Tempe South LATM Study

Draft Report

Inner West Council

25 September 2020

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Document Issue History

Report File Name	Prepared	Reviewed	Issued	Date	Issued to
P4533.001R Tempe South LATM Study – Draft Report_DRAFT	C. Mak / G. Yin	SP. Power	C. Mak	24/07/2020	Sunny Jo <sunny@innerwest.nsw.gov.au>
P4533.002R Tempe South LATM Study – Draft Report	C. Mak / G. Yin	G. Yin / SP. Power	G. Yin	25/09/2020	Sunny Jo <sunny@innerwest.nsw.gov.au>

EXECUTIVE SUMMARY

Background

As part of the conditions of consent for an approved Bunnings Warehouse at 728-750 Princes Highway, the Eastern City Planning Panel has conditioned that a Local Area Traffic Management (LATM) study to be undertaken for the Tempe South area, in order to manage the impacts of the proposed development.

Study Area

The study area for the LATM study consists of local roads in Tempe South, which are Barden Street, Edwin Street, Fanning Street, Foreman Street, Hart Street, Holbeach Avenue, Smith Street, South Street, Stanley Street, Station Street, Tramway Street, Union Street, Wentworth Street and Zuitton Lane. Data analysed and concept designs developed during the study are limited to these roads.

At the beginning of the study, background information and documents relating to the proposed Bunnings development were reviewed, providing information on future proposed traffic and road changes in the area. This included a desktop study of existing site conditions and review of surrounding land uses and road network information.

Data Review

Crash history, traffic and parking data were analysed as part of the study. Traffic and parking surveys were conducted to capture the levels of traffic and parking demand within the study area. This included tube counts, parking occupancy surveys and intersection counts

Crash history data between January 2014 and December 2018 were analysed. It was found that 12 crashes occur within the study area, with two (2) involving vehicles at intersections with Princes Highway. Five (5) of the crashes occurred along Holbeach Avenue, two (2) occurred along Smith Street and two (2) occurred along Edwin Street. Out of the five (5) Holbeach Avenue crashes, four (4) involved Vulnerable Road Users (VRU), which included motorcyclists, pedal cyclists and pedestrians.

Traffic surveys were undertaken on 19 March 2020, Thursday and 21 March 2020, Saturday, recording relevant data such as traffic volumes, heavy vehicle volumes and 85th percentile speeds. The surveys were undertaken during the early stages of the COVID-19 pandemic, therefore, the surveys may not have accurately reflected typical traffic conditions. However, Council decided to proceed with the LATM study and the traffic survey data was subsequently deemed suitable for the study.

From the traffic surveys, it was found that some of the local roads have relatively higher average daily traffic volumes than other roads in the study area. The 85th percentile speeds on these roads are also relatively higher than the other roads, with speeds of more than 40 km/h but lower than the speed limit of 50 km/h. Some roads with a truck load limit were also found to be used by heavy vehicles.

The crash history and traffic survey data analysed helped to identify roads that require LATM devices in order to provide traffic calming and reduce vehicle speeds, reduce general traffic volumes by deterring traffic, reduce heavy vehicle volumes and reduce crash risk.

Parking occupancy and duration surveys were undertaken for Barden Street, Fanning Street, Smith Street and a section of South Street on 19 March 2020, Thursday and 21 March 2020, Saturday. The parking surveys were also undertaken during the early stages of the COVID-19 pandemic, and may not accurately reflect typical parking conditions. The parking data showed that on average, Smith Street had 18 vacant spaces on Thursday and 27 vacant spaces on Saturday.

It is understood that up to 13 parking spaces along Smith Street will be removed as part of the Bunnings development. The parking survey data was used to determine the number of available kerbside parking spaces on a typical Thursday and Saturday and assess the impact of removing spaces due to Bunnings. These numbers then influenced the LATM treatment options proposed along Smith Street, as different LATM devices may also require removal of some kerbside parking spaces. It was found that Smith Street will have very few or no available parking spaces left when excluding parking that was removed due to the

Bunnings and the LATM devices. This may result in any parking overflow onto surrounding streets. The existing parking occupancy of around 50% along the surrounding Barden and South Streets mean that these roads are able to absorb any of the Smith Street parking overflow.

Site Audits

Site audits of existing traffic and parking signage, bicycle and pedestrian facilities, LATM devices and refuse collection issues were undertaken on Wednesday 4 March 2020. Audits for Edwin and Tramway Streets were undertaken on Tuesday 15 September 2020, including site observations of current school traffic operations.

A finding of the audit was the lack of truck load limit signage on the northern end of Wentworth Street near Princes Highway, which is peculiar due to the presence of such signage on the southern end of Wentworth Street and other local roads in the study area. This finding was taken into consideration when developing the LATM concept designs.

Traffic Generation and Impact

Approximated traffic generation rates and traffic volumes from previous studies were reviewed and adjusted to better represent potential traffic using local streets north of Princes Highway, namely Union Street. It was determined that Union Street could accommodate up to approximately 30% of Bunnings generated traffic leaving the site, based on acceptable performance limits of a local road.

The closure of Union Street was also explored and was determined as not feasible due to the effects to other local streets and required alternative routes.

Risk Priority Scoring Assessment

A scoring system was developed to determine streets that require LATM treatments. This was based on the crash history and traffic data analysed, and other factors such as existing road width, availability of existing LATM devices, distance to schools and existing and future land use. Points were allocated to each road or road section based on the level of risk. The higher the points, the higher the risk for future crashes, and hence the higher the need for LATM devices.

Based on the scoring criteria, seven (7) streets (priority streets), being Smith Street, Edwin Street, Holbeach Avenue, Stanley Street, Union Street, Wentworth Street and Tramway Street, had relatively higher scores than other roads in the study area. Therefore, LATM devices are recommended to be implemented on these roads.

Proposed Treatments Justification

A detailed selection criteria and list of suitable LATM measures were developed based on existing devices in the area and typical LATM devices presented in *Austroads Guide to Traffic Management Part 8 - Local Area Traffic Management*.

Treatment options were then proposed for each of the four priority streets to address the specific issue(s) identified:

- **Smith Street Option 1:** Road narrowing using kerb blisters to slow down traffic, with contrasting pavement to highlight the change in road environment
- **Smith Street Option 2:** Mountable concrete median to provide a horizontal deflection and slow down traffic
- Other Smith Street treatments: on-road and off-road bicycle transitions, extension of shared path and angled on-ramp for cyclists, along with a widened footpath on the western side of Smith Street. An optional landscaped verge may also be provided between the widened footpath and roadway, which will result in the removal of kerbside parking.
- **Holbeach Avenue Option 1**: A set of four speed cushions at mid-block to provide a vertical deflection and slow traffic down
- **Holbeach Avenue Option 2**: A set of two speed cushions at mid-block to provide a vertical deflection and road narrowing using kerb blisters, with the aim of slowing down traffic

- **Stanley Street Option 1**: Flat top road humps at two mid-block locations to provide a vertical deflection and slow traffic down
- **Stanley Street Option 2**: Road narrowing using kerb blisters at two mid-block locations to slow traffic down
- **Wentworth Street Option 1**: Road narrowing using kerb blisters at both ends of the road to slow traffic down, with contrasting pavement to highlight the change in road environment
- **Wentworth Street Option 2**: Flat top road humps at both ends of the road to provide a vertical deflection and slow traffic down
- **Union Street Option 1**: Flat top road humps at two mid-block locations to provide a vertical deflection and slow traffic down
- **Union Street Option 2**: A 10 km/h shared zone between Princes Highway and School Lane to slow down traffic and providing priority to pedestrians
- **Edwin Street**: A flat top road hump west of Stanley Street to slow traffic and deter non-local traffic
- **Tramway Street**: Contrasting Pavement Threshold at Unwins Bridge Road and Edwin Street to act as a visual gateway and deter non-local traffic
- Other Union Street treatments: A contrasting pavement at the entry of Union Street at Princes Highway to deter non-local traffic from using these streets.

Where possible, landscaping is proposed to improve the aesthetics of the street environment and enhance sense of place.

Additionally, contrasting thresholds have also been proposed for Barden Street, Fanning Street, Hart Street and Station Street to visually separate the local streets and the Princes Highway. This assists in highlighting the local road environment and deter non-local traffic from using these streets. This treatment can also be used to support a reduction in speed limit in the future, subject to discussion and approval by Transport for NSW.

The existing bus stop along Princess Highway outside the site of the development may be impacted by the development. The provision of replacement bus stops would be a matter for Transport for NSW and is outside the scope of this study

The traffic movements in and out of Bunnings site via Princes Highway and Smith Street have been considered during the Development Application (DA) stage of the development. Any changes to traffic movements to Bunnings cannot be changed during the development of this LATM study.

Infrastructure Itemisation

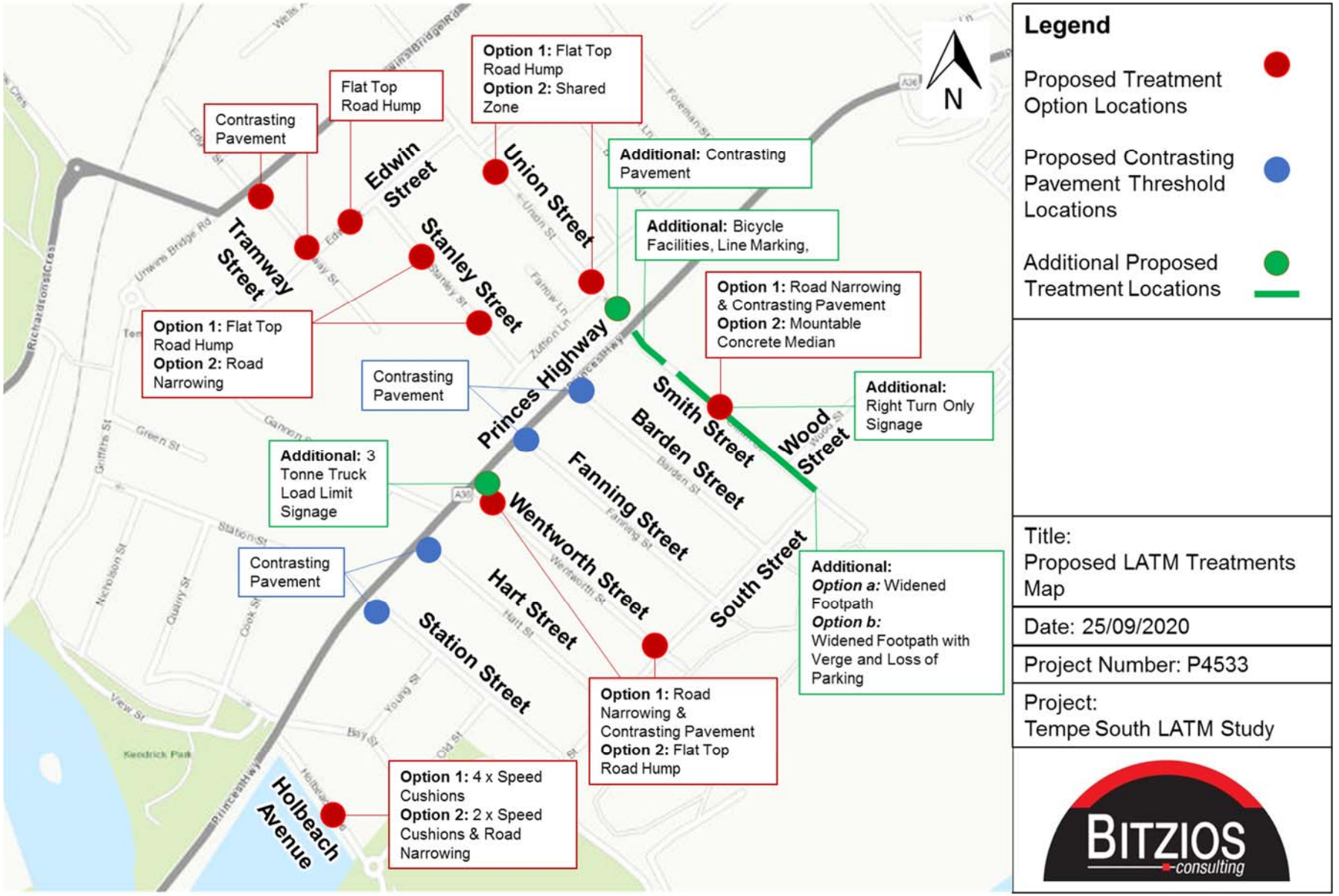
Each option was broken down into individual components including signage. Treatments requiring signage include bicycle infrastructure at Smith Street, speed cushions and flat top road humps. Additionally, truck restriction signage will be provided at the northern end of Wentworth Street where there is no existing signage.

Cost Estimation

Indicative costs for each component were estimated based on average standard costs provided by Inner West Council, as well as rates presented within *Local Infrastructure Benchmark Costs (IPART NSW).* Naturally, the highest cost treatments include those requiring substantial civil works, such as flat top road humps, footpath widening, and kerb blisters.

Estimated costs for each option and measure ranges from $18,000 to $190,000, with the lowest cost treatment being the contrasting pavement, and the highest cost being the Smith Street treatment options.

Proposed Treatment Locations



CONTENTS

Tables

Figures

Appendices

1. INTRODUCTION

1.1 Background

As part of the conditions of consent for an approved Bunnings Warehouse at 728-750 Princes Highway, the Eastern City Planning Panel has conditioned that a Local Area Traffic Management (LATM) study to be undertaken for the Tempe South area, in order to manage the impacts of the proposed development.

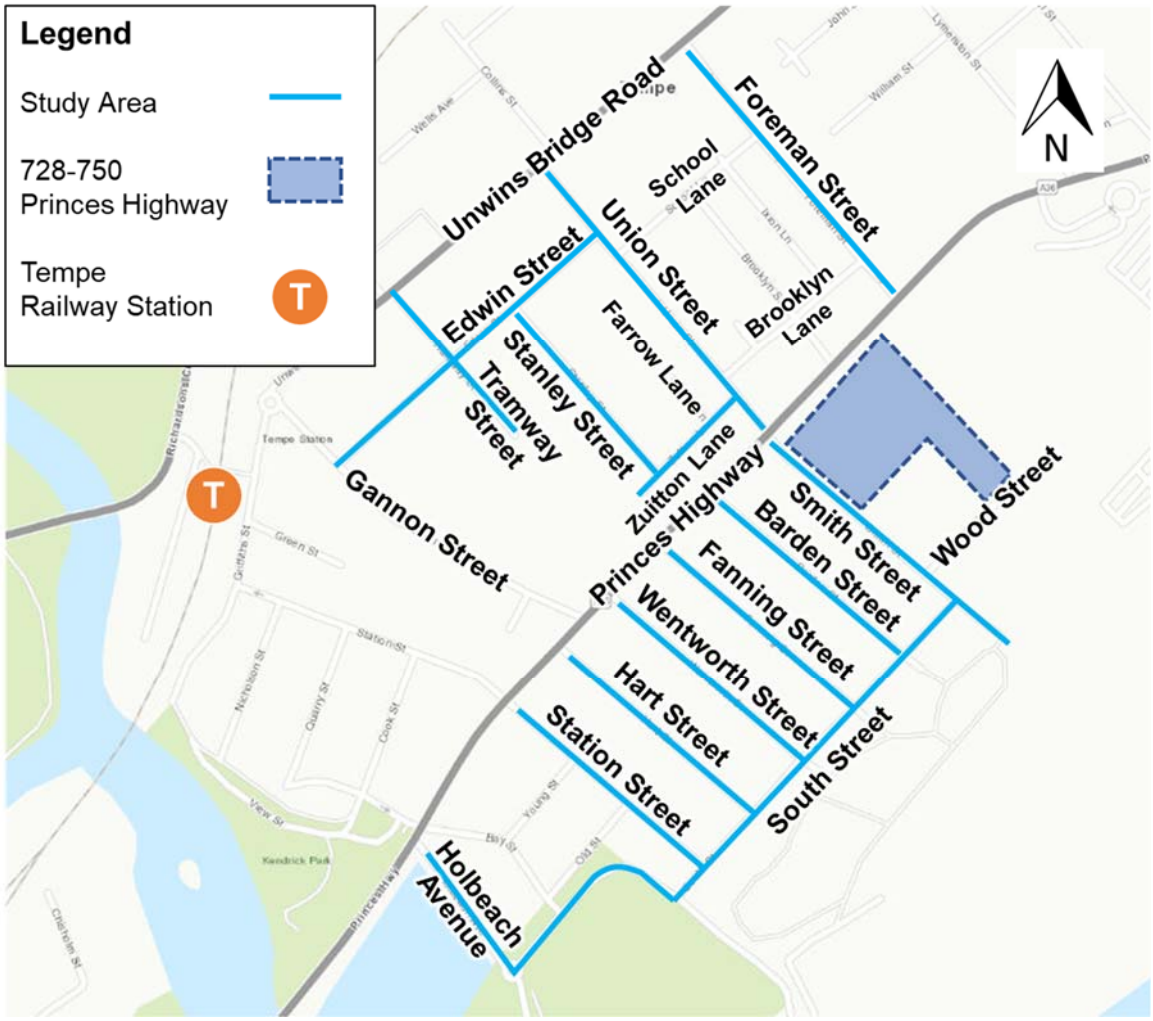
Inner West Council (Council) has commissioned Bitzios Consulting to undertake this LATM study.

1.2 Study Area

The LATM study area includes the local roads adjoining Princes Highway and Unwins Bridge Road in the Tempe South precinct, namely:

- Barden Street
- Edwin Street
- Fanning Street
- Foreman Street
- Hart Street
- Holbeach Avenue (excluding the Tempe Recreation Reserve access road)
- Smith Street
- South Street
- Stanley Street
- Station Street (between Princes Highway and South Street)
- Tramway Street
- Union Street
- Wentworth Street
- Zuitton Lane

The study area and the proposed development (728-750 Princes Highway) are illustrated in Figure 1.1.



Adapted from ESRI Maps

Figure 1.1: Study Area

1.3 Purpose and Scope

This report details the assessment of the traffic conditions within the Tempe South study area and its findings. The study included:

- Review of existing conditions, including:
  - Surrounding Land Uses
  - Road Hierarchy
  - Public Transport and Active Transport
  - Garbage Collection
  - Parking Controls
- Review of Future developments, including proposed developments and traffic generation
- Crash Data Analysis
- Traffic and Parking Data Analysis, including:
  - Intersection traffic counts
  - Vehicle tube count speed and volume data
  - Heavy vehicle proportions
  - Parking occupancy data
- On site audit, including:

- Traffic and parking signs
- LATM and traffic calming devices
- Bicycle and pedestrian facilities
- Waste management

- Development of a scoring system and identification of priority streets for treatment
- Development of potential LATM treatments
- Recommendation and assessment of LATM treatments and locations
- Development of an infrastructure schedule based on treatment options
- Cost estimation of each type of the recommended treatment
- Methodology and assumptions used for cost estimation.

1.4 Local Area Traffic Management

1.4.1 What is Local Area Traffic Management

According to Austroads Guide to Traffic Management Part 8 – Local Area Traffic Management (AGTM08-16) (summarised):

LATM is concerned with the planning and management of the usage of road space within a local traffic area. It involves the use of physical devices, streetscaping treatments and other measures (including regulations and other non-physical measures) to influence vehicle operation, in order to create safer and more pleasant streets in local areas.

LATM is essentially system-based and area-wide. It considers neighbourhood traffic-related problems and their proposed solutions in the context of the local area or a group of streets within it, rather than only at isolated locations. In addition, it requires that physical traffic measures be seen as a sequence of interrelated devices rather than individual treatments.

The primary target of LATM is to change driver behaviour, both directly by physical influence on vehicle operation, and indirectly by influencing the driver's perceptions of what is appropriate behaviour in that street. The objective is to reduce traffic volumes and speeds in local streets to increase amenity, liveability, and improve safety and access for all road users.

The need for LATM usually arises from:

- an intent to reduce traffic-related problems
- orderly traffic planning and management
- a need to modify 'transport' behaviour
- a desire to improve the community space and sense of place
- a desire to improve environmental, economic and social outcomes
- traffic interventions associated with new development or the implementation of pedestrian and bicycle plans and other local policies (e.g. RTA 2002).

1.4.2 Stages of a LATM

The general stages involved in preparing a LATM study, as per *AGTM08-16*, are outlined in Table 1.1. This study primarily covers Stage 2 of the LATM process, with partial coverage of Stage 3 items.

Table 1.1: Stages of a LATM

Tasks	Status in this study
Stage 1: Initiating an LATM program (completed)	
▪ Decide that action is needed ▪ Define study area, precincts and functional hierarchy of roads ▪ Develop study plan, including type of treatments and study costs ▪ Develop consultation strategy ▪ Council decision ▪ Prepare brief for consultant, if required	Completed by Council prior to start of the study
Stage 2: Data collection and problem identification	
▪ Define and collect required data ▪ Identify problems ▪ Identify potential solutions ▪ Define and confirm objectives	▪ Section 2 outlines the existing condition of the study area. ▪ Sections 3 to 5 outlines the data analysis and identification of problems. ▪ Section 6 outlines future conditions to be considered in the development of LATM plans. ▪ Section 9 outlines potential solutions that can be used in the study.
Stage 3: Development of plans	
▪ Clarify suitable strategies (including confirmation of LATM as an appropriate response) ▪ Develop outline schemes and supporting arterial improvements ▪ Consult on draft plans ▪ Assess and refine alternatives ▪ Select, present to council for adoption	▪ Section 9 outlines treatment options proposed
Stage 4: Scheme design	
▪ Location and design of treatments ▪ Consult with nearby owners/occupiers ▪ Prepare contract documents	▪ Section 9 outlines the location of treatment options ▪ Section 10 lists the rationale for the location and design ▪ Section 11 outlines the components of treatments ▪ Section 12 outlines the estimated cost of the treatments
Stage 5: Implementation	
▪ Confirm timing and staging ▪ Conduct additional 'before' studies as required ▪ Community information ▪ Construct/install ▪ Safety audit	Community consultation undertaken currently
Stage 6: Monitoring and review	

Tasks	Status in this study
▪ After' data collection, observation and reports ▪ Identify unanticipated impacts or outcomes ▪ Review technical and community assessment of scheme ▪ Revise as needed and feasible ▪ Record and report process and outcomes	Not undertaken yet

Source: Austroads Guide to Traffic Management Part 8: Local Area Traffic Management

1.5 Referenced Documents

The following documents have been reviewed and referenced as part of this LATM study.

- Draft Integrated Transport Strategy 2019
- Marrickville Bicycle Strategy August 2007
- Marrickville Pedestrian Access and Mobility Plan (PAMP) 2009
- Draft Inner West Council Public Domain Parking Policy 2019
- Crash database provided by Council
- Local Traffic Committee Report and Correspondence relating to traffic and development issues in the study area
- Development Consent conditions in relation to 728—750 Princes Highway, Tempe
    - Joint Regional Planning Panels (JRPP) report
    - Initial and revised traffic assessment reports by Transport and Traffic Planning Associates (TPPA)
    - Peer review of traffic assessment report by GTA Consultants
    - Other assessments
- Austroads Guide to Road Design, Part 6A Pedestrian and Cyclist Paths (AGRD06A-17)
- Austroads Guide to Traffic Management, Part 8 Local Area Traffic Management (AGTM08-16)
- RTA/RMS/Transport for NSW Technical Directions & Guidelines, including:
    - RTA NSW Bicycle Guidelines 2003
    - RTA Guide to Traffic Generating Development, 2002
    - Transport for NSW – Safer Speed policy and Guidelines Version 1 July 2012
    - RMS Permit Parking Guidelines 2005
- Australian Standards AS1742 - Manual of uniform traffic control devices:
    - AS1742.10 – 2009: Part 10: Pedestrian control and protection
    - AS1742.13 – 2009: Part 13: Local area traffic management
- Other RMS/Austroads Guidelines or Australian Standards

1.5.1 Previous LATM Studies

An LATM study was previously conducted by GTA Consultants (for Inner West Council) of the St Peters and Tempe area in 2010 (*St Peters/Tempe LATM Study 2010*). Details on this study are provided in Section 2.10.

2. EXISTING CONDITIONS

2.1 Geographic Location

The study area is located within the suburb of Tempe, approximately 7km south-east of the Sydney CBD (the City). Tempe is the southernmost suburb within the Inner West LGA.

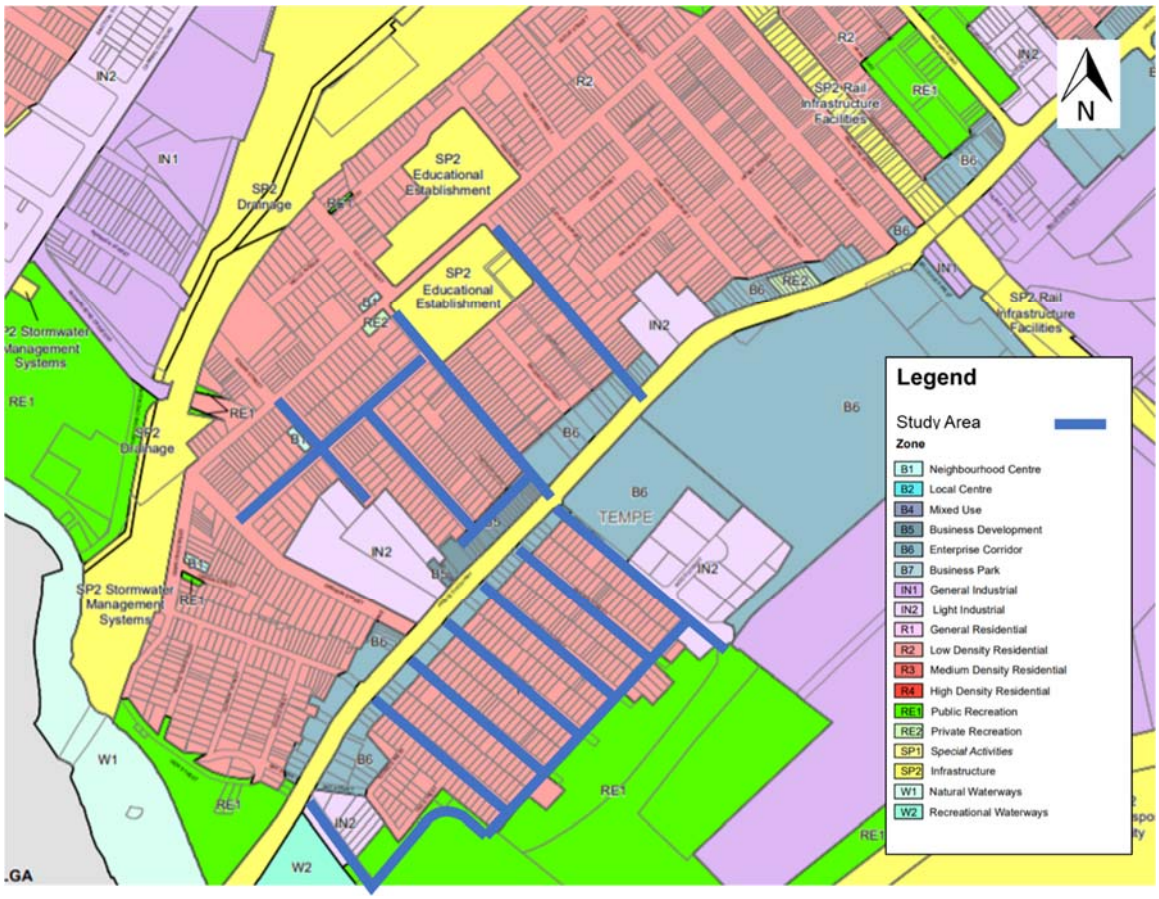
Cooks River and Alexandria Canal run along the western and southern boundaries of Tempe. Wolli Creek is located across Cooks River to the west and Sydney Airport land located across Alexandria Canal to the south.

2.2 Land Use

Based on the Marrickville Council LEP 2011, the study area is primarily comprised of the following land uses:

- R2 – Low Density Residential
- B6 – Enterprise Corridor (Commercial)
- IN2 – Light Industrial
- SP2 – Infrastructure (Educational Establishment i.e. schools)

The land zoning map is shown in Figure 2.1.



Source: Marrickville Local Environment Plan 2011, NSW Legislation

Figure 2.1: Tempe Land Zoning Map

2.2.1 Residential

The study area and roads listed in Section 1.1, mostly access low density residential lots, with some service access to commercial lots fronting Princes Highway and Wood Street.

2.2.2 Non-Residential

2.2.2.1 Commercial

Commercial lots are primarily located along the Princes Highway corridor, including tyre repair shops, motorcycle workshops, cafes, service stations, medical and dental clinics, a pub, a bus depot and other small retail. No large retail developments are located within the study area.

The larger commercial lots occupied by the IKEA Tempe and Decathlon sports stores are located towards the north east of the study area.

2.2.2.2 Industrial

Industrial land uses are located along the Princes Highway corridor, the eastern side of Smith Street, and Wood Street. As such, heavy vehicles access these lots using Smith Street and Wood Street.

The Tempe Bus Depot is located to the west of the study area on Princes Highway towards Gannon Street.

2.2.2.3 Schools

Two schools are located to the north of the study area along Unwins Bridge Road. Tempe Public School is bounded by Union Street, Foreman Street and Unwins Bridge Road.

2.2.3 Parks & Reserves

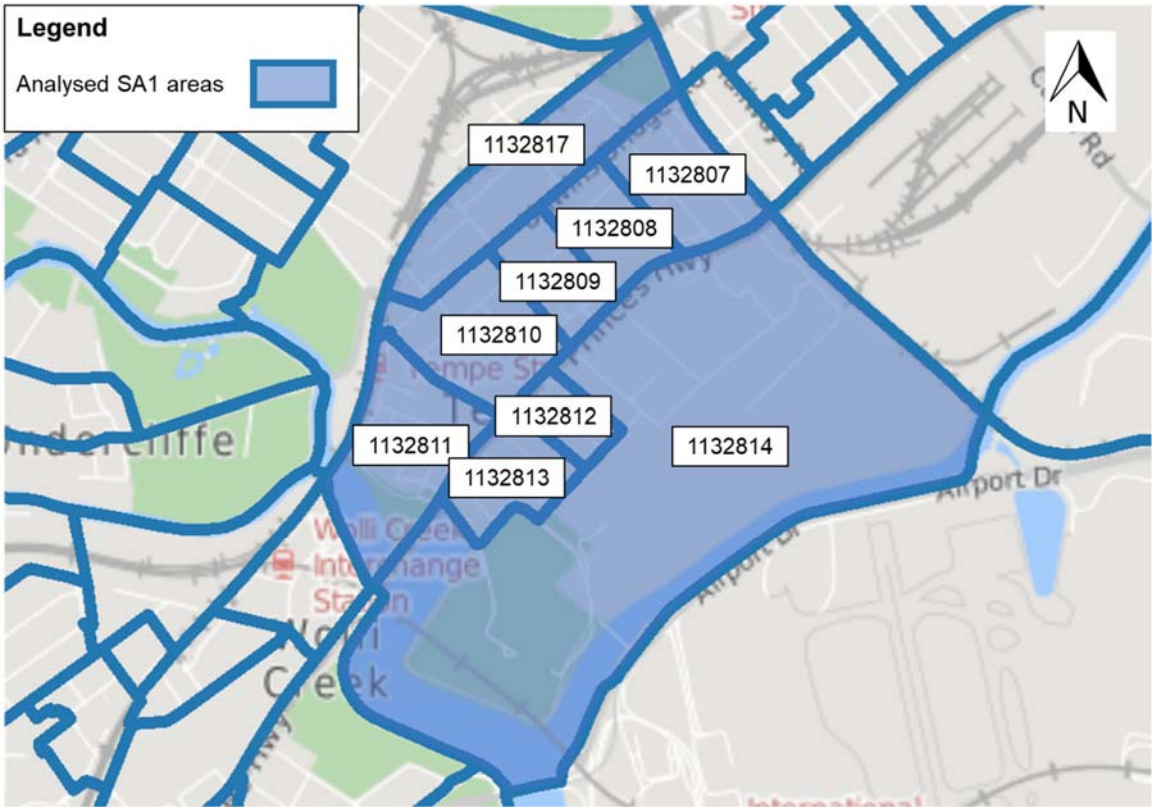
Located towards the south of the study area are large recreation spaces, including Tempe Lands, Tempe Dog Park, Tempe Golf Range, Tempe Recreation Reserve and Tempe Reserve. They are accessed via Holbeach Avenue and South Street.

2.3 Garbage Collection

Council garbage collection occurs on Fridays between 5:00 AM and 12:00 PM. Previous information indicates that 10.5m refuse collection vehicles are used. There are no fixed garbage collection routes.

2.4 Area Demographics

The 2016 Census data was reviewed to identify travel trends to and from the study area. Nine (9) SA1 level statistical areas (codes 1132807-1132814 and 1132817) cover majority of the suburb of Tempe including the study area, shown in Figure 2.2.



Source: Australian Bureau of Statistics (ABS)

Figure 2.2: Analysed SA1 areas

Census data, including Journey to Work data, for the nine (9) SA1 areas were compared to the Greater Sydney average shown in Table 2.1.

Table 2.1: Tempe Demographic Data

	Tempe SA1 areas	Greater Sydney Average
Age		
Young population between age 20 and 34	21%	23%
Aged population over age 65	12%	14%
Vehicle Ownership		
Vehicle ownership of one (1) motor vehicles or more	85%	88%
Vehicle ownership of two (2) motor vehicles or more	36%	50%
Mode of Travel to Work		
Public transport as mode of travel to work	41%	26%
Private vehicles as mode of travel to work	50%	67%
Bicycle riders as mode of travel to work	3%	1%
Walking only as mode of travel to work	4%	5%

A comparison of statistics reveals:

- The study area features a slightly higher proportion of younger residents and lower proportion of older residents than the Greater Sydney average
- Vehicle ownership in Tempe is less than the Greater Sydney average

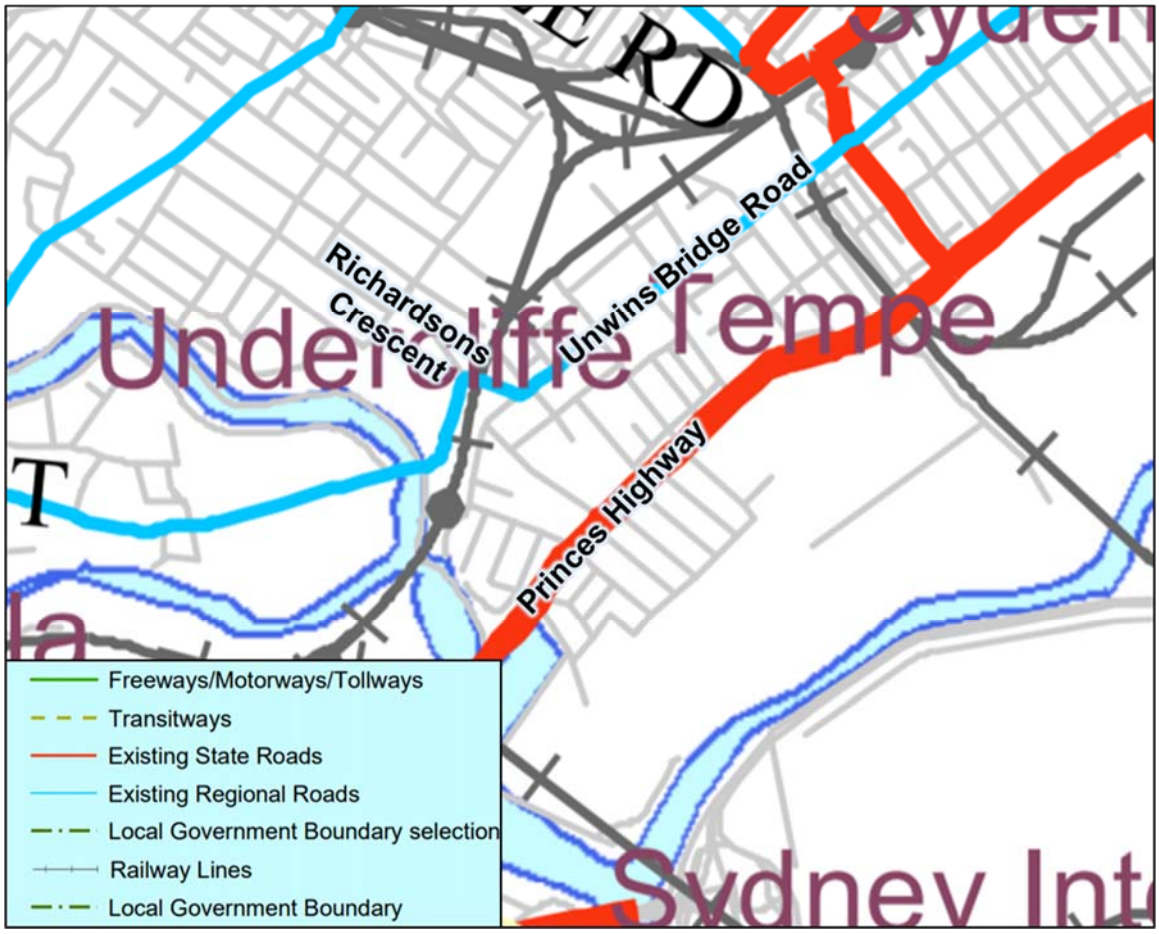
- Consistent with the lower vehicle ownership rate, a high proportion of Tempe residents use public transport to travel to work
- Proportion of residents cycling to work is higher than the Sydney average

Journey to work patterns are likely attributed to the number of public transport services available, including both buses and trains (detailed in Section 2.6) and active transport facilities (including cycling routes) nearby.

2.5 Road Classification

Road Classification in Tempe is shown in Figure 2.3, featuring:

- State Road - Princes Highway within Tempe is a state road (HW1), while
- Regional Road – Unwins Bridge Road from Richardsons Crescent to Campbell Street, and Richardson Crescent from Cooks River to Unwins Bridge Road
- Local Roads - all other roads



Source: Transport for NSW (Roads & Maritime)

Figure 2.3: Road Classification in Tempe

2.6 Public Transport

2.6.1 Trains

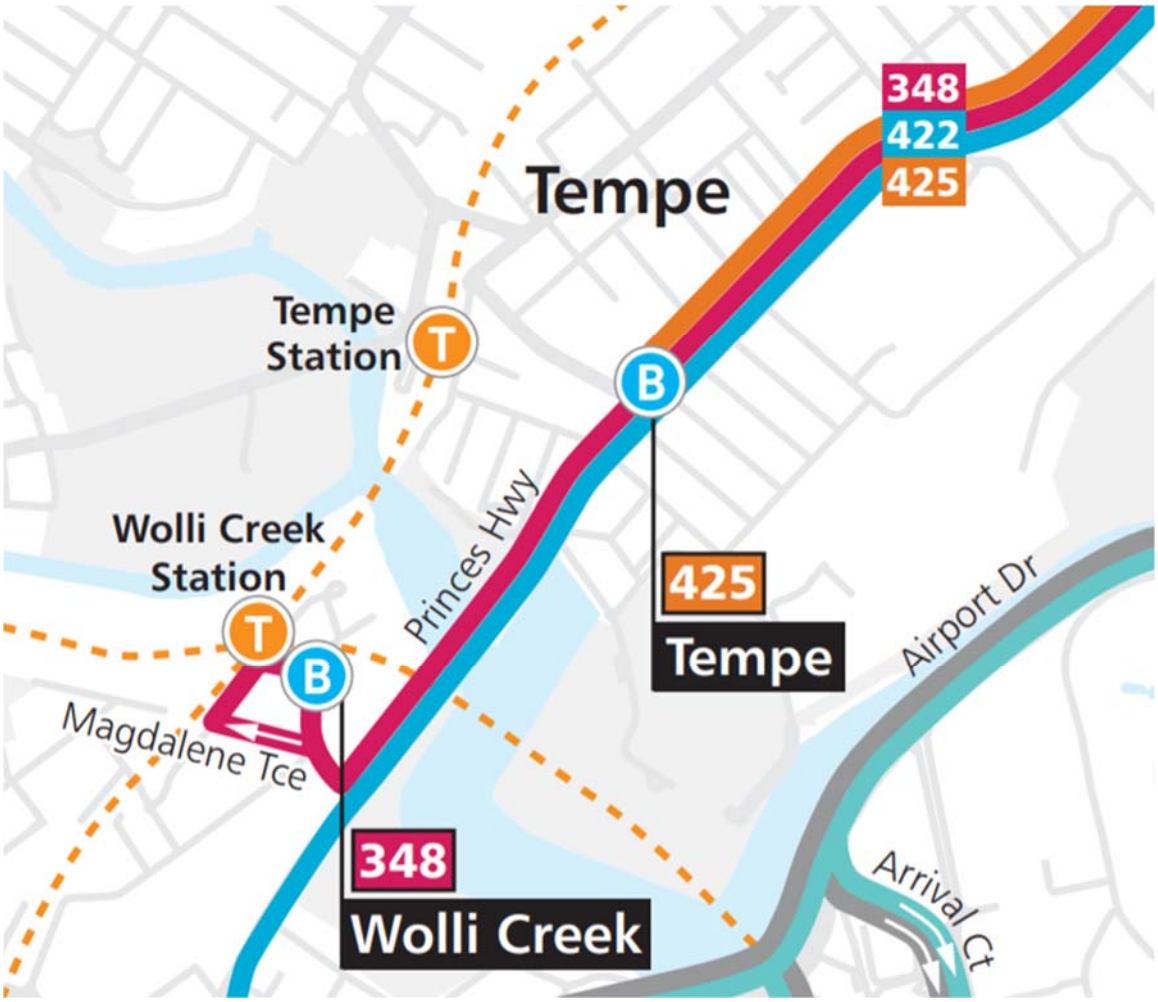
The nearest train station to the study area is Tempe railway station in the west, serviced by the T4 (Eastern Suburbs & Illawarra Line), with services running every 10 minutes per direction on weekdays off-peak. The next nearest station is Wolli Creek railway station located approximately 1km west of the study area and is within walking distance. Wolli Creek is services by both the T4 and T8 (Airport & South Line) services. Both T4 and T8 services stop at stations within the City.

2.6.2 Buses

Three public bus routes operate in the Tempe area along Princes Highway. The public bus network is shown in Figure 2.4. Additionally, there is one school bus route servicing Tempe High School students, which runs along Unwins Bridge Road.

The Tempe bus depot is located at the corner of Princes Highway and Gannon Street, accessed via Princes Highway.

The public and school bus services in Tempe are summarised in Table 2.2.



Source: Transit Systems

Figure 2.4: Public Bus Services in Tempe

Table 2.2: Bus Routes

Route Number	Route Description	Roads Serviced	Weekday Off-peak Frequency (min)
348	Bondi Junction to Wolli Creek	Princes Highway	30
422	Kogarah to Central Pitt Street	Princes Highway	15
425	Tempe to Dulwich Hill	Princes Highway	60
700S (School bus)	Earlwood to Tempe High School	Richardsons Crescent, Unwins Bridge Road, Collins Street	One AM service towards school, one PM service from school

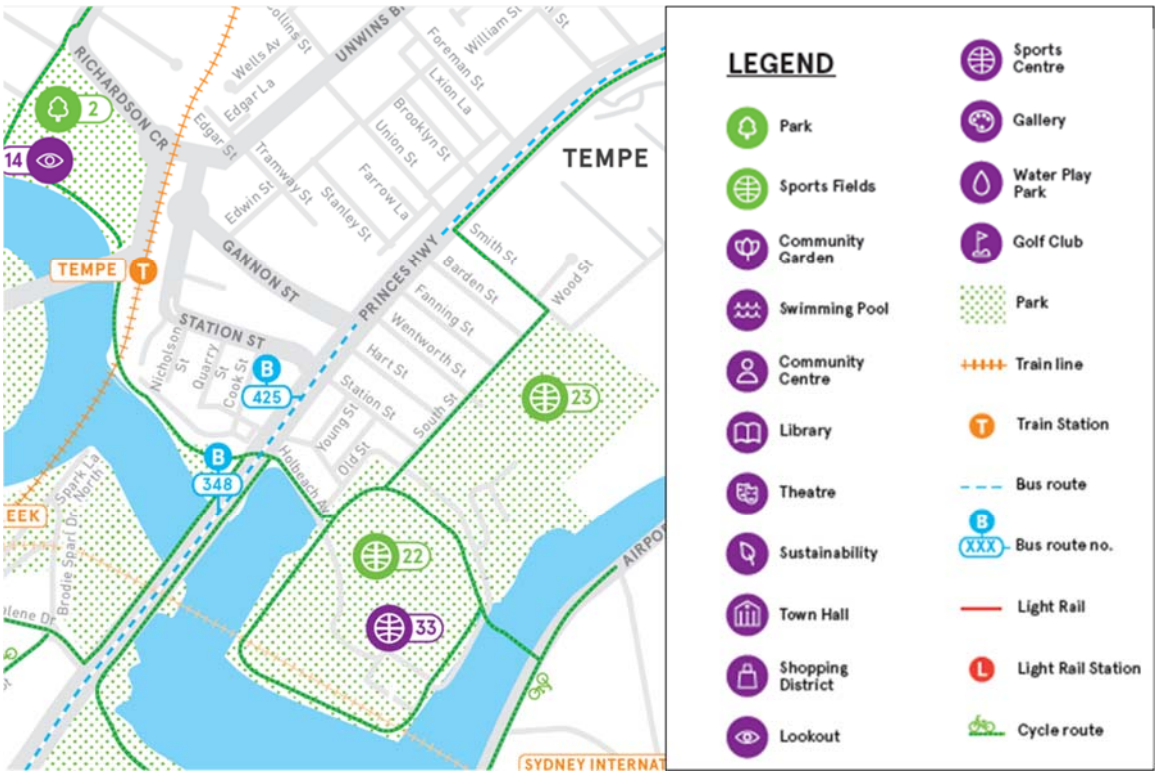
2.7 Other Transport

2.7.1 Bicycles

The local bicycle network (based on the Stay Active in Marrickville Map) is shown in Figure 2.5, and the (previously) proposed bicycle network in the Marrickville Bicycle Strategy 2007 is shown in Figure 2.6.

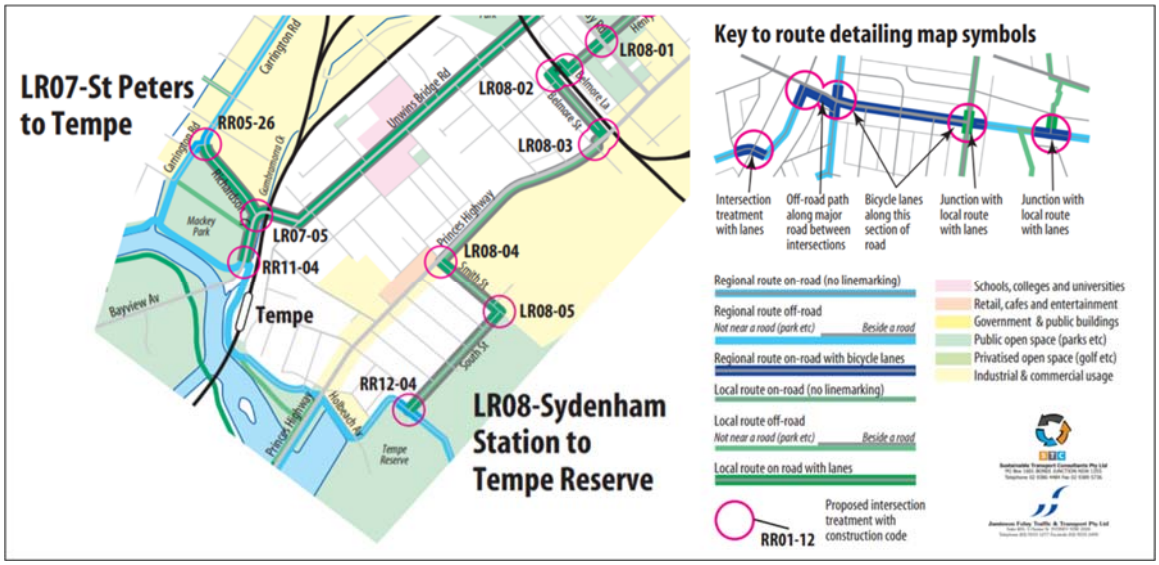
Two routes are present within the study area:

- Local Route L13 (shown as LR08 in Figure 2.6) – following Holbeach Avenue, South Street and Smith Street
- Alexandra Canal cycleway - following Holbeach Avenue, through Tempe Reserve and along Airport Drive on the southern bank of Alexandria Canal



Source: Staying Active in Marrickville Map (Inner West Council)

Figure 2.5: Existing Bicycle Routes in Tempe



Source: Marrickville Bicycle Strategy 2007

Figure 2.6: Proposed Bicycle Network in Tempe

Additionally, there are unpaved off-road paths within Tempe Lands that are used for walking and cycling. Entry points to Tempe Lands are located at the Smith Street cul-de-sac and at various points along South Street.

2.7.1.1 Bicycle Detour

As part of the Sydney Gateway Environment Impact Statement (November 2019), volumes were recorded on the cycleway on the southern bank of Alexandra Canal in March 2019. The average volumes on the cycleway were 600 cyclists and 100 pedestrians per day. During the morning and afternoon peaks, the volumes were 90 cyclists and 10 pedestrians.

Due to the permanent removal of the current shared path along Airport Drive as part of the Sydney Gateway project, a bicycle detour is proposed to follow the road through Tempe Recreation Reserve, to Tempe Wetlands near South Street and through the industrial lands to the east. Details of the detour are described in Section 6.3.2.

2.7.2 Pedestrians

The local footpath network is well connected through and surrounding the study area, with footpaths located along both sides of most roads. Signalised crossings are also provided at intersections and mid-block on Princes Highway and mid-block on Unwins Bridge Road. A pedestrian (zebra) crossing is also located on Union Street outside Tempe Public School.

2.7.3 Carshares

The use of carshare services has been increasingly popular in recent years. Popular carshare services used in Sydney include Car Next Door and GoGet, which operate in the study area and surrounds.

2.7.3.1 Car Next Door

Car Next Door is a carshare service that allows private car owners to rent their vehicles to other registered users on an hourly or daily service. As of March 2020, six (6) vehicles within or surrounding the study area have been signed up for Car Next Door, shown in Figure 2.7. It is important to note that the shown locations are approximate only.

2.7.3.2 Go Get

Go Get is another carshare service, where members are able to rent GoGet vehicles from their pods on an hourly or daily basis. As of March 2020, there are no GoGet pods within the study area; however, there are seven (7) nearby car pods within walking distance from the study area, including two (2) within the IKEA Tempe carpark. Additionally, IKEA Tempe has 12 van pods, with vans available to be rented. It is important to note that the pods in IKEA Tempe are located within its carpark and therefore can only be rented during the carpark's opening hours.

The location of GoGet car and van pods around the study area are shown in Figure 2.7.

Source: GoGet & Car Next Door, Adapted from GoogleMaps

Figure 2.7: GoGet Pod Locations in Tempe

Bunnings Car Share

As part of the Bunnings development application Consent Condition No.5 four (4) car share spaces are to be provided within the Bunnings development.

2.8 Parking Controls

Kerbside parking controls within the study area are shown in Figure 2.8). Most of the kerbside parking available is unrestricted on-street parallel parking with some time limited parking (one hour) along Union Street and Foreman Street. Due to the narrow nature of the roads in the study area, many vehicles were observed partially parking on the footpath (See Section 5).

Angled parking is provided along Holbeach Avenue near Bay Street. It provides unrestricted parking for residents as well as users of Tempe Recreation Reserve.

Persons with a disability (PWD) spaces are located along Edwin Street, Union Street, Foreman Street, Wentworth Street and Union Street.

There are 'No Parking' restrictions along Zuitton Lane and Farrow Lane due to their narrow widths. No Stopping restrictions are found along Union Street where kerb blisters are located.

Adapted from ESRI Maps

Figure 2.8: Existing Parking Restrictions

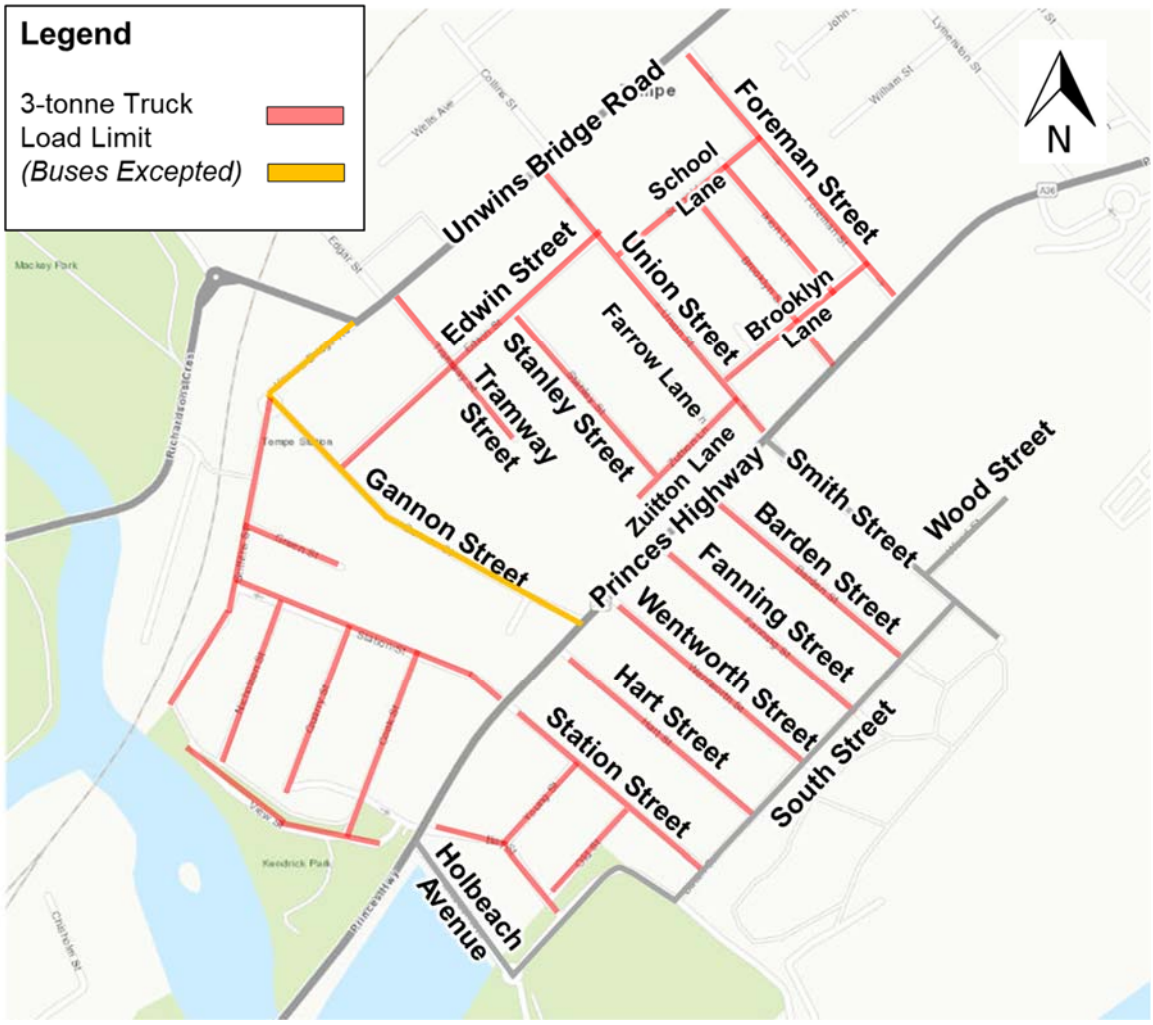
2.9 Truck Load Limits

A 3-tonne truck load limit is implemented in the study area and surrounds, covering local side roads near or connecting to Princes Highway, shown in Figure 2.9.

Wentworth Street was identified to maintain an inconsistent truck restriction, with signage only present at South Street (see traffic sign audit, section 5.1.2). It was confirmed the truck restriction applied along Wentworth street with signage missing at Princes Highway.

Another inconsistency of signage was at Tramway Street facing Unwins Bridge Road, where a "Gannon Street" tag plate was affixed to the truck limit sign. With the tag plate, it gives an indication that the truck limit applies to Gannon Street but not Tramway Street. It is possible that the tag plate was wrong affixed to this sign and should have been affixed to another sign on Unwins Bridge Road.

A 3-tonne truck load limit does not apply to Holbeach Avenue, South Street, Smith Street, Wood Street, Princes Highway and most of Unwins Bridge Road



Adapted from ESRI Maps

Figure 2.9: Truck Load Limit in Tempe

2.10 Previous LATM Study in Tempe

Planning approval of 630-726 Princes Highway (IKEA Tempe development) was granted by the NSW Department of Planning in July 2009. A condition of the approval required an LATM study to

be undertaken by Council "to identify the traffic and transport impacts of the proposed development and recommend ways in which any potential adverse impacts on local residential streets could be mitigated." GTA Consultants was commissioned by the then-Marrickville Council to undertake the study which was completed in October 2010. IKEA Tempe opened in November 2011.

The study identified:

- Smith Street, South Street, Union Street and Wentworth Street have higher 85th percentile speeds compared to the other roads in the areas, ranging between 40 and 50 km/h on Thursdays and Saturdays, with 85th percentile speeds along Smith Street exceeding 50 km/h on Saturdays.
- One 'fixed object' crash occurred on Station Street near South Street.
- Speed humps on South Street and Union Street, median island rumble bars at Edwin Street, and the pedestrian crossing on Union Street outside Tempe Public School required repainting of line marking
    - It is important to note that the school crossing on Union Street was not a raised crossing as of 2010, and the nearby speed hump had since been replaced by a pair of kerb blisters with contrasting pavement.
    - The rumble bar at Edwin Street at Union Street had since been replaced by contrasting pavement
- Recommendation to introduce further LATM devices

The devices and measures implemented included:

- speed cushions on Smith Street
- the right turn ban from Princes Highway to Union Street
- the right turn ban from Gannon Street to Edwin Street
- the median island rumble strips at Edwin Street and Tramway Street
- closing the median gap at Station Street
- raised thresholds on Foreman Street, only at Unwins Bridge Road and Princes Highway

The speed cushions on Smith Street were eventually removed in 2012 and 2017 respectively, as a result of resident complaints about the noise produced by trucks driving over the speed cushions.

2.11 Existing LATM Devices & Measures

Existing LATM devices and traffic controls were identified during site audits, detailed in Section 5.1.

3. CRASH DATA ANALYSIS

3.1 Crash History Data

The NSW Speed Zoning Guidelines recommend a minimum of three years of crash data for a statistical crash analysis. For the purpose of this assessment, crash data between 1 January 2014 and 31 December 2018 was sourced from Council representing five (5) years of data. The data included reported crash events within the entire Inner West Council LGA and were filtered to include crashes within the study area. Crashes along Princes Highway within 15 metres from intersections of the study area roads were also included.

As per Rule 287 (3) of the NSW Road Rules 2014, crashes are only recorded if they are reported to police and when one of the following occurs:

- Any person is killed or injured
- Drivers involved in the crash do not exchange particulars
- When a vehicle involved in the crash is towed away.

The crash history between the five (5) years of data within and surrounding the study area were analysed, and a total of 12 crashes were recorded along streets within the study area. Out of the 12 crashes in the study area, two (2) involved vehicles at intersections with Princes Highway.

3.2 Crash Statistics

3.2.1 Crash History

Figure 3.1 shows the crash history between January 2014 and December 2018.

There is an overall trend of steady number of crashes per year, with less than 4 crashes happening each year. Most of the crashes involve an injury.

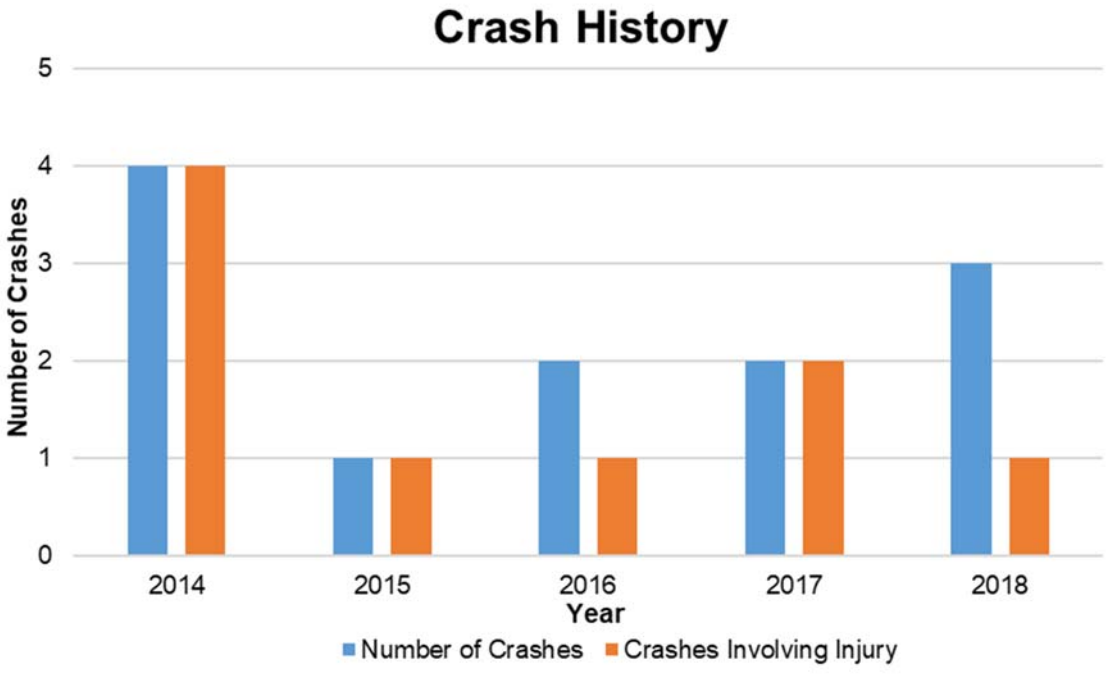


Figure 3.1: Crash History between January 2014 and December 2018

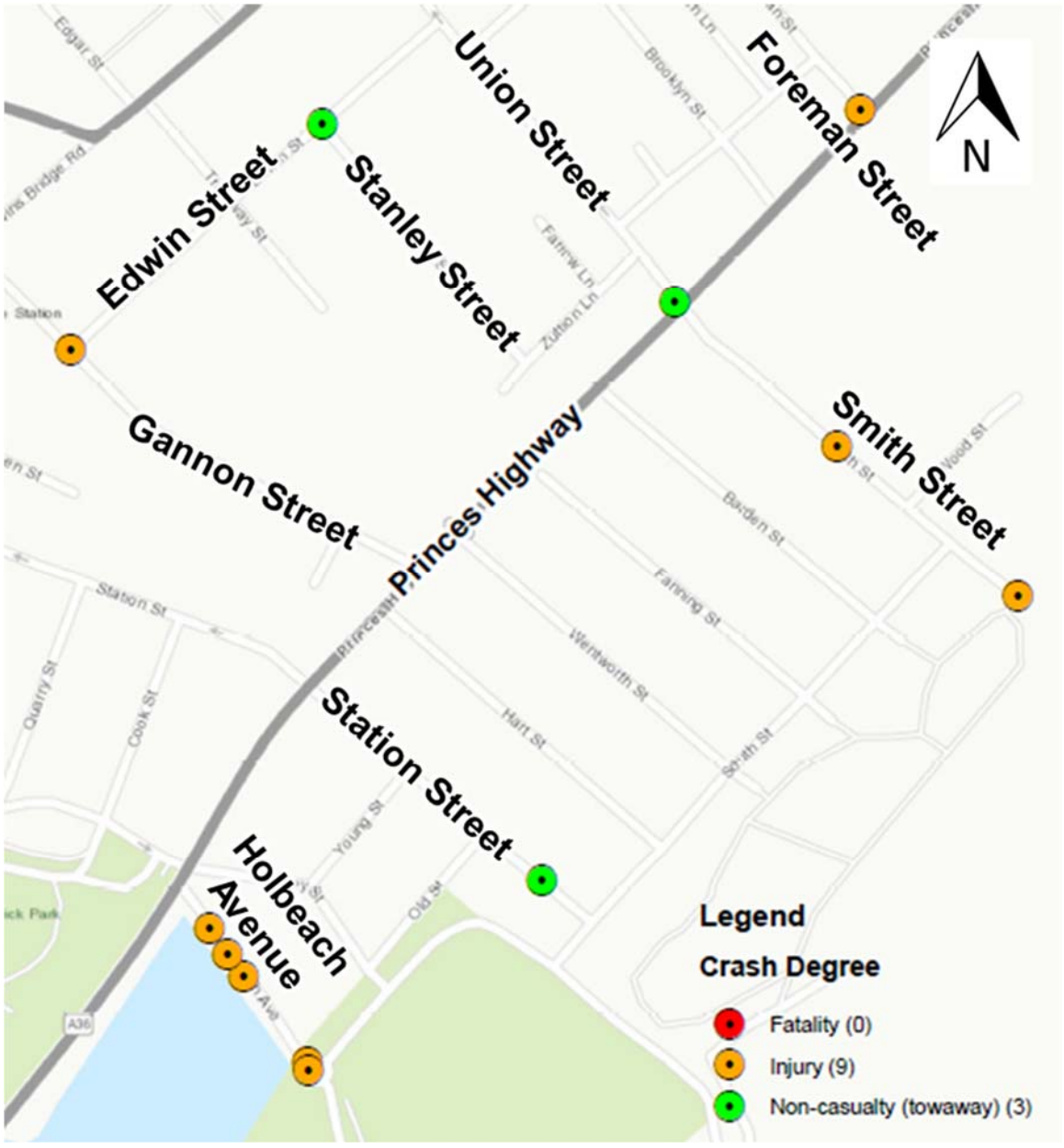
3.2.2 Crash Severity

Table 3.1 summarises the number of crashes within the 5 years of crash data based on crash severity.

Table 3.1: Number of Crashes Based on Crash Severity

Crash Severity	Number of Crashes	Percentage
Fatal	0	0%
▪ Injury	9	75%
Non-casualty (towaway)	3	25%
Total	12	100%

The crash data shows that the majority of crashes within the study area were not fatal but resulted in injury (75%). The locations of the crashes are shown in Figure 3.2. They are also shown in **Appendix A**.



Adapted from ESRI Maps

Figure 3.2: Crash Degree Severity

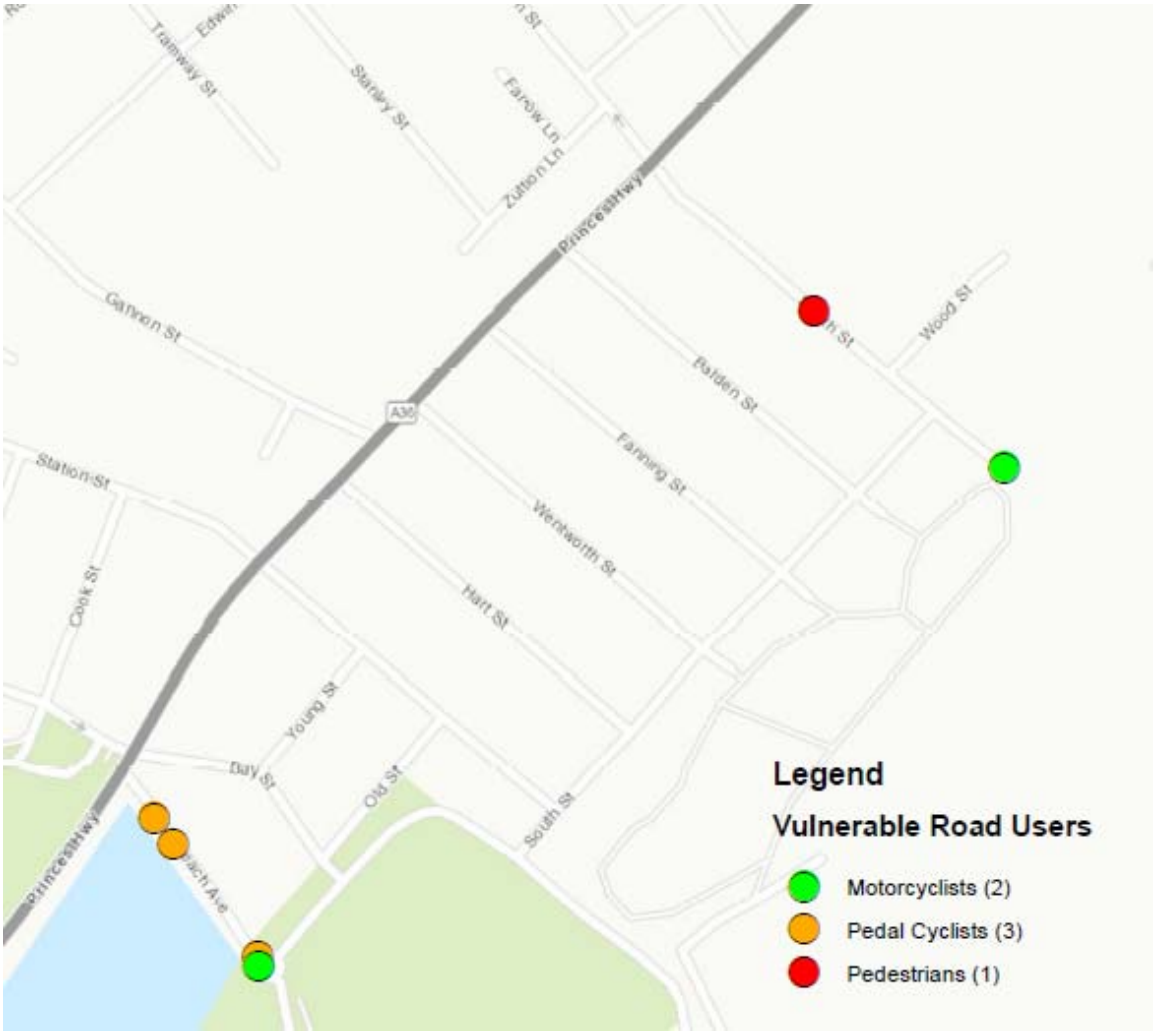
3.2.3 Vulnerable Road Users

Table 3.2 summarises the number of vulnerable road user (VRU) crashes within the 5 years of crash data based on crash severity. VRUs are classified into motorcyclists, pedal cyclists and pedestrians.

Table 3.2: Number of Vulnerable Road User Crashes Based on Crash Severity

Crash Severity	Vulnerable Road User			Total
	Motorcyclist	Pedal Cyclist	Pedestrian	
Fatal	0	0	0	0
▪ Injury	2	3	1	6
Non-casualty (towaway)	0	0	0	0
Total	2	3	1	6
Percentage	33%	50%	17%	-

The crash data shows that all crashes involving vulnerable road users were not fatal, however, resulted in an injury. There were six (6) vulnerable road user crashes out of the total of 12 crashes, which is a relatively high percentage (50%). Pedal cyclists were recorded to have the highest percentage of vulnerable road user crashes (50%). The location of crashes involving VRU are shown in Figure 3.3. They are also shown in **Appendix A**.



Adapted from ESRI Maps

Figure 3.3: Vulnerable Road Users

3.3 Analysis of Trends and Contributing Factors

3.3.1 Crash Type

The 12 crashes were classified into road user movement (RUM) codes, as shown in Table 3.3. The crashes are also further detailed in Table 3.4, ordered by crash severity.

Table 3.3: Crash Summary by Crash Type

Crash Type	RUM Codes	Number of Crashes	Percentage of Total
Crashes involving pedestrians	00 – 09	1	8
Crashes involving vehicles from adjacent directions	10 – 19	3	25%
Crashes involving vehicles from opposing directions	20 – 29	0	0%
▪ Crashes involving vehicles from the same direction	30 – 39	1	8%
Crashes involving manoeuvring vehicles	40 – 49	4	33%
Crashes involving vehicles overtaking	50 – 59	0	0%

Crash Type	RUM Codes	Number of Crashes	Percentage of Total
Crashes involving vehicles on path – vehicles hitting parked vehicles or objects on the roadway (e.g. animals, temporary objects)	60 – 69	0	0%
Crashes involving vehicles leaving the roadway on a straight length of road	70 – 79	2	17%
Crashes involving vehicles leaving the roadway on a curve	80 – 89	1	8%
Crashes involving vehicle passengers and miscellaneous crashes	90 – 99	0	0%
Total		10	100%

From Table 3.3, the majority of the crashes resulted from manoeuvring issues (33%).

Holbeach Avenue has the highest number of crashes, recording five (5) out of 12 crashes (42%). Out of the five crashes, three (3) crashes involved pedal cyclists (60%), and four (4) crashes resulted from manoeuvring issues (80%).

Considering this, this analysis will identify any trending issues and/or contributing factors that may have contributed to the likelihood of the aforementioned crash types.

Table 3.4: Crash Details by Road

Road	Crash Severity	Crash Type	Specific RUM Code	Vulnerable Road User
Holbeach Avenue	Injury	Involving manoeuvring vehicles	RUM 48: From footpath	Pedal Cyclist
Holbeach Avenue	Injury	Involving manoeuvring vehicles	RUM 47: Emerging from driveway	-
Holbeach Avenue	Injury	Involving manoeuvring vehicles	RUM 48: From footpath	Pedal Cyclist
Holbeach Avenue at South Street	Injury	Involving vehicles from adjacent directions	RUM 10: Cross traffic	Motorcyclist
Holbeach Avenue	Injury	Involving manoeuvring vehicles	RUM 49: Other Manoeuvring	Pedal Cyclist
Smith Street	Injury	Involving vehicles leaving the roadway on a straight length of road	RUM 74: Out of control on carriageway	Motorcyclist
Smith Street	Injury	Involving pedestrians	RUM 3: Playing, working, lying, standing on carriageway	Pedestrian
Princes Highway at Foreman Street	Injury	Involving vehicles from adjacent directions	RUM 13: Right near	-
Station Street	Non-casualty (towaway)	Involving vehicles leaving the roadway on a straight length of road	RUM 71: Left off carriageway into object / parked vehicle	-
Princes Highway at Smith Street	Non-casualty (towaway)	Involving vehicles from adjacent directions	RUM 10: Cross traffic	-
Edwin Street	Injury	Involving vehicles from the same direction	RUM 30: Rear end	-
Edwin Street at Stanley Street	Non-casualty (towaway)	Involving vehicles leaving the roadway on a curved length of road or when turning	RUM 85: Right off left bend into object / parked vehicle	-

3.3.2 Crash Casualty Rates

Typical casualty crash rates for urban and rural roads are provided within the NSW Speed Zoning Guidelines. A table of typical urban casualty rates from the NSW speed zoning guidelines is shown in Table 3.5.

Table 3.5: Typical Urban Casualty Rates

URBAN TYPICAL CASUALTY RATE *(casualties per km per year)*							
Road category	Speed zones						
	50	60	70	80	90	100	110
Motorway / freeway	–	–	0.049	0.039	0.463	0.148	1.219
State highway	0.014	0.450	0.827	0.217	0.177	0.101	0.177
Other classified road	0.102	1.351	1.361	0.360	0.253	0.111	0.007
Unclassified road	0.446	0.874	0.376	0.154	0.077	0.064	0.008

NOTE:
- Discretion is needed in comparing these rates to the rate on a particular section of road. A specific road section may not fall comfortably into any single category.
- The values do not suggest an acceptable level.

Source: Transport for NSW Centre for Road Safety - NSW Speed Zoning Guidelines (Section 3)

The typical urban casualty rate for a 50km/h unclassified road is 0.446 casualties per km per year.

Table 3.6 summarises the number of crashes per year and calculated casualty rate (casualties per year per km) for each section of road. Princes Highway was excluded as all other crashes along the road were not analysed. Station Street was also excluded as its only crash had no casualties.

Table 3.6: Crash Casualty Rate by Road

Road	Length (km)	Casualties						Rate	
		2014	2015	2016	2017	2018	Total	Per year	Per km per year
Holbeach Avenue (south of Princes Highway, between Princes Highway & roundabout)	0.15	3	1	0	1	0	5	1	6.7
Smith Street	0.30	0	0	0	1	1	2	0.4	1.3
Edwin Street	0.34	1	0	0	0	0	1	0.2	0.6
Total		4	1	0	2	1	8	-	-

From the crash casualty rate results calculated in Table 3.6, it can be seen that Holbeach Avenue, Smith Street and Edwin Street present a rate exceeding the typical urban casualty rate of 0.446 casualties per km per year.

3.4 Crash Data Analysis Summary

Based on the crash analysis results, the majority of the crashes resulted from manoeuvring issues. Most of them also involved a vulnerable road user. Holbeach Avenue has the highest number of crashes, the highest number of crashes involving vulnerable road users, and the highest crash casualty rate in the study area.

4. TRAFFIC SURVEY DATA ANALYSIS

4.1 Environmental Capacity and Speed Performance Standards

The *RTA Guide to Traffic Generating Developments 2002* (GTGD) provides justification for an acceptable environmental limit for each road classification, listed in Table 4.1.

Table 4.1: Environmental Capacity Performance Standards

Road Class	Type	Maximum Speed (km/h)	Max Peak Hour Volume (veh / hour)
Local	Access way	25	100
	Street	40	200 goal 300 maximum
Collector	Street	50	300 goal 500 maximum

The *GTGD* also recommends that a typical residential street should ideally exhibit a flow of traffic less than 2,000 vehicles per day (vpd), with a design objective of less than 1,500 vpd to maintain a comfortable traffic environment for local residents.

4.2 Traffic Surveys

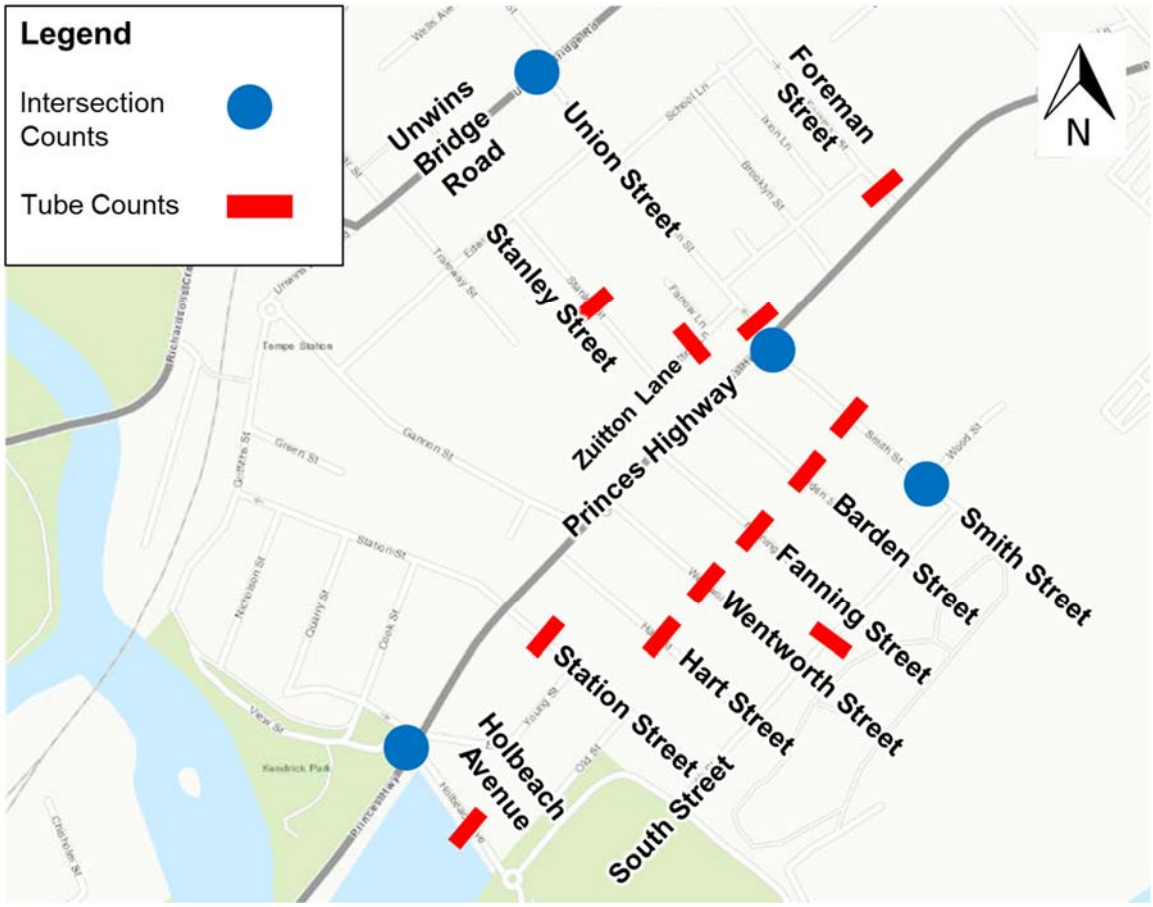
4.2.1 Data List

In March 2020, Council has commissioned Austraffic to undertake traffic surveys as part of the study and provided the surveys to Bitzios Consulting for analysis. In September 2020, Bitzios Consulting commissioned Matrix Data Collection to undertake further traffic survey for analysis. The traffic surveys undertaken are listed in Table 4.2. The data collected were analysed to provide information about traffic operation in the study area, such as volumes and speed.

Table 4.2: Traffic Survey Data

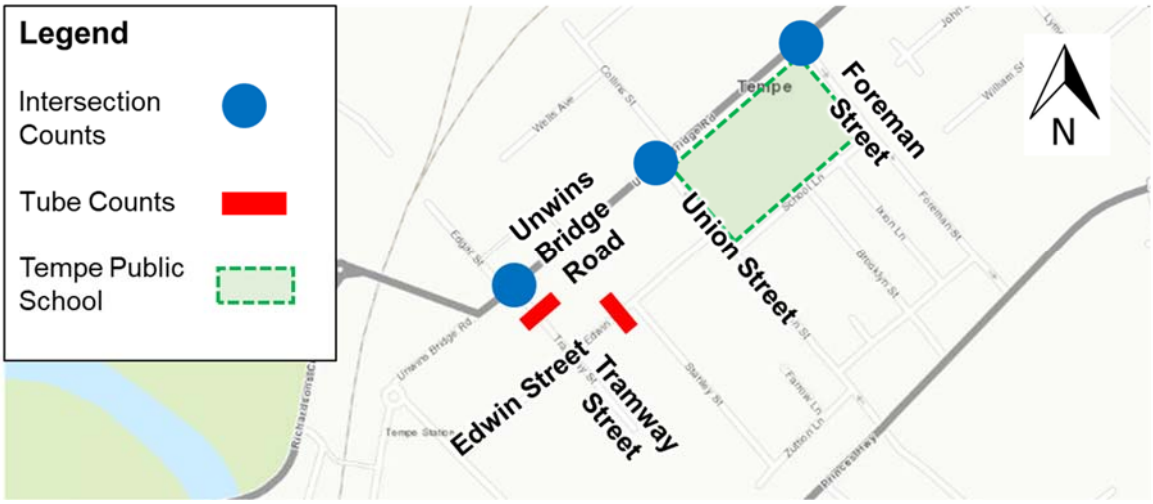
Survey	Date(s)	Time	Locations
Intersection Counts	19 March 2020, Thursday	16:00 PM to 18:00 PM	At four locations, shown in Figure 4.1: ▪ Princes Highway / Union Street / Smith Street ▪ Smith Street / Wood Street ▪ Unwins Bridge Road / Union Street ▪ Princes Highway / Holbeach Avenue
	21 March 2020, Saturday	11:00 AM to 13:00 PM	
	8 September 2020, Tuesday	7:30 AM to 9:30 AM 14:00 PM to 16:00 PM	At three locations, shown in Figure 4.2: ▪ Unwins Bridge Road / Union Street ▪ Unwins Bridge Road / Foreman Street ▪ Unwins Bridge Road / Tramway Street
Tube Counts (Volumes & Speed)	19 March 2020, Thursday to 25 March 2020, Wednesday	24-hour	At multiple locations shown in Figure 4.1
	9 September 2020, Wednesday to 15 September 2020, Tuesday	24-hour	At Edwin Street and Tramway Street, shown in Figure 4.2

Survey	Date(s)	Time	Locations
Parking Occupancy & Duration	19 March 2020, Thursday	7:00 AM to 7:00 PM	At locations shown in Figure 4.3
	21 March 2020, Saturday	7:00 AM to 7:00 PM	



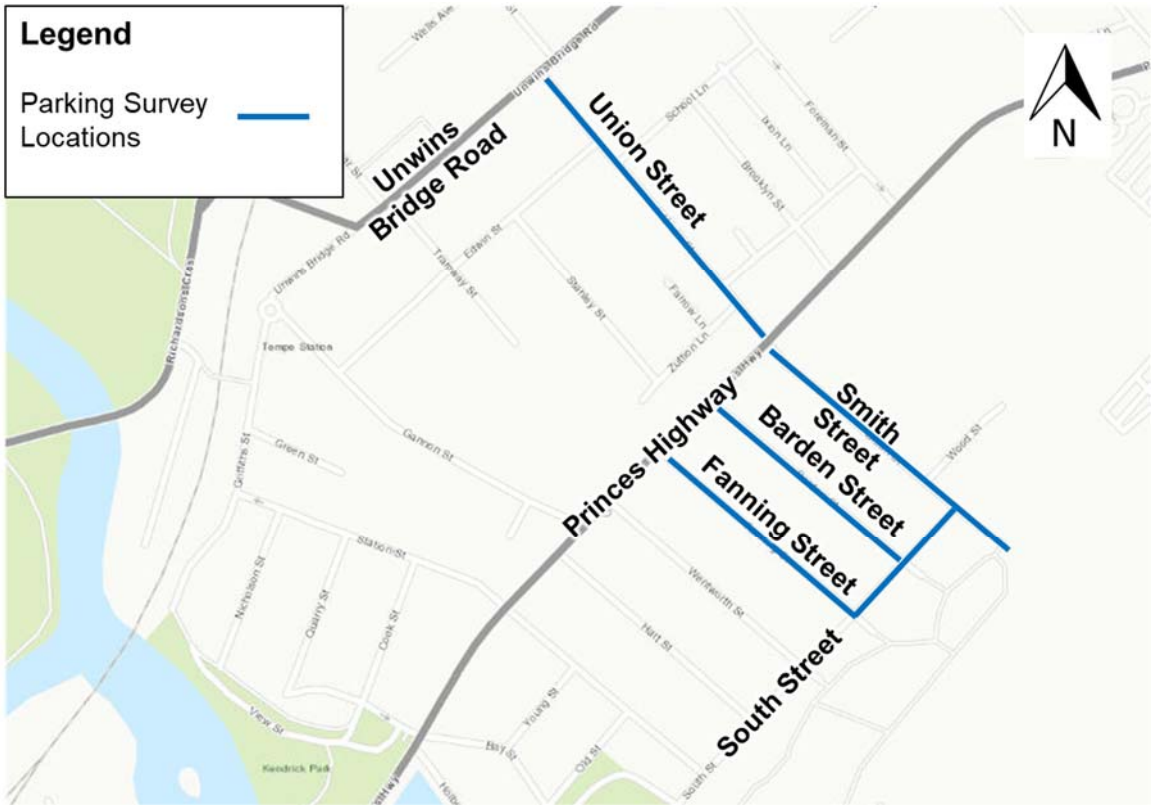
Adapted from ESRI Maps

Figure 4.1: Intersection Count & Tube Count Locations (March 2020)



Adapted from ESRI Maps

Figure 4.2: Intersection Count & Tube Count Locations (September 2020)



Adapted from ESRI Maps

Figure 4.3: Parking Surveys Locations

It is important to note that the surveys in March were undertaken shortly after the start of the COVID-19 pandemic in New South Wales, when limits to gatherings have started to be imposed. The surveys in September were also undertaken in the midst of the COVID-19 pandemic. As such, some workers would be working from home during the survey dates. Therefore, the surveys may not accurately reflect the usual traffic operation or parking condition before the pandemic. Schools were not closed and were operating as usual on both surveys.

Despite the potential inaccuracies in the data, Council made the decision to proceed with the LATM study with these volumes. This is acceptable as no traffic modelling is involved and hence volumes do not have to be accurate. **Any traffic volumes obtained are to be compared relative to other streets in the study area.** Streets with relatively higher volumes or heavy vehicle compositions than other streets would be identified as a potential location for LATM devices. This will likely be the same using pre-COVID or post-COVID traffic data. Vehicular speed is a representative of driver behaviour which is not influenced by changes in traffic volumes.

A comparison of the intersection counts data to previous traffic assessments or surveys are shown in Table 4.3.

4.2.2 Intersection Counts

In March 2020, intersection count surveys were undertaken on a Thursday afternoon and Saturday weekday, for the four intersections listed in Table 4.2. The peak hour intersection counts for the intersections for the Thursday and Saturday are shown in Figure 4.4 and Figure 4.5. It is important to note that there is a No Right Turn restriction from Princes Highway (southwest bound) to Union Street.

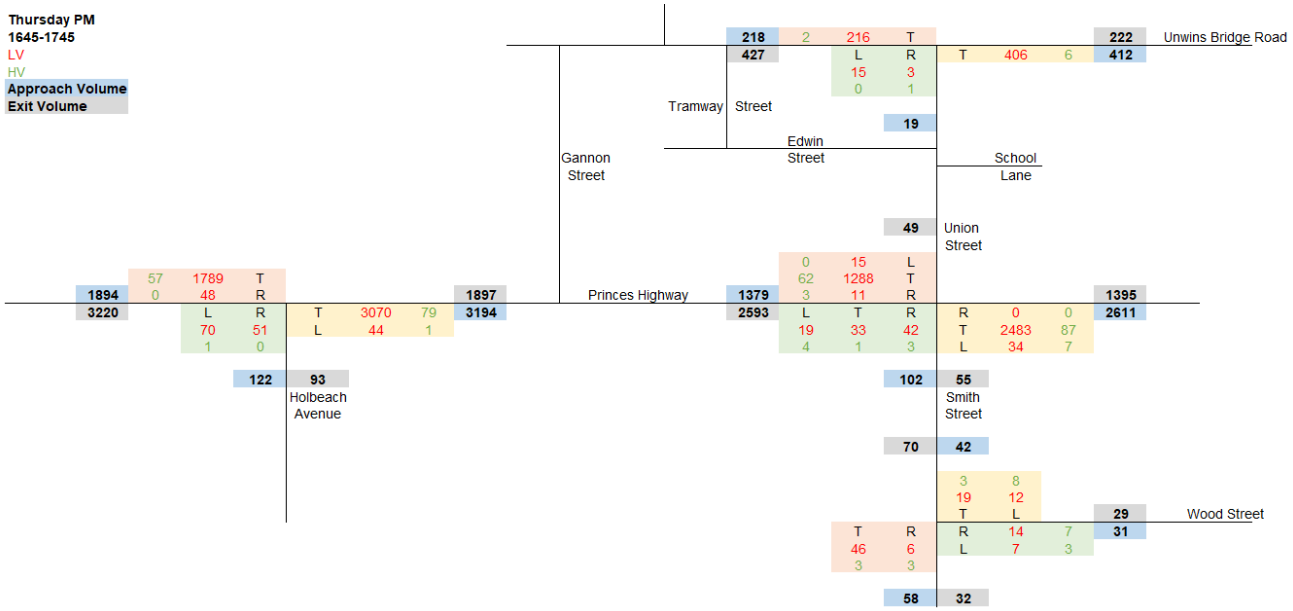


Figure 4.4: Thursday PM Peak Hour Intersection Counts (March 2020)

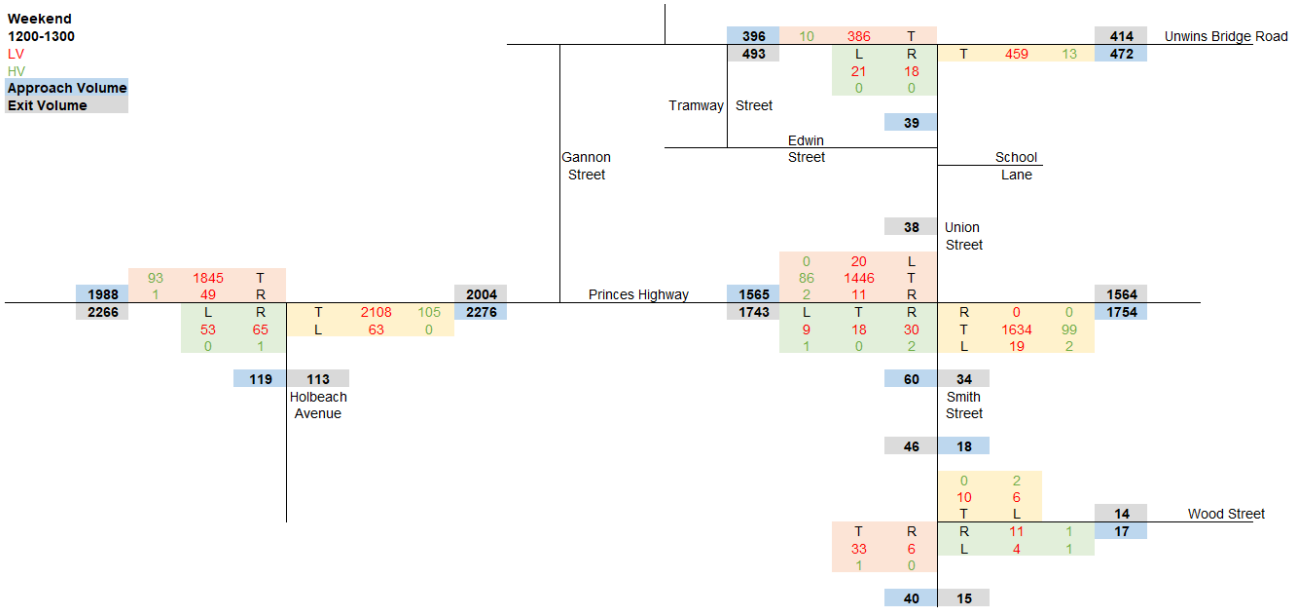


Figure 4.5: Saturday Peak Hour Intersection Counts (March 2020)

In September 2020, further intersection count surveys were undertaken on a Tuesday morning and afternoon, for the three intersections listed in Table 4.2. The surveys were undertaken to understand the traffic operations surrounding Tempe Public School before and after school hours. The peak hour intersection counts for the intersections for the Thursday and Saturday are shown in Figure 4.6 and Figure 4.7. It is important to note that there is a No Right Turn restriction from Unwins Bridge Road (eastbound) to Foreman Street, and a peak-hour only No Right Turn restriction from Unwins Bridge Road (eastbound) to Tramway Street.

It can be seen that the major vehicular routes are along Princes Highway and along Unwins Bridge Road for the Thursday and Saturday. This is expected as Princes Highway and Unwins Bridge Road are state and regional roads respectively.

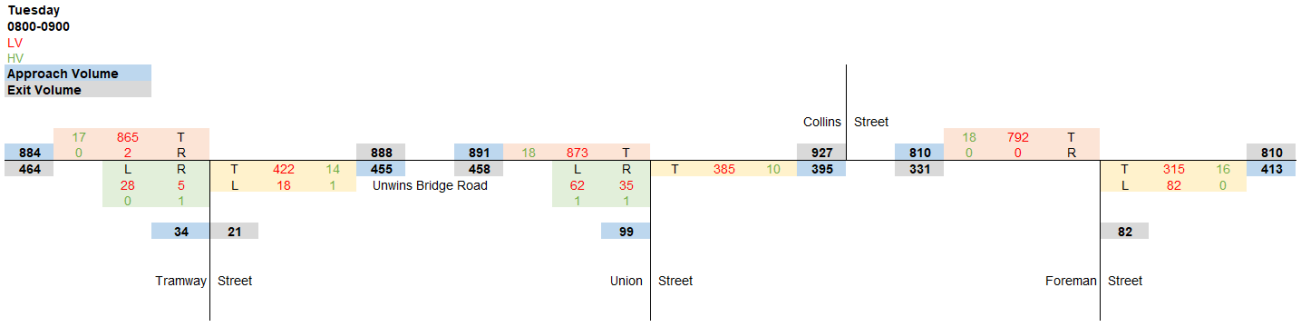


Figure 4.6: Tuesday AM Peak Hour Intersection Counts (September 2020)

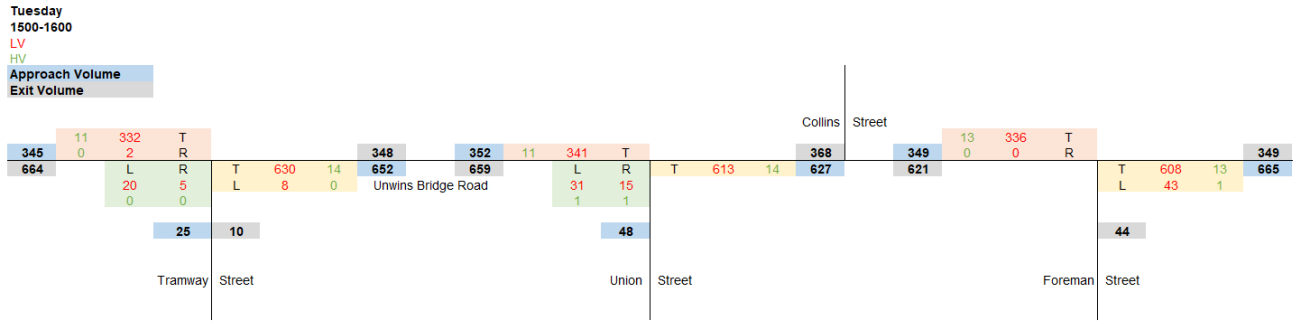


Figure 4.7: Tuesday PM Peak Hour Intersection Counts (September 2020)

As for heavy vehicular movement, due to the truck load limits in the Tempe area (see Section 2.9), heavy vehicles are only found along roads without any truck load limit, such as Princes Highway, Smith Street, Wood Street and Unwins Bridge Road. With the exception of Princes Highway, the number of heavy vehicles is not high, with at most 15 heavy vehicles per hour.

There are occasional heavy vehicles turning in and out of Holbeach Avenue and Union Street but the numbers are very low (less than 2 per movement). This shows that the existing truck load limit is well implemented and is effective in the Tempe area.

The existing No Right Turn restriction from Princes Highway to Union Street, introduced as part of the previous LATM study (Section 2.10), has also proven effective, with no vehicles observed to be turning right into Union Street.

From the intersection counts, less than 50 vehicles per hour use Union Street. However, tube count surveys will provide a better understanding on the utilisation of Union Street.

4.2.2.1 Comparison with pre-COVID data

A comparison of the intersection count data with previous traffic assessments and surveys in the area is shown in Table 4.3.

Table 4.3: Comparison of traffic volumes with pre-COVID surveys (Union Street / Smith Street / Princes Highway)

Traffic Assessment / Data	Survey Date(s)	Smith Street		Union Street
		Southbound volumes	Northbound volumes	Northbound volumes
Thursday PM				
TTPA Bunnings TIA	2017 or before (exact date unknown)	47	133	37

Traffic Assessment / Data	Survey Date(s)	Smith Street		Union Street
		Southbound volumes	Northbound volumes	Northbound volumes
GTA peer review of the TIA	6 December 2018	46	131	72
This LATM study	19 March 2020	55	102	49
Saturday midday				
TTPA Bunnings TIA	2017 or before (exact date unknown)	33	50	22
GTA peer review of the TIA	8 December 2018	58	85	81
This LATM study	21 March 2020	34	60	38

The intersection counts are consistent with counts undertaken by Transport and Traffic Planning Associates (TTPA) as part of the Traffic Impact Assessment (TIA) for the Bunnings Development (published October 2017) (see Section 6.2 for details of the development). However, they are lower than the counts undertaken by GTA Consultant for their peer review of the TIA (published January 2019), particularly for vehicles entering Union Street.

4.2.3 Tube Counts

24-hour tube counts were collected for seven days for all the study area roads. Information such as volumes, heavy vehicle composition, and speed data were recorded for both directions of the road.

From the data, the average daily traffic (ADT) volumes, the 85th percentile speeds, and daily heavy vehicle percentage and volumes were extracted for all directions of the locations, shown in Table 4.4. The directions stated were the directions on surveys. Relatively higher values are highlighted orange.

Table 4.4: Tube Count Data Summary

Street	Location	Direction	ADT Volumes	85th Percentile Speed (km/h)	Heavy Vehicle Composition	
					%	Volumes
Barden Street	Between Princes Highway & South Street	EB	71	30.5	4.9%	3
		WB	74	32.8	8.2%	6
Fanning Street	Between Princes Highway & South Street	EB	108	35.5	6.7%	7
		WB	112	34.4	4.3%	5
Foreman Street	Between Princes Highway and Brooklyn Lane	EB	261	34.1	5.7%	15
Hart Street	Between Princes Highway & South Street	EB	273	30.3	3.0%	8
		WB	63	30.4	9.5%	6
Holbeach Avenue	Between Princes Highway & Roundabout	NB	505	44.1	8.9%	45
		SB	551	40.9	4.9%	27
Smith Street	Between Princes Highway & Wood Street	EB	320	46.5	36.0%	115
		WB	604	38.8	25.0%	151
		NB	510	28.3	6.0%	31

South Street	Between Smith Street & Station Street	SB	182	30	25.0%	46
Stanley Street	Between Edwin Street & Zuitton Lane	EB	164	45.5	7.7%	13
		WB	120	41.9	7.8%	9
Station Street	Between Princes Highway & Young Street	EB	85	30.6	3.7%	3
		WB	20	31.7	7.0%	1
Union Street	Between Princes Highway & Zuitton Lane	WB	487	26.9	3.4%	17
Wentworth Street	Between Princes Highway & South Street	EB	72	32.1	6.7%	5
		WB	151	36.1	6.7%	10
Zuitton Lane	Between Union Street & Stanley Street	NB	123	22	5.6%	7
		SB	82	19.9	2.8%	2
Edwin Street	Between Stanley Street & Tramway Street	EB	290	31.1	6.9%	20
		WB	439	38.1	1.8%	8
Tramway Street	Between Unwins Bridge Road & Edwin Street	NB	253	19	2.8%	7
		SB	318	23.6	1.9%	6

Maps showing the values of ADT, 85th percentile speeds, and heavy vehicle percentage and volumes are shown in **Appendix B**.

4.2.3.1 Traffic Volumes

All local streets in the study area have a VPD of less than 1,500, the comfortable limit for a local residential traffic environment as according to *GTGD*. Moderately high volumes of more than 500 vpd can be observed on Smith Street, South Street and Holbeach Avenue. Union Street and Edwin Street have volumes of between 400 to 500 vehicles. This is expected for Union Street as it is one of the more direct routes between Princes Highway and Unwins Bridge Road

4.2.3.2 85th Percentile Speeds

All local streets in the study area have an 85th percentile speed of less than the posted speed limit of 50 km/h. Most recorded 85th percentile speeds are less than 40 km/h, with Holbeach Avenue, Stanley Street and Smith Street having speeds between 40 and 50 km/h. It is important to note that on these roads, LATM devices aimed at reducing speeds and narrowing road widths are not present.

4.2.3.3 Heavy Vehicle Composition

Many of the streets in the study area with the 3-tonne truck load limit have heavy vehicle volumes of 10 or less. However, roads such as Stanley Street, Union Street, Foreman Street, Wentworth Street and Edwin Street have volumes of around 10 to 20 heavy vehicles per day.

Roads without the truck load limit have relatively higher heavy vehicle volumes per day, such as Holbeach Avenue, South Street and Smith Street. In particular, Smith Street has heavy vehicle volumes of more than 100 per day in each direction, justified by the commercial and industrial land use along Smith Street and Wood Street.

In terms of heavy vehicle percentages, most of the roads have a heavy vehicle percentage of more than 5%. In particular, Smith Street and South Street have relatively higher heavy vehicle percentages.

4.2.4 Parking Occupancy & Duration

Parking occupancy and duration surveys were undertaken on a Thursday and a Saturday in March 2020. The surveys were conducted in hourly periods between 7:00 AM to 7:00 PM. Roads surveyed are highlighted in Figure 4.3.

The surveys recorded a total of 291 spaces on the roads surveyed. 57% of these spaces were occupied on the Thursday while 54% of the spaces were occupied on the Saturday.

The parking occupancies by time of day and parking durations for the Thursday and Saturday are summarised in Table 4.5 to Table 4.8.

Table 4.5: Thursday Parking Occupancy Rate by Hourly Period

Road	Side	Section	Restriction	Parking Capacity	0700-0800	0800-0900	0900-1000	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1500-1600	1600-1700	1700-1800	1800-1900	Average
Fanning Street	West	Entire Section	Unrestricted	34	59%	47%	44%	47%	47%	41%	50%	44%	47%	59%	62%	59%	50%
	East	Entire Section	Unrestricted	29	76%	72%	76%	69%	69%	76%	72%	69%	76%	72%	76%	90%	74%
Barden Street	West	Entire Section	Unrestricted	30	50%	50%	53%	60%	50%	40%	43%	50%	53%	60%	63%	47%	52%
	East	Entire Section	Unrestricted	33	52%	42%	45%	48%	45%	45%	45%	58%	58%	45%	48%	52%	49%
South Street	North	Between Fanning St & Barden St	Unrestricted	9	44%	22%	33%	33%	33%	33%	56%	33%	44%	44%	44%	33%	38%
		Between Barden St & Smith St	Unrestricted	10	40%	40%	40%	40%	40%	40%	40%	40%	50%	50%	50%	70%	45%
	South	Entire Section	Unrestricted	16	0%	0%	0%	6%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Smith Street	West	Between Princes Hwy & South St	Unrestricted	31	61%	65%	74%	81%	77%	77%	84%	77%	87%	81%	77%	61%	75%
		Between South St & cul-de-sac	No Parking	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Road	Side	Section	Restriction	Parking Capacity	0700-0800	0800-0900	0900-1000	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1500-1600	1600-1700	1700-1800	1800-1900	Average
	Cul-de-sac	-	No Parking	0	0%	0%	0%	0%	0%	0%	0%	100 %	0%	100 %	300%[2]	0%	100%[2]
	East	Between cul-de-sac & Wood St	Unrestricted	3	33%	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100%	0%	86%
		Between Wood St & Princes Hwy	Unrestricted	27	59%	59%	63%	63%	63%	63%	70%	67%	63%	67%	63%	56%	63%
Union Street	East	Between Princes Hwy & Brooklyn Ln	No Parking	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		Between Brooklyn Ln & School Ln	Unrestricted	7	86%	43%	71%	71%	57%	71%	57%	71%	57%	71%	71%	71%	67%
			PWD	1	100%	100 %	100 %	100 %	100 %	100 %	0%	0%	0%	0%	0%	100 %	58%
			Unrestricted	15	80%	80%	67%	67%	73%	67%	87%	80%	67%	80%	80%	80%	76%
			No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		Between School Ln & Unwins Bridge Rd	No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			Unrestricted	8	0%	25%	25%	25%	25%	25%	25%	25%	25%	25%	12%	12%	21%

Road	Side	Section	Restriction	Parking Capacity	0700-0800	0800-0900	0900-1000	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1500-1600	1600-1700	1700-1800	1800-1900	Average
	West	Between Unwins Bridge Rd & Edwin St	No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			No Parking	0	0%	0%	100 %	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%[2]
			Unrestricted	7	86%	86%	86%	86%	86%	86%	86%	100 %	100 %	86%	71%	100 %	88%
			No Stopping	0	0%	0%	0%	0%	100 %	100 %	0%	0%	0%	0%	0%	0%	100%[2]
		Between Edwin St & Zuitton Ln	No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			Unrestricted	27	78%	63%	52%	56%	59%	56%	56%	59%	59%	59%	67%	56%	60%
		Between Zuitton Ln & Princes Hwy	No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			1P[1]	4	75%	75%	75%	75%	75%	75%	25%	50%	50%	75%	50%	25%	60%
			No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total				291	57%	53%	55%	57%	55%	54%	56%	57%	58%	60%	61%	56%	57%

Notes:
1. 1P restriction during 8:30 AM - 6:00 PM Mon-Fri
2. A percentage of 100% for a No Stopping or No Parking restriction means there is a vehicle that is illegally stopping or parked. A percentage of 300% means there are three (3) vehicles that are illegally stopping or parked

Table 4.6: Saturday Parking Occupancy Rate by Hourly Period

Road	Side	Section	Restriction	Parking Capacity	0700-0800	0800-0900	0900-1000	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1500-1600	1600-1700	1700-1800	1800-1900	Average
Fanning Street	West	Entire Section	Unrestricted	34	50%	50%	41%	44%	41%	53%	62%	56%	59%	56%	50%	59%	52%
	East	Entire Section	Unrestricted	29	90%	93%	97%	93%	93%	90%	100%	83%	72%	69%	86%	90%	88%
Barden Street	West	Entire Section	Unrestricted	30	60%	53%	57%	50%	47%	57%	53%	53%	50%	47%	50%	40%	51%
	East	Entire Section	Unrestricted	33	61%	55%	42%	48%	45%	55%	55%	55%	55%	48%	55%	61%	53%
South Street	North	Between Fanning St & Barden St	Unrestricted	9	33%	22%	22%	33%	33%	33%	67%	67%	78%	67%	67%	67%	49%
		Between Barden St & Smith St	Unrestricted	10	50%	60%	50%	40%	50%	40%	40%	40%	40%	30%	40%	30%	43%
	South	Entire Section	Unrestricted	16	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	6%	6%	1%
Smith Street	West	Between Princes Hwy & South St	Unrestricted	31	71%	61%	65%	55%	61%	68%	71%	71%	71%	65%	68%	65%	66%
		Between South St & cul-de-sac	No Parking	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Road	Side	Section	Restriction	Parking Capacity	0700-0800	0800-0900	0900-1000	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1500-1600	1600-1700	1700-1800	1800-1900	Average
	Cul-de-sac	-	No Parking	0	0%	0%	0%	0%	0%	0%	0%	0%	100 %	100 %	0%	0%	100%[2]
	East	Between cul-de-sac & Wood St	Unrestricted	3	0%	0%	0%	33%	0%	0%	0%	0%	33%	33%	33%	33%	14%
		Between Wood St & Princes Hwy	Unrestricted	27	48%	48%	48%	44%	48%	41%	52%	52%	56%	59%	52%	56%	50%
Union Street	East	Between Princes Hwy & Brooklyn Ln	No Parking	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		Between Brooklyn Ln & School Ln	Unrestricted	7	71%	57%	71%	71%	43%	43%	71%	71%	71%	71%	71%	71%	65%
			PWD	1	100%	100 %	100 %	100 %	100 %	0%	0%	0%	0%	100 %	100%	100 %	67%
			Unrestricted	15	80%	80%	73%	80%	73%	53%	60%	80%	80%	80%	93%	73%	76%
			No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		Between School Ln & Unwins Bridge Rd	No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			Unrestricted	8	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	12%	1%

Road	Side	Section	Restriction	Parking Capacity	0700-0800	0800-0900	0900-1000	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1500-1600	1600-1700	1700-1800	1800-1900	Average
	West	Between Unwins Bridge Rd & Edwin St	No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			No Parking	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			Unrestricted	7	71%	71%	71%	71%	57%	43%	43%	71%	86%	86%	71%	0%	62%
			No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		Between Edwin St & Zuitton Ln	No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			Unrestricted	27	67%	67%	56%	52%	70%	59%	48%	44%	52%	48%	56%	59%	56%
		Between Zuitton Ln & Princes Hwy	No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			1P[1]	4	75%	75%	75%	50%	50%	75%	50%	50%	25%	25%	75%	75%	58%
			No Stopping	0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total				291	58%	55%	53%	51%	52%	52%	56%	55%	56%	53%	57%	55%	54%

Notes:
1. 1P restriction during 8:30 AM-12:30 PM Sat
2. A percentage of 100% for a No Stopping or No Parking restriction means there are cars that are illegally stopping or parked.

Table 4.7: Thursday Parking Duration Proportions

Road	Side	Section	Restriction	Total Vehicles	Parking Duration											
					1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	9 hours	10 hours	11 hours	12 hours
Fanning Street	West	Entire Section	Unrestricted	47	26%	15%	19%	6%	4%	2%	11%	0%	2%	2%	2%	11%
	East	Entire Section	Unrestricted	51	25%	14%	12%	4%	6%	4%	8%	2%	2%	10%	0%	14%
Barden Street	West	Entire Section	Unrestricted	43	23%	28%	9%	7%	7%	5%	0%	0%	2%	2%	5%	12%
	East	Entire Section	Unrestricted	40	30%	15%	5%	10%	10%	0%	3%	3%	5%	0%	5%	15%
South Street	North	Between Fanning St & Barden St	Unrestricted	9	44%	11%	0%	11%	0%	0%	11%	0%	0%	0%	0%	22%
		Between Barden St & Smith St	Unrestricted	8	38%	0%	0%	13%	0%	0%	0%	0%	0%	0%	13%	38%
	South	Entire Section	Unrestricted	1	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Smith Street	West	Between Princes Hwy & South St	Unrestricted	42	19%	12%	5%	5%	2%	5%	5%	5%	7%	5%	5%	26%
		Between South St & cul-de-sac	No Parking	0	-	-	-	-	-	-	-	-	-	-	-	-
	Cul-de-sac	-	No Parking	4	75%	25%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	East	Between cul-de-sac & Wood St	Unrestricted	3	0%	0%	0%	0%	0%	0%	0%	0%	0%	67%	33%	0%
		Between Wood St & Princes Hwy	Unrestricted	29	17%	14%	3%	3%	0%	7%	3%	3%	10%	3%	0%	34%

Road	Side	Section	Restriction	Total Vehicles	Parking Duration											
					1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	9 hours	10 hours	11 hours	12 hours
Union Street	East	Between Princes Hwy & Brooklyn Ln	No Parking	0	-	-	-	-	-	-	-	-	-	-	-	-
		Between Brooklyn Ln & School Ln	Unrestricted	14	43%	7%	14%	7%	0%	0%	0%	7%	14%	0%	0%	7%
			PWD	2	50%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%
			Unrestricted	30	20%	30%	13%	3%	3%	7%	0%	0%	3%	3%	0%	17%
			No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
		Between School Ln & Unwins Bridge Rd	No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
			Unrestricted	2	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	50%	0%
	West	Between Unwins Bridge Rd & Edwin St	No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
			No Parking	1	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			Unrestricted	12	42%	0%	0%	0%	0%	17%	0%	0%	8%	0%	0%	33%
			No Stopping	1	0%	100 %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		Between Edwin St & Zuitton Ln	No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
			Unrestricted	38	34%	16%	5%	0%	5%	3%	8%	3%	0%	3%	0%	24%

Road	Side	Section	Restriction	Total Vehicles	Parking Duration											
					1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	9 hours	10 hours	11 hours	12 hours
Union Street		Between Zuitton Ln & Princes Hwy	No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
			1P[1]	9	44%	11%	11%	11%	11%	0%	0%	0%	0%	0%	11%	0%
			No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
Total				386	28%	16%	9%	5%	4%	4%	4%	2%	4%	4%	3%	18%

Notes:
1. 1P restriction during 8:30 AM - 6:00 PM Mon-Fri

Table 4.8: Saturday Parking Duration Proportions

Road	Side	Section	Restriction	Total Vehicles	Parking Duration											
					1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	9 hr	10 hr	11 hr	12 hr
Fanning Street	West	Entire Section	Unrestricted	52	37%	13%	15%	4%	6%	4%	0%	2%	4%	2%	2%	12%
	East	Entire Section	Unrestricted	60	25%	17%	10%	3%	7%	7%	2%	3%	7%	2%	0%	18%
Barden Street	West	Entire Section	Unrestricted	40	23%	13%	13%	8%	13%	10%	5%	3%	3%	0%	3%	10%
	East	Entire Section	Unrestricted	45	29%	16%	7%	11%	9%	4%	4%	0%	0%	0%	2%	18%
South Street	North	Between Fanning St & Barden St	Unrestricted	9	22%	11%	0%	11%	0%	22%	0%	0%	11%	0%	0%	22%
		Between Barden St & Smith St	Unrestricted	10	30%	10%	20%	0%	0%	0%	0%	20%	0%	0%	0%	20%
	South	Entire Section	Unrestricted	1	0%	100 %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Smith Street	West	Between Princes Hwy & South St	Unrestricted	39	18%	13%	10%	5%	5%	3%	8%	5%	0%	0%	3%	31%
		Between South St & cul-de-sac	No Parking	0	-	-	-	-	-	-	-	-	-	-	-	-
	Cul-de-sac	-	No Parking	2	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	East	Between cul-de-sac & Wood St	Unrestricted	2	50%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%
		Between Wood St & Princes Hwy	Unrestricted	32	22%	6%	13%	13%	16%	6%	3%	3%	0%	0%	0%	19%

Road	Side	Section	Restriction	Total Vehicles	Parking Duration											
					1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	9 hr	10 hr	11 hr	12 hr
Union Street	East	Between Princes Hwy & Brooklyn Ln	No Parking	0	-	-	-	-	-	-	-	-	-	-	-	-
		Between Brooklyn Ln & School Ln	Unrestricted	9	11%	0%	0%	22%	22%	22%	0%	0%	0%	0%	0%	22%
			PWD	2	0%	0%	50%	0%	50%	0%	0%	0%	0%	0%	0%	0%
			Unrestricted	29	24%	10%	10%	14%	17%	3%	0%	0%	3%	3%	0%	14%
			No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
		Between School Ln & Unwins Bridge Rd	No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
			Unrestricted	1	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	West	Between Unwins Bridge Rd & Edwin St	No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
			No Parking	0	-	-	-	-	-	-	-	-	-	-	-	-
			Unrestricted	8	0%	13%	0%	38%	13%	0%	0%	0%	0%	0%	38%	0%
			No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
		Between Edwin St & Zuitton Ln	No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
			Unrestricted	46	35%	22%	4%	9%	4%	7%	2%	2%	0%	2%	0%	13%

Road	Side	Section	Restriction	Total Vehicles	Parking Duration											
					1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	9 hr	10 hr	11 hr	12 hr
Union Street		Between Zuitton Ln & Princes Hwy	No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
			1P[1]	6	17%	33%	17%	0%	0%	0%	0%	17%	0%	0%	0%	17%
			No Stopping	0	-	-	-	-	-	-	-	-	-	-	-	-
Total				393	26%	14%	10%	8%	9%	6%	3%	3%	2%	1%	2%	16%

Notes:
1. 1P restriction during 8:30 AM-12:30 PM Sat

A map showing the average parking occupancy rates is provided in **Appendix B**.

4.2.4.1 Parking Data Summary

The parking occupancy data shows that

- Out of the 291 spaces, about 50 to 60% of the spaces are occupied at any one time on both days.
- There are little differences in parking occupancy between Thursday and Saturday, except for Smith Street.
- For Smith Street, the occupancy rate is higher on the Thursday and lower on Saturday.
    - The occupancy rates for the section of Smith Street southeast of South Street (up to the cul-de-sac) are significantly different between Thursday and Saturday. This is because of the low number of spaces resulting in high fluctuations of occupancy rates.
- For Fanning Street the occupancy rate on the eastern side is higher than the western side on both days, with occupancy rates of 74% and 88% on Thursday and Saturday respectively.
- On the Thursday, there are occasional vehicles parking or stopped at each section with No Stopping or No Parking restrictions. These restrictions are along Smith Street and Union Street.
- The southern side of South Street is rarely occupied, which is consistent with site observations and Street View. This is due to the narrow width of South Street which is only wide enough for a parking lane and a trafficable lane.
- All other roads have parked vehicles on both sides of the road, if allowed
- Parking occupancy is relatively higher on Union Street near the school on Thursdays, with the western and eastern sides having occupancy rates of 88% and 76% respectively.
- The parking duration data shows that:
- Almost 400 vehicles parked during the surveyed time period.
- On both Thursday and Saturday:
    - about 27% of all users park less than an hour
    - about 15% park less than 2 hours
    - about 17% of users park for at least 12 hours, i.e. potentially residents

The parking occupancy and duration data will be considered when determining locations and suitability of LATM devices. This data also sets a base line for the parking demand in the study area. This can be used for a comparative study to identify changes in parking demand after any new developments have been built.

An assessment of the Smith Street on-street parking availability considering changes to Smith Street as a result of the proposed Bunnings development is detailed in Section 6.2.

5. SITE INSPECTIONS

5.1 Site Audits

A site inspection and audit within the study area was undertaken, on Wednesday 4 March 2020, to gain an understanding of the current conditions of the streets within the study area (including parking behaviour), and identify existing LATM devices and traffic control infrastructure. Details on traffic and parking signage were also recorded.

The site audit covered the following traffic items and are detailed in the sections below:

- LATM Devices
- Traffic Signs
- Parking Signs
- Bicycle Facilities
- Pedestrian Facilities
- Waste Management/Collection Issues

The signage audit included the following items:

- Type of Sign (and relevant codes) or device
- Direction of sign control
- Restrictions and times of operation
- Condition
- Location (GPS co-ordinates)
- Applicable direction of traffic

Bicycle and Pedestrian Facilities

- Cycle related signage / road markings and their location
- Wayfinding signage and their location
- Kerb ramps and crossings

Waste Management

- Evidence of issues with road geometry or surfaces that can affect waste collection

A database of the audit findings was developed including photographs of signs and infrastructure, located in **Appendix C**.

5.1.1 LATM Audit

An audit of existing LATM devices within the study area was conducted, covering the following aspects:

- LATM type
- Location (including road name)
- Line marking and physical condition

A total of 16 LATM devices were identified within the study area, presented in Table 5.1 and Figure 5.1.

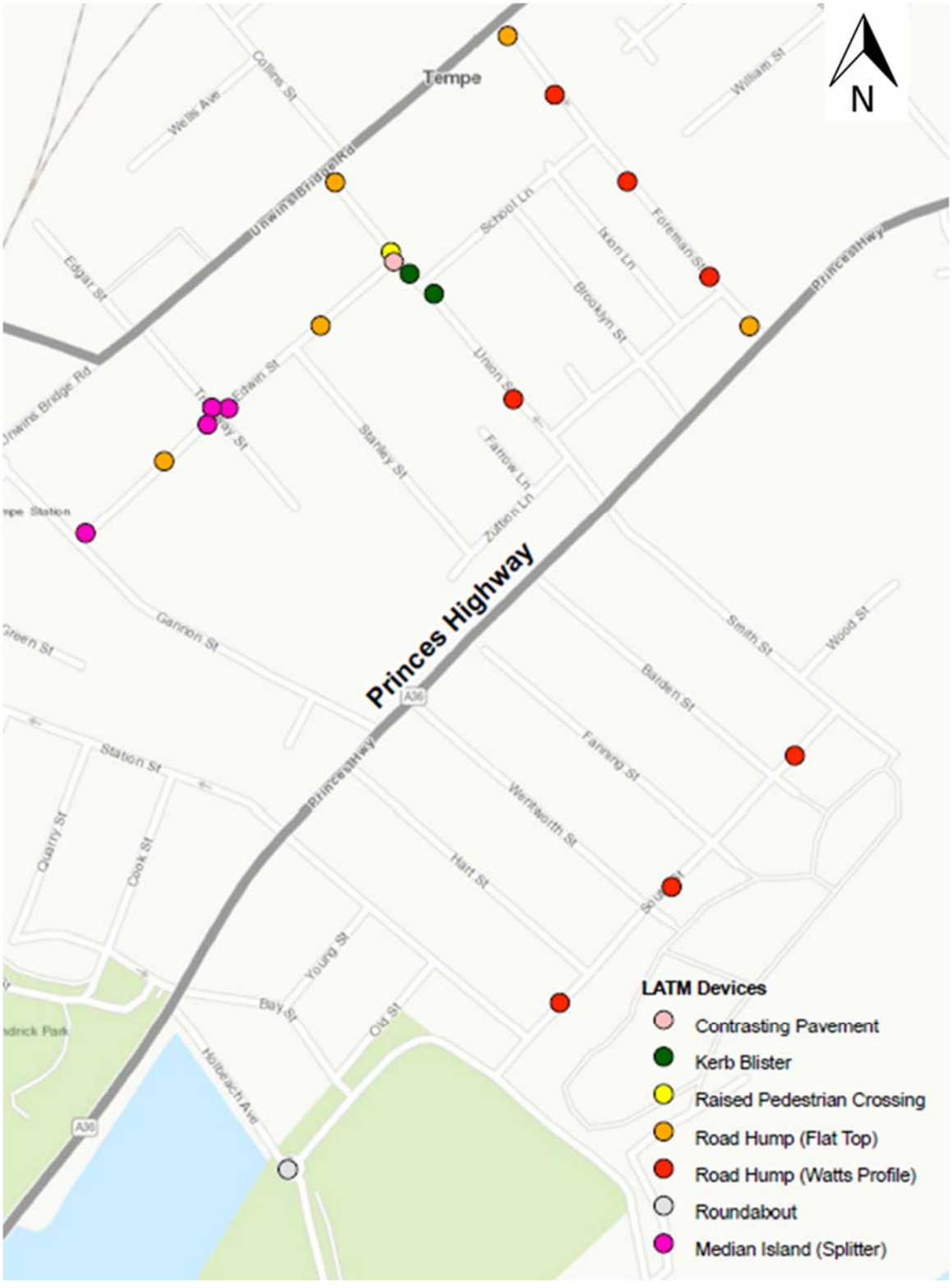
Table 5.1: Existing LATM Devices & Controls

Road	Traffic Calming or Treatment	Treatment Type
Union Street	Yes	▪ Road Hump (Watts Profile) ▪ Road Hump (Flat Top) – Raised Thresholds ▪ Kerb Blisters ▪ Contrasting Pavement ▪ Raised Pedestrian Crossing (Wombat Crossing) ▪ One-way restriction
Foreman Street	Yes	▪ Road Hump (Watts Profile) ▪ Road Hump (Flat Top) - Raised Thresholds ▪ Kerb Blisters ▪ One-way restriction
Edwin Street	Yes	▪ Road Hump (Flat Top) ▪ Contrasting Pavement ▪ Median Island (Splitter Rumble Strips)
Tramway Street	Yes	▪ Median Island (Splitter Rumble Strips)
South Street	Yes	▪ Road Hump (Watts Profile)
Holbeach Avenue	Yes	▪ Roundabout (with Pedestrian Refuge Islands)

A number of these devices are in addition to those proposed as part of the previous *St Peters/Tempe LATM Study*. This includes:

- Raised thresholds, kerb blisters, raised pedestrian crossing and contrasting pavement on Union Street
- An additional Watts Profile hump on South Street
- Roundabout at Holbeach Avenue.

Signage associated with the LATM devices are covered under the Traffic Sign Audit in Section 5.1.2.



Adapted from ESRI Maps

Figure 5.1: Existing LATM Devices

5.1.2 Traffic Sign Audit

The traffic sign audit covered all traffic signs along each roadway, including regulatory, warning and wayfinding signage. Signage associated with LATM devices (such as directional hazard markers or speed hump warning sign) were included in the traffic signage audit. The audit covered:

- Sign type & associated RMS code
- Road and location (including road name and co-ordinates)
- Applicable direction of traffic
- Sign condition
- Visibility obstruction (if any)

A total of 153 traffic signs were recorded within the study area. A database of traffic signs identified in the audit is provided in **Appendix C**. A summary list of the types of traffic signs recorded are shown in Table 5.2.

Majority of the signs were found to be in a good condition with unobstructed visibility. Some signs were found to be vandalised with stickers or graffiti, or faded, however, were still mostly legible. A number of signs were also found to be dislocated or facing the wrong way. Some signs were also obstructed by trees, or covered by another sign immediately above or below the obstructed sign.

A large proportion of the traffic signs are speed hump and speed hump ahead signs (with relevant tag plates), one-way, and the 3-tonne truck load limit signs. The speed hump related signage are mostly along South Street, Union Street and Foreman Street, while the 3-tonne truck load limit signage are located on the entry to roads with the load limit restriction (see Section 2.9).

Table 5.2: Traffic Signs Audit

Traffic Sign Recorded	Sign Code	Locations
No Through Road	G9-18	Holbeach Avenue, Smith Street, Wood Street, Tramway Street
Stop	R1-1	Holbeach Avenue, School Lane, Edwin Street
Roundabout Give Way	R1-13	Holbeach Avenue
Give Way	R1-2	Holbeach Avenue, Station Street, Union Street, Foreman Street, Tramway Street
Traffic Signal Stop	R1-4	Holbeach Avenue, Smith Street
All Traffic Left Only	R2-14_L	Station Street, Fanning Street
All Traffic Right Only	R2-14_R	School Lane
One Way Left	R2-2_L	Princes Highway, Zuitton Lane, Unwin's Bridge Road, Edwin Street
One Way Right	R2-2_R	School Lane, Princes Highway, Brooklyn Lane, Unwins Bridge Road
Two Way	R2-223	Holbeach Avenue
Keep Left	R2-3	Holbeach Avenue
No Entry	R2-4N	Foreman Street
No Right Turn	R2-6_R	Unwins Bridge Road, Gannon Street
Pedestrian Crossing	R3-1	Union Street
Speed Limit Sign (25 km/h)	R4-1	Holbeach Avenue

Traffic Sign Recorded	Sign Code	Locations
School Zone Sign (including illuminated)	R4-230 & R4-230-1	School Lane, Foreman Street, Union Street, Edwin Street
End School Zone	R4-231	Foreman Street, Edwin Street
Local Traffic Area (50 km/h)	R4-240 (50 km/h)	Fanning Street, Barden Street, Smith Street
End Local Traffic Area (50 km/h)	R4-241	Fanning Street, Barden Street, Smith Street
Trucks Prohibited 3-tonne & over	R6-222, R6-10-2 and R9-221	Old Street, Bay Street, Union Street, Fanning Street, Barden Street, Station Street, Hart Street, Edwin Street
"6AM-10AM 3PM-7PM Mon-Fri" Tag Plate	R9-1-2	Unwins Bridge Road
"When Signals Black Out or Flashing" Tag Plate	R9-201	Smith Street
Hazard Warning Marker	T5-5	Union Street, Foreman Street, Holbeach Avenue
Roundabout Warning	W2-7	Holbeach Avenue
Speed Hump Ahead	W3-4	South Street, Union Street, Edwin Street, Foreman Street
Speed Hump	W5-10	South Street, Union Street, Edwin Street, Foreman Street
Pedestrian Warning	W6-1	Holbeach Avenue, Union Street
Pedestrian Crossing Ahead / Left	W6-2 & W6-2-1	Union Street, Edwin Street
Children Crossing	W6-3	Union Street
"School" Tag Plate	W8-14	Union Street
Speed Tag Plates for Speed Hump signs (various speeds)	W8-2	South Street, Union Street, Edwin Street, Foreman Street
"Refuge Island" Tag Plate	W8-211	Holbeach Avenue

5.1.3 Parking Sign Audit

The parking sign audit captured any signage associated with kerbside and parking controls, including 'No Stopping' and 'No Parking' areas. The audit covered (where applicable):

- Location (road name and co-ordinates)
- Sign type & associated RMS sign code
- Direction of arrow
- Time restrictions and operation days/times
- Applicable traffic direction
- Sign Condition
- Any visibility obstructions

As most of the study area has unrestricted on-street parking, there are very few parking signs with timed or conditional restrictions. The rest of the signs, particularly, those close to intersections, are No Stopping and No Parking signs. A total of 89 parking signs were recorded.

Majority of signs are legible, with some signs heavily faded and illegible (including wording and arrow).

Parking zones associated with the parking signs was previously presented in Figure 2.8. A map of parking signs recorded is provided in **Appendix C**.

5.1.4 Bicycle Facilities Audit

The bicycle facilities audit covered both physical and visual treatments provided for cyclists, such as ramps or crossings and cycle route pavement markings and signage. The audit included:

- Any bicycle-related route-finding signage
- Any shared paths and cycleways
- Any shared bicycle/pedestrian signalised crossing
- Location of bicycle facility (including road name)

Most bicycle facilities are located along the bicycle routes shown in Section 2.7.1, which include Holbeach Avenue, South Street and Smith Street. This includes shared paths and associated signage and bicycle route signage. Signalised shared pedestrian / bicycle crossings are also located at the intersections of Princes Highway / Holbeach Avenue and Princes Highway / Smith Street.

A bicycle on-ramp is also present near the Holbeach Avenue approach to Princes Highway. This allows cyclists along the roadway of Holbeach Avenue to join the shared path along Holbeach Avenue and Princes Highway.

A map of bicycle facilities is provided in **Appendix C**.

5.1.5 Pedestrian Facilities Audit

The pedestrian facilities audit identified features providing accessible pedestrian connectivity within the study area. This included:

- Any kerb ramps
- Any pedestrian refuges
- Any signalised pedestrian crossing or shared bicycle/pedestrian crossings
- Any pedestrian (zebra) crossings

The study area is well-connected by footpaths, with the exception of laneways such as Farrow Lane and Zuitton Lane and were therefore not included as part of the pedestrian facilities audit.

Kerb ramps are present at crossing points at most intersections in the study area.. In most circumstances, the kerb ramps occur in pairs; one on each side of the road. Where pairs of kerb ramps are not present, this creates a break in footpath connectivity, presenting accessibility issues for low mobility pedestrians, such as wheelchair users.

These issues should be further explored and addressed as part of a different study such as a Pedestrian Accessibility Mobility Plan.

5.1.6 Waste Management Audit

The waste management audit focussed on identifying evidence of issues or potential issues affecting waste collection. This may include items such as insufficient geometry, damage to kerbs/corners or other evidence of manoeuvring issues.

Very few issues were found that may affect residential waste collection in the study area.

A kerb runover was noted at the corner of Farrow Lane and Zuitton Lane, shown in Figure 5.2. These roadways feature narrow road widths which would be expected to be restrictive for waste collection vehicles.

Figure 5.2: Kerb Runover at Farrow Lane

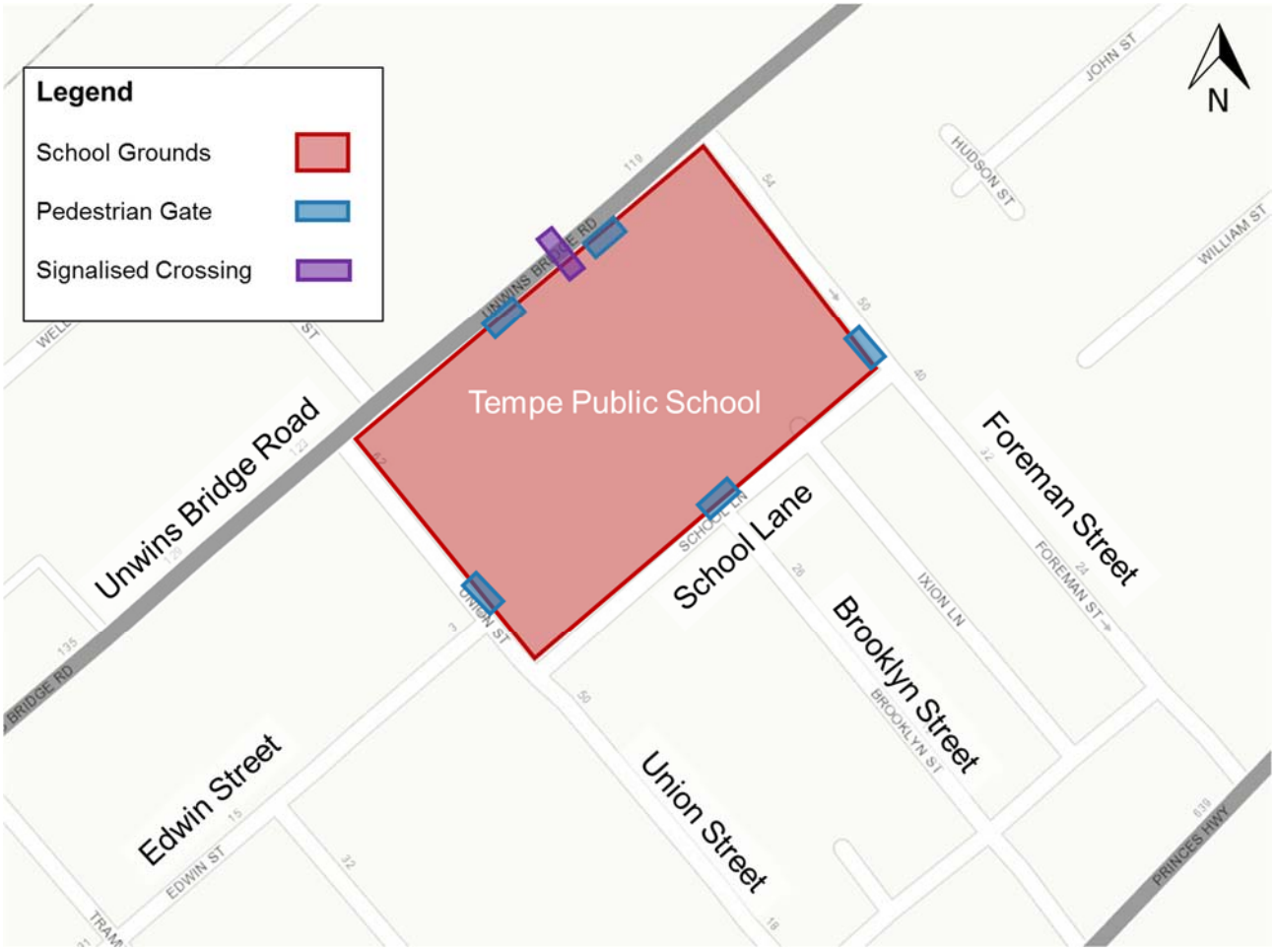
5.2 Tempe Public School Observations

5.2.1 Overview

A site visit was also undertaken on Tuesday 15 and Wednesday 16 September 2020, to observe traffic patterns and behaviours related to Tempe Public School. The site observations focussed on student pickup and drop off operations, parking and pedestrian routes. School hours were observed between 09:00 AM and 3:00 PM.

5.2.1.1 Access Points

The school has a number of pedestrian access gates along it's perimeter, with the school's main building entrance located along Unwins Bridge Road west of the signalised crossing, shown in Figure 5.3.



Adapted from ESRI Maps

Figure 5.3: School Access Locations

5.2.1.2 AM School Peak Observations

The following was observed during the AM peak period:

- School traffic peak extends between 8:30am and 9:00am with little traffic prior to 8:20am.
- Pedestrian access gates on Union Street, School Lane and Foreman Street open from approximately 8:30am
- Parents were observed to
- Drop off students near access gates without leaving their vehicle, stationary for up to 30 seconds
- Park on Edwin Street and walk up to the gate on Union Street
- Vehicles stopped to give way to one another along Edwin Street, causing some congestion
- Queues on Union Street at Unwins Bridge Road occasionally extended to Edwin Street
- Pedestrians approach school primarily along Union Street, Edwin Street and Unwins Bridge Road
- Traffic along School Lane was primarily westbound as vehicles circulate around the school

5.2.1.3 PM School Peak Observations

The following was observed during the PM peak period:

- School traffic peak extends between 2:30pm and 3:15pm

- Most parents arrived via Foreman Street, Edwin Street and Brooklyn Street
- Parents parked and waited in their vehicles along Union Street, Brooklyn Street, School Lane and Edwin Street
- vehicles were observed to circulate westbound from Foreman Street via School Lane, Union Street and Edwin Street, before exiting the area
- Blockages due to vehicles travelling in opposite directions along Edwin Street, giving way to one another
- Pedestrian movements primarily along Edwin Street, Union Street, Foreman Street and Unwin's Bridge Road.
- Large groups of students along Unwins Bridge Road towards Tempe and Sydenham Station directions.

5.2.1.4 Pedestrian Areas

The areas shown in Figure 5.4 featured large volumes of pedestrians as parents picked up and dropped off students, or travelled between parked vehicles and the school. These areas are primarily focussed around access gates, including Union Street and Edwin Street.

Adapted from ESRI Maps

Figure 5.4: Pedestrian Areas

6. FUTURE CONDITIONS

6.1 Future Residential Development

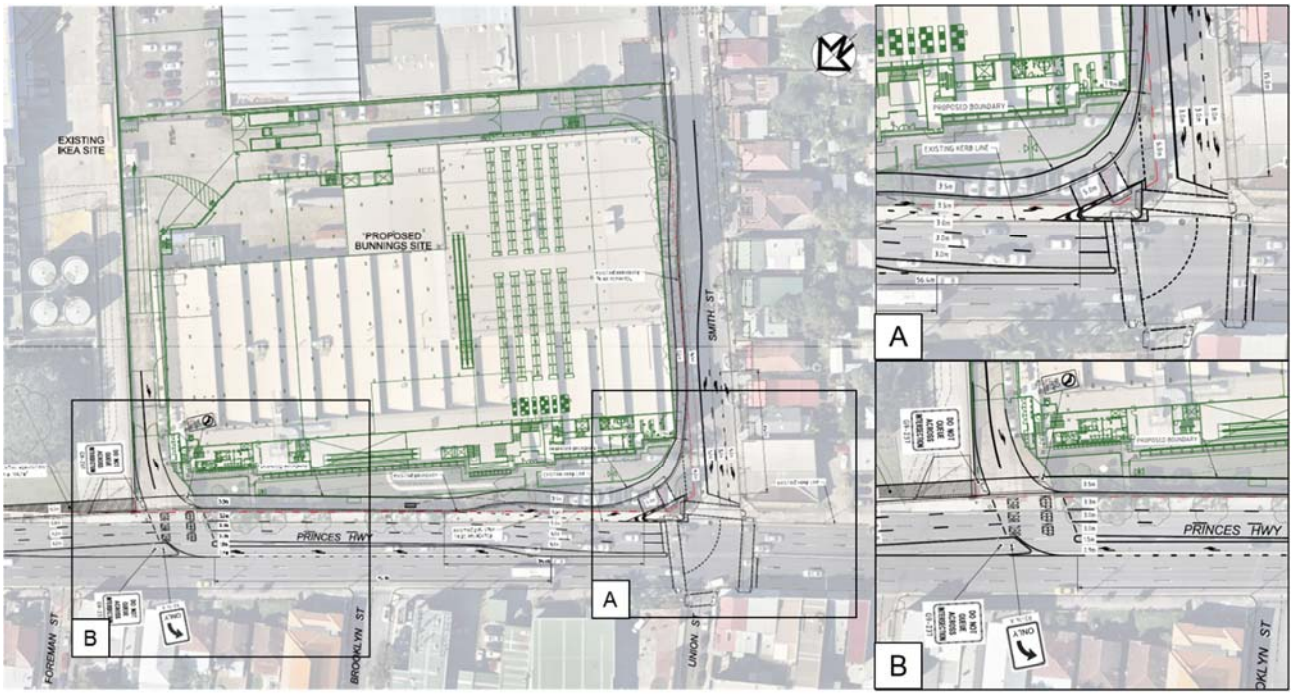
There are not any known high impact residential developments, such as medium or high-density developments, currently pending within Tempe and the study area.

Based on population forecasts provided by Forecast ID (using Census data from 2006 to 2016), Tempe is expected to experience a negative population growth until 2031. As such, it is expected that there will be very little traffic growth in traffic volumes in Tempe for the next 10 years. This excludes traffic along major through roads and connectors such as Princes Highway or Unwins Bridge Road.

6.2 Future Bunnings Development

The proposed Bunnings Development is to be located at the south-east corner of Princes Highway and Smith Street, with vehicular access to be provided via Smith Street and Princes Highway. A Traffic Impact Assessment (TIA) was undertaken by Transport and Traffic Planning Associates (TTPA) in October 2017, indicating the following proposed road changes (also shown in Figure 6.1):

- A new left turn slip lane from Princes Highway to Smith Street
- Removal of parking on the eastern side of Smith Street and a reduction to one departure lane on Smith Street
- Widening of Smith Street approach to Princes Highway to three lanes
- Customer and delivery access (“Smith Street access”) to Bunnings from Smith Street at existing driveway location
- Access to Bunnings from Princes Highway to be located north-east of the Smith Street intersection
- A new unsignalised right turn bay from Princes Highway eastbound to Bunnings Warehouse Princes Highway access
- Only left turns permitted from the Bunnings Princes Highway access
- Relocation of the southwest-bound bus stop on Princes Highway, currently located on the approach to Smith Street.



Source: Bunnings Warehouse Tempe – Proposed Road Layout General Arrangement Plan 2 – AT&L 2017

Figure 6.1: Proposed Road Changes

6.2.1 Smith Street On-Street Parking Assessment

It is understood that up to 13 spaces of on-street parking of Smith Street are proposed to be removed as part of the Bunnings development. To mitigate the loss of on-street parking, as part of the Bunnings development application consent conditions (condition number 6), 13 of the car spaces within Bunnings warehouse are to be dedicated as public car parking spaces available to local residents to offset the loss of on street parking. However, these public car spaces are intended to be available during Bunnings trading hours only. This removes the flexibility of parking at any time of the day for any duration. Given that most residents are expected to park overnight or outside business hours, as a worst-case scenario, these spaces will not be considered as part of the assessment. Further, Bunnings customers are assumed to not use on-street parking on Smith Street as 424 on-site parking spaces are provided.

Based on parking occupancy data, Table 6.1 shows the average number of occupied spaces and vacant spaces along Smith Street on the Thursday and Saturday. There are on average 18 vacant spaces along Smith Street on Thursday and 27 vacant spaces on Saturday. The removal of 13 on-street spaces result in an estimated 5 and 14 vacant spaces remaining on Thursday and Saturday respectively. Therefore, Smith Street will be able to cope with the loss of 13 on-street spaces, and residents do not have to seek other on-street parking elsewhere.

Table 6.1: Parking Occupancy on Smith Street

Side	Section	Parking Capacity	Occupied Spaces (Average)	Vacant Spaces
Thursday				
West	Between Princes Highway & South Street	31	23	8
East	Between cul-de-sac & Wood Street	3	3	0
	Between Wood Street & Princes Highway	27	17	10

Side	Section	Parking Capacity	Occupied Spaces (Average)	Vacant Spaces
Total		61	43	18
Saturday				
West	Between Princes Highway & South Street	31	20	11
East	Between cul-de-sac & Wood Street	3	0	3
	Between Wood Street & Princes Highway	27	14	13
Total		61	34	27

Any proposed treatments resulting in the removal of further parking spaces on Smith Street (mainly the western side) may further reduce the number of vacant spaces along Smith Street.

6.2.2 Traffic Generation

It is expected that there will be an increase in traffic along Smith Street due to traffic generated by the proposed Bunnings Development. The increase in volumes along Smith Street will be limited to the section of Smith Street between Princes Highway and the proposed Bunnings access. Generated trips by the Bunnings development are not expected to use Smith Street south of the Bunnings access and subsequently South Street.

A further assessment of impacts on surrounding local streets from the generated traffic is discussed in Section 7.

6.2.2.1 Previous Traffic Generation

Traffic generation was previously determined by the Traffic Impact Assessment (TIA) developed by TTPA at the DA stage of the Bunnings Proposal and within GTA Consultant's peer review of the TIA.

A summary of key assumptions is provided in Table 6.2.

Table 6.2: Previous Traffic Generation – Key Assumptions

Item	TTPA Consultants	GTA Consultants
Traffic Generation Rates (veh/100m^2 GFA)	▪ 1.56 (PM peak) ▪ 4.5 (weekend peak)	▪ 1.56 (PM peak) ▪ 4.7 (weekend peak)
Existing Traffic Reduction	90 vph (PM Peak)	Nil
Passing Trade Traffic Reduction	▪ 27% (PM peak) ▪ 28% (weekend peak)	▪ 28% (PM peak) ▪ 28% (weekend peak)
In / Out Split	40% In / 60% Out	50% In / 50% Out
Distribution at Princes Highway / Smith Street / Union Street	▪ 45% East (Princes Highway) ▪ 45 % West (Princes Highway) ▪ 10% North (Local Streets)	

On review of the previously calculated traffic volumes, it was determined that the volumes presented by GTA Consultants provide a better representation of expected traffic volumes based on:

- Higher weekend traffic generation rate – based on existing survey data and trend
- Exclusion of existing on site traffic – Existing site was (and remains) non-operational

- 50:50 split of in/out trips. – customers generally spend less than an hour at Bunnings Warehouse

As such, the total in/out volumes calculated by GTA consultants, outlined in Table 6.3, have been adopted in this LATM study.

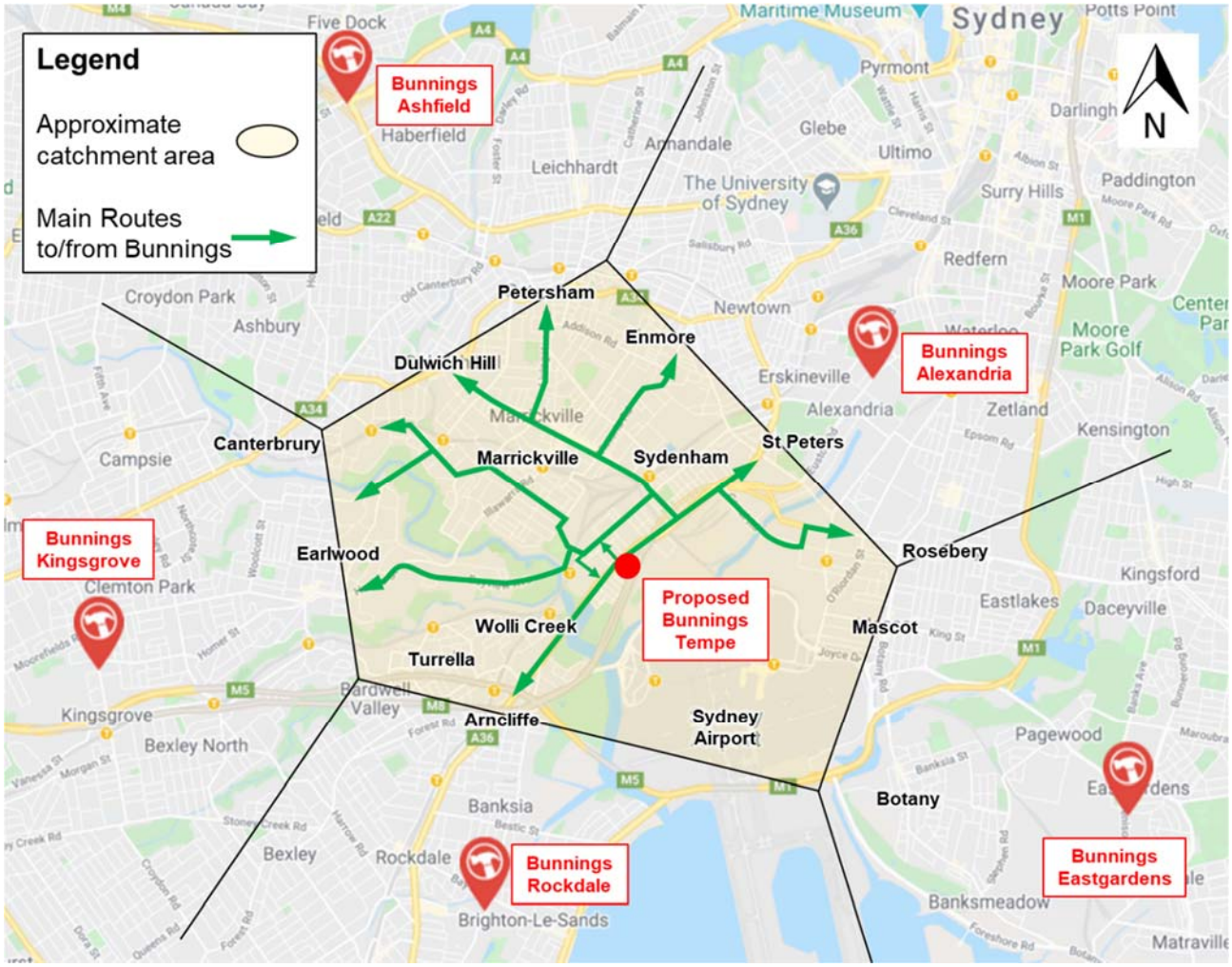
Table 6.3: Traffic Generation Volumes

Peak	Total Trips (veh / hour)	Directional Split		Volumes (veh / hour)	
		In	Out	In	Out
PM	226	50%	50%	113	113
Saturday	670			335	335

6.2.2.2 Adjusted Traffic Distribution

The previously adopted 45 / 45 / 10 split of traffic (based on previous studies conducted at the IKEA site, located to the east) was determined as an under representation to the potential split of traffic accessing and leaving the proposed Bunnings Warehouse site.

Using the locations of adjacent Bunnings Warehouse stores, a potential catchment area was estimated, shown in Figure 6.2. This area covers suburbs extending from Canterbury to the west, Roseberry to the east, Petersham to the north and Arncliffe to the south. Key roads leading to and from the proposed Tempe Bunnings Warehouse are also shown (details on routes are provided in Section 7).



Adapted from GoogleMaps

Figure 6.2: Approximate Catchment Area of Proposed Bunnings Warehouse

Based on the location and density of suburbs to the north of the proposed Bunnings Site, a substantial amount of traffic is expected to travel to and from these areas. As such, it would be more realistic to assign a greater proportion of this traffic heading north using local streets, particularly as these streets provide a more direct route to the rail bridge on Richardson Crescent (at Tempe) or Gleeson Avenue (at Sydenham) via Unwins Bridge Road.

Volumes as a result of adjusted / greater distribution of Bunnings traffic (up to 30%) using local streets north of Princes Highway are provided in Table 6.4. A large majority of traffic will still be expected to use Princes Highway to access routes to the north of the area.

Table 6.4: Adjusted Traffic Distribution

Peak	Total Trips (veh / hour)	Vehicle Volumes			
		10%	20%	25%	30%
PM	113	11	23	28	34
Saturday	335	34	67	84	101

6.2.3 Other Changes

It is understood that the existing bus stop along Princess Highway outside of the development site may be impacted by the development. The provision of replacement bus stops is outside the scope of this study

6.3 Future Road Network

6.3.1 WestConnex

The new M8 tunnel, opened in July 2020, runs underneath the study area as part of the WestConnex project. There will be no connections or changes to study area roads. The St. Peters interchange, located approximately 2km northeast of Tempe, connects the M8 with roads towards the eastern suburbs such as Mascot and Kingsford, and the City's inner south such as Alexandria and Waterloo.

Currently, traffic from the M5 exit at Arncliffe runs via Princes Highway, through Tempe, then via Canal Road or Sydney Park Road to get to the inner south and eastern suburbs respectively. The opening of the new M8 and St Peters interchange may provide an alternative route from the existing M5 to these suburbs, bypassing the Tempe area and is expected to reduce traffic along Princes Highway through Tempe. However, it is not expected to influence traffic along the side roads such as Union Street, Holbeach Avenue and Smith Street.

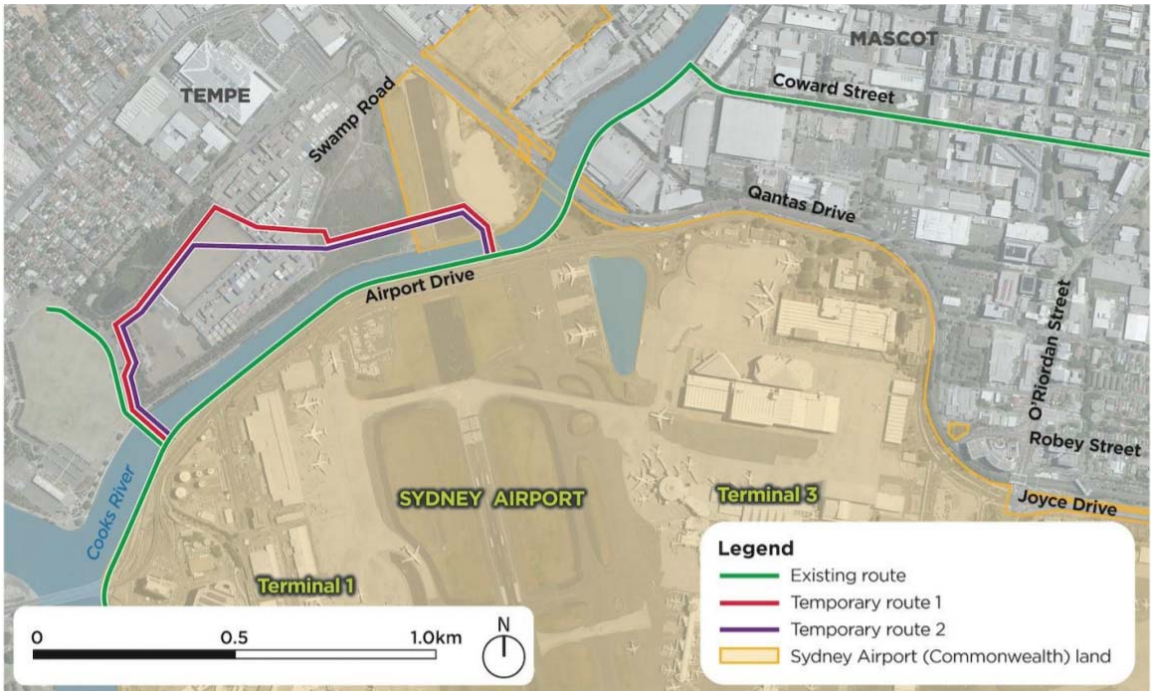
The M8, though open, is counted as future road network as it opened after the traffic surveys were undertaken.

6.3.2 Sydney Gateway

Sydney Gateway is a future motorway connection between the St Peters interchange and Sydney Kingsford Smith Airport, scheduled to be completed by 2023. The proposed alignment is located adjacent to between Tempe Golf Range and the Alexandria Canal, and does not pass through the study area. However, a construction site is proposed to be located within Tempe Lands on the sites of the Tempe Golf Range and Tempe Dog Park. It is expected for up to 100 light vehicles to access

the site via Holbeach Avenue, to be undertaken between 2021 and 2023. Construction vehicle trucks will not be allowed to use Holbeach Avenue to access the Tempe Lands construction site.

Additionally, the current Alexandria Canal shared path will be closed and relocated as part of the project, a temporary active transport link is proposed to run adjacent to Tempe Recreation Reserve and Tempe Lands, shown in Figure 6.3, serving as a temporary detour of the closed shared path. As such, a greater number of cyclists and pedestrians expected towards the south of the study area.



Source: Sydney Gateway Environmental Impact Assessment

Figure 6.3: Sydney Gateway - Temporary Active Transport Link

7. BUNNINGS IMPACTS TO LOCAL TRAFFIC

The increased traffic generated from Bunnings will have a flow on impact onto surrounding local residential roads in the study area. This can lead to an increase of traffic issues such as excessive volumes and speeds on the local roads, which is not desirable. Any LATM devices proposed will aim to mitigate these impacts.

7.1 Routes to and from Bunnings

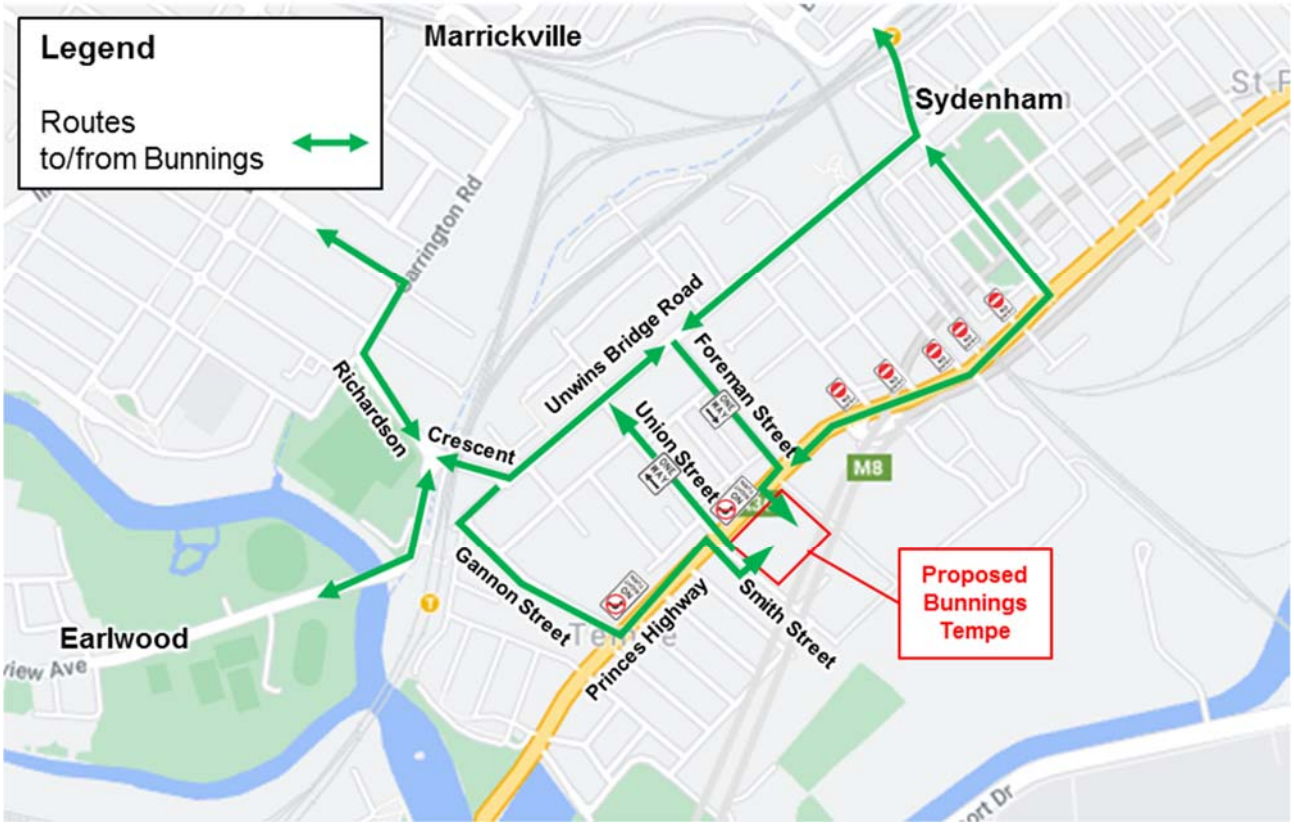
As shown in Figure 6.2, the expected catchment area of the proposed Tempe Bunnings Warehouse covers a broad area of Sydney's Inner West. Key routes and roads identified to access these areas include those outlined in Table 7.1:

Table 7.1: Summary of Routes

Direction	Roads
North	Princes Highway, Railway Street, Sydenham Road, Marrickville Road, Unwins Bridge Road, Richardson Crescent, Warren Road
East	Princes Highway, Gardeners Road
West	Princes Highway, Unwins Bridge Road, Richardson Crescent, Bayview Avenue, Wardell Road
South	Princes Highway

As a result of local rail crossings, there is potential for Bunnings customers to utilise local streets north of the Princes Highway, which provide a more direct route from Princes Highway to the rail bridge on Richardson Crescent (at Tempe) or Gleeson Avenue (at Sydenham) via Unwins Bridge Road.

Due to existing traffic management measures already in place, the most likely local roads used include Gannon Street, Union Street and Foreman Street, with Union Street being the most direct northbound route available from Smith Street. These access routes between Unwins Bridge Road and Princes Highway are shown in Figure 7.1.



Adapted from GoogleMaps

Figure 7.1: Access Routes between Unwins Bridge Road and Princes Highway

7.2 Impacts to Union Street

As a result, it can be expected that Union Street experiences an increase in traffic during peak periods. This is less than favourable due to the narrow geometry, the residential environment of the street and location of Tempe Public School to the north.

The increase in traffic as a result of the proposed Bunnings Warehouse is previously outlined in Table 6.4. A comparison of potential traffic volumes on Union Street is provided in Table 7.2.

Table 7.2: Comparison of Potential Traffic Volumes on Union Street

Peak	Traffic Volumes (veh / hour)	Total Traffic on Union Street*				Acceptable Environmental Limit
		10%	20%	25%	30%	Local Road
March 2020 Counts						< 200 vph
PM	51	62	74	79	85	
Saturday	41	75	108	125	142	
December 2018 Counts						
PM	72	83	95	100	106	
Saturday	81	115	148	165	182	

** by proportion split of Bunnings Warehouse traffic, see Table 6.4*

While an assessment of up to 30% of the expected traffic generated by Bunnings Warehouse more than doubles the existing traffic volumes along Union Street (in comparison to both 2018 and 2020 volumes), the increase in traffic can be accommodated by Union Street and does not exceed the acceptable environmental limit (200 vehicles per hour) previously outlined in Table 4.1 (*RTA Guide to Traffic Generating Developments 2002*).

7.3 Impacts to School Operations

Based on Bunnings Warehouse visitation pattern information (made available by *Google*), the highest visitation typically occurs:

- Weekday – between 10am and 4pm
- Weekends – between 9am and 6pm

With this in mind, traffic generated by the proposed Bunnings is more likely to have an impact on school operations during the PM School peak (typically between 2:30pm and 3:30pm). This may include:

- Increased vehicle volumes along Union Street
- Increased congestion and queueing at the intersection with Unwins Bridge Road
- Potential 'rat-running' using Edwin Street and Tramway Street
- Increased congestion with vehicles parked along Union Street and Edwin Street

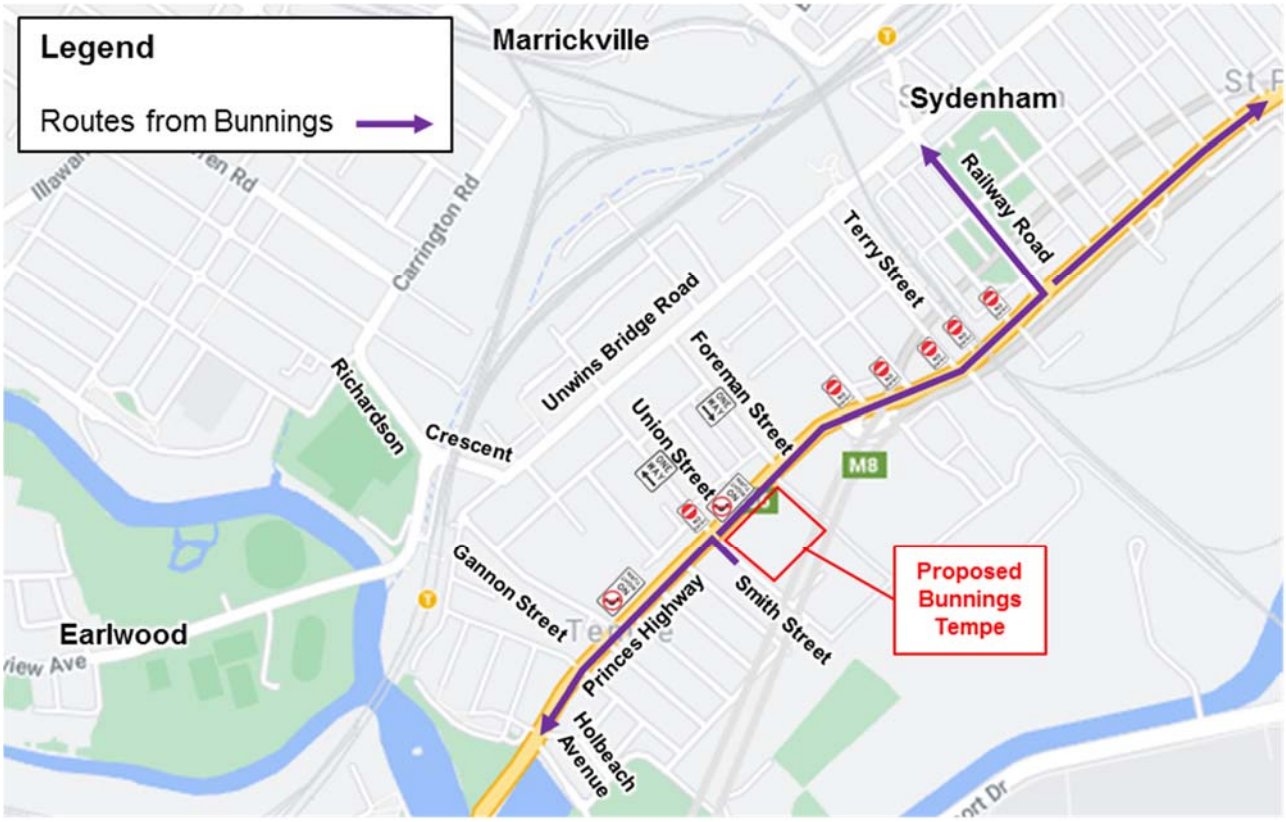
Traffic associated with Bunnings trade customers will typically occur before peak traffic periods and is not expected to impact the AM school peak.

7.4 Closure of Union Street

7.4.1 Traffic re-direction

To prevent non-local traffic from using Union Street, the concept of a road closure has been considered at Princes Highway. We understand that this is supported by the local community members in Union Street. This closure aims to re-direct Bunnings related traffic emerging from Smith Street, to utilise the Princes Highway and other higher order roads to access Unwins Bridge Road and beyond, as shown in Figure 7.4 . This would result in the following routes:

- Right turn from Smith Street onto Princes Highway, then left turn onto Railway Road or Campbell Road
- Left turn from Smith Street onto Princes Highway, U-turn using the Holbeach Avenue roundabout, then right turn onto Princes Highway, then left turn onto Gannon Street



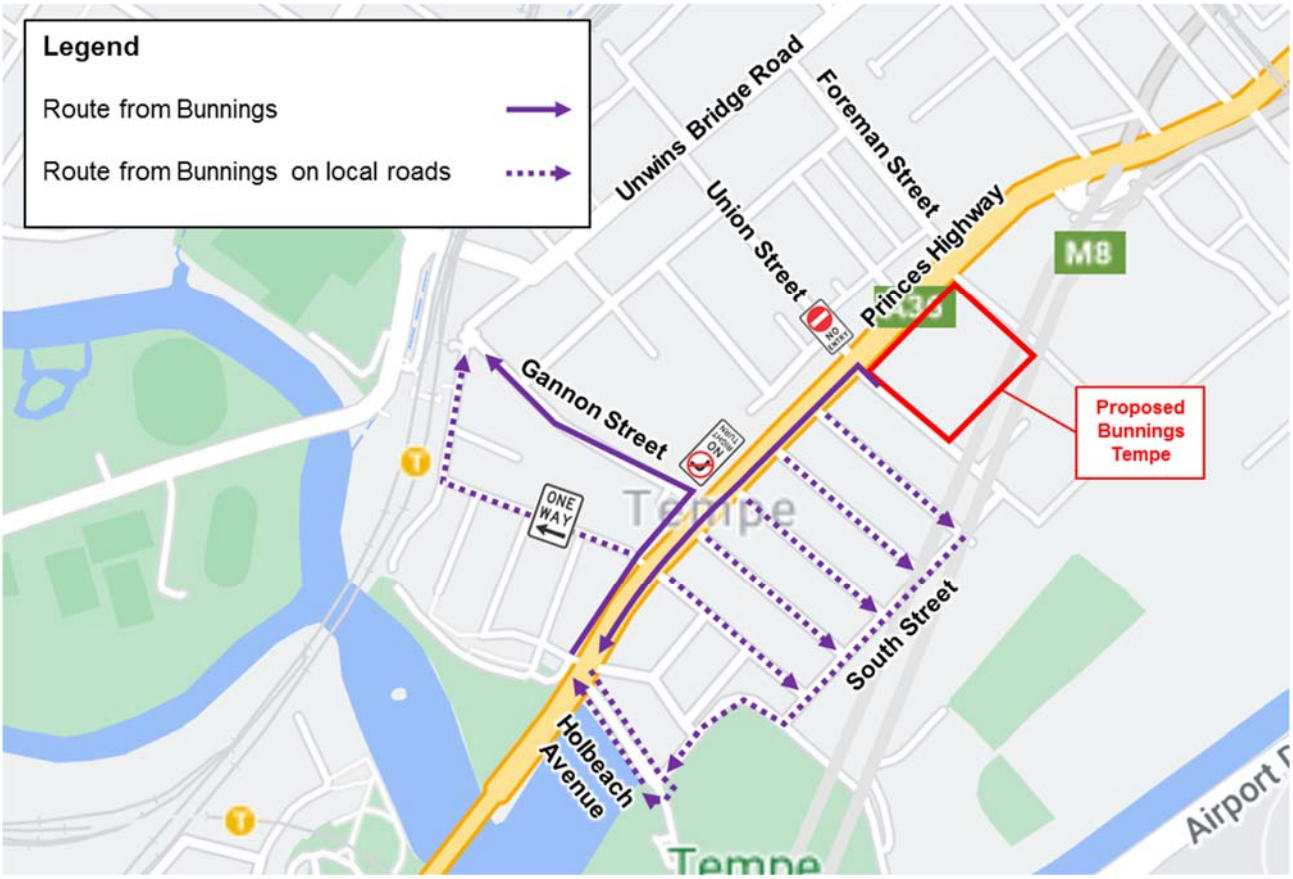
Adapted from GoogleMaps

Figure 7.2: Routes with Union Street Closure

7.4.2 Impact to other Local Streets

Due to the no right turn currently in place for westbound traffic on Princes Highway at Gannon Street, drivers may utilise alternative routes along local streets south of Princes Highway to turn around and access Gannon Street via a left turn, as shown in Figure 7.3.

These streets may experience a greater volume of vehicles turning from Princes Highway, which is not favourable due to the limited available carriageway and residential environment of the street. Most vehicles would be expected to use Holbeach Avenue to perform the u-turn manoeuvre.



Adapted from GoogleMaps

Figure 7.3: Access to Gannon Street using Local Streets

7.4.3 Impact on Access for Residents

Due to the no right turn currently in place for westbound traffic on Princes Highway at Union Street, access to Union Street is currently gained by:

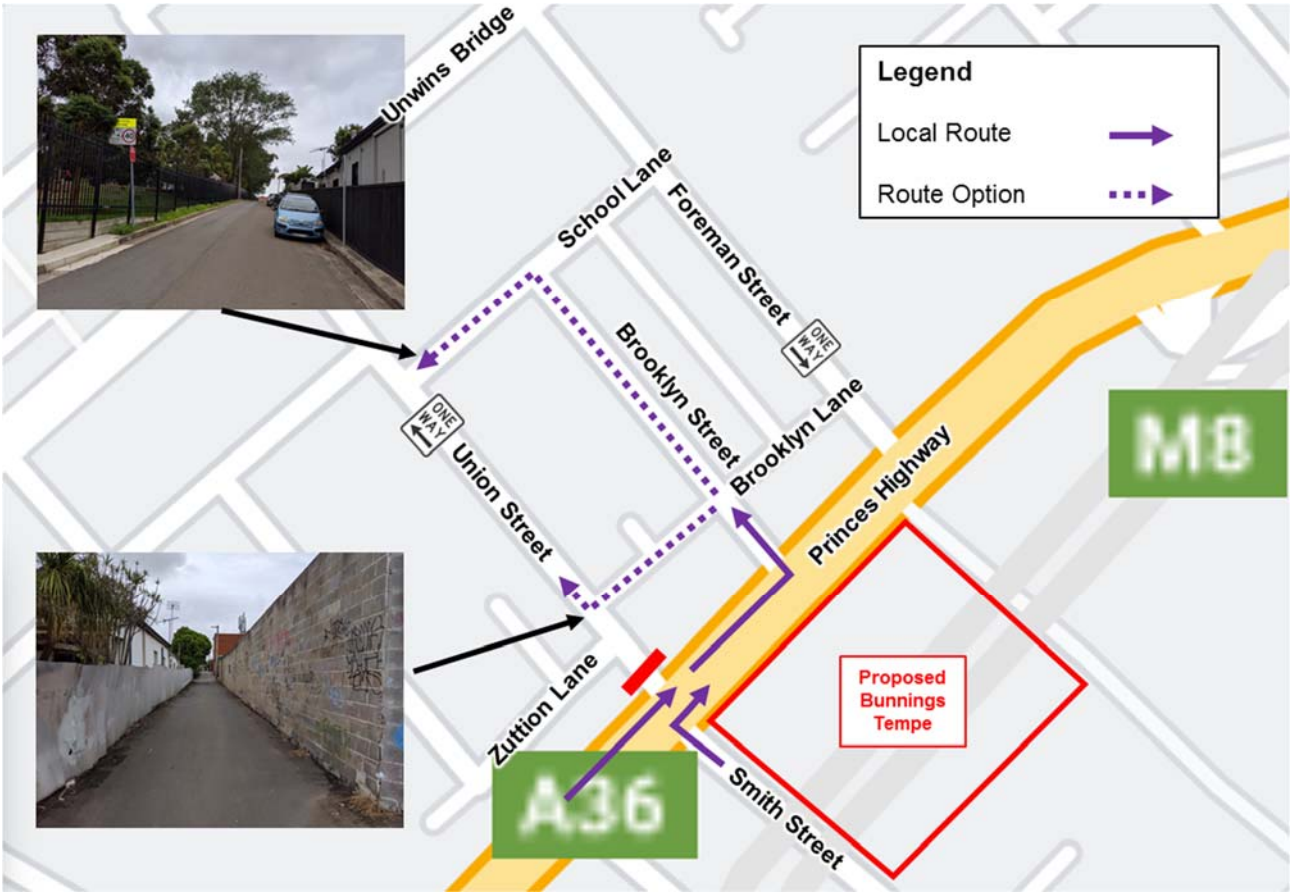
- Left turn from Princes Highway
- Through from Smith Street

The closure of Union Street would restrict access to the left turn from Princes Highway only (under a partial closure), or remove access altogether (with a full closure).

The alternative route for local residents on Union Street would then include the left turn from Princes Highway to Brooklyn Street, then left at Brooklyn lane or School Lane to access Union Street, as shown in Figure 7.4. It would be expected most residents would utilise Brooklyn Lane as it provides best access to properties along Union Street.

While Brooklyn Street is a wider street and capable of accommodating the increase in local traffic, Brooklyn Lane is a narrow bi-directional laneway (also shown Figure 7.4) which would not accommodate such traffic. Particularly during the AM peak where local residents are likely to access Princes Highway via Brooklyn Lane as well as school traffic.

Further, despite being undesirable, vehicles leaving Bunnings via Smith Street may also attempt to take this route, which will exacerbate traffic issues arising from using narrow lane ways as a main access route.



Adapted from GoogleMaps

Figure 7.4: Local Routes with Union Street Closure

In consideration of the potential outcomes due to a closure of Union Street at Princes Highway, a closure is not recommended and other treatments to deter vehicles from using Union Street is preferred such as those proposed in this LATM study.

8. RISK PRIORITY ASSESSMENT

8.1 Methodology

Each study area road was assessed against criteria to determine its risk for future crashes based on the data collected. Criteria included:

- Crash history
- 24-hour vehicle volumes (existing)
- 85th percentile vehicle speeds
- Heavy vehicle volumes (existing)
- Road width
- Availability of existing LATM devices
- Proximity to schools
- Existing land use
- Future traffic volumes, taking into consideration traffic generated from Bunnings

Points were allocated to each road or road section based on the level of risk. The higher the points, the higher the risk for future crashes, and hence the higher the need for LATM devices.

a) Crash history (max 4)

- 4 points for crash casualty rates of more than the typical urban casualty rate of 0.446, as listed in Table 3.6.

The points are applied to Edwin Street, Holbeach Avenue and Smith Street.

b) 24-hour vehicle volumes (max 4)

- 2 points (per direction) for ADT of more than 400, as listed in Table 4.4.

The points are applied to Edwin Street, Holbeach Avenue, Smith Street, South Street and Union Street.

c) 85th percentile vehicle Speeds (max 4)

- 2 points (per direction) for 85th percentile speeds of more than 40 km/h, as listed in Table 4.4.

The points are applied to Holbeach Avenue, Smith Street and Stanley Street.

d) Heavy vehicle volumes (max 4)

- For roads without a truck load limit
    - 1 point (per direction) for daily heavy vehicle volumes of more than 50, as listed in Table 4.4; and
    - 1 point (per direction) for daily heavy vehicle percentages of more than 10%, as listed in Table 4.4.

The points are applied to Smith Street and South Street.

- For roads with the 3-tonne truck load limit
    - 1 point (per direction) for daily heavy vehicle volumes of more than 10, as listed in Table 4.4; and
    - 1 point (per direction) or daily heavy vehicle percentages of more than 5%, as listed in Table 4.4.

The points are applied to all roads with the load limit except Tramway Street.

Road width (max 4)

- 4 points where the available trafficable road width is more than two car widths – high potential/incentive to speed up and collide with pedestrians, adjacent parked vehicles or vehicles travelling in opposite direction

The points are applied to Holbeach Avenue and Smith Street only, which have wider roads than the other roads in the study area.

- 2 points where the available trafficable road width is equal or less than two car widths – low potential/incentive to speed up and collide with pedestrians, adjacent parked vehicles or vehicles travelling in opposite direction

The points are applied to all other roads accessed.

Existing LATM devices

- -1 (negative one) point for each set of LATM devices located on that road.
    - Multiple LATM devices at the same location are counted as one set (e.g. A flat top road hump with kerb blisters and contrasting pavement)
    - The three median rumble strips at the intersection of Edwin Street and Tramway Street are counted as one set on Edwin Street and one set on Tramway Street
    - Roundabouts are excluded, but any pedestrian refuge islands or median islands are included.

e) Proximity to schools (max 4)

- 4 points if the roads are within 100 metres from a school and/or have school zones, and frequently have children walking around.

The points are applied to Union Street, Foreman Street and Edwin Street, which are in close proximity to Tempe Public School.

f) Existing land use (max 4)

- 4 points for local traffic and residential streets. While this does not directly contribute to crash risk, safety is more paramount in a local traffic areas, and residential roads should be given some priority for implementation of LATM schemes.

The points are applied to all roads except Holbeach Avenue and Zuitton Lane, which are not predominantly residential.

g) Future traffic volumes (max 4)

- 4 points where additional Bunnings Warehouse generated traffic may flow onto, based on the evaluation in Section 7, assuming no changes in turning restrictions or accesses; or
- 4 points for local streets forecasted to have daily volumes are to exceeding 1500

The points are applied to Smith Street, Union Street, Edwin Street and Tramway Street, which are potential routes for Bunnings traffic. No streets are forecasted to have more than 1500 daily volumes.

8.2 Assessment

Based on the above scoring criteria, Table 8.1.presents the accumulated scores of each roadway.

Table 8.1: Risk Score by Road

Road	Criteria									
	Crash	Volume	Speed	Heavy Vehicle	Width	Existing LATM	Schools	Existing Land Use	Future Traffic	Total score
Barden Street	-	-	-	1	2	-	-	4	-	7
Edwin Street	4	2	-	2	2	-5	4	4	4	17
Fanning Street	-	-	-	1	2	-	-	4	-	7
Foreman Street	-	-	-	2	2	-5	4	4	-	7
Hart Street	-	-	-	1	2	-	-	4	-	7
Holbeach Avenue (Princes Highway to roundabout)	4	4	4	-	4	-1	-	-	-	15
Holbeach Avenue (roundabout to South Street)	-	-	-	-	4	-	-	-	-	4
Smith Street	4	2	2	4	4	-	-	-	4	20
South Street	-	2	-	1	2	-3	-	4		6
Stanley Street	-	-	4	3	2	-	-	4	-	13
Station Street	-	-	-	1	2	-	-	4	-	7
Union Street	-	2	-	1	2	-5	4	4	4	12
Tramway Street	-	-	-	-	2	-1	-	4	4	9
Wentworth Street	-	-	-	3	2	-	-	4	-	9
Zuitton Lane	-	-	-	1	2	-	-	-	4	3-7

Based on the above assessment, Smith Street exhibits the highest score, followed by Edwin Street and Holbeach Avenue (between Princes Highway and the roundabout), then Stanley Street and Union Street. Wentworth Street and Tramway Street also achieved relatively high scores for local residential roads.

Other local streets, including Barden, Fanning, Hart and Station Streets, have an accumulated score of 7 points. Given the lack of crash history, low vehicle speeds and heavy vehicle composition, these roads do not require any LATM treatments. However, other treatments may be proposed to further deter non-local traffic from using these roads.

8.3 Summary

From the risk priority assessment, LATM devices are recommended to be implemented on, in the order of priority:

- Smith Street – to deal with traffic volume, speed and heavy vehicle issues
- Edwin Street – to deal with traffic volume, heavy vehicle issues and potential future traffic from Bunnings
- Holbeach Avenue (between Princes Highway and the roundabout) – to deal with crash risks, traffic volume and speed issues
- Stanley Street – to deal with speed issues
- Union Street – to deal with traffic volume issues and potential future traffic from Bunnings
- Wentworth Street – to deal with heavy vehicle issues
- Tramway Street – to deal with potential future traffic from Bunnings
- These priority streets are shown in Figure 8.1.

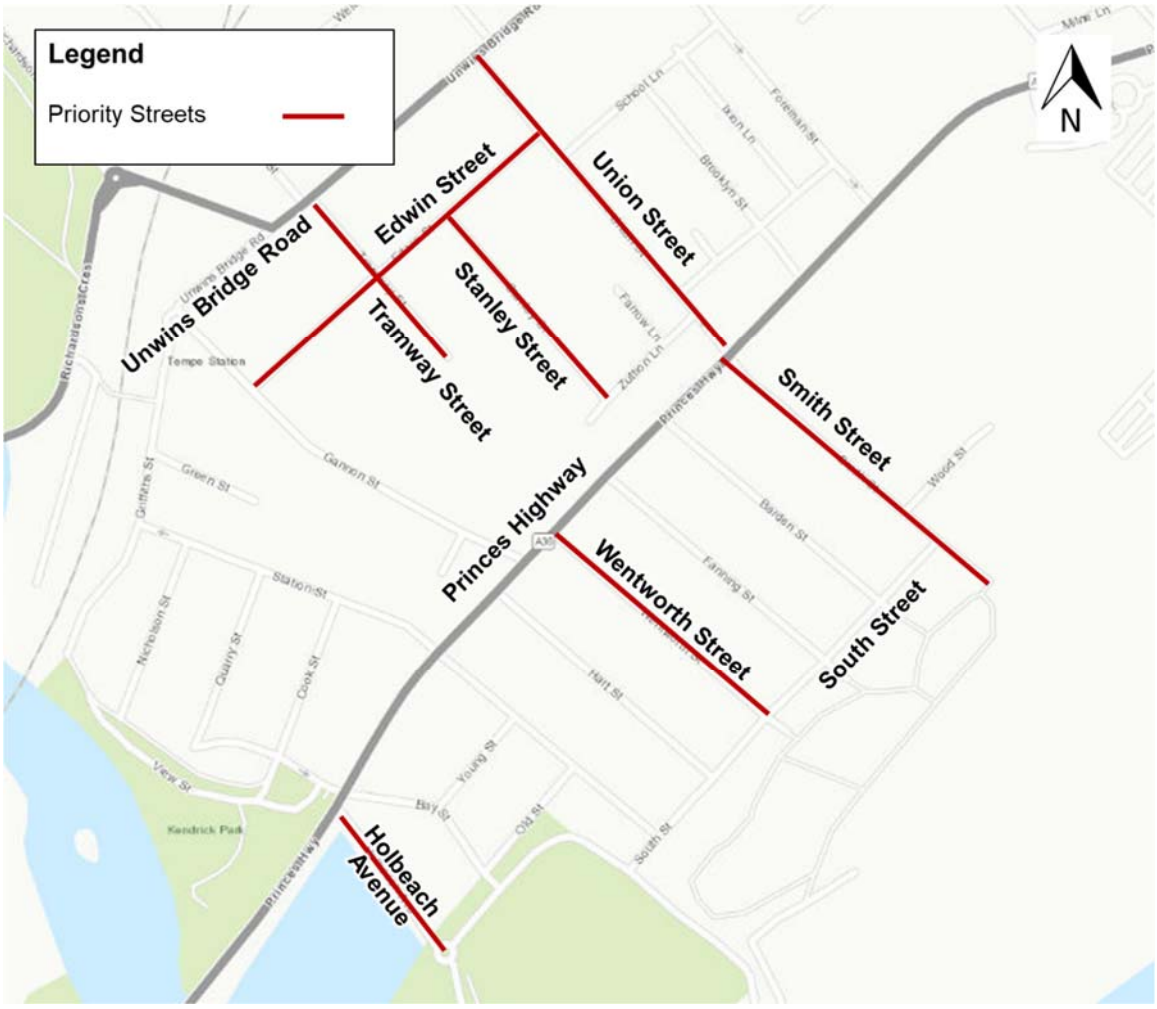


Figure 8.1: Priority Streets for Treatment

9. PRELIMINARY ROAD TREATMENTS

9.1 Traffic Calming and Local Area Traffic Management

Road treatments, including Local Area Traffic Management (LATM) Schemes and traffic calming measures can be implemented to change traffic conditions and speed environments, such that driver behaviour and perception of the road environment would be more appropriate along local residential streets and activity areas.

The primary objectives in introducing LATM schemes as part of this study is to address the following:

- Vehicle speeds
- Vehicle volumes
- Heavy vehicle volumes
- Reducing potential for traffic using local roads (with the exception of Smith Street) to access Princes Highway
- Improving amenity along Smith Street

9.2 Existing Road Treatments

As detailed in Section 2.11, the numerous LATM devices already in use within the study area include:

- Road humps (Watts profile & flat top), including raised thresholds
- Kerb blisters
- Contrasting pavement
- Raised pedestrian (wombat) crossing
- Roundabouts
- Pedestrian refuge islands

The majority of LATM devices are located along Union Street and Foreman Street in the vicinity of Tempe Public School.

9.3 Preliminary Road Treatment Options

To address the issues identified, a wide range of traffic calming devices can be implemented. LATM devices presented in *Austroads Guide to Traffic Management Part 8 – Local Area Traffic Management* were used as a basis for developing a list of suitable devices that could be used.

To create safer local road environments, the key targets for any proposed treatment options include:

- Reducing vehicle speeds
- Minimising traffic levels, including non-resident traffic in local streets
- Deterring heavy vehicles
- Reducing crash risk
- Improving local amenity, including walking and cycling options.

The following traffic calming treatments may potentially be implemented across the study area:

- Entry thresholds
- Flat top road humps

- Raised Pedestrian Crossings
- Speed cushions
- Slow points
- Road narrowing / Kerb blisters
- Pedestrian refuge / Median / Splitter islands
- Line marking (edge line and/or centreline)
- Shared zones.

Descriptions of each of these treatments are provided in Table 9.1.

Table 9.1: Road Treatment Types

Name	Type	Description
Entry Threshold	Physical / Visual	▪ Provides a physical and visual gateway to a local street ▪ May control vehicle speeds in both directions ▪ Design can be varied to accommodate different traffic types and road geometries (such as bicycles) ▪ Include raised platforms, medians and kerb blisters ▪ Opportunity to introduce landscaping elements to enhance streetscape ▪ Commonly used throughout study area ▪ May impact large vehicle movements near intersections
Flat Top Road Hump	Physical	▪ Wide raised platform type 'speed hump' ▪ Controls vehicle speeds by vertical deflection and may reduce traffic volumes ▪ More visually appealing than typical speed humps (such as Watts Profile) ▪ Typically 75-150mm high, 2-6m long ▪ Fullwidth designs control speeds in both directions ▪ Design can be varied to adapt to different road geometries and traffic, including medians and kerb blisters ▪ Can be misconstrued as a pedestrian crossing without roadside barriers (fence, landscaping or other) ▪ Typically low cost
Raised Pedestrian Crossing (Wombat Crossing)	Physical	▪ Flat Top Road Hump combined with marked Pedestrian Crossing ▪ Controls vehicle speeds and provides pedestrian crossing location ▪ Improves pedestrian safety by raising walkway (for better visibility) and calming traffic vehicles ▪ Allows for pedestrian priority
Speed Cushions	Physical	▪ Small plastic or rubber 'cushion' in centre of travel lane (or series across travel lanes) ▪ Controls vehicle speeds by vertical deflection ▪ Smaller and narrower than speed humps or flat top road humps ▪ Slows light vehicles with little impact to heavy vehicles (such as buses) ▪ Can be combined with a median and kerb blisters for further control ▪ Low cost and quick installation

Name	Type	Description
Slow Points	Physical	▪ Controls vehicles by horizontal deflection ▪ Uses series of kerb extensions or blisters on alternating sides of road to create an angled travel lane ▪ Opportunity to introduce landscaping elements to enhance streetscape ▪ Requires considerable length of road to install and potentially high cost ▪ Must consider local driveway access ▪ May impact kerbside parking
Road Narrowing	Physical	▪ Kerb extensions or blisters to reduce available road width at a single point ▪ Use of kerb blisters may allow for kerbside drainage ▪ Often used in conjunction with other treatments (such as entry thresholds and road humps) ▪ Opportunity to introduce landscaping elements to enhance streetscape
Pedestrian Refuge / Median / Splitter Islands	Physical	▪ Raised or flush island positioned at the intersection or the centreline of a street ▪ Narrows lanes ▪ Provide pedestrians with a refuge ▪ Used in areas where there is a need to reduce entry speed of vehicles to a residential street ▪ May not be used on narrow two-lane streets, and where there is insufficient sight distance ▪ Must consider local driveway access ▪ May impact kerbside parking
Line Marking	Visual	▪ May be used where physical treatments are not appropriate ▪ Can provide a visual narrowing of the roadway such that drivers perceive a narrower travel lane and reduce speed ▪ Assists in delineating road components such as cycle lanes and kerbside parking ▪ Available roadway width through bends is visually narrowed when combined with centreline marking ▪ May not be effective along considerably wide roadways
Contrasting Pavement	Visual	▪ Highlight the change in road conditions to drivers ▪ Colour and texture can be designed to fit with local area context ▪ Typically located at start of traffic areas (such as High Pedestrian Activity Areas) ▪ Textured pattern (such as Embossed Hex) can also provide a tactile and audible warning to drivers ▪ Typically low cost
Shared Zone	Regulatory	▪ Located along a road section ▪ Vehicles must give way to all pedestrians ▪ Suitable for a high-pedestrian area ▪ 10 km/h speed limit ▪ Parking can be retained but bays must be marked

It is understood that the Bunnings development may also bring about traffic impacts onto streets just outside of the study area such as Edwin Street and Tramway Street. These impacts have been considered, however, no treatments are proposed on these streets

9.4 Standard LATM Treatments

Based on existing LATM devices found and the types presented by Austroads, a number of potential standard treatment options are proposed for installation across the study area, presented in Table 9.2.

These devices are identified as being appropriate for the context of the study area and address the issues identified on local roads.

Table 9.2: Proposed Standard LATM Treatments

Infrastructure	Description
Flat-top Road Hump	Standard flat top road hump
Speed Cushion	Standard speed cushion(s)
Road Narrowing	Kerb blisters (landscaping)
Median Treatments	Median Island (standard or low-profile)
Line marking	Edge and centre line marking
Contrasting Pavement	Standard at-grade contrasting pavement
Shared Zone	10 km/h shared zone with marked parking bays

Examples of some of these treatments are provided in Figure 9.1 below.

Left to Right: Flat top road hump, road narrowing (kerb blisters with landscaping)

Figure 9.1: Examples of Treatments

There are other treatments that may be implemented or installed additionally, complementing the proposed LATM treatments. Treatments identified as suitable for the study area include:

- Bicycle facilities, including bicycle ramps, shared paths and bicycle markings
- Signage, to complement the LATM treatments
- Footpath widening

9.5 Treatment Criteria

As there is a large range of available LATM devices available, the selection and location of these devices is important to address the specific issues along each street. A range of factors and considerations are to be given in the selection process to determine suitable and appropriate LATM treatments. As such, a treatment selection criteria was developed to inform the selection and location of proposed LATM devices.

9.5.1 Austroads LATM Selection Toolkit

The selection of an appropriate LATM is greatly dependent on the overall objective for the particular roadway, the local context of the road environment and the needs of local road users.

Austroads Guide to Traffic Management Part 8 – Local Area Traffic Management provides a toolkit and selection rubric, which outlines the relative use of different LATM devices based on previous research and practice within Australia and New Zealand. The Austroads Toolkit which provides a description and use of LATM devices is provided in Table 9.3.

Table 9.3: Austroads LATM Toolkit

Measure		Reduce speeds	Reduce traffic volume	Reduce crash risk	Increase pedestrian safety	Increase bicycle safety
Vertical deflection devices (Section 7.2)	Road humps	✓	✓	✓	–	–
	Road cushions	✓	✓	✓	–	✓
	Flat-top road humps	✓	✓	✓	–	✓
	Wombat crossings	✓	✓	✓	✓	✓
	Raised pavements	✓	✓	✓	–	✓
Horizontal deflection devices (Section 7.3)	Lane narrowings/kerb extensions	✓	–	–	✓	–
	Slow points	✓	✓	–	–	–
	Centre blister islands	✓	✓	–	✓	–
	Driveway links	✓	✓	–	✓	✓
	Mid-block median treatments	✓	–	✓	✓	✓
	Roundabouts	✓	✓	✓	–	–
Diversion devices (Section 7.4)	Full road closure	–	✓	✓	✓	✓
	Half road closure	–	✓	✓	✓	✓
	Diagonal road closure	–	✓	✓	✓	✓
	Modified T-intersection	✓	✓	✓	✓	✓
	Left-in/left-out islands	–	✓	✓	✓	–
Signs, linemarking and other treatments (Section 7.5)	Speed limit signs	✓	–	✓	✓	✓
	Prohibited traffic movement signs	–	✓	✓	–	✓
	One-way (street) signs	–	✓	✓	✓	–
	Give-way signs	✓	✓	✓	✓	✓
	Stop signs	✓	✓	✓	✓	✓
	Shared zones	✓	✓	–	✓	✓
	School zones	✓	–	✓	✓	✓
	Threshold treatments	✓	✓	✓	–	✓
	Tactile surface treatments	✓	–	–	–	–
	Bicycle facilities	–	–	✓	–	✓
	Bus facilities	–	✓	–	–	–

9.5.2 Treatment Criteria

The information presented within the Austroads LATM selection toolkit and consideration of other road environment elements was used to develop a specific treatment selection criteria and is presented in Table 9.4.

The criteria include considerations of the following:

- Speed and traffic volume reduction
- Crash risk reduction
- Relative traffic volumes
- Deterrence against non-local traffic
- Pedestrians, bicycles and buses
- Kerbside parking
- Road and traffic noise generation
- Roadway width requirements.

Table 9.4: Proposed Treatment Selection Criteria

Type	Details	Reduce Speed	Reduce Traffic Volumes	Reduce Crash Risk	Suitable for High Traffic Volumes	Deter Non-Local Traffic	Accommodate Pedestrians	Bicycle Friendly	Bus Route friendly	Parking friendly	Noise Considerations	Wide Road required	Other remarks
LATM Treatments													
Road hump	Flat top road hump	Yes	Yes	Yes	Yes	Yes	No	Yes[3]	Yes[4]	Yes	Yes	No	Preferred for lower traffic volumes
Speed Cushion	Speed Cushion	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes[10]	Yes	No[7]	Preferred for lower traffic volumes
Road narrowing	Kerb blisters (landscaping)	Yes	No	No	Yes	Yes	No	No	No[5]	No	No	Yes	Not to be used on bus routes on a one-way street
Median Treatment	Median Island (standard or low-profile)	Yes	No	Yes	Yes	Yes	No	No[5]	Yes[6]	No	No	Yes	Must conform to Transport for NSW standards
Line-Marking	Edge, centre and lane line marking	Yes[1]	No	Yes[2]	Yes	Yes	-	-	Yes	Yes	No	Yes[8]	Parking lane width may vary, minimum 2.1m
Contrasting Pavement	Standard Contrasting Pavement	Yes	No	No	Yes	Yes	-	-	Yes	Yes	Yes[9]	No	Visual and tactile treatment only
Shared zone	10 km/h shared zone with marked parking bays	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	No	No[10]	Not to be used on heavy vehicle or bus routes
Other Treatments													
Bicycle Facilities	Bicycle ramps, shared paths and bicycle markings	-	-	-	-	-	No	Yes	-	-	No	No	

Type	Details	Reduce Speed	Reduce Traffic Volumes	Reduce Crash Risk	Suitable for High Traffic Volumes	Deter Non-Local Traffic	Accommodate Pedestrians	Bicycle Friendly	Bus Route friendly	Parking friendly	Noise Considerations	Wide Road required	Other remarks
Signage	Signage to complement LATM treatments	varies					-	-	-	-	No	No	
Footpath widening	Widened footpath	-	-	-	-	-	Yes	Yes	-	No	No	Yes	

Notes:

1. *If travel lane is sufficiently narrowed*
2. *May effectively reduce kerbside crashes*
3. *Ramps can be designed to be bicycle friendly*
4. *Flat top road humps can be designed to bus friendly specifications (ref. STA guidelines)*
5. *Bus routes require 3.2m to 3.5m wide travel lane, which will not be an effective road narrowing for regular traffic*
6. *If 3.5m travel lane is maintained*
7. *More effective on narrow roads. Installation on bus routes require 3.5m travel lane*
8. *Generally applied to wide road*
9. *Noise to be considered if using textured surface treatment (such as embossed pattern or similar)*
10. *A minimum trafficable width of 2.8m is required to meet shared zone warrants*

9.6 Proposed Treatment and Locations

Based on the selection criteria, a number of proposed treatment options were developed for the priority roads identified in Section 8.3. Additional proposed treatments for other roads in the study area were also developed. The proposed treatments are outlined in Table 9.5.

Table 9.5: Proposed Treatment and Locations

Road	Option	Type	Location	▪ Features
Smith Street	1	Road Narrowing & Contrasting Pavement	Immediately south of proposed Bunnings access,	▪ Landscaped kerb blisters with low height shrubs ▪ At-grade contrasting pavement treatment (embossed text pattern)
	2	Mountable Concrete Median Treatment		▪ Mountable low-profile concrete median with contrasting pavement
	Addition to both options	Right Turn Only Signage	Opposite and facing Bunnings access	▪ R2-14_R (Right Turn Only) sign
		Line Marking	Between Princes Highway and Bunnings Access	▪ Edge and centre line markings to provide a visual narrowing of the roadway ▪ Road environment would appear distinctively different to the southern section of Smith Street ▪ Delineation of adjusted lane arrangement near Princes Highway
		Bicycle Facilities	Between Princes Highway and Bunnings Access	▪ Extend shared path for a short distance from Princes Highway along both sides of Smith Street ▪ Inclusion of an angled bicycle ramp for southbound cyclists to transition between the shared path and Smith Street ▪ Signage and marking to indicate transitions between shared path and on-road cycling

Road	Option	Type	Location	▪ Features
		Widened Footpath	Western side of road, between No. 48 and South Street	Option a (Option 1a or Option 2a): ▪ Widen western footpath ▪ Retain existing kerbside parking on the western side of Smith Street ▪ Shift centreline to suit road width Option b (Option 1b or Option 2b): ▪ Widen western footpath with adjacent landscaped verge ▪ Removal of existing kerbside parking on the western side of Smith Street ▪ Some paved parking bays within the landscaped area to offset loss of parking ▪ Turning pocket to allow vehicles to turn right out of No.1 Smith Street
Holbeach Avenue	1	Speed Cushions	Between driveways of 14 and 18 Holbeach Avenue ▪	▪ Set of four speed cushions of 100mm height, across roadway
	2	Speed Cushions & Road Narrowing		▪ Set of two speed cushions of 100mm height in travel lanes ▪ Landscaped kerb blisters with low height shrubs
Stanley Street	1	Flat Top Road Hump	Near streetlight outside 14 Stanley Street Near streetlight outside 37 Stanley Street	▪ Concrete flat top road hump of 100mm height, across road width ▪ Contrasting surface treatment ('terracotta' colour surface of similar) ▪ Landscaped barriers (kerbside)
	2	Road Narrowing		▪ Landscaped kerb blisters with low height shrubs
Wentworth Street	1	Road Narrowing & Contrasting Pavement	At entry from Princes Highway (specifically south of Tempe Tyre Centre vehicular access) At entry from South Street (specifically north of the drainage pit)	▪ Landscaped kerb blisters with low height shrubs ▪ At-grade contrasting pavement treatment (embossed text pattern)
	2	Flat Top Road Hump		▪ Concrete flat top road hump of 100mm height, across road width ▪ Contrasting surface treatment ('terracotta' colour surface of similar) ▪ Bollard and chain barriers (kerbside)

Road	Option	Type	Location	▪ Features
	Addition to both options	3 Tonne Truck Limit Signage	Outside 846 Princes Highway Outside 45 Wentworth Street	▪ R6-10-2 and R9-231 (Truck Load Limit) signs ▪ W8-245N_L (Left Arrow) Signage, only on Princes Highway
Union Street	1	Flat Top Road Hump	Outside 2D Union Street Outside 46 Union Street	▪ Concrete flat top road hump of 100mm height, across road width ▪ Contrasting surface treatment ('terracotta' colour surface of similar) ▪ Bollard and chain barriers (kerbside)
	2	Shared Zone[1]	Between Princes Highway and School Lane	▪ "10" Speed Markers ▪ Marked parking bays, with some overlapping with footpath ▪ R4-4 (Shared Zone), R2-10 (Give Way to Pedestrians) and R5-65 (Park in Bays Only) signs at the start of shared zone and entry points at Zuitton Lane and Brooklyn Lane ▪ R4-5 (End Shared Zone) signs at the end of shared zone and exit points at Zuitton Lane and Brooklyn Lane
	Addition to both options	Contrasting Pavement Threshold	At entry from Princes Highway	▪ At-grade contrasting pavement treatment (embossed text pattern)
Edwin Street	1	Flat Top Road Hump	Outside No. 14 Union Street	▪ Concrete flat top road hump of 100mm height, across road width ▪ Contrasting surface treatment ('terracotta' colour surface of similar) ▪ Landscaped barriers (kerbside)
Tramway Street	1	Contrasting Pavement Threshold	At entries (Unwins Bridge Road and Edwin Street)	▪ At-grade contrasting pavement treatment (embossed text pattern)
Barden, Fanning, Hart and Station Streets	-	Contrasting Pavement Threshold[2]	At entry from Princes Highway	▪ At-grade contrasting pavement treatment (embossed text pattern)

1. Assessment against the shared zone criteria is detailed in Section 10.6.3. Shared zones are subject to Transport for NSW review and approval

2. Subject to a 40km/h Local Traffic Area proposal and/or Transport for NSW review and approval

The following considerations were given when locating each of the above treatments:

- Spacing: a maximum spacing between 80m and 120m was adopted (following *Austroads LATM Guidelines*)
- Presence of existing street lighting and light posts
- Kerb ramps
- Property accesses and driveways
- Road gradients
- Driver sight distances and visibility.

Assessment of the different treatments are further detailed in Section 10.

The locations of the proposed treatments options, contrasting pavement thresholds and additional Smith Street treatments are shown in Figure 9.2 and in **Appendix D**.

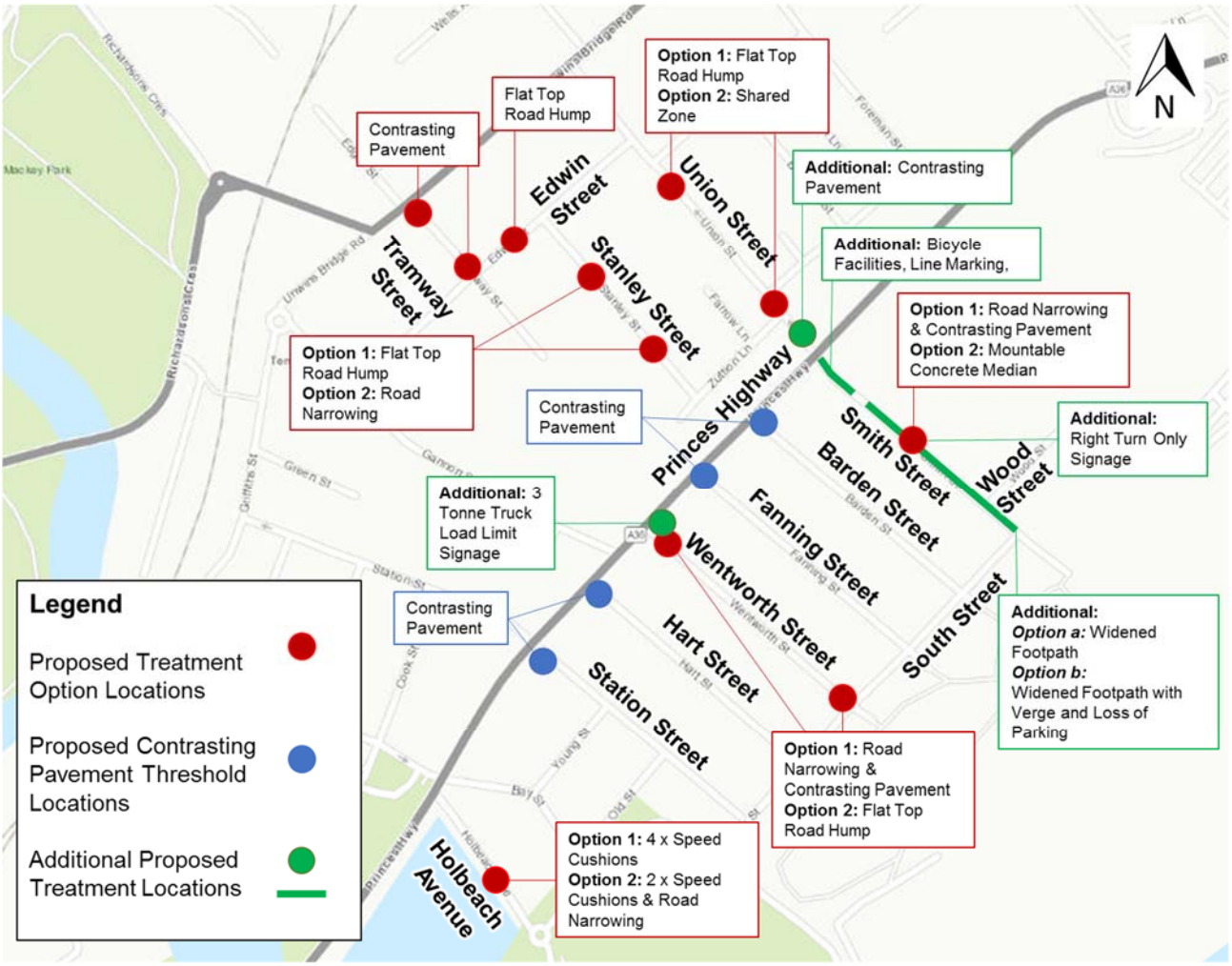
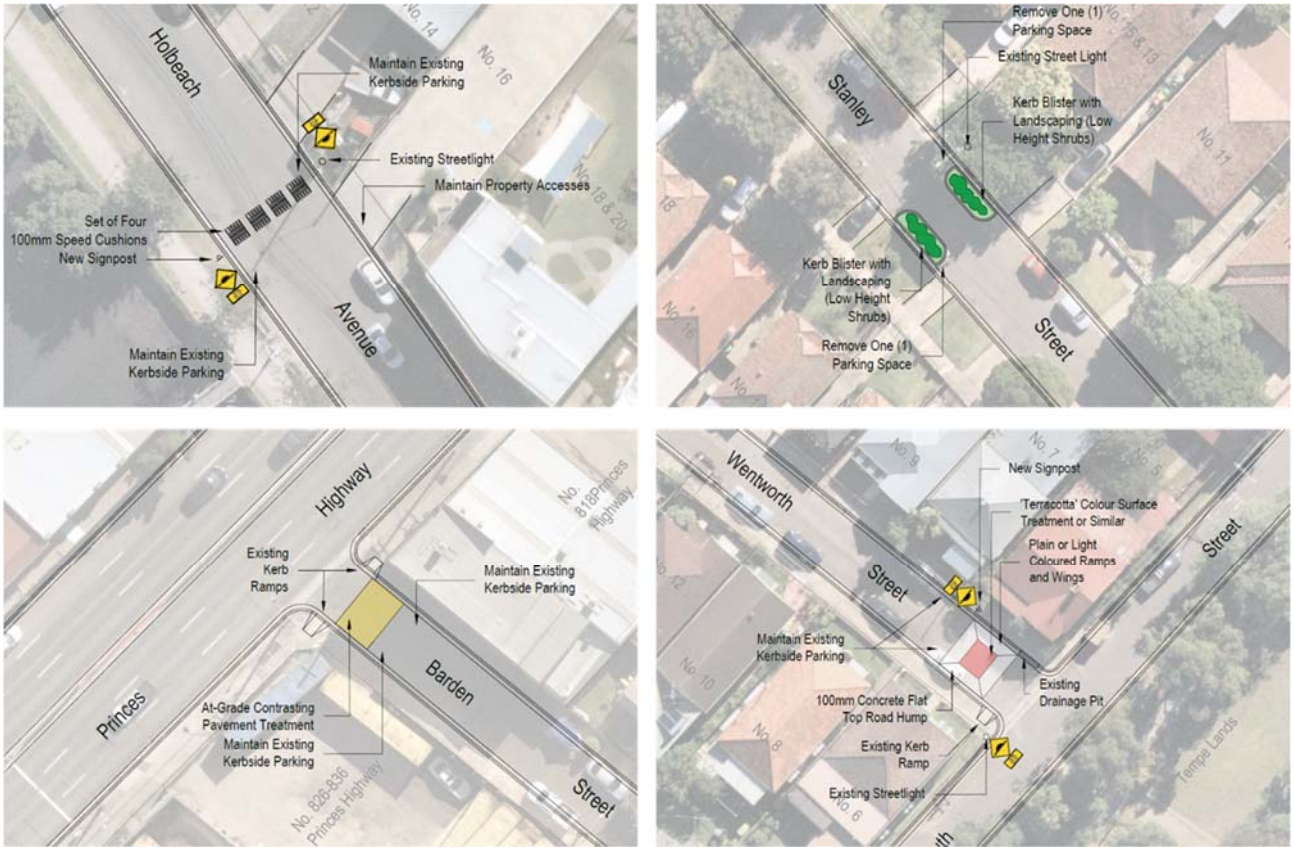


Figure 9.2: Proposed Treatment Locations

9.7 Concept Designs

A sample of concept designs related to the proposed treatment are presented in Figure 9.3. Detailed treatment concept designs are provided in **Appendix D.**



Clockwise from top: Speed Cushions, Road Narrowing (kerb Blisters), Flat Top Road Hump, Kerb Blisters and Contrasting Pavement

Figure 9.3: Sample Concepts of Proposed Treatments

10. PROPOSED TREATMENT JUSTIFICATION

10.1 Overview

This section describes each treatment option in detail by street and discusses its merits and potential impacts to the road environment such as property access and kerbside parking. The merits and impacts are summarised at the end of this section in Table 10.3 and Table 10.4 respectively.

Any LATM measures proposed may have an impact on the travel time of emergency service vehicles through the area. However, in consideration of the existing road environment along these local streets, any additional proposed LATM measures are not expected to have a significant impact to emergency service vehicle access. Additionally, the treatments proposed are not located along public or school bus routes, therefore, there are no anticipated impacts to buses.

10.2 Smith Street

10.2.1 Issues

As discussed in previous sections, the issues present on Smith Street are:

- Smith Street has relatively high average daily traffic (ADT) volumes, up to 600 vehicles per day in each direction, compared to other local roads in the study area.
- Smith Street has relatively high 85th percentile speeds of up to 46 km/h per direction compared to other local roads.
- Due to industrial land use located along Smith Street and its adjoining Wood Street, heavy vehicles are common along Smith Street. From the tube count data, on average, between 100 and 150 heavy vehicles travel along Smith Street daily in each direction, and make up 25 to 36% of the total daily traffic.
- Based on crash history, three (3) crashes occurred along Smith Street between January 2014 and December 2018, with two (2) crashes resulting in injuries.
- The proposed Bunnings development will be mainly accessed via Smith Street. There are concerns that the development will generate both light and heavy vehicle traffic, not just on Smith Street, but on other local roads such as Barden Street, South Street and Holbeach Avenue.
- Speed cushions were installed along Smith Street, as part of a previous LATM study, were removed in 2012 and 2017 respectively. This was due to resident complaints about the noise produced by trucks driving over the speed cushions. As such, vertical deflection devices such as speed humps were not considered as treatment options on Smith Street.

10.2.2 Location of Treatment Options

Treatment options for Smith Street will be located between the Bunnings access and access to No.1 Smith Street. The placement of treatment options mid-block on Smith Street breaks up the long straight section of the roadway, preventing drivers from gathering speed along the length of the road.

10.2.3 Option 1: Road Narrowing & Contrasting Pavement

This option involves landscaped kerb blisters on each side of the road, and an at-grade embossed text pattern as contrasting pavement between the kerb blisters. Additional measures to Smith Street regardless of Options 1 or 2 are described separately in Section 10.2.5.

10.2.3.1 Merits

Road narrowing will provide a narrow travel width, similar to existing treatments on neighbouring streets like Barden or Fanning Streets, which have an 85th percentile speed of less than 40 km/h. Therefore, providing road narrowing will strongly encourage traffic to slow down. Lower speeds will in turn increase travel time and may deter non-local traffic from utilising Smith Street.

Landscaping on the kerb blisters will also improve the aesthetics of the roadway and enhance sense of place. It may also provide clearer changes in road geometry for vehicles approaching the treatment.

The contrasting pavement will highlight the entry to a local traffic area by providing a physical and visual gateway treatment to the south section of Smith Street. The differentiation of road environment may be able to deter vehicles from turning left from the proposed Bunnings access onto Smith Street southbound. Combined with road narrowing, the reduced geometry may also be less favourable to heavy vehicles.

Road narrowing will result in a loss of parking along Smith Street. However, the removal of parking will improve sightlines for vehicles exiting the driveways from Bunnings and No.1 Smith Street. It also improves manoeuvrability of these turns as there is a reduced likelihood of parked vehicles obstructing the access points.

10.2.3.2 Impacts to Parking

The Bunnings development will result in the proposed removal of up to 13 spaces of on-street parking along Smith Street. These spaces are compensated with 13 spaces within Bunnings warehouse, which are open to access during Bunnings trading hours only. This removes the flexibility of parking at any time of the day for any duration. Given that most residents are expected to park overnight or outside business hours, as a worst-case scenario, these spaces will not be considered as part of the assessment.

From the parking surveys conducted on 19th and 21st March 2020, on a Thursday and Saturday respectively, it was deduced that on average, Smith Street has 18 vacant spaces on Thursday and 27 vacant spaces on Saturday. With the loss of 13 parking spaces due to the Bunnings development, this will result in an estimated 5 and 14 vacant spaces remaining on Thursday and Saturday respectively.

Road narrowing will result in a loss of up to two (2) parking spaces on the western side and one (1) space on the eastern side, a total of three (3) spaces. The remaining availability of on-street parking on Smith Street will therefore be able to cope with the further removal of spaces due to road narrowing.

10.2.3.3 Other Impacts

The kerb blisters will be built between the Bunnings access and the access to No.1 Smith Street. There are no property accesses on the western side at the proposed location. As such, there will be no impacts of the treatments on the accesses along Smith Street.

The at-grade contrasting pavement also means that there will be no additional noise generated as compared to vertical deflection devices such as speed cushions. An at-grade pavement also provides minimal or no impacts to cyclists riding along Smith Street.

The treatment option may have an impact on the travel time of emergency service vehicles through the area. However, in consideration of the existing road environment along these local streets, any additional proposed LATM measures are not expected to have a significant impact to emergency service vehicle access.

10.2.4 Option 2: Mountable Concrete Median

This option is a mountable low-profile concrete median. The pavement on the top of the median will also be contrasted against the road surface. Additional measures to Smith Street regardless of Options 1 or 2 are described separately in Section 10.2.5.

10.2.4.1 Merits

The change in road geometry highlights local traffic area by providing a physical and visual gateway treatment to the south section of Smith Street. The reduction in geometry also aid in the differentiation of road environment and may deter vehicles turning left from proposed Bunnings access onto Smith Street southbound.

The treatment is a horizontal deflection device and will be able to slow traffic by diverting vehicles around the island, particularly heavy vehicles due to their larger turn radius.

The median island will result in a loss of parking along Smith Street (see next section). Similar to option 1, the removal of parking may improve sightlines of vehicles turning out from the accesses onto Smith Street. It also improves manoeuvrability of these turns as there is a reduced likelihood of parked vehicles obstructing the access points of 1 Smith Street.

The median island is low-profile and mountable to allow vehicles to turn right out of 1 Smith Street onto Smith Street northbound and mount over the median.

10.2.4.2 Impacts to Parking

As mentioned in Option 1, Smith Street will have an estimated 5 and 14 vacant spaces remaining on Thursday and Saturday respectively, after spaces are removed for the Bunnings development.

The median island will result in a loss of seven (7) parking spaces on the western side and one (1) space on the eastern side, a total of eight (8) spaces. With the removal of these eight spaces, this will result in a **shortage of three (3) spaces** on a Thursday, and residential parking will be displaced onto adjacent streets such as Barden Street or South Street. Parking availability on Saturday will still be able to cope with the additional removal of spaces due to the median island.

On Thursday, Barden Street has a parking occupancy rate of around 50% out of 63 spaces, and South Street between Smith and Fanning Streets has a parking occupancy rate of around 40% out of 19 spaces. This means out of a total of 82 spaces, 39 are occupied and 42 are vacant, and therefore, Barden and South Streets will be able to cope with the additional parking demand of the three displaced vehicles.

It is also important to note that this is based on the worst-case scenario where most residents are expected to park overnight or outside Bunnings trading hours. It is possible that some residents may park within Bunnings overnight.

10.2.4.3 Other Impacts

As the median island is built in the centre of the roadway, it will not require changes to accesses along Smith Street. Traffic exiting 1 Smith Street will still be able to turn right onto Smith Street northbound by mounting over the concrete median.

The island will also slow down cyclists riding along Smith Street as they need to divert around the island. However, the impact is minimal and the device is still ‘bicycle-friendly’.

The treatment option may have an impact on the travel time of emergency service vehicles through the area. However, in consideration of the existing road environment along these local streets, any

additional proposed LATM measures are not expected to have a significant impact to emergency service vehicle access.

10.2.5 Additional Measures to Options 1 & 2

In addition to the location specific treatment as part of Option 1 and 2, other measures are proposed along Smith Street between Princes Highway and South Street. Some of these measures will also aid in increased connectivity for cyclists along pedestrians and Smith Street.

10.2.5.1 Right Turn Only Sign

The “Right turn only” sign located opposite and facing Bunnings will enforce turn restrictions, preventing traffic exiting Bunnings from turning left onto Smith Street and using local streets.

10.2.5.2 Line Marking

Edge and centre line markings will be provided along Smith Street (partially under Option 1, full length under Option 2), in addition to proposed line marking as part of Bunnings development arrangement. It will also provide differentiation between the northern and southern sections of Smith Street. Recommended delineation alignments to tie in with the proposed treatments have also been provided in the concept drawings in **Appendix B**.

10.2.5.3 Bicycle Infrastructure

To provide off and on road bicycle transitions and connect the route on Smith Street to Princes Highway, the existing shared paths along Princes Highway will be extended on Smith Street, with kerb ramps and delineation. This aims to aid bicycles to transition to mixed traffic (bicycle and vehicles) along Smith Street away from the Princes Highway intersection. This will involve realignment and widening of the existing footpaths to allow one-way bicycle travel at minimum.

An angled bicycle ramp for southbound cyclists will be located on the eastern shared path, along with wayfinding and pavement markings to guide cyclists onto the road. Northbound cyclists will utilise the existing driveway of 48 Smith Street to access the extended shared path. Signage and marking will be used to guide cyclists to transition onto the shared path to travel along the existing Princes Highway shared paths.

On-road bicycle markings spaced evenly along Smith Street reaffirm that Smith Street is a mixed-traffic cycling route.

10.2.5.4 Widened Footpath

Option a

The non-shared path section of the western footpath will be widened to 2.5m width to provide improved pedestrian facility. This option is known as **Option 1a or 2a** in the concept plans. Kerbside parking will be retained and delineated by edge line marking. The delineation will also provide a road narrowing along Smith Street and assist in slowing down vehicles.

Option b

Alternatively, the kerbside parking may be replaced with a landscaped verge of 1.6m width to provide a form of screening between the widened footpath and the roadway. This option is known as **Option 1b or 2b** in the concept plans. The reduced roadway width will also assist in slowing down vehicles. However, this will result in the loss of 31 kerbside parking spaces on the western side of the road. Six (6) spaces will be retained for parking, resulting in a net loss of 25 spaces on the western side of the road, i.e. a total of 26 spaces on both sides.

As mentioned previously, Smith Street will have an estimated 5 and 14 vacant spaces remaining on Thursday and Saturday respectively, after spaces are removed for the Bunnings development. The removal of 26 spaces will result in the overflow of 21 and 12 spaces onto adjacent streets on Thursday and Saturday respectively. Barden and South Streets, with a total of 42 vacant spaces, will be able to absorb the overflow of parking from Smith Street.

A summary of the loss in parking on Smith Street for the different options is shown in Table 10.1.

Table 10.1: Loss of Smith Street Parking Spaces between Different Options

Option	Western side	Eastern side	Total spaces lost from Design	Spaces removed for Bunnings	Total spaces removed	Existing vacant spaces	Vacant spaces remaining[1]
Thursday							
Option 1a	3	1	4	13	17	18	1
Option 2a	8	1	9	13	22	18	-4
Option 1b	25	1	26	13	39	18	-21
Option 2b	25	1	26	13	39	18	-21
Saturday							
Option 1a	3	1	4	13	17	27	10
Option 2a	8	1	9	13	22	27	5
Option 1b	25	1	26	13	39	27	-12
Option 2b	25	1	26	13	39	27	-12

1. Negative vacant spaces indicates parking demand exceeds capacity, resulting in parking overflow

10.3 Holbeach Avenue

10.3.1 Issues

As discussed in previous sections, the issues present on Holbeach Avenue are:

- Holbeach Avenue has relatively high average daily traffic (ADT) volumes, up to 550 vehicles per day in each direction, compared to other local roads in the study area.
- Holbeach Avenue has relatively high 85th percentile speeds of up to 44 km/h per direction compared to other local roads.
- Based on crash history, five (5) crashes occurred along Holbeach Avenue between January 2014 and December 2018, all resulting in injuries.

10.3.2 Location of Treatment Options

Treatment options for Smith Street will be located between the accesses of 14 and 16 Holbeach Avenue. Placing treatment options mid-block on Holbeach Avenue breaks up the long straight section of the roadway, preventing drivers from speeding up along the road.

The existing streetlight outside 14 Holbeach Avenue will also provide visibility of the device at night.

10.3.3 Option 1: Speed Cushions

This option involves a set of four (4) speed cushions of 100mm height across the roadway, along with associated signage.

10.3.3.1 Merits

It is generally uncomfortable for drivers of vehicles to travel over vertical deflections at high speeds. By providing speed cushions as vertical deflections, vehicles will slow down in order to safety travel over the speed cushions. Lower speeds will in turn increase travel time and may deter non-local traffic from utilising Holbeach Avenue as an alternative route.

10.3.3.2 Impacts to Parking

As speed cushions do not require changes in roadway geometry, there will also be no impacts to kerbside parking or driveway accesses. Vehicles can still park over the road hump.

10.3.3.3 Other Impacts

The low profile of speed cushions allows for buses and service vehicles to travel to the Tempe recreation area. Bicycles can also safely get over speed cushions after slowing down.

Noise generated from travelling over speed cushions is not an issue as the land use along Holbeach Avenue is non-residential in nature.

10.3.4 Option 2: Speed Cushions and Road Narrowing

This option is similar to option 1 in providing speed cushions. However, only a set of two (2) speed cushions of 100mm height will be provided across the roadway, with landscaped kerb blisters on each side of the road to provide narrowing of the roadway.

10.3.4.1 Merits

Similar to Option 1 for Smith Street, road narrowing will provide a narrow travel width and will likely be able to force traffic to slow down. Landscaping on the kerb blisters may also improve the aesthetics of the roadway and enhance sense of place. It may also provide clearer changes in road geometry for vehicles approaching the treatment.

Road narrowing will result in a loss of parking along Holbeach Avenue (see next section). However, the removal of parking may improve sightlines of vehicles turning out from the accesses onto Holbeach Avenue. It also improves manoeuvrability of these turns as there is a reduced likelihood of parked vehicles obstructing the access points of 14 and 16 Holbeach Avenue.

10.3.4.2 Impacts to Parking

Road narrowing will result in a loss of up to one (1) parking space on each side of the road, a total of two (2) spaces. While there are no parking surveys available for Holbeach Avenue, observations during site visit show that there are ample vacant on-street parking spaces along Holbeach Avenue during the daytime. It is very likely that the parking availability of Holbeach Avenue is able to cope with the loss of a mere two spaces.

10.3.4.3 Other Impacts

Impacts of speed cushions on traffic have been outlined in Option 1 and will not differ in Option 2.

The kerb blisters will be built between 14 and 16 Holbeach Avenue. There are no property accesses on the western side at the same location. As such, there will be no impacts of the treatments on the accesses along Holbeach Street.

The treatment option (road narrowing) may have an impact on the travel time of emergency service vehicles through the area. However, in consideration of the existing road environment along these local streets, any additional proposed LATM measures are not expected to have a significant impact to emergency service vehicle access.

10.4 Stanley Street

10.4.1 Issues

As discussed in previous sections, the issues present on Stanley Street are:

- Stanley Street has relatively high 85th percentile speeds of up to 45 km/h per direction compared to other local roads, although these speeds are below the speed limit of 50 km/h.
- Stanley Street also has up to 13 heavy vehicles per direction daily, despite the 3 tonne truck load limit imposed.

10.4.2 Location of Treatment Options

Treatment options for Stanley Street will be located at two locations: outside 14 and 37 Stanley Street. The treatments to be installed at both locations will be the same.

Placing treatment options on two mid-block locations along Stanley Street breaks up the long straight section of the roadway, preventing drivers from speeding up along the road. The spacing between both locations are also consistent with spacing recommendations

Existing streetlights outside 13-15 Stanley Street and 37 Stanley Street will also provide visibility of the devices at night.

10.4.3 Option 1: Flat Top Road Hump

This option involves a 100mm high concrete flat top road hump across the roadway at each location. The hump will have a contrasting surface treatment, usually a ‘terracotta’ colour surface.

10.4.3.1 Merits

Similar to speed cushions, by providing flat top road humps as vertical deflections, vehicles will slow down in order to safety travel over the humps. Lower speeds will in turn increase travel time and may deter non-local traffic from utilising Stanley Street.

Flat top road humps are consistent with other LATM devices in the area, particularly along Edwin Street.

10.4.3.2 Impacts to Parking

As flat top road humps do not require changes in roadway geometry, there will also be no impacts to kerbside parking or driveway accesses. Vehicles can still park over the road hump.

10.4.3.3 Other Impacts

As Stanley Street is not a heavy vehicle or bus route, there will be no noise generated as a result of trucks or buses travelling over the road hump. Bicycles will still be able to safely get over speed cushions.

10.4.4 Option 2: Road Narrowing

This option involves landscaped kerb blisters on each side of the road at each location.

10.4.4.1 Merits

Similar to road narrowing options proposed in other roads, road narrowing will provide a narrow travel width and will likely be able to force traffic to slow down. Lower speeds will in turn increase travel time and may deter non-local traffic from utilising Stanley Street.

Landscaping on the kerb blisters may also improve the aesthetics of the roadway and blend into the local landscape. It may also provide clearer changes in road geometry for vehicles approaching the treatment.

Road narrowing will result in a loss of parking along Stanley Street (see next section). However, the removal of parking may improve sightlines of vehicles turning out from the accesses onto Stanley Street. It also improves manoeuvrability of these turns as there is a reduced likelihood of parked vehicles obstructing nearby access points.

Kerb blisters are consistent with other LATM devices in the area, particularly along Union Street.

10.4.4.2 Impacts to Parking

Road narrowing will result in a loss of up to one (1) parking space on each side of the road at each of the two (2) locations, a total of four (4) spaces. While there are no parking surveys available for Stanley Street, observations made during a site visit show that there are ample vacant on-street parking spaces along Stanley Street during the daytime. It is very likely that the parking availability of Stanley Street is able to cope with the loss of four spaces.

10.4.4.3 Other Impacts

The kerb blisters will be built in between driveways of properties along Stanley Street. As such, there will be no impacts on the property access.

Road narrowing in general may slightly increase travel time of emergency service vehicles through the area due to reduced speed. However, considering the existing road environment along these local streets, any additional proposed LATM measures are not expected to have a significant impact on emergency service vehicle access.

10.5 Wentworth Street

10.5.1 Issues

As discussed in previous sections, the issues present on Wentworth Street are:

- Wentworth Street has up to 10 heavy vehicles per direction daily, despite the 3-tonne truck load limit imposed.
- A signage audit noted missing truck load limit signage when approaching Wentworth Street from Princes Highway.

10.5.2 Location of Treatment Options

Treatment options for Wentworth Street will be located at two locations: north of South Street (outside 5 Wentworth Street) and south of Princes Highway (outside 846-854 Princes Highway, south of the Tempe Tyre Centre access). The treatments to be installed at both locations will be the same.

10.5.3 Option 1: Road Narrowing & Contrasting Threshold

This option involves landscaped kerb blisters on each side of the road at each location, and an at-grade embossed text pattern as contrasting pavement between the kerb blisters.

10.5.3.1 Merits

Similar to Option 1 for Smith Street, providing road narrowing will encourage traffic to slow down. Lower speeds will in turn increase travel time and may deter non-local traffic from utilising Stanley Street.

Landscaping on the kerb blisters may also improve the aesthetics of the roadway and enhance sense of place. It may also provide clearer changes in road geometry for vehicles approaching the treatment.

The contrasting pavement will highlight the local traffic area by providing a physical and visual gateway treatment to Wentworth Street. The differentiation of road environment may discourage vehicles from turning into Wentworth Street, particularly from South Street. Combined with road narrowing, the reduce geometry may also be less favourable to heavy vehicles and deter them from turning into Wentworth Street.

Road narrowing will result in a loss of parking along Wentworth Street. However, the removal of parking may improve sightlines for vehicles exiting driveways onto Wentworth Street. It also improves manoeuvrability of these turns as there is a reduced likelihood of obstruction from parked vehicles .

10.5.3.2 Impacts to Parking

Road narrowing will result in a loss of up to one (1) parking space on each side of the road at the location south of Princes Highway. There is no nominal loss of parking spaces at the location north of South Street as it is within 10 metres from a T-intersection, meaning it has an existing non-signposted No Stopping restriction. Therefore, a total of two (2) spaces will be lost.

While there are no parking surveys available for Wentworth Street, observations during site visit show that there are ample vacant on-street parking spaces along Wentworth Street during the daytime. It is very likely that the parking availability of Wentworth Street is able to cope with the loss of two spaces.

10.5.3.3 Other Impacts

At the location south of Princes Highway, the kerb blisters will be built between the property access of 846 Princes Highway and Tempe Tyre Centre access. At the location north of South Street, there are no property accesses adjacent to the device location. As such, there will be no impacts on the accesses along Wentworth Street.

Road narrowing in general may slightly increase travel time of emergency service vehicles through the area due to reduced speed. However, considering the existing road environment along these local streets, any additional proposed LATM measures are not expected to have a significant impact on emergency service vehicle access.

10.5.4 Option 2: Flat Top Road Hump

This option involves a 100mm high concrete flat top road hump across the roadway at each location. The road hump will have a contrasting surface treatment, usually a ‘terracotta’ colour surface.

10.5.4.1 Merits

By providing flat top road humps as vertical deflections, vehicles will slow down in order to safety travel over the humps. Lower speeds will in turn increase travel time and may deter non-local traffic from utilising Wentworth Street.

10.5.4.2 Impacts to Parking

As flat top road humps do not require changes in roadway geometry, there will also be no impacts to kerbside parking or driveway accesses. Vehicles can still park over the road hump.

10.5.4.3 Other Impacts

As Wentworth Street is not a heavy vehicle or bus route, there will be no noise generated as a result of trucks or buses travelling over the road hump. Bicycles will still be able to safely get over the road humps.

10.5.5 Additional Measures to Options 1 & 2

In addition to Option 1 or 2, truck restriction (3t limit) is proposed at the northern end of Wentworth Street. The signage along Princes Highway will provide an early indication and warning of the truck restriction along Wentworth Street, while the signage along Wentworth Street south of the Tempe Tyre Centre access will enforce the truck load limit and reinforce the local road environment. The signage aims to reduce heavy vehicles accessing Wentworth Street from Princes Highway, with the exception of delivery vehicles accessing Tempe Tyre Centre.

10.6 Union Street

10.6.1 Issues

As discussed in previous sections, the issues present on Union Street are:

- Union Street has relatively high average daily traffic (ADT) volumes of almost 500 vehicles per day, compared to other local roads in the study area.
- Due to its proximity to a school, there is high pedestrian activity especially before and after school hours

Additionally, Union Street will be impacted by traffic generated from Bunnings, and will likely heighten any of the existing traffic issues.

Other options such as a closure of Union Street at Princes Highway have been considered, however, such a closure will result in a number of unfavourable routes and outcomes.

10.6.2 Option 1: Flat Top Road Hump

This option involves a 100mm high concrete flat top road hump across the roadway at each location. The road hump will have a contrasting surface treatment, usually a ‘terracotta’ colour surface.

The flat top road humps will be located outside 2 Union Street and outside 46 Union Street.

10.6.2.1 Merits

By providing flat top road humps as vertical deflections, vehicles will slow down in order to safety travel over the humps. Lower speeds will in turn increase travel time and may deter non-local traffic from utilising Union Street, in particularl utility type vehicles.

10.6.2.2 Impacts to Parking

As flat top road humps do not require changes in roadway geometry, there will also be no impacts to kerbside parking or driveway accesses. Vehicles can still park over the road hump.

10.6.2.3 Other Impacts

As Union Street is not a heavy vehicle or bus route, there will be no noise generated as a result of trucks or buses travelling over the road hump. Bicycles will still be able to safely travel over the road humps.

10.6.3 Option 2: Shared Zone

This option involves implementing a 10 km/h shared zone between Princes Highway and School Lane. Marked parking bays will be provided along the shared zone, with some overlapping with the footpath. The shared zone will require approval from Transport for NSW.

10.6.3.1 Shared Zone Warrants

Transport for NSW *Shared Zone Policy* (SS/12/01) provides a set of criteria for implementing shared zones. The proposal area was assessed against the criteria, shown in Table 10.2. Transport for NSW technical direction *Design and implementation of shared zones including provision for parking* (TTD2016/001) was also considered for the design of the shared zone.

10.6.3.2 Merits

A 10 km/h shared zone will force vehicles to slow down along Union Street. Additionally, vehicles must always give way to all pedestrians crossing Union Street. This will increase pedestrian safety, particularly to school children from Tempe Public School and Union Street residents. Lower speeds will also increase travel time and may deter non-local traffic from utilising Union Street.

Marked parking bays will be provided along the shared zone, with some overlapping with the footpath. This will formalise parking on the footpath, which is already present on Union Street.

10.6.3.3 Impacts to Parking

The marked parking bays will retain parking along Union Street. However, each bay must meet the dimensional requirements of *AS2890.5 On-street parking*, which state that most spaces must be 6.0-6.7 metre long. The parking bays will be slightly longer than the existing unmarked parking spaces, hence reducing the parking capacity of Union Street and a small reduction of parking spaces. Based on the parking surveys, the parking occupancy of Union Street is about 60-80%, which allows some room for the reduction of a few parking spaces without impacting on capacity. The PWD space on the eastern side of Union Street will be retained and marked.

10.6.3.4 Other Impacts

As the shared zone has no physical changes to the roadway, there will be no changes to waste collection services and routes. Parking bays will not be marked outside driveway accesses to maintain property accesses at all times.

10.6.4 Additional Measures to Options 1 & 2

An at-grade contrasting pavement is proposed at the start of Union Street to deter non-local traffic from travelling along Union Street.

Table 10.2: Shared Zone Criteria Assessment

Features	Shared Zone Criteria	Union Street between Princes Highway and School Lane	Meets Criteria?
Current traffic flows	≤ 100 vehicles per hour and ≤ 1000 vehicles per day	Less than 100 per hour based on intersection count surveys and tube counts Average of 487 vehicles per day based on tube counts	Yes
Current speed limit	≤50 km/h	50 km/h	Yes
Length of proposed Shared Zone	≤400 metres	Around 215 metres	Yes
Current speed limit of adjoining roads	≤50km/h	Adjoining roads Smith Street, Zuitton Lane, Brooklyn Lane and School Lane are not signposted and are assumed to have the default 50 km/h speed limit. Princes Highway is 60 km/h, however vehicles would already have to slow down when turning into Union Street.	Yes
Current Carriageway width	Minimum traffic width of 2.8 metres	Assuming vehicles are allowed to park on footpaths, a traffic width of at least 2.8 metres is possible	Yes
Route Access	Must not be located along bus routes or heavy vehicle routes except delivery or garbage trucks	No bus routes Not a heavy vehicle route due to the 3 tonne truck load limit	Yes
Streets with narrow or no footpaths	Where pedestrians are forced to use the road	Footpaths are already quite narrow and are further narrowed with parked vehicles on footpath	Yes
Kerbs	Kerbs must be removed unless excepted by RMS / Transport for NSW	A Category 2 shared zone as shown in TTD2016/001 can be implemented, without the removal of kerbs.	Yes
All criteria met?			Yes

10.7 Edwin Street

10.7.1 Issues

As discussed in previous sections, the issues present on Edwin Street include:

- Relatively high average daily traffic (ADT) volumes of over 400 vehicles per day, compared to other local roads in the study area
- Due to its proximity to a school, there is a high level of pedestrian activity especially during AM and PM school peaks

In addition, there is potential for Bunnings generated traffic to use Edwin Street as an alternative route to access Unwins Bridge Road.

10.7.2 Option 1: Flat Top Road Hump

This option involves a 100mm high concrete flat top road hump across the roadway with a contrasting surface treatment, such as a ‘terracotta’ colour surface and light coloured ramps / wings.

The flat top road hump will be located outside No. 14 Edwin Street, and complement the existing road hump on east of Stanley Street.

10.7.2.1 Merits

While speed is not a concern along Edwin Street, by providing flat top road hump as vertical deflections, vehicles will slow down in order to safety travel over the humps. This provides two benefits:

- Lower speeds to increase pedestrian safety, particularly during school pick up and drop off locations
- Increased travel time and a less comfortable road environment in conjunction with the existing road hump and narrow carriageway should deter non-local traffic from using Edwin Street.

10.7.2.2 Impacts to Parking

No changes to kerbside alignments are proposed, the flat top road hump will have no impact on kerbside parking or driveway accesses. Vehicles can still park over the road hump. Landscaped barriers on the kerbside may hinder opening of car doors.

10.7.2.3 Other Impacts

As Edwin Street is not a heavy vehicle or bus route, there will be little noise generated as a result of trucks or buses travelling over the road hump. Bicycles will still be able to safely travel over the road humps.

10.8 Tramway Street

10.8.1 Issues

Tramway Street does not currently experience excess traffic speed or volume issues, however has been identified as potential alternative route or rat run for non-local traffic, including Bunnings development traffic.

10.8.2 Option 1: Contrasting Thresholds

Due to the restricted carriageway and length of road and existing splitter island at Edwin Street, further physical treatment won't be necessary along Tramway Street. However, contrasting thresholds are proposed to be located at each end (Unwins Bridge Road and Edwin Street).

10.8.2.1 Merits

The contrasting thresholds provide a visual indicator of the change in road environment on entry to Tramway Street, particularly at Unwins Bridge Road. The threshold will act as a visual gateway to the local residential area and aim to deter non-local traffic.

10.8.2.2 Impacts to Parking

The contrasting threshold will have no impacts to existing kerbside parking.

10.9 Barden, Fanning, Hart and Station Streets

At-grade contrasting threshold pavements are proposed along Barden, Fanning, Hart and Station Streets just south of Princes Highway.

While there are no existing issues with these four roads, LATM measures should still be put in place to further deter non-local traffic from travelling along these local roads, particularly from Princes Highway.

It is understood that a 40 km/h Local Traffic Area, including the study area south of Princes Highway, is intended to be implemented in the future. This reduction in speed limit will be subject to a speed review study, potentially including further proposed traffic calming treatments. These treatments and the 40km/h Local Traffic Area will be subject to review and approval by Transport for NSW.

10.9.1.1 Merits

The contrasting pavement will highlight the local traffic area by providing a physical and visual gateway treatment to these local roads. The differentiation of road environment may be able to deter vehicles turning left from Princes Highway onto the local roads.

10.9.1.2 Impacts to Parking

As the threshold pavements require no physical change to the roadway geometry, there will be no impacts to parking. As the proposed locations are within 10 metres from T-intersections, there are already existing No Stopping restrictions at the locations in accordance with the Australian Road Rules.

10.9.1.3 Other Impacts

As the contrasting pavements do not involve any horizontal or vertical deflection of the roadway, there will be no impacts to property access, cyclists or emergency service vehicles.

10.10 Summary of Merits

The merits of each proposed treatment are summarised in Table 10.3. Deterring non-local traffic was a key objective in all proposed treatments.

Table 10.3: Merits of Proposed Treatments

Road	Option	Type	Rationale
Smith Street	1	Road Narrowing and Contrasting Pavement	▪ Historic non-preference for vertical deflection devices such as speed humps or cushions ▪ Kerb blisters slows traffic by providing a narrow travel width ▪ Can reduce travel width similar to neighbouring streets ▪ Highlights local traffic area by providing a physical and visual gateway treatment to the south section of Smith Street ▪ Differentiation of road environment may deter vehicles turning left from proposed Bunnings access Smith Street south ▪ Reduced geometry less favourable to heavy vehicles ▪ Breaks up long straight section of roadway ▪ Landscaped elements may enhance sense of place ▪ Removal of parking improves sightlines and manoeuvrability of traffic entering Smith Street ▪ No noise impacts to residences ▪ Bicycle friendly (with appropriate road markings)
	2	Mountable Concrete Median Treatment	▪ Historic non-preference for vertical deflection devices such as speed humps or cushions ▪ Highlights local traffic area by providing a physical and visual gateway treatment to the south section of Smith Street ▪ Differentiation of road environment may deter vehicles turning left from proposed Bunnings access Smith Street south ▪ Reduced geometry less favourable to heavy vehicles and slows traffic by diverting vehicles around the island ▪ Breaks up long straight section of roadway ▪ Removal of parking improves sightlines and manoeuvrability of traffic entering Smith Street ▪ No noise impacts to residences ▪ Bicycle friendly (with appropriate road markings) ▪ Low-profile allows right-turning trucks out of 1 Smith Street to mount over the median
	Additional to both options	Right Turn Only Signage	▪ Right turn only" sign deters traffic exiting Bunnings from turning left onto Smith Street

Road	Option	Type	Rationale
Smith Street	Additional to both options	Line Marking	▪ Difference in line marking between the northern and southern sections of Smith Street provide differentiation of road environment between both sections ▪ Differentiation of road environment may deter vehicles turning left from proposed Bunnings access Smith Street south ▪ Recommended lane delineation alignments tie in with the proposed treatments ▪ Provides clear travel lanes for vehicles and cyclists, with sufficient clearance from parked vehicles and opposing traffic
		Bicycle Facilities	▪ Shared paths allow cyclists to ride between on-road cycling along Smith Street and the Princes Highway shared path without dismounting ▪ Bicycle ramps provide off and on-road bicycle transitions between the Smith Street roadway and the shared path ▪ On-road bicycle markings spaced evenly along Smith Street reaffirm that Smith Street is a mixed-traffic cycling route
		Widened Footpath	▪ Provide improved pedestrian facility ▪ Reduced roadway provides a road narrowing along Smith Street and assist in slowing down vehicles
		Optional Landscaped Verge (Option b)	▪ Provides form of screening from the roadway
Holbeach Avenue	1	Speed Cushions (x4)	▪ Slows vehicles down by providing vertical deflection which may be inconvenient to speeding vehicles ▪ Lower speeds increase travel time and may deter non-local traffic ▪ Allows for bus and service vehicle travel to Tempe recreation area ▪ Does not impact kerbside parking ▪ Minimises impact to driveway access ▪ No noise impacts to residences (industrial area) ▪ Located near street lighting for better visibility at night ▪ Spacing between intersections consistent with recommendations ▪ Bicycle friendly

Road	Option	Type	Rationale
Holbeach Avenue	2	Speed Cushions (x2) & Road Narrowing	▪ Slows vehicles down by providing vertical deflection which may be inconvenient to speeding vehicles ▪ Lower speeds increase travel time and may deter non-local traffic ▪ Provides further traffic calming by narrowing the available roadway ▪ Landscaped kerb blisters may enhance the local streetscape ▪ Provides physical and visual gateway to area ▪ No noise impacts to residences (industrial area) ▪ Located near street lighting for better visibility at night ▪ Spacing between intersections consistent with recommendations ▪ Bicycle friendly
Stanley Street	1	Flat Top Road Hump	▪ Breaks up long straight section of roadway ▪ Slows vehicles down by providing vertical deflection which may be inconvenient to speeding vehicles ▪ Lower speeds increase travel time and may deter non-local traffic ▪ Consistent with other LATM devices in the area ▪ Located near street lighting for better visibility at night ▪ Treatment spacing consistent with spacing recommendations ▪ Does not impact kerbside parking
	2	Road Narrowing	▪ Slows vehicles down by providing horizontal deflection ▪ Lower speeds increase travel time and may deter non-local traffic ▪ Kerb blisters break up long straight section of roadway ▪ Provides a permanent narrowing of roadway ▪ Landscaped features are visually more appealing and will allow the device to blend into the local streetscape ▪ Located near street lighting for better visibility at night ▪ Treatment spacing consistent with spacing recommendations ▪ Consistent with other LATM devices in the area
Wentworth Street	1	Road Narrowing & Contrasting Pavement	▪ May deter heavy vehicle traffic and slow vehicles down by reducing roadway widths and increasing roadway friction ▪ Lower speeds increase travel time and may deter non-local traffic ▪ Highlights local traffic area by providing a visual gateway treatment to the local roads ▪ Differentiation of road environment may deter vehicles from turning into Wentworth Street

Road	Option	Type	Rationale
Wentworth Street	2	Flat Top Road Hump	▪ Slows vehicles down by providing vertical deflection which may be inconvenient to speeding vehicles ▪ Lower speeds increase travel time and may deter non-local traffic ▪ Highlights local traffic area by providing a visual gateway treatment to the local roads ▪ Differentiation of road environment may deter vehicles turning into Wentworth Street
	Additional to both options	3 Tonne Truck Limit Signage	▪ Deter heavy vehicles from turning into Wentworth Street from Princes Highway, other than to access Tempe Tyre Centre
Union Street	1	Flat Top Road Hump	▪ Breaks up long straight section of roadway ▪ Slows vehicles down by providing vertical deflection which may be inconvenient to speeding vehicles ▪ Lower speeds increase travel time and may deter non-local traffic ▪ Consistent with other LATM devices in the area ▪ Located near street lighting for better visibility at night ▪ Treatment spacing consistent with spacing recommendations ▪ Does not impact kerbside parking
	2	Shared Zone	▪ Slows vehicles down with a 10 km/h speed limit ▪ Lower speeds increase travel time and may deter non-local traffic ▪ The nature of shared zone also gives priority to pedestrians and increase pedestrian safety ▪ Marked parking bays on footpaths formalises parking on footpath
	Additional to both options	Contrasting Pavement Threshold	▪ Highlights local traffic area by providing a visual gateway treatment to the local roads ▪ Differentiation of road environment may deter vehicles from turning into Union Street from Princes Highway
Edwin Street	1	Flat Top Road Hump	▪ Breaks up long straight section of roadway ▪ Slows vehicles down by providing vertical deflection ▪ Lower speeds improve pedestrian safety, increases travel time and may deter non-local traffic ▪ Consistent with existing road hump on Edwin Street ▪ Located near street lighting for better visibility at night ▪ Treatment spacing consistent with spacing recommendations ▪ Does not impact kerbside parking
Tramway Street	1	Contrasting Pavement Threshold	▪ Highlights local traffic area by providing a visual gateway treatment to the local roads ▪ Differentiation of road environment may deter vehicles from turning into Tramway Street from Unwins Bridge Road

Road	Option	Type	Rationale
Barden, Fanning, Hart and Station Streets	-	Contrasting Pavement Threshold	▪ Highlights local traffic area by providing a visual gateway treatment to the local roads ▪ Differentiation of road environment may deter vehicles from turning into these local streets from Princes Highway ▪ Complements existing truck load limit signage

10.11 Summary of Impacts

The possible impacts on kerbside parking, property accesses and cyclists are summarised in Table 10.4.

Table 10.4: Impacts of Proposed Treatments

Road	Option	Type	Impacts to Parking & Access	Impacts to Cyclists
Smith Street	1	Road Narrowing and Contrasting Pavement	▪ Up to two (2) parking spaces removed on the western side and one (1) space on the eastern side Combined with the loss of 13 on-street parking as part of Bunnings development, a total of 16 on-street parking will be lost. Two (2) vacant spaces will still be available on Smith Street on an average Thursday. ▪ No impacts to 1 Smith Street access.	▪ Minimal impacts to cyclists on roadway
	2	Mountable Concrete Median Treatment	▪ Up to seven (7) parking spaces removed on the western side and one (1) space on the eastern side. Combined with the loss of 13 on-street parking as part of Bunnings development, a total of 21 on-street parking will be lost. On average Thursday, there will be a **shortage of three (3) spaces** and will result in a flow-on effect of residential parking onto other streets such as Barden Street or South Street. ▪ Right-turning vehicles exiting 1 Smith Street access may and will be allowed to mount over the low-profile median.	▪ Cyclists on roadway will have to slow down to divert around the median treatment
	Additional to both options	Right Turn Only Signage	▪ Vehicles exiting the Bunnings access must turn right	▪ No impact to cyclists
		Line Marking	▪ Minimal impacts	▪ Minimal negative impacts

Road	Option	Type	Impacts to Parking & Access	Impacts to Cyclists
		Bicycle Facilities	▪ One (1) parking space loss	▪ Minimal negative impacts
		Widened Footpath	▪ Footpath must be designed to allow access driveways and the roadway ▪ Minimal impacts to parking, as kerbside parking will be retained	▪ No impact to cyclists
		Optional Landscaped Verge (Option b)	▪ Removal of 25 parking spaces on the western side	▪ No impact to cyclists
Holbeach Avenue	1	Speed Cushions (x4)	▪ No impacts to parking, as vehicles are still able to park over speed cushions ▪ No impacts to property accesses.	▪ Minimal impacts to cyclists as they are expected to utilise the shared path adjacent to roadway
	2	Speed Cushions (x2) and Road Narrowing	▪ One (1) parking space removed on each side of the roadway, total two (2) ▪ No impacts to property accesses.	▪ Minimal impacts to cyclists as they are expected to utilise the shared path adjacent to roadway
Stanley Street	1	Flat Top Road Hump	▪ No impacts to parking, as vehicles are still able to park over flat top road humps ▪ No impacts to property accesses.	▪ Cyclists on roadway will have to slow down to safely get over the hump
	2	Road Narrowing	▪ For each location: one (1) parking space removed on each side of the roadway, total two (2) per location ▪ No impact to property accesses.	▪ Minimal impacts to cyclists on roadway
Wentworth Street	1	Road Narrowing & Contrasting Pavement	▪ For the location south of Princes Highway: one (1) parking space removed on each side of the roadway, total two (2) spaces ▪ No nominal loss of parking spaces for the location north of South Street, as it is located within 10 metres from a T-intersection, meaning it has an existing non-signposted No Stopping restriction ▪ Minimal impacts to property accesses, including vehicular access to Tempe Tyre Centre. May impact waste access to Tempe Tyre Centre.	▪ Minimal impacts to cyclists on roadway

Road	Option	Type	Impacts to Parking & Access	Impacts to Cyclists
	2	Flat Top Road Hump	▪ No impacts to parking, as vehicles are still able to park over flat top road humps ▪ No impacts to property accesses.	▪ Cyclists on roadway will have to slow down to safely get over the hump
	Additional to both options	3 Tonne Truck Limit Signage	▪ Any heavy vehicle accidentally turning into Wentworth Street will have to exit via Tempe Tyre Centre	▪ No impact to cyclists
Union Street	1	Flat Top Road Hump	▪ No impacts to parking, as vehicles are still able to park over flat top road humps ▪ No impacts to property accesses.	▪ Cyclists on roadway will have to slow down to safely get over the hump
	2	Shared Zone	▪ The longer marked parking bays will result in a small number of parking spaces ▪ Parking bays will stay clear of property driveways to ensure no impact to property accesses	▪ Cyclists will have to give way to pedestrians
	Additional to both options	Contrasting Pavement Threshold	▪ No impacts to parking and access.	▪ No impact to cyclists
Edwin Street	1	Flat Top Road Hump	▪ No impacts to parking and access.	▪ No impact to cyclists
Tramway Avenue	1	Contrasting Threshold	▪ No impacts to parking and access.	▪ No impact to cyclists
Barden, Fanning, Hart and Station Streets	-	Contrasting Pavement Threshold	▪ No impacts to parking and access.	▪ No impact to cyclists

11. INFRASTRUCTURE ITEMISATION

11.1 Methodology

Most of the concept designs of LATM treatments were designed against on-site conditions such as road width and geometry, with reference to Australian Standards and Austroads design guidelines. However, the contrasting pavement thresholds presented are typical designs which may be adapted in each treatment location.

The following general costing methodology was adopted:

- Treatments were itemised and broken down into their composite elements, such as reinforced concrete platforms, line marking, signs, and landscaping
- Previous LATM studies, benchmark infrastructure costs and pedestrian facility planning reports recently undertaken in NSW were consulted to estimate a baseline treatment unit cost
- A unit cost per treatment type was developed based on the itemisation and base line unit costs
- The total estimated cost was developed based on the quantity and unit cost of each treatment.

The assumptions and exclusions made as a part of our cost estimations are outlined in the sections below.

11.2 Relevant Guidelines

11.2.1 Australian Standards

AS1742 Manual of Uniform Traffic Control Devices was the primary reference consulted for this study for specifications on traffic calming devices, and relevant signage and line marking. Both *AS1742 Part 10: Pedestrian Control and Protection* and *AS1742 Part 13: Local Area Traffic Management were* consulted for the specifications, with the former relating to refuge and median islands, and wombat crossings, and the latter relating to thresholds and other humps.

The Roads and Maritime Supplement to Australian Standard 1742 – Manual of Uniform Traffic Control Devices parts 1-15 (Version 2.4) (known simply as RMS supplement to AS1742) was consulted for any Roads and Maritime (RMS) modification or practices that differ from AS1742. The supplement cross references a number of RMS (and its predecessor Roads and Traffic Authority) technical directions, which are listed in Section 11.2.4.

11.2.2 Austroads Guide to Traffic Management

Austroads Guide to Traffic Management Part 8 – Local Area Traffic Management was also consulted for recommended specifications on treatments not covered in AS1742 or the RMS supplement to AS1742.

The RMS Austroads Guide Supplements – Austroads Guide to Traffic Management Part 8 – Local Area Traffic Management (known simply as RMS supplement to Austroads) was consulted for any Roads and Maritime (RMS) modification or practices that differ from Austroads.

11.2.3 STA Bus Infrastructure Guidelines

The *State Transit Authority Bus Infrastructure Guidelines* outlines a number of infrastructure design aspects which must be taken into considering when implementing traffic calming treatments along bus routes. These are recommended to ensure a minimisation of impacts to bus operations.

11.2.4 Transport for NSW Technical Directions and Guidelines

Transport for NSW (and its predecessors Roads and Maritime Services (RMS) and Roads and Traffic Authority (RTA)) delineation guidelines were also consulted for specification for zebra crossings and edge and centre line markings:

- Roads and Traffic Authority Delineation Section 4 – Longitudinal Markings was consulted for dimensions of edge and centre line markings.
- Roads and Traffic Authority Delineation Section 7 – Transverse Lines Pedestrian Facilities was consulted for dimensions of pedestrian (zebra) crossings.

Transport for NSW technical direction *Design and implementation of shared zones including provision for parking* (TTD2016/001) was consulted for requires signage for shared zones.

11.3 Treatments

Each proposed treatment option was broken down into its key components, such as physical components and any required signage. Itemised components of the proposed standard treatments may include (but are not limited to):

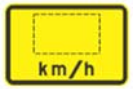
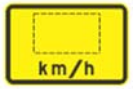
- Concrete components (such as platforms, kerb blisters, refuge islands etc)
- Line marking or road surface marking
- Surfacing or surface colour treatment
- Signage
- Landscaping
- Civil works

Table 11.1 details the breakdown of each proposed treatment type.

These traffic calming devices are identified as being appropriate for the context of the zone and can assist in creating a safer local road environment.

Table 11.1: Proposed Treatments

LATM Treatments	Description	Components	Signs and Posts
Road narrowing	Landscaped kerb blisters with low height shrubs	▪ Kerb blisters ▪ Treatment surfacing ▪ Civil works ▪ Landscaping	n/a
Contrasting pavement	At-grade contrasting pavement treatment (embossed text pattern)	▪ Contrasting pavement (at-grade) ▪ Treatment surfacing ▪ Civil works	n/a
Line marking	Edge, centre line and lane delineation marking	▪ Edge line marking ▪ Centre line marking ▪ Lane Delineation (L1 and C1)	n/a
Mountable concrete median	Mountable low-profile concrete median with contrasting pavement	▪ Low-profile median island ▪ Treatment surfacing ▪ Signage ▪ Civil works	n/a
Right Turn Only signage		▪ Signage ▪ Civil works	▪ 1 x R2-14_R  ▪ ▪ 1 x signpost

LATM Treatments	Description	Components	Signs and Posts
Speed cushions	100mm high speed cushions (either in set of 2 or set of 4)	▪ Speed cushions ▪ Signage ▪ Civil works	▪ 2 x W5-10  ▪ 2 x W8-2 (25 km/h)  ▪ 1 x signpost[1]
Flat top road hump	100mm high flat top road hump with contrasting surface treatment (‘terracotta’ colour surface of similar)	▪ Raised Hump ▪ Line marking ▪ Treatment surfacing ▪ Signage ▪ Civil works ▪ Roadside barrier (landscaping or bollard and chain type)	▪ 2 x W5-10  ▪ 2 x W8-2 (25 km/h)  ▪ 1 x signpost[2]
Bicycle facilities	Shared path and Bicycle on-ramp	▪ Footpath demolition ▪ Shared path (new) ▪ Bicycle ramp ▪ Bicycle marking (bicycle symbols and arrows) ▪ Signage ▪ Civil works	▪ 5 x R8-2  ▪ 2 x R7-4  ▪ 3 x signposts

LATM Treatments	Description	Components	Signs and Posts
Widened footpath	Widened footpath of 2.5m width, with optional landscaped verge	▪ Footpath demolition ▪ Footpath (new) ▪ Treatment surfacing ▪ Civil works ▪ Landscaping (verge)	▪ n/a
3 tonne truck limit signage	3 tonne truck limit signage	▪ Signage	▪ 2 x R6-10-2  ▪ 2 x R9-231 (3 tonne)  ▪ 1 x W8-245N_L  ▪ 1 x signpost[3]

LATM Treatments	Description	Components	Signs and Posts
Shared zone	10 km/h shared zone with marked parking bays	▪ Signage ▪ Line marking	▪ 3 x R4-4  ▪ 3 x R5-5  ▪ 3 x R2-10  ▪ 3 x R5-65  ▪ 1 signpost[4]

Image Source: Transport for NSW

1. The speed cushion treatment will only be installed at Holbeach Avenue, using an existing streetlight pole and a new signpost instead of two signposts.

2. It is assumed that each location requires one new signpost:

- The flat top road hump treatment (Option 2) at Wentworth Street north of South Street will utilise an existing streetlight pole and a new signpost

- The flat top road hump treatment (Option 2) at Wentworth Street south of Princes Highway will utilise the signpost used for the 3 tonne truck limit signage, and a new signpost

- The flat top road hump treatment (Option 1) at Stanley Street (at each location) will utilise an existing streetlight pole and a new signpost instead of two signposts.

- The flat top road hump treatment (Option 1) at Union Street (at both locations) will utilise an existing streetlight pole and a new signpost instead of two signposts. It will be assumed one new signpost is needed per location.

3. The 3 tonne truck limit signage treatment will only be installed at Wentworth Street south of Princes Highway, using an existing streetlight pole and a new signpost instead of two signposts.

4. The shared zone treatment will only be installed along Union Street, using an existing streetlight pole, an existing signpost, an existing traffic signal post and a new signpost.

12. COST ESTIMATION

12.1 Treatments

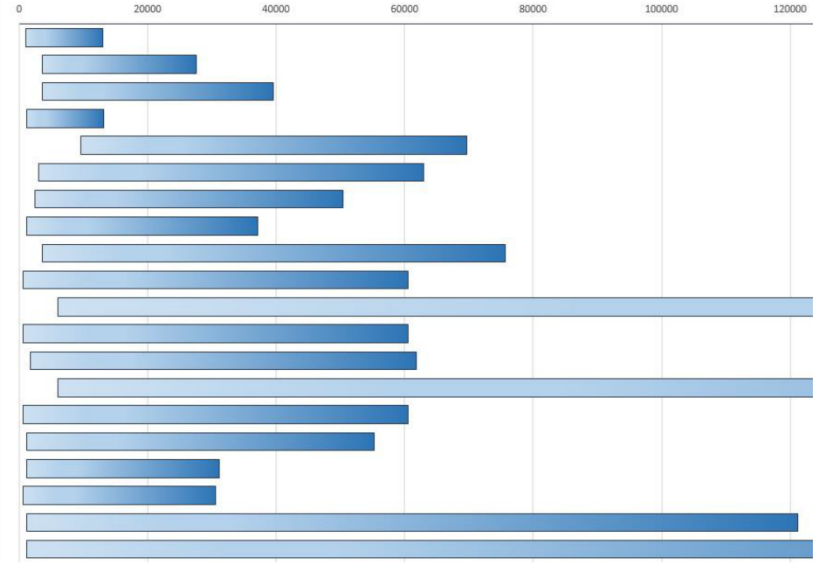
12.1.1 Cost Factors

The cost of implementing these treatments is highly dependent upon the contextual surroundings at each install site. Factors which can affect the costs include:

- Material selection
- Size of treatment
- Accommodation for drainage
- Street lighting
- Any kerb or gutter works
- Adjustments to any pits
- Any landscaping
- Requirement of street closures or traffic control
- Any other additional features, such as supplementary line marking or pedestrian fencing.

In developing cost estimates for the different types of treatments, *Austroads Guide to Traffic Management Part 8 (Local Area Traffic Management)* was consulted. The graph in Figure 12.1 shows the relative construction costs of LATM devices.

Local Area Traffic Management Device	Construction Cost (2015 AUD$)
Road humps (round profile)	1,000 - 12,000
Flat-topped road humps	3,600 - 24,000
Wombat crossing	3,600 - 36,000
Road cushions	1,200 - 12,000
Raised intersection pavements	9,600 - 60,000
Kerbside lane narrowings / kerb extensions - per 100 m	3,000 - 60,000
Slow points (angled or straight)	2,400 - 48,000
Blister islands	1,200 - 36,000
Driveway links - per 100 m	3,600 - 72,000
Median treatments - per 100 m	600 - 60,000
Roundabouts	6,000 - 480,000
Full road closure	600 - 60,000
Half / part / diagonal road closure	1,800 - 60,000
Modified "T" intersection	6,000 - 300,000
Pedestrian crossings	600 - 60,000
Perimeter threshold treatments	1,200 - 54,000
Tactile surface treatments - per 100 m	1,200 - 30,000
Bicycle lanes / bypasses - per 100 m	600 - 30,000
bus only links / bus bypasses - per 100 m	1,200 - 120,000
Shared zones - per 100 m	1,200 - 180,000



Source: Damen (2007) cited in Austroads Guide to Traffic Management Part 8

Figure 12.1: Relative LATM Device Costs

Council has provided average standard costs for various LATM treatments, signage, installation and marking, which is the main source used for cost estimation. The Independent Pricing and Regulatory Tribunal New South Wales (IPART NSW) report *Local Infrastructure Benchmark Costs* was also consulted for the cost estimates of some treatments.

The costs detailed in this report should be taken as indicative only. The final treatment costs will ultimately be subject to detailed design at each specific site location.

12.1.2 Treatment Signage

There is a minimum provision of signs required to be installed to accompany the specific treatments proposed, as previously detailed in Section 11.3. These primarily include warning signage associated with the treatments modifying road geometry, such as 'speed hump' warning signs. The provision of these signs is included within the treatment-specific signage costs.

The standard costs of signs were provided for 3 tonne load limit (two signs), speed hump and speed advisory signs, which is $83 per sign. The standard cost of a galvanised signpost is $105, and the cost of installing a signpost in concrete is $205.

12.1.2.1 Assumptions

The following assumptions were made for estimating treatment-associated signage costs:

- The cost of a single sign was estimated at $83
- All signposts are assumed to be installed in concrete. As such, the total cost for a signpost and its installation was assumed to be $310.
- Parking restriction signs (certain treatments like kerb blisters have specific restrictions on nearby on-street parking) have ***not*** been included, as their implementation will be specific to parking conditions at each location.

The minimum sign requirement for each type of treatment is presented in Table 12.1 below.

Table 12.1: Signage Costs per Treatment

LATM Treatment	No. of Signs (each)	No. of Posts (each)	Cost
Road narrowing	-	-	-
Contrasting pavement	-	-	-
Line marking	-	-	-
Mountable concrete median	-	-	-
Right Turn Only signage (Smith Street)	1	1	$393
Speed cushions	4	1	$642
Flat top road hump	4	1	$642
3 tonne truck limit Signage (Wentworth Street south of Princes Highway)	5	1	$725
Bicycle facilities (Smith Street)	7	3	$1511
Shared zone	12	1	$1306

It should be noted the values presented in Table 12.1 do not include labour and installation costs, other than the installation of signposts. The costs of the individual signs and posts are shown to be a relatively small component of the total treatment cost.

Depending on Council's sign inventory and the quality of replaced/removed signs, there may be opportunities to recycle use of old signs where appropriate. Due to their nature, these considerations are subject to detailed design and the actual installation process.

12.1.3 Item Unit Costs

The total unit cost of each component of the treatments identified in Table 11.1 have been estimated at the following costs in Table 12.2. It is important to note that these prices are indicative.

Table 12.2: Item Unit Cost

Item	Unit	Unit Cost ($)
Treatment (excludes treatment-specific signage)		
Kerb blister	Each	$5,000
Contrasting pavement (at-grade)	Each	$15,000
Mountable concrete median	Each	$10,000
Speed cushion	Each	$900
Flat top road hump	Each	$35,000
Footpath demolition	Per square metre	$55
New footpath or shared path	Per square metre	$120
Kerb and gutter	Per metre	$115
Bicycle ramp	Each	$5,000
Barrier (Landscape or Fence type)	Each	$1,000
Verge Landscaping	Per metre	$100
Signage		
Right Turn Only signage at Smith Street	-	$393
Speed cushions signage	Per set of speed cushions	$642
Flat top road hump signage	Per flat top road hump	$642
Bicycle signage at Smith Street	-	$1511
3 tonne truck limit signage at Wentworth Street south of Princes Highway	-	$725
Shared zone signage at Union Street	-	$1306
Marking		
Line marking of 100-150mm width (including edge and centreline)	Per metre	$6
Shared zone parking bay marking - assumed 4x6m longitudinal marking and 2x2.1m transverse marking, equating to 28m of linemarking	Per 6 metre (a pair of parking bays) of shared zone	$169
Bicycle symbols	Per symbol	$62
Directional symbols (arrow)	Per symbol	$62
Speed Marker	Per symbol	$62

These estimates are based on the following assumptions:

- Estimates were prepared for a 'standard' treatment for typical conditions within the study area
  - Dimensions and specifications (other than width) are assumed to be the same for each treatment regardless of site and conditions
- Cost of the treatments exclude costs of treatment-specific signage (speed hump warning signs for flat top road humps etc.)
- Costs of treatment-specific and associated sign posts exclude associated parking restriction signs (see Section 12.1.2).
- Flat top road humps have the same cost as a raised pedestrian crossing, which has a cost of $35,000 based on Council's average standard costs

- Footpath widening or shared path construction includes a complete demolition of the old footpath and construction of a 100mm tall reinforced concrete footpath
- General and landscaping maintenance costs are not included

12.2 Landscaping

The provision of landscaped treatments allows for visually attractive devices with additional functionality. For example, landscaped kerb blisters deter pedestrians from using devices such as flat-top road humps as road crossing devices.

Landscaped treatments can contribute to a more positive community reception of new traffic calming devices. Residents may be inclined to more readily accept a device which contributes to the local streetscape aesthetic with landscaping reflective of the contextual surrounds. Conversely, there may be community backlash over an excessive implementation of devices perceived as intrusive and utilitarian due to the impact to local amenity.

An example of a landscaped versus non-landscaped kerb blister is displayed in Figure 12.2.

Figure 12.2: Kerb Blisters – Landscaping (left) and Standard (right)

However, providing landscaping on treatments requires additional costs, both capital costs for the installation process (soil infill, plant species, etc.) and on-going maintenance costs (watering, general upkeep of the plants, potential future replacements).

Austroads Guide to Traffic Management Part 8, citing City of Knox's Annual LATM Program Review (2002), suggests that the construction costs of an LATM can be reduced by 20-25% with the removal of landscaped features.

12.3 Maintenance

Maintenance costs are an additional consideration when installing treatments, dependent upon a number of factors including:

- Material choice: concrete treatments tend to have a longer life-span than those made out of asphalt or small unit pavers, therefore requiring less future maintenance costs
- Any supplementary elements to the treatment, including street furniture and accompanying warning signage is vulnerable to ongoing damage and potential vandalism
- Devices which require a horizontal deflection of the vehicle (chicane slow points, wide median splitter islands, etc.) may require further reinforcement works to the pavement to handle the side pressures exerted by the vehicle tyres
- Line marking and road symbols must be maintained and refreshed if their condition deteriorates, as efficiency and effectiveness is strongly linked to their visibility.

The high degree of variability in maintenance costs renders it difficult to estimate with a satisfactory degree of accuracy. Maintenance needs and costs will be monitored by Council following the installation of the treatments.

12.4 Estimated Total Treatment Costs

The estimated treatment cost for the entire study area is itemised in Table 12.3. This cost includes all treatment and sign costs identified in the earlier sections. Lengths measured for line marking and landscaping treatments are approximate only.

Table 12.3: Estimated Treatment Cost

Road	Option	Item	Unit Cost ($)	Quantity	Total ($)	Including 10% Contingency Cost & 10% Design Cost
Smith Street	Option 1a - Road Narrowing & Contrasting Pavement (including additional measures)	Kerb blisters	$5,000	2	$10,000	$12,000
		Contrasting pavement	$15,000	1	$15,000	$18,000
		Right Turn Only signage	$393	1	$393	$472
		Line marking	$6 / m	approx. 350m	$2,100	$2,520
		Shared path (western)	$120 / m^2	approx. 30m x 2m	$7,200	$8,640
		Shared path (eastern)	$120 / m^2	approx. 65m x 2.5m	$19,500	$23,400
		Bicycle ramp	$5,000	2	$10,000	$12,000
		Bicycle symbols and arrows	$62	14	$868	$1,042
		Footpath demolition	$55 / m^2	approx. 230m x 1.5m	$18,975	$22,770
		New footpath	$120 / m^2	approx. 200m x 2m	$48,000	$57,600
		Kerb and gutter	$115 / m	approx. 230m	$26,450	$31,740
		Total			$158,486	$190,183
	Option 1b - Road Narrowing & Contrasting Pavement (including additional measures)	Similar to Option 1a	$153,900	1	$158,486	$190,183
		Less one kerb blister	$5,000	- 1	- $5,000	- $6,000
		Less line marking (on western side)	$6 / m	- 100 m	- $600	- $720
		Verge landscaping	$100 / m	180m	$18,000	$21,600
		Total			$170,886	$205,063

Road	Option	Item	Unit Cost ($)	Quantity	Total ($)	Including 10% Contingency Cost & 10% Design Cost
Smith Street	Option 2a - Mountable Concrete Median Treatment (including additional measures)	Mountable concrete median	$10,000	1	$10,000	$12,000
		Right turn only signage	$393	1	$393	$472
		Line marking	$6 / m	approx. 500m	$3,000	$3,600
		Shared path (western)	$120 / m^2	approx. 30m x 2m	$7,200	$8,640
		Shared path (eastern)	$120 / m^2	approx. 65m x 2.5m	$19,500	$23,400
		Bicycle ramp	$5,000	2	$10,000	$12,000
		Bicycle symbols and arrows	$62	14	$868	$1,042
		Footpath demolition	$55 / m^2	approx. 230m x 1.5m	$18,975	$22,770
		New footpath	$120 / m^2	approx. 200m x 2m	$48,000	$57,600
		Kerb and gutter	$115 / m	approx. 230m	$26,450	$31,740
		Total			$144,386	$173,263
	Option 2b - Mountable Concrete Median Treatment (including additional measures)	Similar to Option 1a	$138,900	1	$144,386	$173,263
		Less line marking (on western side)	$6 / m	- 140 m	- $840	- $1,008
		Verge landscaping	$100 / m	150m	$15,000	$18,000
		Total			$158,546	$190,255
Holbeach Avenue	Option 1 - Speed Cushions	Speed cushions	$900	4	$3,600	$4,320
		Speed cushion signage	$642	1 set	$642	$770
		Total			$4,242	$4,666
	Option 2 - Speed Cushions & Road Narrowing	Speed cushions	$900	2	$1,800	$4,320
		Kerb blister	$5,000	2	$10,000	$12,000
		Speed cushion signage	$642	1	$642	$770
		Total			$14,242	$17,090

Road	Option	Item	Unit Cost ($)	Quantity	Total ($)	Including 10% Contingency Cost & 10% Design Cost
Stanley Street	Option 1 – Flat Top Road Hump	Flat top road humps	$35,000	2	$70,000	$84,000
		Flat top road hump signage	$642	2	$1,284	$1,541
		Landscaping Barrier	$1,000	4	$4,000	$4,800
		Total			$71,284	$85,541
	Option 2 – Road Narrowing	Kerb blisters	$5,000	4	$20,000	$24,000
		Total			$20,000	$24,000
Wentworth Street	Option 1 - Road narrowing & Contrasting Pavement (including additional measures)	Kerb blisters	$5,000	4	$20,000	$24,000
		Contrasting pavement	$15,000	2	$30,000	$36,000
		3 Tonne Truck Limit signage	$725	1 set	$725	$870
		Total			$50,275	$60,870
	Option 2 - Flat Top Road Hump (including additional measures)	Flat top road humps	$35,000	2	$70,000	$84,000
		Flat top road hump signage	$642	2	$1,284	$1,541
		3 Tonne Truck Limit signage	$725	1 set	$725	$870
		Bollard and Chain barrier	$1,000	4	$4,000	$4,800
		Total			$76,009	$91,211
Union Street	Option 1 - Flat Top Road Hump (including additional measures)	Flat top road humps	$37,000	2	$74,000	$84,000
		Flat top road hump signage	$642	2	$1,284	$1,541
		Contrasting pavement	$15,000	1	$15,000	$18,000
		Bollard and Chain barrier	$1,000	4	$4,000	$4,800
		Total			$90,284	$108,341
	Option 2 - Shared Zone (including additional measures)	Shared zone signage	$1,306	1	$1,306	$1,567
		“10” speed marker	$62	2	$124	$149
		Parking bay marking	$169 per 6m of shared zone	215 m (roughly 36 * 6m)	$1,015	$1,218

Road	Option	Item	Unit Cost ($)	Quantity	Total ($)	Including 10% Contingency Cost & 10% Design Cost
		Contrasting pavement	$15,000	1	$15,000	$18,000
		Total			$17,445	$20,934
Barden Street	Contrasting Pavement Threshold	Contrasting Pavement	$15,000	1	$15,000	$18,000
Fanning Street	Contrasting Pavement Threshold	Contrasting Pavement	$15,000	1	$15,000	$18,000
Hart Street	Contrasting Pavement Threshold	Contrasting Pavement	$15,000	1	$15,000	$18,000
Station Street	Contrasting Pavement Threshold	Contrasting Pavement	$15,000	1	$15,000	$18,000
Edwin Street	Flat Top Road Hump	Flat top road humps	$37,000	2	$70,000	$84,000
		Flat top road hump signage	$642	2	$1,284	$1,541
		Landscaping barrier	$1,000	4	$2,000	$2,400
		Total			$73,284	$87,941
Tramway Street	Contrasting Pavement Threshold	Contrasting Pavement	$15,000	2	$30,000	$36,000

13. CONCLUSION

In order to manage the traffic impacts related to the proposed Bunnings Development at No. 728-750 Princes Highway, an LATM study was conducted on behalf of Inner West Council. The study area included a number of local streets within Tempe South adjoining the Princes Highway.

The study reviewed existing conditions on site and expected future traffic conditions within the local area and provides recommendation on appropriate LATM treatment options to be implemented along certain streets.

A summary of key processes undertaken and findings in this study is as follows:

- Background information and documents relating to the proposed Bunnings development were reviewed, providing information on future proposed traffic and road changes in the area
- Existing site conditions, surrounding land uses and road network information was reviewed
- A site inspection and audit was conducted, including identification of existing LATM devices, traffic signs, parking signs and restrictions, pedestrian and bicycle facilities, and refuse collection issues
- Traffic and parking surveys were conducted to capture the levels of traffic and parking demand within the study area. This included tube counts, parking occupancy surveys and intersection counts
- The survey of on-street parking on Smith Street showed that on average, there are 18 vacant spaces on Thursday and 27 vacant spaces on Saturday. After the removal of spaces due to the Bunnings development and the proposed LATM treatments Smith street parking is expected to be at capacity.
- The traffic survey data was analysed and identified streets requiring further LATM devices in order to:
    - Provide traffic calming and reduce vehicle speeds
    - Reduce general traffic volumes by deterring traffic
    - Reduce Heavy Vehicle volumes
    - Reduce crash risk
- A scoring system was developed to determine priority streets requiring LATM treatments
- A detailed selection criteria and list of suitable LATM measures were developed based on existing devices in the area and typical LATM devices presented in *Austroads Guide to Traffic Management Part 8 - Local Area Traffic Management*
- Up to two LATM Treatment options were presented for each priority street. These treatment options included:
- Holbeach Avenue – Outside No. 14 and No 16 Holbeach Avenue
    - Option 1: *Speed Cushions*, set of four across roadway
    - Option 2: *Speed Cushions*, set of two with *Kerb Blisters*
- Smith Street – Outside No. 28 Smith Street and south of proposed Bunnings Access
    - Option 1: Road Narrowing using Kerb blisters and contrasting pavement marking
    - Option 2: Mountable Concrete Median and associated line marking
    - Both options are to be supplemented by *Right Turn Only signage*, *edge line marking, bicycle ramp, and shared path* between Princes Highway and the LATM treatment, and *widened footpath* between Princes Highway and South Street. An optional *landscaped verge* may also be provided between the widened footpath and roadway, which will result in the removal of kerbside parking.
- Stanley Street – Outside No. 14 and No. 35 Stanley Street
    - Option 1: Flat Top Road Hump

    - Option 2: Road narrowing using *Kerb Blisters*
- Wentworth Street – South of Princes Highway and North of South Street
    - Option 1: Road narrowing using Kerb Blisters and contrasting pavement marking
    - Option 2: Flat Top Road Hump
    - Both options will include *3 Tonne Truck Limit signage* at Princes Highway and Wentworth Street to deter heavy vehicles from entering Wentworth Street
- Union Street
    - Option 1: Flat Top Road Hump outside 2D and 46 Union Street
    - Option 2: *Shared Zone* between Princes Highway and School Lane
    - Both options will include a contrasting pavement threshold
- Edwin Street
    - Option 1: Flat Top Road Hump outside No. 14 Edwin Street
- Tramway Street
    - Option 1: Contrasting Pavement Threshold at Unwins Bridge Road and Edwin Street
- Additionally, contrasting pavements were proposed for the entries of Barden, Fanning, Hart and Station Streets from Princes Highway.
- Each treatment was assessed for its merits and impacts to parking, property accesses, cyclists and emergency service vehicles.
- Concept designs of each treatment were developed
- The treatments proposed were itemised into their constituent parts, including signage and line marking
- The type and number of signs associated with each type of treatment were identified, along with the number of signposts required
- A baseline treatment unit cost was established, based on:
    - Council provided rates
    - Previous experience
    - IPART Benchmark infrastructure costs
    - Austroads Guide to Traffic Management Part 8
    - A review of previous LATM studies and pedestrian facility planning reports for other studies in NSW
- A standard cost of signs (such as speed hump warning signs etc.) was included in the treatment unit cost
- Ancillary signs such as advance warning signs and parking restriction signs were not included in the treatment unit cost, as they are subject to the specific implementation site of each treatment
- Estimated costs for each option or measure, including contingency and design costs, range from **$18,000** to **$190,000**, with an at-grade contrasting pavement as the least cost option and treatment options along Smith Street resulting with the highest cost.