Northern Beaches Council

Frenchs Forest Town Centre

Transport Strategic Design

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1 Introduction

1.1 Background

The Northern Beaches Council (Council) commissioned Arup Pty Ltd to prepare a transport strategic design report to support the Frenchs Forest Town Centre project. This report aims to inform the development of a Special Infrastructure Contribution (SIC levy) and a Local Infrastructure Contribution Plan.

A SIC levy is a levy paid by developers to share the cost of delivering state and regional infrastructure required to support a growing community. SIC levies are utilised for all planned precincts and growth areas in Sydney and support infrastructure such as construction or upgrade of state and regional roads or transport facilities such as bus shelters and interchanges.

A Local Infrastructure Contribution (S7.11) Plan is paid by developers to share the cost of delivering local infrastructure within a catchment area.

This report outlines the transport infrastructure items needed to support the strategic development of the precinct and provides indicative cost estimates which aim to inform the development of both a SIC levy and a S7.11 contribution.

The aims of this report will be to:

- Provide an overview of traffic and active travel infrastructure items
- Identify land parcels for the purpose of land acquisition and land uptake for land acquisition
- Outline traffic related infrastructure works required to support the development of the catchment area
- Outline active travel related infrastructure works required to support the development of the precinct
- Provide indicative cost estimates for each infrastructure item for the SIC Levy and S7.11 Plan.

1.2 Subject Area

The subject area of this study is the local area which borders the proposed Frenchs Forest Town Centre. The location of the town centre is shown in Figure 1.

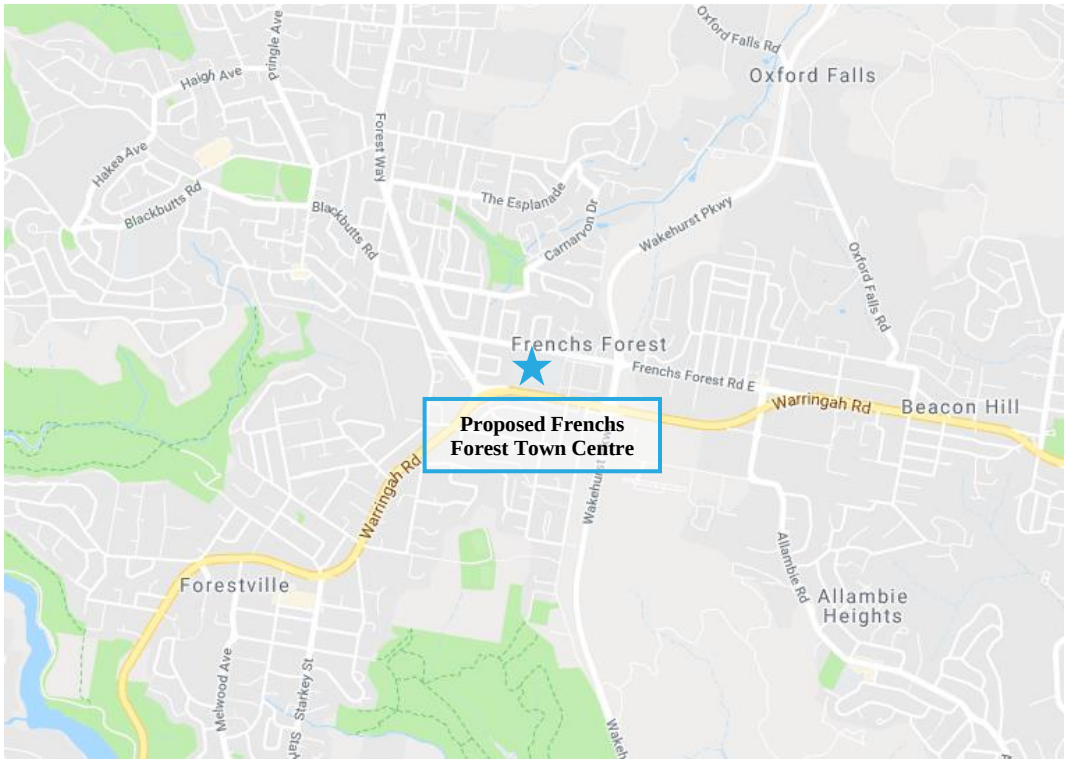


Figure 1: Proposed Frenchs Forest Town Centre

1.3 Report Structure

Section 1 provides an introduction to the aims and purpose of this report.

Section 2 provides an overview of the existing transport conditions in the vicinity of the precinct.

Section 3 provides an overview of the proposed development.

Section 4 outlines the traffic related infrastructure requirements such as new roads and intersection upgrades which would be required to support the development.

Section 5 outlines the active travel related infrastructure requirements such as new off-road shared paths and pedestrian facilities which would be required to support the development.

Section 6 provides the transport network performance

Section 7 provides indicative cost estimates for each of the infrastructure items, including for the SIC levy and for the S7.11 contribution.

Section 8 provides a conclusion of the findings of this report.

2 Existing Conditions

2.1 Road Network

The town centre is bounded by Frenchs Forest Road West to its north and Warringah Road to its south. These roads provide east-west connectivity for the entire precinct, while Wakehurst Parkway and Forest Way provide north-south connectivity.

2.1.1 Frenchs Forest Road West

Frenchs Forest Road West runs to the north of the hospital precinct and is a collector road with two lanes in each direction. It has been upgraded as a part of the Northern Beaches Hospital works. Frenchs Forest Road West will serve as the primary road for town centre access.

2.1.2 Warringah Road

Warringah Road runs to the south of the hospital precinct and is classified as a state road that runs between Roseville and Dee Why. It currently has three lanes in each direction in the vicinity of the precinct and is being upgraded to provide an underpass for through traffic and surface roads for local access as a part of the Northern Beaches Hospital works. Warringah Road will be one of the main roads connecting the precinct to the rest of Sydney.

2.1.3 Wakehurst Parkway

Wakehurst Parkway runs in a north-south direction and is classified as a state road connecting Balgowlah and Narrabeen. It generally has one lane in each direction for most of its length and will be one of the main roads connecting the precinct to the rest of Sydney.

2.1.4 Forest Way

Forest Way runs in a north-south direction and is classified as a state road connecting Frenchs Forest to Belrose. It generally has three lanes in each direction in the vicinity of the precinct and is also the location of the Forestway Shopping Centre, an existing focal point for retail activities in the Frenchs Forest area.

2.2 Public Transportation

The precinct is serviced by a number of bus routes which help connect it to the wider Sydney Area including Dee Why, Chatswood and Wynyard. The nearest bus stops and bus routes in the vicinity of the precinct are shown in Figure 2.

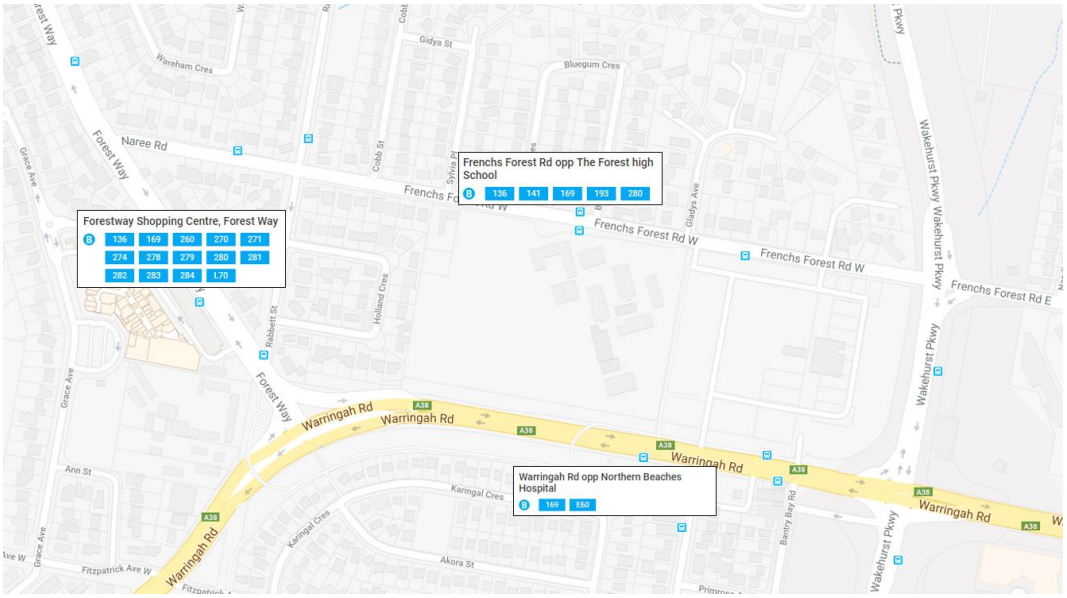


Figure 2: Existing bus services serving the precinct
Base map Source: Google Maps

2.3 Cycling and Walking Network

The road network surrounding the precinct has a well-developed walking network with footpaths generally provided on both sides of the street. The current cycling network in the vicinity of the precinct is shown in Figure 3. It is noted that this map includes cycling network upgrades which are a part of the Northern Beaches Hospital upgrade works and may currently be in the construction phase.

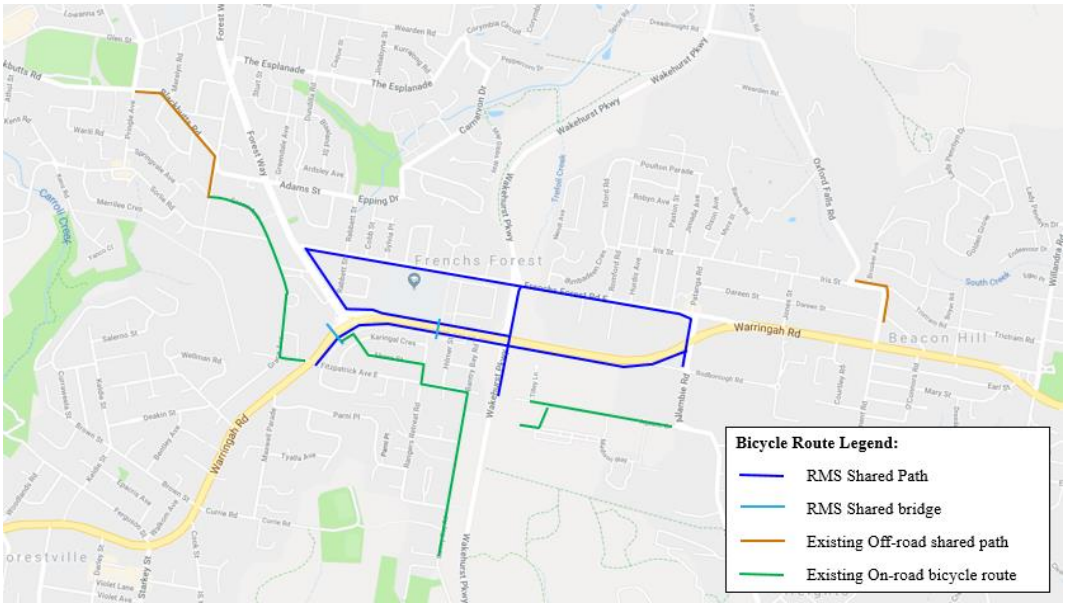


Figure 3: Cycling network overview
Base map source: Google Maps

3 Development Phases

The precinct will be developed over 3 phases. Phase 1 includes the core town centre development as well as some additional developments along Karingal Crescent and Frenchs Forest Road. The total residential yield for Phase 1 is 1,930 dwellings accommodating 4,246 residents.

Phases 2 and 3 involve the wider development of the precinct bringing the total residential yield to 4,360 dwellings. Phase 2 would include an additional 1,115 dwellings accommodating 2,453 residents, while Phase 3 would accommodate 1,315 dwellings accommodating 2,893 residents.

The plans for the Precinct Development infrastructure delivery also needs to consider the potential for future growth across the employment lands located directly to the southeast of the precinct around Aquatic Drive, Rodborough Road and Frenchs Forest Road (east), which under current development controls has significant potential to contribute to meeting the long-term employment growth targets of the Northern Beaches.

The Frenchs Forest Business Park is one of nine major business parks across greater Sydney. Given it does not have height restrictions and would benefit from spectacular regional views, its capacity for future growth is significant. This is further strengthened by its proximity to the planned beaches link tunnel and East-West rapid bus network which will significantly improve accessibility to Sydney CBD, Sydney airport and the eastern economic corridor.

The proximity to the Belrose and Terrey Hills Business and Industry development areas and the link to the A3 – Mona Vale Road/Lane Cove Road Corridor should also be considered as ancillary service provision areas to support the Hospital and Education Precinct. These areas could provide improved freight servicing opportunities such as vertical warehousing and consolidation centres to support the Precinct.

Consideration should be given to removing several pinch points along the Forest Way corridor to the north of the designated precinct boundaries to connect the precinct to the A3 corridor.

The phases of the precinct are shown in Figure 4 and Figure 5.

Figure 4: Geographical Phases of Precinct

Figure 5: Precinct Breakdown

4 Traffic Infrastructure Requirements

4.1 Overview

To support the development of the Frenchs Forest Town Centre, several upgrades to traffic infrastructure are proposed. Transport modelling has been used to test the infrastructure items and to confirm their need to support the development of the precinct.

The modelling was also used to determine the timing for delivery of each infrastructure item to support the level of development in each phase. Development occurring in Phase 1 was assumed to be more car dependant, as public transport improvements were assumed to occur during Phases 2 and 3. This resulted in the traffic generation for Phase 1 being 75% of the ultimate Phase 3 traffic generation, and hence the majority of the infrastructure upgrade works occur early in the development of the precinct.

The modelling undertaken by Jacobs for Phase 1 on behalf of the Department of Planning, Industry and Environment, with supplementary modelling for Phases 2 and 3 undertaken by Council is described in Section 6.

As shown in the table below, all infrastructure is required to be completed by the 20% build out of stage 2 or equivalent as from that point in time it is not about building additional traffic and transport infrastructure, but how the existing capacity within the network is utilised and a shift in transport modes is achieved across the network. At this point the impact on the Warringah Road corridor needs to be mitigated through Forestville in the west and Beacon Hill in the east.

Table 1 and Figure 6 outline the traffic related infrastructure requirements to support the project.

Table 1: Traffic Infrastructure Requirements

Development Phase	Infrastructure	Item Number	Location	Report Section	Type
Initial Delivery	New Signals	1A	Frenchs Forest Road West/ Bluegum Crescent East/ New Internal Road	Section 4.2.1	Delivered as the primary access to the Precinct
	New Road	1B	Holland Crescent Extension to Town Centre	Section 4.2.2	S7.11
50% Build Out of Phase 1	Road Widening	2A	Frenchs Forest Road West/ Naree Road Widening from Bluegum Crescent to Forest Way	Section 4.3.1	Potential SIC Levy or State Funded
	New Signals	2B	Frenchs Forest Road West/ Sylvia Place	Section 4.3.2	S7.11
	New Road	2C	New Road from Holland Crescent to Frenchs Forest Road West/ Sylvia Place	Section 4.4.9	S7.11
	Bus Infrastructure	2C	Southern End of Holland Crescent to Forest Way/	Section 4.3.3	S7.11

			Rabbett St Intersection		
70% Build Out of Phase 1	New Signals	3A	Naree Road/ Forest Way	Section 4.4.1	Potential SIC Levy or State Funded
	New Signals	3B	Naree Road/ Grace Avenue	Section 4.4.2	Potential SIC Levy or State Funded
	New Road	3C	Naree Road Extension	Section 4.4.3	Potential SIC Levy or State Funded
	Green Bridge	3D	Green Bridge over Warringah Road	Section 4.4.4	Potential SIC Levy or State Funded
	Intersection Upgrade	3E	Adams Street/ Forest Way	Section 4.4.5	S7.11
	Intersection Upgrade	3F	Adams Street/ Rabbett Street	Section 4.4.6	S7.11
	Bus Infrastructure	3G	Forest Way/ Warringah Road Intersection	Section 4.4.7	S7.11
	Bus Infrastructure	3H	Frenchs Forest Road East	Section 4.4.8	S7.11
	New Road	3I	New Road from Holland Crescent to Frenchs Forest Road West/ Sylvia Place	Section 4.3.3	S7.11
Completion of Phase 1 and 20% Build Out of Phase 2	Road Widening	4B	Forest Way Widening	Section 4.5.2	Potential SIC Levy or State Funded
	Traffic Calming	4C	Wareham Crescent, Dundilla Road, Greendale Avenue, Sturt Street	Section 4.5.3	S7.11
	Intersection Upgrade	4D	Fitzpatrick Avenue West/ Warringah Road	Section 4.5.4	S7.11
	Road Widening	4E	Grace Avenue Widening	Section 4.5.5	Potential SIC Levy or State Funded

Figure 6: Traffic Infrastructure Requirements Map

4.2 Initial Delivery

The following items are proposed as a part of the initial delivery of the town centre.

4.2.1 (Item 1A) Frenchs Forest Road West/ Bluegum Crescent/ New Internal Road

It is proposed that the intersection of Bluegum Crescent (eastern end) and Frenchs Forest Road West be upgraded to a signalised intersection to accommodate the new internal road which would provide access to the town centre. This would require relocation of the traffic signals from Bluegum Crescent (western end) to the new location. This would allow safe construction access to the precinct with minimal impact on access to the hospital. This item is considered a SIC Levy item as it would provide strategic access into the town centre.

The upgrade of the Frenchs Forest Road West/ Bluegum Crescent intersection is shown in Figure 7.

Without the infrastructure proposed this intersection performs at a Level of Service F with queues lengths of up to 348 metres and delays of up to 218 seconds. With the infrastructure proposed, the queue lengths reduce to 203 metres and delays reduce to 188 seconds.

Figure 7: Frenchs Forest Road West/ Bluegum Crescent/ New Internal Road

4.2.2 (Item 1B) Holland Crescent Extension to Town Centre

It is proposed that Holland Crescent be extended to provide a direct connection into the town centre from the local precinct to the west. This extension would be approximately 40 metres from the current southern part of Holland Crescent through to the town centre. It would improve road access to and from the town centre and it is expected that it would entail the acquisition of one residential property: 26 Holland Crescent.

It is a separate item to the extension of Holland Crescent to connect to Frenchs Forest Road. The works would also require modifying the existing road environment along the southern leg of Holland Crescent and the priority at the Rabbett Street intersection. There may need to be controls put in place to reduce impacts of increased traffic on the residents that live within the Phase 2 release area.

To provide a secondary access to the Town Centre to improve the level of service at the main access point from Frenchs Forest Road (West) which operates at a LoS F at 70% phase 1 delivery and provides for improved access options from the north and west prior to that point.

Without the infrastructure proposed, the other primary access to the town centre performs at a Level of Service F with queue lengths of up to 148 metres and delays of up to 218 seconds.

With this proposed infrastructure, the intersection will operate at a Level of Service A with queue lengths of 11 metres and delays of 7 seconds. The other primary access to the town centre will also benefit and operate at a Level of Service F with queue lengths of up to 203 metres and delays of up to 188 seconds.

The Holland Crescent Extension is shown in Figure 8.

Figure 8: Holland Crescent Extension to Town Centre

4.3 50% Build Out of Phase 1

The following items are proposed prior to the 50 percent build out of Phase 1.

4.3.1 (Item 2A) Frenchs Forest Road West/ Naree Road Widening from Bluegum Crescent to Forest Way

It is proposed that Frenchs Forest Road West/ Naree Road be widened from Bluegum Crescent to Forest Way. This would require the acquisition of approximately 3.5 metres of all properties on the southern road boundary and a portion of the properties on the Rabbett Street and Frenchs Forest Road/ Naree Road intersection. It may also be prudent to acquire the necessary portions of 2 & 4 Naree Road and 23 Forest Way for the eastbound lane upgrade as well.

This widening would be carried out in order to provide a third lane on Frenchs Forest Road as an extension to the bus lane from Bluegum Crescent to Rabbett Street. West of Rabbett Street, this additional westbound lane would operate as a dedicated left turn lane.

The east bound side of the Frenches Forest Road West will also need to be considered for minor widening, which will not require additional acquisition of property, but will require the overhead 33KV powerlines to be relocated. Due to the technical requirements from Augrid in relation to these lines to only viable solution is to place these lines underground between Rabbett Street and Wakehurst Parkway. This will allow the additional works to be undertaken without the need for property acquisition and allow full access to the development area north of Frenchs Forest Road West without the hazards of power poles in the middle of the high pedestrian/active transport corridor.

The widened Frenchs Forest Road West/ Naree Road is shown in Figure 9.

Figure 9: Frenchs Forest Road West/ Naree Road Widening

This work is required to allow for network optimisation and improved bus on time running through the precinct. As this provides a regional transport network benefit for services running through the precinct this would be an item for the SIC levy. The additional lane west of Rabbett Street provides additional storage for vehicles head west from the precinct and entering the Forest Way Corridor heading south towards Forestville and north towards Belrose. Not providing this infrastructure item will have adverse impacts on all intersections identified in Appendix C.

This infrastructure item will improve bus priority capacity as shown in the SIDRA results in Appendix C. This will also provide additional bus priority capacity to allow the high frequency services to support the town centre and drive modal shift to support further growth.

4.3.2 (Item 2B) Frenchs Forest Road West/ Sylvia Place

It is proposed that the intersection of Frenchs Forest Road West and Sylvia Place be upgraded to a signalised intersection in order to accommodate the new road connecting Frenchs Forest Road West to the extended Holland Crescent. This intersection would help mitigate traffic impacts from the expected growth in traffic volumes due to the town centre development and also allow the primary access to have the final state restrictions put in place.

This intersection upgrade is required to provide a second access to the town centre development. Without this infrastructure improvement, the intersection at the primary access to the town centre will operate at a Level of Service F with queue lengths of 348 metres and delays of 218 seconds.

With this infrastructure improvement, the intersection will operate at a Level of Service F with queue lengths of 221 metres and delays of up to 155 seconds. This will reduce the queue length and delays at the primary entrance to the town centre.

The upgrade of the Frenchs Forest Road West/ Sylvia Place intersection is shown in Figure 10.

Figure 10: Frenchs Forest Road West/ Sylvia Place/ New Road

4.3.3 (Item 2C) Southern End of Holland Crescent to Forest Way/ Rabbett Street Intersection

The Rabbett Street intersection with Forest Way currently operates as an exit only movement out of Rabbett Street. This intersection is restricted for usage by buses only between 6am and 10am. It is proposed that this restriction is increased to a 24-hour restriction on all days in order to prevent this location from becoming a point of congestion due to the increased traffic as a result of the town centre. This should be accompanied by painting of the roadway and increased signage, such as at the Rabbett Street/ Holland Crescent (southern end) intersection to reduce incidents of cars using this roadway.

The Forest Way/ Rabbett Street intersection is shown in Figure 11.

Figure11: Forest Way/ Rabbett Street Intersection

4.4 70% Build Out of Phase 1

The following items are proposed prior to the 70 percent build out of Phase 1.

4.4.1 (Item 3A) Naree Road/ Forest Way Intersection

It is proposed that the Naree Road and Forest Way intersection be upgraded to provide a number of new lanes to improve performance if the Warringah Road Town Centre Access Tunnel is not provided. These works would help enable the closure of Russell Avenue at Forest Way. The works will include a short left turn slip lane on the eastern approach and a new western leg in the form of the new Naree Road extension to Grace Avenue.
A right turn bay from the northern approach of Forest Way could be implemented within the large central median. It is expected that the upgrade of this intersection would not entail property acquisition, however, the upgrade of Naree Road and Forest Way would entail property acquisition. These are shown as separate items in Section 4.4.3 and Section 4.5.2.

This item is considered a potential SIC Levy item as it would provide strategic access for the precinct from the arterial road network. It is also an upgrade to a state road which provides primary access to Phases 2 and 3 of the development.

The upgrade of the Naree Road/ Forest Way intersection is shown in Figure 12.

Figure 12: Naree Road/ Forest Way

The intersection upgrade is required to provide access to the precinct from Warringah Road as there is no direct connection for the main east/west corridor into the precinct. Additional storage is required for the vehicles turning right from Forest way into Naree Road, as the current road configuration only allows storage of 10-12 vehicles prior to impacting the through traffic in lane 3 northbound.
With the demand increased without the upgrade the LoS was F and queue length 2256 metres (northbound) and a delay of 283 seconds, and with the proposed upgrade the LOS

was F and the queue length was reduced to 1070 metres (northbound) and a delay of 290 seconds.

4.4.2 (Item 3B) Naree Road/ Grace Avenue Intersection

It is proposed that a new intersection be constructed at Grace Avenue and the extended Naree Road. This would be a signalised T-intersection with two approach lanes and three exit lanes on the eastern side, two approach and exit lanes on the southern side and one approach and exit lane on the northern side.

This item is considered a potential SIC Levy item as it would provide strategic access for the precinct from the arterial road network as a secondary access route from Warringah Road.

The upgrade of the Naree Road/ Grace Avenue intersection is shown in Figure 113.

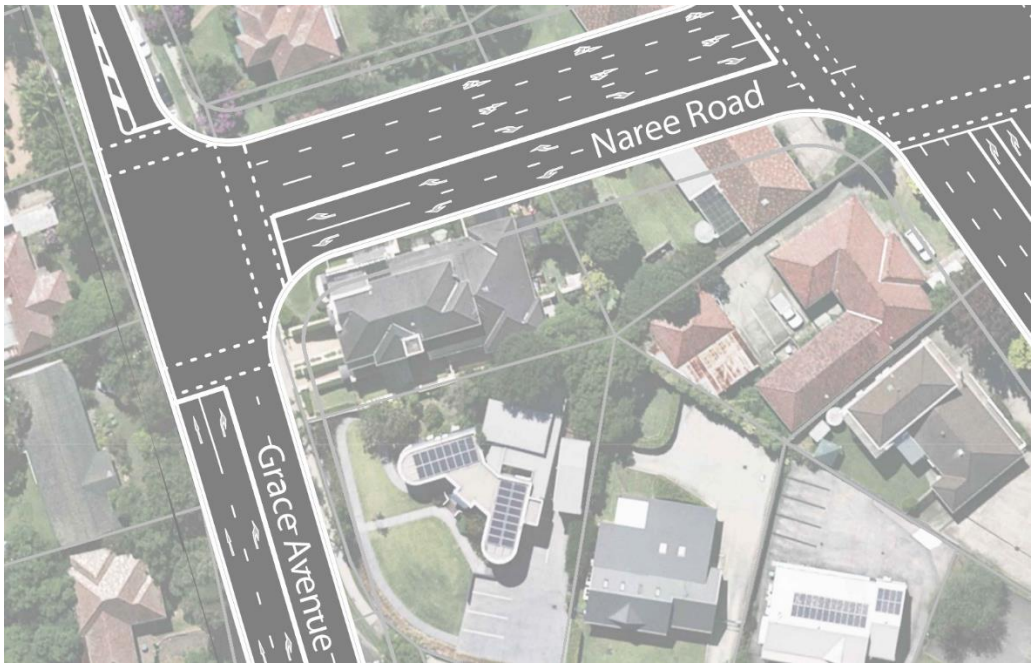


Figure 113: Naree Road/ Grace Avenue

This link would allow the road network to function as per the final configuration with traffic able to access the precinct from Warringah Road via the Fitzpatrick Avenue (East). The Naree Road extension will also provide a connection to assist in the local community accessing the town centre precinct without using the State Road Network. This upgrade removes an accident blackspot that would be made significantly worse given the increase in traffic predicted as part of the uplift across the three phases of the precinct.

4.4.3 (Item 3C) Naree Road Extension

It is proposed that Naree Road be extended from its intersection with Forest Way to provide a connection through to Grace Avenue. This extension would be approximately 100 metres in length and would connect the town centre to the local area to the west of Forest Way, including the existing Forestway Shopping Centre. It is expected that the extension of the road would entail the full acquisition of four residential properties. These include 28 and 30 Forest Way and 41 and 43 Grace Avenue.

The access is considered a potential SIC item as it would be an upgrade to an RMS operated roadway and provide strategic access for the precinct from the arterial road network.

Without this infrastructure item, there are adverse impacts on the intersections at Forest Way/Warringah Rd and Forest Way/Adams St. Impacts on the functionality of Russell Ave and Forest Way will create a safety impact on queue length. The queue length results in a safety impact to the state road.
With this proposed infrastructure item, the modelling results demonstrate improvements at the above intersections.

The construction of the Naree Road extension would allow for the closure of Russell Avenue at Forest Way. The Naree Road Extension is shown in Figure 14.

Figure 14: Naree Road Extension

The connection between Grace Avenue and Naree Road removes the current road link at Russell Avenue, which is an accident blackspot under current loading and will become a significant network issue as the current configuration allows only 4 vehicles into the

protected storage. This additional provides an improved connection to the State Road Network for the community directly to the west of the precinct and for traffic heading south on Forest Way.

4.4.4 (Item 3D) Green Bridge/Linear Transport Interchange over Warringah Road

The green bridge/linear transport interchange is considered a SIC item as it is a strategic project that would provide benefit to the larger community. It would also be beneficial in providing a direct connection to both sides of the Warringah Road Corridor if an express bus service were provided along Warringah Road. This express bus service could serve the town centre by providing a high-frequency public transport service to Chatswood or the Sydney CBD. This would also include vertical transport solutions to access the bus interchange facilities from the green bridge.

It is proposed that a green bridge be constructed over Warringah Road, providing a direct pedestrian connection between the town centre and Karingal Crescent. This green bridge could be 30 metres in width and could serve as an urban landmark, as well as a movement corridor, between the town centre and development on Karingal Crescent which would be entirely separated from the roadway below.

The bridge would require the acquisition of 36 and 38 Karingal Crescent to allow for continuous connection with the existing reserve in Karingal Crescent.

The location of the green bridge over Warringah Road is shown in Figure 15.

Figure 15: Green Bridge over Warringah Road

4.4.5 (Item 3E) Adams Street/ Forest Way

It is proposed that the Adams Street/ Forest Way intersection be upgraded to provide an additional traffic lane on the eastern approach on Adams Street. This would help to improve intersection performance and reduce the queue lengths on this approach by providing additional holding capacity. This is currently an observed problem and would be expected to become significantly worse due to the development of the precinct.

The upgrade of the Adams Street/ Forest Way intersection is shown in Figure 16.

Figure 16: Adams Street/ Forest Way

The volume of traffic that is generated through the delivery of the 3 phases of the project but especially Phase 1 and Phase 2 will require this intersection to be upgraded to allow for improved storage. This significant network optimisation outcome benefits both local and regional traffic flows. This infrastructure also provides enhanced connectivity for the residents on the northern periphery of the precinct to access the regional recreational facilities to the west of Forest Way.

Without this infrastructure improvement, this intersection will operate at Level of Service F with queue lengths of 421 metres and delays of 73 seconds.

With this infrastructure improvement, the intersection will operate at a Level of Service F with queue lengths of 229 metres and delays of up to 87 seconds.

4.4.6 (Item 3F) Adams Street/ Rabbett Street

It is proposed that the intersection of Adams Street and Rabbett Street be upgraded to a roundabout to accommodate increased traffic volume and improve performance. This would include construction of a mountable roundabout and the construction of pedestrian splitter islands on all three approaches and exits of the new roundabout, improving both the vehicle flow and pedestrian amenity of the intersection. It is not expected that any additional land acquisition would be required.

The upgrade of the Adams Street/ Rabbett Street intersection is shown in Figure 17.

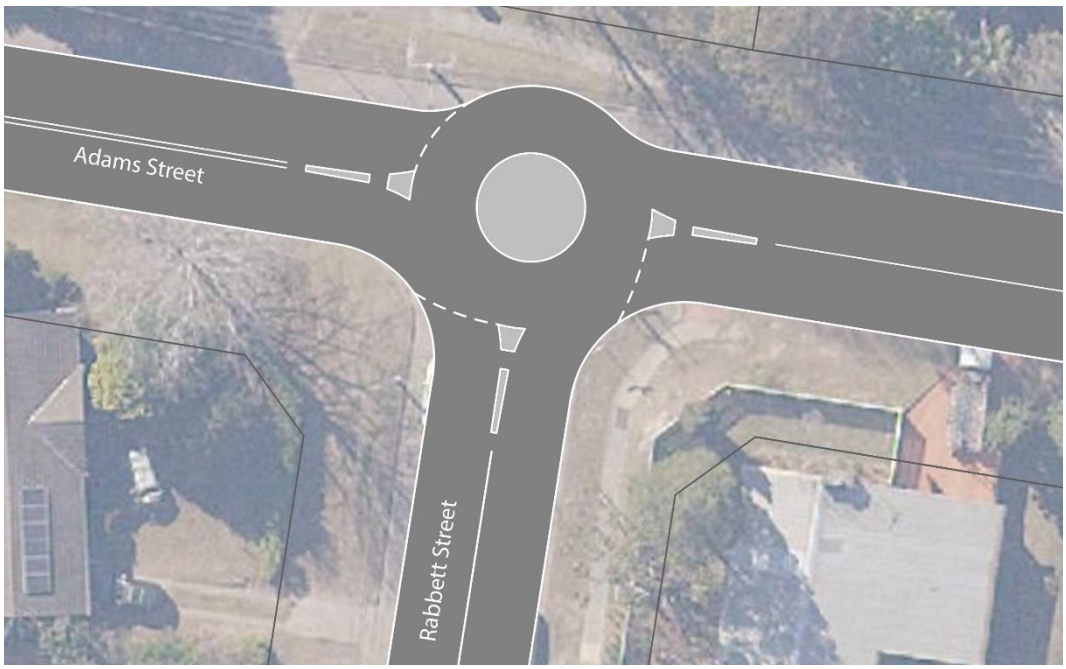


Figure 17: Adams Street/ Rabbett Street

This location will see volumes double (400vPH) at the end state project delivery and as such to optimise the traffic flows through the secondary route to Forest Way. This item is a 7.11 funded item as it has local network benefits by reducing the queue length on all legs during peak periods.

Without this infrastructure improvement, this intersection will not function with the correct priority allocation and cause additional delays both along Rabbett Street into Frenchs Forest Road (west) and into Epping Drive for residents coming out of the residential precinct.

4.4.7 (Item 3G) Forest Way/ Warringah Road Intersection

It is proposed that a bus priority system from Rabbett Street onto Warringah Road be implemented to allow for buses to exit out of Rabbett Street and manage the movement conflicts at this location. This would consist of a traffic light which would hold traffic travelling southbound on Forest Way in order to provide for buses to exit Rabbett Street. These traffic lights would be co-ordinated with the Forest Way/ Warringah Road traffic lights and would have minimal negative impact on the southbound traffic.

It is proposed that this upgrade be delivered in conjunction with a shared pedestrian bridge over Forest Way. This could be designed as an extension to the existing shared bridge over Warringah Road. This shared bridge would allow a direct connection between the town centre, Karingal Crescent and the existing Forestway Shopping Centre. It would also enable the removal of a signalised midblock crossing currently located on Forest Way approximately 200 metres north from the intersection, improving traffic flow.

The shared pedestrian bridge would require partial acquisition of 500C Warringah Road. Taking a set of signals away will improve level of service. Removal of the pedestrian phased signalling will increase green time for vehicles hence, improving network performance.

The location of the shared pedestrian bridge over Forest Way is shown in Figure 18.

Figure 18: Shared Pedestrian Bridge over Forest Way

4.4.8 (Item 3H) Relocation of Bus Stops on Frenchs Forest Road East

It has been observed that, during the morning peak hour, traffic becomes blocked due to eastbound bus operations on Frenchs Forest Road East. This can occur where buses stop at the bus stop in the left lane of the roadway, while vehicles queue to turn right into the driveways, causing a blockage in the roadway where vehicles going through on the road are not able to get past and must wait for the bus to continue moving or the right turn queue to clear. This is shown in Figure 19.

Figure 19: Bus stops on Frenchs Forest Road East

It is recommended that both bus stops be relocated to such locations where buses would not stop parallel to the right turn queue. Further investigation should be carried out to determine the most appropriate and cost-effective locations for this.

Without this infrastructure improvement, significant delays will occur along Frenchs Forest Road East, which will be exacerbated by the traffic resulting from all three phases of the development.

4.4.9 (Item 3I) New Road from Holland Crescent to Frenchs Forest Road West/ Sylvia Place

It is proposed that a new road be constructed from Frenchs Forest Road West to Holland Crescent. This new road would be approximately 130 metres in length from the current intersection of Frenchs Forest Road West and Sylvia Place through to Holland Crescent. It would improve road access to and from the town centre and it is expected that it would entail the full acquisition of the existing Frenchs Forest Police Station and 16 Holland Crescent. The road has been designed with a 90º turn to facilitate future development parcels of land.

The new road between Holland Crescent and Frenchs Forest Road West is shown in Figure 20.

Figure 20: New Road from Holland Crescent to Frenchs Forest Road West

As network demand increases additional access was needed to provide tertiary egress from the precinct during peak load periods along the Frenchs Forest Road corridor. Whilst not improving the level of service at adjoining intersections, this did reduce the queue length from 147 metres to 73 metres at the Rabbett Street and Frenchs Forest Road (west). This infrastructure allows the load to be shared across the several intersections to provide improved network performance.

4.5 Completion of Phase 1 and 20% Build Out of Phase 2

The following items are proposed prior to the 20 percent build out of Phase 2.

4.5.1 (Item 4A) Warringah Road Town Centre Access

Four options were considered for improved town centre access to meet traffic demands from the Warringah Road Corridor.

The first option is a surface option which involves relying on western access from Frenchs Forest Road West, as shown in Figure 12. This would require additional turning capacity in Forest Way at the Naree Road intersection. The improvements required to the Forest Way/ Naree Road intersection are included as Item 3A and the widening of Forest Way to allow for an extension of the right turn bay is included as Item 4B. This is the most cost effective option and provides the best outcome from an ongoing network viability and performance perspective. **That is why this option forms part of the infrastructure requirements for the Precinct. For the purposes of the SIC Levy costing, the surface option has been adopted.**

The second option is a new tunnel constructed from the road underpass on Warringah Road to feed traffic directly into the town centre. This tunnel could include an approximately 60 metre deceleration lane, a 140 metre tunnel segment and a 120 metre ramp up to the surface level and would help to feed traffic in from areas west of the town centre, such as Chatswood, directly into the town centre. The tunnel would considered a SIC item as it would be a significant upgrade to an RMS operated roadway. In contrast to the first surface option, the tunnel would take significant load off Forest Way northbound, as well as the Forest Way/ Naree Road intersection. **This option is a nice to have from a network performance perspective, however it has been discounted on the basis of cost ($60m + contingencies), the impact on the adjoining network during the construction, significant construction challenges that would need to be overcome, and a cost – benefit ratio that rendered it not feasible**.

The third option considered was the use of the existing Hospital entrance intersection at Hilmer Street to provide some form of access and egress to the eastern portion of the Phase 1 area. This would have a benefit to improve access from Warringah Road directly into the precinct, however this would need to overcome several challenges including, current contractual issues between Health Infrastructure and the Hospital operators, traffic movement point of conflict approaching the signals at Hilmer Street, and the existing infrastructure (both road and underground services) which would add to the cost of this option. **This item is marked for further investigation.**

The fourth option assessed was a surface connection at the western end of the Phase 1 Town Centre development between Forest Way and the eastern pedestrian overpass. This would require removal of significant trees along the southern boundary of the precinct. There would also a significant safety hazard due to a three-way traffic movement point of conflict between the eastbound acceleration lane from Forest Way, traffic moving across to the Town Centre entry and traffic moving towards the right turn at Hilmer Street. In future development stages it would also create a hazard for linear bus services along the Warringah Road Corridor. **This item was discounted due these risks that cannot be overcome through engineering solutions without an undesirable network impact on Forest Way. The option was also deemed unacceptable due to the further removal of the group trees along the Warringah Road frontage of the site.**

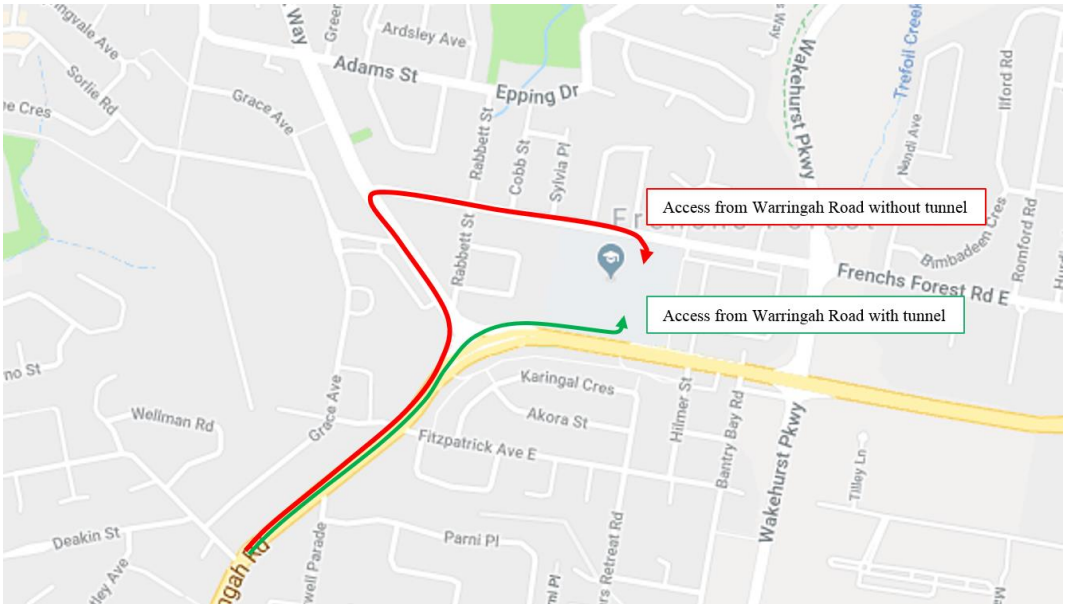


Figure 12: Warringah Road Access

The Warringah Road Town Centre Access Tunnel is shown in Figure 13.

Figure 13: Warringah Road Tunnel Option

4.5.2 (Item 4B) Forest Way Road Widening

It is proposed that Forest Way be widened in order to provide additional access capacity to allow vehicle access from the south and west of the precinct. The widening of Forest Way would be required if Item 4A, the Warringah Road access tunnel, is discounted.

The widening of Forest Way would include the construction of an additional turning lane northbound into Naree Road, including an additional lane approximately 225m back towards the Warringah Road intersection. It is expected that the widening of Forest Way would entail the partial acquisition of a number of properties along Forest Way, as follows:

- Property acquisition on Forest Way (24, 26, 32, 34, 46-38, 40, 23), Russell Avenue (2A) and Naree Road (2, 4). It is expected that property consolidation and resale would be possible with these lots.
- Partial property acquisition on Forest Way (42, 44, 44a, 17, 19, 21, 25, 27, 29) and 3.5 metres along the frontage of the Shopping centre property provide improved road geometry or partial acquisition of 1-15 Forest Way of approximately 4 metres.

The widening of Forest Way would also upgrade the Forest Way/ Naree Road intersection to have a double right turn lane on the southern approach. This item is considered a SIC Levy item as it would provide strategic access for the precinct from the arterial road network.

Without this infrastructure item, there are major impacts on all intersections, especially on the state roads between Beacon Hill Road and Roseville Bridge. The queue length going into Naree Road/Forest Way would be almost 2km.

With this proposed infrastructure item, all intersections above will be improved

The Forest Way road widening is shown in Figure 14.

Figure 14: Forest Way Road Widening

4.5.3 (Item 4C) Traffic Calming

To support the development of the town centre, it is proposed that traffic calming devices, such as speed humps, midblock road closures or chicanes be constructed to improve safety and discourage vehicles from accessing the town centre via residential streets in place of main roads. It is proposed that traffic calming be implemented on the following streets:

- Three flat top concrete speed humps along Wareham Crescent to discourage drivers from skipping the queue on the eastern leg of the Forest Way/ Adams Street intersection.
- Three flat top concrete speed humps along Dundilla Road to discourage drivers from using Dundilla Road to avoid Forest Way and to reduce vehicle speeds and improve safety.
- Two flat top concrete speed humps along Greendale Avenue to discourage drivers from using Greendale Avenue to avoid Forest Way and to reduce vehicle speeds and improve safety.
- Two flat top concrete speed humps along Sturt Street to discourage drivers from using Sturt Street to avoid Forest Way and to reduce vehicle speeds and improve safety.

The locations for the proposed traffic calming measures are shown in Figure 15.

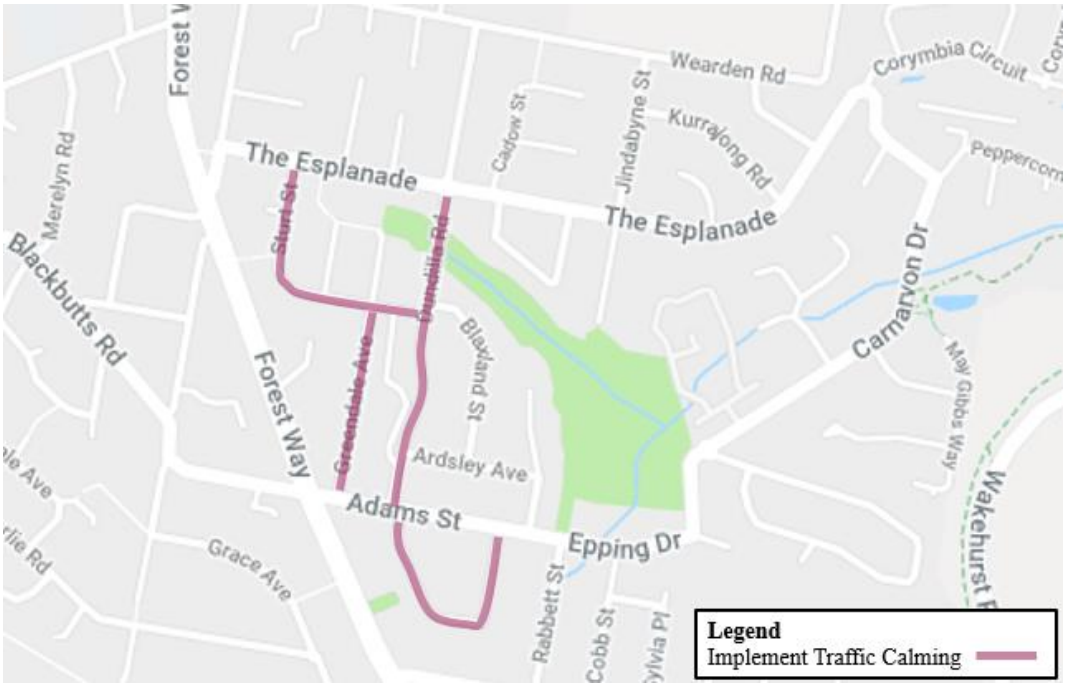


Figure 15: Traffic Calming Locations

These items are required to maintain traffic on the dedicated collector roads and make the rat-run less attractive to vehicles with destinations outside of the local roads. These items will be delivered when 7.11 funding allows or demand requires them based on local need but funded through 7.11 collections.

4.5.4 (Item 4D) Fitzpatrick Avenue West/ Warringah Road Intersection

It is proposed that an additional point of access into the western side of the precinct be provided through the provision of a dedicated slip lane at Fitzpatrick Avenue West. This would require the acquisition of approximately 170 m^2 land from 520 and 524 Warringah Road. This would require the construction of a retaining wall along the Warringah Road frontage of the property. The intersection of Grace Avenue and Fitzpatrick Avenue West would also require upgrade to allow for priority access from Warringah Road.

The Fitzpatrick Avenue West/ Warringah Road slip lane is shown in Figure 16.

Figure 16: Fitzpatrick Avenue West/ Warringah Road intersection

This item is required to service Phase 2 & 3 by taking load off Forest Way at Naree Road and provides additional connectivity for both Phases 2 & 3 via Grace Avenue.

Without this infrastructure item, there are adverse impacts at Warringah Rd and Forest Way. This infrastructure provides a secondary access to the phase 3 area, taking pressure off Forest Way for traffic coming from the west and Warringah Road.

With this proposed infrastructure item, the following improvements can be seen at these intersections at the above intersections.

4.5.5 (Item 4E) Grace Avenue Widening

It is proposed that Grace Avenue be widened between the extended Naree Road and Fitzpatrick Avenue West to provide two lanes in each direction. An allowance has been made for a small amount of property acquisitions in select locations of the alignment, however, it is assumed that the majority of the widening would be accommodated within the existing road reserve.

The widening of Grace Avenue is shown in Figure 17.

Figure 17: Grace Avenue Widening

The item allows for improved network flow between the Fitzpatrick Avenue west intersection and the Naree Road extension. This will assist in local network operations around both Phase 2 and Phase 3.

5 Active Transport Infrastructure Requirements

5.1 Overview

In order to support the development of Phase 1, 2 and 3 of the Hospital Precinct Structure Plan, a number of upgrades to the active transport network are proposed. Active transport infrastructure would help promote non-car modes to access the precinct, such as walking and cycling, and would be essential to ensuring a liveable outcome for the precinct. Good active travel infrastructure can improve the health of the users of the precinct, reduce pollution and help reduce traffic congestion. Table 2 and Figure 18 outline the active transport infrastructure requirements to support the project.

It is important to produce a cohesive network of cycle routes which provide access between the town centre and its surrounding precinct, attracting travellers to choose active travel as a sustainable alternative to private vehicle travel.

Table 2: Overview of Active Transport Infrastructure Requirements

Infrastructure	Item Number	Location	Report Section	Type
Off-road shared path	5	Forest Way	Section 5.3.1	S7.11
		Adams Street	Section 5.3.2	
		Naree Road Extension	Section 5.3.3	
		Rabbett Street	Section 5.3.4	
		Allambie Road (Completed – removed from costings)	Section 5.3.5	
		Warringah Road	Section 5.3.6	
		Aquatic Drive	Section 5.3.7	
		Epping Drive/ Carnarvon Drive/ The Esplanade	Section 5.3.8	
		Dundilla Road	Section 5.3.9	
		Patanga Road/ Dareen Street	Section 5.3.10	
		Grace Avenue to Woodlands Road	Section 5.3.11	
		Peppercorn Drive to Dreadnought Road Connection	Section 5.3.12	
		Dreadnought Road	Section 5.3.13	
		Peppercorn Drive	Section 5.3.14	
On-road cycling friendly treatment	6	Wakehurst Parkway	Section 5.4.1	
		Oxford Falls Road	Section 5.4.2	

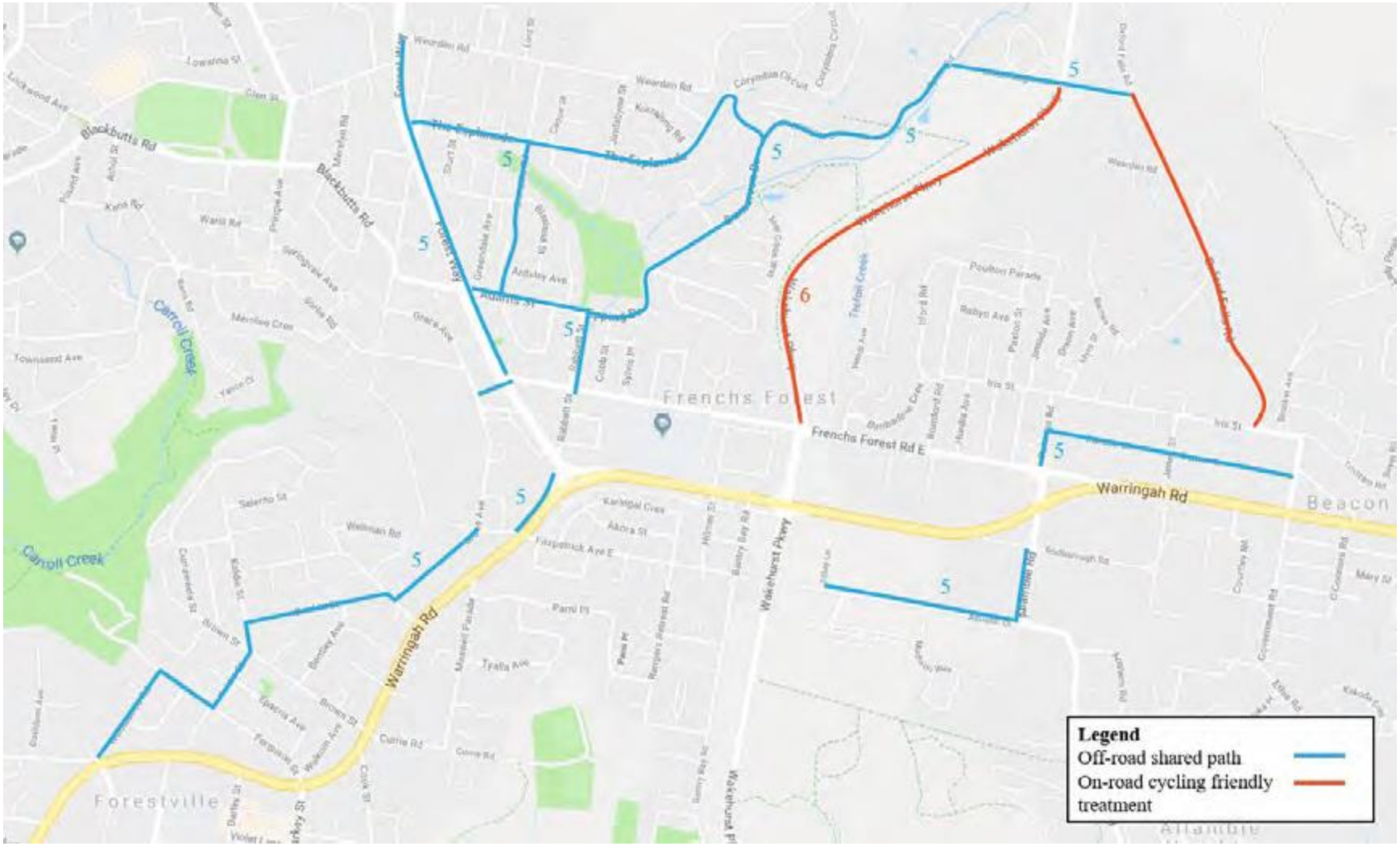


Figure 18: Active Transport Infrastructure Requirements Map

The active transport requirements have not been grouped into phases of the development. The active transport connections should be delivered on a priority basis with the primary delivery to be scheduled to provide connections to the bus priority network, between the areas of increased residential density and recreational facilities and between existing low density residential areas and the town centre precinct. These items should be delivered in line with available funding collected through infrastructure contributions.

5.2 Northern Beaches Hospital Works

Roads and Maritime Services, as a part of the Northern Beaches Hospital project, are delivering a number of active transport works including new and redeveloped footpaths and cycling paths. These are shown in Figure 19.

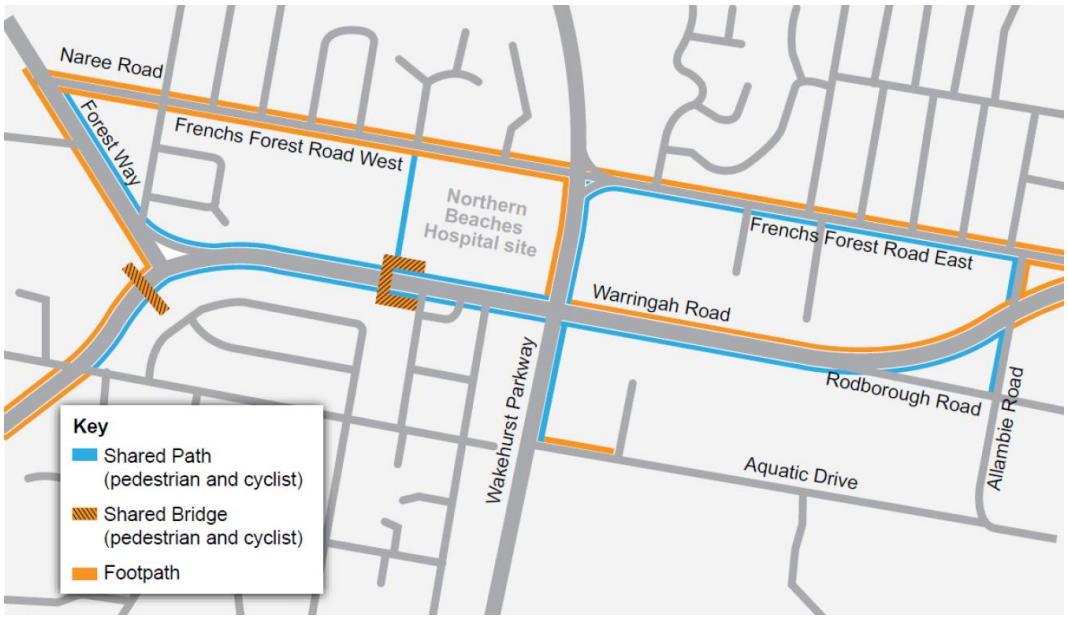


Figure 19: Northern Beaches Hospital active transport upgrades

5.3 Off-Road Shared Paths

As a part of the town centre works, a number of shared paths are required which will help connect the precinct to the larger area. Shared paths help facilitate more walking and cycling journeys and are best suited to busier roads or roads with high speeds and narrow geometries where cyclists may feel unsafe riding on the road. Shared paths can help improve liveability and reduce congestion through providing an attractive alternative to car usage. An example of an off-road shared path is shown in Figure 20.

It is noted that these shared paths should be constructed at the standard width of between 2.5 and 3 metres wide.

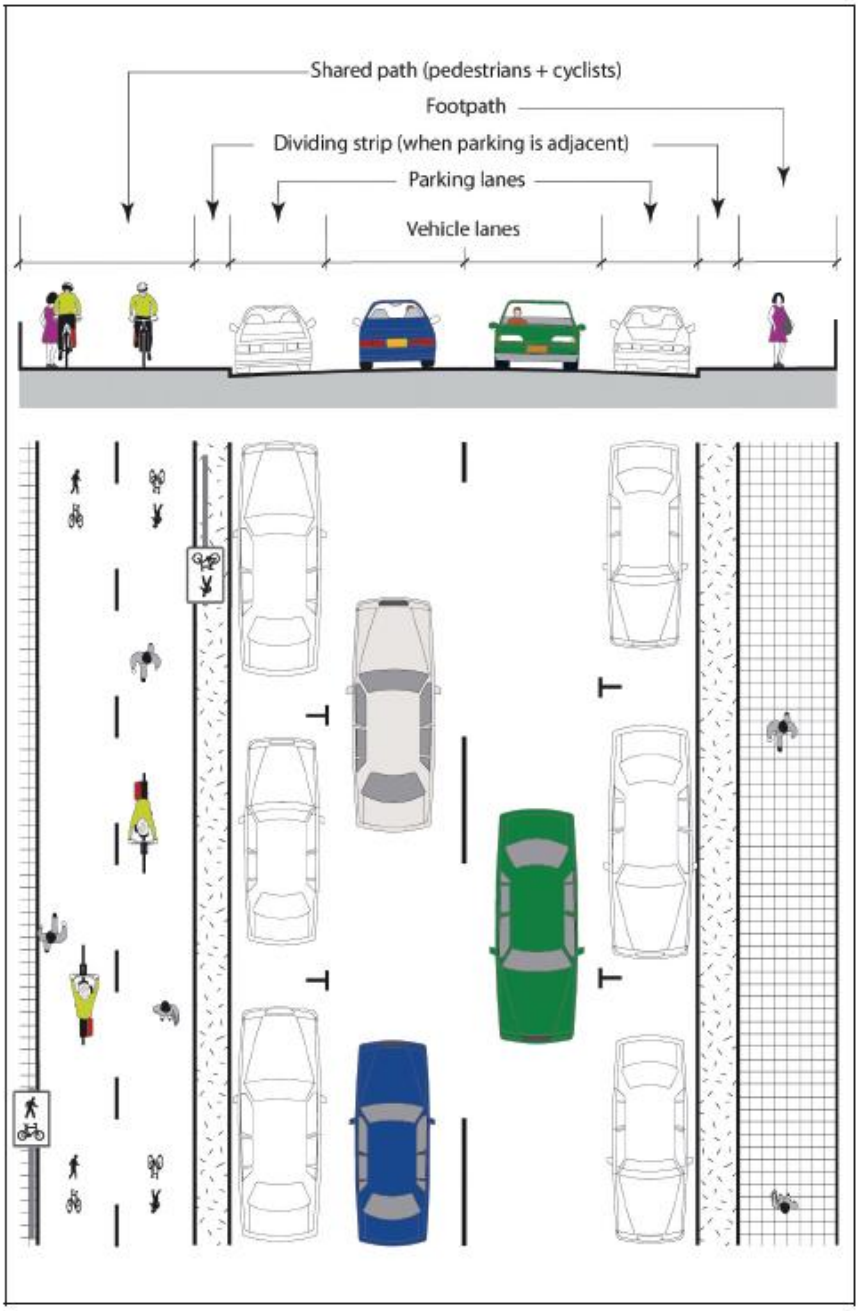


Figure 20: Road with shared path cross section
Source: RTA (2005)

5.3.1 Forest Way

It is proposed that an approximately 1200 metre shared path be constructed along Forest Way from the intersection of Forest Way and Naree Road to the intersection of Wearden Road. In order to align with the current cycling infrastructure on Forest Way, this shared path should be constructed on the eastern side of the road. It is assumed that no additional property acquisition would be required.

This shared path would help provide a pedestrian and cyclist connection between the residential areas and the town centre, as well as also better connecting Wakehurst Public School to the town centre.

The Forest Way shared path is shown in Figure 21.

Figure 21: Forest Way Shared Path

5.3.2 Adams Street

It is proposed that an approximately 420 metre shared path be constructed along Adams Street from the intersection of Adams Street and Rabbett Street to the intersection of Forest Way. In order to avoid destroying trees on the south side of Adams Street, the shared path should be constructed on the north side of the street through upgrading the existing footpath. It should be designed to connect with the shared path currently being delivered by the Northern Beaches Council on the south side of Adams Street east of the Forest Way intersection.

This shared path would help connect the town centre and residential areas to the north-west, and also provide a direct active transport link between the town centre and Lionel Watts Reserve/ Frenchs Forest Showground.

The Adams Street shared path is shown in Figure 22.

Figure 22: Adams Street Shared Path

5.3.3 Naree Road Extension

It is proposed that an approximately 90 metre shared path be constructed along the proposed Naree Road Extension, outlined in Section 5.3.3. In order to align with current cycling infrastructure on Naree Road, this shared path should be constructed on the southern side of the road.

This shared path would help connect Grace Avenue to the town centre and provide a link between the town centre and residential areas to the west and north-west.

The Naree Road Extension shared path is shown in Figure 23.

Figure 23: Naree Road Extension Shared Path

5.3.4 Rabbett Street

It is proposed that an approximately 250 metre shared path be constructed along Rabbett Street from the intersection of Rabbett Street and Frenchs Forest Road W to Epping Drive. As the eastern side of Rabbett Street has an existing footpath while the western side lacks a footpath, it is recommended that the shared path should be constructed on the eastern side of the street through upgrading the existing footpath. This would help remove the need to destroy trees on the western side of the street.

This shared path would help connect the town centre to the residential areas to the north through providing a link between the proposed shared path on Adams Street and on-street cycling on Epping Drive.

The Rabbett Street shared path is shown in Figure 24.

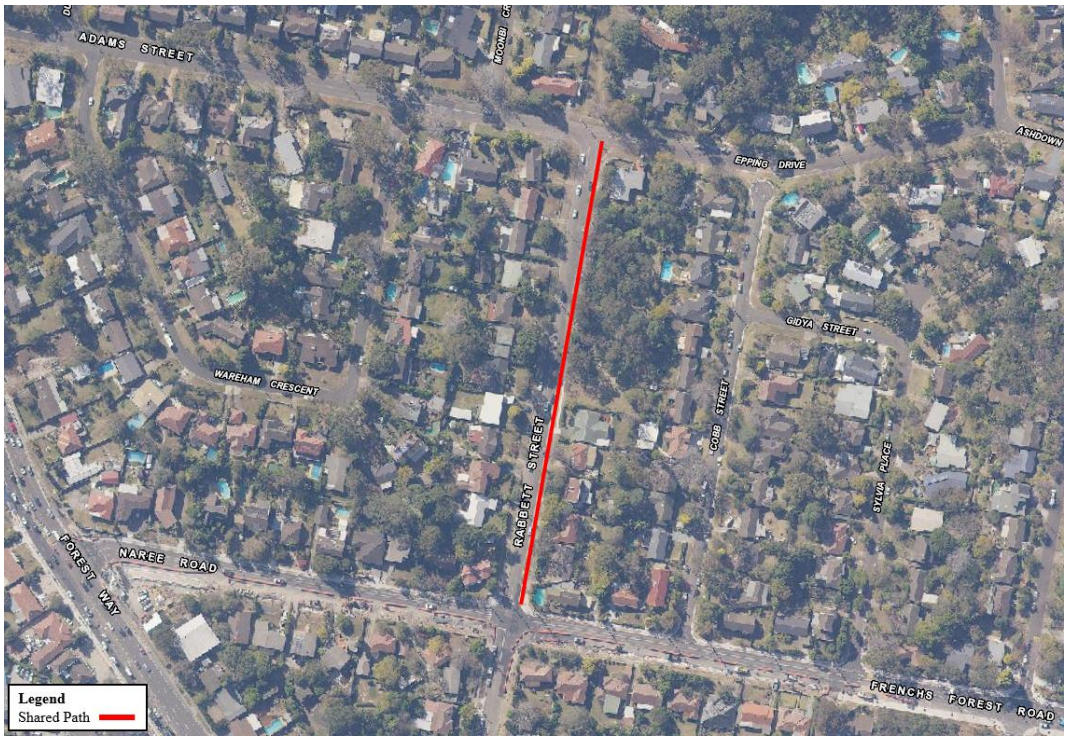


Figure 24: Rabbett Street Shared Path

5.3.5 Allambie Road

It is proposed that an approximately 250 metre shared path be constructed along Allambie Road from the intersection of Allambie Road and Rodborough Road to the intersection with Aquatic Drive. In order to align with current cycling infrastructure on the northern end of Allambie Road, it is recommended that the shared path should be constructed on the western side.

This shared path would help connect the existing cycling friendly facilities on Aquatic Drive to the larger cycling network in the area and provide an active transport link between the town centre and the recreational facilities at Aquatic Reserve. This would also enhance the connectivity of the New High School Precinct with the safe cycling network.

This section has now been completed under TfNSW funded program and removed from the costings.

The Allambie Road shared path is shown in Figure 25.

Figure 25: Allambie Road Shared Path

5.3.6 Warringah Road

It is proposed that an approximately 210 metre shared path be constructed along Warringah Road from the intersection of Warringah Road and Fitzpatrick Avenue and the shared overpass over Warringah Road near the Forest Way intersection. This should be constructed on the western side of the road to provide a connection for vehicles on Fitzpatrick Avenue to the shared bridge.

This shared path would help connect Grace Avenue and Fitzpatrick Avenue to the larger cycling network and help connect residential areas to the south-west to the town centre.

The Warringah Road shared path is shown in Figure 26.

Figure 26: Warringah Road Shared Path

5.3.7 Aquatic Drive

It is proposed that an approximately 660 metre shared path be constructed along Aquatic Drive from the intersection of Aquatic Drive and Allambie Road to Tilley Lane. In order to align with existing infrastructure on Fitzpatrick Avenue East and Allambie Road, it is recommended that the shared path should be constructed on the northern side, taking place of an existing informal but well utilised pedestrian path.

This shared path would replace the existing on-road cycleway on Aquatic Drive, which may be unsafe for cyclists such as school students at the future high school near this area. This can include vehicles turning in or out of the parking spaces conflicting with cyclists on the cycleway, as well as parked vehicles opening their doors into the path of cyclists. The shared path would also provide an active transport link between the town centre and the recreational facilities at Aquatic Reserve.

The Aquatic Drive shared path is shown in Figure 27.

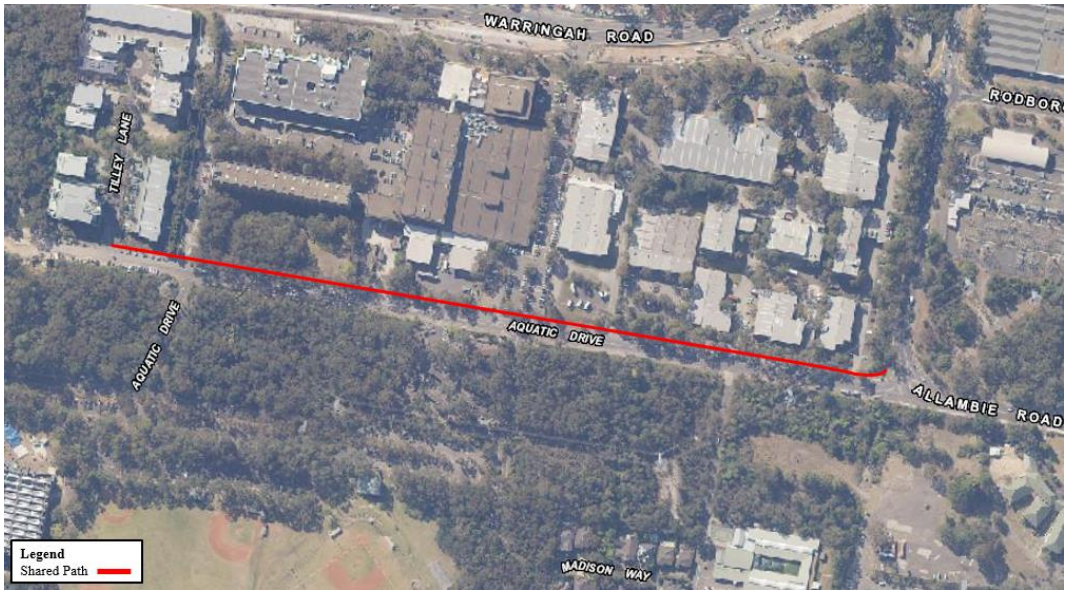


Figure 27: Aquatic Drive Shared Path

5.3.8 Epping Drive/ Carnarvon Drive/ The Esplanade

It is proposed that a shared path be constructed along Epping Drive/ Carnarvon Drive and The Esplanade to provide better cycling conditions and improve cycling connections between the precinct and the residential areas to the north of the precinct. This shared path would help connect the residential areas to the north of the town centre as these roads serve as collector roads for this area.

The location of the shared paths on Epping Drive, Carnarvon Drive and The Esplanade are shown in Figure 37.

Figure 37: Epping Drive/ Carnarvon Drive/ the Esplanade Shared Path

5.3.9 Dundilla Road

It is proposed that a shared path be constructed on Dundilla Road between Adams Street and The Esplanade. This would provide a connection between the proposed shared paths on Adams Street and The Esplanade, helping connect the precinct to the residential areas to the north of the precinct. This shared path would help make this road, which operates as a collector road for the residential areas to the north of the precinct, more appealing to cyclists.

The location of the shared path on Dundilla Road are shown in Figure 38.

Figure 38: Dundilla Road Shared Path

5.3.10 Patanga Road/ Dareen Street

It is proposed that a shared path be constructed on Patanga Road between Frenchs Forest Road East and Dareen Street, as well as on Dareen Street between Patanga Road and Ellis Road. This would provide a connection between the shared paths recently constructed on Frenchs Forest Road East and the shared path on Ellis Road and Oxford Falls Road. This shared path would help provide a connection between the precinct and the residential areas to the east of the precinct.

The location of the shared path on Patanga Road and Dareen Street is shown in Figure 39.

Figure 39: Patanga Road/ Dareen Street Shared Path

5.3.11 Grace Avenue to Woodlands Road

It is proposed that a shared path be constructed on the roads between Grace Avenue (at the Grace Avenue/ Fitzpatrick Avenue West intersection) and Woodlands Road (at the Woodlands Road/ Warringah Road intersection).

This shared path would formalise an existing commonly used cycle route and help provide a connection between the precinct and the residential areas to the south-west of the precinct. Furthermore, this cycling route would also provide a connection to the existing cycleway on Warringah Road and the pedestrian/cyclist bridge over Warringah Road.

The location of the shared path from Grace Avenue to Woodlands Road is shown in Figure 40.

Figure 40: Grace Avenue to Woodlands Road Shared Path

5.3.12 Peppercorn Drive to Dreadnought Road Connection

It is proposed that an approximately 425 metre shared path be constructed, potentially along an existing unpaved trail between Peppercorn Drive along Spicer Road and the proposed shared path on Dreadnought Road.

This shared path would provide an active transport shortcut between the Carnarvon Drive shared path and the Oxford Falls area which includes Oxford Falls Grammar School. Furthermore, it would also help link the cycling friendly Wakehurst Parkway north of Dreadnought Road to the town centre. This shared path would formalise an existing pedestrian trail at this location, shown in Figure 41.

Figure 41: Existing pedestrian trail from Spricer Road to Peppercorn Drive

The Peppercorn Drive to Dreadnought Road connection is shown in Figure 42.

Figure 42: Peppercorn Drive to Dreadnought Road Shared Path

5.3.13 Dreadnought Road

It is proposed that a shared path be constructed on Dreadnought Road between the intersection of Dreadnought Road and Oxford Falls Road to the intersection with Spicer Road.

This shared path would provide a connection between Wakehurst Parkway, the proposed shared path connecting to Peppercorn Drive via Spicer Road and the Oxford Falls area which includes Oxford Falls Grammar School. Furthermore, it would also help better link the cycling friendly Wakehurst Parkway north of Dreadnought Road to the town centre.

The location of the shared path on Dreadnought Road is shown in Figure 43.

Figure 43: Dreadnought Road Shared Path

5.3.14 Peppercorn Drive

It is proposed that a shared path be constructed on Peppercorn Drive. This shared path would provide a connection between the proposed shared paths on Carnarvon Drive and connecting to Dreadnought Road via Spicer Road, providing a connection between the town centre and the Oxford Falls Area.

The location of the shared path on Peppercorn Drive are shown in Figure 44.

Figure 44: Peppercorn Drive Shared Path

5.4 (Item 6) On-Road Cycling Friendly Treatment

As a part of the town centre works, a number of on-road cycling friendly treatments are proposed which aim to help improve cycling conditions in the vicinity of the town centre. These treatments may include:

- Dedicated on-road cycling lane on busier or faster roads
- Expanding road shoulder width to accommodate cyclists.
- Bicycle markings and signage to remind drivers to share the road with bicycles
- Bicycle arrows (such as existing on Grace Avenue)
- Speed humps with cyclist bypass
- Partial road closure with cyclist bypass
- Green painted bicycle lanes or bicycle “jumps” at intersections

Examples of on-road cycling infrastructure are shown in Figure 45.

Figure 45: On-road cycling friendly treatment examples

5.4.1 Wakehurst Parkway

It is proposed that on-road cycling friendly treatments be implemented on Wakehurst Parkway between the intersection of Wakehurst Parkway and Frenchs Forest Road and the intersection with Dreadnought Road. This could be in the form of widening the road shoulder where it is not sufficient in order to allow cyclists to cycle safely along the shoulder. These on-road cycling facilities would provide a connection to the town centre and the Oxford Falls area which includes Oxford Falls Grammar School. Furthermore, it would also help link Wakehurst Parkway north of Dreadnought Road to the town centre.

The location of the cyclist friendly treatments on Wakehurst Parkway are shown in Figure 46.

Figure 46: Wakehurst Parkway Cycle Friendly Treatment

5.4.2 Oxford Falls Road

It is proposed that on-road cycling friendly treatments be implemented on Oxford Falls Road between the intersection of Oxford Falls Road and Dreadnought Road and the intersection of Iris Street and Oxford Falls Road. This could be in the form of widening the road shoulder where it is not sufficient in order to allow cyclists to cycle safely along the shoulder.

These on-road facilities would help link the town centre and the cycling network on Dareen Street and Frenchs Forest Road to the Oxford Falls area which includes Oxford Falls Grammar School. Furthermore, it would also help link Wakehurst Parkway north of Dreadnought Road to the cycling network.

The location of the cyclist friendly treatments on Oxford Falls Road are shown in Figure 47.

Figure 47: Oxford Falls Road Cycle Friendly Treatment

6 Transport Network Performance

6.1 Introduction

Sections 4 and 5 of this report provided a list of traffic and active travel infrastructure items which would be required in order to support the delivery of the project. This section provides an overview of the performance of the network for different levels of development, with and without the proposed infrastructure items in place.

It is noted that Arup has not been involved in the most recent modelling for this project but are reporting on outputs based on modelling undertaken by Jacobs for Phase 1 on behalf of the Department of Planning, Industry and Environment, with supplementary modelling for Phases 2 and 3 (applied on top of Phase 1) undertaken by Council.

The transport modelling was used to test the infrastructure items and to confirm their need to support the development of the precinct. The modelling was also used to determine the timing for delivery of each infrastructure item to support the level of development in each phase.

6.2 Transport Modelling Methodology – Phase 1

Modelling for Phase 1 of the precinct was undertaken by Jacobs for the Department of Planning, Industry and Environment. The traffic generation modelled by Jacobs is shown in Table 3.

Table 3: Phase 1 Traffic Generation

Land Use	AM Rate	PM Rate	Phase 1		
			Yield (Phase 1)	AM Trips/ Hour	PM Trips/ Hour
Resi dwellings (high density)	0.4 per dwelling	0.45 per dwelling	1,901	760	855
Resi dwellings (med density)	0.5 per dwelling	0.55 per dwelling	231	116	127
Commercial	1.6 per 100m2	1.2 per 100m2	5,852 m²	94	71
Retail (supermarket)	4.3 per 100m2	12.3 per 100m2	5,891 m² GLFA	254	725
Retail (other)	2.7 per 100m2	7.6 per 100m2	8,660 m2 GLFA	233	658
Hotel	0.3 per 100m2	0.3 per 100m2	11,300 m2	34	34
Education	0.8 per 100m2	0.8 per 100m2	24,450 m2	196	196
Aged care/community	1.0 per 100m2	1.6 per 100m2	15,375m2	154	246
Total				**1,841**	**2,912**

The impacts of the Phase 1 development traffic have been assessed through the use of an Aimsun traffic model with the aim of identifying constraints in the network and testing possible infrastructure improvements to support the development of Phase 1 of the precinct.

The distribution of traffic generated by the Frenchs Forest Planned Precinct has been derived from an analysis of origin-destination patterns from the strategic Sydney Motorway Project Model (SMPM) modelling provided by RMS.

Modelling outputs are provided in Appendix D.

6.3 Transport Modelling Methodology – Phase 2 & 3

6.3.1 Basis of additional modelling

As part of the Planned Precinct Development at Frenchs Forest, Council's Transport Network Team has looked at several additional access options as a response to the work undertaken by Jacobs on behalf of the Department of Planning, Industry and Environment, with concerns raised regarding the suitability of the access to the Phase 1 release area from Frenchs Forest Road (West). Upon detailed assessment of the initial proposed access intersection, Council determined that the proposed configuration, when modelled, did not function with a suitable level of service (LoS). In particular, once the development yield approached the threshold of 70% of the stage 1 delivery, the service level became an issue.

Arup was commissioned by Council to develop some concept designs and preliminary cost estimates to provide alternative and/or additional access options for not only the full delivery of Phase 1 but to assist with the full delivery of all three current planned redevelopment stages. The options Arup developed included additional surface connections to service the town centre, dedicated public transport options and infrastructure, and two options for access directly into the Phase 1 delivery area from the eastbound Warringah Road corridor.

The additional surface connections are designed to spread the traffic load along Frenchs Forest Road (West) at Bluegum Crescent (East), Sylvia Place, and Rabbett Street. By restricting some movements at these intersections network performance is optimised to maintain an acceptable level of service. Additional road capacity along the Naree and Frenchs Forest Road corridor is required to provide for bus service enhancements for local and express services, and provide improved state road network performance at the Forest Way/ Naree Road intersection.

To provide pedestrian connectivity between the Town Centre and the south precinct, a new green pedestrian bridge is proposed to be constructed and will also provide a means to deliver an express bus connection for the town centre on the Warringah Road corridor. This can include vertical transport options to the surface road without the need for extensive compliant ramps, like those constructed for the existing pedestrian bridges across the corridor.

To assist with overall network performance along Warringah Road and Forest Way Arup investigated an option for a direct connection from the bypass slot, currently under construction as part of the Northern Beaches Hospital connectivity enhancement project, to allow eastbound traffic to enter the precinct and relieve the increased traffic load on the Warringah Road and Forest Way intersection and the Forest Way and Naree Road intersection. The construction would require

demolition of newly built road assets and may have an adverse impact on network performance if the methodology for the construction is not carefully considered and staged to minimise this impact. The initial cost benefit ratio (CBR), when assessed in pure infrastructure terms, is not a preferred option and does not comply with current guidance. However, when a whole of project approach is looked at, the cost of the alternate options, including additional property acquisition spend, the political and community issues that will invariably arise and the potential network impact in the later delivery phases, need to be considered. Whilst not required on day 1 of the project, the route needs to be considered as part of the development plan to not prohibit the connection in the future. When modelled, using the network model validated by RMS for the project, this option produces a reduction in eastbound travel time along Warringah Road in the AM peak by a minimum of 45 seconds or 12% improvement on the worst infrastructure combination, and only an increase of 8 seconds on the current (no additional development scenario).

Jacobs modelled 7 infrastructure options as part of the extension of the work they previously carried out for Department of Planning, Industry and Environment, however the optimisation of the network has not been fully assessed and does not take into account full delivery of all 3 phases and the potential additional impacts of out of scope development that will provide additional load to the state and local road transport network. The proposed infrastructure delivery schedule and timing is based on the proposed infrastructure Council believes is required to secure the most feasible transport outcomes for the priority precinct over the proposed structure plan delivery timeframe. The timing is derived from the assumptions contained in the Jacobs report modelling and has been extrapolated to take into account the overall development yield and generation across all three phases of the precinct under the Council adopted Structure Plan.

6.3.2 Modelling inputs

Modelling for Phases 2 and 3 of the precinct was undertaken by Council using the SIDRA Intersection 8 microsimulation software. The AM and PM traffic generation rates for Phase 2 and 3 assume that a Bus Rapid Transit (BRT) style service would be operational connecting the precinct to the larger public transport network, including to key destinations such as Chatswood and the Sydney CBD. The provision of higher density residential within the precinct with good public transport access leads to a higher level of containment of trips within the precinct and hence a reduction in the traffic generation rates.

Two development outcomes were modelled being 4360 and 5360 dwellings. The infrastructure requirements for each scenario were found to be the same, that is, development greater than 3,000 dwellings would have an adverse impact on the traffic and transport network. The bulk of the additional dwellings are delivered in the Phase 2, when the containment and public transport servicing allow for the additional yield. This would best be defined as worst-case impact modelling and shows the network can cope with the increased demand provided the transport infrastructure and servicing is provided.

The traffic generation modelled by the council is shown in Table 4.

Table 4: Phase 2 and 3 Traffic Generation

Land Use	AM Rate	PM Rate	Phase 2			Phase 3		
			Yield (Phase 2)	AM Trips/ Hour	PM Trips/ Hour	Yield (Phase 3)	AM Trips/ Hour	PM Trips/ Hour
Resi dwellings (high density)	0.29 per dwelling	0.29 per dwelling	3685	1069	1069	5000	1450	1450
Resi dwellings (med density)	0.29 per dwelling	0.29 per dwelling	360	105	105	360	105	105
Commercial	1.2 per 100m2	1.2 per 100m2	5,852 m²	71	71	6,680 m²	81	81
Retail (supermarket)	2.24 per 100m2	5.19 per 100m2	5,891 m² GLFA	132	305	13,406 m² GLFA	300	696
Retail (other)	2.24 per 100m2	5.19per 100m2	8,660 m2 GLFA	194	450	22,738m2 GLFA	509	1180
Hotel	0.3 per 100m2	0.3 per 100m2	11,300m²	34	34	11,300m²	34	34
Education	0.8 per 100m2	0.8 per 100m2	22,450m²	196	196	22,450m²	196	196
Aged care/community	1.0 per 100m2	1.6 per 100m2	15,375m²	154	246	15,375m²	154	154
Total				**1,955**	**2,476**		**2,829**	**3,896**

The SIDRA Intersection network modelled by Council is shown in Figure 48.

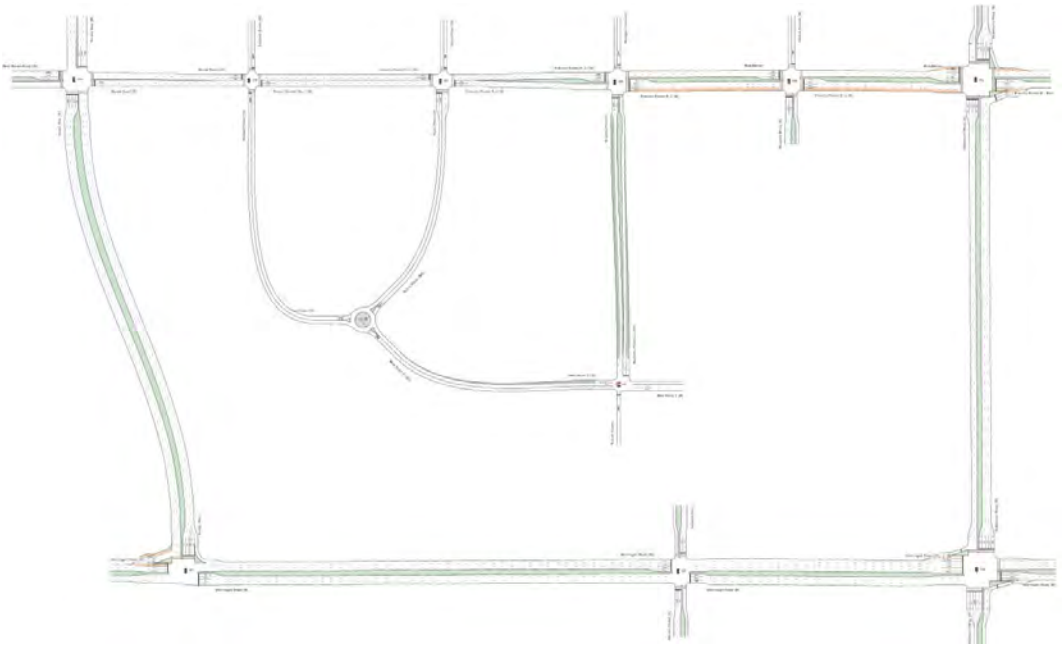


Figure 48: SIDRA Intersection Network

6.3.3 Modelling assumptions

It has been assumed that the Beaches Link project would be operational by Phases 2 and 3 of the precinct. Therefore, the project has resulted in a change to the traffic generation, however, the journey patterns of travellers have not been redistributed to take into account any changes that may occur due to the project.

For the Sidra 8 Network model, the incremental network load has been applied in the logical travel paths. These are based on local traffic flow and volumes taken from the SCATS system in the current network configuration and extrapolated to model the expected network impacts of the dynamic traffic distribution. This approach will also allow agility in response to changes over time to emerging technology and changes in transport expectation by the community.

The staging of works has considered the construction time to be included prior to the deemed point of need for each infrastructure item being reached. However, this is a guidance based on the concept design only, and detailed design and schedule will need to be programmed to provide the infrastructure in a timely fashion as development proceeds.

Modelling outputs are provided in Appendix C.

6.4 Public Transport Improvements

From the point of 50% of Phase 2 delivery or precinct wide equivalent, additional implementation of bus lanes on Warringah Road and other network enhancements along the Warringah Road Corridor outside the delivery precinct will be required, along with investigation of additional public transport service options to ensure the full delivery of the three phases of the project.

This will include dedicated bus lanes including priority signalling at all intersections from Beacon Hill to Roseville. This would result in modal change (potentially forced) from single private car to public transport through the re-purposing of existing traffic lanes, enhanced bus service timing and traffic signal phasing to favour the state road through traffic over local traffic. Council will need to investigate reclassification of local roads to sub-arterial roads and removal of traffic calming in some locations to assist in managing local traffic efficiently in partnership with TfNSW (RMS) to limit the impact of some intersection signalisation to reduce congestion.

7 Indicative Cost Estimates

7.1 Special Infrastructure Contributions (SIC Levy)

Table 5 outlines the indicative cost estimates for the Special Infrastructure Contribution items. It is noted that these cost estimates have been prepared at a strategic level for indicative purposes only, and a quantity surveyor should be engaged to prepare detailed cost estimates for the project. Further details of the cost estimates are shown in Appendix A.

Table 5: SIC Infrastructure Cost Estimates

Item Number	Name	Acquisition Cost	Infrastructure Cost (includes contingency)	Estimated Cost (Rounded to nearest $10,000)
1A	Frenchs Forest Road West/ Bluegum Crescent East/ New Internal Road	$0	$6,680,000	$6,680,000
3A	Naree Road/ Forest Way	$0	$7,280,000	$7,280,000
3B	Naree Road/ Grace Avenue	$760,000	$1,350,000	$2,110,000
3C	Naree Road Extension	$7,872,000	$12,298,000	$20,170,000
3D	Green Bridge over Warringah Road	$3,164,000	$57,306,000	$60,470,000
4B	Forest Way Widening	$17,778,000	$25,512,000	$43,290,000
4E	Grace Avenue Widening	$132,000	$8,848,000	$8,980,000
Total SIC Levy Items		**$29,706,000**	**$119,274,000**	**$148,980,000**

7.2 Local Infrastructure Contribution (S7.11 Contribution)

Table 6 outlines the indicative cost estimates for the Local Infrastructure Contribution items. It is noted that these cost estimates have been prepared at a strategic level for indicative purposes only, and a quantity surveyor should be engaged to prepare detailed cost estimates for the project. Further details of the cost estimates are shown in Appendix A.

Table 6: S7.11 Cost Estimates

Item Number	Name	Acquisition Cost	Infrastructure Cost (includes contingency)	Estimated Cost (Rounded to nearest $10,000)
1B	Holland Crescent Extension to Town Centre	$1,764,000	$2,854,000	$4,618,000
2A	Frenchs Forest Road West/ Naree Road Widening from Bluegum Crescent to Forest Way	$7,953,000	$17,512,000	$25,465,000
2B	Frenchs Forest Road West/ Sylvia Place	$0	$540,000	$540,000
2C	Southern End of Holland Crescent to Forest Way/ Rabbett St Intersection	$0	$10,000	$10,000
3E	Adams Street/ Forest Way	$0	$660,000	$660,000
3F	Adams Street/ Rabbett Street	$0	$250,000	$250,000
3G	Forest Way/ Warringah Road Intersection	$540,000	$2,160,000	$2,200,000
3H	Frenchs Forest Road East	$0	$80,000	$80,000
3I	New Road from Holland Crescent to Frenchs Forest Road West/ Sylvia Place	$9,072,000 ($6,792,000)	$12,928,000	$22,000,000
4C	Wareham Crescent, Dundilla Road, Greendale Avenue, Sturt Street	$0	$640,000	$640,000
4D	Fitzpatrick Avenue West/ Warringah Road	$408,000	$1,592,000	$2,000,000
5	Off-Road Shared Paths	$0	$2,550,000	$2,550,000
6	On-Road Cycle Friendly Treatments	$0	$200,000	$200,000
Total S7.11 Items		**$19,737,000**	**$41,976,000**	**$61,713,000**

8 Conclusions

This report has been prepared to outline the transport strategic design to support all three phases of the Frenchs Forest Town Centre project and addresses both traffic and active travel related infrastructure.

Traffic infrastructure items which have been outlined include new roads, widening of existing roads, upgrades to signalised and unsignalised intersections, new bus bays and traffic calming works. Active travel related infrastructure items which have been outlined include off-road shared paths, on-road cycling friendly treatment and pedestrian/shared bridges.

This report also provides indicative cost estimates for each infrastructure item to inform the development of a SIC Levy and S7.11 contribution. These contributions allow developers to share in the cost of delivering the infrastructure required to support new developments or shield the existing community from negative impacts as a result of the new development. The cost estimates shown in Appendix A have been prepared for indicative purposes only and a quantity surveyor should be engaged to prepare detailed cost estimates for the project.

Appendix A

Indicative Costings

Item Number	SIC Levy Item	Cost (rounded to nearest $10,000)
1A	Frenchs Forest Road West/ Bluegum Crescent East/ New Internal Road	$ 6,680,000
3A	Naree Road/ Forest Way	$ 7,280,000
3B	Naree Road/ Grace Avenue	$ 2,100,000
3C	Naree Road Extension	$ 19,570,000
3D	Green Bridge over Warringah Road	$ 59,660,000
4B	Forest Way Widening	$ 43,290,000
4E	Grace Avenue Widening	$ 8,260,000
	Total SIC Levy Items	**$ 146,840,000**
4A	Optional - Warringah Road Town Centre Access Tunnel	$ 53,270,000

Item Number	S7.11 Item	Cost (rounded to nearest $10,000)
1B	Holland Crescent Extension to Town Centre	$ 4,620,000
2A	Frenchs Forest Road West/ Naree Road Widening from Bluegum Crescent to Fores	$ 25,470,000
2B	Frenchs Forest Road West/ Sylvia Place	$ 540,000
2C	New Road from Holland Crescent to Frenchs Forest Road West/ Sylvia Place	$ 10,000
3E	Adams Street/ Forest Way	$ 660,000
3F	Adams Street/ Rabbett Street	$ 250,000
3G	Forest Way/ Warringah Road Intersection	$ 2,020,000
3H	Frenchs Forest Road East	$ 80,000
3I	New Road from Holland Crescent Extension to Frenchs Forest Road West	$ 21,990,000
4C	Wareham Crescent, Dundilla Road, Greendale Avenue, Sturt Street	$ 640,000
4D	Fitzpatrick Avenue West/ Warringah Road	$ 2,000,000
5	Off-Road Shared Paths	$ 14,570,000
6	On-Road Cycle Friendly Treatments	$ 120,000
	Total S7.11 Items	**$ 72,970,000**

Item 1A

Estimated cost: Town centre access point

	Item	Rate Value	Per	Amount	$ Cost
1 Concept Development	EIS (50m-150m)		**5.0% of construction cost**	$ 3,158,577.15	**$ 157,928.86**
	Project Management		**10.0% of total stage cost**	$ 157,928.86	**$ 15,792.89**
	Client Representation		**10.0% of project management cost**	$ 15,792.89	**$ 1,579.29**
	Total Stage Cost				**$ 175,301.03**
2 Detailed Design & Documentation	Investigation & Design		**6.0% of construction cost**	$ 3,158,577.15	**$ 189,514.63**
	Project Management		**10.0% of total stage cost**	$ 189,514.63	**$ 18,951.46**
	Client Representation		**10.0% of project management cost**	$ 18,951.46	**$ 1,895.15**
	Total Stage Cost				**$ 210,361.24**
3 Property Acquisitions	Assumed $/Sqm	**$ 2,400**	**per sqm**	**0**	$ -
	Professional Services for Property		**7.0% of property acquisition cost**	$ -	$ -
	Project Management		**10.0% of total stage cost**	$ -	$ -
	Client Representation		**10.0% of project management cost**	$ -	$ -
	Total Stage Cost				**$ -**
4 Utility Adjustments	Adjust Utilities		**25.0% of infrastructure cost**	$ 3,158,577.15	**$ 789,644.29**
	Project Management		**10.0% of total stage cost**	$ 789,644.29	**$ 78,964.43**
	Client Representation		**10.0% of project management cost**	$ 78,964.43	**$ 7,896.44**
	Total Stage Cost				**$ 876,505.16**
5 Infrastructure Construction	New Signals	**$ 350,000**	**per signal**	1	**$ 350,000.00**
	New Town Centre Access (60m)	**$ 4,000,000**	**per lane km**	0.12	**$ 480,000.00**
	Intersection civil/ kerb/ linemarking	**$ 2,000,000**	**per signal**	1	**$ 2,000,000.00**
	PA Insurance		**0.55% of costs**	$ 2,830,000.00	**$ 15,565.00**
	Project Management		**10% of total stage cost**	$ 2,845,565.00	**$ 284,556.50**
	Client Representation		**10% of project management cost**	$ 284,556.50	**$ 28,455.65**
	Total Stage Cost				**$ 3,158,577.15**
6 Finalisation	Project Data & Post Completion Review		**1.0% of infrastructure cost**	$ 3,158,577.15	**$ 31,585.77**
	Project Management		**10.0% of total stage cost**	$ 31,585.77	**$ 3,158.58**
	Client Representation		**10.0% of project management cost**	$ 3,158.58	**$ 315.86**
	Total Stage Cost				**$ 35,060.21**

Contingency	50%	**$ 2,227,902.39**
	TOTAL COST	**$ 6,683,707.18**

Element:	**Traffic & Transport**
Item Number	**1B**
Item Description	**Holland Crescent Extension to Town Centre**

Explanation of Item

Extend Holland Crescent to Town Centre

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Land Acquisition	735	m2	$ 2,400.00	Council	$ 1,764,000.00
Demolition of existing structures	271	m2	$ 267.00	IPART 3.1	$ 72,357.00
New 3 lane sub-arterial road	40	m	$ 8,814.00	IPART 1.1	$ 352,560.00
Street Lighting	2	each	$ 15,367.00	IPART 1.17	$ 30,734.00
New 1.2m footpath on both sides	80	m	$ 226.00	IPART 1.10	$ 18,080.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 2,237,731.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 4,617,418.06**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities
Payment of full waste levy for solid waste or restricted special waste
Road and footpath closures
Contaminated materials
Surplus excavation of materials
Import of fill required for site levlling

Element:	**Traffic & Transport**
Item Number	**2A**
Item Description	**Frenchs Forest Road West/ Naree Road from Bluegum Crescent to Forest Way**

Explanation of Item

Widen Frenchs Forest Road West/ Naree Road
Additional Lane at Rabbett Street

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Sub-Arterial Road Widening	500	m	$ 6,422.00	IPART 1.2	$ 3,211,000.00
2.5m wide shared cycleway/ pedestrian footpath	500	m	$ 669.00	IPART 1.10	$ 334,500.00
Street Lighting	13	each	$ 15,367.00	IPART 1.17	$ 199,771.00
Land Acquisition	3314	m2	$ 2,400.00	Council	$ 7,953,600.00
Rabbett Street Turning Lane	100	m	$ 6,422.00	IPART 1.2	$ 642,200.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 12,341,071.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 25,465,028.69**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities
Payment of full waste levy for solid waste or restricted special waste
Additional excavated material requiring disposal off-site
Imported fill required for site levelling

Element:	**Traffic & Transport**
Item Number	**2B**
Item Description	**Sylvia Place/ Frenchs Forest Rd West/ New Road**

Explanation of Item

New Signals due to new road from Holland Crescent

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
New Signalised Intersection	1	signal	$ 260,680.00	IPART 1.13	$ 260,680.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 260,680.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 537,896.89**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities

Element:	**Traffic & Transport**
Item Number	**2C**
Item Description	**Southern End of Holland Crescent to Forest Way/ Rabbett St Intersection**

Explanation of Item

Upgrading restriction to Bus Only 24 Hour, requiring painting of surface

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Road Pavement Resurfacing/ Painting	70	m2	$ 97.00	IPART 1.21	$ 6,790.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 6,790.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 14,010.74**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities

All or part of works to be completed at night

Element:	**Traffic & Transport**
Item Number	**3A**
Item Description	**Naree Rd/ Forest Way**

Explanation of Item

Intersection upgrade to accommodate additional turn lanes and include land aquisiton

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
New intersection slip lane and other works	150	m	$ 19,266.00	3*IPART 1.2	$ 2,889,900.00
New Signals	1	signal	$ 260,680.00	IPART 1.13	$ 260,680.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 3,150,580.00**

Adjustment Factors	Factor
Congestion (Heavy)	1.4
Total Adjustment Factors	**1.4**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 7,281,147.91**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities
Payment of full waste levy for solid waste or restricted special waste
Road and footpath closures
Contaminated materials
Surplus excavation of materials
Import of fill required for site levlling

Element:	**Traffic & Transport**
Item Number	**3B**
Item Description	**Naree Road/ Grace Avenue**

Explanation of Item

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Land Acquisition	316	m2	$ 2,400.00	Council	$ 758,400.00
New Signals	1	signal	$ 260,680.00	IPART 1.13	$ 260,680.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 1,019,080.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 2,102,807.89**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities

Element:	**Traffic & Transport**
Item Number	**3C**
Item Description	**Naree Rd Extension**

Explanation of Item

Extend Naree Road through to Grace Avenue

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Land Acquisition	3280	m2	$ 2,400.00	Council	$ 7,872,000.00
Demolition of existing structures	1031	m2	$ 267.00	IPART 3.1	$ 275,277.00
New 4 lane sub-arterial road	100	m	$ 10,235.00	IPART 1.1	$ 1,023,500.00
Additional Lane	100	m	$ 2,000.00	assumed	$ 200,000.00
Street Lighting	6	each	$ 15,367.00	IPART 1.17	$ 92,202.00
New 1.2m footpath on one side (cycleway on other side costed later)	100	m	$ 226.00	IPART 1.10	$ 22,600.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 9,485,579.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 19,572,899.42**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities
Payment of full waste levy for solid waste or restricted special waste
Road and footpath closures
Contaminated materials
Surplus excavation of materials
Import of fill required for site levlling

Item 3D

Estimated cost: Green bridge (30m)

	Item	Rate Value	Per	Amount	$ Cost
1 Concept Development	EIS (50m-150m)	**5.0%**	**of construction cost**	$ 25,949,441.25	**$ 1,297,472.06**
	Project Management	**10.0%**	**of total stage cost**	$ 1,297,472.06	**$ 129,747.21**
	Client Representation	**10.0%**	**of project management cost**	$ 129,747.21	**$ 12,974.72**
	Total Stage Cost				**$ 1,440,193.99**
2 Detailed Design & Documentation	Investigation & Design	**6.0%**	**of construction cost**	$ 25,949,441.25	**$ 1,556,966.48**
	Project Management	**10.0%**	**of total stage cost**	$ 1,556,966.48	**$ 155,696.65**
	Client Representation	**10.0%**	**of project management cost**	$ 155,696.65	**$ 15,569.66**
	Total Stage Cost				**$ 1,728,232.79**
3 Property Acquisitions	Assumed $/Sqm	**$ 2,400.00**	**per sqm**	**1110**	**$ 2,664,000.00**
	Professional Services for Property	**7.0%**	**of property acquisition cost**	$ 2,664,000.00	**$ 186,480.00**
	Project Management	**10.0%**	**of total stage cost**	$ 2,850,480.00	**$ 285,048.00**
	Client Representation	**10.0%**	**of project management cost**	$ 285,048.00	**$ 28,504.80**
	Total Stage Cost				**$ 3,164,032.80**
4 Utility Adjustments	Adjust Utilities	**25.0%**	**of infrastructure cost**	$ 25,949,441.25	**$ 6,487,360.31**
	Project Management	**10.0%**	**of total stage cost**	$ 6,487,360.31	**$ 648,736.03**
	Client Representation	**10.0%**	**of project management cost**	$ 648,736.03	**$ 64,873.60**
	Total Stage Cost				**$ 7,200,969.95**
5 Infrastructure Construction	Lifts	**$ 250,000**	**per lift**	1	**$ 250,000.00**
	Green Bridge	**$ 5,000**	**per m2**	4500	**$ 22,500,000.00**
	Escalator	**$ 500,000**	**per escalator**	1	**$ 500,000.00**
	PA Insurance	**0.55%**	**of costs**	$ 23,250,000.00	**$ 127,875.00**
	Project Management	**10%**	**of total stage cost**	$ 23,377,875.00	**$ 2,337,787.50**
	Client Representation	**10%**	**of project management cost**	$ 2,337,787.50	**$ 233,778.75**
	Total Stage Cost				**$ 25,949,441.25**
6 Finalisation	Project Data & Post Completion Review	**1.0%**	**of infrastructure cost**	$ 25,949,441.25	**$ 259,494.41**
	Project Management	**10.0%**	**of total stage cost**	$ 259,494.41	**$ 25,949.44**
	Client Representation	**10.0%**	**of project management cost**	$ 25,949.44	**$ 2,594.94**
	Total Stage Cost				**$ 288,038.80**

Contingency	50%	**$**	**19,885,454.79**
	TOTAL COST	**$**	**59,656,364.36**

Element:	**Traffic & Transport**
Item Number	**3E**
Item Description	**Adams Street**

Explanation of Item

Widen Adams Street

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Sub-arterial road widening	50	m	$ 6,422.00	IPART 1.2	$ 321,100.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 321,100.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 662,569.78**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities

Payment of full waste levy for solid waste or restricted special waste

Additional excavated material requiring disposal off-site

Imported fill required for site levelling

Element:	**Traffic & Transport**
Item Number	**3F**
Item Description	**Adams Street/ Rabbett Street**

Explanation of Item

New roundabout construction + Pedestrian Refuges

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
New Roundabout	1	roundabout	$ 100,069.00	IPART 1.14	$ 100,069.00
New Pedestrian Refuges	4	crossings	$ 5,490.00	IPART 1.15	$ 21,960.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
			Total Base Cost		**$ 122,029.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 251,799.21**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities

Element:	**Traffic & Transport**
Item Number	**3G**
Item Description	**Forest Way/ Warringah Road Intersection**

Explanation of Item

Add bus priority to manage movement conflicts at this location
Upgrade pedestrian bridge

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
New Signalised Intersection (Rabbett St/Forest Way)	1	each	$ 260,680.00	IPART 1.17	$ 260,680.00
Co-ordinating signals for priority system (Forest Way/ Warringah Rd)	1	each	$ 50,000.00	Assumed	$ 50,000.00
Cycle Overbridge (84m)	3	28m span	$ 31,973.00	IPART 1.19	$ 95,919.00
Modify Original Bridge	1	each	$ 31,973.00	assumed	$ 31,973.00
Land Acquisition	225	m2	$ 2,400.00	Council	$ 540,000.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
			Total Base Cost		**$ 978,572.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 2,019,222.16**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities
All or part of works to be completed at night

Element:	**Traffic & Transport**
Item Number	**3H**
Item Description	**Bus Stop Relocation**

Explanation of Item

Relocate bus stops to fix blockage issue

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Bus Shelters	2	shelters	$ 17,515.00	IPART 1.16	$ 35,030.00
Demolition of existing shelters (20m2 each)	20	m2	$ 267.00	IPART 3.2	$ 5,340.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 40,370.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 83,300.97**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities
Payment of full waste levy for solid waste or restricted special waste
Road and footpath closures
Contaminated materials
Surplus excavation of materials
Import of fill required for site levlling

Element:	**Traffic & Transport**
Item Number	**3I**
Item Description	**New Road from Holland Crescent Extension to Frenchs Forest Road West**

Explanation of Item

Connect Holland Crescent to Frenchs Forest Rd West

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
New 3 lane sub-arterial road	130	m	$ 8,814.00	IPART 1.1	$ 1,145,820.00
Demolition of existing structures	1071	m2	$ 267.00	IPART 3.1	$ 285,957.00
Street Lighting	6	each	$ 15,367.00	IPART 1.17	$ 92,202.00
New 1.2m footpath on both sides	260	m	$ 226.00	IPART 1.10	$ 58,760.00
Land Acquisition	3780	m2	$ 2,400.00	Council	$ 9,072,000.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 10,654,739.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 21,985,388.01**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities
Payment of full waste levy for solid waste or restricted special waste
Road and footpath closures
Contaminated materials
Surplus excavation of materials
Import of fill required for site levlling

Item 4A

Estimated cost: Warringah Road access point (tunnel option)

	Item	Rate Value	Per	Amount	$ Cost
1 Concept Development	Planning	5.0%	of construction cost	$ 25,173,748.28	$ 1,258,687.41
	Project Management	10.0%	of total stage cost	$ 1,258,687.41	$ 125,868.74
	Client Representation	10.0%	of project management cost	$ 125,868.74	$ 12,586.87
	Total Stage Cost				**$ 1,397,143.03**
2 Detailed Design & Documentation	Investigation & Design	6.0%	of construction cost	$ 25,173,748.28	$ 1,510,424.90
	Project Management	10.0%	of total stage cost	$ 1,510,424.90	$ 151,042.49
	Client Representation	10.0%	of project management cost	$ 151,042.49	$ 15,104.25
	Total Stage Cost				**$ 1,676,571.64**
3 Property Acquisitions	Assumed $/Sqm	$ 2,400	per sqm	0	$ -
	Professional Services for Property	7.0%	of property acquisition cost	$ -	$ -
	Project Management	10.0%	of total stage cost	$ -	$ -
	Client Representation	10.0%	of project management cost	$ -	$ -
	Total Stage Cost				**$ -**
4 Utility Adjustments	Adjust Utilities	25.0%	of infrastructure cost	$ 25,173,748.28	$ 6,293,437.07
	Project Management	10.0%	of total stage cost	6293437.069	$ 629,343.71
	Client Representation	10.0%	of project management cost	629343.7069	$ 62,934.37
	Total Stage Cost				**$ 6,985,715.15**
5 Infrastructure Construction	Ramp Construction	$ 10,000,000	per km	0.12	$ 1,200,000.00
	Additional Auxiliary Deceleration Lane (Use Tunnel Rate)	$ 100,000,000	per km	0.06	$ 6,000,000.00
	Tunnel Construction	$ 100,000,000	per km	0.14	$ 14,000,000.00
	Retaining Wall	$ 1,500.00	per m2	750	$ 1,125,000.00
	CCTV	$ 30,000.00	total	1	$ 30,000.00
	VMS	$ 200,000.00	total	1	$ 200,000.00
	PA Insurance	0.55%	of costs	$ 22,555,000.00	$ 124,052.50
	Project Management	10%	of total stage cost	$ 22,679,052.50	$ 2,267,905.25
	Client Representation	10%	of project management cost	2267905.25	$ 226,790.53
	Total Stage Cost				**$ 25,173,748.28**
6 Finalisation	Project Data & Post Completion Review	1.0%	of infrastructure cost	$ 25,173,748.28	$ 251,737.48
	Project Management	10.0%	of total stage cost	251737.4828	$ 25,173.75
	Client Representation	10.0%	of project management cost	25173.74828	$ 2,517.37
	Total Stage Cost				$ 279,428.61

Contingency		50%	**$ 17,756,303.35**
		TOTAL COST	**$ 53,268,910.04**

Element:	**Traffic & Transport**
Item Number	**4B**
Item Description	**Forest Way Widening**

Explanation of Item

Widen Forest Way

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Sub-Arterial Road Widening	400	m	$ 6,422.00	IPART 1.2	$ 2,568,800.00
2.5m wide shared cycleway/ pedestrian footpath	400	m	$ 669.00	IPART 1.10	$ 267,600.00
Street Lighting	10	each	$ 15,367.00	IPART 1.17	$ 153,670.00
Land Acquisition	7408	m2	$ 2,400.00	Council	$ 17,779,200.00
Bus Stop Indented Bay	30	m	$ 6,422.00	IPART 1.2	$ 192,660.00
Bus Shelter	1	each	$ 17,515.00	IPART 1.16	$ 17,515.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 20,979,445.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 43,289,773.54**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities

Payment of full waste levy for general solid waste or restricted special waste

Additional excavated material (over and above that stated in the basis of cost) requiring disposal off-site

Imported fill required for site levelling

Contaminated materials

Surplus excavated material requiring disposal off-site

Imported fill required for site levelling

Element:	**Traffic & Transport**
Item Number	**4C**
Item Description	**Traffic Calming**

Explanation of Item

Construct flat top road humps

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Flat top road humps - Dundilla Road	3	each	$ 30,885.00	IPART 1.9	$ 92,655.00
Flat top road humps - Wareham Crescent	3	each	$ 30,885.00	IPART 1.9	$ 92,655.00
Flat top road humps - Greendale Avenue	2	each	$ 30,885.00	IPART 1.9	$ 61,770.00
Flat top road humps - Sturt Street	2	each	$ 30,885.00	IPART 1.9	$ 61,770.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 308,850.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 637,292.67**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Element:	**Traffic & Transport**
Item Number	**4D**
Item Description	**Fitzpatrick Avenue West/ Warringah Road Slip Lane**

Explanation of Item

New Slip Lane & Deceleration Lane from Warringah Road into Fitzpatrick Avenue West

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
New Sub-Arterial Road (Slip Lane)	50	m	$ 2,231.00	IPART 1.5	$ 111,550.00
Sub-Arterial Road Widening (Deceleration Lane)	70	m	$ 6,422.00	IPART 1.2	$ 449,540.00
Land Acquisition	170	m2	$ 2,400.00	Council	$ 408,000.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 969,090.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 1,999,656.65**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities
Contaminated materials
Surplus excavated material requiring disposal off-site
Imported fill required for site levelling
Payment of full waste levy for general solid waste or restricted special waste
Additional excavated material (over and above that stated in the basis of cost) requiring disposal off-site
Imported fill required for site levelling

Element:	**Traffic & Transport**
Item Number	**4E**
Item Description	**Grace Avenue Widening**

Explanation of Item

Widening of Grace Avenue to 2 lanes in each direction between the extended Naree Road and Fitzpatrick Avenue West

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Land Acquisition	55	m2	$ 2,400.00	Council	$ 132,000.00
Sub-Arterial Road Widening	550	m	$ 6,422.00	IPART 1.2	$ 3,532,100.00
Street Lighting	14	each	$ 15,367.00	IPART 1.17	$ 215,138.00
New 1.2m footpath on both sides	550	m	$ 226.00	IPART 1.10	$ 124,300.00
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
			Total Base Cost		**$ 4,003,538.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 8,261,050.44**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities
Payment of full waste levy for solid waste or restricted special waste
Road and footpath closures
Contaminated materials
Surplus excavation of materials
Import of fill required for site levlling

Element:	**Traffic & Transport**
Item Number	**5**
Item Description	**Off-road shared path**

Explanation of Item

Demolition of existing footpath, construction of 2.5m shared cycleway

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Forest Way	1200	m	$ 690.00	IPART 1.11	$ 828,000.00
Adams Street	420	m	$ 690.00	IPART 1.11	$ 289,800.00
Naree Road Extension	90	m	$ 669.00	IPART 1.10	$ 60,210.00
Rabbett Street	250	m	$ 690.00	IPART 1.11	$ 172,500.00
Allambie Road	250	m	$ 690.00	IPART 1.11	$ 172,500.00
Warringah Road	210	m	$ 690.00	IPART 1.11	$ 144,900.00
Aquatic Drive	660	m	$ 669.00	IPART 1.10	$ 441,540.00
The Esplanade, Carnarvon, Epping	2400	m	$ 690.00	IPART 1.11	$ 1,656,000.00
Dundilla Road	520	m	$ 669.00	IPART 1.10	$ 347,880.00
Patanga Road/ Dareen Street	900	m	$ 669.00	IPART 1.10	$ 602,100.00
Grace Avenue to Woodlands Road	1800	m	$ 669.00	IPART 1.10	$ 1,204,200.00
Dreadnought Road	650	m	$ 690.00	IPART 1.11	$ 448,500.00
Peppercorn Drive	350	m	$ 690.00	IPART 1.11	$ 241,500.00
Peppercorn Drive to Dreadnought Road Connection (Path)	425	m	$ 669.00	IPART 1.10	$ 284,325.00
Peppercorn Drive to Dreadnought Road Connection (Vegetation Clearing, 5m width)	2125	m	$ 3.81	IPART 3.2	$ 8,096.25
Peppercorn Drive to Dreadnought Road Connection (Security lighting, 50m distance)	43	each	$ 3,146.00	IPART 3.22 (L)	$ 135,278.00
Bike racks in key places	20	each	$ 1,121.00	IPART 1.22	$ 22,420.00
				Total Base Cost	**$ 7,059,749.25**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 14,567,351.34**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities
Payment of full waste levy for solid waste or restricted special waste
Road and footpath closures
Contaminated materials
Surplus excavation of materials
Import of fill required for site levelling

Element:	**Traffic & Transport**
Item Number	**6**
Item Description	**On-road cycleway**

Explanation of Item

Cycle Friendly Treatment

Financial Year Work to be commenced	
Financial Year Work to be completed	

Cost Estimate

Component	Quantity	Unit	Rate	Source	Amount
Wakehurst Parkway	1700	m	$ 20.00	Average Cost for signage & linemarking	$ 34,000.00
Oxford Falls Road	1300	m	$ 20.00	Average Cost for signage & linemarking	$ 26,000.00
Bike racks in key places	5	each	$ 20.00	Average Cost for signage & linemarking	$ 100.00
			$ 20.00	Average Cost for signage & linemarking	$ -
			$ 20.00	Average Cost for signage & linemarking	$ -
			$ 20.00	Average Cost for signage & linemarking	$ -
			$ 20.00	Average Cost for signage & linemarking	$ -
			$ 20.00	Average Cost for signage & linemarking	$ -
			$ 1,121.00	IPART 1.22	$ -
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				Total Base Cost	**$ 60,100.00**

Adjustment Factors	Factor
Congestion (Moderate)	1.25
Total Adjustment Factors	**1.25**
Contingency	**1.5**
ABS Producer Price Indicies Adjustment	**1.1005** (Index 3101, Jun 2013 to Jun 2018)
Total Cost Estimate	**$ 124,012.59**

Prepared by Arup

Notes

Key identified risks (excluded from costs but allowed for in contingency)

Relocation/diversion of existing utilities

All or part of works to be completed at night

Appendix B

Land Acquisitions

ARUP

Subject Land Acquisition Mapping

Date 6 September 2019 **Job No/Ref** 237921

Introduction

The land acquisition requirements for the SIC Levy and S7.11 infrastructure items have been identified.

Item Number	SIC Levy Item	Land needed
1A	Frenchs Forest Road West/ Bluegum Crescent East/ New Internal Road	No
2A	Frenchs Forest Road West/ Naree Road Widening from Bluegum Crescent to Forest Way	Yes
3A	Naree Road/ Forest Way	No
3B	Naree Road/ Grace Avenue	Yes
3C	Naree Road Extension	Yes
3D	Green Bridge over Warringah Road	Yes
4B	Forest Way Widening	Yes
4E	Grace Avenue Widening	Yes
Item Number	**S7.11 Item**	
1B	Holland Crescent Extension to Town Centre	Yes
2B	Frenchs Forest Road West/ Sylvia Place	No
2C	Southern End of Holland Crescent to Forest Way/ Rabbett St Intersection	No
3E	Adams Street/ Forest Way	No
3F	Adams Street/ Rabbett Street	No
3G	Forest Way/ Warringah Road Intersection	Yes
3H	Frenchs Forest Road East	No
3I	New Road from Holland Crescent to Frenchs Forest Road West/ Sylvia Place	Yes
4C	Wareham Crescent, Dundilla Road, Greendale Avenue, Sturt Street	No
4D	Fitzpatrick Avenue West/ Warringah Road Slip Lane	Yes
5	Off-road shared path	No
6	On-road cycleway	No

Subject Land Acquisition Mapping

Date 6 September 2019 **Job No/Ref** 237921

Item Number 2A

141, 143, 145, 147, 149, 151, 153 and 155 Frenchs Forest Road – 574sqm

1, 1A, 3, 5, 7 and 9 Naree Road + 21A Forest Way – 2,726sqm

15 Rabbett Street – 14sqm

Total – 3,314sqm

Subject Land Acquisition Mapping

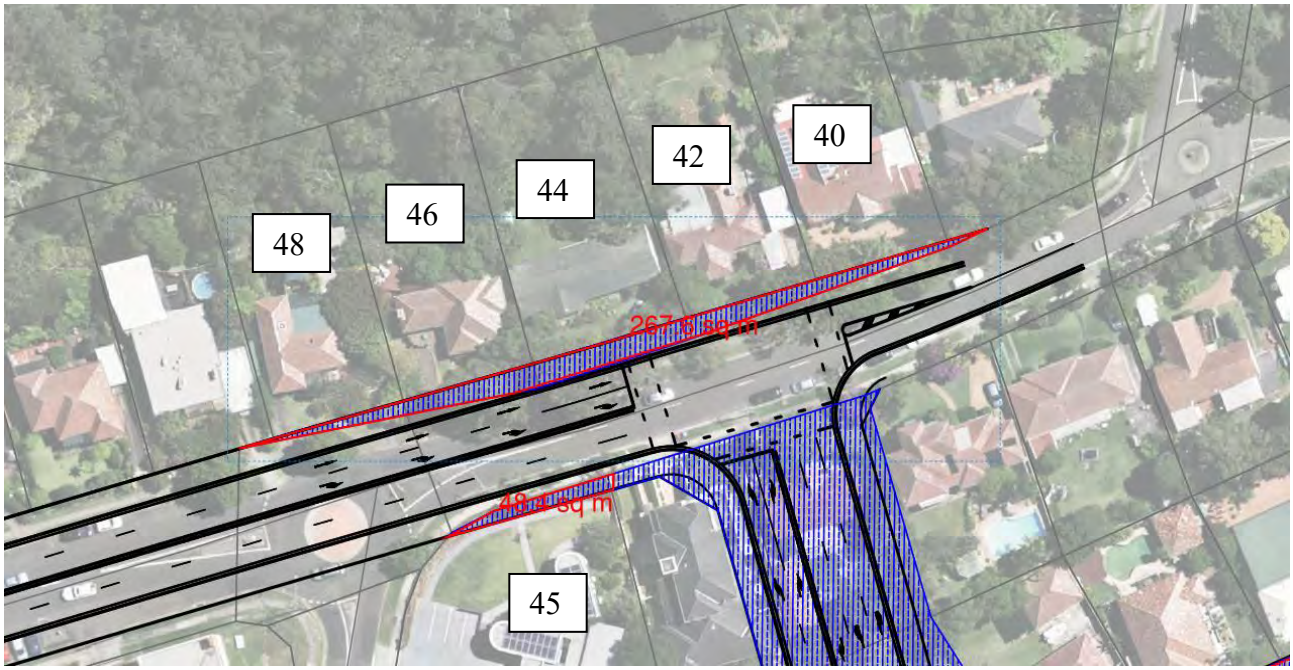
Date 6 September 2019 **Job No/Ref** 237921

Item Number 3B

40, 42, 44, 46 and 48 Grace Ave – 267.6sqm

45 Grace Ave – 48.4sqm

Total - 316sqm



Subject Land Acquisition Mapping

Date 6 September 2019 **Job No/Ref** 237921

Item Number 3C

28 Forest Way – 800sqm

30 Forest Way – 850sqm

41 Grace Ave – 800sqm

43 Grace Ave – 830sqm

Total – 3,280sqm

Subject Land Acquisition Mapping

Date 6 September 2019 **Job No/Ref** 237921

Item Number 3D

36 Karingal Crescent – 550sqm

38 Karingal Crescent – 560sqm

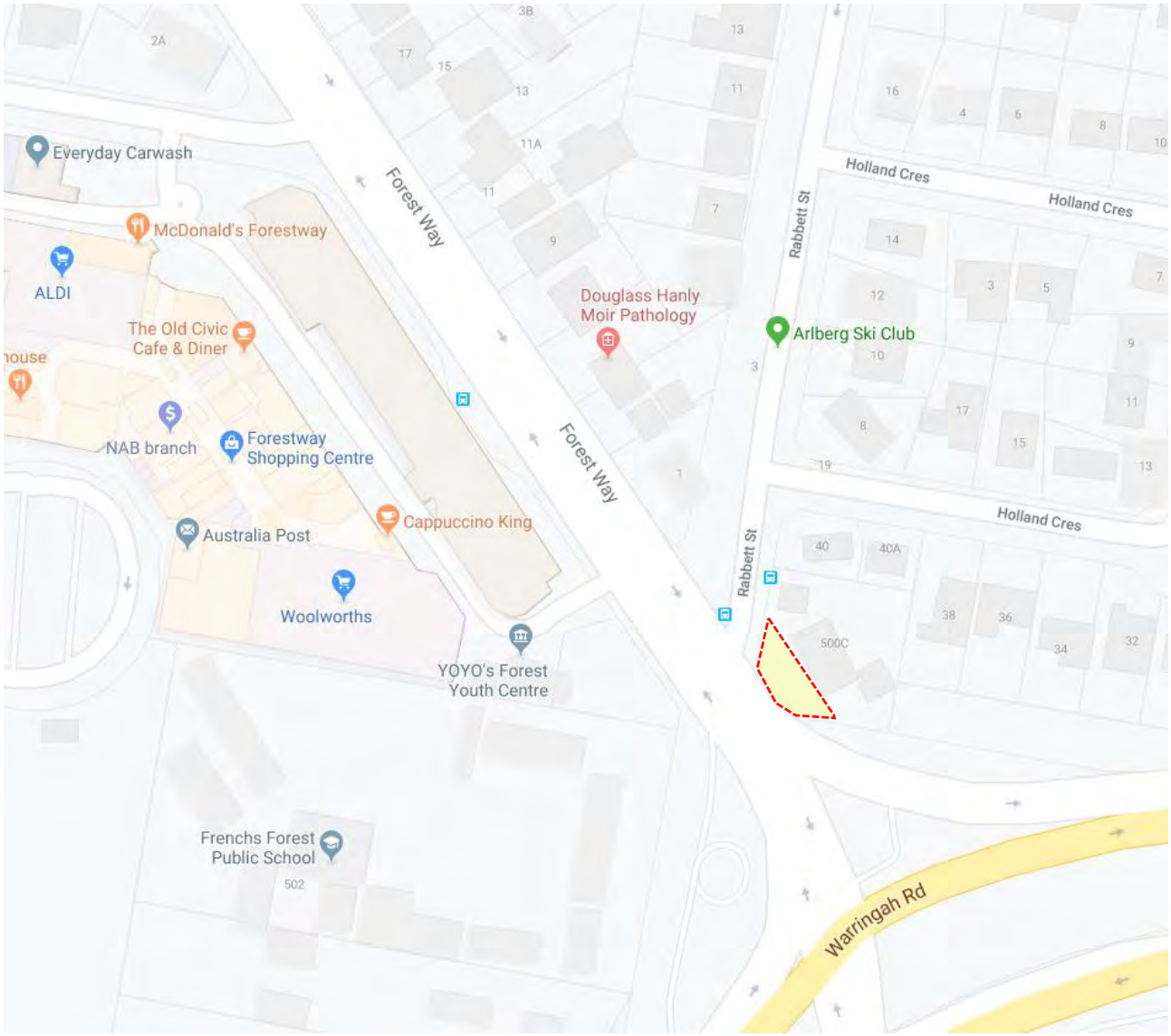
Total – 1,110sqm

Subject Land Acquisition Mapping

Date 6 September 2019 **Job No/Ref** 237921

Item Number 3G

500C Warringah Road (Partial acquisition) – 225sqm



Subject Land Acquisition Mapping

Date 6 September 2019 **Job No/Ref** 237921

Item Number 4B

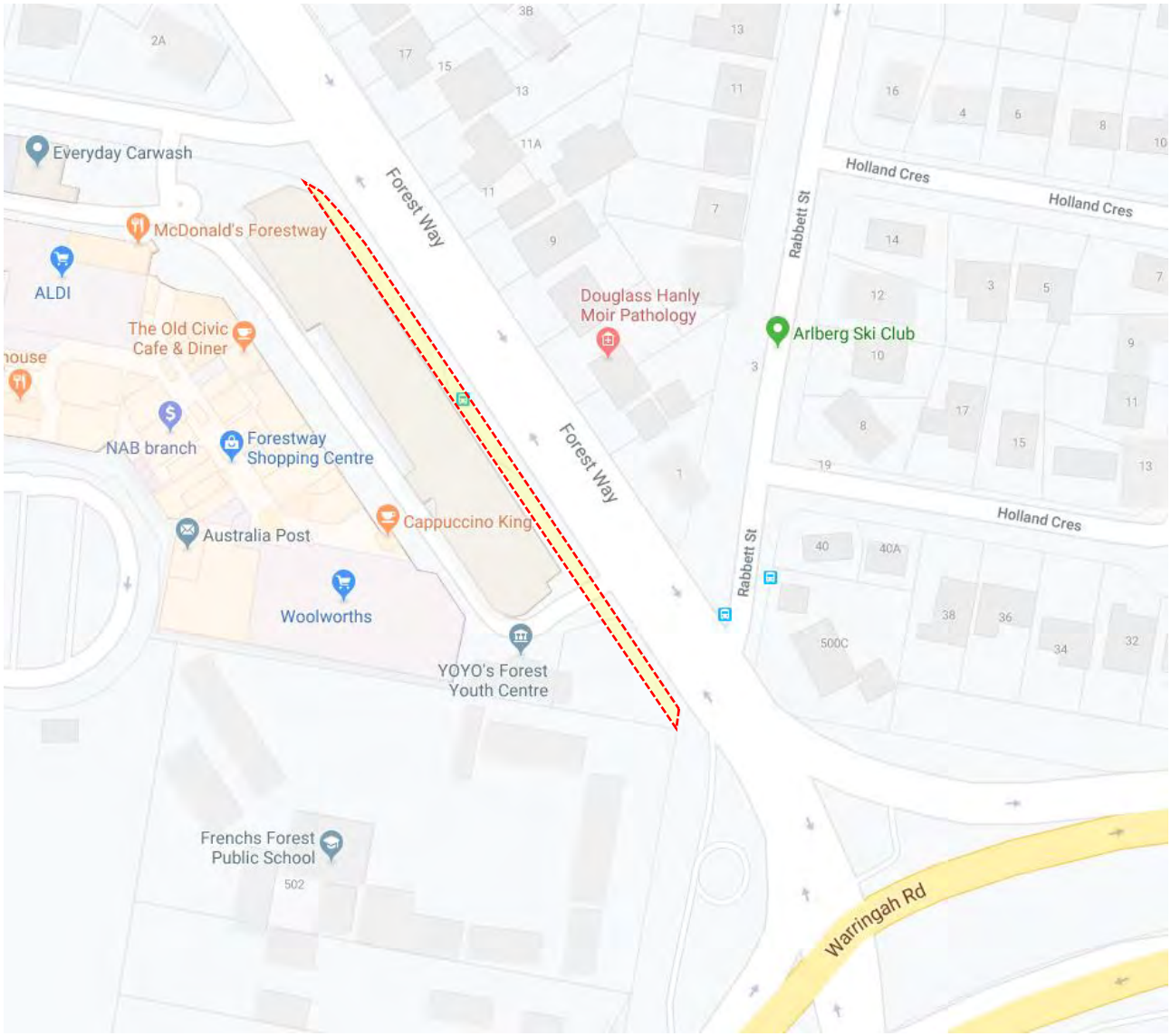
Address	Requirement	Area (sqm)
2a Russell Avenue	Full acquisition – reconsolidate and sell	1181
17 Forest Way	Partial acquisition	62
19 Forest Way	Partial acquisition	64
21 Forest Way	Partial acquisition	70
23 Forest Way	Partial acquisition	77
25 Forest Way	Partial acquisition	53
27 Forest Way	Partial acquisition	74
29 Forest Way	Partial acquisition	74
Forestway Shopping Centre	Partial acquisition	714
24 Forest Way	Full acquisition – reconsolidate and sell	888
26 Forest Way	Full acquisition – reconsolidate and sell	860
28 Forest Way	Item 3C	
30 Forest Way	Item 3C	
32 Forest Way	Full acquisition – reconsolidate and sell	781
34 Forest Way	Full acquisition – reconsolidate and sell	763
38 Forest Way	Full acquisition – reconsolidate and sell	771
40 Forest Way	Full acquisition – reconsolidate and sell	847
42 Forest Way	Partial acquisition	65
44 Forest Way	Partial acquisition	37
44a Forest Way	Partial acquisition	27
Total		**7,408**

Subject Land Acquisition Mapping

Date 6 September 2019 **Job No/Ref** 237921

Subject Land Acquisition Mapping

Date 6 September 2019 **Job No/Ref** 237921



Subject Land Acquisition Mapping

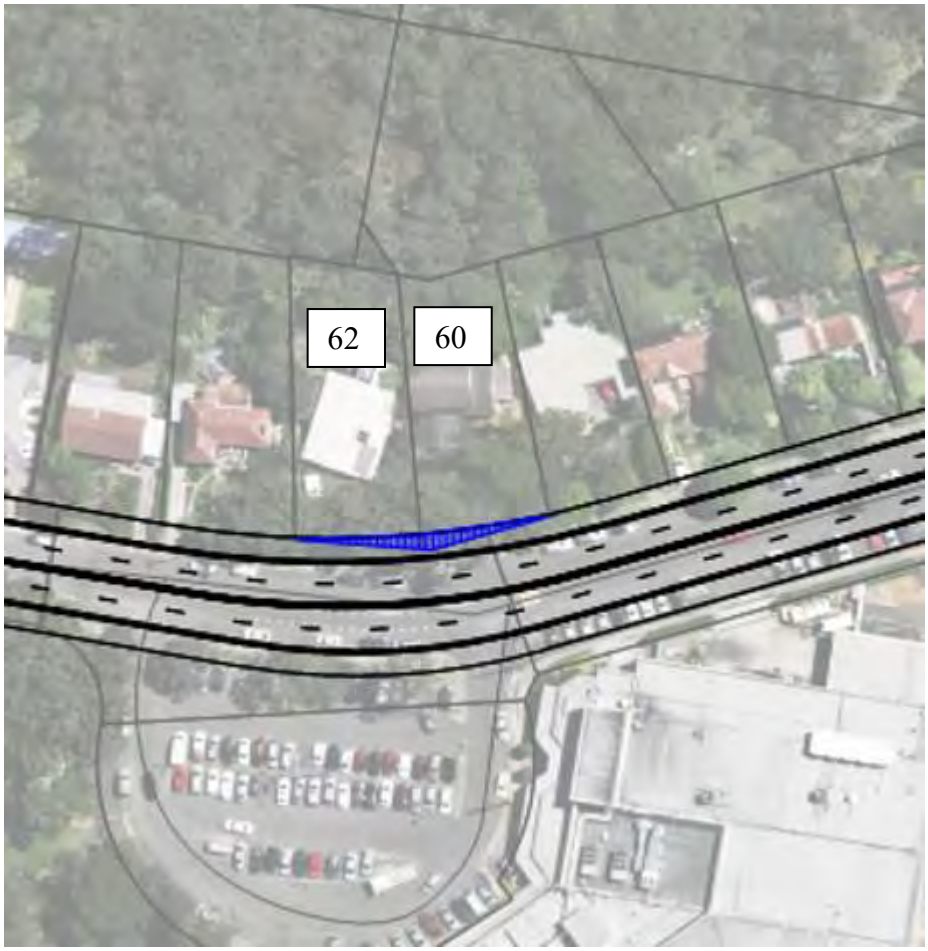
Date 6 September 2019 **Job No/Ref** 237921

Item Number 4E

60 Grace Ave – 30sqm

62 Grace Ave – 25sqm

Total – 55sqm



Subject Land Acquisition Mapping

Date 6 September 2019 **Job No/Ref** 237921

Item Number 1B

26 Holland Crescent – 735sqm

Subject Land Acquisition Mapping

Date 6 September 2019 **Job No/Ref** 237921

Item Number 3I

137 Frenchs Forest Road West – 2,830sqm

16 Holland Crescent – 950sqm

Total – 3,780sqm

Subject Land Acquisition Mapping

Date 6 September 2019 **Job No/Ref** 237921

Item Number 4D

520 -522 Warringah Road – 150sqm

524 Warringah Road – 21sqm

Total – 171sqm

Appendix C

Council - SIDRA Modelling Results Overview

Location		Phase 1 - Infrastructure required to enable development of Town Centre and peripheral development - Residential Yield of 1938.			Phase 2 - Additional 1900 Dwellings + Phase 1 infrastructure and new provision to cater for growth, including East-West BRT - Total Residential Yield 3838.			Phase 3 - Additional 1350 Dwellings and additional retail/commercial development on Forest Way site + Phase 2 infrastructure (more employment containment and corridor capacity redeployment) - Total Residential Yield of 5188			Phase 0 - Full development yield with no additonal infrastructure		
		Queue Length	Delay	LoS	Queue Length	Delay	LoS	Queue Length	Delay	LoS	Queue Length	Delay	LoS
Frenchs Forest Road (West) and Precinct primary entry	OVERALL	405.0m (worst lane)	126.6 sec (average)	F	271.6m (worst lane)	188.7 sec (average)	F	203.1m (worst lane)	188.2 sec (average)	F	347.8m (worst lane)	217.6sec (average)	F
	north leg	6.2m	51.9	D	16.6m	88.5	F	38.7m	65.1	E	299.5m	334.7	F
	south leg	180.0m	184.8	F	180m	146.2	F	180m	182.8	F	160.3m	319.9	F
	east leg	251.5m	155.1	F	267.4m	623	F	203.1m	130	F	395.7m	301.2	F
	west leg	405m	119.9	F	58.6m	80.8	F	33.6m	73.7	E	338m	273	F
Wakehurst Parkway and Frenchs Forest Road	OVERALL	212.2m (worst lane)	87.2 sec (average)	F	213.4m (worst lane)	78.1 sec (average)	E	116.2m (worst lane)	52.9 sec(average)	D	2369.5m (worst lane)	941.0 sec (average)	F
	north leg	159m	172.1	F	140.9m	98.7	F	86.9m	61.3	E	424.4m	185.2	F
	south leg	22.3m	57.7	E	213.4m	97.8	F	19m	42.3	D	2369.5m	180.2	F
	east leg	3.7m	83.9	F	28.7m	62.5	E	3.7m	83.9	F	623.3m	178.9	F
	west leg	212.2m	144.9	F	37.2m	76.5	E	71.2m	77.2	E	222.7m	136.1	F
Forest Way and Naree Road (Phase 0 and 1 without Naree Rd extension)	OVERALL	2256.0m (worst lane)	160.4 sec (average)	F	1755.4m(worst lane)	176.2 sec (average)	F	1675.0m (worst lane)	289.8 sec (average)	F	2255.6m (worst lane)	283.1sec (average)	F
	north leg	1559.3m	185.2	F	1356.0m	209.9	F	1122.2m	197.6	F	3510.6m	552.1	F
	south leg	2256m	131.6	F	748.4m	194.3	F	1070.6m	191.9	F	4608.6m	514.3	F
	east leg	215m	201.7	F	215.0m	165	F	215m	145.2	F	215m	186.7	F
	west leg	-	-	-	-	-	-	399.7m	201.2	F	-	-	-
Town Centre to Rabbett Street	OVERALL	454.4m (worst lane)	5.9 sec (average)	N/A	2.2m (worst lane)	5.4sec (average)	N/A	1.8m (worst lane)	5.3 sec (average)	N/A	1.0m (worst lane)	4.6 sec (average)	N/A
	north leg	1.4m	7.2	A	2.2m	9.4	A	1.8m	9	A	1m	7.8	A
	south leg	-	-	-	-	-	-	-	-	-	-	-	-
	east leg	454.4m	3.8	A	0.9m	4.7	A	0.9m	4.4	A	0.1m	4.1	A
	west leg	0m	4.6	A	0m	4.6	A	0m	4.6	A	0m	4.6	A
Frenchs Forest Road (West) and Naree Road and Rabbett Street	OVERALL	204.1m (worst lane)	56.4 sec (average)	F	73.9m (worst lane)	40.1 sec (average)	D	159.6m (worst lane)	52.5 sec (average)	D	405.0m (worst lane)	607.6 sec (average)	F
	north leg	16.1m	73.6	E	12.7m	48.4	D	67.3m	119.3	F	291.3m	283.8	F
	south leg	56.2m	118.1	F	61.4m	49.5	D	70m	74.4	E	39.7m	57.8	E
	east leg	178m	109.6	F	73.1m	47.6	D	18m	74.6	E	147.3m	281.8	F
	west leg	37.5m	82.8	F	73.9m	52.6	D	112.5m	58.5	E	215m	397.9	F
Holland Crescent and access to the Town Centre	OVERALL				12.9m (worst lane)	8.1 sec (average)	A	11.1m (worst lane)	7.3 sec (average)	A			
	north leg				1.2m	5.3	A	1.1m	5	A			
	south leg				12.9m	6.6	A	11.1m	6.7	A			
	east leg				-	-	-	-	-	-			
	west leg				8.1m	12.2	B	3.6m	10.2	B			
Frenchs Forest Road and Sylvia Place	OVERALL				205.0m (worst lane)	149.9 sec (average)	F	221.0m (worst lane)	155.3 sec (average)	F			
	north leg				14.8m	88.8	F	221m	129.7	F			
	south leg				85m	167.2	F	85m	129.2	F			
	east leg				205m	100.8	F	205m	186.4	F			
	west leg				175m	195.3	F	175m	181.4	F			
Adam Street and Forest Way	OVERALL	744m (worst lane)	313 (average)	F	705m (worst lane)	293 (average)	F	746m (worst lane)	334 (average)	F	621m (worst lane)	796 (average)	F
	north leg	744m	184	F	705m	172	F	746m	187	F	621m	831	F
	south leg	82m	52	D	108m	50	D	50m	55	E	43m	34	C
	east leg	325m	118	F	133m	108	F	229m	87	F	421m	73	E
	west leg	501m	252	F	376m	239	F	367m	303	F	327m	1964	F

Appendix D

Jacobs - Modelling Outputs

JACOBS

Memorandum

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Subject	**Option Scenarios**	**Project Name**	Frenchs Forest Priority Precinct
Attention	Patrick Bastawrous	**Project No.**	IA179100
From	Iwan Smith		
Date	1 May 2019		
Copies to			

1. Introduction

Jacobs has been engaged by Northern Beaches Council to undertake additional model runs for the Frenchs Forest Priority Precinct. The scope of study includes modelling of various scenarios of the precinct and the surrounding road network. These scenarios were run using the Frenchs Forest Priority Precinct traffic model in Aimsun 8.2.1.

This memorandum summarises the model outputs (intersection level of service, travel times and network statistics) for the above options and compares the Level of Service of access intersections with the Department of Planning and Environment's (DPE) preferred option.

2. Modelled scenarios

The following seven scenarios were modelled:

1. Current scenario (no precinct or precinct upgrades and standard background growth)
2. Option A: new accesses via Frenches Forest Road at Bluegum Crescent only
3. Option B: Option A and new proposed tunnel access (in only) via Frenches Forest Road at Bluegum Crescent
4. Option C: Option A and two additional signalised access points via Frenches Forest Road at Rabbett Street and Sylvia Place
5. Option D: Options A, B and C
6. Option E: Option D and Naree Road extension to Grace Avenue
7. Option F: Option E and Slot along Warringah Road

3. Model Outputs

3.1 Intersection Level of Service

The delay and Level of Service of the above options for the two access intersections in the preferred option, Bluegum Crescent and Hilmer Street, are shown below in Table 3.1. More detailed intersection level of service for other intersections in the model area are provided in Appendix A.

Table 3.1 Access delay and LoS

Option	Bluegum Crescent (West) Access				Hilmer Street Access			
	AM		PM		AM		PM	
	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	LoS
Current scenario	3	A	4	A	26	B	24	B
Option A	28	B	29	C	28	B	36	C
Option B*	20	B	21	B	26	B	36	C
Option C*	20	B	21	B	29	B	34	C
Option D*	20	B	21	B	26	B	36	C
Option E*	20	B	21	B	27	B	35	C
Option F*	20	B	21	B	26	B	37	C

*No access from the Priority Precinct proved at Bluegum Crescent West in these options

In each option, the delays at the access intersections change but do not substantially improve as more accesses are added to the development. This indicates that the performance of these intersections is largely governed by minimum phase times at each intersection and that these intersections all generally have sufficient capacity irrespective of the number of accesses to and from the precinct.

3.2 Travel time

Travel time comparisons for each option are provided for the following routes:

- Frenchs Forest Road between Forest Way and Allambie Road
- Warringah Road between Davidson Park and Cornish Avenue

A summary of travel times on these routes for each option is provided in Table 3.2 and Table 3.3.

Table 3.2: Frenchs Forest Road travel time

Option	2026 AM travel time (mm:ss)		2026 PM travel time (mm:ss)	
	Eastbound	Westbound	Eastbound	Westbound
Current scenario	03:03	04:09	03:03	04:04
Option A	03:37	04:38	04:04	05:53
Option B	06:55	06:10	09:25	05:53
Option C	06:45	06:07	09:21	05:56
Option D	07:03	06:06	09:23	05:55
Option E	06:52	06:09	09:28	06:00
Option F	06:44	06:07	09:18	05:53

Table 3.3: Warringah Road travel time

Option	2026 AM travel time (mm:ss)		2026 PM travel time (mm:ss)	
	Eastbound	Westbound	Eastbound	Westbound
Current scenario	06:35	06:14	08:01	05:38
Option A	06:50	06:07	09:13	05:58
Option B	07:38	06:09	09:14	05:54
Option C	06:55	06:08	09:31	05:55
Option D	07:24	06:01	09:17	05:51
Option E	07:06	06:09	09:08	05:46
Option F	06:43	06:07	09:20	05:54

Analysis of travel time along Frenchs Forest Road shows that those options with a higher number of accesses along French Forest Road generally have higher travel times, reflecting the additional delays associated with the traffic signals at these new access locations.

Modelled travel times on Warringah Road generally show little difference in travel times between options, except in the morning peak eastbound, where the additional demand associated with the access directly from Warringah Road leads to higher delays associated with greater demand on Warringah Road to use this left-in access.

3.3 Network statistics

A summary of the overall network statistics for each option is provided in Table 3.4.

Table 3.4: Summary of network statistics

Option	2026 AM			2026 PM		
	VKT	VHT	Av Network Speed	VKT	VHT	Av Network Speed
Current scenario	98,718	2,752	35.9	105,011	2,870	36.6
Option A	104,999	3,185	33.0	113,118	3,469	32.6
Option B	105,207	3,173	33.2	113,235	3,485	32.5
Option C	105,400	3,215	32.8	113,217	3,486	32.5
Option D	104,822	3,210	32.7	113,219	3,484	32.5
Option E	105,396	3,207	32.9	113,204	3,566	31.7
Option F	104,567	3,127	33.4	113,900	3,481	32.7

Analysis of the overall network statistics shows very small differences in average network speed across the options, with the exception of those associated with the left in access on Warringah Road. This is a result of the additional traffic travelling along Warringah Road to use this access.

4. Conclusions

The six option scenarios run in the Frenches Forest Priority Precinct traffic model showed very minor improvements in the Level of Service over DPE's preferred option. As the number of vehicles accessing and leaving the development is relatively small, additional accesses do not substantially improve the Level of Service of the proposed access intersections.

The inclusion of a left in access from Warringah Road would increase the traffic travelling eastbound on Warringah Road that would otherwise turn left into Forest Way and access the precinct from French Forest Road. This would increase traffic on Warringah Road and increase delays along the surface sections of the road.

Appendix A

1. Current scenario

1.1 Delay and LoS

Intersection	AM peak			PM peak		
	Volume (veh)	Delay (s)	LoS	Volume (veh)	Delay (s)	LoS
Warringah Road/Forestville Ave	6779	22	B	6839	29	C
Warringah Road/Darley St	6511	14	B	6796	12	A
Warringah Road/Starkey St	6689	25	B	7242	24	B
Warringah Road/Currie Road	6486	28	B	6960	11	A
Warringah Road/Forest Way	2658	47	D	3091	50	D
Warringah Road/Hilmer Street	2764	26	B	3644	24	B
Warringah Road/Wakehurst Parkway	4279	61	E	4621	59	E
Warringah Road/Allambie Road	4961	40	C	5223	37	C
Warringah Road/Government Road	4778	27	B	5232	40	C
Frenchs Forest Road/Wakehurst Parkway	3302	46	D	3187	47	D
Frenchs Forest Road/Gladys Avenue	1846	6	A	1555	21	B
Frenchs Forest Road/Bluegum Crescent West	1460	3	A	1047	4	A
Frenchs Forest Road/Rabbett Street	1452	28	B	1039	13	A
Frenchs Forest Road/Forest Way	3620	19	B	4254	17	B
Frenchs Forest Road/Bluegum Crescent East	1488	6	A	1352	4	A
Frenches Forest Road/Sylvia Place	1348	1	A	1031	1	A

1.2 Travel times

Road	Direction	2026 AM	2026 PM
Warringah Road	EB	06:35	08:01
	WB	06:14	05:38
Frenchs Forest Road	EB	03:03	03:03
	WB	04:09	04:04

1.3 Network statistics

Statistic	AM peak	PM peak
Vehicle kilometres travelled (VKT)	98,718	105,011
Vehicle hours travelled (VHT)	2,752	2,870
Average speed (km/h)	35.9	36.6
Delay (s)	55	55
Unreleased vehicles	0	0

2. Option A

2.1 Delay and LoS

Intersection	AM peak			PM peak		
	Volume (veh)	Delay (s)	LoS	Volume (veh)	Delay (s)	LoS
Warringah Road/Forestville Ave	7053	19	B	7309	42	C
Warringah Road/Darley St	6812	14	B	7276	18	B
Warringah Road/Starkey St	7114	21	B	7815	29	C
Warringah Road/Currie Road	6822	23	B	7475	12	A
Warringah Road/Forest Way	3068	63	E	3373	76	F
Warringah Road/Hilmer Street	3028	28	B	4152	36	C
Warringah Road/Wakehurst Parkway	4710	63	E	5370	54	D
Warringah Road/Allambie Road	5436	47	D	5651	42	C
Warringah Road/Government Road	5040	30	C	5525	40	C
Frenchs Forest Road/Wakehurst Parkway	3554	48	D	3721	44	D
Frenchs Forest Road/Gladys Avenue	2085	6	A	1991	16	B
Frenchs Forest Road/Bluegum Crescent West	1833	28	B	2113	29	C
Frenchs Forest Road/Rabbett Street	1716	22	B	2006	34	C
Frenchs Forest Road/Forest Way	4528	52	D	5146	38	C
Frenchs Forest Road/Bluegum Crescent East	1877	22	B	2195	35	C
Frenches Forest Road/Sylvia Place	1564	0	A	1830	1	A

2.2 Travel times

Road	Direction	2026 AM	2026 PM
Warringah Road	EB	06:50	09:13
	WB	06:07	05:58
Frenchs Forest Road	EB	03:37	04:04
	WB	04:38	05:53

2.3 Network statistics

Statistic	AM peak	PM peak
Vehicle kilometres travelled (VKT)	104,999	113,118

Statistic	AM peak	PM peak
Vehicle hours travelled (VHT)	3,185	3,469
Average speed (km/h)	33.0	32.6
Delay (s)	66	69
Unreleased vehicles	1	177

3. Option B

3.1 Delay and LoS

Intersection	AM peak			PM peak		
	Volume (veh)	Delay (s)	LoS	Volume (veh)	Delay (s)	LoS
Warringah Road/Forestville Ave	7065	19	B	7281	46	D
Warringah Road/Darley St	6821	14	A	7256	18	B
Warringah Road/Starkey St	7126	20	B	7793	28	B
Warringah Road/Currie Road	6824	23	B	7467	12	A
Warringah Road/Forest Way	3210	72	F	3598	72	F
Warringah Road/Hilmer Street	2891	26	B	3977	36	C
Warringah Road/Wakehurst Parkway	4536	60	E	5252	57	E
Warringah Road/Allambie Road	5418	48	D	5590	43	C
Warringah Road/Government Road	4990	28	B	5493	50	D
Frenchs Forest Road/Wakehurst Parkway	3499	49	D	3581	46	D
Frenchs Forest Road/ Gladys Avenue	2039	7	A	1881	15	B
Frenchs Forest Road/Bluegum Crescent West	1265	1	A	1457	1	A
Frenchs Forest Road/Rabbett Street	4354	48	D	4789	34	C
Frenchs Forest Road/Forest Way	1842	20	B	1937	21	B
Frenchs Forest Road/Bluegum Crescent East	1309	6	A	1340	5	A
Frenches Forest Road/Sylvia Place	7065	19	B	7281	46	D

3.2 Travel times

Road	Direction	2026 AM	2026 PM
Warringah Road	EB	07:38	09:14
	WB	06:09	05:54
Frenchs Forest Road	EB	06:55	09:25
	WB	06:10	05:53

3.3 Network statistics

Statistic	AM peak	PM peak
Vehicle kilometres travelled (VKT)	105,207	113,235
Vehicle hours travelled (VHT)	3,173	3,485
Average speed (km/h)	33.2	32.5
Delay (s)	65	70
Unreleased vehicles	1	108

4. Option C

4.1 Delay and LoS

Intersection	AM peak			PM peak		
	Volume (veh)	Delay (s)	LoS	Volume (veh)	Delay (s)	LoS
Warringah Road/Forestville Ave	7061	19	B	7282	44	D
Warringah Road/Darley St	6809	14	B	7261	18	B
Warringah Road/Starkey St	7114	21	B	7805	29	C
Warringah Road/Currie Road	6822	24	B	7472	12	A
Warringah Road/Forest Way	3165	56	D	3387	81	F
Warringah Road/Hilmer Street	3104	29	B	4188	34	C
Warringah Road/Wakehurst Parkway	4755	64	E	5406	59	E
Warringah Road/Allambie Road	5445	46	D	5627	43	D
Warringah Road/Government Road	5073	30	C	5517	42	C
Frenchs Forest Road/Wakehurst Parkway	3571	49	D	3708	45	D
Frenchs Forest Road/ Gladys Avenue	2057	7	A	1979	14	B
Frenchs Forest Road/Bluegum Crescent West	1387	0	A	1671	1	A
Frenchs Forest Road/Rabbett Street	4535	35	C	5129	38	C
Frenchs Forest Road/Forest Way	1842	20	B	1937	21	B
Frenchs Forest Road/Bluegum Crescent East	1309	6	A	1340	5	A
Frenches Forest Road/Sylvia Place	7061	19	B	7282	44	D

4.2 Travel times

Road	Direction	2026 AM	2026 PM
Warringah Road	EB	06:55	09:31
	WB	06:08	05:55
Frenchs Forest Road	EB	06:45	09:21
	WB	06:07	05:56

4.3 Network statistics

Statistic	AM peak	PM peak
Vehicle kilometres travelled (VKT)	105,400	113,217
Vehicle hours travelled (VHT)	3,215	3,486
Average speed (km/h)	32.8	32.5
Delay (s)	66	70
Unreleased vehicles	1	138

5. Option D

5.1 Delay and LoS

Intersection	AM peak			PM peak		
	Volume (veh)	Delay (s)	LoS	Volume (veh)	Delay (s)	LoS
Warringah Road/Forestville Ave	7062	19	B	7285	44	D
Warringah Road/Darley St	6820	14	A	7264	18	B
Warringah Road/Starkey St	7122	20	B	7805	28	B
Warringah Road/Currie Road	6835	23	B	7472	12	A
Warringah Road/Forest Way	3423	76	F	3618	62	E
Warringah Road/Hilmer Street	3129	26	B	3967	36	C
Warringah Road/Wakehurst Parkway	4839	64	E	5217	57	D
Warringah Road/Allambie Road	5343	45	D	5694	43	C
Warringah Road/Government Road	5084	29	C	5560	60	E
Frenchs Forest Road/Wakehurst Parkway	3551	53	D	3579	46	D
Frenchs Forest Road/ Gladys Avenue	2049	10	A	1878	14	B
Frenchs Forest Road/Bluegum Crescent West	1159	0	A	1245	1	A
Frenchs Forest Road/Rabbett Street	4386	61	E	4875	34	C
Frenchs Forest Road/Forest Way	1842	20	B	1937	21	B
Frenchs Forest Road/Bluegum Crescent East	1309	6	A	1340	5	A
Frenches Forest Road/Sylvia Place	7062	19	B	7285	44	D

5.2 Travel times

Road	Direction	2026 AM	2026 PM
Warringah Road	EB	07:24	09:17
	WB	06:01	05:51
Frenchs Forest Road	EB	07:03	09:23
	WB	06:06	05:55

5.3 Network statistics

Statistic	AM peak	PM peak
Vehicle kilometres travelled (VKT)	104,822	113,219
Vehicle hours travelled (VHT)	3,210	3,484
Average speed (km/h)	32.7	32.5
Delay (s)	68	69
Unreleased vehicles	1	120

6. Option E

6.1 Delay and LoS

Intersection	AM peak			PM peak		
	Volume (veh)	Delay (s)	LoS	Volume (veh)	Delay (s)	LoS
Warringah Road/Forestville Ave	7059	19	B	7291	45	D
Warringah Road/Darley St	6813	15	B	7261	18	B
Warringah Road/Starkey St	7118	22	B	7810	28	B
Warringah Road/Currie Road	6823	25	B	7480	12	A
Warringah Road/Forest Way	3116	59	E	3684	65	E
Warringah Road/Hilmer Street	2883	27	B	3900	35	C
Warringah Road/Wakehurst Parkway	4635	72	F	5163	60	E
Warringah Road/Allambie Road	5441	47	D	5676	44	D
Warringah Road/Government Road	5041	30	C	5560	51	D
Frenchs Forest Road/Wakehurst Parkway	3637	48	D	3652	44	D
Frenchs Forest Road/ Gladys Avenue	2165	7	A	2007	13	A
Frenchs Forest Road/Bluegum Crescent West	1204	1	A	1354	1	A
Frenchs Forest Road/Rabbett Street	4445	35	C	5255	46	D
Frenchs Forest Road/Forest Way	1842	20	B	1937	21	B
Frenchs Forest Road/Bluegum Crescent East	1309	6	A	1340	5	A
Frenches Forest Road/Sylvia Place	7059	19	B	7291	45	D

6.2 Travel times

Road	Direction	2026 AM	2026 PM
Warringah Road	EB	07:06	09:08
	WB	06:09	05:46
Frenchs Forest Road	EB	06:52	09:28
	WB	06:09	06:00

6.3 Network statistics

Statistic	AM peak	PM peak
Vehicle kilometres travelled (VKT)	105,396	113,204
Vehicle hours travelled (VHT)	3,207	3,566
Average speed (km/h)	32.9	31.7
Delay (s)	65	71
Unreleased vehicles	1	147

7. Option F

7.1 Delay and LoS

Intersection	AM peak			PM peak		
	Volume (veh)	Delay (s)	LoS	Volume (veh)	Delay (s)	LoS
Warringah Road/Forestville Ave	7068	19	B	7312	44	D
Warringah Road/Darley St	6817	15	B	7285	18	B
Warringah Road/Starkey St	7125	21	B	7824	29	B
Warringah Road/Currie Road	6827	24	B	7485	11	A
Warringah Road/Forest Way	2990	56	D	3370	49	D
Warringah Road/Hilmer Street	2846	26	B	3858	37	C
Warringah Road/Wakehurst Parkway	4516	64	E	5057	62	E
Warringah Road/Allambie Road	5299	45	D	5590	42	C
Warringah Road/Government Road	4980	27	B	5522	43	C
Frenchs Forest Road/Wakehurst Parkway	3564	46	D	3616	45	D
Frenchs Forest Road/ Gladys Avenue	2181	8	A	2081	14	A
Frenchs Forest Road/Bluegum Crescent West	1139	1	A	1338	1	A
Frenchs Forest Road/Rabbett Street	4482	37	C	5215	44	D
Frenchs Forest Road/Forest Way	1842	20	B	1937	21	B
Frenchs Forest Road/Bluegum Crescent East	1309	6	A	1340	5	A
Frenches Forest Road/Sylvia Place	7068	19	B	7312	44	D

7.2 Travel times

Road	Direction	2026 AM	2026 PM
Warringah Road	EB	06:43	09:20
	WB	06:07	05:54
Frenchs Forest Road	EB	06:44	09:18
	WB	06:07	05:53

7.3 Network statistics

Statistic	AM peak	PM peak
Vehicle kilometres travelled (VKT)	104,567	113,900
Vehicle hours travelled (VHT)	3,128	3,481
Average speed (km/h)	33.4	32.7
Delay (s)	65	66
Unreleased vehicles	58	62