



NORTHWEST RAPID TRANSIT

**SPEED ZONE AND PEDESTRIAN
CROSSING REVIEW
TECHNICAL NOTE**

Cherrybrook Station

for

NORTH WEST RAIL LINK

OPERATIONS, TRAINS and SYSTEMS

Technical Note	Cherrybrook Station Precinct 40km/h Speed Zone and Pedestrian Crossing Review
Issue Date/Revision	10/06/2016 / Rev F
Author/ Checker/ Approval	LL / DH / GH

1.0 Introduction

This technical note was developed to inform the design process for the planning, design development and implementation of an appropriate urban and station precinct speed environment and to identify pedestrian crossing points and treatments to facilitate access to and from the planned station precinct.

1.1 Station Precinct and Design Status

This technical paper was prepared as part of the civil design package to support an evolving precinct design for Stage 3 Cherrybrook Station.

1.2 Purpose

To provide evidence that can be used to justify the eligibility of designing some precinct roads with a 40km/h speed environment and/ or the introduction of pedestrian crossings at points that will both facilitate the safe crossing of pedestrians and serve key pedestrian desire lines.

1.3 Objective

The principal objective of designing station precinct road network is to:

- Support planned growth and area intensification.
- Improve pedestrian and cycling safety by reducing the risk of fatalities and injuries.
- Ensure that station precinct roads provide a safe and protective environment for users.
- Help to appropriately manage conflict in and around the transport interchange.
- Provide adequate provision for facilitating movement between station, transport interchange facilities and its surrounding catchment.
- Prioritise movement through the station precinct for pedestrians and cyclists.
- Ensure that walking and cycling is promoted and supported as a mode of access to NWRL stations.

2.0 Background

This section provides an overview of the forecast growth surrounding the station precinct and the proposed network functionality directly surrounding Cherrybrook Station.

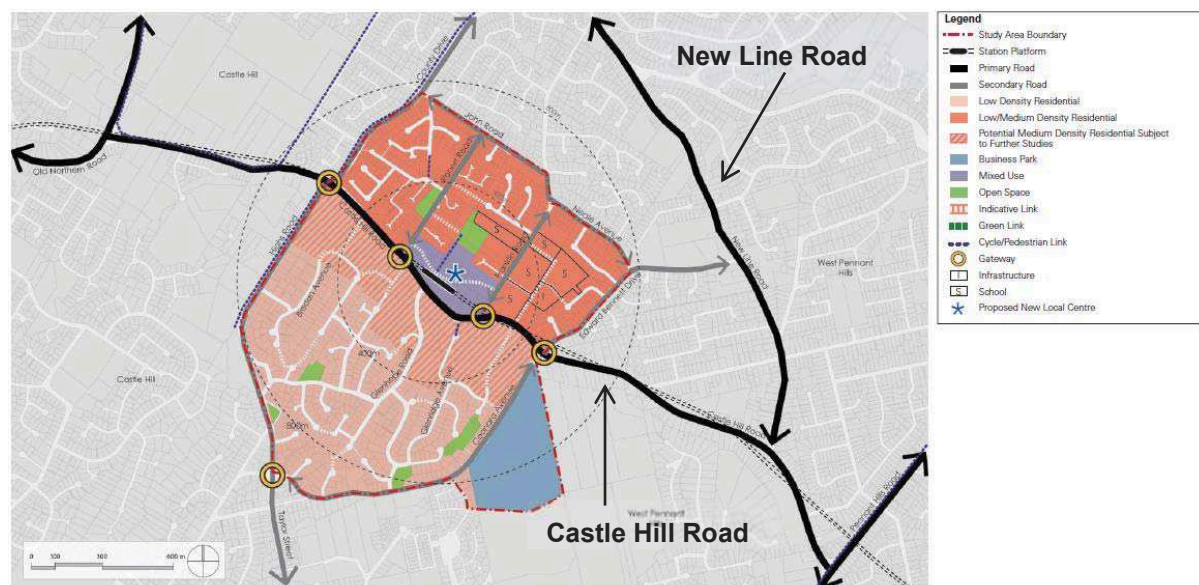
2.1 Planned Growth

The existing Cherrybrook Station precinct is predominantly low density residential dwellings sited on large or medium sized allotments to the north and south of Castle Hill Road. Tangara Girls School is located north east of the proposed station location. A new local centre is planned immediately adjacent to the station, surrounded by mixed use land.

The planning of the station precinct allows for a 400 space commuter car park, which is planned to help contain travel growth across the region network and offers access from surrounding Cherrybrook station precinct catchment and less accessible suburbs situated to its north and south. The combined effect from the intensification of land use planned to be situated around the new Cherrybrook local centre and the proposed station precinct is expected to drive growth in pedestrian and traffic activity, and will need to be appropriately managed to ensure that access can be maintained.

Figure 1 provides the draft Cherrybrook Station Structure Plan (DoP/ TfNSW, Sept 2013) which outlines future development areas and associated land use surrounding the station precinct.

Figure 1 Draft Cherrybrook Station Precinct Structure Plan



The structure plan highlights that the area surrounding the station will accommodate an additional 3,000 new dwellings by 2036. This will be achieved through the intensification of areas situated around the station precinct as identified in the draft Structure Plan. The existing school will also accommodate an expansion to cater for an additional 600 students.

The proposed changes to the current site include the establishment of a local centre adjacent to the new station with medium density residential development to the north and east of the station and low density residential development to the south and west. The station is also well connected to the strategic road network, with Castle Hill Road to the south, feeding into Pennant Hills Road to the east and Old Northern Road to the west.

A review of the draft Hills Corridor Strategy indicates that Council has established a strategy that is consistent with the planning carried out by NSW Government. There are noted to be minor

differences in forecasted growth in the surrounding precinct, which includes a slight increase in the number of new dwellings.

2.2 Network Functionality

The existing and planned road network surrounding the Cherrybrook Station precinct will provide a sound level of access for local residents.

Higher order roads, such as Castle Hill Road and New Line Road will continue to function as part of the sub regions arterial road network. Both Franklin Road and Robert Road will be upgraded from local roads to function as local collectors roads linking existing and future land use, including the planned Cherrybrook Station precinct to the Castle Hill Road arterial road network.

The above roads will also play an important role in facilitating access for local bus services, and station passengers travelling to the station precinct by private vehicle through either the kiss and ride or 400 space park and ride facility.

The local station precinct road network plays a different role to the external road network with a focus on facilitating access for all travel modes through the provision of designated signposted kerbside areas. This helps to promote and support all forms of intermodal activity, manage access priorities and conflict, and integrate the precinct and its surrounding planned environment. The proposed Precinct Street A between Robert Road and Franklin Road has been designated as a precinct road in a high activity area, which will function as an access road for the kerbside facilities adjacent to the station including kiss and ride, buses and taxis, as well as providing access to the multi-storey car park.

The functionality, spatial layouts and key access routes for Cherrybrook Station and the surrounding precinct are shown on Figure 2 and Figure 3.

Figure 2 Network Functionality, Traffic Management and Station Precinct Facilities

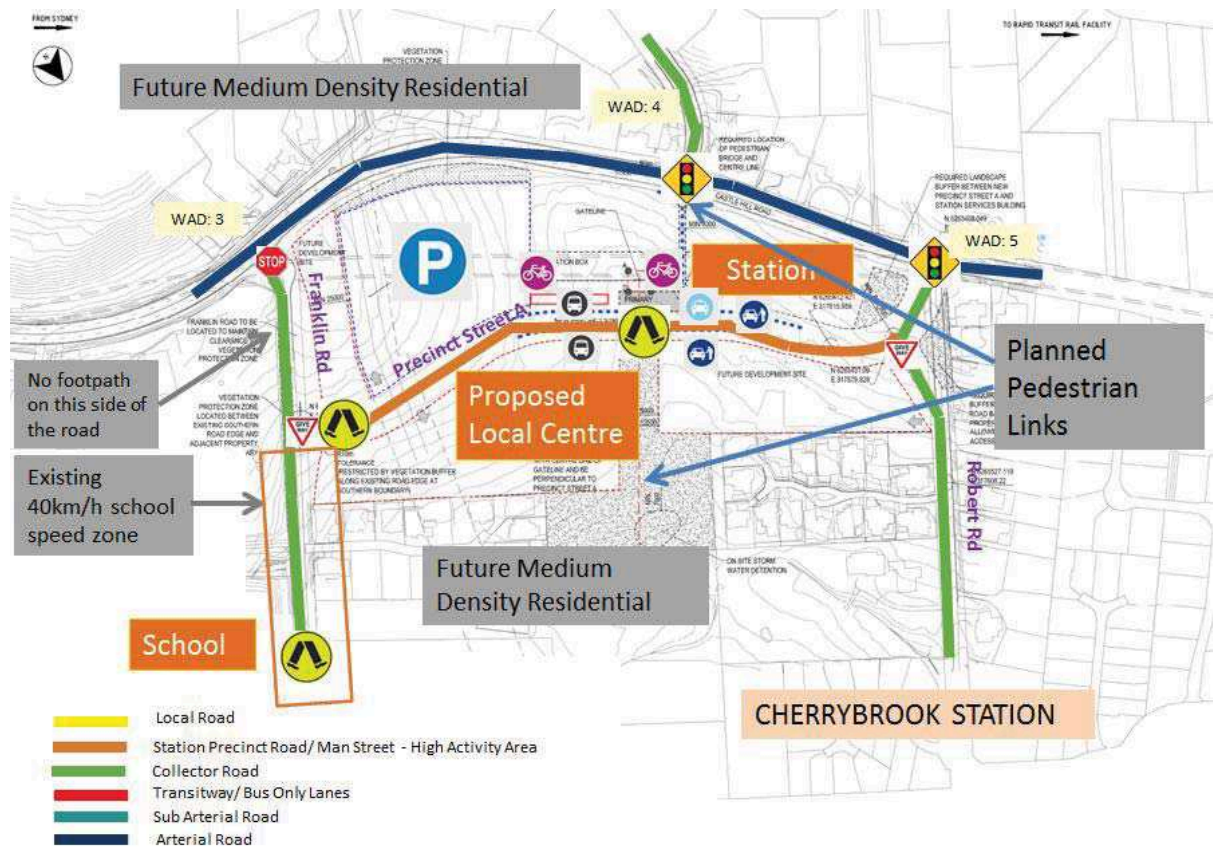
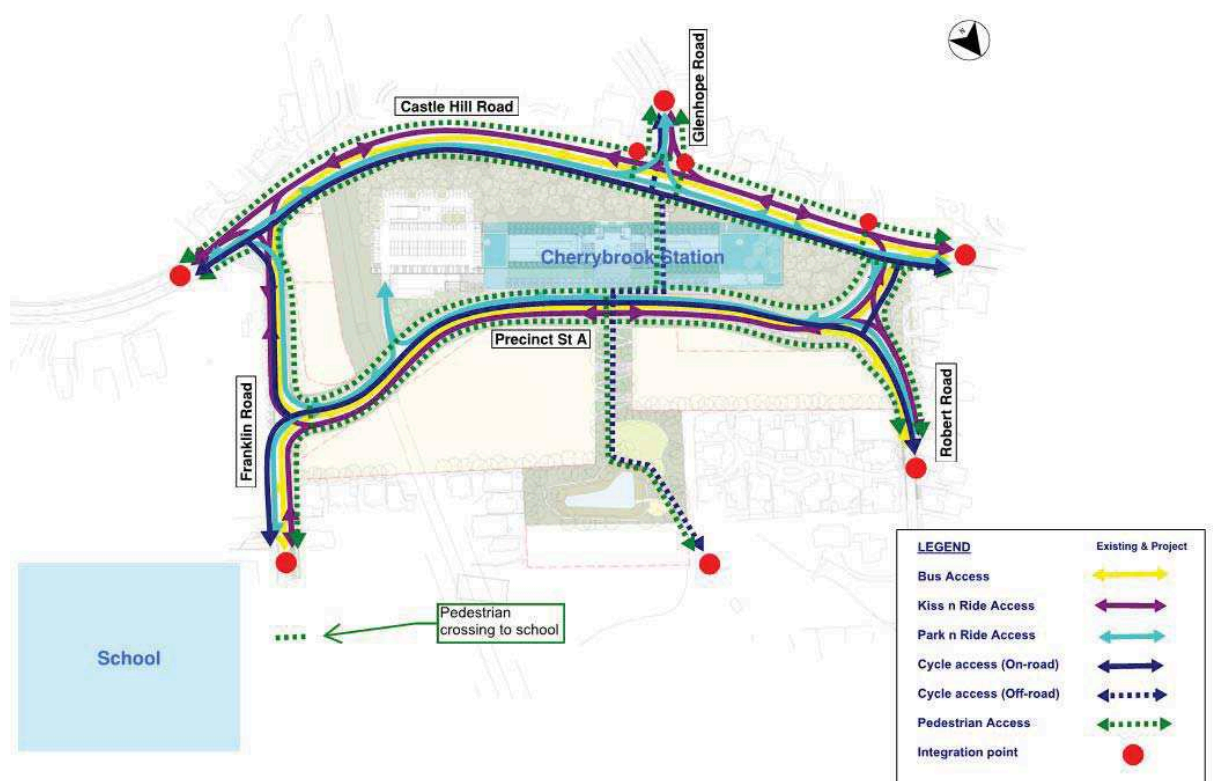


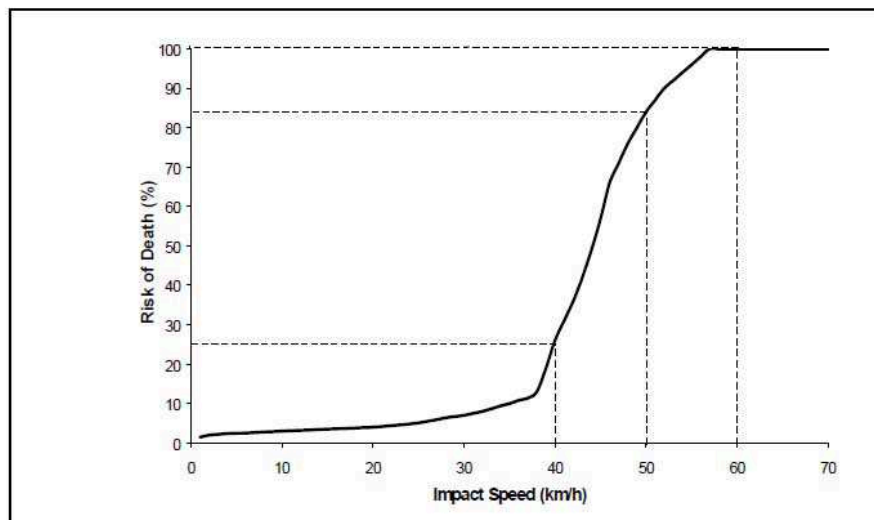
Figure 3 Station Precinct Access and Movement Plan



2.3 Road Safety

Research carried out by the Monash University Accident Research Centre (MUARC) acknowledges the importance of engineering pedestrian treatments for pedestrian safety, however, indicates that further major gains can only be achieved by tackling the issue of traffic speed. Research undertaken in 1997 presents risk profile for a pedestrian fatality is directly associated with travel speed and rapidly increases when the travel speed goes beyond 40km/h. This relationship is presented in Figure 4.

Figure 4 Relationship between Risk of Death to Pedestrians and Impact Speed



Relationship Between Risk of Death to Pedestrians & Impact Speed

Source: Anderson, R., McLean, A., Farmer, M., Lee, B., & Brooks, C., (1997). *Vehicle travel speeds and the incidence of fatal pedestrian crashes. Accident Analysis and Prevention* 29(5), 667 – 674.

3.0 Reference Material

The following reference material has been used to determine the need for marked pedestrian crossings and the implementation of 40km/h speed zone in high pedestrian activity areas along the road network situated within the Cherrybrook Station precinct.

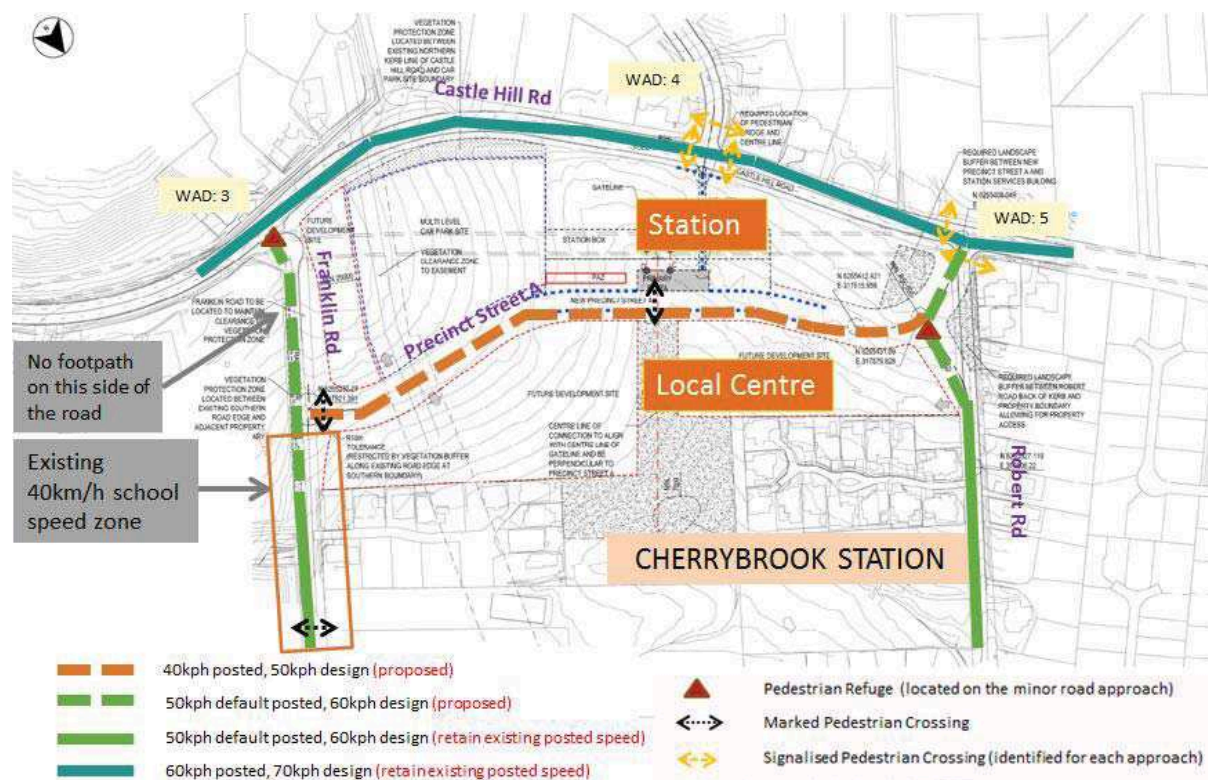
- AS 1742.10 – Manual of uniform traffic control devices (Part 10) – Pedestrian control and protection.
- AS 1742.13 Manual of uniform traffic control devices (Part 13) – Local area traffic management.
- RMS AS1742 Part 1-15 Supplement (Oct 2014).
- RMS Technical Directions – TDT 2001/04b – Use of Traffic Calming Devices as Pedestrian Crossings.
- AustRoads – Guide to Traffic Management - Part 6 - Intersections, Interchanges and Crossings.
- AustRoads – Guide to Traffic Management - Part 7: Traffic Management in Activity Centres.
- AustRoads – Guide to Traffic Engineering Practice – Part 10 – Local Area Traffic Management.

- NWRLOTS WAD Packages 3, 4 and 5.
- NWRL Operational Precinct Traffic Analysis (OPTAR) (TfNSW, 13/05/2013).
- Sydney Metro Northwest Pedestrian-Cycle Network & Facilities Strategy (TfNSW, June 2015).
- North West Rail Link: Draft Cherrybrook Station Structure Plan – A Vision for Cherrybrook Station Surrounds (TfNSW/ DoP&E, Sept 2013).
- Draft 'The Hills Corridor Strategy' – Sensibly delivering housing and employment around the Sydney Metro Norwest (The Hills Shire Council, Sept 2015).

4.0 Proposal

Figure 5 provides an overview of the proposed Cherrybrook Station precinct road layout, proposed speed environment, pedestrian crossing locations (including proposed marked crossings) and key surrounding land uses.

Figure 5 Cherrybrook Station Facilities and Road Speed Network



Pedestrian access within the Cherrybrook Station precinct will be facilitated through the provision of the following:

- Marked pedestrian crossings (zebra crossings):
 - Mid-block marked crossing on Precinct Street A (serving movement between growth areas to the north, kiss and ride spaces and bus stops on Precinct Street A and Cherrybrook Station).

- Marked crossing on Precinct Street A (serving movement between the school and Cherrybrook Station).
- Mid-block marked crossing on Franklin Road next to Tangara school (serving movement between the school and station).
- Pedestrian refuge crossings:
 - Intersection of Franklin Road and Castle Hill Road (Franklin Road approach).
 - Precinct Street A / Robert Road intersection (serving movement from the west to the station).

The following roads will be signposted as 40km/h high pedestrian activity areas:

- Precinct Street A between Robert Road and Franklin Road

The station precinct road network will be designed to facilitate current and future roles with a focus on managing traffic speeds (40km/h high activity or 50km/h default urban signposted speed limits), conflict through traffic calming (if the link is not identified to provide access to commuter car parks) and kerbside activity. The following roads will be signposted as 40km/h high pedestrian activity areas:

- Precinct Street A between Robert Road and Franklin Road.

5.0 Criteria for Evaluating 40km/h Speed Zones in High Pedestrian Areas

The application of 40 km/h speed zones is covered by the Roads and Traffic Authority (now Roads and Maritime Services - RMS) '40km/h speed limits in high volume pedestrian areas' Guideline. The criteria for selection, implementation process and associated engineering works for treatment options are provided within the guideline.

The methodology of the selection criteria is the category of road (A, B or C) in relation to surrounding land use and the application of appropriate treatments for a 40km/h speed precinct speed (i.e. gateway, traffic calming or modal separation).

The process charts for this methodology are provided in Figure 6 and Figure 7.

Figure 6 RTA Flowchart for Identification of High Volume Pedestrian Areas

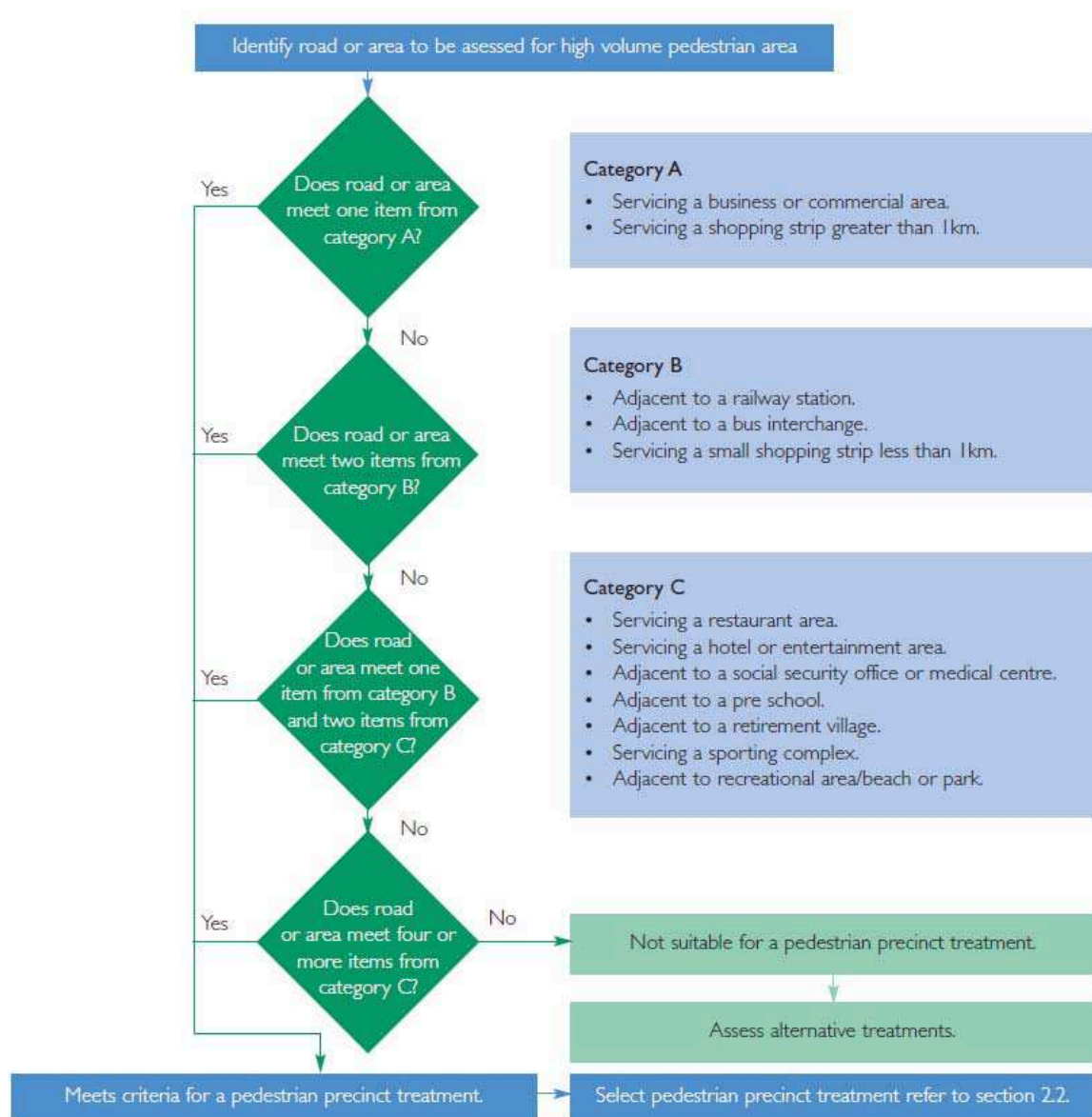
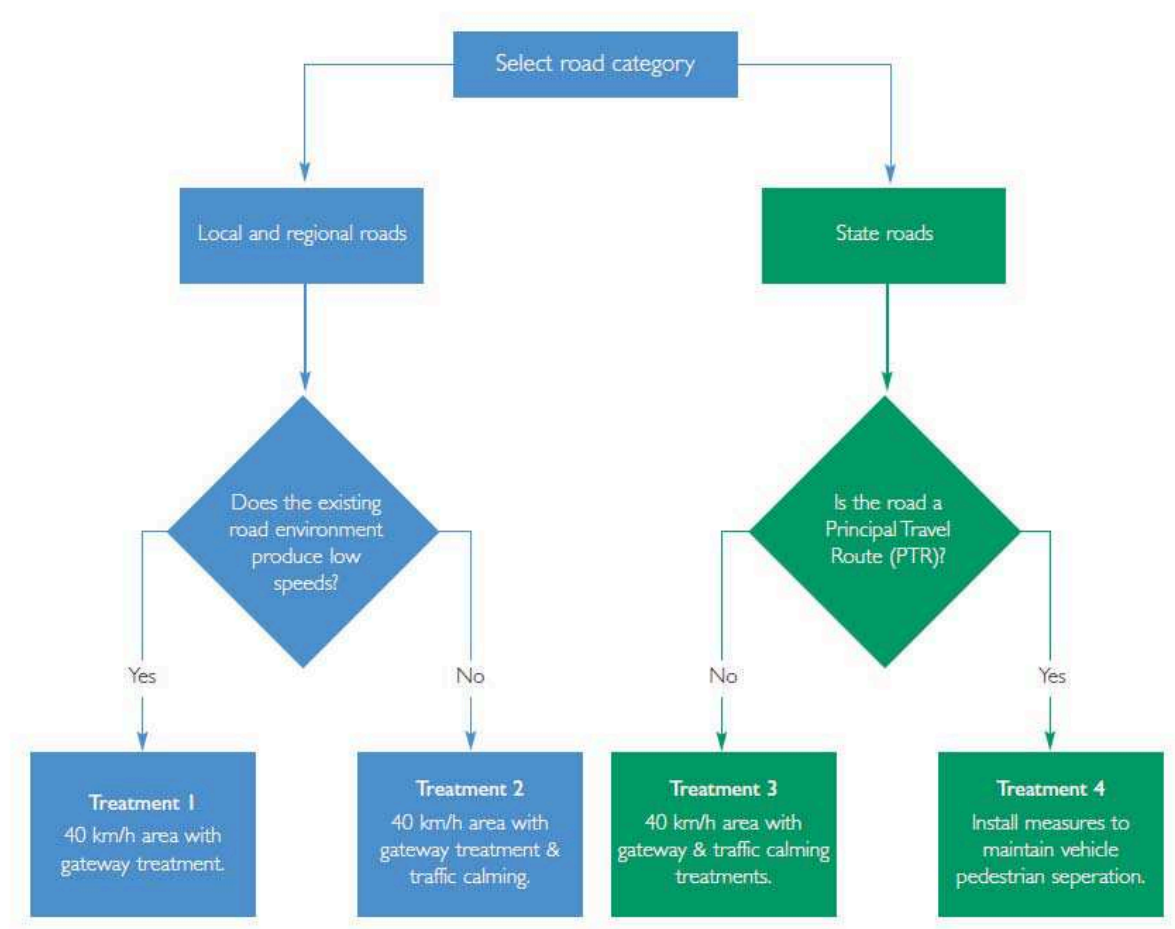


Figure 7 RTA Flowchart for Identifying Appropriate Treatment Options



6.0 Pedestrian Crossing Warrants

For this assessment, the proposed mid-block zebra crossings situated on Precinct Street A and have been appraised based on both numerical warrants and qualitative design attributes. The following provides an overview of the warrants associated with a marked pedestrian crossing as specified within RTA Guidelines and Australian Standards.

6.1 Zebra Crossings

The warrant for marked mid-block pedestrian crossings has been taken from Zebra Crossings at intersections (AS1742 Part 10 – Section 6 and the RMS Supplements to section 6.3, July 2013), which indicates that eligibility is based on the following:

- Traffic Demand and safety:
 - Pedestrian (P) movements exceeding 30 per hour and traffic volumes (V) exceeding 500 vehicles per hour and the combined product of $PV =$ or greater than 60,000 for three hours in a typical day; or

OR

- If school children represent 50% of pedestrians using the crossing then the pedestrian flows must be greater than or equal to 30 per hour and traffic volumes should equal or exceed 200 vehicles per hour for two hours in a typical day.

OR

- Use by aged or impaired:
 - At least 50% of pedestrians are aged or impaired and volumes exceed $P \geq 30$, $V \geq 200$, $PV \geq 60,000$ for three 1-hour periods in a typical day.

OR

- Special warrant:
 - In certain circumstances where $45,000 \leq PV \leq 60,000$, $P \geq 30$ and $V \geq 500$, the use of a crossing should be justified by council.

6.2 Signalised Intersection or Midblock Crossings

The assessment of pedestrian crossings at the signalised intersections of Castle Hill Road/Glenhope Road and Castle Hill Road/Precinct Street A is deemed not to be required and has already been justified and approved through the inclusion as a specification within the Works Authorisation Deed NWRL - OTS Works between Transport for NSW and RMS NSW.

7.0 Traffic and Pedestrian Movement Forecasts

To assess the warrants for new marked pedestrian crossings, traffic and pedestrian movements were forecasted at the Cherrybrook Station precinct for the initial design year (2021).

Pedestrian forecasts were estimated to determine the use of proposed precinct crossing points and are based on station demand, mode of access, location of station facilities and associated distribution. These pedestrian estimates were then compared to estimated traffic volumes along the relevant station precinct roads to understand the level of activity, likelihood of gaps in traffic and the need to prioritise pedestrian movement.

7.1 Data Sources and Assumptions

The data sources and assumptions listed in Table 1 have been used in the development of the traffic and pedestrian movement forecasts and to validate and review the station precinct's traffic facility requirements.

Table 1 Cherrybrook Station Pedestrian Flow Data Sources and Assumptions

Data/ Demand	Source Document	Appropriate Use of Data
<p>Pedestrian demand data for Cherrybrook Station is:</p> <p>AM peak hour</p> <ul style="list-style-type: none"> 3,000 station entries 325 station departures <p>PM peak hour</p> <ul style="list-style-type: none"> 260 station entries 2,400 station departures 	<p>07.01.01.53 NWRL OTS SPR Appendix 45 - Service and System Performance Requirements (SPR 45)</p>	<p>The data is based on NSW Government regional modelling and land use forecasts and defines the maximum station facility passenger capacity needs for the new NWRL project corridor. SPR 45 provides both initial and ultimate design year maximum peak hour station flow forecasts for AM peak hour, which is separated into entries and exits. PM peak demand is based on applying an 80% factor to the AM demand levels and the transposition of AM and PM values, which is consistent with SPR 62 Returnable Schedule 3.2 (B) and other project calculations for platform flows.</p>
<p>The typical peak hour initial design year pedestrian demand data for Cherrybrook Station are:</p> <p>AM peak hour</p> <ul style="list-style-type: none"> 1,400 (2,150) station entries 200 (325) station departures <p>PM peak hour</p> <ul style="list-style-type: none"> 160 (260) station entries 1,120 (1,720) station departures <p>*(2,150) ultimate design year demand.</p>	<p>Mott MacDonald Traffic and Pedestrian Analysis – 2021 Baseline Assessment With NWRL Development</p> <p>Operational Precinct Traffic Analysis Report 01.04.05.04.02.03.01</p>	<p>The pedestrian and traffic flow analysis is based on 2021 AM and PM peak hour traffic network forecasts presented in the OPTAR and redistribution of traffic flows within the station precinct.</p>
<p>Pedestrian distribution data (walk only modes)</p>	<p>Active Transport (Walking and Cycling) Strategy 01.04.05.04.02.07</p> <p>Figure 5-9 and 5-10 are relevant to Cherrybrook Station</p>	<p>Precinct planning and pedestrian distributions forecasts were generated by TfNSW for the planning of station precincts with the data aligning with known future land use strategies. The AM arrival and departure profile was obtained from the Active Transport Strategy for Cherrybrook Station. PM values are the transposition of AM</p>

Data/ Demand	Source Document	Appropriate Use of Data
		values.
<p>Mode Share breakdown for Cherrybrook Station:</p> <ul style="list-style-type: none"> • Walk only (20%) • Cycling (3%), • Bus (24%) • PnR (32%) • KnR (21%) <p>ATS mode share data sourced is for AM arrivals only and has been transposed to PM departures. AM departures and PM arrivals are assumed at 100% walk only mode share as per the ATS.</p>	<p>NWRL Active Transport (Walking and Cycling) Strategy 01.04.05.04.02.07 (ATS)</p> <p>NWRL Integrated Transport and Land Use Strategy 01.04.05.04.02.07 (ITLU)</p> <p>Note: The ATS document provides a tabulated version of the ITLU data</p>	<p>Mode share data was obtained by TfNSW for the planning of station precincts with the data aligning with planned land use and associated strategies and plans. The station mode share split was predicted in the Active Transport Strategy (ATS) for the AM only with private vehicle generated trips representing 79% of all station trips in the initial design year. It is assumed that people arriving or departing the station precinct will use the same mode on their return trip.</p>
Traffic demand data	<p>Mott MacDonald Traffic Analysis – 2021 Baseline Assessment With NWRL Development</p> <p>Operational Precinct Traffic Analysis 01.04.05.04.02.03.01</p>	<p>The traffic analysis is based on 2021 AM and PM peak traffic network forecasts presented in the OPTAR and redistribution of traffic flows within the station precinct.</p>

The Cherrybrook Station passenger demand by mode share using both OPTAR and ATS data as described above is provided within Table 2

Table 2 Station Arrivals and Departures by Mode Share

Mode Share	Walk	Bus	PnR	KnR	Cycle	Total
AM Arrival	20%	24%	32%	21%	3%	100%
	280	336	448	294	42	1,400
AM Departure	100%	-	-	-	-	100%
	200	-	-	-	-	200
PM Arrival	100%	-	-	-	-	100%
	160	-	-	-	-	160
PM Departure	20%	24%	32%	21%	3%	100%
	224	269	358	235	34	1,120

The distribution of these station arrivals and departures has been based on the following assumptions:

- **Walking** - passenger demand flows are based on OPTAR median demand and the distribution flow diagrams presented in the ATS to estimate station demand walking trips only. This demand distribution profile is orientated towards pedestrian crossings, if the facility aligns with the defined desire line to the station. It should be noted that most other travel mode station demand has a walking component which is detailed below.

- **Cycling** – passengers cycling to the station are assumed to access the station directly and therefore do not use any of the marked crossings in this instance.
- **Bus** – Based on the mode share profile presented in the ITLU and the peak hour demand presented in OPTAR with all bus service routes travelling and dropping passengers in the station precinct at the bus interchange on Precinct Street A. It is assumed that 50% of this passenger demand will arrive / depart on the northern side of Precinct Street A (opposite side of the road to the station). This bus demand is converted into walking trips and assumed to use the marked crossings on Precinct Street A (crossings B) to access the station, whilst the remaining 50% arrive / depart on the southern side and do not use the crossings.
- **Park and Ride (PnR)** – Based on the mode share profile presented in the ITLU and the peak hour demand presented in OPTAR and identifies that total passenger demand for parking exceeds the Cherrybrook Station commuter car parking supply. The car park is designed to accommodate 400 spaces and the modelling undertaken with OPTAR demand levels indicates that 64% of PnR trips will access the car park, whilst the remaining 36% will park in other locations external to the station precinct. Passengers that park in the commuter car park do not need to use a crossing to access the station. The remaining 36% are assumed to travel to the station via similar routes identified for the walk only trips.
- **Kiss and Ride (KnR)** – Based on the mode share profile presented in the ITLU and the peak hour demand presented in OPTAR with all KnR arriving and departing the station precinct on Precinct Street A. It is assumed that 67% of this passenger demand will arrive / depart on the northern side of Precinct Street A (opposite side of the road to the station). This KnR demand is converted into walking trips and assumed to use the marked crossings on Precinct Street A (crossing B) to access the station, whilst the remaining 33% arrive / depart on the southern side and do not use the crossings.

Other users of pedestrian crossings in the station precinct by 2021 (modelled initial design year) are based on the following assumptions:

- Non station users are based on people who walk to their workplace, additional bus passenger trips that are required to access workplaces and schools situated around the station precinct or local residents that board or alight a bus service in the station precinct to travel to different destinations. This demand was estimated using the residential forecasts (employment forecasts are very low and therefore are not factored) stated in the Cherrybrook Structure Plan (DoP, June 2013) and assumes the following:
 - 40% of the dwelling growth is achieved by 2021.
 - 50% of the target dwelling growth is already accounted for by the demand generated by Cherrybrook Station. A factor of 1.2 has been assumed to cater for dwelling growth outside of the station precinct.
 - Similar mode share assumptions to that stated in ATS for bus and walking based trips.
 - Approximately 25% of generated bus demand will use the station precinct bus stop (precinct Street A) to access the service.
 - Student trip assumptions for student arrival surrounding the precinct is 40% overall walking mode share (60% arrive via other modes such as KnR directly at the school), with 50% already factored into station entries / exits. Students primarily use the crossing at Franklin Street / Precinct Street A for access to the school.

- Approximately 25% of total demand uses the marked crossing on Precinct Street A / Franklin Road which are primarily associated with access to the nearby school.

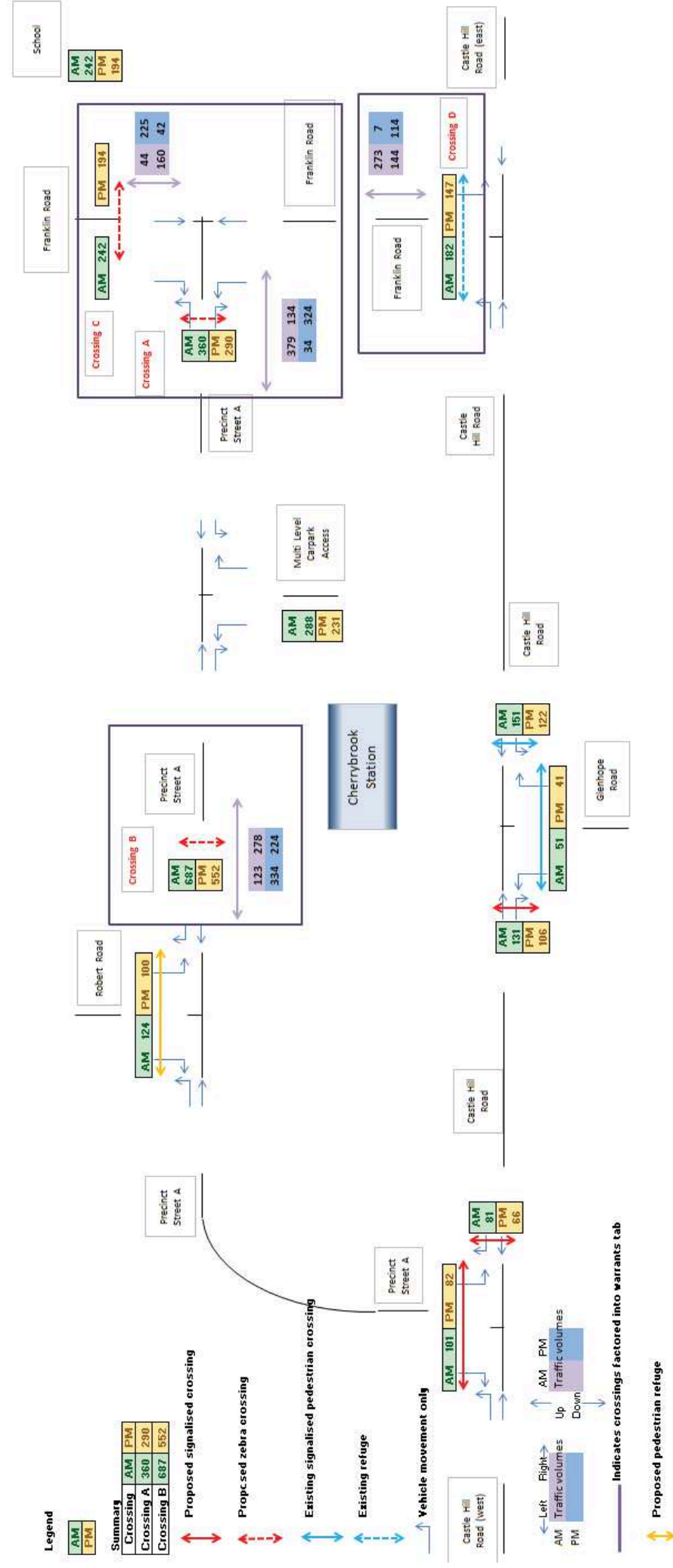
The demand forecast for walking movement in the station precinct assumes that there is minimal existing pedestrian movement around the station locality.

The estimated 2021 initial design year pedestrian movement flows across planned pedestrian crossings in the Cherrybrook Station precincts are based on the above assumptions and the estimated pedestrian flows together with traffic are presented in Figure 8.

The results indicate that whilst pedestrian movements are very high the actual amount of through traffic movement along Precinct Street A is low.

Demand predictions for Cherrybrook station (including OPTAR and SPR 45 demand estimates) were reviewed as part of a separate appraisal process and the findings have indicated the OPTAR median range station demand estimation aligns with demand estimates that support the project approval. This indicates the typical weekday initial design year peak hour demand estimate produced by the TfNSW/BTS PTPM for the project, the EIS and facility provision requirements stated in the NWRLOTS Project Deed Exhibit 1 SPR.

Figure 8 Cherrybrook Station Pedestrian Flow Summary – OPTAR Initial Design Year Passenger Demand



It is noted that station entries and exits (passenger demand) are forecast to increase by the ultimate design year which factors long term patronage growth to safeguard future capacity of the system.

This patronage increase will primarily be generated by intensification and growth surrounding the station precinct over time.

As stated in SPR 45 and OPTAR, Cherrybrook Station demands are forecast to increase in the AM Peak Hour to:

- 4,000 (SPR 45) or 2,150 (OPTAR) entries.
- 450 (SPR 45) or 325 (OPTAR) exits.

And in the PM Peak Hour to:

- 360 (SPR 45) or 260 (OPTAR) entries.
- 3,200 (SPR 45) or 1,720 (OPTAR) exits.

It is expected that the ultimate design year mode share will differ from the 2021 initial design year ATS forecasts. This is expected to be driven by a shift to non-car modes linked to improvements in both rail and bus public transport services, and planned intensification of land use surrounding the station.

Pedestrian demands at proposed crossings beyond the initial design year (2021) are not included as part of this appraisal.

8.0 Assessment

This section reviews the eligibility for a 40km/h speed limit in high activity areas, the need for a pedestrian crossing against the numerical warrants for proposed pedestrian crossings and undertakes a qualitative review of design parameters associated with the implementation of marked pedestrian crossings and determines if any further traffic calming treatments are required.

The location and labels of the proposed pedestrian crossings in the station precinct area is shown in Figure 9. These labels are referred to in the following assessments.

Figure 9 Location of Marked Pedestrian Crossings



It is noted that steep grades on Franklin Road make a pedestrian crossing further south of location C potentially hazardous due to the difficulty of vehicles stopping while approaching the pedestrian crossing on a downhill slope. Crossing D was also assessed to determine if this location met the warrant for a marked pedestrian crossing and if a pedestrian refuge was a suitable facility.

8.1 RTA Guideline - 40km/h Review Process

The process specified in the RTA guideline that is used to justify both a reduced speed limit and traffic calming within a high activity precinct is summarised in Table 3. These requirements have been applied to Precinct Street A in the Cherrybrook station precinct and the outcome is presented in Table 3.

Table 3 Cherrybrook Station Precinct 40km/h Review Process

Step 1	Eligibility
Category A – eligibility = 1 from the below list	
Servicing a business or commercial area.	
Servicing a shopping strip greater than 1km.	
Category B - eligibility = 2 from the below list	
Adjacent to a railway station.	X
Adjacent to a bus interchange.	X
Servicing a small shopping strip less than 1km.	
Category C - eligibility = 4 from the below list	Not Required
<i>Meets criteria for a pedestrian precinct treatment</i>	Yes
Step 2	
Road Type	Local (Precinct Street A)
Does the existing road produce low speeds? <ul style="list-style-type: none"> - tight horizontal geometry - short length of carriageway before intersection - existing posted 40km/h limit 	Yes
Treatment type	*1
Traffic calming required?	No

*1 = 40kph area with gateway treatment

*2 = 40kph area with gateway treatment and traffic calming

The assessment clearly highlights that the introduction of a proposed 40km/h speed zone along New Precinct Street A (between Robert Road and Franklin Road) meets the design criteria specified in the RMS guideline and if implemented would be required to be supported by facilities that will help to control and slow traffic speed.

8.2 Review of Pedestrian Crossing Numerical Warrants

The numerical warrants are identified in AS1742.10 (and the associated RMS Supplement to section 6.3) for marked pedestrian crossings and the RMS Traffic Signal Design Guide Part 2 for traffic signals and are used to identify if the level of activity or traffic condition is eligible for the proposed pedestrian crossing treatment. The assessment process and the outcome is summarised in Table 4 for OPTAR passenger demand levels.

Table 4 Cherrybrook Station Precinct Pedestrian Crossings Numerical Warrant Review – OPTAR Passenger Demand

Cherrybrook Station	Assessment	Numerical Warrants								
	Standard / Guide	AS1742.10	RMS RSDG Part 2	RMS RSDG Part 2	Midblock Signalised	Pedestrian Volume Warrant	Estimated Pedestrian Volume	Traffic volume Warrant	Estimated Traffic Volume	PV Warrant
Pedestrian Crossing	Proposed Arrangement	Marked	Signalised Intersection	Midblock Signalised	Pedestrian Volume Warrant	Estimated Pedestrian Volume	Traffic volume Warrant	Estimated Traffic Volume	PV Warrant	PV Range
A: Franklin Rd/ Precinct St A	Marked Crossing	Yes	N/A	N/A	30	216 - 360	200	308 - 513	60,000	66,485 – 184,680
B: Precinct St A	Marked Crossing	No	N/A	N/A	30	412 - 687	500	241 - 557	60,000	99,175 – 307,464
C: Franklin Rd	Marked Crossing	No	N/A	N/A	30	145 - 242	200	122 - 268	60,000	17,762 – 51,910
D: Franklin Rd/ Castle Hill Rd	Pedestrian refuge	No	N/A	N/A	30	109 - 182	500	250 – 417	60,000	17,849 – 75,917
Castle Hill Rd/ Glenhope Rd	Intersection - signalised	N/A	WAD	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Castle Hill Rd/ Precinct St A	Intersection - signalised	N/A	WAD	N/A	N/A	N/A	N/A	N/A	N/A	N/A

The assessment highlights that the proposed marked crossing at New Precinct Street A/Franklin Road meets the numerical warrants on all grounds, while the other marked crossings meet the numerical warrants on some grounds, but not all elements. In particular the forecast traffic flows are lower and generally don't meet the warrant, but at the same time the pedestrian flows are observed to easily exceed that specified under the warrant. It is also noted that the pedestrian crossings will be located on a pedestrian desire line and provide safe and direct pedestrian access across Precinct Street A between the bus stops, kiss and ride facilities and new local centre.

8.3 Alignment with Design Principles

This section uses the design principles identified in RMS Technical Direction 2001/04b, AustRoads Guide to Traffic Management Part 7: Traffic Management in Activity Centres and Part 6 - Intersections, Interchanges and Crossings to identify if design elements that would justify the introduction of proposed pedestrian crossing treatments are achieved. The assessment process and the outcome are summarised in Table 5 and Table 6.

Table 5 Cherrybrook Station Precinct Pedestrian Crossings as Traffic Calming Devices Review

Cherrybrook Station	Assessment Criteria	Qualitative - Implementation to Support Traffic Calming					
	Standard/ Guide	RMS TDT 2007/04b - Use of traffic calming devices as pedestrian crossings					
Pedestrian Crossing	Proposed Arrangement	Visual cue of a change in traffic conditions	Discourage through traffic	Reducing speed and traffic volume	Improving road safety	Align with pedestrian desire lines	Provide priority to pedestrians over vehicles
A: Franklin Rd/ Precinct St A	Marked Crossing	Yes	No	Yes	Yes	Yes	Yes
B: Precinct St A	Marked Crossing	No	No	Yes	Yes	Yes	Yes
C: Franklin Rd	Marked Crossing	No	No	Yes	Yes	Yes	Yes
D: Franklin Rd/ Castle Hill Rd	Pedestrian refuge	Yes	No	Yes	Yes	Yes	Yes
Castle Hill Rd/ Glenhope Rd	Intersection - signalised	N/A	N/A	N/A	N/A	N/A	N/A
Castle Hill Rd/ Precinct St A	Intersection - signalised	N/A	N/A	N/A	N/A	N/A	N/A

Table 6 Cherrybrook Station Precinct Pedestrian Crossings and Activity Centre Review

Cherrybrook Station	Assessment Criteria	Qualitative - Supports Activity Centre Needs		Qualitative - Improves Operation & Safety		
	Standard/ Guide	AustRoads GtTM Part 7: Traffic Management in Activity Centres		AustRoads GtTM Part 6 - Intersections, Interchanges and Crossings		
Pedestrian Crossing	Proposed Arrangement	Minimises impact on reliability of on-street public transport operations	Provides a safe, convenient and attractive pedestrian environment	Reduces conflict	Simplifies decisions	Minimises Delay
A: Franklin Rd/ Precinct St A	Marked Crossing	No	Yes	Yes	Yes	No
B: Precinct St A	Marked Crossing	No	Yes	Yes	Yes	No
C: Franklin Rd	Marked Crossing	No	Yes	Yes	Yes	No
D: Franklin Rd/ Castle Hill Rd	Pedestrian refuge	No	Yes	Yes	Yes	No
Castle Hill Rd/ Glenhope Rd	Intersection - signalised	N/A	N/A	N/A	N/A	N/A
Castle Hill Rd/ Precinct St A	Intersection - signalised	N/A	N/A	N/A	N/A	N/A

The assessment indicates that all pedestrian crossing treatments would assist in managing safe pedestrian access, traffic flow, convenience and decision making.

8.4

RMS Risk Management Proforma for Complimentary Traffic Calming

The Predicted Hazard Index (PHI) for traffic calming at pedestrian crossings is identified in RMS Technical Direction 2001/04b – Use of Traffic Calming Devices at Pedestrian Crossings. This appraisal process was used to review the risk factor associated with the proposed pedestrian crossing environment at Cherrybrook Station. PHIs were determined for each pedestrian crossing in order to understand the level of risk and the associated recommended management action required. This assessment was requested to be applied by RMS and is typically used for situations where roads and surrounding land use are already established and supported by established data sets. The PHI is based on the following variables:

- The length of the crossing point
- The 85th percentile speed of traffic
- The volume of pedestrians using the crossing
- The volume of traffic passing over the crossing
- Various other factors including crash history, surrounding land use, road grades, etc.

The proposed pedestrian crossings at Cherrybrook Station will be located on new precinct streets within a Greenfield site which is planned to support a new station, local centre and commercial mixed uses. As a result, the data typically required under the PHI is either not available or cannot be estimated with a high level of certainty. To account for this, a number of scenarios have been considered to provide an understanding of the potential impact from changes to input data sets, which relate to safety. For instance, if the crossings are not situated along Precinct Street A or applied with additional traffic calming is it then likely to encourage higher traffic speeds and as a result does this increase the likelihood of a pedestrian accident? It is noted that the precinct streets are planned to be pedestrian prioritised areas, and the omission of crossings could potentially create a less safe environment that may then warrant crossings and additional traffic calming.

On this basis, five scenarios were considered to determine various risk levels according to the assumption applied. These include:

1. **Base Scenario** – no recorded crashes are assumed, or increase in traffic or traffic speed above the baseline assumption, which assumes that marked pedestrian crossings are situated within the station precinct and the environment would be controlled;
2. **Sensitivity Test 1** – Assesses the impact if a fatality is recorded with the other data remaining as stated in the base scenario;
3. **Sensitivity Test 2** – A higher speed environment assumed with traffic travelling 10km/h above the posted speed limit to account for the potential for greater speeds and other data remaining as stated in the base scenario;
4. **Sensitivity Test 3** – Includes both recorded fatality and higher travel speed assumptions specified in sensitivity tests 1 & 2 with the other data remaining as stated in the base scenario; and
5. **Sensitivity Test 4** – Includes all assumptions specified in sensitivity test 3, as well as a 20% increase in traffic volumes.

The evaluation is based on risk category management action ranges shown in Table 7, which provide the direction based on a numerical score.

Table 7 Cherrybrook Station Precinct Pedestrian Crossings Recommended Management Actions

PHI	Recommended Management Action & Plan
=> 120 (High (H) and Significant (S))	Provide a pedestrian crossing (zebra crossing) and kerb ramps. A pedestrian crossing can be placed on these facilities without reference to the warrants if the traffic calming device was provided before May 1998 (Reference RTA Technical Direction 98/6).
=>50 <120 (Medium (M))	If a traffic calming device has been provided after May 1998, the RTA's pedestrian crossing (zebra crossing) warrants must be met. If the traffic calming device does not meet the pedestrian crossing warrants it should be removed.
<50 (Low (L))	Restrict Pedestrian access across the facility by using fencing, and bollards, as well as remove kerb ramps, etc.
	Monitor the device on an annual basis

The outcomes of this assessment are presented in Tables 8 and 9.

Table 8 Cherrybrook Station Precinct Pedestrian Crossings Predicted Hazard Index (PHI) Calculations – Crossings A & B

		Crossing A					Crossing B						
PHI - Elements		PHI					PHI						
		Input Value	Base Scenario	Sensitivity Test 1	Sensitivity Test 2	Combined Sensitivity Test A	Combined Sensitivity Test B	Input Value	Base Scenario	Sensitivity Test 1	Sensitivity Test 2	Combined Sensitivity Test A	Combined Sensitivity Test B
L	Length of Crossing (m)	12.5	157	942	368	2207	2649	7	181	1088	425	2549	3059
S	85th Percentile Speed of Traffic (km/h)	40						40					
P	Pedestrians per hour using the traffic calming device	360						687					
V	Vehicles (PCUs per hour) in both directions at the traffic calming device	545						589					
NWF	Net Weighting Factor	40						40					
PHI	Categorical rating		High	High	High	High	High		High	High	High	High	High

Table 8 Cherrybrook Station Precinct Pedestrian Crossings Predicted Hazard Index (PHI) Calculations – Crossings C & D

		Crossing C					Crossing D						
PHI - Elements		Input Value	PHI				Input Value	PHI					
			Base Scenario	Sensitivity Test 1	Sensitivity Test 2	Combined Sensitivity Test A		Combined Sensitivity Test B	Base Scenario	Sensitivity Test 1	Sensitivity Test 2	Combined Sensitivity Test A	Combined Sensitivity Test B
L	Length of Crossing (m)	13	93	558	139	837	1004	9	69	414	103	621	745
S	85th Percentile Speed of Traffic (km/h)	50						50					
P	Pedestrians per hour using the traffic calming device	242						182					
V	Vehicles (PCUs per hour) in both directions at the traffic calming device	296						421					
NWF	Net Weighting Factor	40						40					
PHI	Categorical rating		Medium	High	High	High	High		Medium	High	Medium	High	High

The analysis indicates the following:

- Crossing A is a high risk crossing for all scenarios, driven by significant volumes of pedestrians and vehicle traffic, and the presence of the local school (Tangara). This indicates a requirements for traffic calming in all scenarios to provide safe access to and from the station.
- Crossing B is a high risk crossing for all scenarios, driven by significant volumes of pedestrians and vehicle traffic, and the presence of the local school. This also indicates a requirements for traffic calming in all scenarios to provide safe access to and from the station.
- Crossing C is a medium risk crossing in the base scenario, and a high risk crossing under a scenario where a fatality or travel speeds above the posted speed limit are recorded. This crossing serves a key desire line between the local school and the station.
- Crossing D is a medium risk crossing in the base scenario, and a high risk crossing if a fatality is recorded. This crossing serves a desire line between the station and residential areas to the east.

9.0 Recommendations

The review of proposed signposted travel speeds and pedestrian crossings has identified the following:

- Precinct Street A satisfies the selection criteria under category 2 for the installation of the signposted 40km/h speed limit in high activity areas. It is recommended that these streets are designed and supported by a gateway treatment and include traffic calming in the form of pedestrian crossings.
- It is recommended that the design and signposted travel speed of all precinct roads and external roads, which are specified in OTS WAD and Council Interface Agreement are adopted with a minor signposted travel speed modification from minimum 50km/h to 40km/h on New Precinct Street A. This is specified in Figure 5 and includes:

Road Name	WAD Design (Signposted) Speed	Council Interface Design (Signposted) Speed	Adopted Design (Signposted) Speed
Castle Hill Road	70km/h	(Min 50km/h)	70km/h (60km/h)
Robert Road (to limit of works)	60km/h	(Min 50 km/h)	60km/h (50km/h)
Franklin Road (to limit of works)	60km/h	(Min 50 km/h)	60km/h (50km/h)
Precinct Street A	N/A	N/A	50km/h (40km/h)

- That all existing signalised pedestrian crossings, as shown in OTS WAD package 4, at the signalised intersection of Castle Hill Road/Glenhope Road are retained, and proposed crossings should be designed and delivered from day one of opening.
- That all signalised pedestrian crossings, as shown in OTS WAD package 5, at the new signalised intersection of Castle Hill Road/Precinct Street A should be designed and delivered from day one of opening.
- The introduction of a marked pedestrian crossing on Precinct Street A at Franklin Road (Crossing A) is warranted based on anticipated pedestrian and vehicular flows due to the crossing functioning as a key desire line between the station and local school. The implementation of the marked crossing is justified on these grounds as well as safety, which relates to the need to provide a safe location for the pedestrians accessing the school.
- The introduction of a marked pedestrian crossing on Precinct Street A adjacent to the station plaza (Crossing B) is warranted based on anticipated pedestrian flows, but not based on traffic volumes (some traffic accesses the car park and does not use this section of the road). The implementation of the marked crossing is justified on access and safety grounds, which relates to the need to provide a safe location for the high volumes of pedestrians

accessing the station and the routes functioning as a key desire line between the station and many other facilities and areas, including bus stops, kiss and ride bays, the planned local centre and residential development and shared path to the north.

- The introduction of a marked pedestrian crossing on Franklin Road next to Tangara school (Crossing C) is warranted based on anticipated pedestrian flows, but not based on traffic volumes. The implementation of a marked crossing in this location is justified on access and safety grounds, which relates to the need to provide a safe location for the pedestrians accessing the local school.
- The introduction of a marked pedestrian crossing on Franklin Road at Castle Hill Road (Crossing D) is warranted based on anticipated pedestrian flows, but not based on traffic volumes. The implementation of a pedestrian refuge is therefore justified on access and safety grounds, which relates to the need to provide a safe location for the pedestrians accessing the station from residential areas to the east.
- The PHI risk assessment indicates that the risk appraisal would require a crossing at locations A and B on the basis of meeting the RMS recommended management actions and plans.
- It is recommended that the proposed location of marked crossings and the recommended treatments, including line marking and signage, are adopted as shown in Appendix A.