3. Pennant Hills Rd / Evans St / Lloyds Ave	Signal	19	B	28	B

Based on the above, the intersection improves significantly to LoS B during both AM and PM peak.

It is noted however, that based on Table 7.7 the intersection currently performs poorly with high delays experienced on the minor roads. The intersection performance will worsen significantly in the future years regardless of any developments. Therefore, the signalisation of the intersection would benefit both existing pedestrians / motorists as well as other proposed and approved developments.

As presented in Table 6.6, the additional traffic generated by all the proposed developments is likely to have minimal impact with traffic from the subject site making up less than 3% of the total traffic at this intersection.

7.6 Housing and Productivity Contribution

The Housing and Productivity Contribution (HPC) replaces the previous Special Infrastructure Contribution (SIC) in the NSW planning legislation.

The Housing and Productivity Contribution is a fair and consistent development charge that will help fund the delivery of infrastructure in high-growth areas. This new system will be simple and fair, increasing investment certainty and supporting connected communities.

The Housing and Productivity Contribution will be made through a Ministerial planning order that will set out:

- the amount of the contribution
- the area where the contributions will apply
- the types of development that the contributions will apply to
- when it needs to be paid and other details about how the contributions will be administered.

The Housing and Productivity Contribution is proposed to apply over much larger areas and set fair and consistent contributions toward the costs of infrastructure provided by the NSW Government.

Currently, SICs apply to small geographical areas that are subject to growth and change. These are a more bespoke approach which don't always provide for consistency and certainty.

When fully implemented, the Housing and Productivity Contribution is expected to collected $700 million annually across the four growth regions, to deliver the infrastructure needed to support housing and productivity.

Some types of development may be exempt from paying the contribution. This may include public housing, seniors housing (within the meaning of the Standard Local Environmental Plan), affordable housing and secondary dwellings (sometimes called 'granny flats') carried out under the Housing State Environmental Planning Policy (SEPP).

The HPC is proposed to commence on 1 October 2023.

It is anticipated that the proposed payment of the HPC for this development would address the off-site traffic impacts on the State and Regional Roads, as there are no direct and specific upgrades triggered by the development.

8 Public Transport Access

Traffic modelling has identified that the road network is at or close to capacity on Pennant Hills Road with delays forecast to increase. Therefore, development along the Parramatta Light Rail corridor needs to focus on providing adequate access to public transport.

The site is well situated with access to public transport with the light rail station within 400m of the site and high frequency bus routes along Pennant Hills Road. The 550 bus route that has frequencies of 10 minutes during the peak periods and provides access between Parramatta and Macquarie Park via Epping. This service would provide access to Epping Station which in turn provides access to the Sydney CBD and the broader heavy rail network.

Figure 8.1: Pennant Hills Road – Evans Street – Lloyds Avenue Signalisation

The biggest impediment to access to bus stops on Pennant Hills Road is the ability to cross Pennant Hills Road to access the westbound bus stop on the opposite side of Pennant Hills Road. Under current arrangements pedestrians would need to walk some 400m to access signalised crossings and there is a safety concern that people will attempt to cross Pennant Hills unaided by a signalised crossing. Therefore, it is recommended to signalise the intersection of Evans Street, Pennant Hills Road to provide pedestrian access to the eastern side of Pennant Hills Road. As discussed above, the proposed development traffic makes up less than 3% of total traffic at this intersection. The developer would contribute to the upgrade of the intersection via the Housing and Productivity Contribution (HPC).

9 Conclusion

This report examines the traffic and parking implications of the mixed-use development at 18 Shirley Street and 263-273 and 277-281 Pennant Hills Road, Carlingford. The key findings of the report are presented below.

- The site will be located near the future Parramatta Light Rail terminus offering opportunity for high density near a public transport service with high frequency service.
- The site currently has a DA1103/2011/JP approval for 450 residential units with the residual portion of the site permitting an additional 100-120 residential units. The proposal development includes 723 residential units, 2,600m^2 retail GFA and a 110-place childcare with 20 staff and a 2,500m^2 community centre/library. The proposed community centre/library would replace the existing Carlingford branch library.
- Parramatta Council's 'Harmonisation' DCP 2023 came into effect on August 28th. However, Council have accepted the application of the rates stipulated under the previous The Hills DCP 2012 for the development.
- The proposed development generates a total statutory parking requirement of 1,236 spaces to comply with The Hills DCP 2012 (Carlingford DCP) requirements.
- Based on the State Environmental Planning Policy (SEPP) 65, a Development Application cannot be refused on account of parking provisions if car parking is provided to be equal to, or greater than the minimum about of car parking specified in Part 3J of the Apartment Design Guide. Applying the rates specified, the development cannot be refused on grounds of car parking if the residential component provides the minimum GTGD 2002 prescription of 842 spaces.
- The development proposal has designed for a total of 1,356 car parking spaces (including 1,189 residential car spaces), which satisfies both TfNSW GTGD 2002 and The Hills DCP 2012 car parking requirements.
- The proposed parking layout is generally consistent with the dimensional requirements as set out in the Australian/New Zealand Standard for Off Street Car Parking (AS/NZS2890.1:2004 and AS/NZS2890.6:2009).
- The DA approved development is estimated to generate approximately 137 vehicle trips during the AM and PM peak. Note, a conservate trip rate of 0.24 trips per unit has been adopted for high-density residential units.
- The proposed development is anticipated to generate net additional 233 trips and 330 trips in the AM and PM peak, respectively. This is very conservative considering the trip containment and Parramatta Light Rail in 2024.
- Two known proposed mixed-use developments are located within the vicinity of the site in the Carlingford Precinct. These developments would provide high-density residential apartments, childcare, retail and restaurant use. The total traffic generation from these

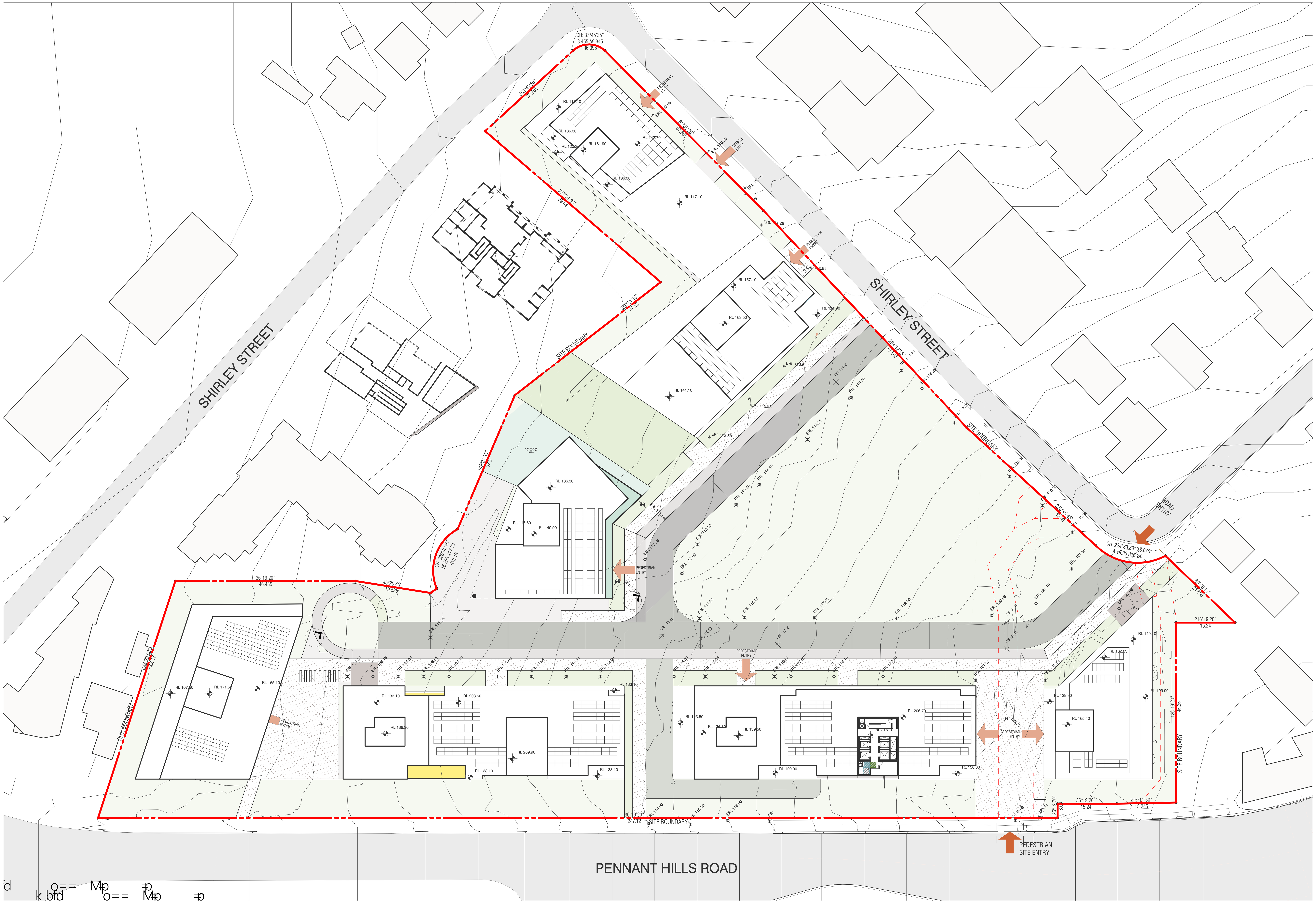
developments is estimated to be 109 trips and 107 trips during the AM and PM peak, respectively.

- A cumulative traffic impact assessment has been undertaken using SIDRA network modelling. A 5-year and 10-year future with and without development/s has been assessed. The modelling indicates key intersections on Pennant Hills Road would deteriorate to LoS F in the 5 and 10-year future base, regardless of any developments.
- The addition of each development site and a cumulative development assessment indicates that overall there would be negligible impacts on the Pennant Hills Road corridor, noting that the future 5 and 10-year base would operate at LoS E/F. As such, the addition of development traffic would maintain the same LoS and would be no worse.
- In particular the scenarios S6 and S12 which included the traffic from the subject development, when compared to Scenarios S2 and S8 which are "traffic growth only scenarios", show that there is little difference between the intersection performance in terms of Level of Service and average delay so it can be concluded that the subject development will have negligible traffic impacts. Additionally, comparing S6 with S5 and S12 with S11 indicates that the net additional traffic would have minor traffic impacts above the approved development.
- Given that the roads are forecasts to be congested on Pennant Hills it is important to provide access to public transport. The site is within 400m walking distance of Parramatta Light rail and 200m of bus stops on Pennant Hills Road.
- Discussions have been held with TfNSW regarding the potential provision of a signalised intersection at Evans Street and Pennant Hills Road to allow for signalised pedestrian access to bus stops on the opposite side of Pennant Hills Road.
- It is note that the development traffic from the proposed development makes up less than 3% of total traffic at this intersection. The developer could contribute to the upgrade of the intersection via the Housing and Productivity Contribution (HPC).

Overall, the traffic and parking aspects of the proposed development is considered to be satisfactory.

Appendix A

Development Plans – Ground Floor & Carpark levels only



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B0 PARKING SCHEDULE

LEVEL	Usage Category	QTY
LOWER GROUND 8		
	Residential	237
LOWER GROUND 7		
	Residential	237
LOWER GROUND 6		
	Residential	399
LOWER GROUND 5		
	Commercial	46
	Custom	27
	Residential	134
	Visitor	82
LOWER GROUND 4		
	Commercial	58
	Residential	28
LOWER GROUND 3		
	Commercial	36
	Residential	24
LOWER GROUND 2		
	Residential	24
LOWER GROUND 1		
	Residential	24
		1356

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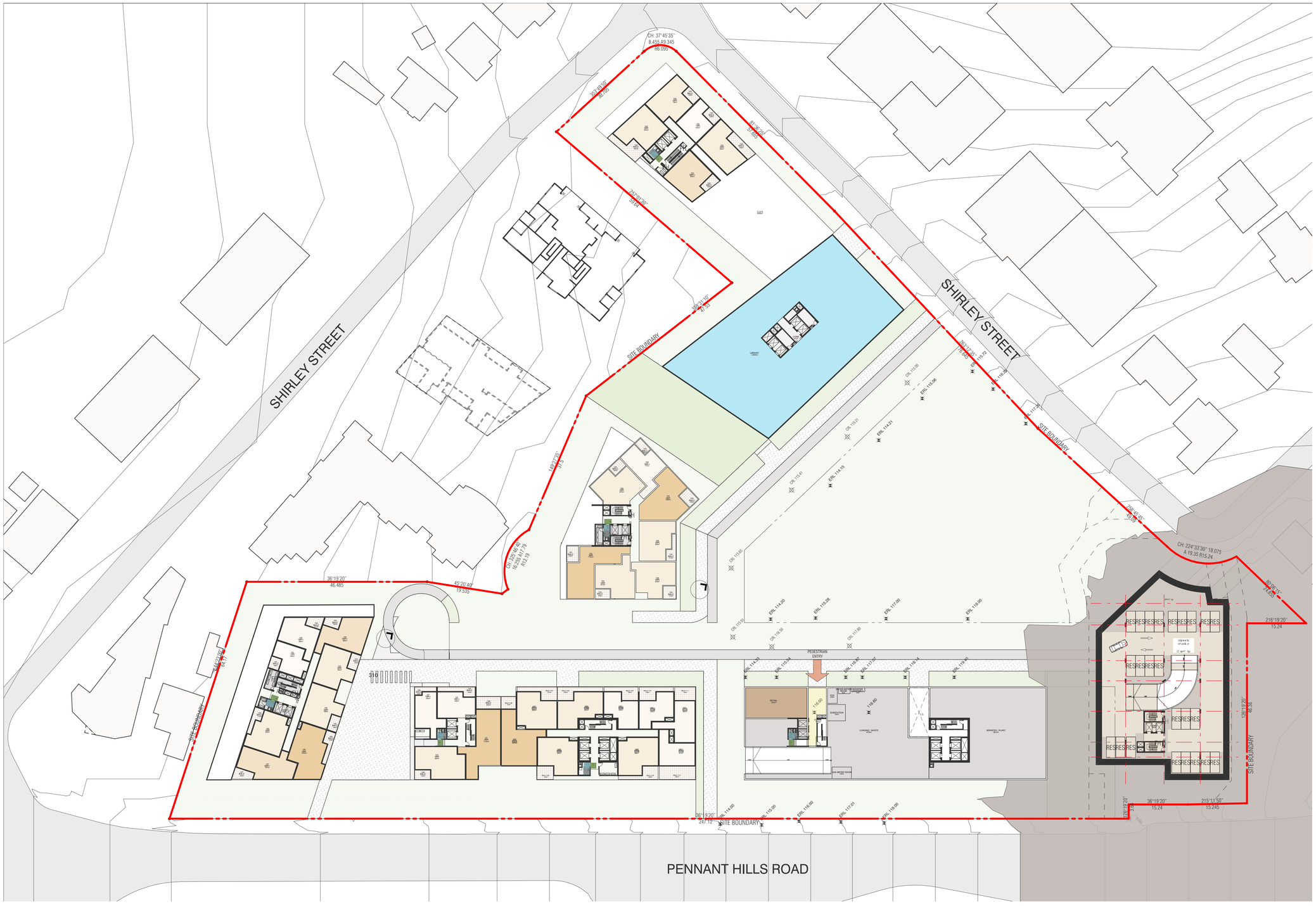

B0 PARKING SCHEDULE

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	Residential	237
LOWER GROUND 6		
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	Commercial	58
	Residential	28
LOWER GROUND 3		
	Commercial	36
	Residential	24
LOWER GROUND 2		
	Residential	24
LOWER GROUND 1		
	Residential	24
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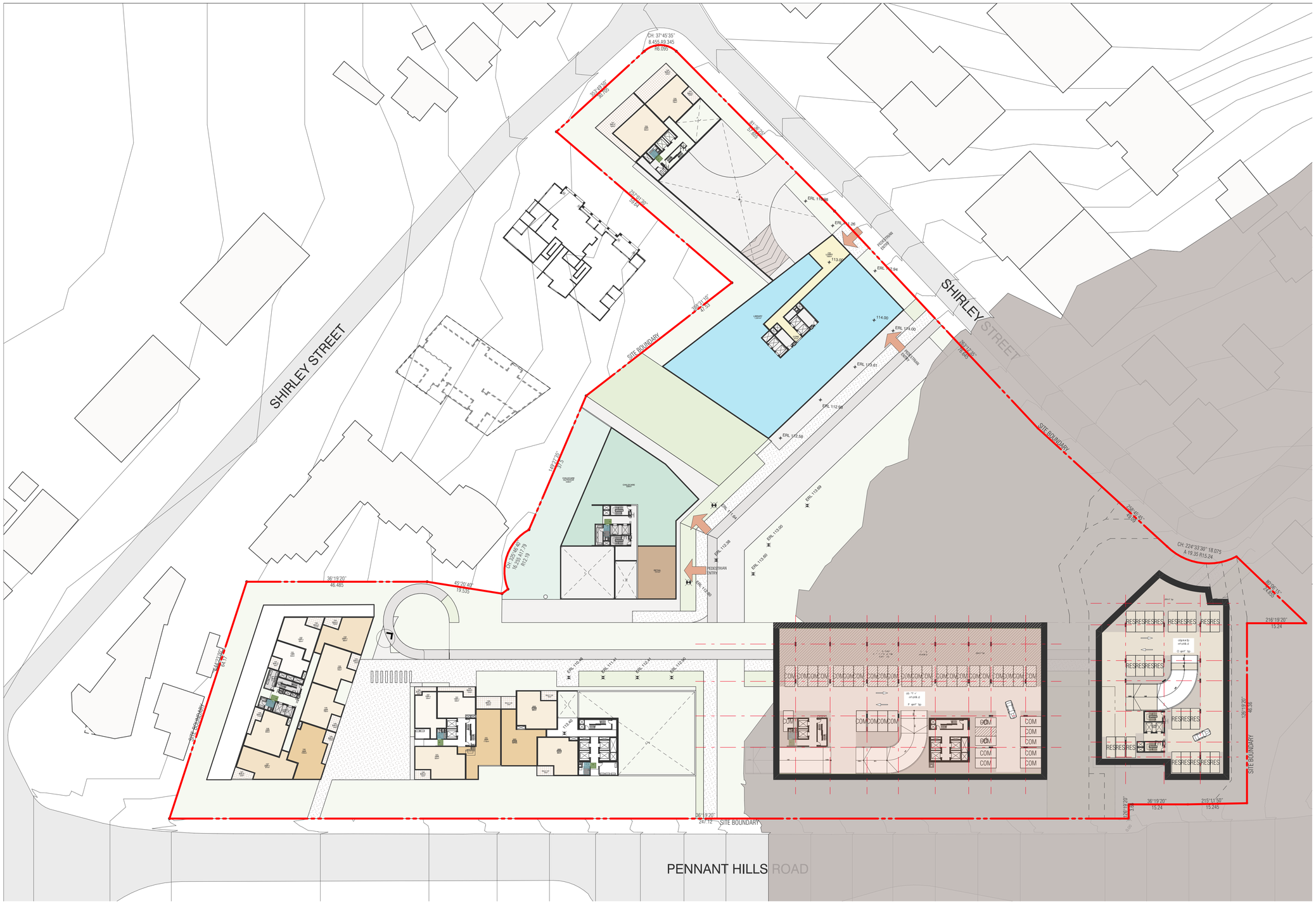

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LOWER GROUND 7		
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LOWER GROUND 6		
	Residential	399
LOWER GROUND 5		
	Commercial	46
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	Visitor	82
LOWER GROUND 4		
	Commercial	58
	Residential	28
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		1356

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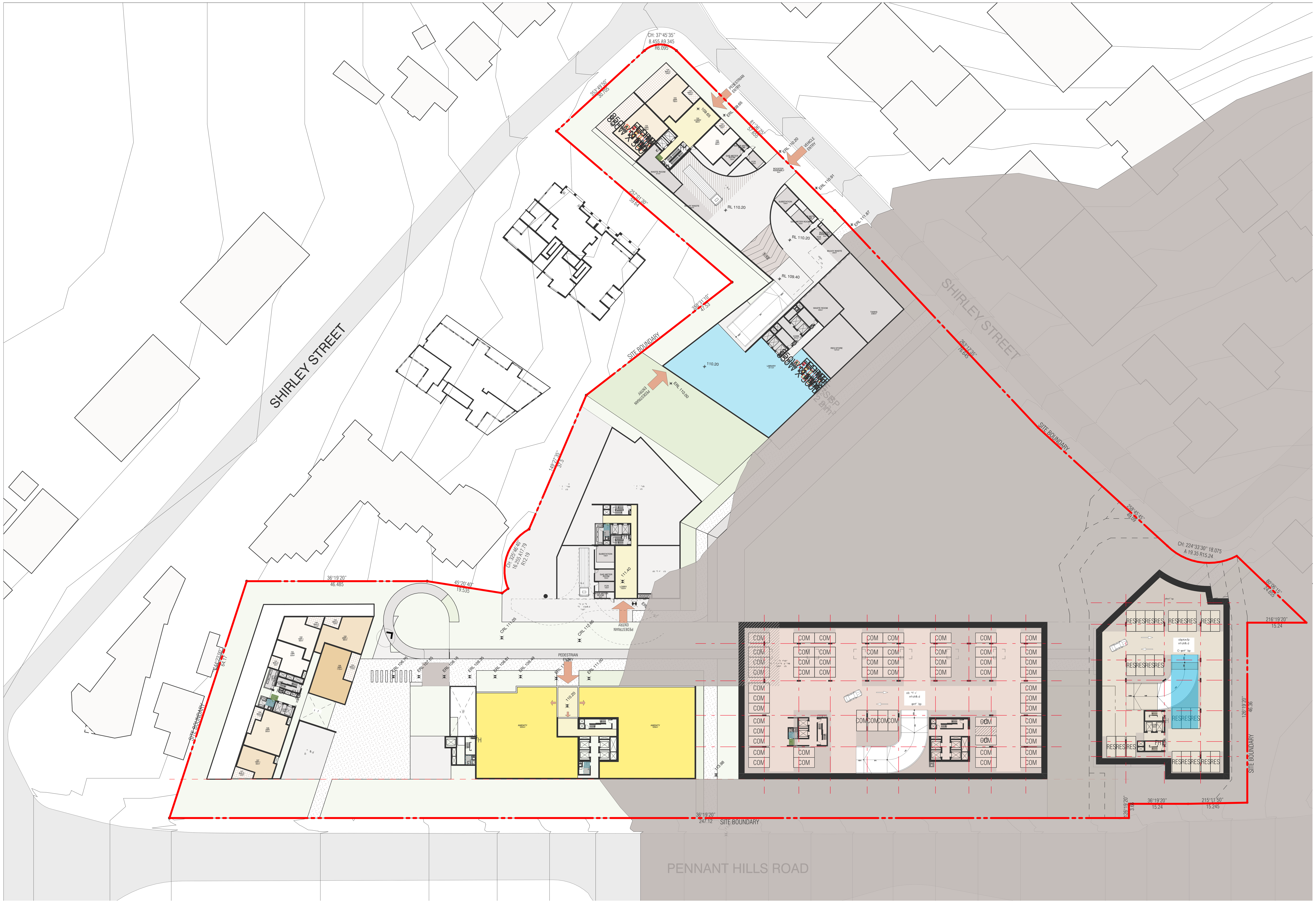

B0 PARKING SCHEDULE

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LOWER GROUND 5		
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	Residential	134
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	Commercial	58
	Residential	28
LOWER GROUND 3		
	Commercial	36
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	Residential	24
LOWER GROUND 1		
	Residential	24
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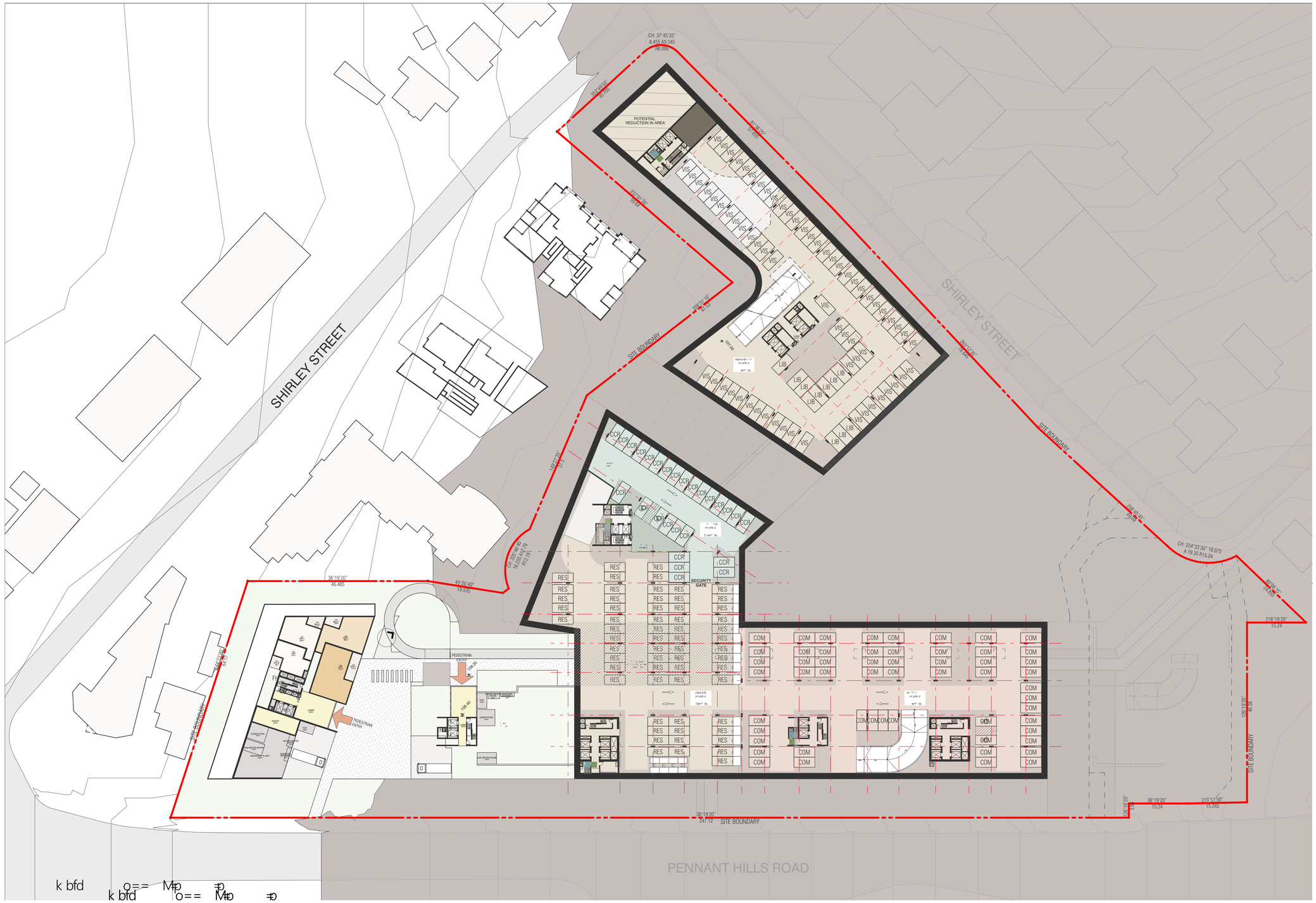

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	Residential	24
LOWER GROUND 2		
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LOWER GROUND 1		
	Residential	24
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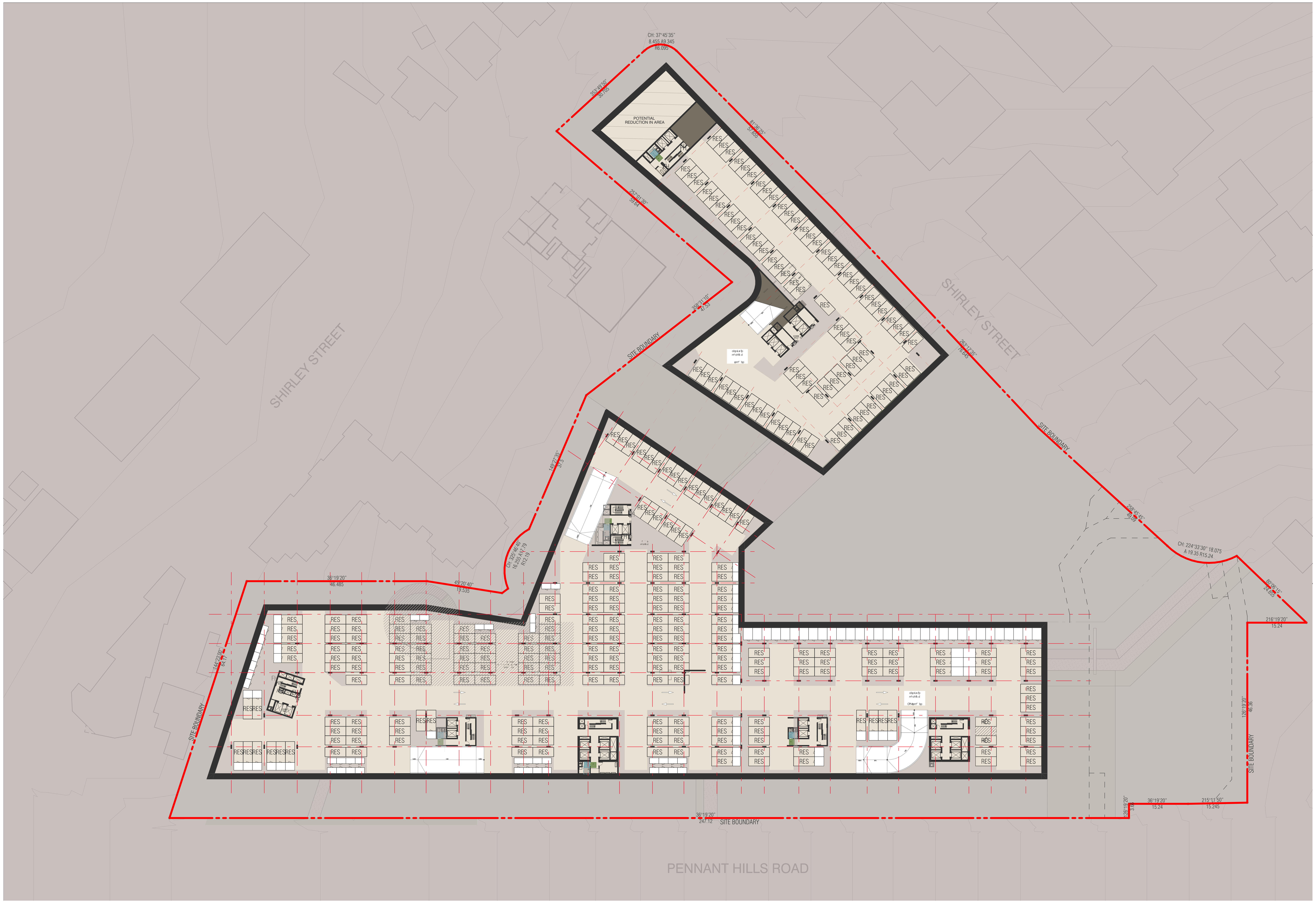

B0 PARKING SCHEDULE

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B0 PARKING SCHEDULE

LEVEL	Usage Category	QTY
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LOWER GROUND 7		
	Residential	237
LOWER GROUND 6		
	Residential	399
LOWER GROUND 5		
	Commercial	46
	Custom	27
	Residential	134
	Visitor	82
LOWER GROUND 4		
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	Residential	28
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CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCING WORK. DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER CONTRACT DOCUMENTS. DO NOT SCALE DRAWINGS. USE FIGURED DIMENSIONS ONLY. SEEK CLARIFICATION OF INCONSISTENCES / CONFLICTS.

PROJECT
CARLINGFORD APARTMENTS, MERITON
263-281 PENNANT HILLS ROAD, CARLINGFORD
SYDNEY NSW 2118

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DRAWN	DATE	CHECKED	PLOT DATE	JOB NO.	SCALE	DRAWING TITLE
TF	25.08.2023	AV	23.08.2023	20188	AS SHOWN@A1	GA - LOWER GROUND 7

ISSUE PURPOSE PRELIMINARY

REV. -

DRAWING NO. **PP02.1.01**

B0 PARKING SCHEDULE

LEVEL	Usage Category	QTY
LOWER GROUND 8		
	Residential	237
LOWER GROUND 7		
	Residential	237
LOWER GROUND 6		
	Residential	399
LOWER GROUND 5		
	Commercial	46
	Custom	27
	Residential	134
	Visitor	82
LOWER GROUND 4		
	Commercial	58
	Residential	28
LOWER GROUND 3		
	Commercial	36
	Residential	24
LOWER GROUND 2		
	Residential	24
LOWER GROUND 1		
	Residential	24
		1356

BIMcloud: fkaeprdbim01 - BIMcloud/20188 Pennant Hills Road, Carlingford/00 BIM MODELS/SD_TP-DA/CENTRAL MODELS/20188 General_Cleaned

REVISION			REVISION
-	PLANNING PROPOSAL	NB	25.08.2023

LEVELS PENDING GFA REVIEW & STRUCTURE REVIEW

CARPARK NUMBERS PENDING GFA REVIEW & STRUCTURE REVIEW

QUALITY ASSURANCE (FK IS A CERTIFIED COMPANY TO ISO 9001-2015)

THIS PROJECT IS SUBJECT TO THE FK QUALITY ASSURANCE SYSTEM

UNCONTROLLED COPY

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NOTES

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DRAWN	DATE	CHECKED	PLOT DATE	JOB NO.	SCALE	DRAWING TITLE
TF	25.08.2023	AV	23.08.2023	20188	AS SHOWN@A1	GA - LOWER GROUND 8

ISSUE PURPOSE	REV.	DRAWING NO.
PRELIMINARY	-	**PP02.1.00**

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