BROOKVALE STRUCTURE PLAN IMPLEMENTATION

Transport Strategy – Planning Proposal Version

Northern Beaches Council

25/06/2026

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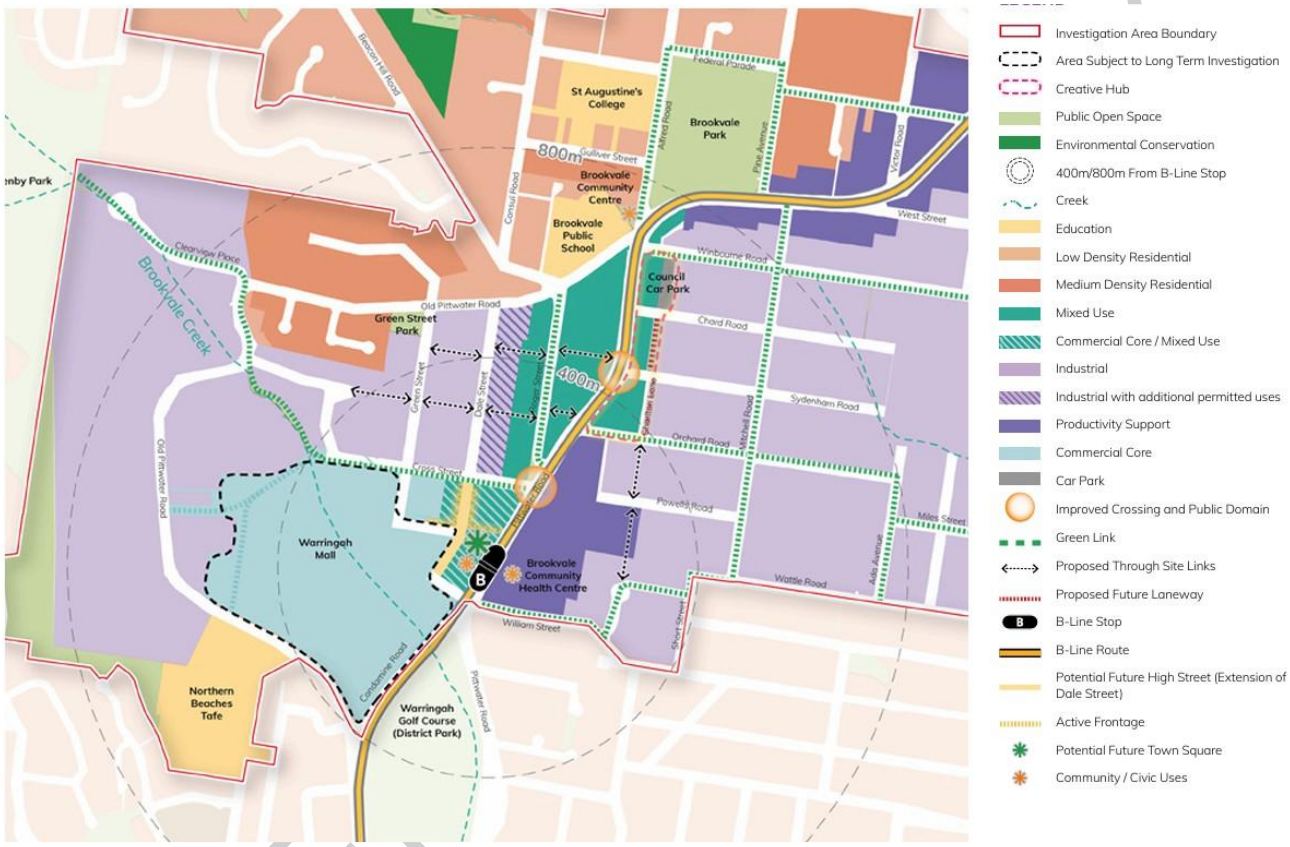
1. INTRODUCTION

1.1 Background

The Brookvale Structure Plan was endorsed by Northern Beaches Council (*Council*) in November 2023. Since then, Council has been working through the more detailed planning associated with specific areas within the Structure Plan like the planned 'Medium Rise' areas surrounding Roger Street and the 'Higher Rise' areas within and surrounding the Warringah Mall site.

The Structure Plan framework is presented in Figure 1.1.



Source: Brookvale Structure Plan (Nov, 2023)

Figure 1.1: Brookvale Structure Plan Framework Map

In addition to this, the NSW Government has since released its Low and Mid-Rise (*LMR*) Housing Policy. A number of areas within 800m of the Warringah Mall Shopping Centre fall under this policy and allow for:

- **0m–400m from the centre**: Mid-rise apartments allowed with up to 6 stories (22 m) in R3 zones with the potential for higher density development
- **400m–800m from the centre**: Allows for apartments up to 4 stories in R3 zoned areas and townhouses / terraces / small flat buildings in R1–R2 zoned areas.

Furthermore, ScentreGroup (as the owners of the Warringah Mall site) have worked with the NSW Housing Delivery Authority to commence a State Significant Development for the site with a vision of a large-scale mixed-use development with new residential dwellings on top of existing retail.

Council is considering how to incorporate the LMR housing policy allowances, potential development within and surrounding the Warringah Mall site and street and access changes in these areas into its updated Structure Plan and as the basis for identifying the transport infrastructure components of a Contributions Plan.

1.2 Transport Infrastructure Plan Development

Bitzios Consulting previously prepared the Brookvale Dee Why TMAP which provided the transport strategies to support the Brookvale Dee Why Master Plan and then the Brookvale Structure Plan.

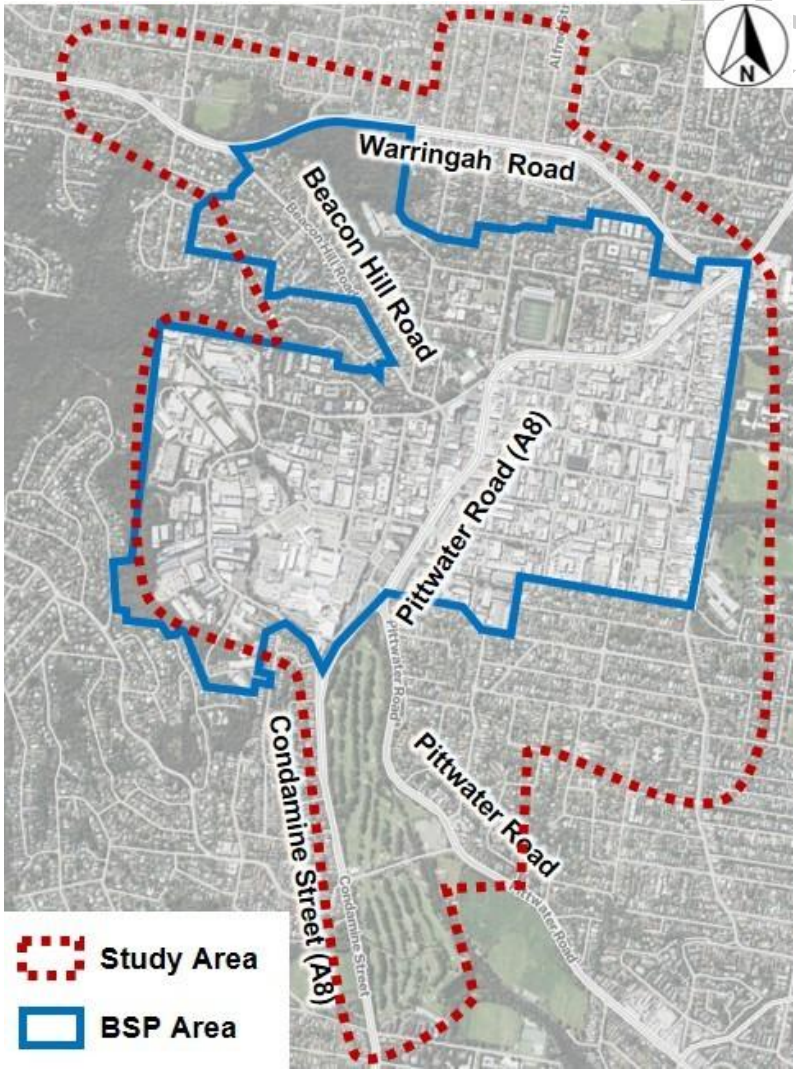
Bitzios Consulting has since been commissioned by Council to identify the transport infrastructure needs associated with the implementation of the Brookvale Structure Plan. This work has included:

- Identification of street typologies under the NSW Movement and Place Framework and its Design of Roads and Streets (DORAS) Manual for key streets in the Structure Plan area to inform the need for traffic management works as the area develops
- Identification of intersection and street upgrade needs, supported by traffic modelling
- Determination of active transport infrastructure needs based on an updated active transport network strategy considering the latest Structure Plan changes.

An Aimsun-based traffic microsimulation model developed for the previous TMAP project has been 'cut down' to the Brookvale Structure Plan area and updated with more recent data. This updated model, plus localised intersection modelling using SIDRA have been used to finalise proposed intersection upgrades to accommodate the traffic demands added by development proposed under the Structure Plan.

Following this interim report, for major transport infrastructure items, concept plans are to be prepared along with cost estimates. For the traffic infrastructure upgrade items, contribution calculations have been completed to inform the Contributions Plan schedules.

The study area considered for the Brookvale Transport Infrastructure Plan is shown in Figure 1.2



Basemap source: SDT Explorer

Figure 1.2: Brookvale Transport Infrastructure Plan Study Area

2. MOVEMENT AND PLACE ASSESSMENT

2.1 Overview and Key Approaches

The Movement and Place Framework was introduced by TfNSW to provide a structured approach to the planning, design, and delivery of transport infrastructure. The framework considers the inherent contradictions between areas of civic value and transport corridors, providing guidance to manage conflicts when they overlap. The use of this framework is intended to produce consistent and improved outcomes for the development of public infrastructure throughout NSW.

The Movement and Place assessment is undertaken in 6 key steps:

- **Step 1:** Vision and Evaluation Criteria
- **Step 2:** Understand 'Place'
- **Step 3:** Understand 'Movement'
- **Step 4:** Overlay and discuss conflicts, issues, and opportunities
- **Step 5:** Develop options
- **Step 6:** Choose the preferred option.

The Movement and Place Framework contains a variety of guides to assist in the application of the framework. This study focuses on utilising the Design of Roads and Streets Manual (DORAS) to categorise street environments into 4 generic groups:

- **Main Streets:** Links that attract both high volumes of vehicle and pedestrian traffic. Links such as these are typically lined with businesses whilst providing through connectivity for vehicles.
- **Main Roads:** Links of higher vehicle capacity, providing key connections between urban areas.
- **Civic Spaces:** Links fronted by businesses and recreational facilities with high pedestrian activity and limited utility for vehicle access.
- **Local Streets**: A diverse range of links with both limited connectivity and civic value, primarily serving as accesses for nearby properties.

Each key link within the study area has been assigned 1 of 22 street types based on its movement and place function as shown in Figure 2.1. Streets have then been prescribed treatments to reconcile conflicts in their current and desired configurations.

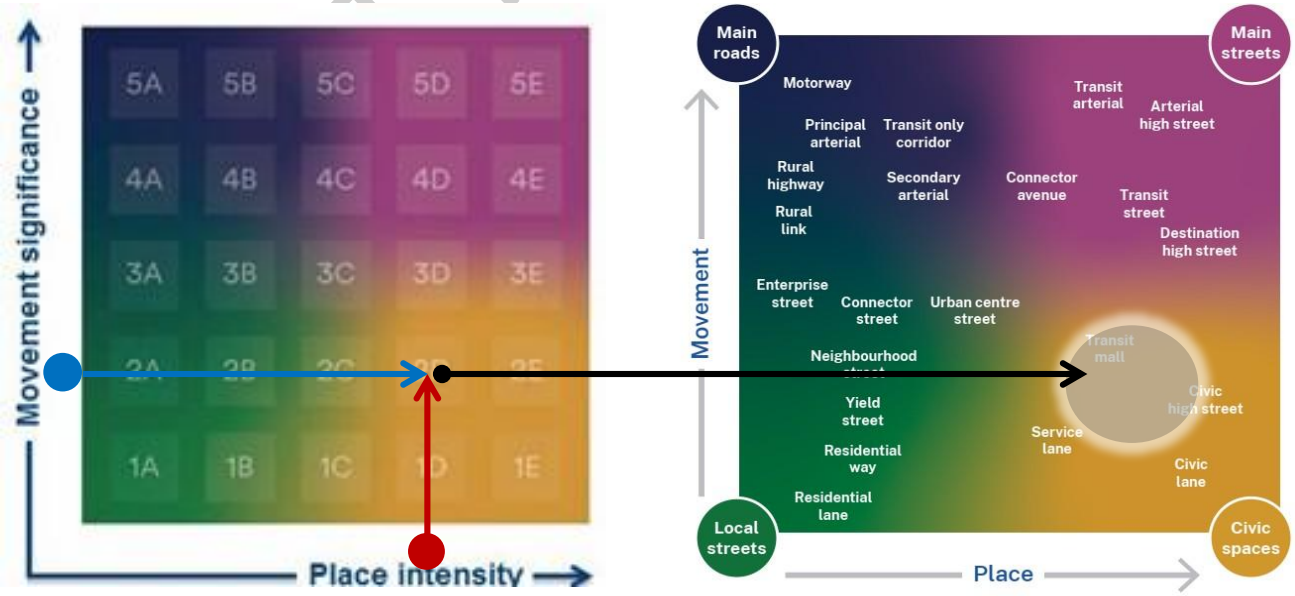


Figure 2.1: Movement and Place and DORAS application approach

2.2 Place Values Assessment

Place values are assigned to areas based on their existing and proposed land use scale and type. The character of the streetscape and cultural significance is also considered, with greenery, heritage, and active transport facilities improving its Place value.

2.2.1 Existing Civic Value

Two key regional attractions are located within the study area, including the Westfield Warringah Mall and the Brookvale Oval. Both are classified as district centres, despite their difference in character.

The entirety of the Brookvale Industrial Precinct is categorised as a town centre, contrasting to its primarily low-density residential surroundings. A wide variety of businesses exist within both the eastern and western industrial precincts with varying civic value.

Numerous local places are located throughout the outskirts of the town centre, including schools, parks, and religious facilities. These are generally utilised by a specific demographic or are not expected to attract regional traffic.

2.2.2 Proposed Civic Value

The Brookvale Structure Plan emphasises a substantial increase in land use intensity and 'activation' of the Cross Street Roger Street, and Pittwater Road corridors.

'The Core' is shown as a metropolitan area for its proposed vast open space and serve as the centre of activity at Brookvale. New developments along Roger Street and Pittwater Road are expected to be mixed use (such as shop-top housing) of primarily local importance. The links will become active transport corridors with enhanced greenery, substantially improving its place value.

The remainder of the study area remains similar in place value, as the density and types of businesses they house is not proposed to be substantially altered. A comparison between the existing and future place values within Brookvale are shown in Figure 2.2.

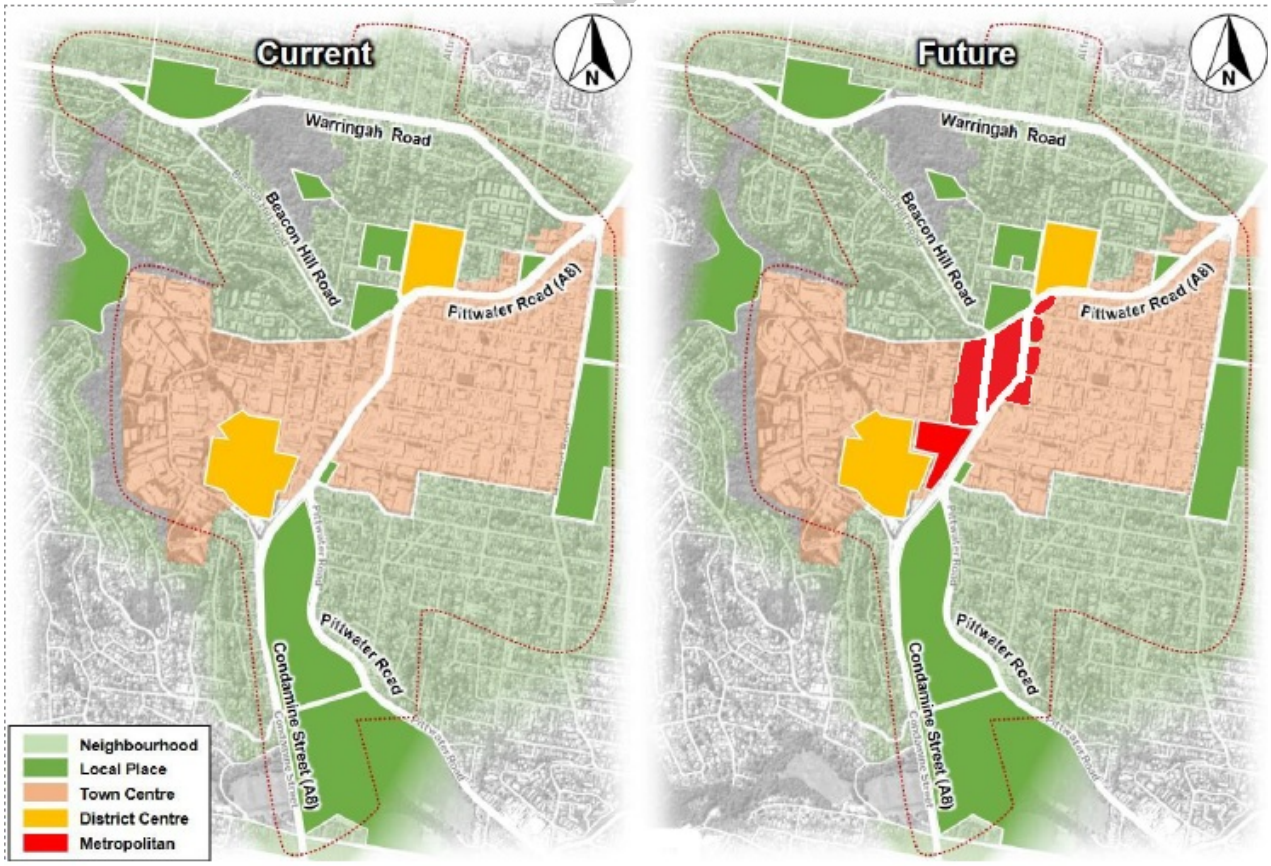


Figure 2.2: Place Values Assessment (Current and Future)

2.3 Movement Values Assessment

Roadways are assigned movement values based on their capacity, connectivity, and expected demand. All travel modes and transport purposes are considered in this assessment, including commuters, cargo, public transport, and active transport corridors. The categories of links used in this assessment are defined as:

- **Principal Arterial:** High-capacity routes providing through connection to metropolitan centres
- **Arterial:** High-capacity routes providing through connection to regional centres
- **Distributor:** Moderate-capacity routes providing connection to local centres and collectors
- **Collector:** Low-capacity links providing the primary connection from local accesses and points of interest to higher order roads
- **Local Access:** Low-capacity links at the final leg of a journey (only key routes shown).

2.3.1 Existing Movement Values

Brookvale lies at the confluence of multiple key regional roads, the primary of which is the A8 – a 6-lane corridor that forms the main north-south route for the Northern Beaches LGA. The A8 also forms the public transport backbone of the northern beaches, featuring bus lanes and the B-Line bus service that runs between Wynyard (Sydney CBD) and Mona Vale at a 'turn up and go' frequency.

Roads within the Brookvale Industrial Precinct form a grid network, with a hierarchy loosely defined by signalised intersections with the A8. Similar volumes of traffic utilise each parallel link.

2.3.2 Proposed Movement Values

The movement value of key links within the study area are not expected to change significantly as a result of the Brookvale Structure Plan. Changes to the value of links are centred around the Cross Street, Roger Street, and Westfield Warringah Mall internal links with route closures affecting other minor links. A comparison between the existing and future place values within Brookvale are shown in Figure 2.3.

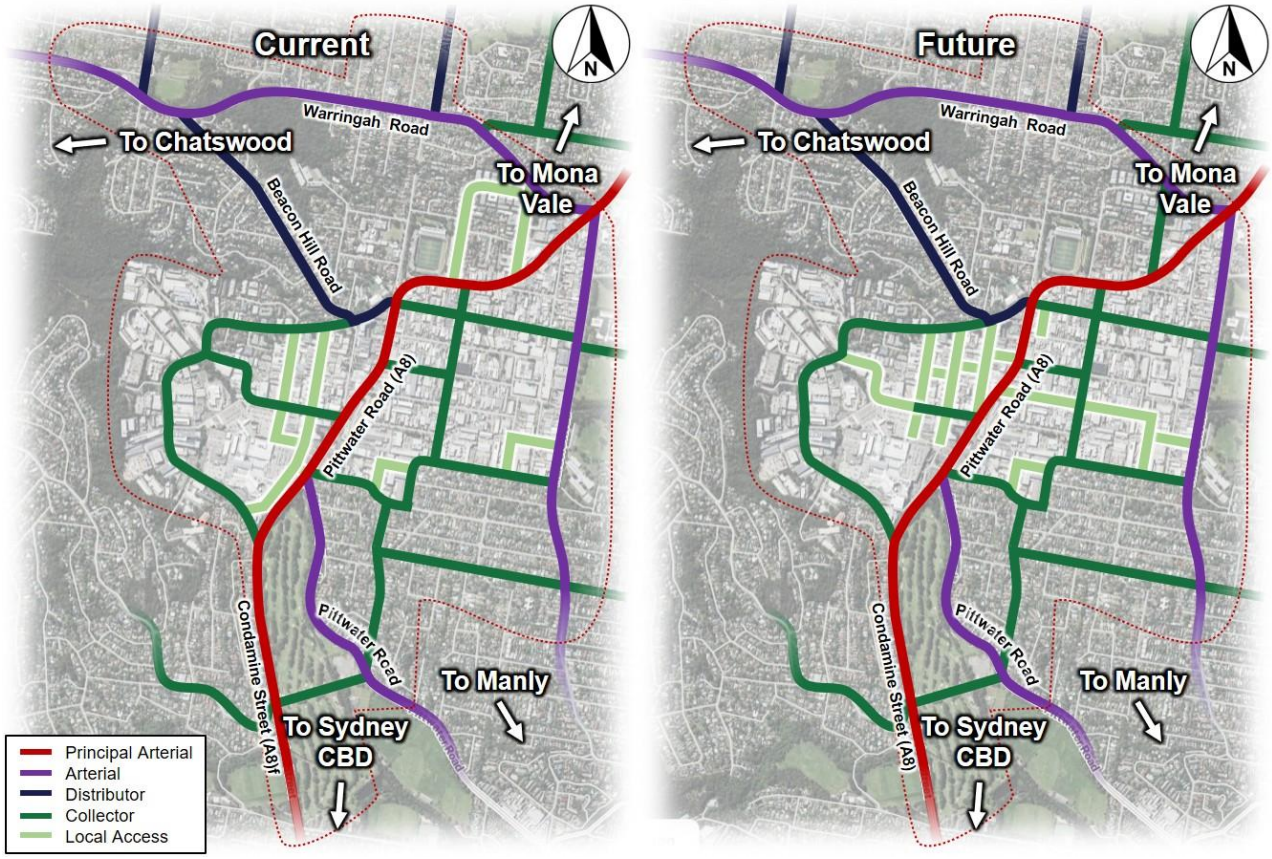


Figure 2.3: Movement Values Assessment (Current and Future)

2.4 Street Typologies

Links are assigned DORAS street types as a result of the movement and place value assessments. Despite the variety of 22 street types identified by the manual, not all streets within the study area have an appropriate typology. Streets are assigned the closest type according to their movement and place values, and differences in character are taken into consideration in each design solution.

Changes to street typologies are primarily representative of the increase of place value within 'The Core' and Roger Street catchments. Vehicle movement consolidation at certain links also causes minor changes to street categorisation. Figure 2.4 and Table 5.1 show the existing and proposed street types.

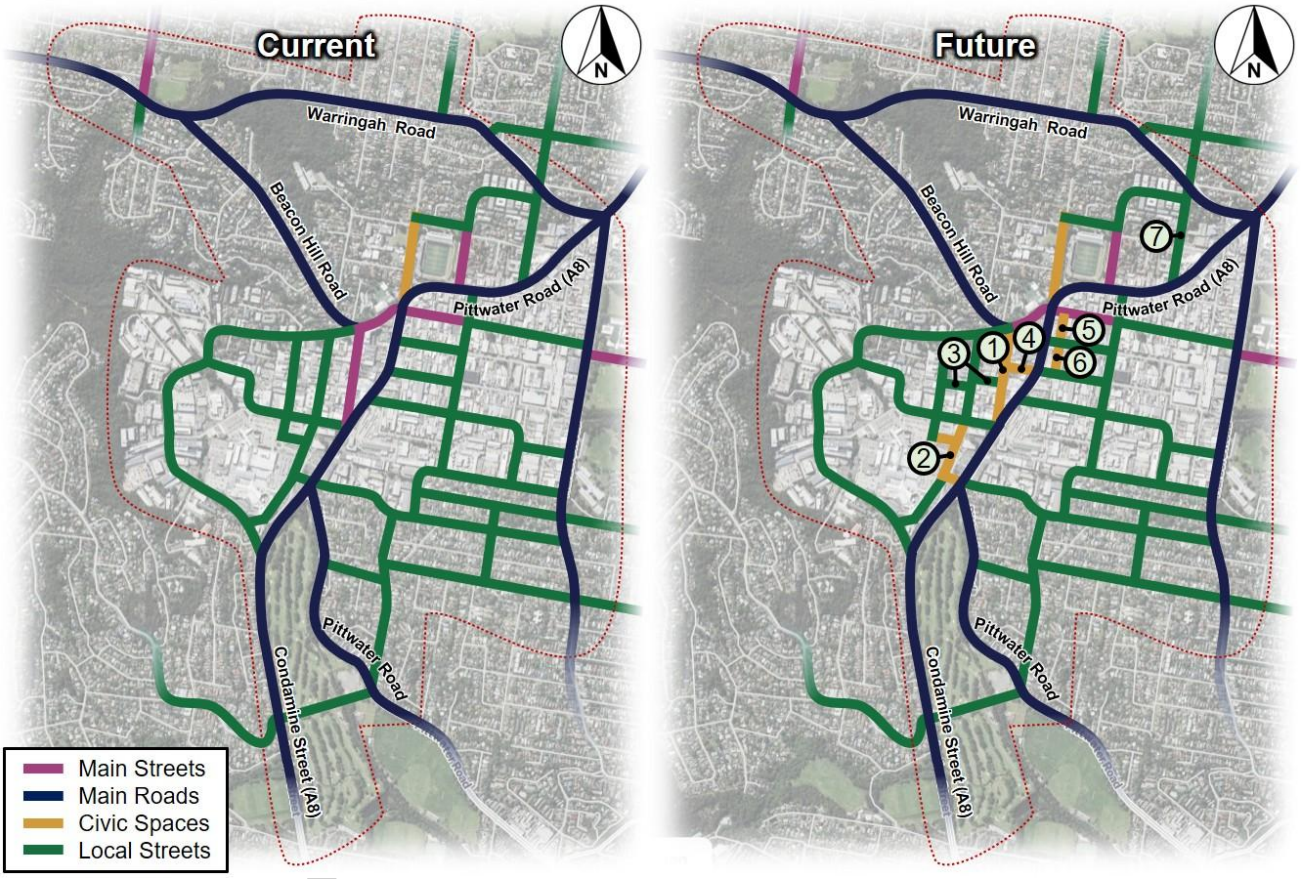


Figure 2.4: Street Typologies (Current and Future)

Table 2.1: New Streets and Streets with Changing Typologies

ID	Street	From Type	To Type
1	Roger Street	Connector Avenue	Destination High Street
2	Dale Street at The Core	Connector Street	Destination High Street
3	New vehicle links between Green Street and Roger Street	-	Residential Way
4	New pedestrian link between Roger Street and Pittwater Road	-	Civic Lane
5	Winbourne Road Carpark pedestrianisation	-	Civic Lane
6	New shared link between Chard Road and Sydenham Road	-	Service Lane
7	Victor Road	Neighbourhood Street	Connector Street

2.5 Summary of Street Management Works

The purpose of existing street management works is predominantly to moderate vehicle speeds along local streets. The sustained steep gradients found within the residential catchments allow drivers to build up excessive speeds without pressing on the accelerator. The existing management works include 2 types of key treatments:

- Threshold treatments to indicate to drivers they are entering a local street environment
- Midblock vertical deflection devices to physically restrict the speed that may be built up along a link.

Vertical deflection devices have the added benefit of reducing 'rat-run' behaviour, by impacting the comfort of using local streets where main road alternatives exist.

Existing Street Management Treatments

The eastern and western industrial zones are not currently covered by speed humps or other geometric constrictions as they must maintain heavy vehicle access. The wider 'enterprise streets' within these corridors therefore present a challenge for vehicle speed management. The existing street management works are shown in Figure 2.5.

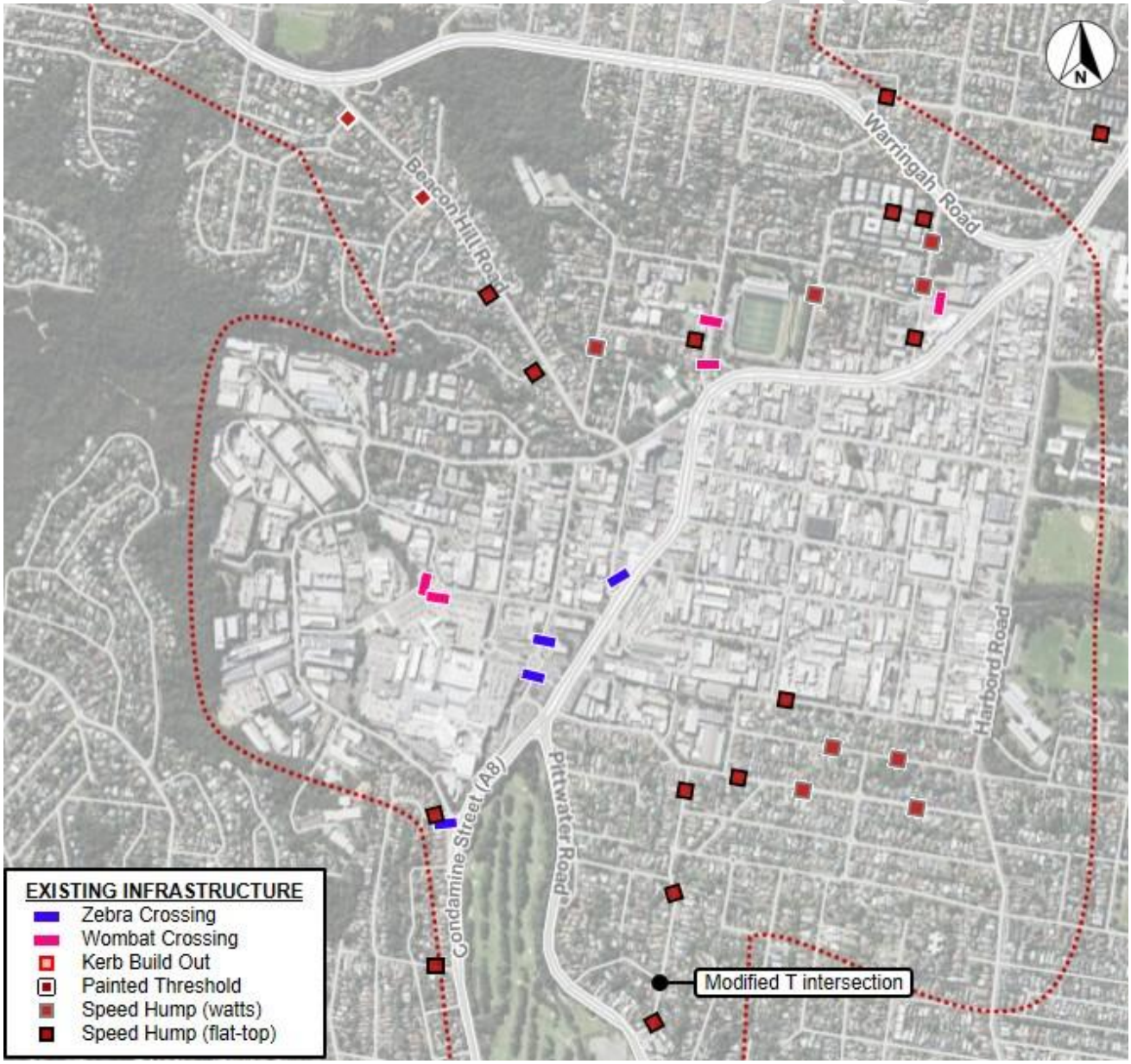


Figure 2.5: Existing Street Management Measures

Proposed Street Management Treatments

Proposed street management works were determined using the DORAS manual and *Austroads Guide to Traffic Management Part 8: Local Street Management*. The DORAS manual provides a list of general design solutions that mitigate inherent issues for each street typology and creates a suitable environment for the intended purpose of the link. AGTM Part 8 was used to determine the suitability of each treatment for the roadway context. Key treatments considered for the study area are listed in Table 2.2.

The proposed street management works have been largely identified on links which have changed typology as the character of the link must be updated to reflect its renewed purpose. Treatments to achieve this include turn bans and one-way restrictions, with associated kerb buildouts. These additionally provide shorter, safer crossings for active transport users and slow vehicle traffic performing turns. These street management works are shown in Figure 2.6 and detailed further in Table 5.1.

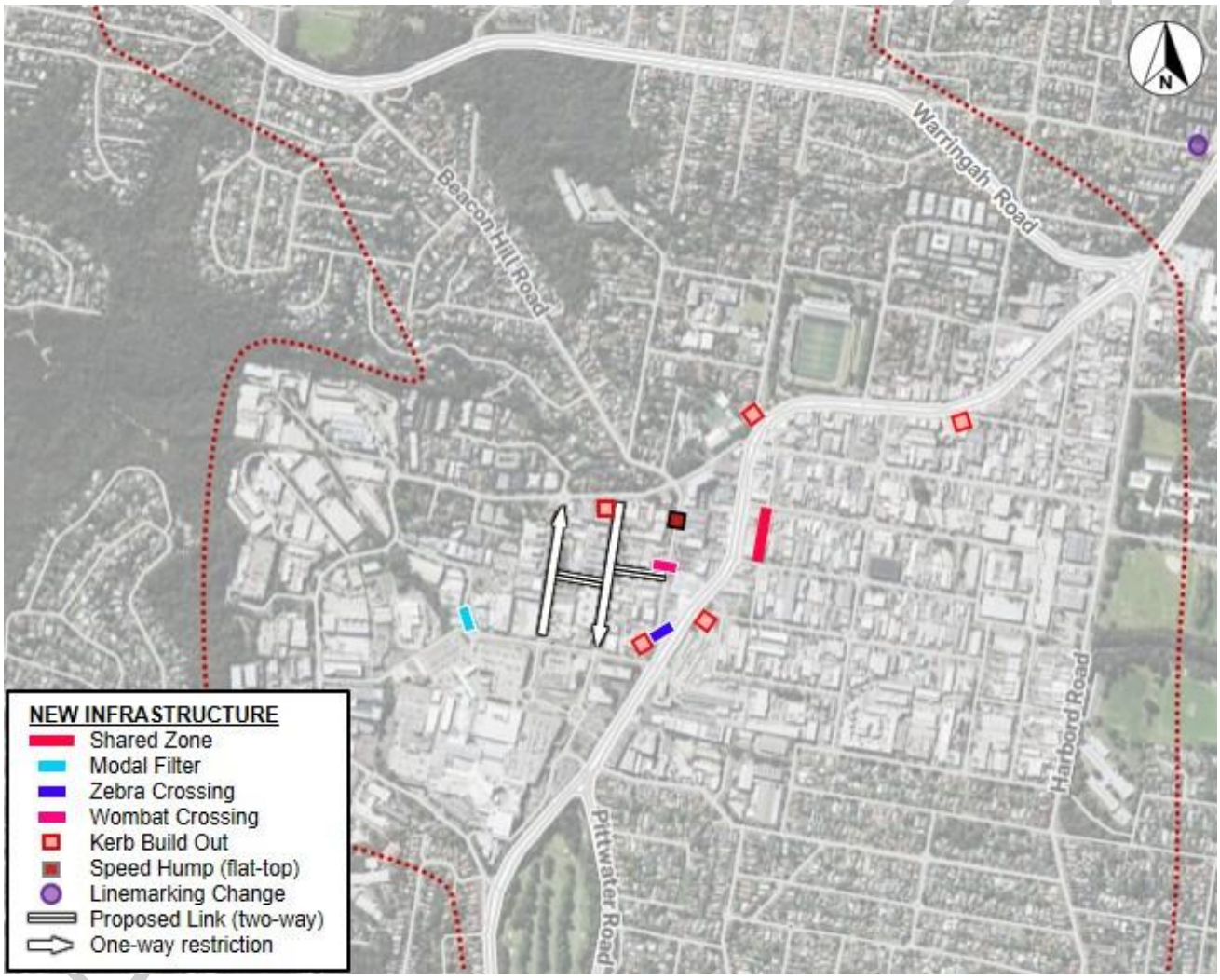


Figure 2.6: Proposed Street Management Locations and Works

Table 2.2: Investigated Street Management Treatment Types

Treatment Type	Description	Existing Example
Threshold Treatments	Low-cost treatments which indicate a change in road environment to drivers. These are typically used where there is a sharp change in speed zones or road hierarchy, from a main street to a local street. **Examples:** Painted threshold, textured threshold, road narrowing, road humps.	
Vertical and Horizontal Deflection Devices	Physical features on the roadway which force changes to the travel path of a vehicle. These devices slow vehicle speeds through differing mechanisms: ▪ Vertical: drivers will avoid discomfort or potential damage to their vehicle ▪ Horizontal: require vehicles to manoeuvre or yield to other vehicles These devices can be used at midblock locations at regular intervals to discourage vehicles from building up excessive speeds. Vertical deflection devices are often used at the approach to priority-controlled intersections to ensure speeds through the intersection are predictable and appropriate. **Examples:** centre blister island, lane narrowing, flat-top speed humps, speed cushions, raised pavements.	 
Pedestrian Crossing Facilities	Features on the roadway which provide pedestrians safer and more timely crossings across roadways. **Examples:** signalised marked foot crossings, raised pedestrian crossings, pedestrian refuges.	
Diversion Devices	Turn bans and road closures may be used to improve safety and traffic performance along main roads and local streets. These are accompanied by diversion devices, which includes changes to the carriageway geometry, ensuring it is difficult or impossible for vehicles to make the restricted movements. Modal filters may be included in the treatment to maintain permeability for active transport users, taking advantage of the reduced traffic demand. **Examples:** Kerb buildout, bollards, raised median, left-in left-out islands.	
Signage	Signage communicates the road rules to drivers and other road users. This informs drivers of the intended speed limits and priorities at roadways, creating a predictable and safe environment. These may complement physical changes in the road environment that will enforce the signage. **Examples:** Speed limits, shared zones	
Line marking	Line marking coordinates movements between road users and can additionally communicate road rules. These may substitute for more costly physical infrastructure, indicating legal movements and appropriate driving speeds. **Examples:** Lane realignment, dragons teeth	

3. TRAFFIC CAPACITY NEEDS ASSESSMENT

3.1 Overview

Traffic modelling was undertaken at the microsimulation level using Aimsun software to assess the needs and solutions across the Brookvale network as a result of the Structure Plan growth and road changes. The outcomes from the modelling help inform and shape the

The modelling was undertaken to address the following key items:

- Understanding the latest existing traffic conditions across the study area in a post-COVID landscape (in comparison to the recent TMAP modelling)
- Exploring the current and future network pinch points and congestion patterns, particularly along the key Pittwater Road corridor
- Evaluate the future capacity of the road network to absorb and cater for the traffic growth associated with the Structure Plan
- Identify any supplementary infrastructure solutions required to support the Structure Plan growth to ensure that the road network continues to operate at a sustainable level of performance.

3.2 Base Traffic Model Development

3.2.1 Modelled Area

The layout of the 2024 Base Model and the zoning system is shown in Figure 3.1.

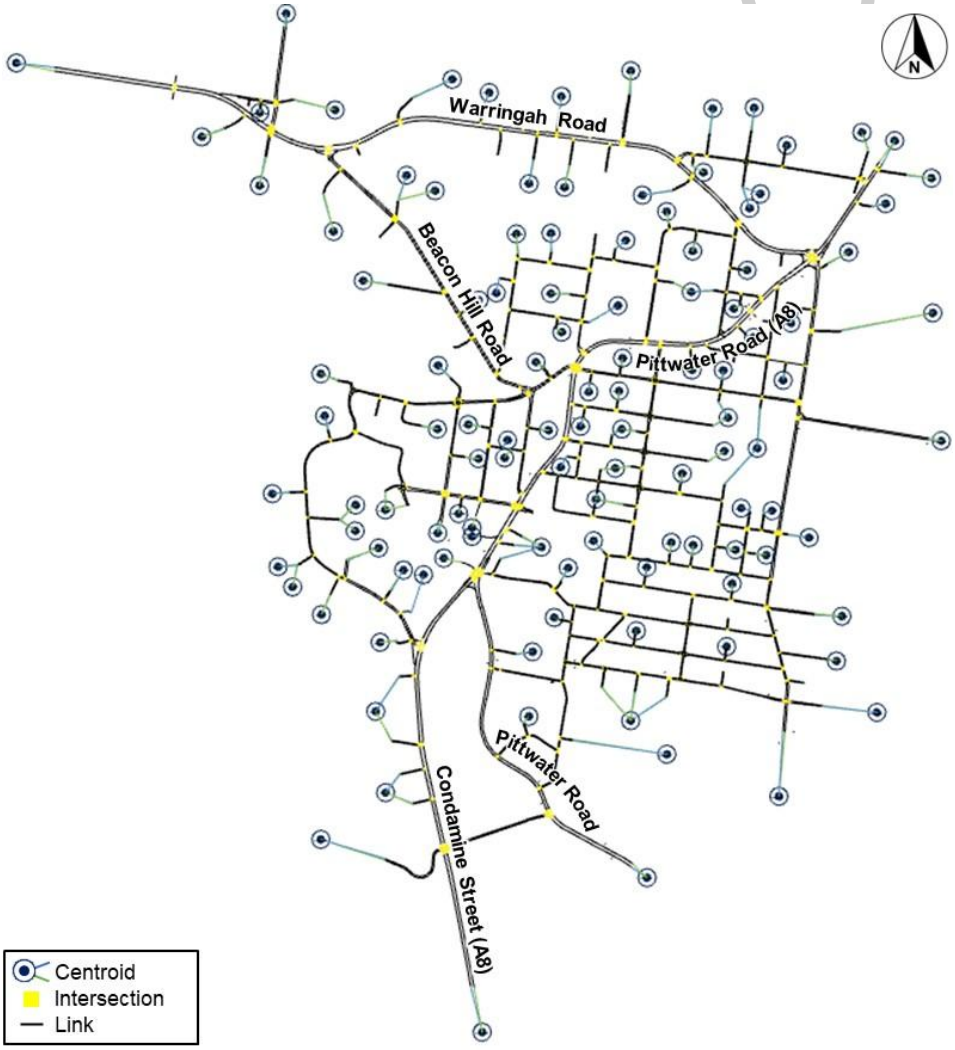


Figure 3.1: 2024 Base Model Layout

3.2.2 2024 Current Base Model Development

The traffic models used in this study were built upon the modelling foundation from the 2021 Brookvale Dee Why TMAP. The network was updated to reflect the latest road conditions in Structure Plan study area and revalidated to traffic data collected on Wednesday 28 August 2024.

Traffic zones in the network represented small land parcels of similar land use, based on an aggregation of zones from the Census Mesh Block system. The density of traffic zoning for the model facilitated a more accurate release of traffic across the study area, particularly for the core Structure Plan area surrounding the Warringah Mall and the industrial precinct.

The base model development, calibration and validation is outlined in *P6599.002R Brookvale SPTS Calibration Validation Report*.

3.2.3 2041 Future Base Model Development

The development of the 2041 future year scenarios involved the estimation of background and development traffic growth for each of the initial future year land use scenarios. This process involved running a custom land use scenario through TfNSW's Strategic Traffic Forecasting Model (STFM) via projected population and employment numbers for each of the region's travel zones. To adapt the high-level STFM demand matrices for compatibility with the detailed Aimsun network, travel zones are disaggregated into their representative centroids. The association between travel zones and Aimsun centroids is visualised in Figure 3.2.

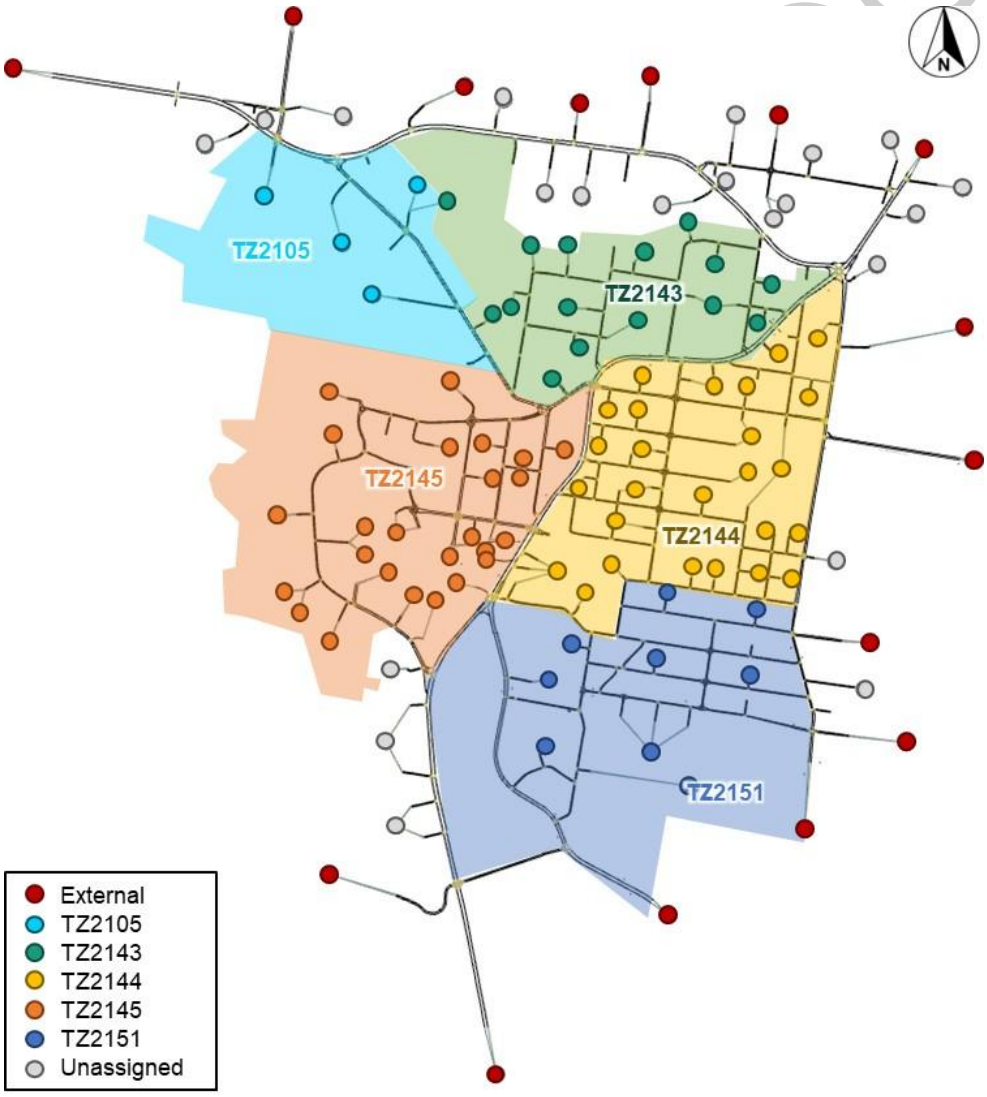


Figure 3.2: Travel Zone and Centroid Association

Two initial future year 2041 scenarios were created: the 'No BSP' and 'BSP' scenarios. The former suppressed any traffic growth within the Structure Plan zones between 2021 and 2041. The latter added the baseline Structure Plan growth projections into these zones to evaluate the expected traffic impacts in a 'with development' scenario.

The traffic demand creation process is shown in Figure 3.3.I

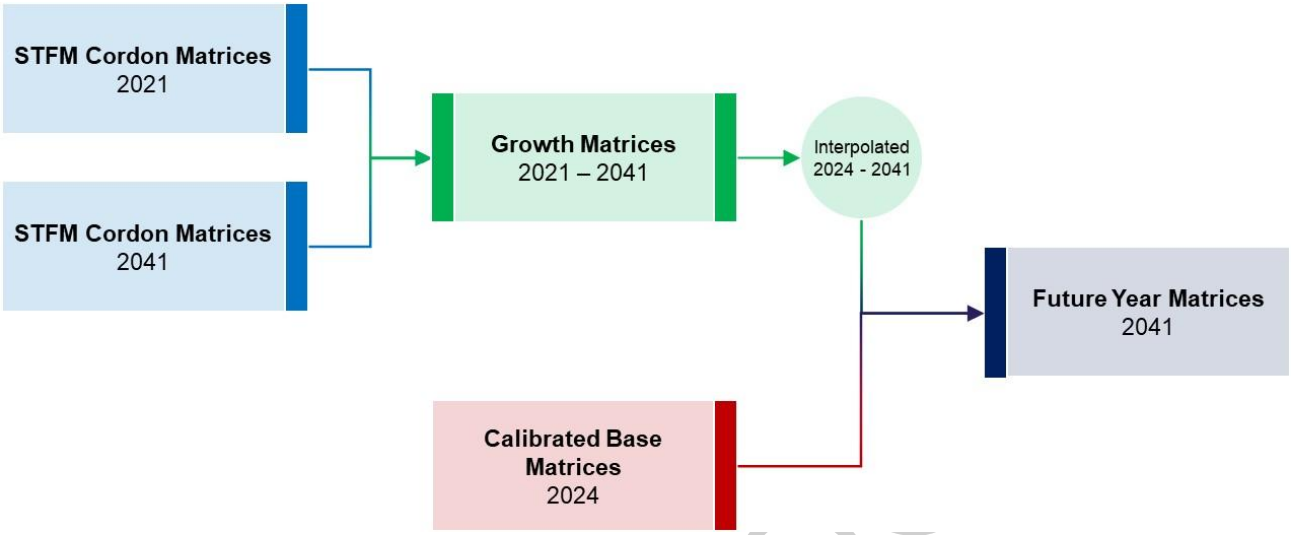


Figure 3.3: 2041 No BSP and BSP Traffic Demand Estimation Process

The growth in traffic between 2024 and 2041 was calculated from the difference between 2021 and 2041 STFM traffic volumes, interpolated to account for the 3-year difference in 'current year'. These growth matrices were added on top of the calibrated matrices to produce future year matrices. The total resulting traffic demand for each scenario is summarised in Table 3.1.

Table 3.1: Modelled 2-Hour Traffic Volumes

Scenario	Total Network Volume (veh)	Difference from 2024 (veh)	% Change
AM Peak			
2024 Base	30,749	-	-
2041 No BSP	30,518	-231	-0.8%
2041 BSP	31,157	+408	+1.3%
PM Peak			
2024 Base	32,579	-	-
2041 No BSP	32,798	+219	+0.7%
2041 BSP	33,763	+1,184	+3.6%

3.2.4 Option and Scenarios

As part of the modelling assessment, a number of yield scenarios and road network options were run in addition to the No BSP and BSP scenarios. A summary of these scenarios is shown in Table 3.2.

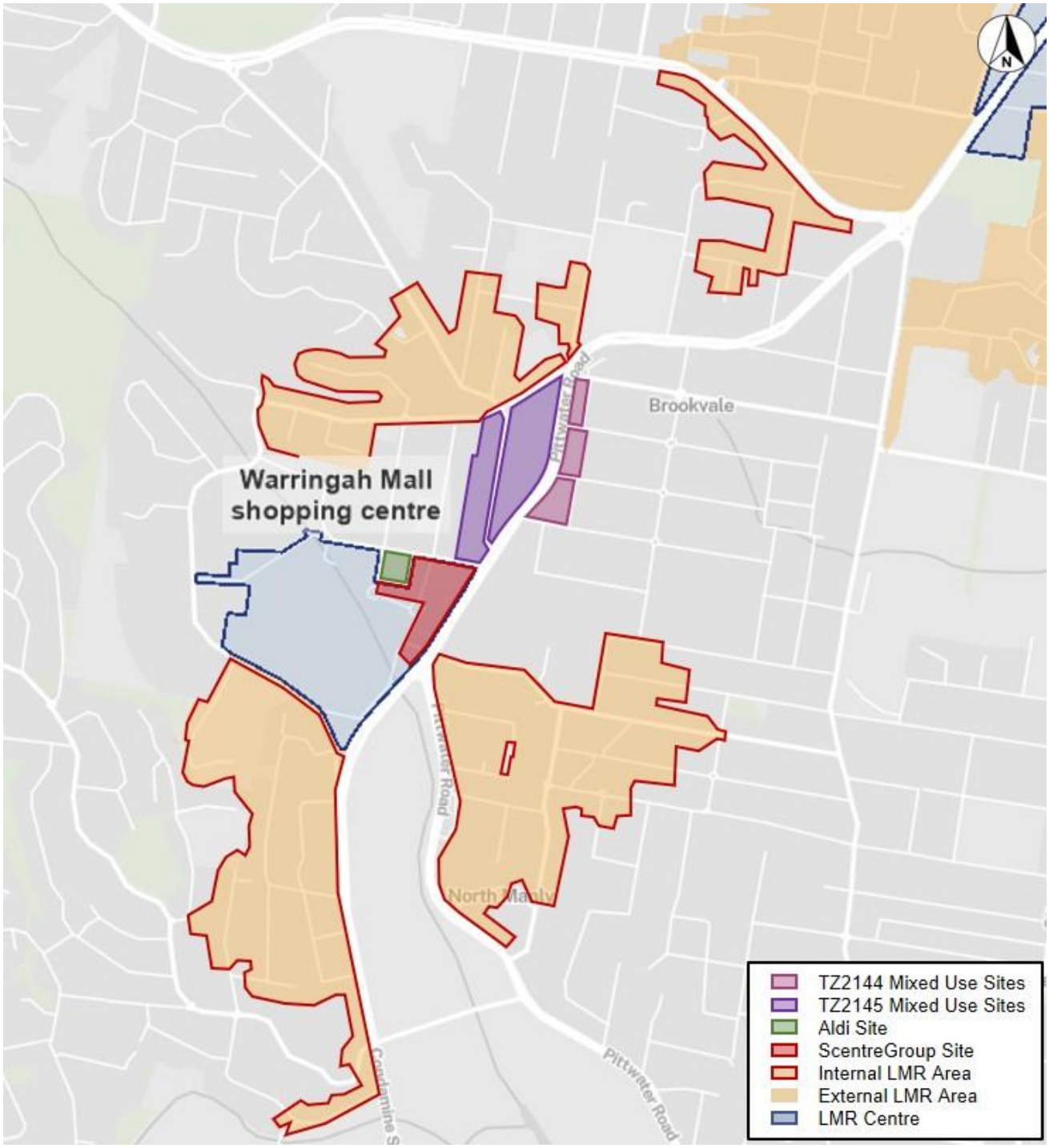
Table 3.2: Traffic Models and Associated BSP Yields

Model Name	Change in Yields		Description
	Dwellings	Employment	
2024 Base	-	-	Model reflecting existing conditions
2041 No BSP	-	-	Traffic demand after 17 years of background growth + suppressed growth in Structure Plan zones
2041 BSP	1,356	900	Traffic demand after 17 years of background growth + initial BSP yields
2041 BSP Option 1	1,867	900	2041 BSP + increased Scentre Group (SG) site yields + a number of planned Black Spot Program works
2041 BSP Option 2	2,567	900	2041 Option 1 + increased SG site yields
2041 BSP Option 3	2,567	900	2041 Option 2 + initial test of SG site access upgrades
2041 BSP Option 4	1,817	900	2041 Option 1 + removal of growth on SG site + increased mixed-use yields in Roger Street catchment
2041 BSP Option 5	1,941	900	2041 Option 4 + additional yields on Aldi site + traffic infrastructure works testing
2041 BSP Option 5 *Sensitivity Testing*	2,441 - 3,941	900	2041 Option 5 + sensitivity testing for network capacity based on increased SG site yields
2041 BSP Option 6	2,751	900	2041 Option 5 + LMR growth in surrounding catchments + traffic infrastructure works testing
2041 BSP Ultimate	3,703	900	2041 Option 6 + final BSP dwelling allowance on SG site + final traffic infrastructure works

3.2.5 Details on Additional Traffic Generation and Distribution

The above options evaluated a number of scenarios that included additional dwellings on top of the initial BSP yields provided for the strategic STFM runs. It is noted that employment figures remained unchanged through all option scenarios. The tested changes to regional demographics resulted in a need to estimate the additional traffic generation and distribution through the network.

The locations of the additional dwellings are shown in Figure 3.4.



Source: Adapted from LMR Viewer – Low and Mid-Rise Housing Indicative Map

Figure 3.4: Option Case Additional Yields

The components of the residential yields tested in each option scenario are summarised in Table 3.3.

Table 3.3: Modelled Options and Dwelling Yields

Model Name	Dwelling Yield Component					Total Increase
	Base BSP	SG Site	Aldi	Mixed Use	LMR	
2024 Base	-	-	-	-	-	-
2041 No BSP	-	-	-	-	-	-
2041 BSP	1,067	289	-	-	-	1,356
2041 BSP Option 1	1,067	800	-	-	-	1,867
2041 BSP Option 2	1,067	1,500	-	-	-	2,567
2041 BSP Option 3	1,067	1,500	-	-	-	2,567
2041 BSP Option 4	1,067	0	-	750	-	1,817
2041 BSP Option 5	1,067	0	168	706	-	1,941
2041 BSP Option 5 Sensitivity	1,067	0-2,000	168	706	-	variable
2041 BSP Option 6	1,067	0	168	712	804	2,751
2041 BSP Ultimate	1,067	850	0	982	804	3,703

It is noted that LMR yields were determined by HillPDA Consulting for a total projected growth over 15-years at 'viable' sites. This growth forecast only assessed internal LMR sites.

The traffic generated by the dwellings additional to the initial BSP yields were calculated through a variety of methods based on their land use and location:

- Mixed-use yields along Roger Street and Aldi sites utilised a trip generation rate calculated from the STFM outputs for TZ2144 and TZ2145 (to reflect similar trip characteristics for the area as identified by the strategic modelling)
- LMR dwellings used medium-density residential rates from the *TfNSW Guide to Traffic Impact Assessment (2024)*
- The ScentreGroup site used surveyed rates from a high-density residential site in Manly (Site 4) from *RMS Trip Generation Surveys – High Density Residential (Car Based), Data Report 2017*. This site was used as its traffic generation rates represented a median site located in a relatively similar transport context to the SG site.

A comparison between the traffic generation rates used are shown in Table 3.4.

Table 3.4: Traffic Generation Rates for Additional Yields

Land Use / Site	Traffic Generation Rate (vehicle trips/dwelling)	
	AM Total	PM Total
Mixed Use (TZ2144)	0.235	0.223
Mixed Use (TZ2145)	0.249	0.397
Low Mid-Rise Housing Policy	0.390	0.370
ScentreGroup Site	0.270	0.300

As all additional yields are residential in nature, it was assumed that all traffic generated are light vehicles. Directional splits were similarly assumed to be typical of residential sites:

- **AM Peak:** 30% inbound / 70% outbound
- **PM Peak:** 70% inbound / 30% outbound.

Traffic was distributed to the network according to the demand profile of their respective TZ as provided in the STFM. No adjustments for linked trips were assumed for the additional trip generation.

3.3 Base Model Results

3.3.1 Assessment Metrics

The modelled traffic network performance was evaluated with a number of key traffic engineering metrics, including aggregated network-wide statistics, travel times along key routes, and intersection queueing patterns. These outputs were compared between the models to determine needs for traffic infrastructure works.

The network output metrics were:

- **Vehicle Hours Travelled:** the total aggregate travel time for all vehicles that completed a trip during the simulation period
- **Vehicle Kilometres Travelled:** the total aggregate travel distance for all vehicles that have completed a trip during the simulation period
- **Average Delay Time:** the average delay time experienced by each vehicle to travel a kilometre of distance, calculated as the difference between free-flow (ideal) vs. actual travel time
- **Completed Trips:** the total number of vehicles that has successfully completed a trip during the simulation period
- **Incomplete Trips:** the total number of vehicles that were remaining within the network at the end of the simulation period
- **Unreleased Trips:** the number of vehicles that were still waiting to enter the network at the end of the simulation period.

Another, more localised metric to assess the adequacy of traffic network performance was the intersection Level of Service (LOS). This measures the delay of vehicles passing through an intersection, with differing methodologies based on the intersection control:

- **Signalised intersections:** Average delay of all vehicles at the intersection
- **Priority intersections:** Delay of the worst turning movement.

For the purposes of this study, the target intersection LOS was identified as LOS D given the existing level of activity along the major A8 corridor. It was acknowledged that some intersections may not reasonably reach this target without significant upgrades.

A summary of the LOS thresholds is shown in Table 3.5.

Table 3.5: Level of Service (TfNSW)

Level of Service	Delay Thresholds (seconds)
A	Delay ≤ 14.5
B	14.5 < Delay ≤ 28.5
C	28.5 < Delay ≤ 42.5
D	42.5 < Delay ≤ 56.5
E	56.5 < Delay ≤ 70.5
F	70.5 < Delay

Source: Traffic Modelling Guidelines (2025, TfNSW)

Intersections were additionally cross-checked in SIDRA, a microanalytical modelling tool for assessing individual intersections and small networks. This program was used to fine-tune indicative intersection layouts, providing the minimum tenable lane configuration and lengths based on queue lengths and LOS.

3.3.2 Base Year Network Performance Summary

The 2024 Base model was reflective of the observed traffic issues in the study area, with a notable level of congestion at key points in the network particularly in the PM peak.

During the AM peak, heavy queueing was noted at the boundaries of the network, especially on Pittwater Road (from Dee Why) and other key access points onto arterial roads like Willandra Road. The Pittwater Road / Warringah Road / Harbord Road intersection forms a key pinch point of the network, with high delays over 70s (LOS F) throughout the 2-hour peak. Typical Pittwater Road southbound queues during the second half of the AM peak period are shown in Figure 3.5.

Figure 3.5: 2024 Base AM Peak: Warringah Road / Pittwater Road / Harbord Road

Willandra Road provides the only signalised right-turn opportunity onto Warringah Road for over 1km, serving a large proportion of the residential-heavy Narraweena and Cromer catchments. As a result, delays on the southbound approach are extremely high and queues consistently extend up to and beyond Tristam Road during the AM peak. Figure 3.6 shows the typical extent of queueing at the start of green at Warringah Road.

Figure 3.6: 2024 Base AM Peak: Willandra Road Southbound at Warringah Road

The Pittwater Road / Old Pittwater Road / Winbourne Road intersection also shows signs of congestion, particularly on the western approach. A heavy southbound movement along Beacon Hill Road proceeds to turn right onto Pittwater Road via Old Pittwater Road, resulting in a saturation of the right turn lane. Typical queues during the AM peak period are shown in Figure 3.7.

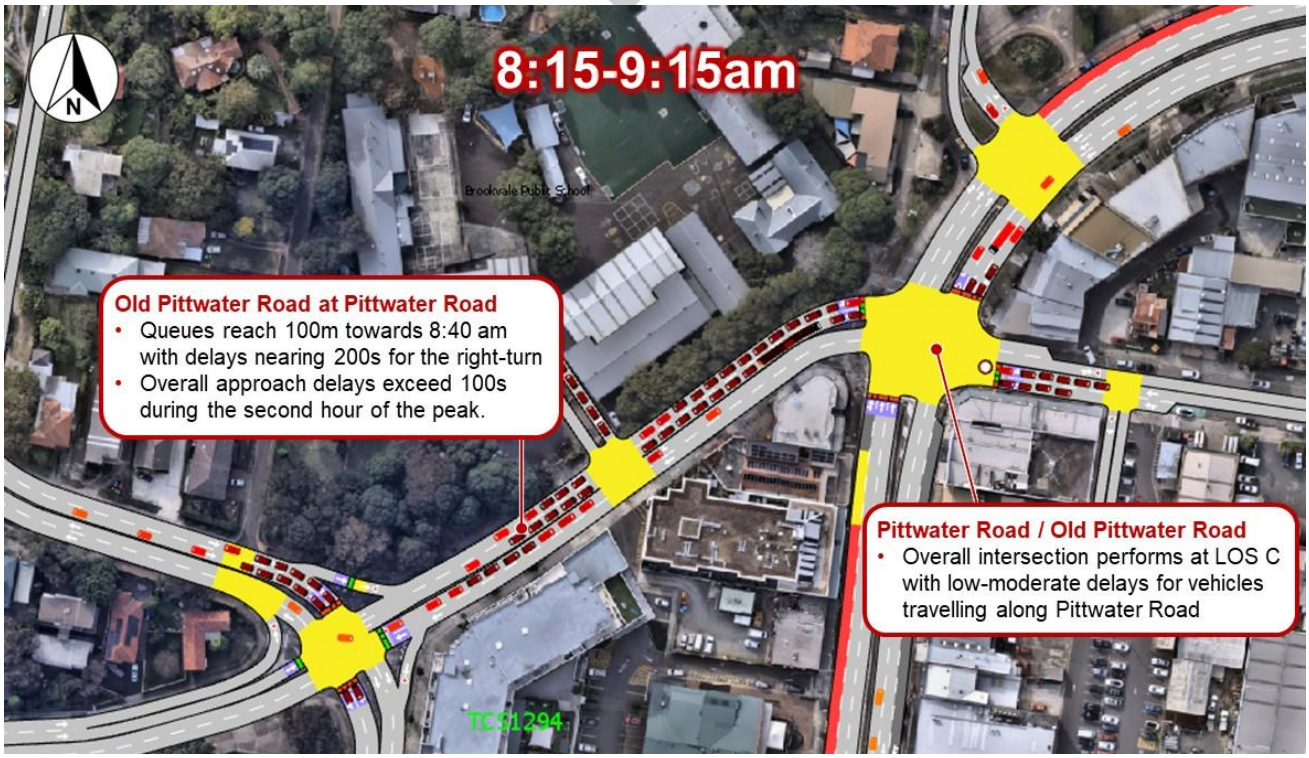


Figure 3.7: 2024 Base AM Peak: Willandra Road Southbound at Warringah Road

During the PM peak, there is significant congestion within the study area network. Key congestion points along Pittwater Road cause high delays and long queues, especially at the major Pittwater Road / Warringah Road / Harbord Road intersection. Additionally, heavy traffic demands for secondary roads like Beacon Hill Road are seen to oversaturate the road capacity.

The most significant network pinch point in the PM peak is the Pittwater Road / Warringah Road / Harbord Road intersection, acting as a gateway into the northern suburbs (Dee Why, Collaroy, Narrabeen, etc.). Extremely heavy northbound movements along the A8 corridor funnel through this intersection, resulting in queues which regularly extend back over 500m. Vehicles take multiple cycles to clear this intersection, resulting in a number of stop-start movements. The typical queueing is shown in Figure 3.8.

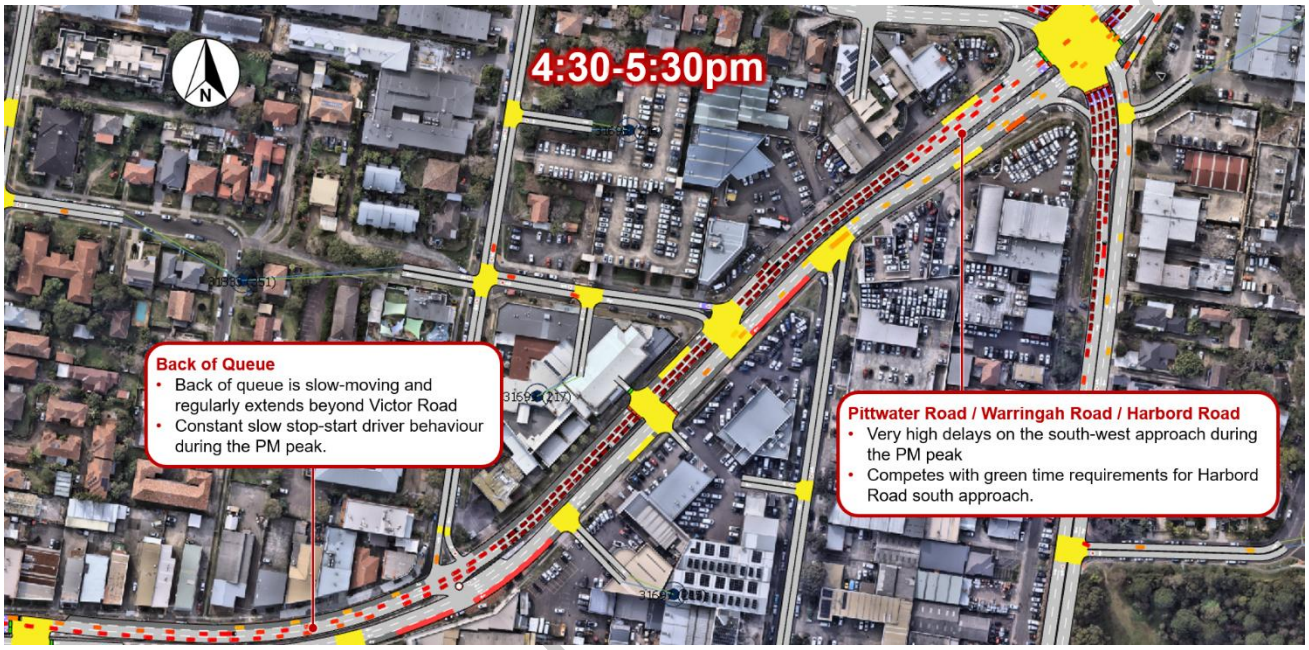


Figure 3.8: 2024 Base PM Peak: Pittwater Road at Warringah Road and Harbord Road

Beacon Hill Road is also a significant congestion point, with slow-moving traffic stemming from queues at the Warringah Road approach. Traffic capacity is limited to a single lane along the majority of the road, resulting in the typical queues as shown in Figure 3.9.

Figure 3.9: 2024 Base PM Peak: Beacon Hill Road Northbound

3.3.3 Future Base and Reference Case Network Performance Summaries

The 2041 Future Base and Reference Case scenarios (i.e. the No BSP and BSP models respectively) were used to understand how the existing traffic network performs under the projected future traffic demands. A comparison between the main observed network capacity constraints and traffic performance issues (delays and queues) in the No BSP and BSP scenarios is shown in Figure 3.10 for the critical PM peak.

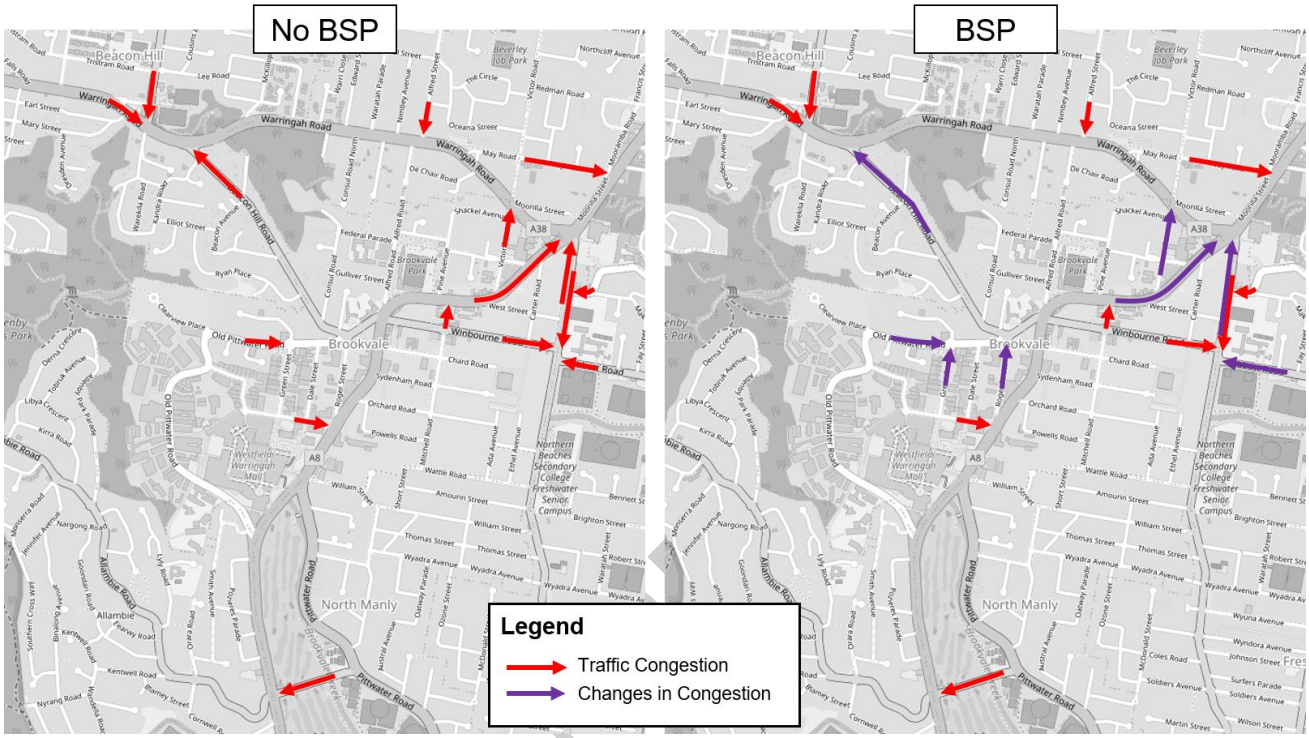


Figure 3.10: 2041 Base PM Peak: Beacon Hill Road Northbound

Generally, it was identified that in the critical PM peak:

- The No BSP scenario operated relatively similarly to the existing 2024 scenario
- The introduction of BSP-associated traffic exacerbated the existing traffic issues at certain locations, particularly around local streets between Old Pittwater Road and Cross Street as well as along the main corridors (Pittwater Road, Harbord Road and Beacon Hill Road).

3.4 Options Modelling Results

3.4.1 Options 1 - 4 Network Performance Summary

Options 1-4 were developed to test the effects of increases in traffic generated on the ScentreGroup site and the mixed-use sites along Roger Street and Pittwater Road. Outputs from these scenarios were used to further develop and inform the yield capacity of the Structure Plan. A later revision to the base model meant that the Option 1-4 scenario outputs were no longer directly consistent with later scenarios.

Option 3 tested an initial road network and site access scheme provided by ScentreGroup (dated September 2024) for changes to intersections on Cross Street and the Pittwater Road / Condamine Street intersection. It is understood that this scheme is currently subject to further amendments and revisions as the plan for the Warringah Mall develops.

Option 4 tested a redistribution of dwelling yields between the other mixed-use sites in the Structure Plan by re-allocating dwellings from the ScentreGroup site.

The modelling outcomes showed that:

- The road network was capable of accommodating Option 1 levels of traffic with limited worsening compared to the BSP scenario
- The road network deteriorated with Option 2 levels of traffic, with a number of critical pinch points developing or worsening as a result
- The upgraded road network in Option 3 improved a number of a critical capacity issues but also resulted in downstream impacts due to greater release of traffic from the core area.
- The reduction in overall traffic demand in Option 4 was substantially better for the road network when compared with Options 2 or 3, with a notable alleviation of traffic congestion symptoms compared to the previous options.

3.4.2 Option 5 Network Performance Summary

Option 5 was developed to test the impact of additional dwellings on the Aldi site on Cross Street. The impacts of a number of road closures for road safety or for civic amenities were additionally tested at this stage.

The modelling outcomes showed that:

- Option 5 showed a similar to slightly worse level of performance when compared to the BSP scenario, entailing that the road network was generally functional from a network-wide traffic perspective
- There was some local worsening in key areas as a result of the yield changes, particularly at:
  - Cross Street right turn onto Pittwater Road
  - Roger Street capacity constraints on approach to Old Pittwater Road
  - Green Street roundabout from the west and south approaches.

A number of initial options for network upgrades were explored during Option 5 and refined further in later scenarios.

3.4.3 Option 5 Sensitivity Network Performance Summary

Sensitivity testing was undertaken using the Option 5 scenario to understand the theoretical capacity of the road network with increases in dwellings on the ScentreGroup site. This was undertaken by iteratively increasing the dwellings until the network reached 'failure'. The outcomes are shown in Figure 3.11.

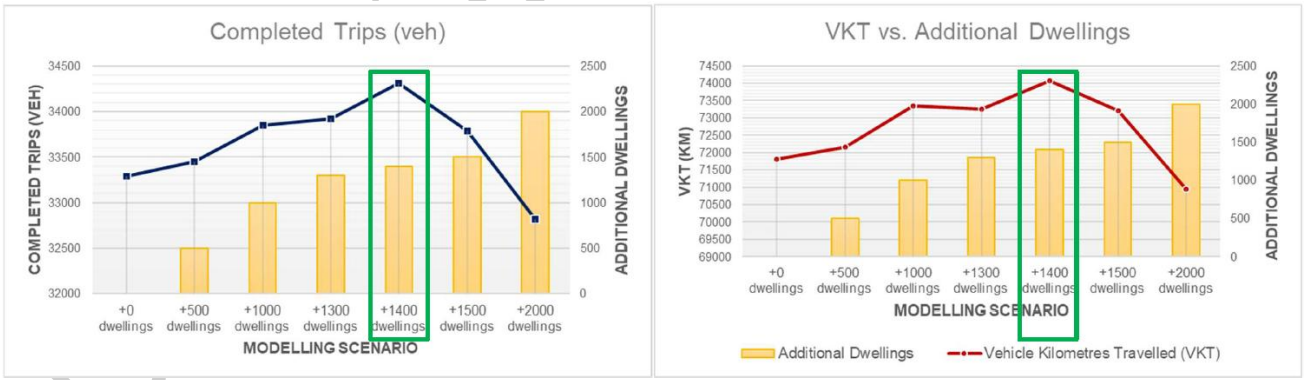


Figure 3.11: Option 5 Sensitivity Testing – Network Capacity Graphs

The analysis identified at a high-level that the network reaches capacity between 1300-1400 dwellings on the ScentreGroup site. Any additional yield in excess of this number results in a decrease in number of completed trips and total kilometres travelled by the traffic demand; despite the additional trip generation, there was less traffic arriving at its destination.

The main points of failure were associated with southbound traffic turning into the road catchment of The Core precinct of the Brookvale Structure Plan:

- Pittwater Road right-turn into Old Pittwater Road
- Pittwater Road right-turn into Cross Street.

3.4.4 Option 6 Network Performance Summary

Option 6 was developed to test the impacts of the State Government's Low and Mid-Rise (LMR) Housing Policy. This would raise building height limits in specific areas, introducing an additional development potential of around 804 dwellings into zones within study area. While most of this is concentrated away from the main Structure Plan area, some overlap is observed for the land on Old Pittwater Road near Beacon Hill Road.

The modelling outcomes showed that:

- Option 6 showed a minor worsening of network performance metrics, with around 7% increase in total travel time and a 10% increase in overall vehicle delays when compared with Option 5
- Impacts were largely observed to be local in nature, particularly on streets like Victor Road, Federal Parade and Old Pittwater Road
- Impacts were mostly contained to the PM scenario, with a minor impact to performance in the AM being accommodatable by the existing road capacity.

Further network upgrade testing was undertaken at this stage to identify potential solutions for LMR-exacerbated network constraints.

3.4.5 'Ultimate' Scenario

The 'Ultimate' scenario was developed based on the interpretation of the findings from the previous options modelling. It was based on a dwelling allowance on the ScentreGroup site of 850 dwellings and incorporated the recommended infrastructure upgrades identified through the options testing.

The modelling outcomes showed that the 2041 Ultimate scenario demonstrated a reasonable level of performance across the study area network comparable or better than the 2041 Future Base case.

3.5 Results Summary

3.5.1 Network Statistics

Table 3.6 summarises the network-wide outputs for the key modelled scenarios.

Table 3.6: Traffic Models Network Statistics Results

Statistic	2024	2041				
	Base	No BSP	BSP	Option 5	Option 6	Ultimate (incl. upgrades)
AM Peak						
Vehicle Hours Travelled	2,548	2,544	2,625	2,710	2,846	2,677
Vehicle Kilometres Travelled	63,821	64,156	64,845	65,397	65,460	68,285
Average Delay Time (s/km)	81	80	82	86	93	76
Completed Trips (veh)	30,186	30,199	30,636	30,851	30,923	32,188
Incomplete Trips (veh)	1,668	1,484	1,551	1,708	1,983	1,628
Unreleased Trips (veh)	108	116	294	351	620	129
PM Peak						
Vehicle Hours Travelled	2,971	2,980	3,223	3,424	3,675	3,096
Vehicle Kilometres Travelled	69,002	67,724	70,567	71,814	72,126	74,289
Average Delay Time (s/km)	97	103	109	115	127	90
Completed Trips (veh)	32,946	32,465	33,664	34,270	34,413	35,475
Incomplete Trips (veh)	1,600	1,828	1,708	1,714	2,046	1,519
Unreleased Trips (veh)	99	245	284	257	440	137

**Options 1-4 were omitted as they utilised a superseded model. Comparisons of those network statistics are therefore redundant.*

3.5.2 Intersection Level of Service

Table 3.7 summarises the overall intersection LOS comparison between the key modelled scenarios. The modelled performance of the Ultimate scenario shows significant improvements to a number of intersections, with nearly all intersections operating at LOS D or better. The main exceptions are the Warringah Road / Willandra Road intersection (which operates barely in the LOS E category) and the Pittwater Road / Warringah Road / Harbord Road major intersection (which remains LOS F).

Table 3.7: Intersection LOS

Intersection	2024	2041				
	Base	No BSP	BSP	Option 5	Option 6	Ultimate (upgrades)
AM Peak						
Pittwater Road / Cross Street	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C
Pittwater Road / Winbourne Road	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C
Old Pittwater Road / Beacon Hill Road	LOS C	LOS C	LOS D	LOS D	LOS D	LOS C
Old Pittwater Road / Green Street	**LOS F**	LOS D	LOS B	LOS B	LOS C	LOS B
Pittwater Road / Mitchell Road	LOS B	LOS B	LOS B	LOS A	LOS A	LOS A
Victor Road / Pittwater Road	LOS B	LOS B	LOS B	**LOS F**	**LOS F**	LOS B
Warringah Road / Pittwater Road	**LOS F**	**LOS F**	**LOS F**	**LOS F**	**LOS F**	**LOS F**
Victor Road / Warringah Road	LOS C	LOS B	LOS C	**LOS F**	LOS D	LOS B
Warringah Road / Beacon Hill Road	LOS B	LOS B	LOS B	LOS B	LOS B	LOS B
Warringah Road / Willandra Road	LOS D	LOS D	LOS D	LOS D	LOS D	LOS E
Willandra Road / Cornish Avenue	**LOS F**	LOS D	LOS D	LOS D	LOS D	LOS C
Harbord Road / Winbourne Road	LOS C	LOS D	LOS D	LOS E	LOS C	LOS C
PM Peak						
Pittwater Road / Cross Street	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C
Pittwater Road / Winbourne Road	LOS B	LOS B	LOS C	LOS C	LOS C	LOS C
Old Pittwater Road / Beacon Hill Road	LOS B	LOS B	LOS B	LOS B	LOS B	LOS C
Old Pittwater Road / Green Street	LOS D	**LOS F**	**LOS F**	LOS D	LOS E	LOS B
Pittwater Road / Mitchell Road	LOS C	LOS B	LOS B	LOS B	LOS B	LOS B
Victor Road / Pittwater Road	**LOS F**	LOS B	**LOS F**	LOS C	**LOS F**	LOS B
Warringah Road / Pittwater Road	**LOS F**	**LOS F**	**LOS F**	**LOS F**	**LOS F**	**LOS F**
Victor Road / Warringah Road	LOS E	LOS D	**LOS F**	**LOS F**	**LOS F**	LOS B
Warringah Road / Beacon Hill Road	LOS C	LOS C	LOS B	LOS C	LOS C	LOS B
Warringah Road / Willandra Road	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D
Willandra Road / Cornish Avenue	**LOS F**	**LOS F**	**LOS F**	**LOS F**	**LOS F**	LOS C
Harbord Road / Winbourne Road	LOS C	LOS D	LOS C	LOS C	LOS D	LOS C

3.6 Proposed Upgrades for the 2041 Ultimate Scenario

The final round of traffic network upgrade testing was completed with the 2041 BSP Ultimate yields, supporting the traffic demand comprised of a total of 3,703 additional dwellings and 900 additional jobs.

The proposed network upgrades included in this scenario is shown in Figure 3.12.

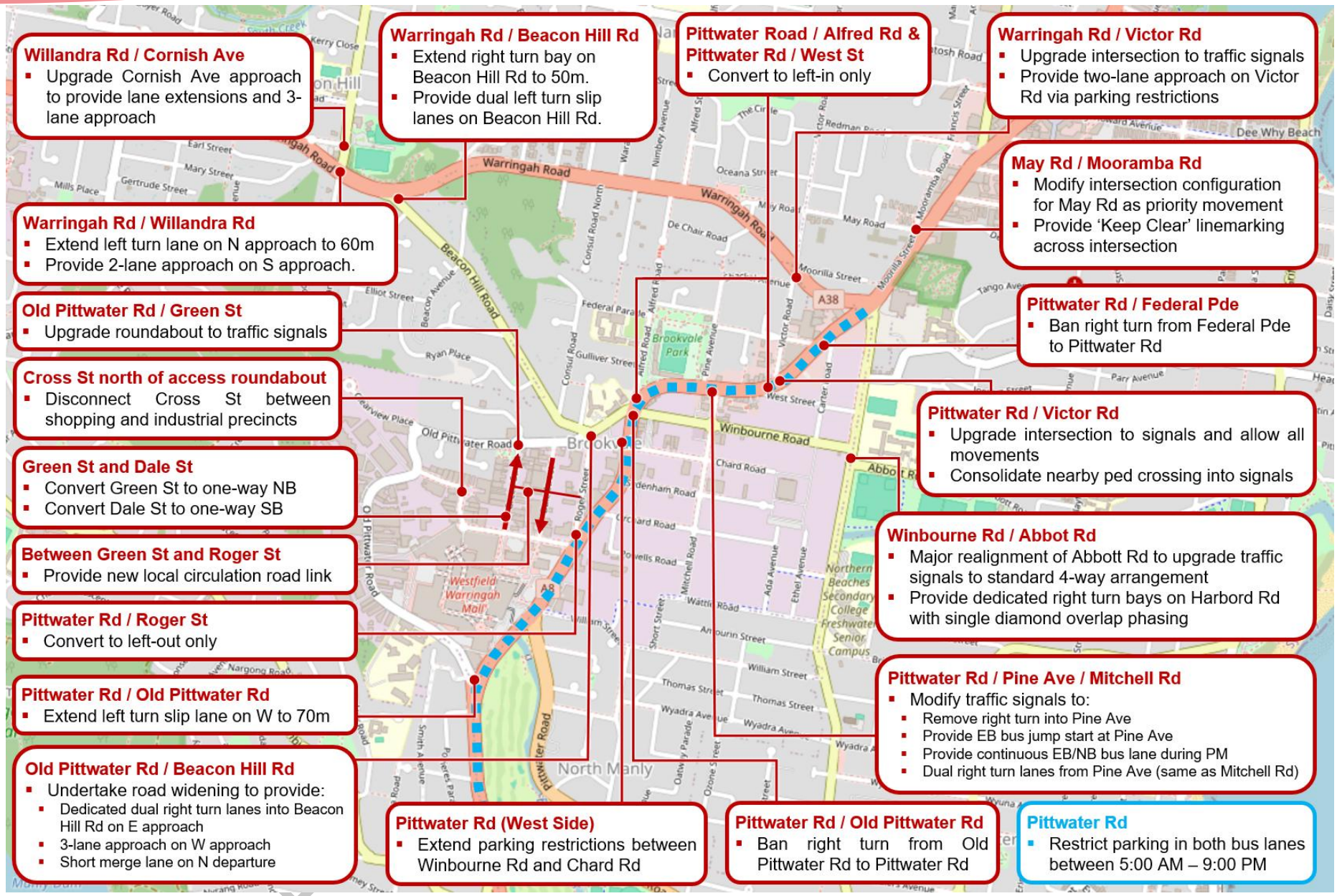


Figure 3.12: Proposed Upgrades

3.7 Pittwater Road / Warringah Road / Harbord Road Intersection

The Pittwater Road / Warringah Road / Harbord Road traffic signals (TCS 1000) is a major intersection with regional significance. It represents the convergence of major arterial corridors, and acts as a gateway to the northern suburbs.

The modelling outcomes show that the intersection operates over-capacity in all scenarios and both peaks. At the 2024 base year, the intersection already shows average intersection delays of 80 seconds, with over 120 seconds of delay on the worst approaches of Pittwater Road (south-west) and Harbord Road (south) during the critical afternoon peak period. This worsens with the combination of regional and Planning Proposal growth allowances, with average delays at the intersection at around 110-120 seconds and worst approaches now operating at over 200 seconds of delay.

The level of queueing and traffic impact generated by this intersection on the road network is extremely high, with over 500m of queues resulting in upstream issues at sites like Pittwater Road / Mitchell Road and Harbord Road / Headland Road. These secondary issues can eventuate in a significant degradation of local road quality, resulting in an overall breakdown of the road network. For example, where vehicles are unable to exit the industrial precinct on Winbourne Road and Mitchell Road due to main corridor blockages. The network is observed to operate very close to this capacity threshold, with queues very close to Mitchell Road in the PM peak in most scenarios.

The average intersection delay at this site across all scenarios is shown Figure 3.13. It is noted that individual approaches or movements can show delays in excess to these values.

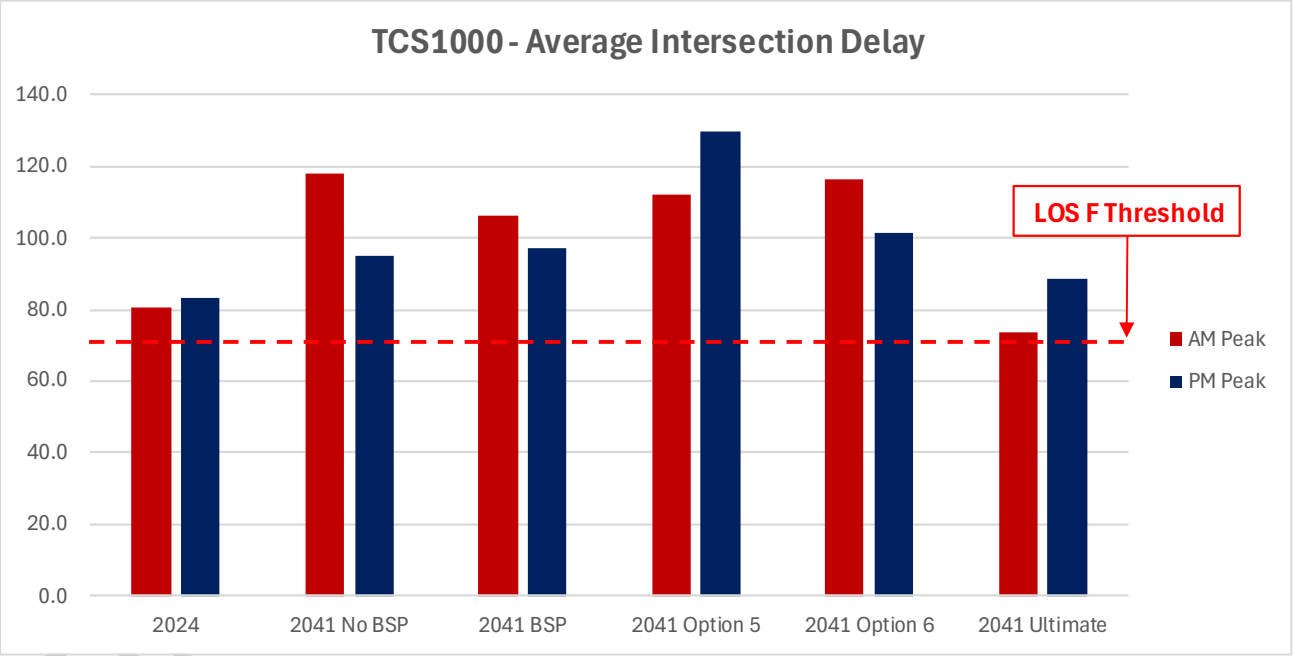


Figure 3.13: Average Intersection Delay at Pittwater Road / Warringah Road / Harbord Road

While the 2041 Ultimate scenario (with associated upgrades) does see an alleviation of traffic pressures, it is notably still above the LOS F threshold and also still worse than the current 2024 conditions during the PM peak (which is observed to be already congested and overcapacity). As such, even with the extensive scheme of proposed infrastructure works, the main network pinch point still remains present and will limit any further regional expansion or growth.

Any further growth within the Planning Proposal areas covered by the Brookvale Structure Plan beyond the allowances in the Ultimate scenario (being 2,899 dwellings and 900 jobs) will likely trigger a need for major upgrades at this intersection. These upgrades will likely need to consider a full grade separation upgrade for Pittwater Road and Warringah Road-Harbord Road corridors to ameliorate traffic conditions to an acceptable level of performance.

3.8 Parking Assessment

3.8.1 Benchmarking Assessment and Key Local Considerations

Off-street car parking rates are a key adjustable parameter affecting strategic transport mode shares. The balance of these rates can act to control traffic generation levels from future developments, and shift travel towards more sustainable options like active and public transport. The parking supply of high-density residential developments has a direct impact on the private vehicle traffic generated by the development, demonstrably for those in areas of lower public transport accessibility. Similar trends are expected from other land uses, provided there is sufficient infrastructure to support alternative modes of transport. Therefore, a reduction in the parking provisions at residential developments can result in a reduction in car trips associated with the site.

The Brookvale town centre area is currently subject to the LGA-wide controls of the Warringah Development Control Plan 2011. These rates set a minimum number of parking spaces to be built within certain land uses and are similar to other LGA-wide rates throughout Sydney. Other controls specific to strategic town centres such as Frenchs Forest provide a maximum number of spaces that residential developments may provide.

A comparison between the parking rates of Brookvale and other areas of Sydney is shown in Table 3.8.

Table 3.8: Parking Rates Comparison

Land Use	LGA-wide Rates			Town / Metropolitan Centre Rates				
	Brookvale	Mosman	North Sydney	Balgowlah	Frenchs Forest	North Sydney	GTIA Cat. 1	GTIA Cat. 2
	Minimum		Maximum	Minimum	Maximum		Reference	
Residential (parking spaces per dwelling)								
Dwelling	2	1	0.5	-	-	1 - 2	-	-
Studio	-	-	0.5	-	0.6	0.3	-	-
1 bed	1	1	0.5	1	0.6	0.4	0.4	0.6
2 beds	1.2	1.5	1	1	1	0.7	0.7	0.9
3+ beds	1.5	2	1	1	1.5	1	1.2	1.4
Visitors	0.25	-	0.16	0.2	0.1	-	-	-
Other Uses (parking spaces per *x*m^2)								
Retail	16.4	16	60	40	21.3	60	26.3 - 57.1	26.3 - 39.2
Office	40	37	60	40	21.3	60	32.3	37.6

The NSW Guide to Transport Impact Assessment (GTIA) rates are also included in this comparison, providing up-to-date reference rates from TfNSW. These separate areas into car parking rate categories based on various demographic measures. The BSP area falls within category 1 or 2 based on the medium-high car mode share and moderate access to public transport options.

The current Brookvale minimum parking rates for residential and retail land uses are observed to be relatively generous / high in comparison to the reference rates across other precincts.

Another key consideration for adjustments to parking rates is the accessibility for public and active transport alternatives. The proposed highest intensity land uses for the Brookvale Structure Plan fall within key public transport catchments:

- All mixed-use developments are within the 400m walking catchment of any bus stops
- All mixed-use developments are within an 800m walking catchment of the B-Line bus stops.

Footpaths linking the BSP areas to the B-Line bus service are mostly direct and well-connected. While not equivalent to a higher-capacity passenger rail service, the Warringah Mall B-Line bus stops are

comparable in regional function and therefore considered to have a similar walking catchment to a train station. The approximate catchments of the Warringah Mall bus hub are shown in Figure 3.14.

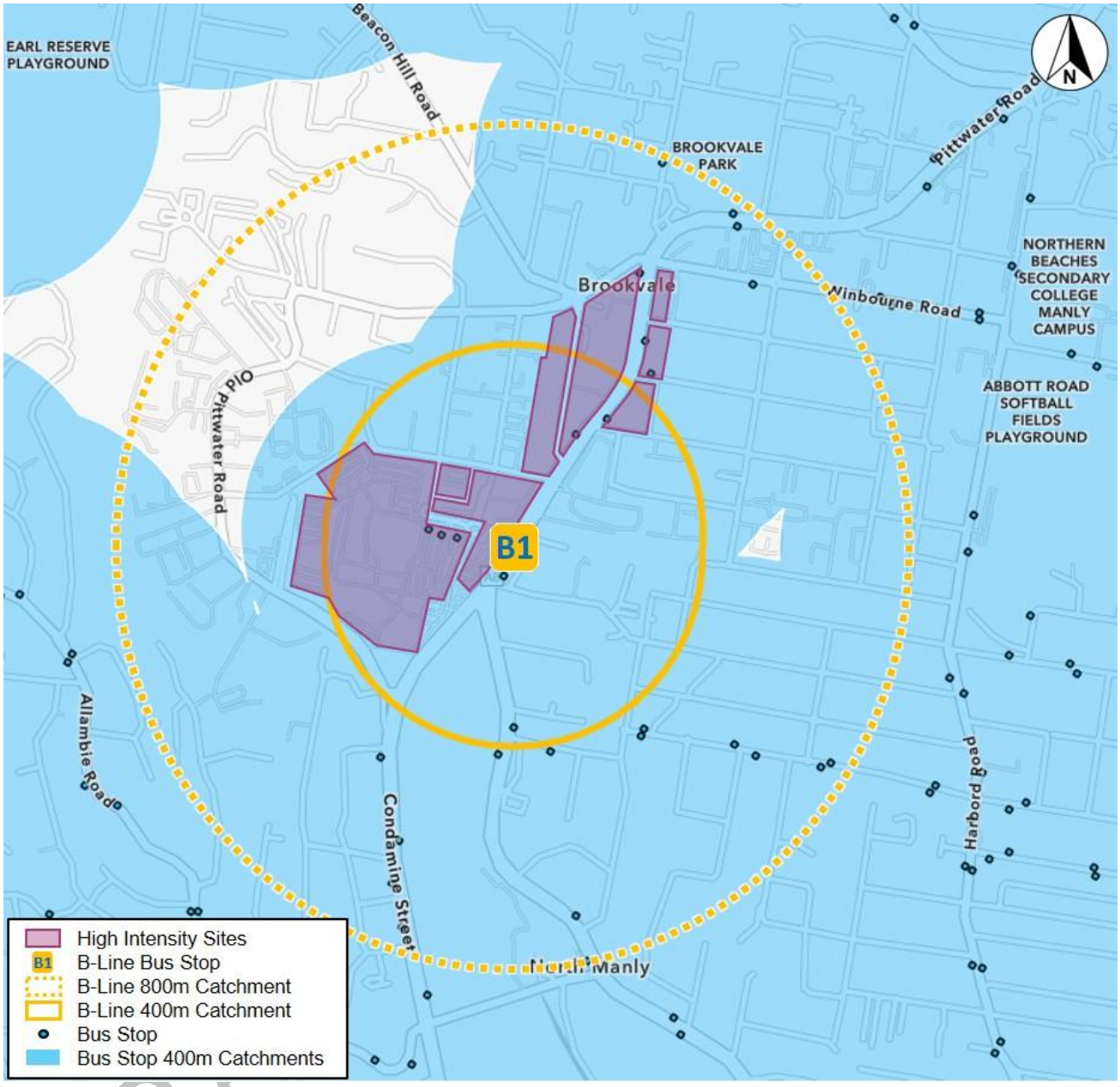


Figure 3.14: Bus Stop Catchments

3.8.2 Recommended Parking Rates

Considering the current regional importance of the BSP area and its proposed densification, car parking rates specific to the BSP area are recommended to be updated to reflect contemporary rates. This will take advantage of the proximity of the high intensity sites to high-capacity bus services and active transport routes.

Maximum parking rates similar to Frenchs Forest are proposed for the BSP area, reducing car dependency and increasing the use of active and public transport for trips generated and attracted from the residential, and commercial land uses.

The recommended parking rates are summarised in Table 3.9.

Table 3.9: Recommended Parking Rates

Land Use	Existing	Proposed
	Minimum	Maximum
Residential (parking spaces per dwelling)		
Dwelling	2	-
Studio	-	0.6
1 bed	1	0.6
2 beds	1.2	0.9
3+ beds	1.5	1.5
Visitors	0.25	0.2
Other Uses (parking spaces per *x*m^2)		
Retail (Per *x*m^2)	16.4	60
Office (Per *x*m^2)	40	60

Minimum parking rates for bicycles are proposed to align with the Warringah DCP 2011 LGA-wide rates are recommended. High-medium security facilities should be provided at:

- Residential sites: 1 per dwelling
- Business and retail premises: 1 per 200m^2 GFA
- General and light industry: 1 per 200m^2 GFA
- Recreation facility: 1 per 4 employees.

Additional bike lockers or sheds are recommended to be provided at the Warringah Mall bus stops to encourage multimodal trips. It is suggested that the bicycle parking at the ScentreGroup and Aldi sites are to be publicly accessible bike sheds or lockers to supplement demand for the B-Line bus stops, alongside provisions of other end-of-trip facilities. This should include charging spaces appropriate for e-bikes in alignment with the expected demand.

4. ACTIVE TRANSPORT INFRASTRUCTURE

4.1 Integrated Active Transport Network Plan

The existing active transport network within the Brookvale Area is catered towards pedestrian access. Footpaths are provided throughout the precinct, with a moderate density of signalised or pedestrian-priority crossing facilities surrounding Warringah Mall. Numerous pedestrian links are located on steep slopes that are otherwise unnavigable for vehicles, including bicycles. These links make shorter pedestrian trips between the Brookvale town centre to Narraweena and Allambie Heights viable. However, a number of crossing points are unsuitable for the wide roadways they are located across, notably along the Pittwater Road and Mitchell Road corridors.

NBC previously endorsed the Northern Beaches Bike Plan 2020, which informs the intended regional cycle route connectivity through the BSP study area, and the desired connections to key local destinations. Existing cycling infrastructure is provided predominantly in the form of shared paths along a number of these cycling routes within the BSP study area. Strava heatmaps show these routes are heavily utilised, in addition to routes without any existing infrastructure. Most notably, the Pittwater Road bus lanes form a key route for recreational cyclists that prefer to avoid the slowdowns and modal conflicts of shared paths within the industrial precincts.

A reduction in the dependence on private vehicles within the precinct is a key aspiration for the BSP. Transport demand is intended to instead be met by improvements in the active transport infrastructure, granting a larger catchment access to the local employment and civic areas. Long distance trips will also be affected if active transport infrastructure enhances multimodal trips with public transport by providing direct access to the Warringah Mall bus stops.

A map of the future active transport network with supporting infrastructure is shown in Figure 4.1.

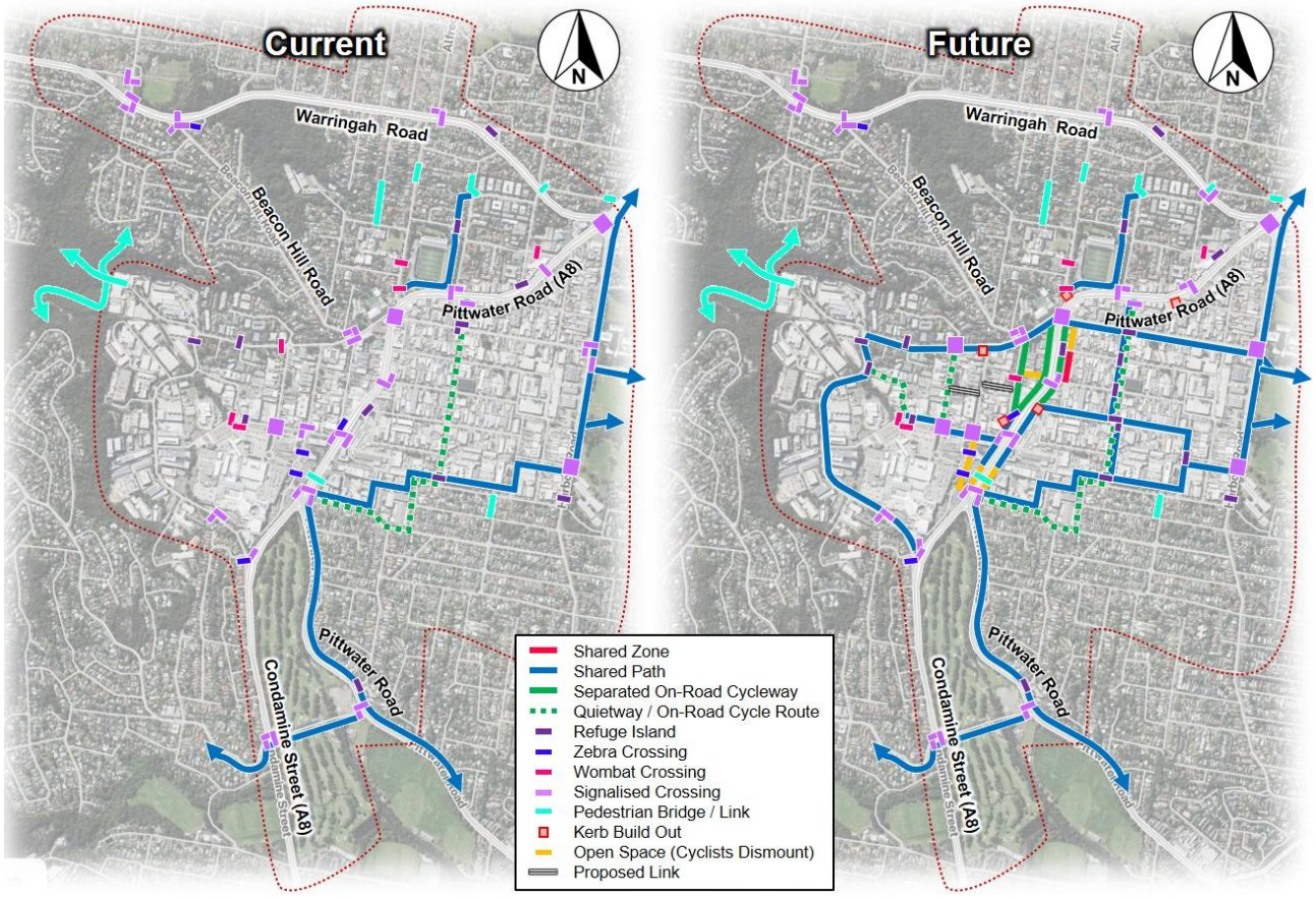


Figure 4.1: Current and Future Active Transport Network Plans

4.2 Proposed Facilities with the Structure Plan

4.2.1 Overview

The shared path network is proposed to be greatly expanded within the BSP area, providing equitable active transport access between residential areas, industrial precincts, and the regional shared path network outside of the study area. This includes connectivity to the Warringah Mall bus stops from the northern side, improving the safety and travel time of multimodal trips.

Separated on-road cycleways are additionally proposed to be provided on Roger Street and Pittwater Road, forming parallel cycling priority links adjacent to civic areas.

These routes will cater for existing demand and provide new opportunities for short to medium distance trips, intended to be used by commuters and shoppers. The proposed active transport infrastructure has been split into 8 key routes as summarised in Table 4.1 and Figure 4.2.

Table 4.1: Key Routes

ID	Route Location	Length	Description
AT-1	Old Pittwater Road	1.9 km	Shared path providing access to the western industrial precinct
AT-2	Winbourne Road	0.8 km	Shared path connecting the proposed dense residential lots to the eastern industrial precinct and regional cycle routes
AT-3	Mitchell Road	0.7 km	Shared path providing access within the eastern industrial precinct
AT-4	Orchard Road	0.7 km	Shared path connecting the Brookvale town centre and Warringah Mall bus stops to the eastern industrial precinct and regional routes
AT-5	Pittwater Road	0.5 km	One-way separated cycleways and shared paths providing connection along Pittwater Road main street and the Warringah Mall bus stops
AT-6	Cross Street (east)	0.4 km	Shared path connecting the Brookvale town centre and Warringah Mall bus stops to the western industrial precinct
AT-7	Cross Street (west)	0.3 km	Quietway connecting the western industrial precinct to the Cross Street cycle routes
AT-8	Roger Street	0.3 km	Two-way separated cycleway providing connection along high intensity land uses

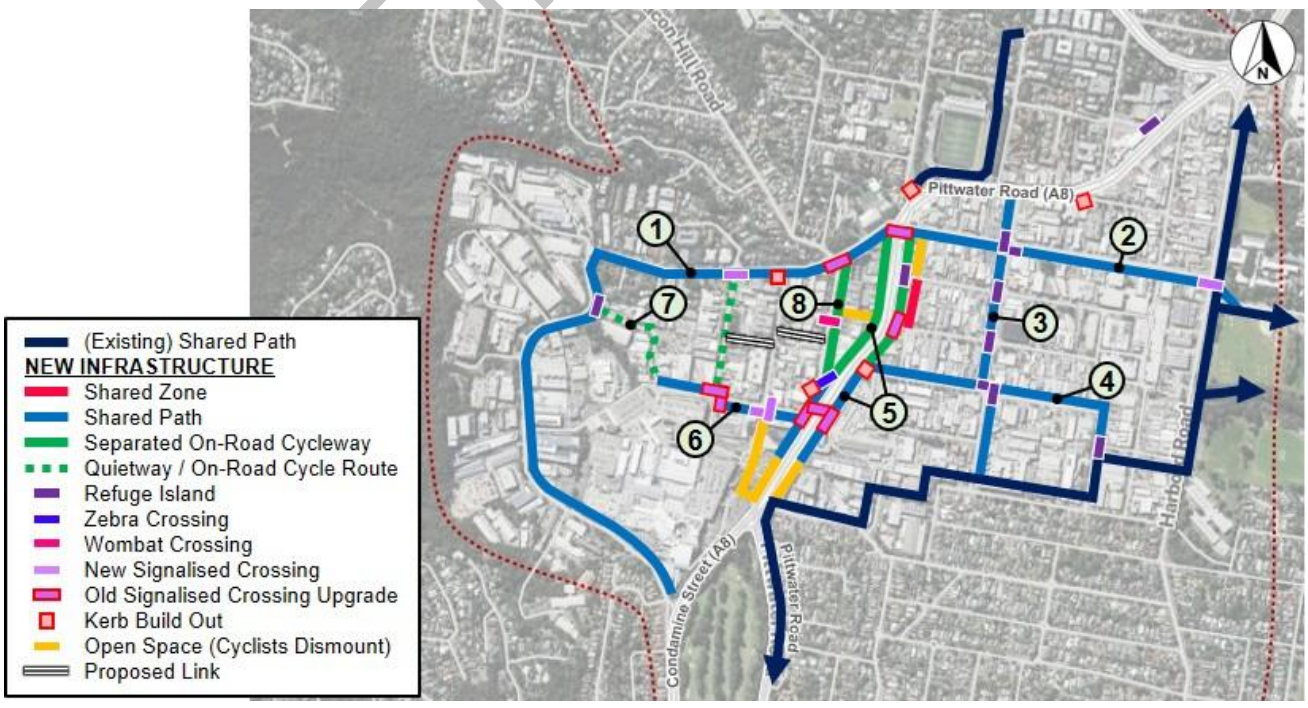
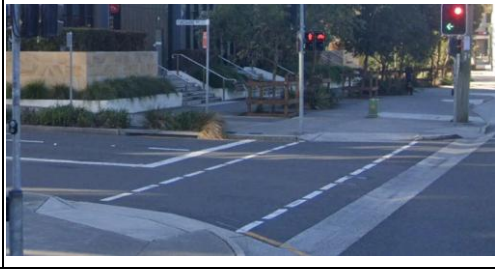


Figure 4.2: Proposed Active Transport Infrastructure Works

A non-exhaustive list of the active transport facilities considered for the transport network plan are shown in Table 4.2 and the proposed active transport infrastructure works are detailed in Table 5.1.

Table 4.2: Investigated Active Transport Infrastructure

Infrastructure	Description	Existing Example
Shared Path	A 3 m wide footpath with a centreline that provides two-way travel for pedestrians and cyclists. ▪ This facility allows adult cyclists to legally cycle on the footpath. ▪ Presents lower amenities for both cyclists and pedestrians due to speed conflicts. This is deemed to be more appropriate for routes within the industrial precincts as cyclists will discern a slower environment. Drivers accessing driveways will have more time to perceive and give priority to cyclists.	
On-Road Separated Cycleway	An on-road priority cycling route separated from vehicles by a kerb. ▪ These provide fast and uninterrupted travel for cyclists ▪ Minimises conflicts between cyclists and drivers, especially for highly trafficked roads ▪ Requires dedications from the road reserve.	
Quietway	A section of low-vehicle traffic roadway that is designated as part of a cycle route. This is supported by painted bicycle symbols and signage. ▪ Low-cost solution requiring minimal changes to existing infrastructure ▪ Relies on infrastructure conflicts between cyclists, and drivers.	
Refuge Islands	A raised median located between opposing traffic lanes with a road-level gap for pedestrians to wait on. These allow pedestrians to give way to one direction of traffic at a time. ▪ Reduces workload on all road users, providing more timely and safer crossings Refuges located on shared paths must additionally be designed for cyclists, with gap dimensions recommended to be 2m by 3m	
Shared Pedestrian Crossings	Crossing facilities resembling zebra or wombat crossings that give priority to pedestrians and cyclists. ▪ This facility allows cyclists to legally cross while mounted. Measures to slow cyclists on approach to the crossing and wide sightlines are recommended to provide drivers sufficient time to perceive and give priority to mounted cyclists.	
Signalised Crossings	Marked crossing facilities at traffic signals timed to prevent conflicts with vehicle movements. ▪ Provides safe crossings across major roads ▪ May be integrated with bicycle lanterns to allow cyclists to legally cross while mounted ▪ May cause significant pedestrian delays compared to alternative crossing facilities depending on traffic signal cycle time.	

4.2.2 Pedestrian Facilities

Conflicts between pedestrians and cyclists on footpaths are expected to increase with a higher active transport mode share. With the current footpath widths throughout most of the precinct, cyclists overtaking pedestrians will require riding on the verge or roadway. Shared paths within the study area are intended to alleviate this issue, providing space for cyclists to overtake along select corridors.

The wide crossings at priority-controlled intersections along Pittwater Road are proposed to be shortened with refuge islands and kerb buildouts, largely corresponding with turn bans. Facilities are to be provided at locations with higher pedestrian traffic, such as at Pittwater Road / Federal Parade as shown in Figure 4.3. This includes the street management upgrade restricting the right-turn out of Federal Parade.

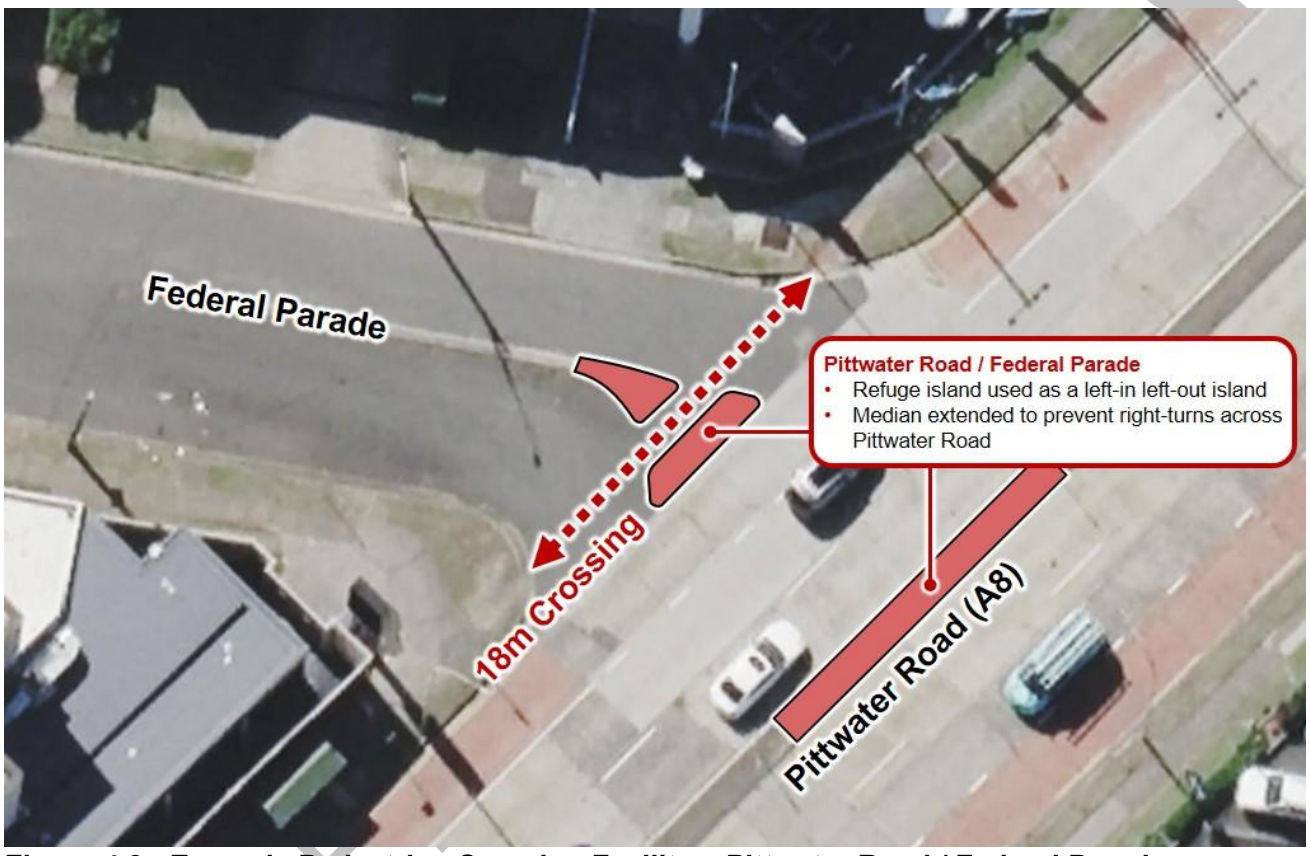


Figure 4.3: Example Pedestrian Crossing Facility – Pittwater Road / Federal Parade

The Pittwater Road / Orchard Road intersection is also expected to experience higher active transport activity, due to the confluence of the proposed separated cycleway and shared path. Reducing the kerb radius here will serve to reduce vehicle turning speeds and improve active transport safety. As there are a multitude of alternative routes, this change is not expected to impact heavy vehicle movements between Pittwater Road and the eastern industrial precinct.

Signalised crossings at the Cross Street / Dale Street intersection are proposed on the south and east legs, providing better connections adjacent to the Brookvale Town Centre. Although alternative crossings are available across the western leg of the intersection, and at both Green Street and Pittwater Road, this will discourage any 'jaywalking' behaviour across the 5-lane roadway.

4.2.3 Industrial Precinct Shared Paths

Shared paths within the industrial precincts serve 2 functions:

- Connect the core of Brookvale precincts to regional cycleways and key destinations
- Provide a distribution network for commuters within the industrial precincts

This will encourage short-medium distance commuting trips to be taken by active transport, reducing the parking and traffic demand within the industrial precincts.

A high density of commercial driveways within the industrial precincts limits the efficacy of separated cycleways, introducing safety risks for cyclists. Shared paths are preferred for these areas due to the slower environment they present to cyclists. With sufficient sight distances at driveways, cyclists and vehicles will be offered more time to react to any conflicts. It is acknowledged that these conditions are also not ideal for shared paths but provides a safer and more accessible alternative to on-road cycling amidst heavy vehicles.

Refuge islands are generally used to provide crossing points across moderately trafficked roads at priority intersections. Where signalised intersections exist, the signalised crossings are proposed to be upgraded with combined pedestrian and cyclist lanterns. Design of new refuge islands will need to take into account heavy vehicle turning paths.

4.2.4 Pittwater Road Cycle Route

The Pittwater Road cycle route will provide a direct cycling connection between the mixed-use lots and the Warringah Mall bus stops. One-way cycleways are proposed along each side of Pittwater Road in the same direction as the adjacent traffic, allowing cyclists to be more easily perceived by turning traffic, and transition between the separated cycleways and on-road mixed traffic north of Old Pittwater Road.

The route transitions between on-road facilities and shared paths towards the Warringah Mall bus stops to allow cyclists to be able to ride on the footpath. This allows cyclists to more easily find bicycle parking or embark on buses. These improvements are intended to enhance multimodal long-distance trips, effectively increasing the catchment area of the Warringah Mall bus stops – most importantly including the B-Line.

As the separated cycleway runs along an active bus route, floating bus stop 'islands' will be required to safely manage conflicts between cyclists and buses. These will increase the area of land dedicated to the road reserve and limits the number of passengers able to wait without interfering with cyclist movements. The latter is not expected to be a significant concern outside of the Warringah Mall bus stops where the issue is circumvented by transitioning to a shared path. Other affected stops may require investigation into passenger alighting volumes at the affected bus stops during the design phase.

4.2.5 Roger Street Cycleway

The Roger Street cycleway serves to separate pedestrians and cyclists on the adjacent civic areas along a direct connection to the Brookvale Town Centre. Notably the steep slopes will increase stopping distances and encourage a build-up of speed for southbound cyclists, introducing safety risks between the active transport modes.

On the northbound direction, the steep uphill is not expected to be a major hindrance on its usage due to the recent uptake in e-bikes throughout Sydney. These gradients would otherwise be a significant barrier of entry for cyclists heading towards Frenchs Forest, Narraweena, and Oxford Falls, increasing travel time and required physical exertion. This effect is also true for Beacon Hill Road and local streets within Brookvale, which have gradients in excess of 10% leading up to Warringah Road.

5. CONCLUSIONS

5.1 Key Findings

The Brookvale Structure Plan proposes an uplift to the Brookvale industrial precincts and surrounding residential areas over the next 15 years. The uplift yields additional dwellings and employment, most densely located at the northeastern corner of the Warringah Mall lot, along Roger Street, and a section of Pittwater Road. Further residential yields were investigated at these locations in an iterative process, arriving at the maximum tenable yields of:

- 2,899 Planning Proposal dwellings
- 804 LMR-associated dwellings
- 900 jobs.

Aimsun traffic models were developed to investigate the impact of the traffic generated by these additional yields by 2041, showing that the future BSP growth will cause a substantial degradation on traffic performance throughout the investigation area. Key pinch-points included:

- Various points throughout the A8 corridor (Pittwater Road and Condamine Street)
- Beacon Hill Road / Old Pittwater Road
- Beacon Hill Road / Warringah Road
- Willandra Road / Warringah Road
- Harbord Road / Winbourne Road / Abbott Road.

The level of network congestion in the growth scenarios highlights the finding that the road network of the study area supporting the Planning Proposal sites operates near or over-capacity without significant works. Increased traffic flows at intersections like Pittwater Road / Cross Street, Old Pittwater Road / Beacon Hill Road, Harbord Road / Abbott Road / Winbourne Road and the major Pittwater Road / Warringah Road / Harbord Road result in queue and delay increases, often with cascading impacts through upstream sites. Due to the compromise in operational performance of the traffic network, targeted capacity improvements were therefore identified to be necessary.

As part of the Ultimate scenario, a set of traffic network upgrades were developed to alleviate the projected congestion. These would achieve acceptable levels of traffic performance largely without substantial expansions of the road reserve. This was in-part achieved through the upgrade of local routes through Victor Road and May Road, alleviating traffic demand from the Pittwater Road / Warringah Road / Harbord Road intersection.

While these upgrades were successful in achieving a better balance for the traffic pressures on the network, it is noted that the network still operates at-capacity due to the major Pittwater Road / Warringah Road / Harbord Road intersection. This intersection still operates at LOS F, especially in the PM peak, even with the substantial works package aiming to support and alleviate the traffic flows at this site. As such, any growth beyond that which has been allowed for in the Structure Plan areas will likely trigger a major upgrade for this intersection (grade-separation). Without this, it is expected that the capacity for any further regional growth will be limited.

The vision for the BSP includes improvements in the active and public transport facilities, reducing car dependency within the study area. Improvements to public transport travel times are proposed to be achieved through the enforcement of bus lanes throughout the day. Improvements to B-Line frequency and commencement of short turn-around bus services are proposed to increase the capacity of the public transport network. These improvements will support the increased ridership from both the mode shift change and projected population growth with the masterplan.

Active transport modes would be encouraged through the introduction of local cycling routes catered towards short-medium distance trips. Key proposed routes would, connect:

- The Brookvale Town Centre and Warringah Mall bus stops
- The eastern and western industrial precincts

- Regional cycling routes identified in the *Northern Beaches Bike Plan (2020)*

Pedestrian infrastructure is largely improved through turn restrictions and road closures, providing an opportunity to provide kerb-buildouts and reduce crossing distances. Additional provisions are proposed at crossings with identified safety deficiencies near high civic value areas.

The infrastructure works list is detailed in Section 5.2.

5.2 Transport Infrastructure Action Plan

All active transport and street management infrastructure including existing and proposed items are shown in Figure 5.1.

All proposed transport infrastructure upgrades (traffic capacity upgrades, street management works and active transport facilities) are itemised and summarised in Table 5.1.

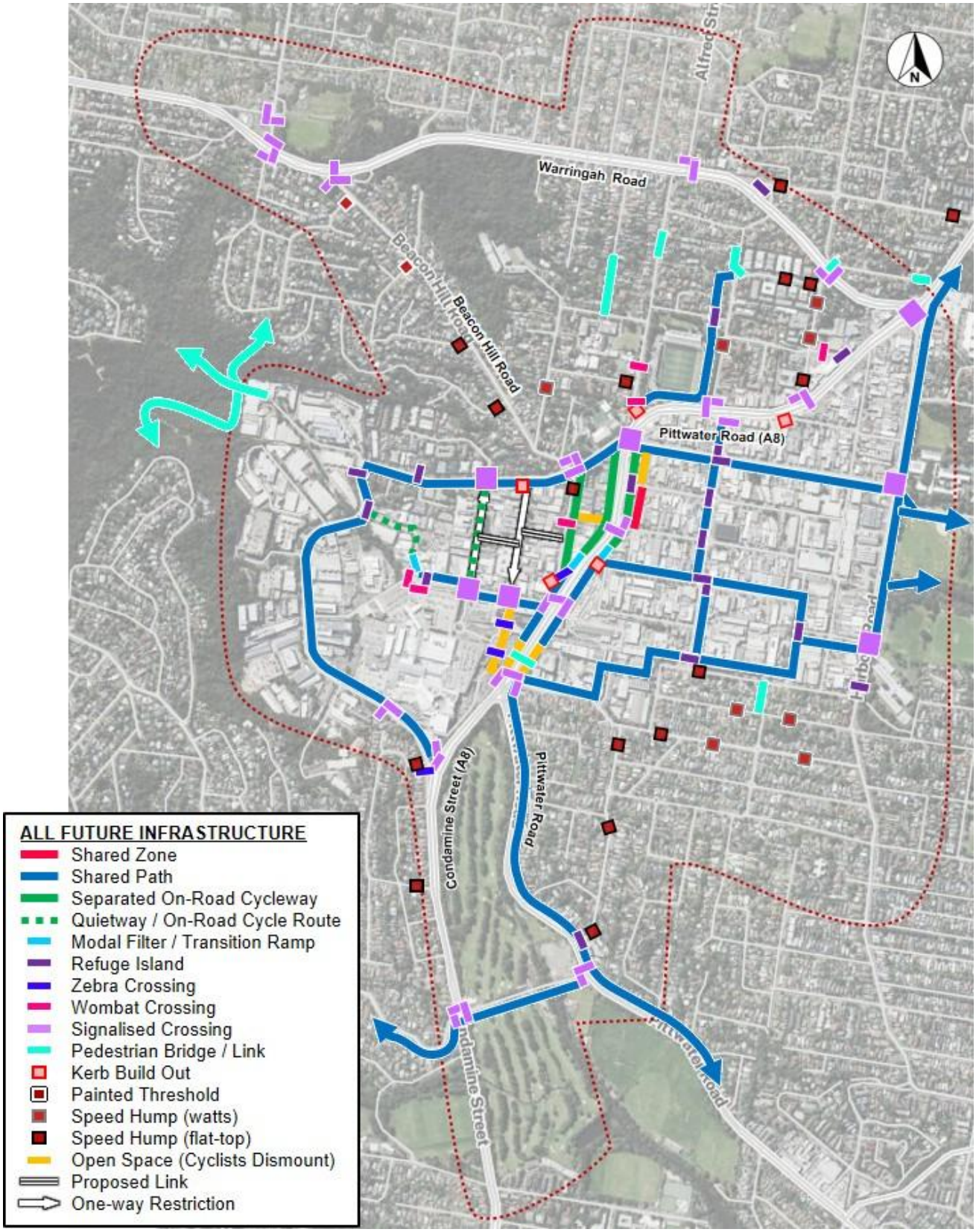


Figure 5.1: Proposed and Existing Active Transport and Street Management Infrastructure

Table 5.1: Brookvale Structure Plan - Transport Infrastructure Action Plan

ID	Location	Works	Purpose
Traffic Capacity Works			
RN-1	Old Pittwater Road / Beacon Hill Road	▪ Provide additional lane on west approach via road widening to extend slip lane to 130m long ▪ Provide new dedicated right-turn bay 65m long on east approach ▪ Provide additional short lane 60m long on north departure.	▪ Control through put through improved lane allocation and pedestrian management.
RN-2	Old Pittwater Road / Dale Street	▪ Provide additional lane in the eastbound carriageway. ▪ Remove turns out of Dale Street (now one-way southbound).	▪ Improve network capacity and pedestrian safety.
RN-3	Old Pittwater Road / Green Street	▪ Upgrade existing roundabout to traffic signals ▪ Two-lane approaches and departures on Old Pittwater Road ▪ Three-lane Green Street approach (now one-way northbound) ▪ One-lane Brookvale Avenue approach and departure.	▪ Improve throughput through improved lane allocation and pedestrian management.
RN-4	Warringah Road / Beacon Hill Road	▪ Provide additional left turn lane on Beacon Hill Road (south approach) ▪ Extend RT bay on south approach to around 50m (approximately up to Kalianna Crescent).	▪ Control through put through improved lane allocation and pedestrian management.
RN-5	Warringah Road / Willandra Road	▪ Extend LT bay on Willandra Road north approach to approximately 55m ▪ Potential to adjust lane widths on Willandra Road between Cornish Avenue and Warringah Road to facilitate new turn lane.	▪ Control throughput through improved lane allocation and pedestrian management.
RN-6	Willandra Road / Cornish Avenue	▪ Extend lanes on west approach: Lane 1 to 110m & Lane 3 to 70m ▪ Reallocates westbound carriageway width for lane extensions. ▪ Potential for no widening to road reserve.	▪ Improve throughput through improved lane allocation and pedestrian management.
RN-7	Willandra Road / Cornish Avenue	▪ Provide two-lane approach on south approach ▪ New Lane 1 is around 20m long ▪ Should be achievable via parking restrictions and line marking.	▪ Improve throughput through improved lane allocation and pedestrian management.
RN-8	Cross Street Green / Street	▪ Provide additional approach Lane 3 on south approach (approximately 65m long) ▪ Convert northern leg to one-way northbound departure.	▪ Control throughput through improved lane allocation and pedestrian management.

ID	Location	Works	Purpose
RN-9	Cross Street / Dale Street	▪ Convert northern leg to one-way southbound approach, with short turning Lane 3 (approximately 45m long) ▪ Remove short RT lane on east approach (can be hatched at this stage).	▪ Control throughput through improved lane allocation and pedestrian management.
RN-10	Pittwater Road / Cross Street	▪ Reconfigure Cross Street west approach lane allocations at Pittwater Road: ▪ Lane 1: unchanged ▪ Lane 2: now shared LT / Th / RT lane (was dedicated left-turn lane) ▪ Lane 3: now dedicated RT (was shared Th / RT) lane.	▪ Provide improved egress from Cross Street with lane 3 east bound to allow bus straight movements.
RN-11	Condamine Street / Old Pittwater Road	▪ Provide new 70m long Lane 1 on Old Pittwater Road NW approach connecting to existing slip lane at intersection.	▪ Consider the need to signalise the free flow left slip lane. Additional work may be required based on the ScentreGroup site access proposal.
RN-12	Pittwater Road / Pine Avenue	▪ Ban RT movement from Pittwater Road into Pine Avenue ▪ Remove dedicated RT lane from Pittwater Road into Pine Avenue ▪ Reconfigure Pine Avenue north approach lane allocations at Pittwater Road: ▪ Lane 1: now shared LT / RT lane (was dedicated LT lane) ▪ Lane 2: unchanged.	▪ Remove the citybound pinch point in the AM ▪ Provide additional road reserve for bus facilities.
RN-13	Pittwater Road / Pine Avenue	▪ Provide new bus jump start on Pittwater Road west approach to intersection ▪ Design in alignment with Design F1 from TfNSW Bus Priority Infrastructure Planning Guide ▪ Provide continuous eastbound bus lane on Pittwater Road via the connection of existing bus lanes through the intersection.	▪ Provision for improved route connectivity and bus priority at the Pine Street traffic signals
RN-14	Pittwater Road / Victor Road	▪ Upgrade existing priority intersection to traffic signals. ▪ Provide new right turn movement from Victor Road to Pittwater Road (currently restricted movement) ▪ Provide two-lane approach on Victor Road. ▪ Provide signalised pedestrian crossings on E and N legs to the intersection.	▪ Facilitate better access to the area between Pittwater Road and Warringah Road ▪ Consolidates traffic using Federal Parade.

ID	Location	Works	Purpose
RN-15	Pittwater Road Mid-block crossing	▪ Remove existing signalised midblock pedestrian crossing.	▪ Consolidate pedestrian crossing movements at new Victor Road traffic signals ▪ Manages the number of traffic signals along the segment of road ▪ May require relocation of Bus Zones.
RN-16	Warringah Road / Victor Road	▪ Upgrade existing priority intersection to traffic signals ▪ Provide two-lane approach on Victor Road (approximately 70m long) ▪ Provide signalised pedestrian crossings on SE and S legs to the intersection ▪ Restrict parking on west side of road to facilitate additional road space for new lanes.	▪ Provide additional traffic capacity access in the precinct south of Warringah Road.
RN-17	Harbord Road / Abbott Road / Winbourne Road	▪ Major reconfiguration of intersection layout from current staggered T intersections to new 4-way cross intersection ▪ Realignment of Abbott Road through Manly Campus NBSC site to meet Winbourne Road ▪ Lane requirements as follows: ▪ North approach: 2x continuous lanes, 1x short RT bay 70m long ▪ East approach: 1x continuous lane, 1x short lane 50m long ▪ South approach: 1x continuous approach lane. 1x short RT bay 30m long. 1x auxiliary lane 85m long ▪ West approach: unchanged.	▪ The existing intersection arrangement is sub-optimal given the offset nature of the current layout. ▪ Improves efficiency of intersection to minimise the impact of turning movement on through traffic along Harbord Road.
RN-18	Between Green Street, Dale Street, and Roger Street	▪ Provide new two-lane two-way road link / laneway between Dale Street and Roger Street.	▪ Improves local routing after Roger Street closure and Dale Street /Green Street one-way arrangements. ▪ Minimises traffic required to dip onto Pittwater Road.
RN-19	Between Green Street, Dale Street, and Roger Street	▪ Provide new two-lane two-way road link / laneway between Dale Street and Green Street.	
RN-20	Pittwater Road / Warringah Road / Harbord Road	▪ Provide future grade separated major reconstruction of the traffic signals with dedicated turning provisions.	▪ Major regional-level upgrade to the road network to unlock traffic, public transport and future yield options in Brookvale, Dee Why and surrounding suburbs.

ID	Location	Works	Purpose
Street Management Works			
SM-1	Dale Street	▪ Convert road to one-way southbound ▪ Two-lane midblock cross-section.	▪ Controls vehicle routing from Warringah Mall precinct
SM-2	Green Street	▪ Convert road to one-way northbound ▪ Two-lane midblock cross-section.	
SM-3	Roger Street between Old Pittwater Road and Pittwater Road	▪ Provide new flat-top road hump around 50m south of Old Pittwater Road.	▪ Enforces slower vehicle speeds to align driver behaviour with high-street context
SM-4	Roger Street at Pittwater Rd	▪ Modify intersection configuration to permit Left Out only ▪ Provide kerb buildout and turnaround point for SB traffic.	▪ Preserve High Street amenity by removing rat-run
SM-5	Cross St at the Warringah Mall access roundabout	▪ Close northern leg of Cross Street / Warringah Mall access roundabout with continuous kerb ▪ Create Cross Street commercial / industrial cul-de-sac ▪ Provide transition ramp linking to shared path on Cross Street	▪ To control traffic and vehicle mix between the various land use categories ▪ Reduce turning traffic volumes on Cross Street / Pittwater Road intersection.
SM-6	Pittwater Rd / Old Pittwater Road / Winbourne Rd	▪ Ban right turn from Old Pittwater Road to Pittwater Road at TCS 0731 ▪ Restrict parking on north side of east departure between Pittwater Road and Winbourne Lane.	▪ Manages citybound pinch point in the AM peak as there is no dedicated bus lane between West Street and Winbourne Road.
SM-7	Alfred Road at Pittwater Road	▪ Modify intersection to Left-In only ▪ Provide kerb buildout and turnaround point for SB traffic	▪ To improve safety around the local schools and Brookvale Park.
SM-8	West Street at Pittwater Road	▪ Modify intersection to Left-In only ▪ Provide kerb buildout and turnaround point for WB traffic	▪ Improves safety on Pittwater Road Corridor
SM-9	Federal Parade at Pittwater Road	▪ Ban RT movement from Federal Parade to Pittwater Road ▪ Converts Federal Parade to LILO intersection ▪ Extend median strip island on Pittwater Road.	▪ Reduce hazardous priority turning movements onto Pittwater Road through queued traffic. ▪ Opportunity to consolidate turning traffic with new Victor Road traffic signals.

ID	Location	Works	Purpose
SM-10	May Road / Mooramba Road	▪ Reconfigure intersection to provide priority for east-west May Road carriageway as the major road ▪ Mooramba Road to be a priority Give Way controlled approach.	▪ Rationalise unclear intersection space and prioritise May Road traffic.
SM-11	Pittwater Road / Orchard Road	▪ Provide kerb build outs on southeastern and northeastern corners of intersection ▪ Kerb radii reduced to viable minimum.	▪ Reduce vehicle turning speed at intersection with higher active transport activity and reduce crossing distance for active transport modes.
SM-12	Old Pittwater Road / Dale Street	▪ Provide kerb build out on southwestern side of intersection.	▪ Reduce crossing distance for active transport modes.
SM-13	Pittwater Road between Kentwell Road and Warringah Road	▪ Bus lane between 5am and 9pm both directions	▪ Prioritise public transport.
SM-14	Warringah Road between Pittwater Road and Allambie Road	▪ Bus lane between 5am and 9pm both directions	▪ Prioritise public transport.
Active Transport Infrastructure Works			
AT-1	Old Pittwater Road between Condamine Street and Pittwater Road	▪ New 1.9km shared path along the length of Old Pittwater Rd on Warringah Mall side.	▪ Provides active transport access to the western industrial precinct.
AT-1a	Old Pittwater Road / Green Street (south leg)	▪ New signalised crossing across south leg of intersection with combined bicycle+pedestrian lantern (as part of signalisation of intersection).	▪ Allows cyclists to cross the road while mounted
AT-1b	Old Pittwater Road / Roger Street (south leg)	▪ Upgrade existing signalised crossing across south leg of intersection to provide combined bicycle+pedestrian lantern.	▪ Allows cyclists to cross the road while mounted.
AT-1c	Old Pittwater Road / Pittwater Road / Winbourne Road (south leg)	▪ Upgrade existing signalised crossing across south leg of intersection to provide combined bicycle+pedestrian lantern.	▪ Allows cyclists to cross the road while mounted.
AT-1d	Old Pittwater Road / Cross Street (east leg)	▪ New refuge island across east leg of intersection.	▪ Improves active transport safety at priority intersection ▪ Shortens effective crossing distance across 13m wide roadway.

ID	Location	Works	Purpose
AT-2	Winbourne Road between Pittwater Road and Harbord Road	▪ New 0.8km shared path along the south side of Winbourne Rd and into Abbott Rd realignment to connect to existing shared path.	▪ Provides active transport connection between dense residential lots to the eastern industrial precinct and regional cycle routes.
AT-2a	Harbord Road / Winbourne Road (south leg)	▪ New signalised crossing across south leg of intersection with combined bicycle+pedestrian lantern (as part of new intersection redesign).	▪ Allows cyclists to cross the road while mounted.
AT-2b	Mitchell Road / Winbourne Road (south leg)	▪ New refuge island across south leg of intersection.	▪ Improves active transport safety at moderately trafficked roundabout.
AT-3	Mitchell Road between Wattle Road and Pittwater Road	▪ New 0.7km shared path along west side of Mitchell Rd between Pittwater Rd and Orchard Rd. East side of Mitchell Rd between Orchard Rd and Wattle Rd.	▪ Provides active transport access within the eastern industrial precinct.
AT-3a	Mitchell Road / Winbourne Road (west leg)	▪ Upgrade refuge island across west leg of intersection to be suitable for cyclists (3m wide).	▪ Provide safe storage space for cyclists on refuge island
AT-3b	Mitchell Road / Chard Road (west leg)	▪ New refuge island across west leg of intersection to be suitable for cyclists (3m wide).	▪ Improves active transport safety at roundabout.
AT-3c	Mitchell Road / Sydenham Road (west leg)	▪ New refuge island across west leg of intersection to be suitable for cyclists (3m wide).	▪ Improves active transport safety at roundabout.
AT-3d	Mitchell Road / Orchard Road (east leg)	▪ New refuge island across east leg of intersection to be suitable for cyclists (3m wide).	▪ Improves active transport safety at roundabout.
AT-4	Orchard Road and Ada Avenue between Pittwater Road and Miles Street	▪ New 0.7km shared path along north side of Orchard Rd and into east side of Ada Ave terminating at Miles St. Utilises item AT-3d.	▪ Provides active transport connection to Brookvale town centre and Warringah Mall bus stops ▪ Provides active transport access within eastern industrial precinct.
AT-4a	Mitchell Road / Orchard Road (north leg)	▪ New refuge island across north leg of intersection to be suitable for cyclists (3m wide).	▪ Improves active transport safety at roundabout.
AT-4b	Miles Street / Ada Avenue (east leg)	▪ New refuge island across east leg of intersection to be suitable for cyclists (3m wide).	▪ Improves active transport safety at priority intersection.

ID	Location	Works	Purpose
AT-5	Pittwater Road between Old Pittwater Road and Warringah Mall Bus Stops.	▪ New 0.5km cycle route between Old Pittwater Road and Warringah Mall Bus Stops.	▪ Provides active transport connection to Warringah Mall bus stops from northern side of Pittwater Road.
AT-5a	Pittwater Road between Old Pittwater Road and Orchard Road (east side)	▪ New one-direction southbound separated on-road cycleway between Winbourne Rd and Orchard Rd on eastern side of Pittwater Road, terminating just north of Orchard Road via transition ramp to shared path.	▪ Provides high-speed cycling connection along Pittwater Road.
AT-5b	Pittwater Road between Orchard Road and Warringah Mall Bus Stops (east side)	▪ New southbound shared path between Orchard Rd and Winbourne Rd on eastern side of Pittwater Road.	▪ Provides transitionary zone between high-speed on-road cycle lane and high pedestrian activity area at the Warringah Mall bus stops ▪ Allows cyclists to ride on footpath to find end-of-trip facilities.
AT-5c	Pittwater Road / Sydenham Road (east leg)	▪ Upgrade existing signalised crossing across east leg of intersection to provide additional bicycle lantern for southbound direction only.	▪ Provides dedicated signal for cyclists.
AT-5d	Pittwater Road / Cross Street / Bus Depot (east leg)	▪ Upgrade existing signalised crossing across east leg of intersection to provide combined bicycle+pedestrian lantern.	▪ Allows cyclists to cross the road while mounted.
AT-5e	Pittwater Road between Old Pittwater Road and Roger Street (west side)	▪ New one-direction northbound separated on-road cycleway between Roger Street and Old Pittwater Road on western side of Pittwater Road, transitioning from shared path via ramp on north side of Roger Street.	▪ Provides uninterrupted high-speed cycling connection along Pittwater Road.
AT-5f	Pittwater Road between Cross Street and Roger Street (west side)	▪ New northbound shared path between Cross Street and Roger Street on western side of Pittwater Road.	▪ Provides transitionary zone between high-speed on-road cycle lane and high pedestrian activity area at the Warringah Mall bus stops ▪ Allows cyclists to ride on footpath to find end-of-trip facilities.
AT-5g	Pittwater Road / Cross Street / Bus Depot (west leg)	▪ Upgrade existing signalised crossing across west leg of intersection to provide combined bicycle+pedestrian lantern.	▪ Allows cyclists to cross the road while mounted.
AT-6	Cross Street between Westfield Access and Pittwater Road	▪ New 0.4km shared path along south side of Cross Street between Green St and Pittwater Rd. North side of Cross St between Green St and Westfield Access.	▪ Provides active transport access between Brookvale Town Centre and Warringah mall bus stops to the western industrial precinct.

ID	Location	Works	Purpose
AT-6a	Pittwater Road / Cross Street / Bus Depot (north leg)	▪ Upgrade existing signalised crossing across north leg of intersection to provide combined bicycle+pedestrian lantern.	▪ Allows cyclists to cross the road while mounted.
AT-6b	Cross Street / Dale Street	▪ New signalised crossing across south leg of intersection to provide combined bicycle+pedestrian lantern.	▪ Allows cyclists to cross the road while mounted.
AT-6c	Cross Street / Green Street	▪ Upgrade existing signalised crossing across east leg of intersection to provide combined bicycle+pedestrian lantern.	▪ Allows cyclists to cross the road while mounted.
AT-6d	Cross Street / Green Street	▪ Upgrade existing signalised crossing across north leg of intersection to provide combined bicycle+pedestrian lantern.	▪ Allows cyclists to cross the road while mounted.
AT-7	Cross Street between Westfield Access and Old Pittwater Road	▪ Provide signage and on-road bicycle symbols on Cross Street between Westfield Access and Old Pittwater Road to indicate on road Quietway / mixed traffic link (0.3km).	▪ Provides wayfinding assistance for cyclists transitioning from shared path to on-road route ▪ Warns drivers of higher cyclist traffic on link.
AT-8	Roger Street between Pittwater Road and Old Pittwater Road (east side)	▪ New 0.3km bidirectional separated cycleway along east side of Roger Street. Ideally 4m minimum width for carriageway, and 0.4m kerb buffer between parking and cycleway. Transition ramps on both ends to connect with adjacent shared paths.	▪ Provides uninterrupted high-speed cycling route along high civic value land uses ▪ Provides direct connection between Brookvale town centre and Warringah Mall bus stops to schools and residential areas.
AT-9	Roger Street Midblock	▪ New raised pedestrian crossing (wombat crossing) across Roger St on north side of proposed link (near proposed open space).	▪ Provides pedestrian priority crossing at high civic value space
AT-10	Pittwater Road / Federal Parade (west leg)	▪ New refuge island across west leg of intersection.	▪ Improves active transport safety at priority intersection near high civic value spaces ▪ Shortens effective crossing distance across 18m wide roadway.

ID	Location	Works	Purpose
AT-11	Pittwater Road / Chard Road (east leg)	▪ New refuge island across east leg of intersection.	▪ Improves active transport safety at priority intersection near high civic value spaces ▪ Shortens effective crossing distance across 14m wide roadway.
AT-12	Warringah Mall Bus Stops	▪ Cyclists Dismount signage at bus stops	▪ Reduces conflicting speed between active transport modes.
AT-13	Cross Street / Dale Street	▪ New signalised crossing across east leg of intersection.	▪ Provides pedestrian crossing across Cross Street directly from Brookvale town centre.
AT-14	Link between Chard Road and Orchard Road	▪ New shared zone link between Chard Road and Orchard Road.	▪ Enhances active transport safety near high civic value area.

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