JMT CONSULTING

Cooks Cove Planning Proposal

Transport Impact Assessment

Prepared for: **Cook Cove Inlet Pty Ltd**

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1 Introduction

1.1 Background

This updated transport assessment report has been prepared, on behalf of Cooks Cove Inlet Pty Ltd, to support the public exhibition and assessment of the Cooks Cove Planning Proposal (PP-2022-1748), which was issued a Gateway Determination by the Department of Planning and Environment on 5 August 2022. The proposal seeks to amend *Bayside Local Environmental Plan 2021* (BLEP 2021) to rezone and insert planning controls for certain land known as Cooks Cove within the BLEP 2021.

The Cooks Cove Planning Proposal aims to facilitate the long-planned transformation of 36.2ha of underutilised and strategically important land at Arncliffe, located to the north of the M5 Motorway and adjacent the western foreshore of the Cooks River. The project seeks a renewed focus on delivering a contemporary logistics and warehousing precinct within a well-connected location, surrounded by enhanced open space provisions. The site forms part of the broader Bayside West 2036 Precincts and generally comprises the footprint of the former Kogarah Golf Club, now in part occupied by a temporary M6 Stage 1 construction compound.

The transport assessment has been prepared to respond to the requirements of the Gateway Determination PP-2022-1748 and Local Planning Direction 5.2, specifically:

"*obtain approval from TfNSW that the planning proposal will not compromise future transport links, deliver a safe road network and enhance walking and cycling connectivity and the use of public transport in accordance with the requirements of the principles*"

1.2 Cooks Cove master plan 2022

The Cooks Cove Master Plan 2022, as prepared by Hassell, represents an optimised and refined reference scheme, to guide best practice design and the preparation of detailed planning controls to achieve an attractive precinct with high amenity. Key features of the Cooks Cove Master Plan are:

- A net development zone of approximately 15ha with up to 343,250m^2 Gross Floor Area (GFA) comprising
  - 290,000m^2 of multi-level logistics and warehousing;
  - 22,350m^2 for commercial office uses;
  - 20,000m^2 for hotel and visitor accommodation uses;
  - 10,900m^2 of retail uses;
- Multi-level logistics with building heights generally up to 5 storeys (approx. 48m)

- A retail podium with commercial office and hotel above, up to a total of 12 storeys (approx. 51m)
- Built form of a scale and composition which caters for the generation of approximately 3,300 new jobs
- A surrounding open space precinct including:
  - A highly activated waterfront including the Fig Tree Grove outdoor dining and urban park precinct
  - A regional Bay to Bay Regional cycle link, 'Foreshore Walk', including active and passive recreational uses, together with environmental enhancements
  - Master planned and Council-owned 'Pemulwuy Park' – with an agreed embellishment outcome of passive open space and environmental enhancements to be delivered in stages post construction of the M6 Stage 1 Motorway
- Complementary on and off-site infrastructure to be delivered by way of State and Local Voluntary Planning Agreements.

Figure 1 Proposed Cooks Cove Master Plan 2022

Source: Hassell

1.3 Proposed planning controls

The Planning Proposal Justification Report, as prepared by Ethos Urban, details the intention to insert new planning provisions covering the Cooks Cove development zone and adjoining lands, through the amendment of the BLEP 2021, accordingly removing this same area from State Environmental Planning Policy (Precincts—Eastern Harbour City) 2021 (formerly Sydney Regional Environmental Plan No. 33 – Cooks Cove).

Specifically, the Planning Proposal will:

- Seek new land use zones within the development zone, including a primary SP4 Enterprise zone across the majority of the Kogarah Golf Course freehold land, RE1 Public Recreation foreshore and passive open space zones and elements of SP2 Infrastructure.
- Impose an overall maximum building height of RL51m with appropriate transitions to respond to aviation controls within limited sections of the site.
- Limit gross floor area (GFA) to the south of Marsh Street to 340,000m^2, with a further 1.25:1 Floor Space Ratio (circa 3,250m^2 of GFA) to the north of Marsh Street, to achieve the overall intended logistics, commercial, retail and short-term accommodation land uses.
- Other additional permitted uses and site-specific planning provisions.
- Reclassification of Lot 14 DP213314 and Lot 1 DP108492 (Council owned and the subject of Charitable Trusts), initially from 'community' to 'operational' to ensure appropriate access, improve utility of public open space and to create a contiguous boundaries. Following rezoning and subdivision it is subsequently intended that Council reclassify residue RE1 parcels as 'community' by resolution.

The proposal is in response to Bayside West Precincts 2036 – Arncliffe, Banksia and Cooks Cove (released August 2018) and the subsequent Ministerial Directions under s9.1 of the EP&A Act, being Local Planning Directions 1.11 Implementation of Bayside West Precincts 2036 Plan and 1.12 Implementation of Planning Principles for the Cooks Cove Precinct.

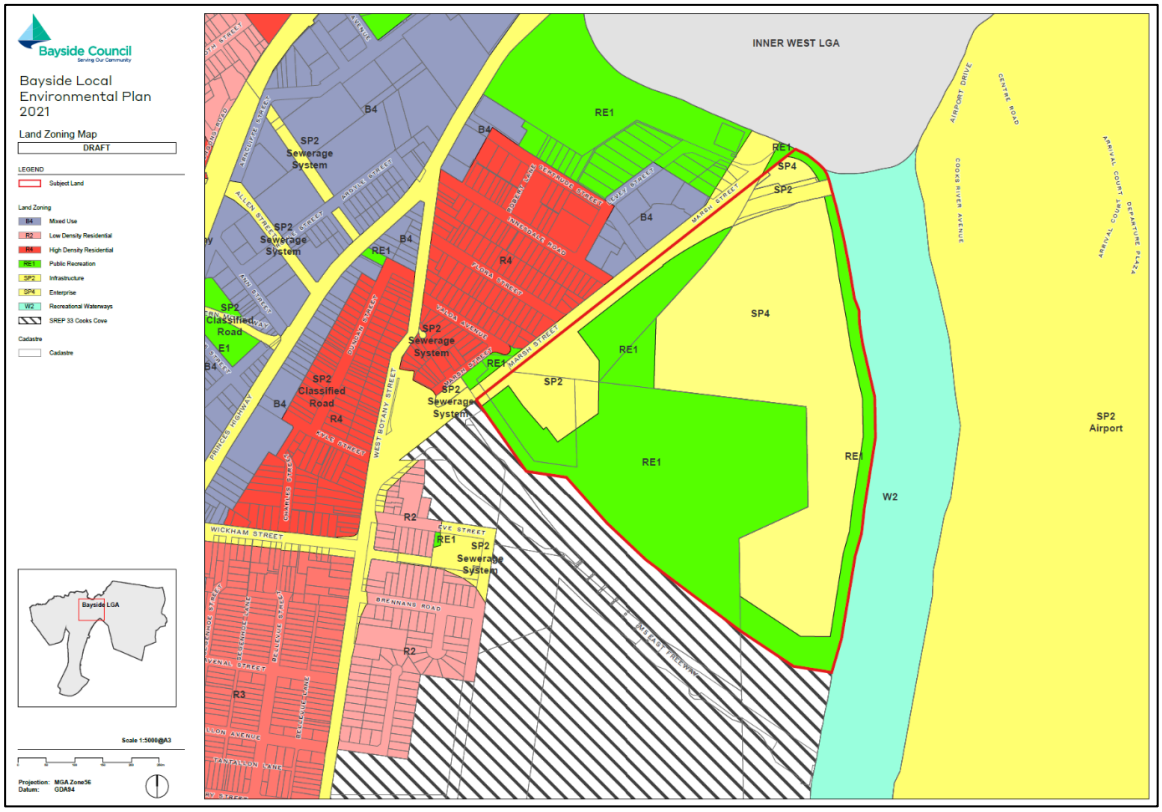


Figure 2 Draft Bayside LEP 2021 Zoning Map

Source: Ethos Urban

1.4 Site description

1.4.1 Cooks Cove

Cooks Cove is located in the suburb of Arncliffe within the Bayside Council Local Government Area (LGA). The site is located to the west of the Cooks River, approximately 10km south of the Sydney Central Business District (CBD). The site enjoys adjacency to key trade-related infrastructure being immediately west of Sydney Kingsford Smith International Airport and approx 6km west of Port Botany.

Cooks Cove is strategically located within close proximity to a number of railway stations including Banksia, Arncliffe, Wolli Creek and the International Airport Terminal, which vary in distance from the site between 700m and 1.1km. The M5 Motorway, providing regional connectivity to the Sydney Metropolitan area, runs in an east-west direction immediately to the south of the site. The M8 and M6 Motorways are, and will be, constructed in tunnels approximately 60 metres beneath the adjoining Bayside Council 'Trust' lands. The Sydney Gateway project, presently under construction to the immediate north of Cooks Cove and Sydney Airport, will substantially improve future accessibility to the St Peters interchange and the wider M4/M5 WestConnex network, via toll free connections, as well as the Domestic Airport and Port Botany.

The Cooks Cove Development Zone is located to the north of the Southern and Western Suburbs Ocean Outfall Sewer (SWSOOS), and is generally bound by the Cooks River to the east and Marsh Street to the north and west. The site is approximately 36.2ha and is owned and managed by a number of landowners, both public and private. Surrounding development includes the Sydney Airport International Terminal precinct, Mercure Sydney Airport, an area of low density dwellings presently transitioning to medium-high density residential flat buildings, recreation and open space facilities and road and airport related infrastructure.

1.4.2 Kogarah Golf Club

Kogarah Golf Club was established in 1928, with the Club occupying the land subject to the Planning Proposal boundary since 1955. At this time, the Cooks River was reconfigured to its current alignment to accommodate the expansion of Sydney Airport. The land presents a highly modified environment, with relatively flat topography, gently moulded fairways and greens, separated by strips of vegetation and man-made water bodies. The golf course clubhouse, car park and maintenance facilities are located in the northern corner of the site, adjacent the Cooks River. Access is provided via Levey Street. The members of Kogarah Golf Club will relocate from the site in May 2024 to new playing facilities.

1.4.3 Arncliffe Motorway Operations Complex

The temporary construction compound for the WestConnex M8 and M6 Stage 1 Motorway tunnelling works was originally established in June 2016. The temporary construction facility occupies approximately 7.5ha and is expected to remain until 2025. At this time the facility will reduce to 1.5ha to accommodate the permanent Arncliffe Motorway Operations Complex, located in the western corner of the site, adjacent Marsh Street. The complex will house ventilation and water treatment plant and maintenance equipment for both the M6 and M8 sub-grade motorways.

1.4.4 Easements and affectations

The Sydney Desalination Plant pipeline runs through the development zone, north-south adjacent the Cooks River. The pipe has a diameter of 1.8m and sits within an easement of 6-9m in width. From south to north the pipeline is constructed in a combination of trench and above ground with mounded cover and then transitions to micro-tunnel and typical depth of circa 11m. The Moomba to Sydney Pipeline, containing ethane gas, follows a similar general alignment north-south adjacent the Cooks River. The pipe has a nominal 225mm diameter, within an easement generally 5m wide and with the pipe located at a depth of 1.2m-2.3m.

2 Planning Context

2.1 State planning context

2.1.1 Greater Sydney Region Plan - A Metropolis of Three Cities

A Metropolis of Three Cities integrates land use, transport and infrastructure planning between the three tiers of government and across State agencies. The Cooks Cove precinct is located within the 'Eastern Harbour' city. The plan aims to facilitate development so that residents live within 30 minutes of their jobs, education and other services – aligning with the mix of uses proposed for the Cooks Cove precinct.

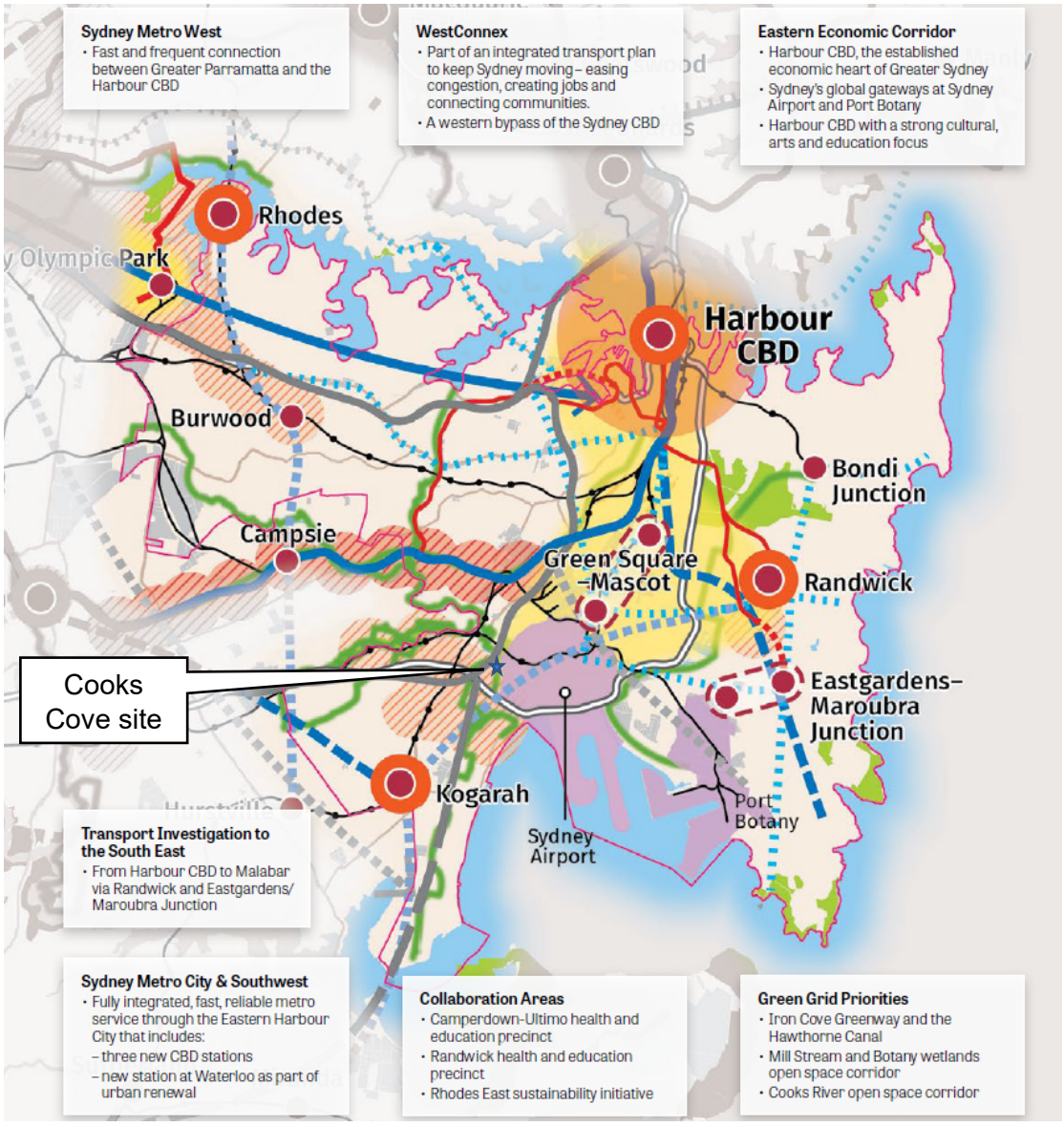


Figure 3 Eastern Harbour City vision

Source: Eastern City District Plan (Greater Sydney Commission)

2.1.2 Future Transport 2056

Future Transport 2056 is an update of NSW's Long Term Transport Master Plan. It is a suite of strategies and plans for transport developed in concert with the Greater Sydney Commission's Sydney Region Plan, Infrastructure NSW's State Infrastructure Strategy, and the Department of Planning and Environment's regional plans, to provide an integrated vision for the state.

The Services and Infrastructure Plans set the customer outcomes for Greater Sydney and regional NSW for the movement of people and freight to meet customer needs and deliver responsive, innovative services. The plans will define the network required to achieve the service outcomes.

Relevant to Cooks Cove are a number of future mass transport corridors serving the Eastern Harbour City, as shown in Figure 4 below.

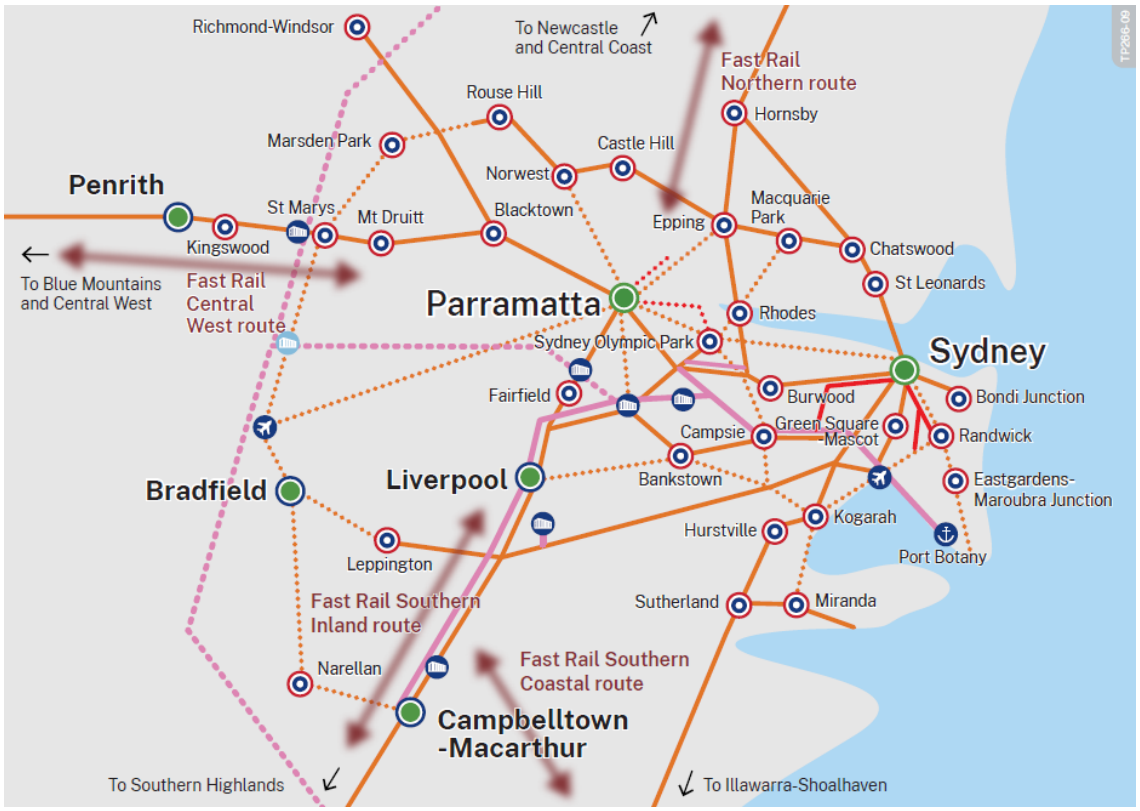


Figure 4 Existing and future passenger and freight rail network

Source: Future Transport Strategy (Transport for NSW)

2.1.3 Bayside West Precincts 2036

The main policy document guiding development in the Arncliffe and Banksia area is the Department of Planning, Industry and Environment's (DPIE) Bayside West Precincts 2036 Plan, finalised in September 2018. Cooks Cove is nominated as one of the three Bayside West Precincts.

As a result of the Bayside West Precincts Plan, Cooks Cove was identified for further investigation to determine its suitability for a mixed use high density residential community. This involved investigating the opportunities and constraint to urban renewal and the development potential of the area. The document notes that the planning for Cooks Cove is subject to assessment by Bayside Council.

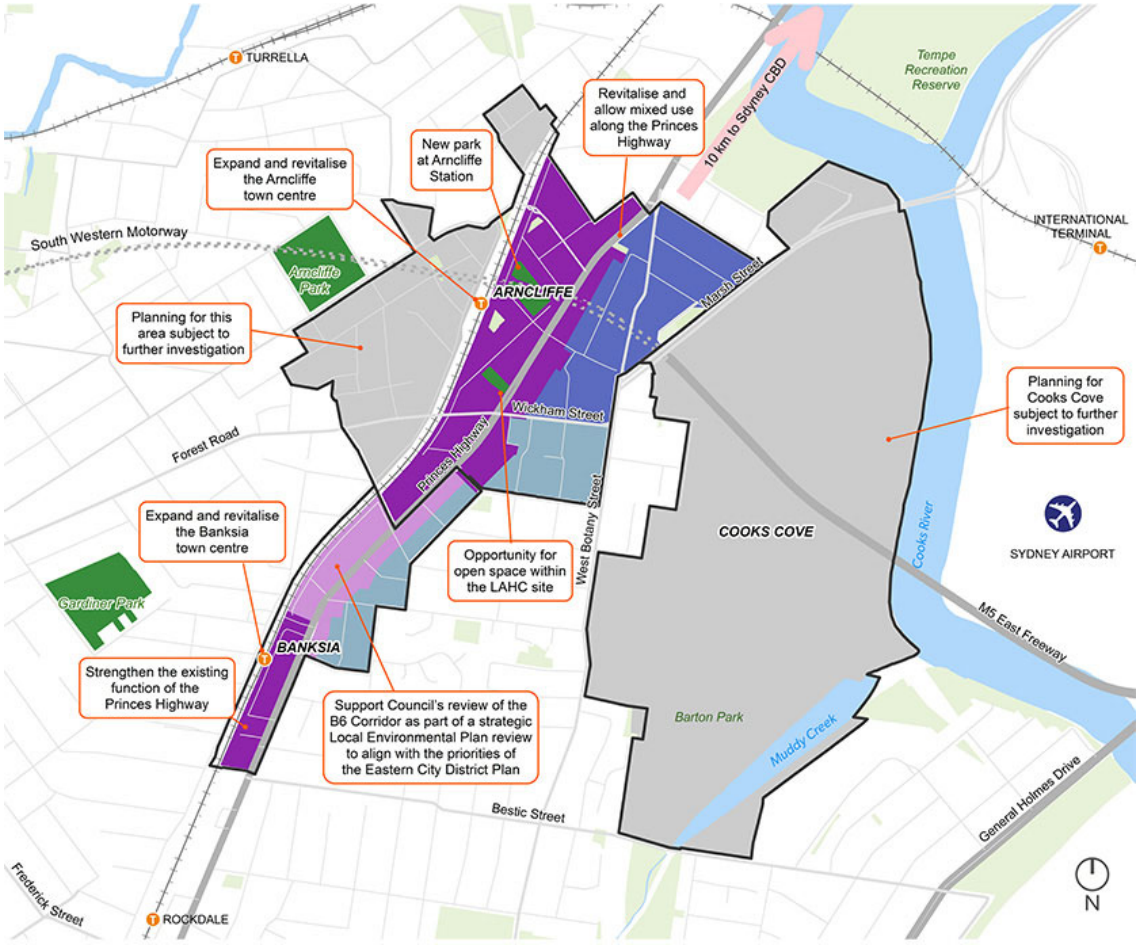


Figure 5 Bayside West precinct

2.2 Future transport infrastructure

2.2.1 Gertrude Street extension

As identified in the Rockdale DCP 2011 an extension of Gertrude Street is proposed from Levey Street (opposite Gertrude Street) to Marsh Street. The proposal would extend the existing Gertrude Street to connect to Marsh Street and would provide vehicle access into the Cooks Cove precinct.

This project critical connection is contemplated by the Minister approved SREP33 Master Plan and associated TMAP, and is consistent with the Section 9.1 Local Planning Direction - 1.12 Implementation of Planning Principles for the Cooks Cove Precinct, specifically principle (h) to "*Deliver a safe road network that balances movement and place, provides connections to the immediate and surrounding areas and is cognisant of traffic conditions in this area*". Appropriately, the 9.1 Direction map (see Figure 6) extends west of Marsh Street to encompass the Gertrude Street extension as well as Levey Street.

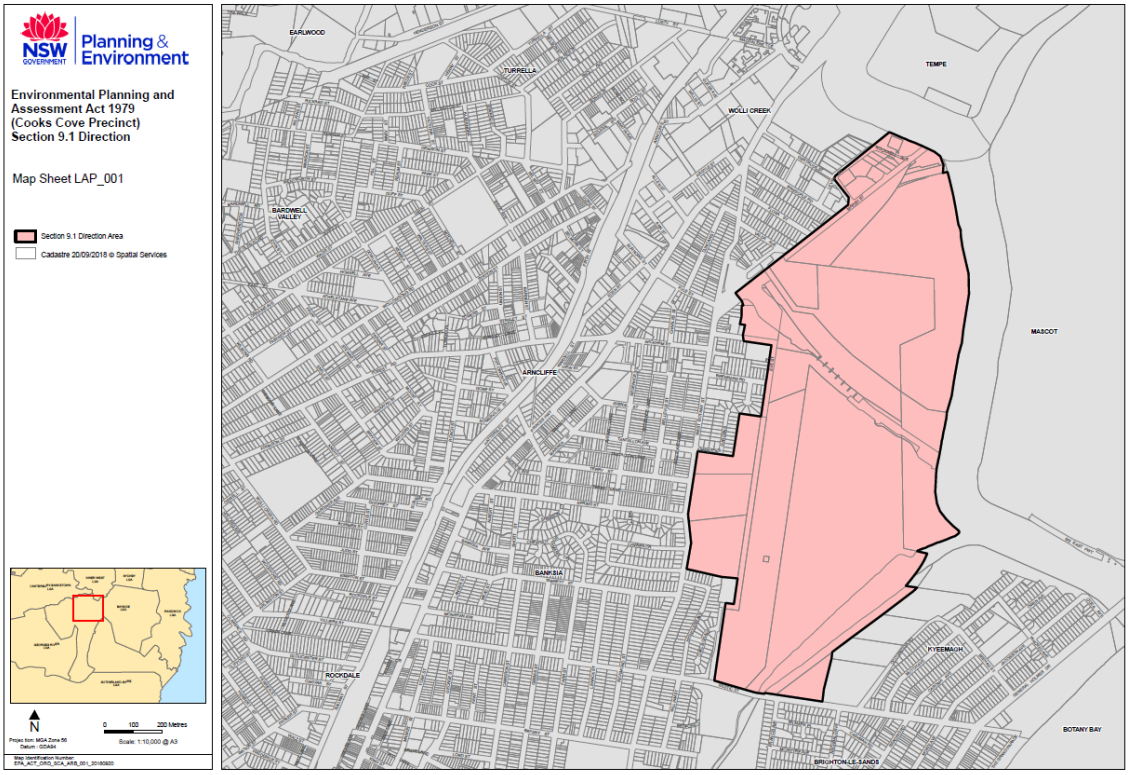


Figure 6 Section 9.1 direction map – Cooks Cove precinct

2.2.2 WestConnex

WestConnex is a 33 kilometre motorway that will extend the M4 Motorway east to the Haberfield area and south to Sydney Airport and duplicate the existing M5 East. The overall scheme will comprise a number of projects staged over a 10 year period, including:

Stage 1: M4 – Parramatta to Haberfield

Stage 2: M8 – Beverly Hills to St Peters

Stage 3: M4-M8 Link – Haberfield to St Peters.

Of particular relevance to the Cooks Cove precinct is the introduction of 9km twin tunnel between the existing M5 east at King Georges Road and the St Peters Interchange. The project, which opened to traffic in 2020, also includes an upgraded interchange at King Georges Road which complements the recently completed widening works on the M5 between Camden Valley Way and King Georges Road.

2.2.3 Sydney Metro City & Southwest

The Sydney Metro City & Southwest project will extend metro rail under Sydney Harbour, through the central business district (CBD) of Sydney and south west to Bankstown, with capacity to run up to 30 trains per hour in each direction through the city on the new line. Sydenham is the closest metro station to Cooks Cove on the Sydney Metro City and Southwest line.

The Project represents a major increase in the capacity of Sydney's rail network, providing a 60 per cent increase in the number of trains in the peak periods and catering for an extra 100,000 customers per hour. The project will significantly improve reliability across the rail network by addressing current and emerging constraints such as train crowding, platform and station crowding.

2.2.4 Sydney Gateway project

The Sydney Gateway project provides for improved capacity and accessibility between Sydney Airport (both Domestic and International) and the Sydney motorway network via the St Peters interchange. By 2036, the project would provide capacity for an additional 60,000 vehicles per day.

Key features of the project include:

- New road links between Sydney Airport's terminals and the Sydney motorway network at St Peters interchange
- New road links to Sydney Airport land
- An active transport link to maintain cycle and pedestrian connections between Tempe, Sydney Airport, the Sydney central business district and Mascot
- Other road operational infrastructure

The project will benefit future Cooks Cove users by reducing traffic flows on surface roads in the vicinity of the site such as on the Princes Highway and provide a convenient connection to and from the motorway network. The transport impact assessment supporting the EIS for the Sydney Gateway project indicates that Marsh Street would carry 67,000 vehicles per day with the Sydney Gateway (and other committed motorway projects) by 2036, a very small increase compared to the 66,000 vehicles per day in a scenario without the project.

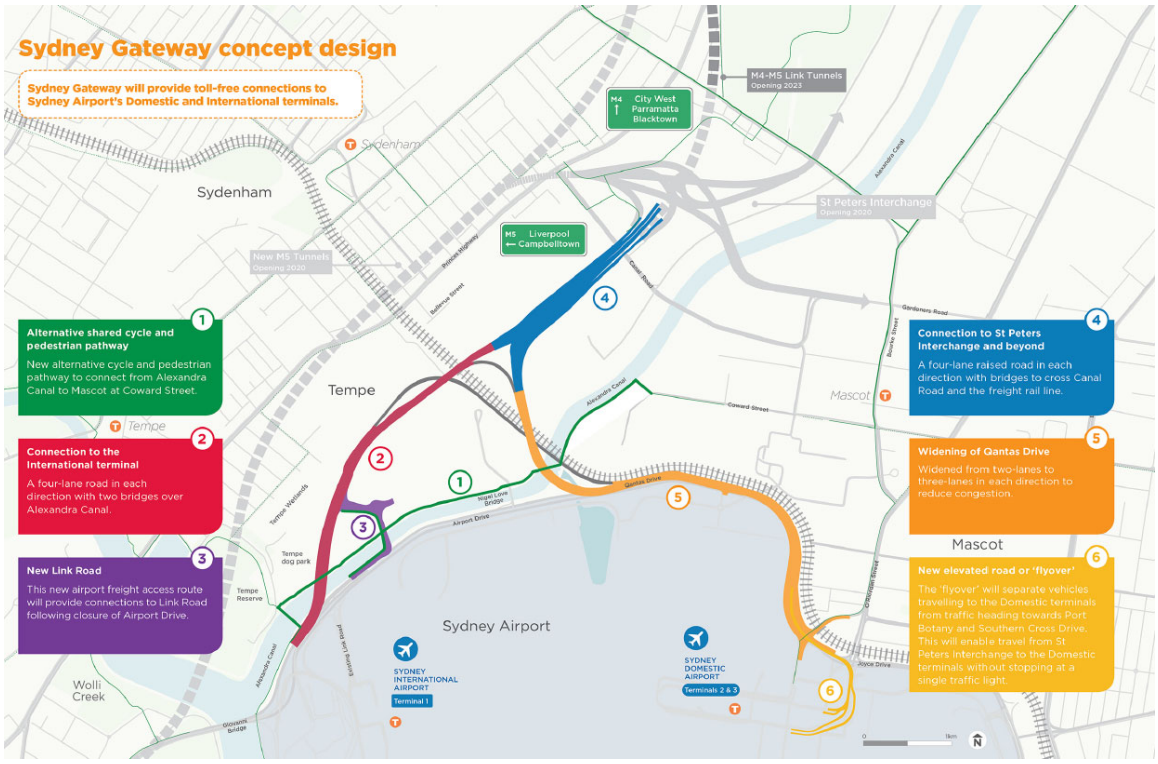


Figure 7 Sydney Gateway project

Source: Transport for NSW

2.2.5 M6 (F6) Motorway

The M6 Motorway (previously F6 Extension) program of works is an approved and committed NSW Government project involving a multi-lane road link that aims to provide better connectivity to Sydney's south. Stage 1 comprises an approximately four-kilometre multi-lane underground road link between the New M5 Motorway and a surface intersection at President Avenue, Kogarah.

The M6 project will provide significant benefits to future users of Cooks Cove by removing traffic from key surface roads such as the Princes Highway and West Botany Street.

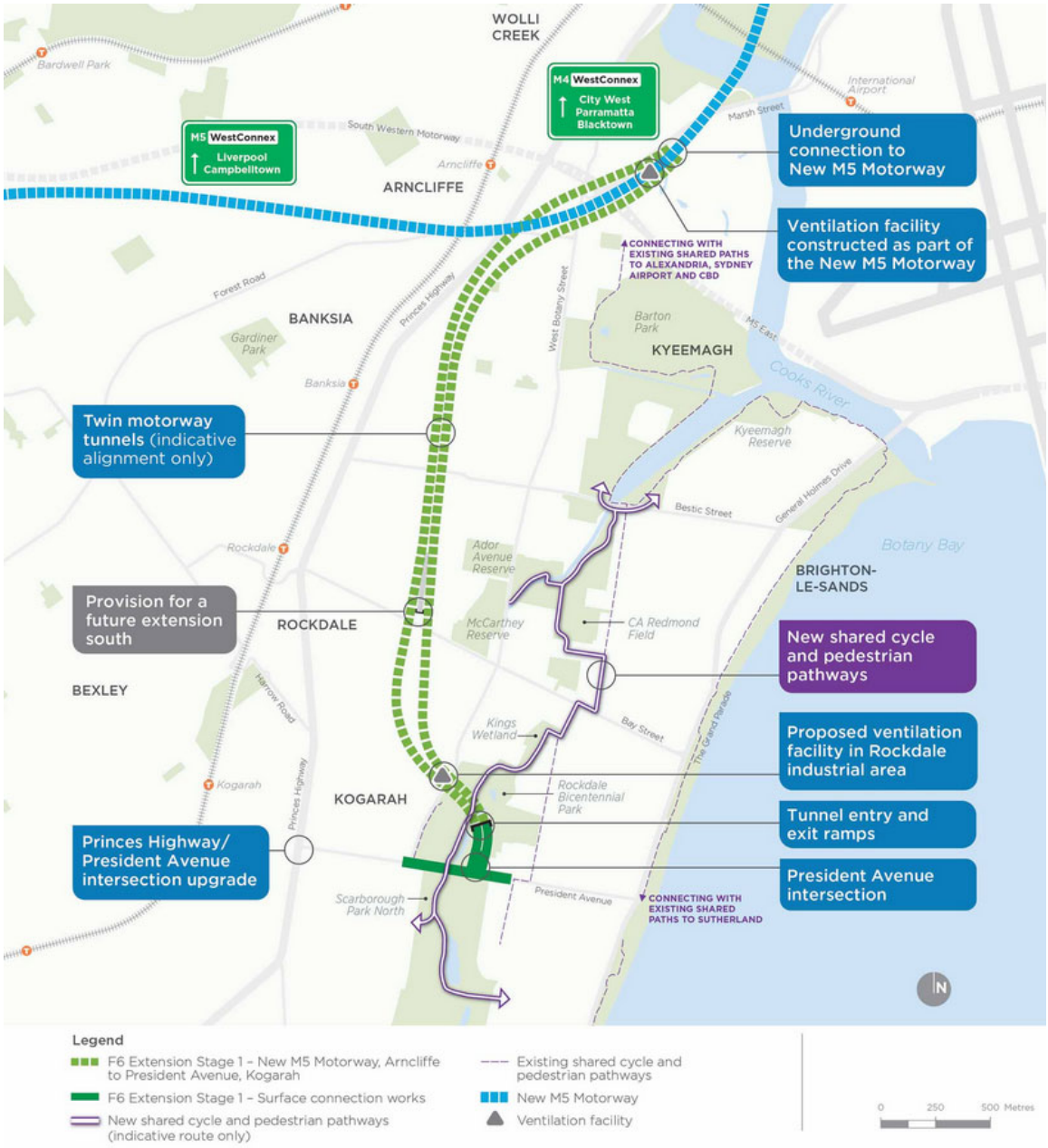


Figure 8 M6 Motorway project

Source: Transport for NSW

2.2.6 More Trains, More Services program

The NSW Government is implementing the 'More Trains, More Services' program to increase the capacity of Sydney's train network. The delivery of Sydney Metro City & Southwest creates the opportunity to address future needs on the existing heavy rail network, in particularly the T4 Illawarra Line and T8 Airport Line.

Utilising new technologies, the next stage of the 'More Trains, More Services' program will deliver an increase in the frequency of services as follows:

- A 30% increase in the number of peak hour services on the T4 line to 24 trains per hour; and
- A 60% increase in the number of peak hour services on the T8 line to 20 trains per hour

This program will significantly enhance public transport capacity and availability for future users of the Cooks Cove precinct.

3 Existing Conditions

3.1 Road network and access

Access to and from the site is currently via one entrance found on the north-east corner of the Kogarah Golf Club known as Levey Street. The driveway passes under the Giovanni Brunetti Bridge and continues to Marsh Street. Access to the site can also be obtained via the Marsh Street / Flora Street signalised intersections which is currently used for construction vehicles associated with the M6 Stage 1 Extension as well as vehicles accessing the Arncliffe Motorway Operations Complex (AMOC).

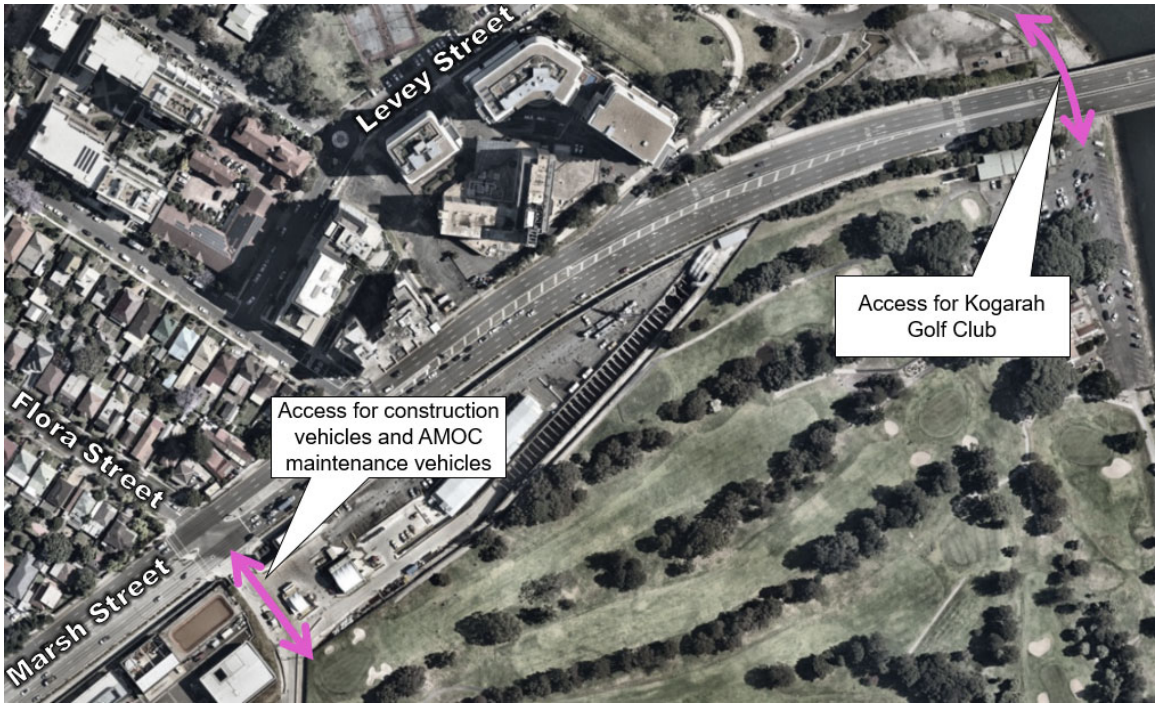


Figure 9 Existing access to and from site

Figure 10 Existing Kogarah Golf Club access

3.2 Traffic volumes

To understand the level of existing traffic flows in the area around Cooks Cove, 24-hour SCATS detector information was provided by Transport for NSW. The detector counts were dated Tuesday 10 May 2022 and provided turning movement counts for the twelve signalised intersections in the vicinity of the site, as illustrated in Figure 11.

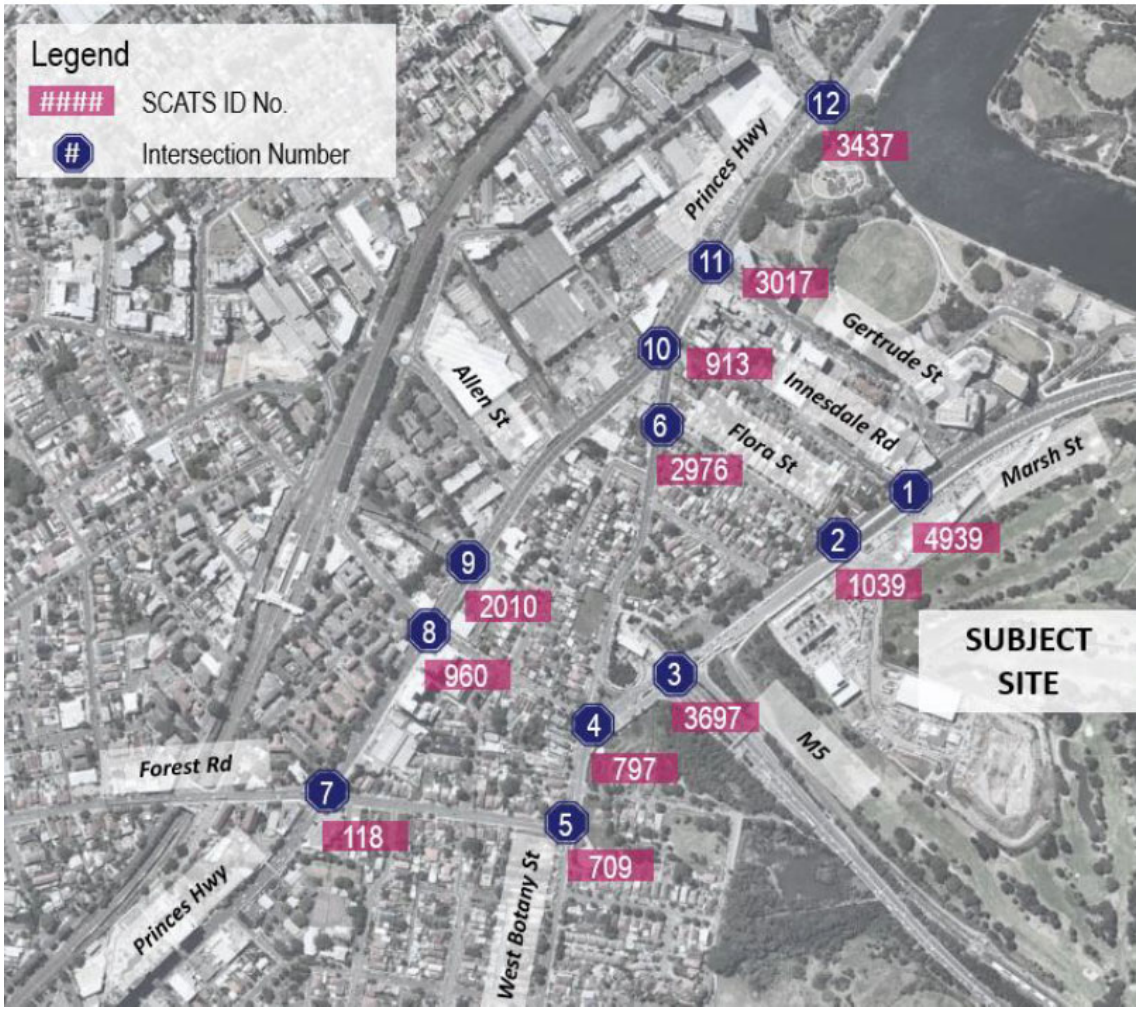


Figure 11 Traffic count locations

3.3 Traffic conditions

A detailed description of existing traffic conditions in the area surrounding the site is provided in the base year traffic modelling report, provided as Appendix A of this document.

As assessment of existing traffic conditions for this assessment was undertaken using available survey data, aerial images, and maps for the existing network conditions. Figure 12 and Figure 13 show the typical traffic conditions during the morning and afternoon peak hours respectively - highlighting areas of congestion along Princes Highway, the M5 East freeway, and Marsh Street. Observations also highlighted the use of Flora Street, Innesdale Road and Gertrude Street as available short cuts or “rat runs” for vehicles travelling between Princes Highway and Marsh Street.

Figure 14 on the following page indicates the existing performance of key intersections surrounding the site based on traffic data collected in 2022 and detailed extensively in the base year traffic modelling report. The analysis indicates that these key intersections generally operate well and with spare capacity during both weekday commuter peak hours.

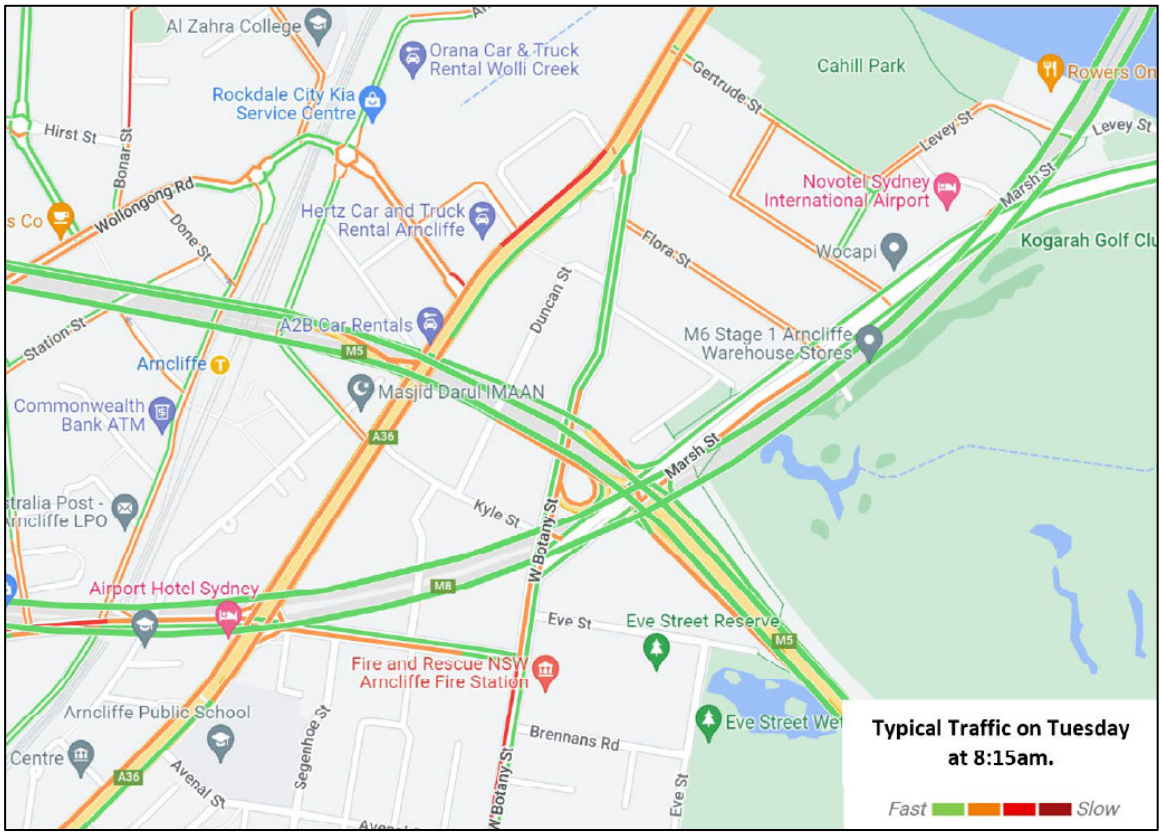


Figure 12 Typical traffic conditions – AM peak hour

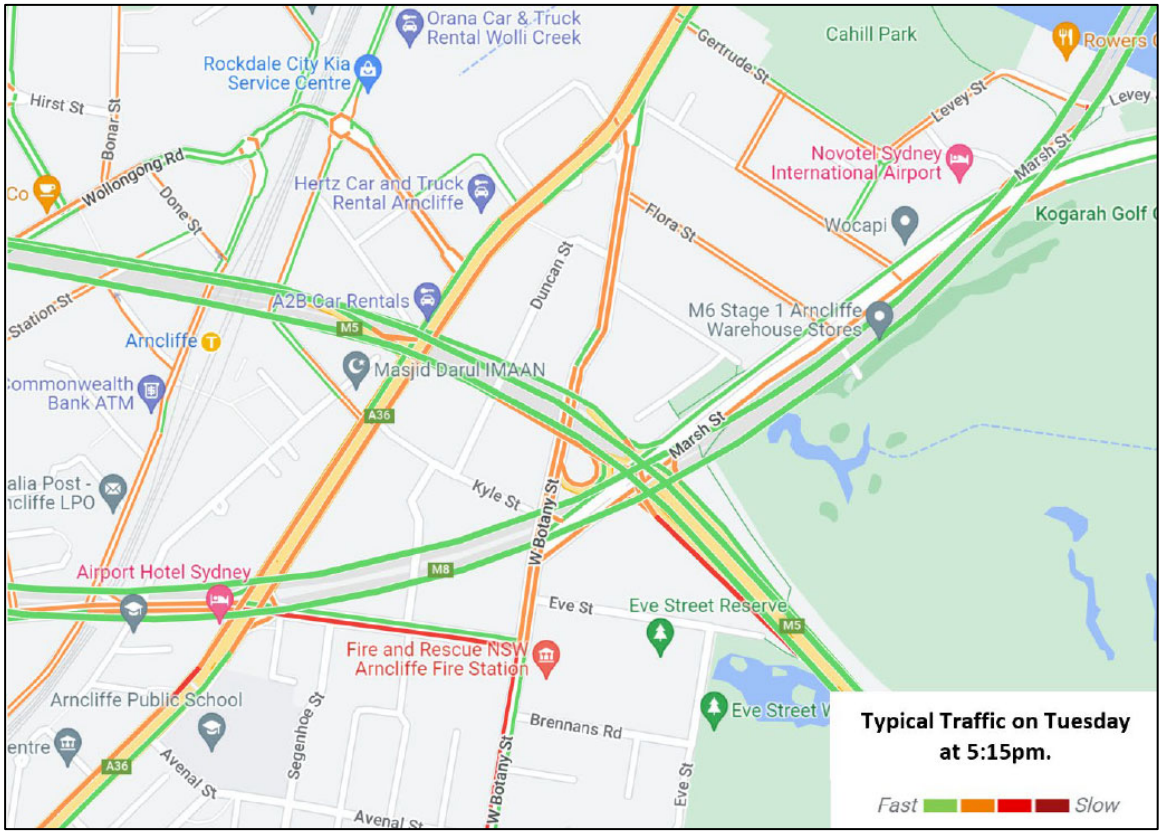


Figure 13 Typical traffic conditions – PM peak hour

Figure 14 Existing intersection level of service

3.4 Public transport

3.4.1 Bus

Rail in Sydney's south plays a critical role in moving people, and as such the bus network is usually designed to support access to rail, provide local access in areas not served by rail and provide cross-regional connections.

The site is located close to three bus lines; the 348, 420 and 422 route as shown in Figure 15. The site is adjacent to a key strategic bus corridor Miranda to Bondi Junction via the Airport (420 bus route) as identified in the TfNSW's 'Sydney's Bus Future's' document.

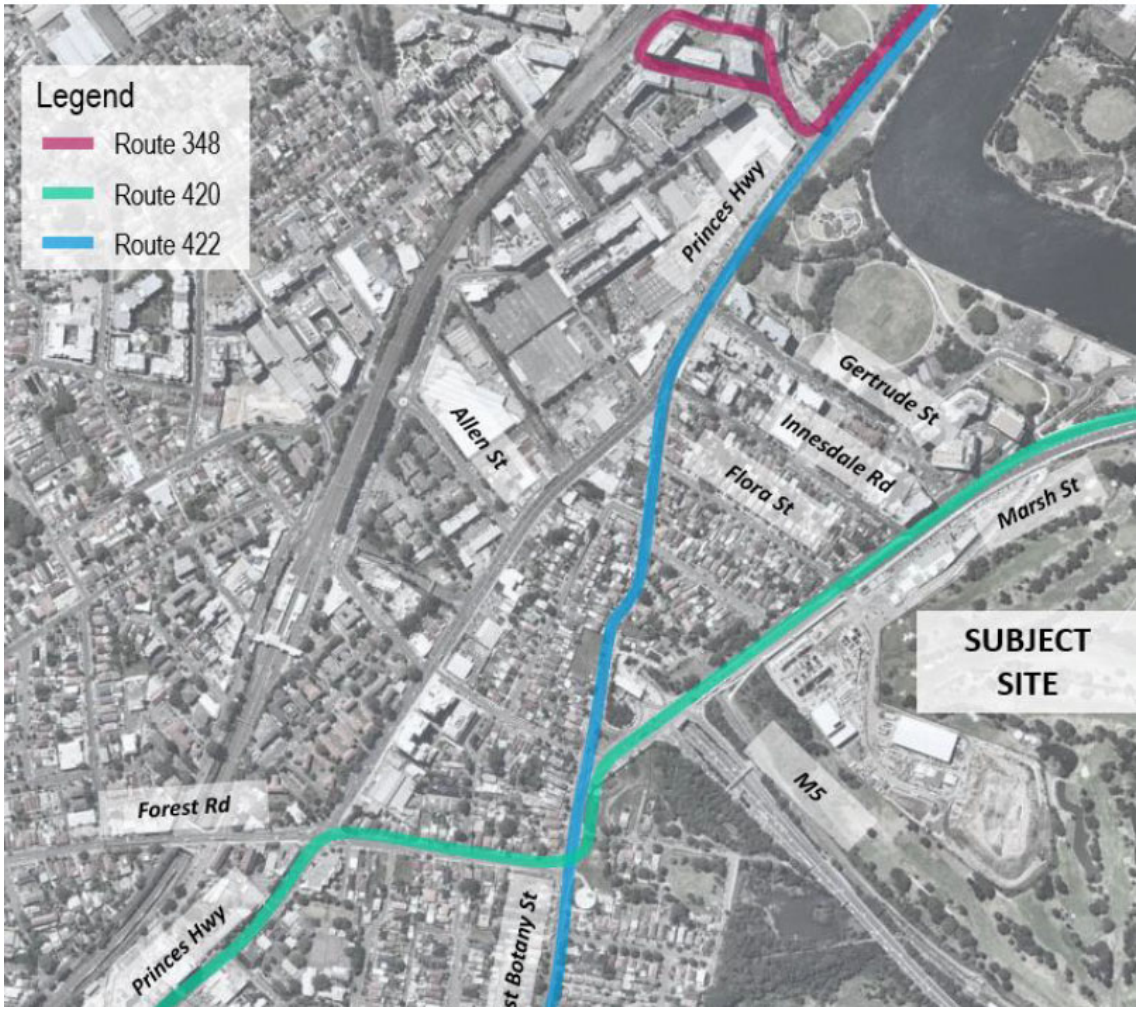


Figure 15 Existing bus routes

3.4.2 Rail

The northernmost edge of the Cooks Cove site is approximately an 800m walk from Wolli Creek train station along the Cooks River foreshore and the westernmost edge of the site is around 1.1km walk from Arncliffe station.

Wolli Creek is serviced by the T8 South / Airport and T4 Eastern Suburbs / Illawarra lines (see Figure 16). The T8 line provides access to the Airport, Green Square, Mascot and suburbs in the southwest of Sydney. The T4 Line connects the Sydney CBD and the South Coast via key centres including Bondi Junction, Rockdale, Kogarah, Hurstville and Sutherland.

The T8 Line provides access between the South West and Sydney CBD via Airport. The nearest station to the east of Cooks Cove is the International Terminal along the T8 Line, currently 1.2km walk away from the site. However, ridership of this line is currently hindered by a station access fee and current pedestrian access from the Cooks Cove investigation area is restricted by the river.

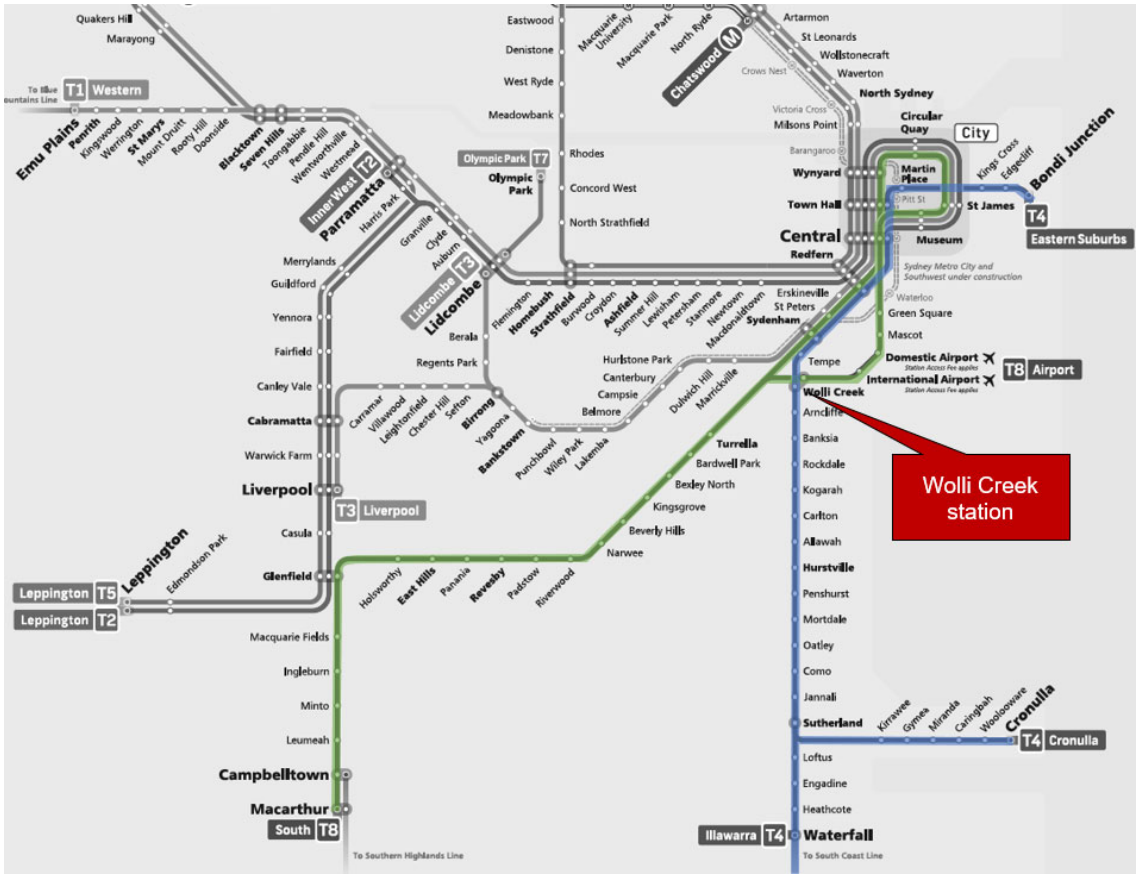


Figure 16 Train lines serving Wolli Creek Station

3.5 Walking and cycling

Existing cycling infrastructure in the area surrounding the site is shown in Figure 17 below. There are many off-road cycle paths in the area that link Botany Bay to Homebush Bay, although the routes the paths take tend to be not very direct and so are presently used more for recreational purposes than for transport. There is presently a missing link between the shared path on the northern side of the Giovanni Brunnetti Bridge and the newly constructed shared path on the southern side of Marsh Street, which connects with the path through to Barton Park.

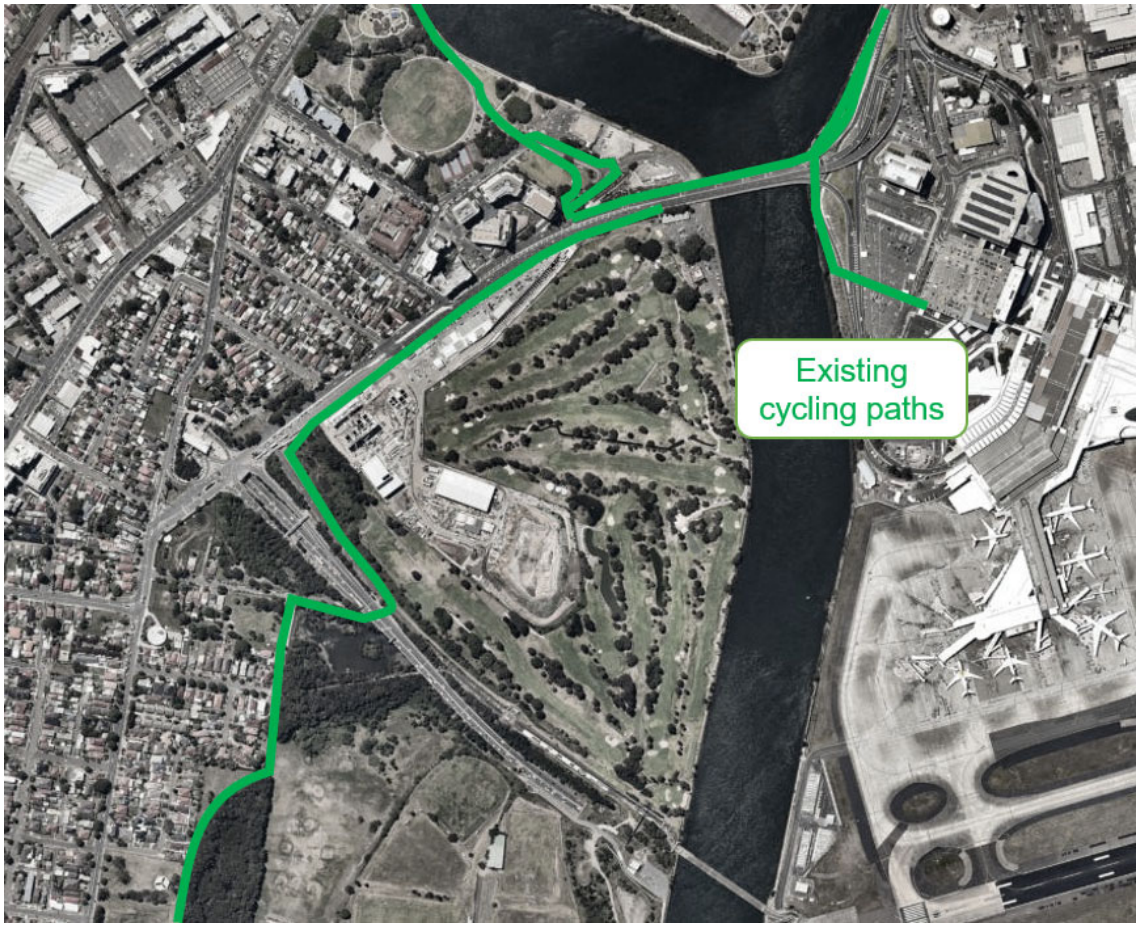


Figure 17 Existing cycling infrastructure

4 Transport Access Strategy

4.1 Vehicle site access

Vehicular access into the site is proposed at three locations as indicated in Figure 18. These access points are as follows:

- **Levey Street:** The existing Levey Street under the Giovanni Brunetti Bridge will be retained for access into the precinct. Although a clearance height limit of 3.1m currently exists under the Giovanni Brunetti Bridge, Levey Street can still accommodate passenger vehicles and small to medium size service vehicles.
- **Gertrude Street**: A new signalised (four way) intersection is proposed at Marsh Street / Gertrude Street which will form the primary access point into the site. The Gertrude Street extension is identified as a forward planning work in Council's Urban Renewal Area Contribution Plan 2019. With the signalisation of the Gertrude Street intersection, the Marsh Street / Innesdale Road intersection will revert to a left in – left out arrangement – consistent with previous discussions with TfNSW.
- **Flora Street:** The existing signalised intersection at Marsh Street / Flora Street will be utilised to provide access into the site as well as the Arncliffe MOC. The intersection layout does not provide for right turns from Marsh Street into the Cooks Cove site – consistent with advice provided by TfNSW.

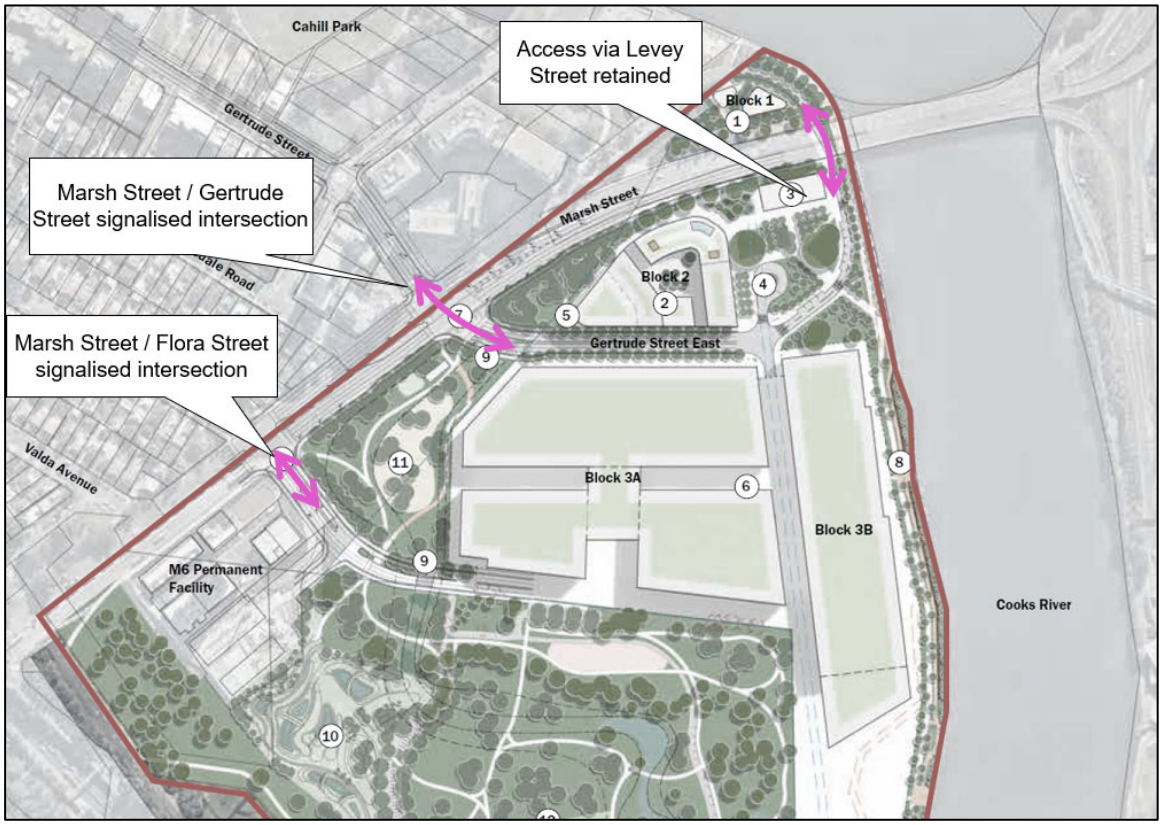


Figure 18 Proposed vehicle access

The location of the site access points on Marsh Street are generally consistent with those proposed by the SREP33 Transport Management Access Plan, which was endorsed by Rockdale Council pursuant to a SREP 33 Stage 1 Master Plan development consent.

Arup have developed designs for the future Marsh Street intersections to confirm these intersections can be constructed entirely within the road reserve or within the Trust lands on site – with no reliance on third party lands. These intersection designs have been incorporated within the detailed traffic modelling and are illustrated in the figures below. A detailed package of design drawings prepared by Arup, including these intersections, are provided separately as part of the Planning Proposal submission.

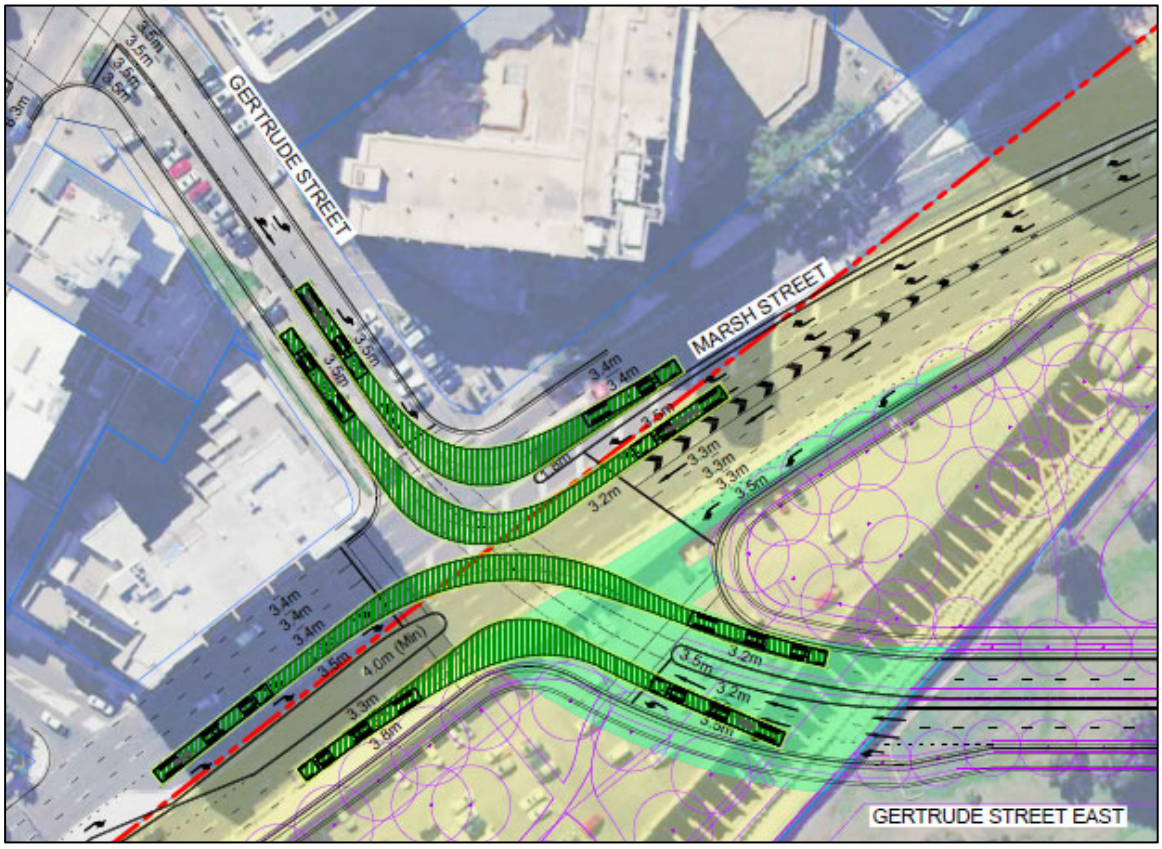


Figure 19 Intersection design – Marsh Street / Gertrude Street

Source: Arup

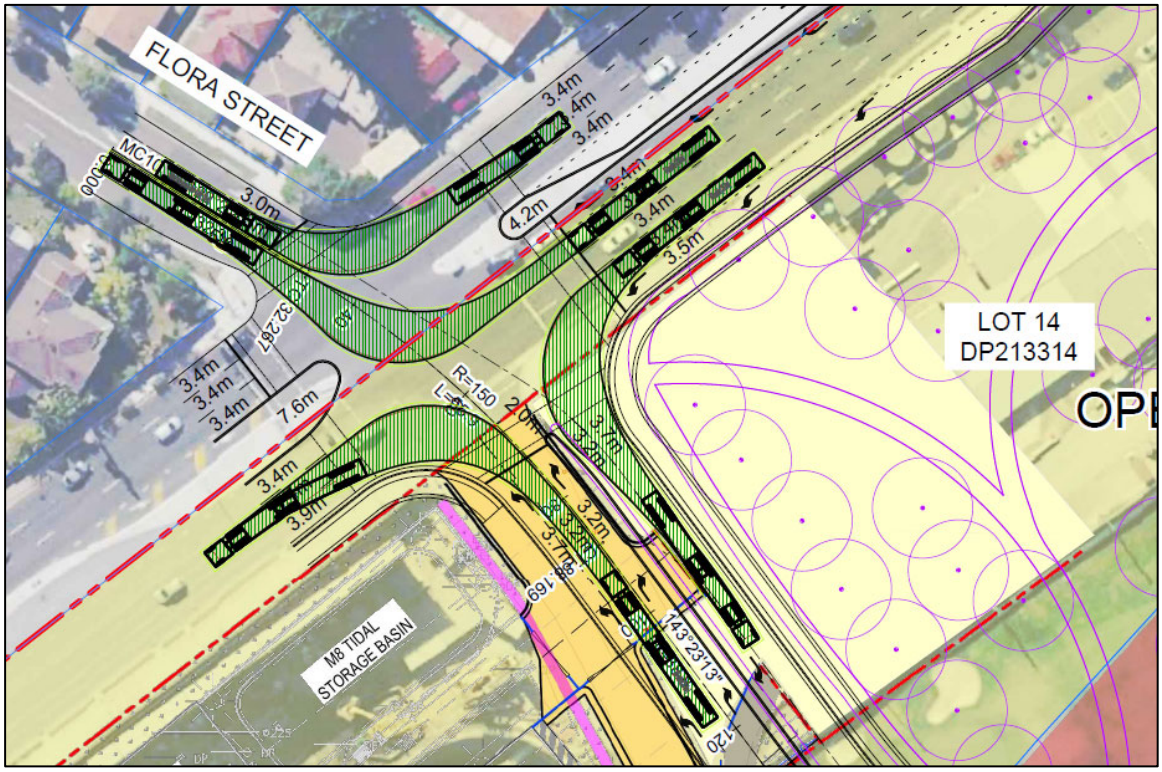


Figure 20 Intersection design – Marsh Street / Flora Street

Source: Arup

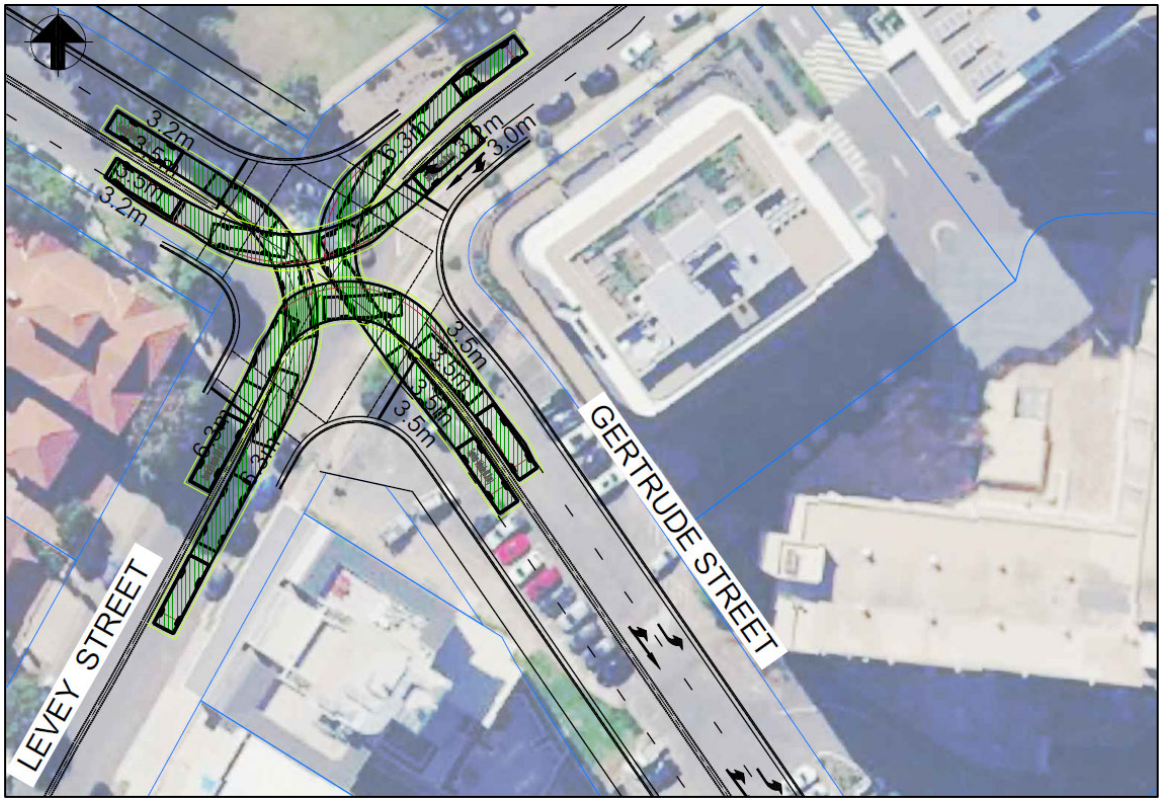


Figure 21 Intersection design – Gertrude Street / Levey Street

Source: Arup

4.2 Internal vehicle circulation

The internal street network provides sufficient flexibility and capacity to accommodate the traffic generated by the entire Cooks Cove precinct, including all vehicle movements including service/loading vehicles. Sufficient width is provided at intersections for vehicle manoeuvring including space for up to 19m articulated vehicles. Appropriate travel lane widths are provided within the site to accommodate the movement of light and heavy vehicles to accommodate a safe, efficient and legible road network.

The southernmost street 'Flora Street East' also provides access to the M8/M6 permanent facility. A turning bay is provided mid-way along Flora Street to enabling turning into the M6/M8 facility and prevent queuing onto Marsh Street. Subject to future negotiation with Council, the road can also provide access to parking areas associated with the future public open space on Lot 1 DP 108492.

Transport for NSW has been consulted extensively in relation to vehicle access into Flora Street East. Correspondence was received on 6 July 2022 from TfNSW confirming "*The developer's proposed access alignment presented in the meeting of the 30th of May 22 and documented in the Arup Mc01 Site Access Layout is satisfactory*". Further details of the proposed arrangements at this location are detailed in the Arup design drawings submitted with this Planning Proposal.

The extension of Gertrude Street into the site and connection with Levey Street (known as 'Gertrude Street East') is expected to be a public street with 24hrs access and designed to the relevant road design standards. The final design and configuration will be determined at DA stage.

The location, design and tenure of all internal roads will be resolved during the DA process and will be largely dictated by future tenant demand requirements. The details of the internal, private road circulation will be resolved at DA stage however a road connection will be provided between Flora Street and Gertrude Street East. At this stage the proposed road location is envisaged along the north-south alignment of the Sydney Desalination Pipeline easement. The road, at a minimum, would be of sufficient width to accommodate the movement of traffic in both directions and designed in accordance with relevant standards.

Whatever the final arrangements are, appropriate rights of way or other legal mechanisms to permit access for WestConnex, utility managers, M6/M8 operator and Bayside Council will be put in place to allow access to, and maintenance of, their relevant facilities.

4.3 Off-street car parking

Off-street parking will be provided in basement and podium level car parks within the development zone in accordance with the relevant Council DCP applicable at the time of development. The exception to this is the commercial office

component of the site which will provide for maximum car parking rates of one space per 80sqm GFA. This maximum rate is to be reinforced in the site specific DCP as well as any other relevant planning instruments (site-specific LEP clause). The site's proximity to Wolli Creek train station and future pedestrian connections make this rate of car parking suitable for the site and will limit the traffic generation associated with the commercial uses.

The reference scheme prepared for the Planning Proposal has considered the following car parking rates as summarised in Table 1.

Table 1 Car parking rates

Use	Car parking rate
Warehouse / Logistics	1 space per 300m^2 GFA plus 1 space per 80m^2 ancillary office
Hotel	1 space per 4 rooms 1 taxi pick-up and set-down space / 100 rooms 2 coach pick-up and set-down spaces
Commercial	1 space per 80m^2 GFA*
Retail	1 space per 40m^2 GFA

* Maximum rate to be reinforced in the site specific DCP as well as any other relevant planning instruments (site-specific LEP clause).

It should be noted that further investigations will need to be undertaken at subsequent stages to confirm the final parking number and layout. The final car parking requirements and provision for the site will be confirmed at the Development Application (DA) stage of the project.

4.4 On-street car parking

The majority of streets within the precinct will provide opportunities for on-street visitor parking. Due to the proximity of the precinct to Sydney Airport, time limited parking is proposed to prevent all day parking in the precinct. A mix of 1, 2 and 4 hour time limited parking would be appropriate, depending on the location with respect to different uses. For example on-street parking in the retail precinct would be limited to either 1-2 hours to encourage a higher turnover of spaces. On-street areas could potentially be used to accommodate car share spaces, drop off / pick up areas and bus zones.

4.5 Public transport measures

Cooks Cove is located within approximately 700m to 1.1km of three railway stations, being Arncliffe, Wolli Creek and Sydney International Airport. These train stations are serviced by the T8 Airport and South Line and the T4 Eastern Suburbs and Illawarra Line. Both lines operate for 20 hours per day and both have operational capacity for 18 trains per hour in each direction. The rail network provides access between Sydney CBD, southwest Sydney, the south coast and key centres including Bondi Junction, Kogarah and Rockdale.

The site is located in proximity to three existing bus routes: the 420 422, and 348. The 420 services part of the strategic bus corridor from Bondi Junction to Rockdale via the Airport and then on to Burwood. The 422 currently runs down the Princes Highway and West Botany Street connecting with Kogarah, Newtown and the Sydney CBD, while the 348 originates adjacent to Wolli Creek Rail Station, providing services to the growing Green Square area.

The Bayside West Precinct 2036 Plan identifies P1 “New bus stops on Marsh Street” “to accommodate access from Cooks Cove to the bus network” as a desired regional infrastructure upgrade to be delivered by the Cooks Cove developer & TfNSW/Council. This recommendation was made to DPE by AECOM 2016.

In relation to bus services for Cooks Cove, provision of a bus bay and shelter on the eastern side of Marsh Street can be provided to serve southbound route 420 (serving Bondi Junction, Rockdale, Burwood) and route 422 (Sydney CBD, Newtown, Kogarah). The Cooks Cove project can facilitate the delivery of a bus bay and shelter on the eastern side of Marsh Street. Contributions will be provided for the delivery of a bus stop on the western side of Marsh Street. A bus bay on the western side of Marsh Street can not be delivered as part of the Cooks Cove project given delivery of this infrastructure would require third party land acquisition which is outside of the control of Cook Cove Inlet Pty Ltd. It is anticipated this bus bay would be delivered as part of any relevant future development in the Bayside West precinct.

The design of the internal street network will offer the opportunity for shuttle bus services to operate within the Cooks Cove site, with a minimum 13m wide carriageway to be provided. On-street bus zones could be provided to accommodate shuttle services to/from Wolli Creek station or other suitable public transport nodes.

4.6 Active transport measures

The following pedestrian and cycling initiatives will be provided as part of the Planning Proposal. This infrastructure will significantly improve connections from the site to surrounding train stations, public transport and services - reducing travel times, improving safety and providing more direct paths of travel.

- A regional separated pedestrian and cycle path, located parallel to the Cooks River. The proposal will deliver a missing 900m long x 20 m wide landscaped waterfront contribution to the 'bay to bay' regional active transport link along the western bank of the Cooks River, incorporating pedestrian, cycling and passive recreation infrastructure. This improvement for pedestrians and cyclists is identified as a desired regional infrastructure upgrade by the Bayside West Precinct 2036 Plan. This foreshore path will provide connectivity to the broader active transport network as illustrated in Figure 22.

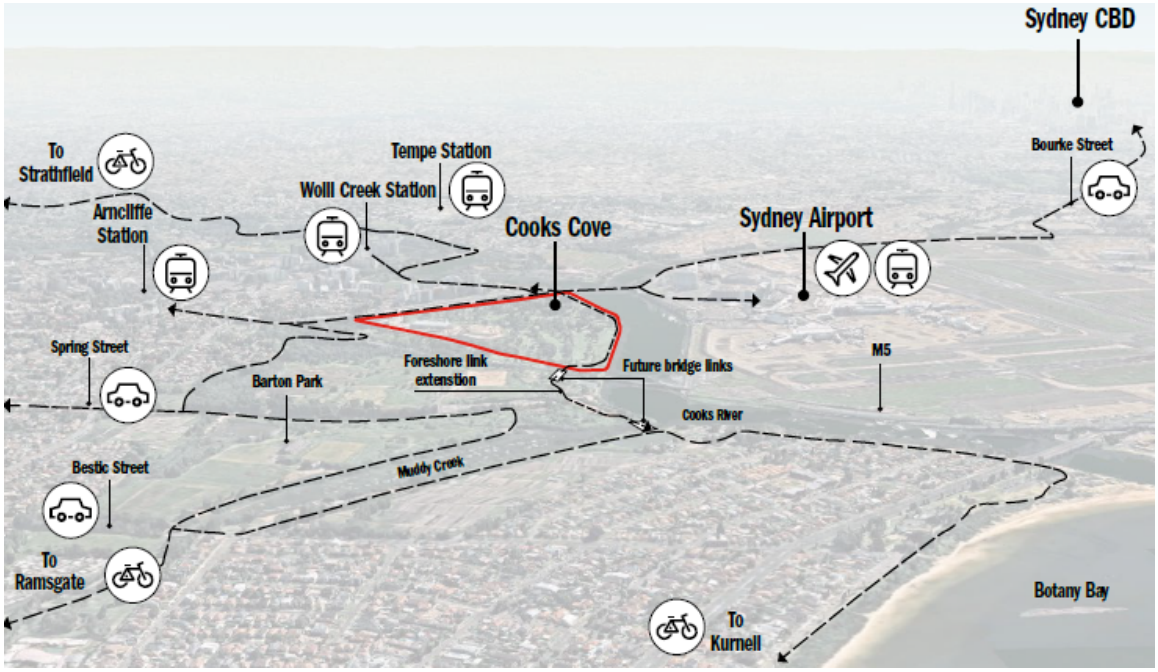


Figure 22 Regional cycling connections

- A $4m contribution to an enhanced pedestrian/cyclist connection on the southern side of the Giovanni Brunetti Bridge, which will connect to the recently completed pedestrian bridge at Sydney Airport to facilitate a direct connection into the International Airport railway station.
- Connection to and embellishment of the new shared path along the length of Marsh Street, constructed as part of recent road widening upgrades;
- New pedestrian footpaths on Gertrude Street (between Marsh Street and Levey Street) as part of the Gertrude Street extension project;
- Bicycle parking and end of trip facilities within future buildings, as well as bicycle infrastructure within the public domain, provided in accordance with relevant Bayside Council controls. Bicycle parking facilities are to be distributed throughout the site to ensure it is convenient to use regardless of the ultimate destination within the site; and
- New pedestrian crossing opportunities across Marsh Street and Levey Street associated with the proposed new and upgraded signalised intersections, including (also refer to Figure 23):
    - New pedestrian crossing on the eastern side of the existing Marsh Street / Flora Street intersection
    - New pedestrian crossing on the western side of the future Marsh Street / Gertrude Street intersection
    - New pedestrian crossings on all approaches of the future Levey Street / Gertrude Street intersection

Figure 23 Pedestrian crossing opportunities

These improved pedestrian connections will be supplemented by the new Gertrude Street East extension providing new connectivity between Levey Street to a foreshore recreation precinct, to the Marsh Street (east) existing cycleway, and a new pedestrian and cycleway network within Pemulwuy Park (Marsh Street Parklands). This new pedestrian and cycling network will be in part facilitated by freehold land dedications for public recreation, that will substantially improve east-west connectivity, and create the opportunity for further walking and cycling connections to Kyeemagh and beyond (subject to the assistance and co-operation of adjoining landowners and stakeholders Sydney Water, Bayside Council and the Commonwealth).

4.7 Green travel plan

Devising a travel demand management plan is an important part of reducing car usage in the new precinct and increasing the sustainability of the development as a whole.

Transport for NSW has recently created a Travel Choices team to help develop travel action plans for businesses. As part of this program, the framework proposes to assess travel demand management is a series of four 'R's. These are remode, retime, reroute and reduce as shown in Figure 24.

Figure 24 The four components of travel demand management

The areas that are able to be addressed as part of the planning proposal stage are ‘remode’ and ‘reduce’. Remoding is about reducing the share of private vehicle trips used for work and every day travel and increasing the share of public transport, walking and cycling. This can be done by making driving less attractive (for example by implementing a managed parking scheme) or by increasing the attractiveness of alternative modes. ‘Reducing’ is about reducing the need for travel by co-locating land uses or other strategies.

This report recommends infrastructure improvements to make public transport, walking and cycling easy and convenient for people travelling to and from the site. The number of additional pedestrian and cycling connections (both internal and external to the site) is a good example of this. In addition, the following sections outline some strategies to further promote alternative modes and reduce the number of car trips generated by the precinct.

4.7.1 Car pooling

Car pooling is an effective means of reducing travel and parking demand by increasing the number of car journeys containing more than one occupant. Car pooling however is generally only effective when incentives are provided to staff that do car pool. Businesses on the site could encourage their staff to car pool as a means of travelling to work at Cooks Cove by:

- Holding a staff event and providing information around the option of car pooling, including the opportunity for staff members to ‘pair up’ based on their home location and travel preferences (as part of an annual travel morning tea information session); and
- Providing incentives for those that car pool, e.g. priority parking within the site or coffee / lunch vouchers

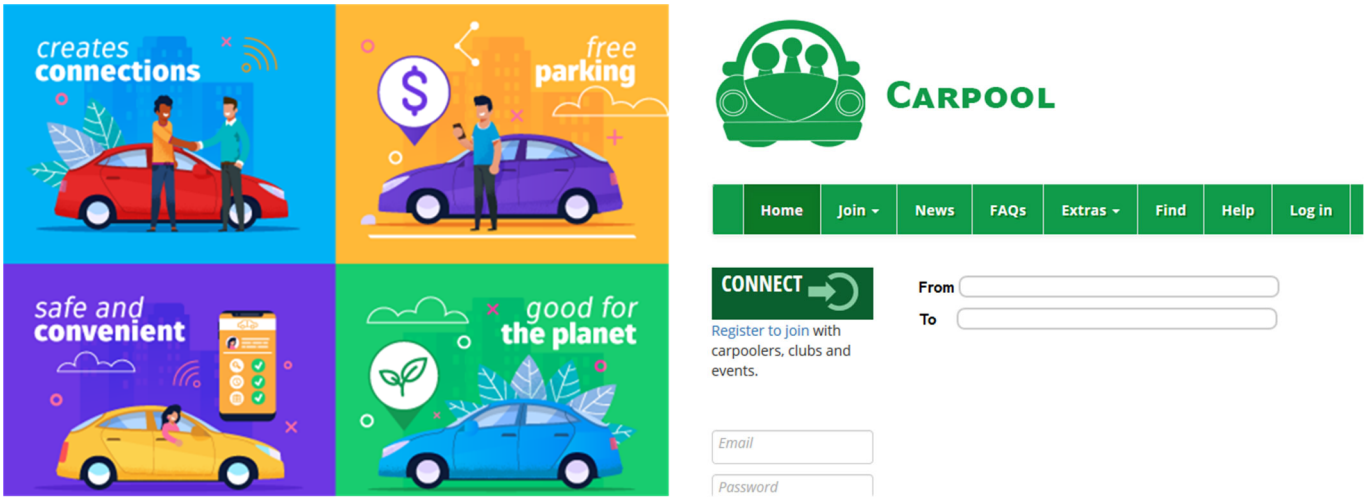


Figure 25 Existing car pooling websites

4.7.2 Car Sharing

Car sharing is a proven means of reducing the number of car journeys generated by a development. Studies on the effectiveness of car sharing schemes shows that every car share space can replace the need for up to 12 private vehicle spaces.

Car share arrangements should form an integral part of new project applications and this can be conditioned at the appropriate time and would form part of a Travel Plan. Information on local car sharing schemes would be provided as part of the staff induction process.

Consultation with car share operators such as Go Get would be undertaken to provide car share vehicles within the proposed future road network or basement car park, for use by staff. This will be dependent upon the requirements of car share operators and would also form part of a Travel Plan.

4.7.3 Cycling

Cycling may only be a viable mode of transport for a small proportion of staff, however it can still contribute to reducing traffic and parking demands for the Cooks Cove site. It may be a convenient way for staff to travel between Wolli Creek Station and the site, which will take just over five minutes on a bike compared to a 15 minute walk.

A number of organisations provide 'pool bikes' for their staff to use for travel during the day. Businesses on the site could consider purchasing 2-3 bikes for staff to use during the day, including potential e-bikes which require less effort than traditional bicycles. Examples of organisations that have purchased e-bikes and allow their staff to use them for trips to/from work include City of Sydney Council, North Sydney Council and Bangarra Dance Company.

Figure 26 City of Sydney and North Sydney Council pool bike schemes

On-site facilities for cyclists such as bicycle parking (in a secure and undercover area) supported by lockers, showers and change-rooms will be provided as part of the future development of the Cooks Cove site. This will enable use of bicycles as a means of travel to the site, including from nearby public transport stops. Other measures for consideration to be implemented by businesses on the Cooks Cove site to encourage cycling include the following:

- Supply a workplace toolkit-this can consist of puncture repair equipment, a bike pump, a spare lock and lights
- Provide local cycle maps to staff
- Participate in annual events such as 'Ride to Work Day'
- Encourage staff interested in cycling to connect with other more confident and experienced riders to provide further encouragement or advice
- Provide cycle safety training courses (provided by others) for staff to improve cycling confidence.

4.7.4 Travel information

During the staff induction process travel information will be incorporated so that new staff members are aware of the travel choices available to them. This would also include a tour of the site to include visit cycle parking areas as well as distributing a copy of the Transport Access Guide.

4.7.5 Transport Access Guide

The information provided within the GTP will be provided to staff and visitors in the form of a package of easy to understand travel information known as a Transport Access Guide (TAG).

TAGs provide customised travel information for people travelling to and from a particular site using sustainable forms of transport – walking, cycling and public transport. It provides a simple quick visual look at a location making it easy to see the relationship of site to train stations, bus stops and walking and cycling routes. Such TAGs encourage the use of non-vehicle mode transport and can reduce associated greenhouse gas emissions and traffic congestion while improving health through active transport choices.

They can take many forms from a Cooks Cove precinct app to maps printed on the back of business cards or brochures. Best practice suggests that the information should be as concise, simple and site centred as possible and where possible provided on a single side/sheet. If instructions are too complex, people are likely to ignore them.

A TAG would be prepared prior to the initial occupancy of the first building on the Cooks Cove site.

5 Traffic Impact Assessment

5.1 Purpose

The purpose of the traffic assessment is to provide an understanding of the road and transport infrastructure upgrades needed to support the Planning Proposal, including identification of transport network upgrades required to mitigate the traffic impacts of the scheme.

The extent of the traffic model is shown in Figure 27, with these extents confirmed following consultation with Transport for NSW.

Figure 27 Traffic model extents

5.2 Background to traffic assessment

Prior to the Gateway Determination received for the Cooks Cove Planning Proposal in August 2022 extensive investigations in relation to the operation of the surrounding road network were undertaken. Most relevant was a 'due diligence traffic assessment' report completed in February 2022 which considered the future operation of the signalised intersections on Marsh Street fronting the site. The purpose of this due diligence assessment (undertaken pre Gateway) was to provide a strategic understanding of the infrastructure required to support the Planning Proposal. The due diligence assessment confirmed that:

- Signalised intersections on Marsh Street have the ability to operate with an acceptable level of performance under the development yields envisaged in the Planning Proposal for the site; and
- The transport infrastructure required to support access to the site (i.e. new intersections on Marsh Street) can be constructed entirely within the road reserve or within the Trust lands on site – with no reliance on third party lands.

The due diligence assessment was not however intended to act as a 'green light' to the project, instead it was intended to provide a sufficient level of comfort to TfNSW and other stakeholders that the development yield proposed for the site has the ability to be achieved, subject to further validation arising from detailed modelling to be undertaken post Gateway.

As requested by TfNSW, a more detailed assessment has been undertaken post-Gateway, utilising the VISSIM micro-simulation software package, which considers a broader study area as previously shown in Section 5.1. The modelling takes into consideration network impacts at a micro-simulation level taking into account downstream queueing impacts, signal dynamics and weaving movements. The modelling has been undertaken in accordance with Transport for NSW traffic modelling guidelines and in close consultation with the relevant team within TfNSW.

This detailed traffic modelling has been used to inform the infrastructure schedule to support the future development of the Cooks Cove site.

5.3 TfNSW consultation

The traffic modelling was completed in close consultation with technical officers from TfNSW. A summary of the meetings held and TfNSW advice provided is noted below:

- 02 March 2022 – TfNSW provides detailed advice in relation to extent of future year traffic modelling required should project receive a Gateway determination
- 23 June 2022 – Traffic modelling methodology report issued to TfNSW

- 11 July 2022 – Meeting held with TfNSW to discuss traffic modelling methodology report. During the meeting TfNSW noted their preference for an updated 2022 base year traffic model to be prepared given the changes in traffic patterns since the opening of the M8 tunnels in 2020.
- 21 July 2022 – Cook Cove Inlet Pty Ltd provides suggested methodology for the update of the base model to TfNSW
- 22 July 2022 – TfNSW confirms that the proposed approach in updating the base year model is acceptable
- 30 August 2022 – Updated base year traffic model and report issued to TfNSW
- 13 September 2022 – Outputs from TfNSW strategic model provided to Cook Cove Inlet Pty Ltd
- 19 September 2022 – TfNSW provides comments on the base year traffic model
- 5 October 2022 – Revised base year traffic model and report issued to TfNSW addressing comments provided
- 31 October 2022 – TfNSW endorses base year model, noting "*TfNSW has completed the review and confirms that our previous comments emailed to you on 19 September 2022 have been satisfactorily addressed*"
- 23 November 2022 – Meeting held with TfNSW officers to present the findings of the future year traffic model.
- 25 November 2022 – Future year VISSIM traffic models issued to TfNSW for review
- 13 December 2022 – TfNSW provides comments on the future year traffic model
- 14 December 2022 – Responses to comments on future year traffic model issued to TfNSW
- 15 December 2022 – TfNSW confirms acceptance of future year traffic models by providing the following advice:

"*TfNSW has reviewed the clarification/justification provided in response to our comments raised during the review of the future year traffic models. These comments are now closed out and no modifications are required to the submitted models.*

However, please note that the future year traffic models have been reviewed without having the benefit of concurrent review of the traffic report which is yet to be submitted. We therefore reserve the right to raise any further modelling comments, including requiring modifications to the submitted models, should the traffic report (and draft letter of offer) contain any material that would necessitate changing any inputs or assumptions in the future year traffic models".

5.4 Traffic modelling methodology

An overview of the process undertaken for the traffic modelling is summarised below, and described in detail in the following sections:

1. Development of a 'base year' micro-simulation traffic model which is reflective of existing traffic conditions in the precinct surrounding the site
2. Working collaboratively with Transport for NSW to obtain strategic modelling outputs which forecast the changes in traffic movements in the study area due to future development and the advent of future infrastructure projects (e.g.M8, M6, Sydney Gateway)
3. Development of a 'future year' traffic model which considers the operation of the road network, both with and without the Cooks Cove development
4. Development of SIDRA model to refine the access intersection configuration requirements, traffic signal phasing and other aspects of the intersection layouts. The VISSIM traffic models were then updated to incorporate the findings of the SIDRA analysis.
5. Using the future year traffic model, identification of upgrades to the transport network to support the Cooks Cove proposal. These upgrades aim to ensure that the road network will operate at a similar level to that which would have occurred had the Planning Proposal not proceeded.

5.5 Base year traffic model

A base year traffic model, reflective of existing traffic conditions, was prepared in accordance with current RMS Traffic Modelling Guidelines. A detailed base year model report, prepared by Stantec, is provided as Appendix A to this document. Transport for NSW endorsed the 2022 base year traffic model via email correspondence dated 31 October 2022.

5.6 Forecast Cooks Cove traffic generation

An assessment has been undertaken to understand the level of traffic movements generated by the Planning Proposal as detailed in the sections below.

5.6.1 Retail

Surveys undertaken by Transport for NSW at a number of retail centres in NSW have been used to determine the traffic generation from the retail uses. The floor area for each shopping centre has been plotted against the surveyed traffic generation rate, and a regression analysis undertaken to establish the relationship between floor area and traffic generation as shown in Figure 28.

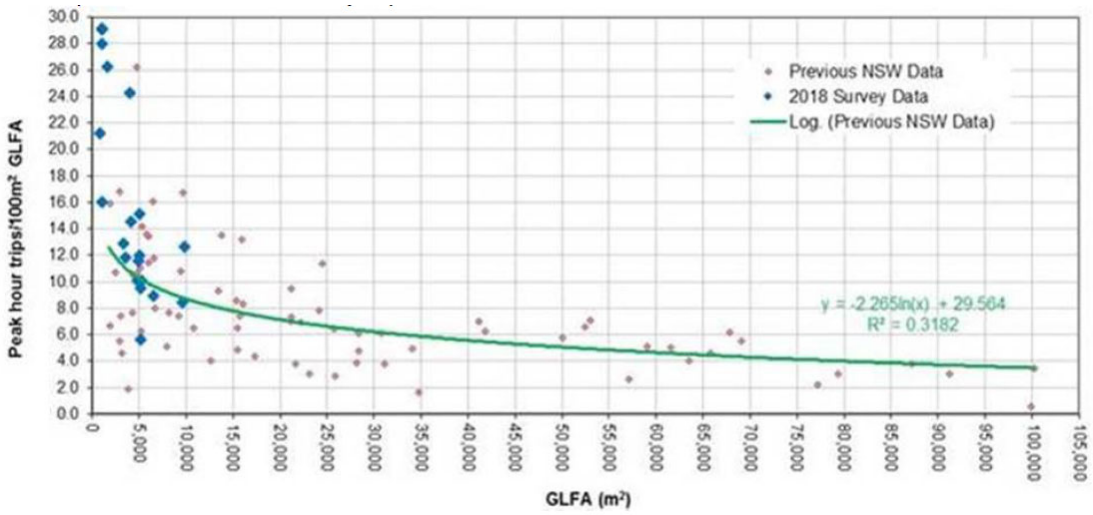


Figure 28 Relationship between retail floor area and traffic generation

Source: Transport for NSW

5.6.2 Hotel

Surveys of the Mercure Hotel (located on the northern side of Marsh Street) were previously undertaken in March 2017 to understand the likely traffic generation of this use. The Mercure Hotel contains 271 hotel rooms and serves a similar purpose to the proposed hotels within the Cooks Cove precinct. The survey observed a total of 21 vehicles over the PM peak hour (5pm – 6pm), comprised of 11 taxis, 5 car drop offs and 5 vehicles parking. This is equivalent to a peak hour traffic generation rate of 0.14 / vehicles room. This rate has been adopted for the purposes of this study.

5.6.3 Commercial

The trip rates adopted for commercial uses are heavily dependent on the rate of parking provided for the site. In the absence of all day commuter parking on nearby streets, workers choosing to drive to Cooks Cove will be reliant on on-site parking.

Although many of the sites surveyed in RMS TDT2013/04a are close to public transport, they contained high parking rates which directly influenced the proportion of people that travel by car. Analysis below demonstrates that, for the sites noted in RMS TDT2013/04a, there is a strong and direct relationship between car parking provision and car mode share. Although each surveyed site has good access to public transport, the surveys showed a significant range in the associated car mode share (and therefore trip generation).

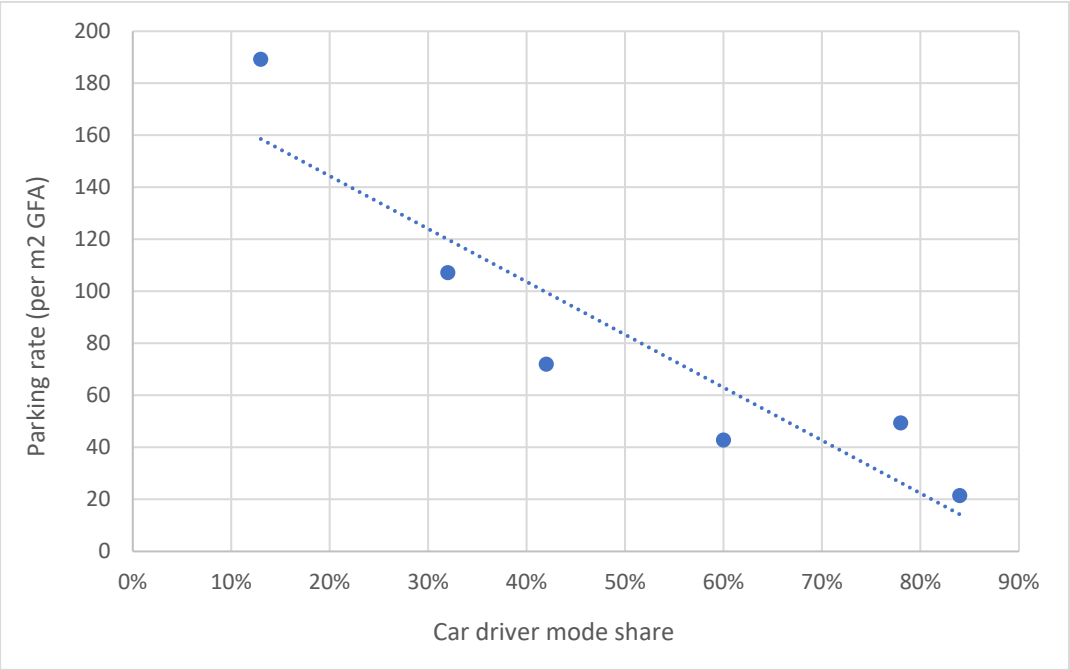


Figure 29 Relationship between parking rates and car driver mode share

The traffic generation rate to be adopted of 0.8 trips / 100m^2 is reflective of the proposed maximum on-site car parking rate of 1 space per 80m^2 GFA. This parking rate would yield a maximum of 265 spaces. The adopted traffic generation rate forecasts approximately 170 vehicle trips associated with the commercial uses, equivalent to 0.65 vehicle movements per parking space. This rate is significantly higher than the 0.4-0.5 vehicle trips / parking space as recommended in TDT2013/04a. Maximum car parking rates for the commercial uses will be adopted and be reinforced in the site specific DCP as well as any other relevant planning instruments (site-specific LEP clause).

5.6.4 Logistics uses

The forecast traffic generation arising from the logistics uses has been determined using trip generation rates for similar industrial sites noted in the Transport for NSW *Guide to Traffic Generating Developments* (TDT 2013/04a). Given the characteristics of the site with a significant amount of warehousing floor space and low proportion of ancillary office, the average trip generation rate of the following three sites in the Sydney Metropolitan area were adopted:

Site	Peak Hour Vehicle Trip Generation (vehicles / 100m^2 GFA)	
	AM Peak Hour	PM Peak Hour
Erskine Park Industrial Estate, Erskine Park	0.13	0.14
Wonderland Business Park, Eastern Creek	0.18	0.18
Riverwood Business Park, Riverwood	0.43	0.23
Average across sites	***0.25***	***0.18***

The fourth surveyed site in the Sydney Metropolitan Area noted in TDT 2013/04a, located in Helensburgh, was not considered appropriate for the purposes of determining a comparable traffic generation rate. This site, with only 1,605m^2 GFA, primarily contains office uses which the TfNSW summary report[1] notes would generate higher number of trips compared to industrial establishments. It is also noted that the Erskine Park and Wonderland sites are the most comparable to the future Cooks Cove site given the amount of GFA provided on these site (>250,000m^2) however as a conservative estimate the Riverwood site (with a GFA of approximately 30,000m^2) has also been included.

5.6.5 Summary

A detailed breakdown of traffic generation forecasts for the Planning Proposal is provided in the following pages of this document. These traffic generation forecasts are consistent with those adopted in the due diligence traffic assessment as well as those noted in the traffic modelling methodology report issued to, and endorsed by, TfNSW.

[1] Trip Generation Surveys—Business Parks and Industrial Estates – TEF Consulting

Table 2 Forecast Cooks Cove traffic generation

Land Use	Quantum	Units	Generation Rate		Containment / Passing Trade		Directionality				Forecast Peak Hour Traffic Generation					
							AM		PM		AM			PM		
			AM	PM	AM	PM	*IN*	*OUT*	*IN*	*OUT*	*IN*	*OUT*	*TOTAL*	*IN*	*OUT*	*TOTAL*
Commercial	21,610	m^2 GFA	0.80	0.80	0.00	0.00	0.95	0.05	0.05	0.95	162	9	170	9	162	170
Retail	7,500	m^2 GLFA*	4.68	9.35	0.25	0.25	0.60	0.40	0.5	0.5	158	105	263	263	263	526
Hotel	300	rooms	0.14	0.14	0	0	0.3	0.7	0.7	0.3	13	29	42	29	13	42
Serviced apartments	0	rooms	0.20	0.20	0	0	0.3	0.7	0.7	0.3	0	0	0	0	0	0
Logistics / warehouse	290,400	m^2GFA	0.25	0.18	0	0	0.6	0.4	0.4	0.6	435	290	725	209	313	522
Total											**803**	**397**	**1200**	**484**	**776**	**1260**

* Consistent with Section 5.7 of the RMS Guide, GLFA: GFA=0.75:1

5.7 Background traffic growth

The most accepted means of forecasting traffic growth and distribution is utilising a strategic traffic model owned and operated by the NSW Government. Following discussions with Transport for NSW, it was agreed that the Strategic Traffic Forecasting Model (STFM) would be the most appropriate tool to understand changes in traffic flows. The outputs from the STFM for the 2036 future year were incorporated into the future year VISSIM models through a concordance process.

As shown in Figure 30 the STFM indicates significant levels of background traffic growth on the surrounding road network, with an annual traffic growth rate of approximately 3% forecast despite the significant investment by the NSW Government in new transport infrastructure such as the M6 and Sydney Gateway Projects.

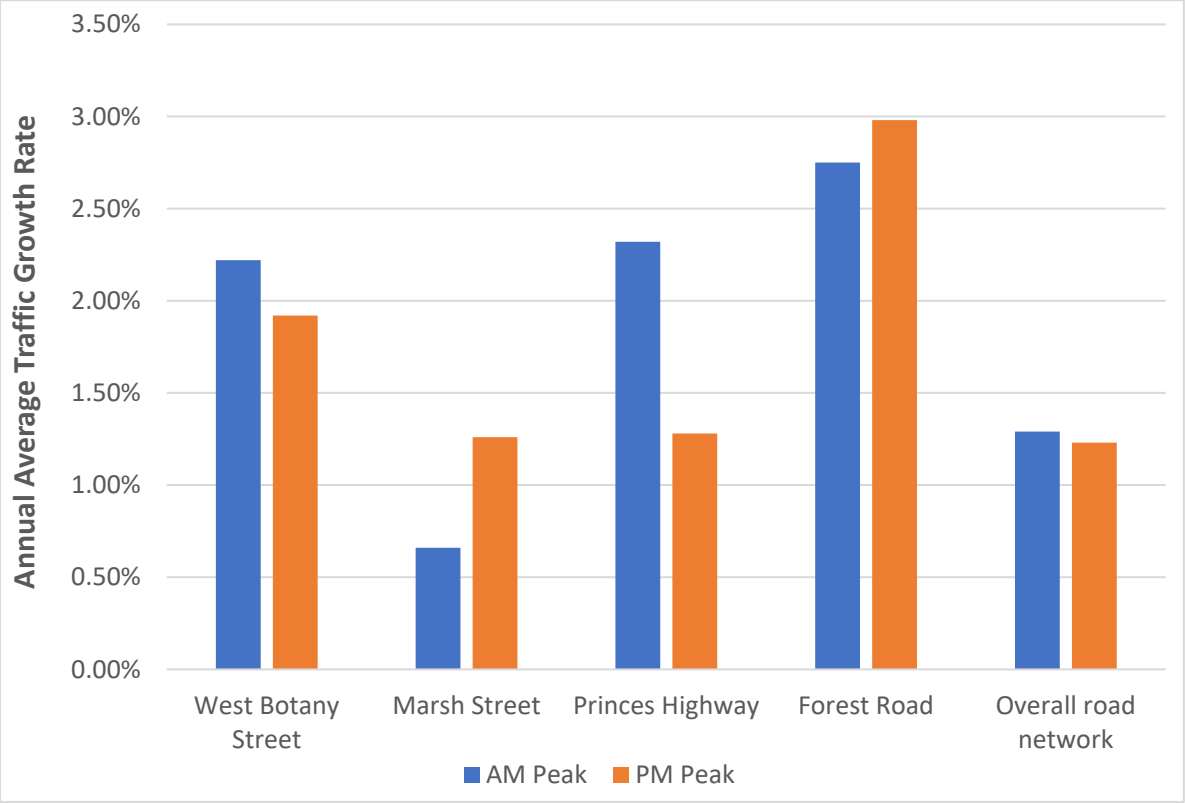


Figure 30 Forecast annual rates of background traffic growth

As illustrated in Figure 31 the forecast growth rates noted in the STFM outputs result in significant increases in traffic movements over the two hour afternoon peak period – with nearly an additional 3,000 additional vehicles on Forest Road west of the Princes Highway. Close to an additional 1,000 vehicles are forecast on the Princes Highway (south of Forest Road) and West Botany Street (south of Wickham Street).

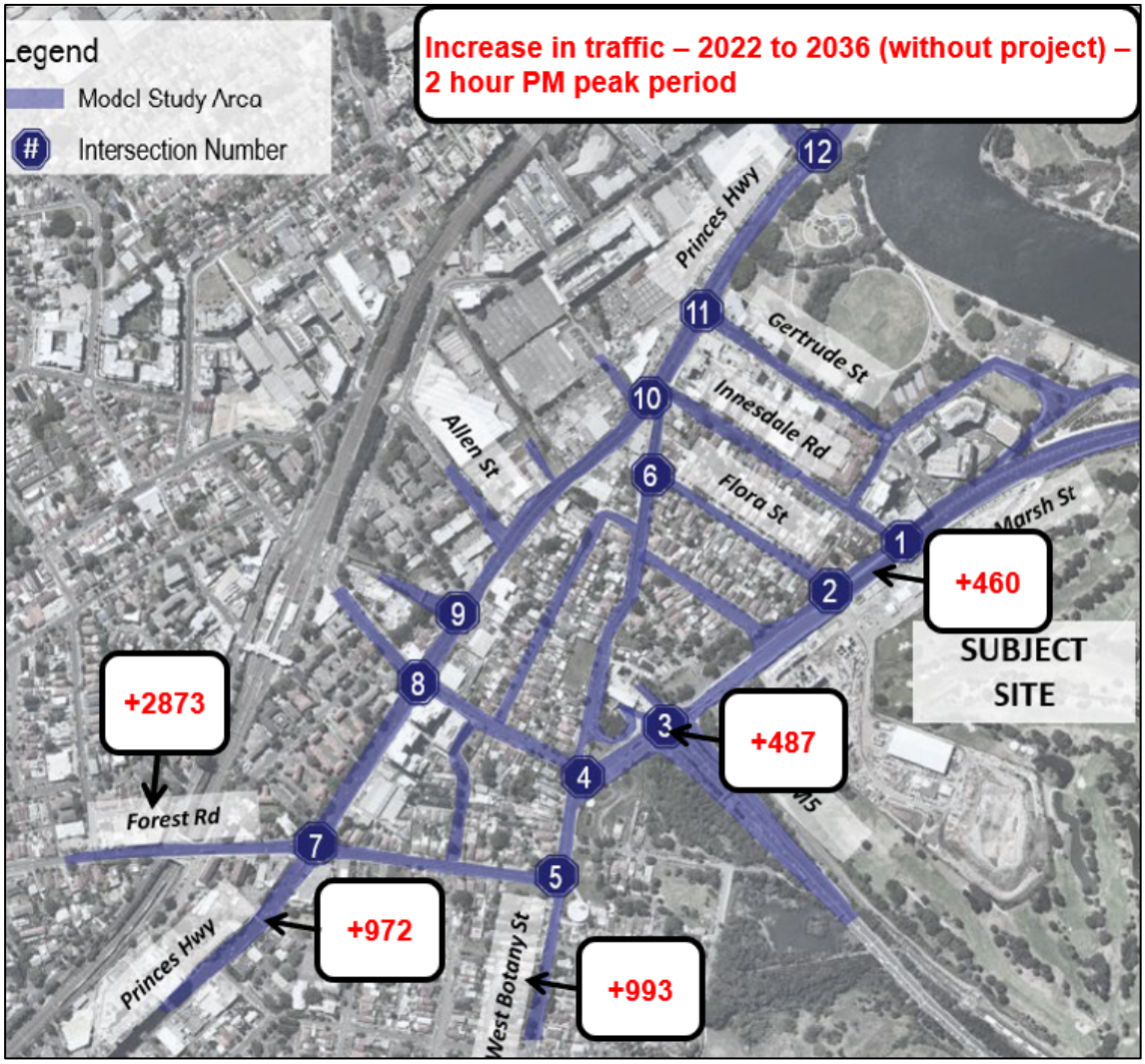


Figure 31 Forecast increase in traffic arising from background growth

It should be noted that a comparison of TfNSW strategic modelling outputs between 2019 (pre-COVID) and 2022 shows negligible difference in forecast traffic growth on Marsh Street. 2019 STFM data indicated traffic growth of 0.8% per annum and 1.1% per annum on Marsh Street during the AM and PM peak hours respectively up to the year 2036. The updated STFM data received in 2022 indicated comparable or higher growth rates for Marsh Street of 0.8% per annum and 1.1% per annum during the AM and PM peak hours respectively over the same time period.

5.8 Traffic modelling scenarios

The following scenarios have been considered as part of the detailed micro-simulation traffic modelling:

(i) Future Base Scenario: 2036 future year, including predicted levels of background traffic growth on the surrounding road network **without** the Cooks Cove development in place

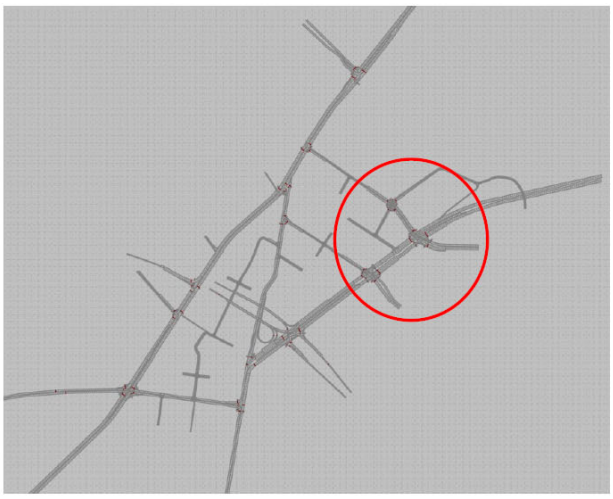
(ii) Future Base + Cooks Cove Scenario: 2036 future year, including predicted levels of background traffic growth on the surrounding road network **with** the Cooks Cove development in place as per the 2022 Cooks Cove Master Plan described in Section 1.2 of this document.

5.9 Road network geometry changes

The road network geometry within the Future Base + Cooks Cove traffic model has been updated to reflect the site access arrangements and intersection configurations developed by Arup (see Section 4.1). An extract from the VISSIM model indicating these road geometry changes is shown in Figure 32 below. Key changes to the road network include:

- Introduction of new four-way signalised intersection at Marsh Street and Gertrude Street;
- Enhancement of the existing Marsh Street / Flora Street signalised intersection, including banning the right turn from Marsh Street (eastbound) into Flora Street East;
- Gertrude Street extension between Marsh Street and Levey Street;
- Traffic signals at the intersection of Gertrude Street and Levey Street; and
- Removal of traffic lights at the Marsh Street / Innesdale Road intersection, with movements restricted to left in / left out only.

Road geometry – Future Base



Road geometry – Future Base + Cooks Cove

Figure 32 Road geometry changes

5.10 Traffic modelling findings

The following sections of this document summarise the findings of the future year traffic modelling with respect to the Marsh Street intersections, access to Sydney Airport as well as impacts on the broader road network. Outputs are generally summarised in terms of intersection level of service, average vehicle speed and unreleased traffic demands. More detailed traffic modelling outputs, including intersection delay and queue lengths, are provided as Appendix B of this report.

5.10.1 Marsh Street intersections

The detailed traffic modelling indicates that the proposed signalised intersections on Marsh Street at Flora Street and Gertrude Street operate acceptably in both the morning and evening peak hours with the Cooks Cove development in place. These site access intersections and the traffic generated by the project do not compromise the ability of TfNSW to continue to deliver a safe road network in the area. The intersection level of service findings for the Future Base + Cooks Cove development scenario is presented in Figure 33 – confirming the previous findings of the due diligence traffic assessment that the proposed intersection configurations are suitable and development yields can be supported.

Figure 33 Future intersection level of service

With respect to the intersection of Marsh Street and the M5 interchange, the difference in intersection performance initially reported in the due diligence assessment (prepared in late 2021) and those reported in this document are associated with:

1. The development of a wider network model which considers the downstream queuing effects from intersections further away from the Cooks Cove site, in particular those along Forest Road; and

2. The increased background traffic flows on the broader road network as contained in the strategic modelling outputs provided by TfNSW compared to those considered in the due diligence assessment.

The traffic modelling indicates that drivers travelling through the Marsh Street / M5 intersection would experience some increased delays as a result of the Cooks Cove proposal - amounting to an additional average wait time of approximately 1 second in the AM peak hour and 14 seconds in the PM peak hour. The modelling shows that the project will not adversley impact traffic in the AM peak hour, while the PM peak hour has a minor increase in wait time of just over 14 seconds when compared to the 'future base' case. This increase in the PM peak hour, in the context of delays on the broader road network, is considered negligible.

5.10.2 Access to Sydney Airport

Detailed analysis has been undertaken along Marsh Street in the eastbound (citybound) direction to understand the impacts of the project on access to Sydney Airport. The modelling indicates that in both peak hours, travel speeds along Marsh Street travelling towards the Airport remain largely consistent between a 'no project' and a 'with project' scenario as illustrated in the figures below.

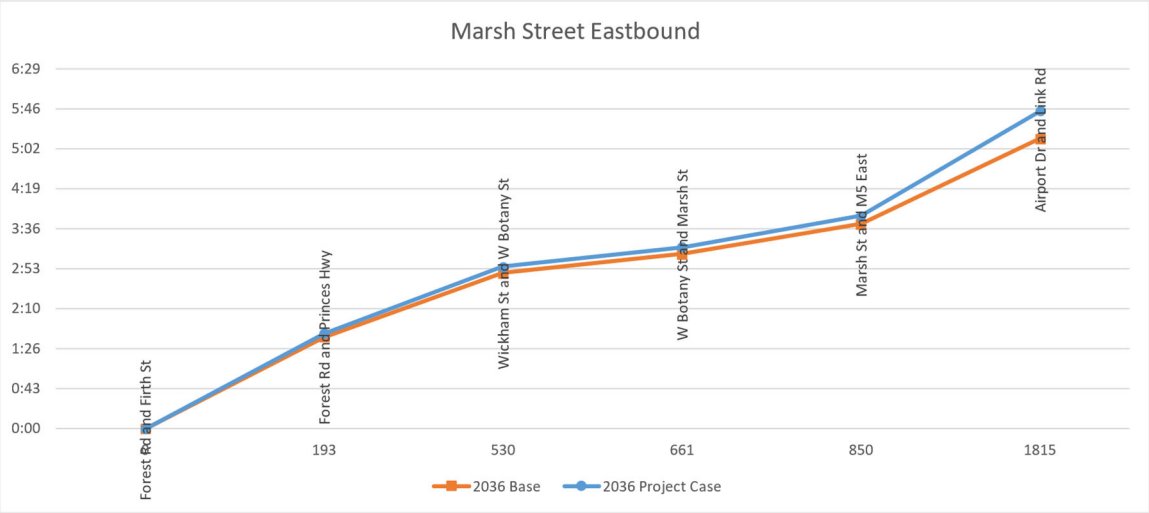


Figure 34 Travel times on Marsh Street towards Sydney Airport (AM peak hour)

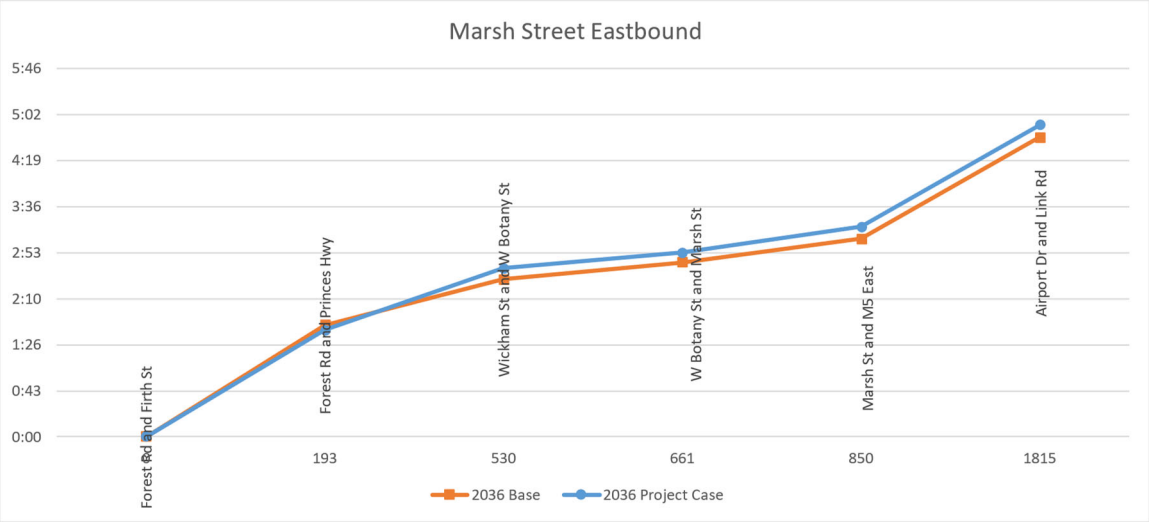


Figure 35 Travel times on Marsh Street towards Sydney Airport (PM peak hour)

5.10.3 Broader road network operation

Due to capacity constraints outside of the modelled network and well away from the Cooks Cove site, specifically on Forest Road west of the Princes Highway, the modelling indicates that even under a scenario where the Cooks Cove site is not developed that there will be significant congestion and delays for vehicles during the afternoon peak hour.

As shown in Figure 36 the average vehicle speed across the road network is predicted to reduce by more than 50% compared to current conditions. This issue is arising due to the predicted level of background traffic growth on the road network as identified in the TfNSW strategic modelling outputs, notwithstanding the investment by the NSW Government in new transport infrastructure such as the M6 and Sydney Gateway Projects which would remove traffic from the surface road network in the area. This deterioration is unrelated to the Cooks Cove proposal.

When considering the impacts of the project on the overall network during the morning peak hour travel times and vehicle delays remain relatively stable during the morning peak hour. During the PM peak hour average speeds are forecast to reduce from approximately 13km/h (under the Future Base scenario) to just under 10km/h with the Planning Proposal in place.

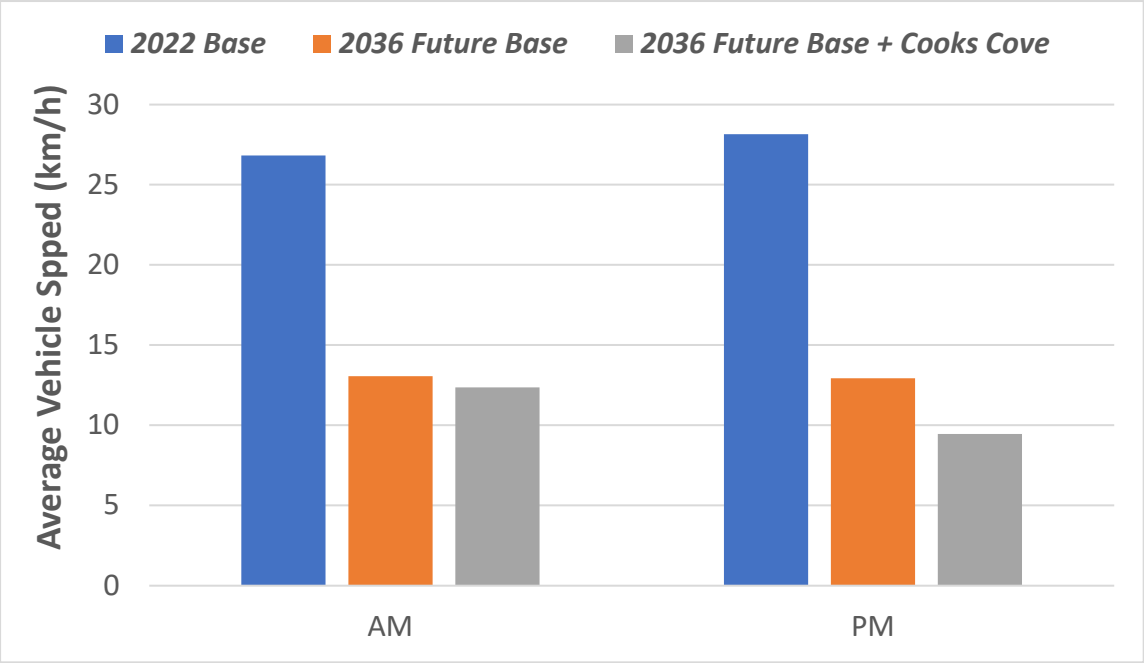


Figure 36 Average vehicle speeds – broader road network

The outputs from the TfNSW strategic model, which is an unconstrained model that assumes traffic will continue to grow without drivers adjusting their behaviours, are resulting in significant numbers of 'unreleased vehicles' on the road network as indicated in Figure 37.

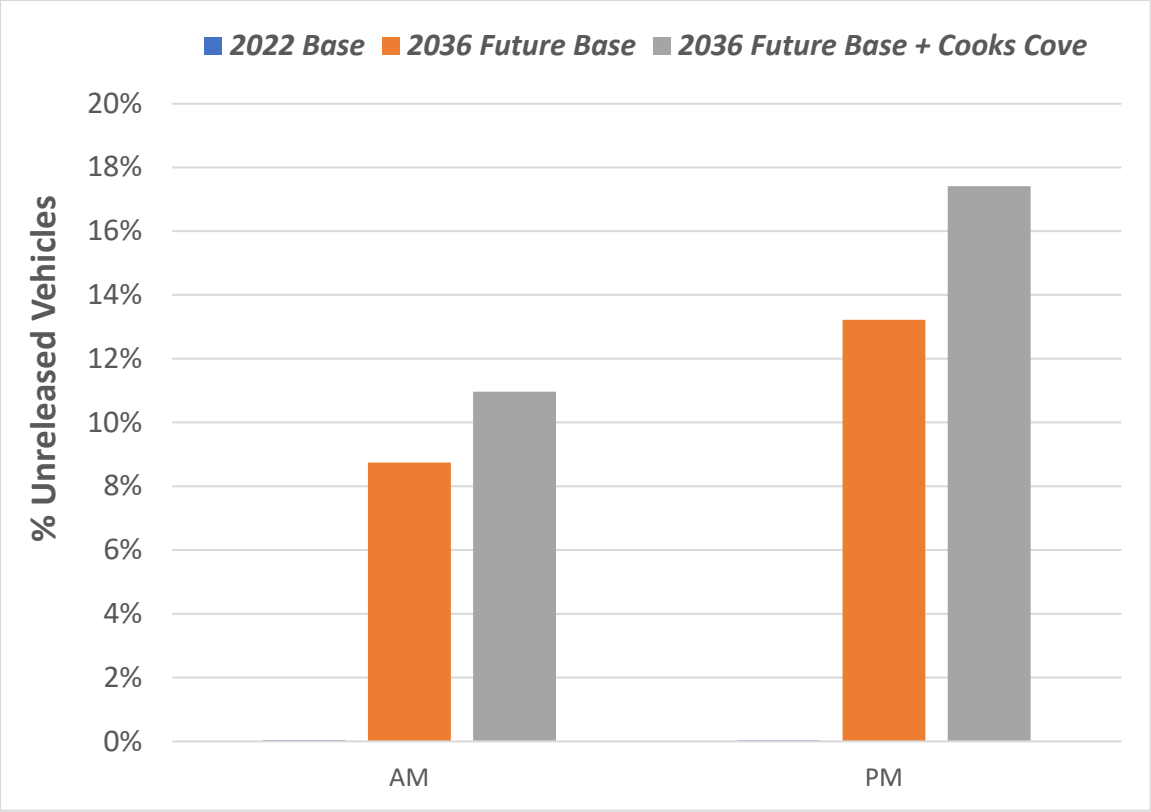


Figure 37 Unreleased vehicles

The key contributing factors to the unreleased demand experienced in the modelling are the high level of competing demands at critical locations and the associated signal timing / available green time that can be allocated to each intersection approach. Under the 2036 Base Case and Project Case scenarios, signal phase times were optimised where possible to balance network flows and queueing in order maintain a functioning road network. However, future traffic demand assumptions informed by strategic modelling (STFM) resulted in a high level of competing demands converging at the Princes Highway / Forest Road / Wickham Street. The queues from this intersection extend to upstream intersections and impact throughput at other sites. In addition, the traffic signals at the Forest Road / Firth Street intersection also acts as an end constraint at the western extents of the model and contributes to the capacity constraints experienced.

Unreleased demand represents demand waiting to enter the model at the extents therefore it is demand not currently in the network and does not directly contribute to impacting Marsh Street traffic flows. However, the model will

attempt to continually push out this demand resulting in a more constant flow of traffic demand into the model network during the assessed peak periods. While the forecast level of traffic demand may not all be released into the network at specific zones, the traffic flow on Marsh Street would largely be governed by other operational network elements within the model area (e.g. signals) which as mentioned above have been optimised at the network level.

The table below indicates the level of unreleased demand from the respective zones in the 2036 scenarios. The highest number of unreleased demand generally stems from Forest Road in both the AM and PM peaks, while Princes Highway also contributes with high levels of unreleased demand in the PM peak.

Table 3 Details of unreleased traffic demand

Parking Lot / Zone Number	Road Name	2036 Base		2036 Project	
		AM	PM	AM	PM
2	Marsh St				
3	Innesdale Rd	41			
7	M5 NB Offramp	351	211	495	517
9	West Botany St	348	381	464	467
11	Princes Hwy South		16		769
13	Forest Road	490	948	542	845
15	Burrow St	368	99	445	182
24	Princes Hwy North		605		592
30	Brodie Sparks Dr	302	112	164	114
36	Valda St			116	
39	Segenhoe St	90		89	
43	Duncan St Res	98		90	
46	Charles St Res			23	
Total		**2,088**	**2,372**	**2,428**	**3,903**

5.10.4 Sensitivity testing

Due to these capacity constraints in the Future Base model, particularly on Forest Road west of the Princes Highway, the traffic model was found to behave in a highly sensitive manner – with any incremental (albeit relatively small) increases in traffic flows resulting from the Cooks Cove development are resulting in significant increases in delays. This unfortunately does not allow for an 'apples for apples' comparison to understand the relative impact of the project. As shown in Figure 38 the Cooks Cove proposal contributes only an additional 3%-5% in traffic movements on Forest Road and the Princes Highway when compared to the general background growth forecast under the STFM. The greatest relative increases are along Marsh Street in the immediate vicinity of the site.

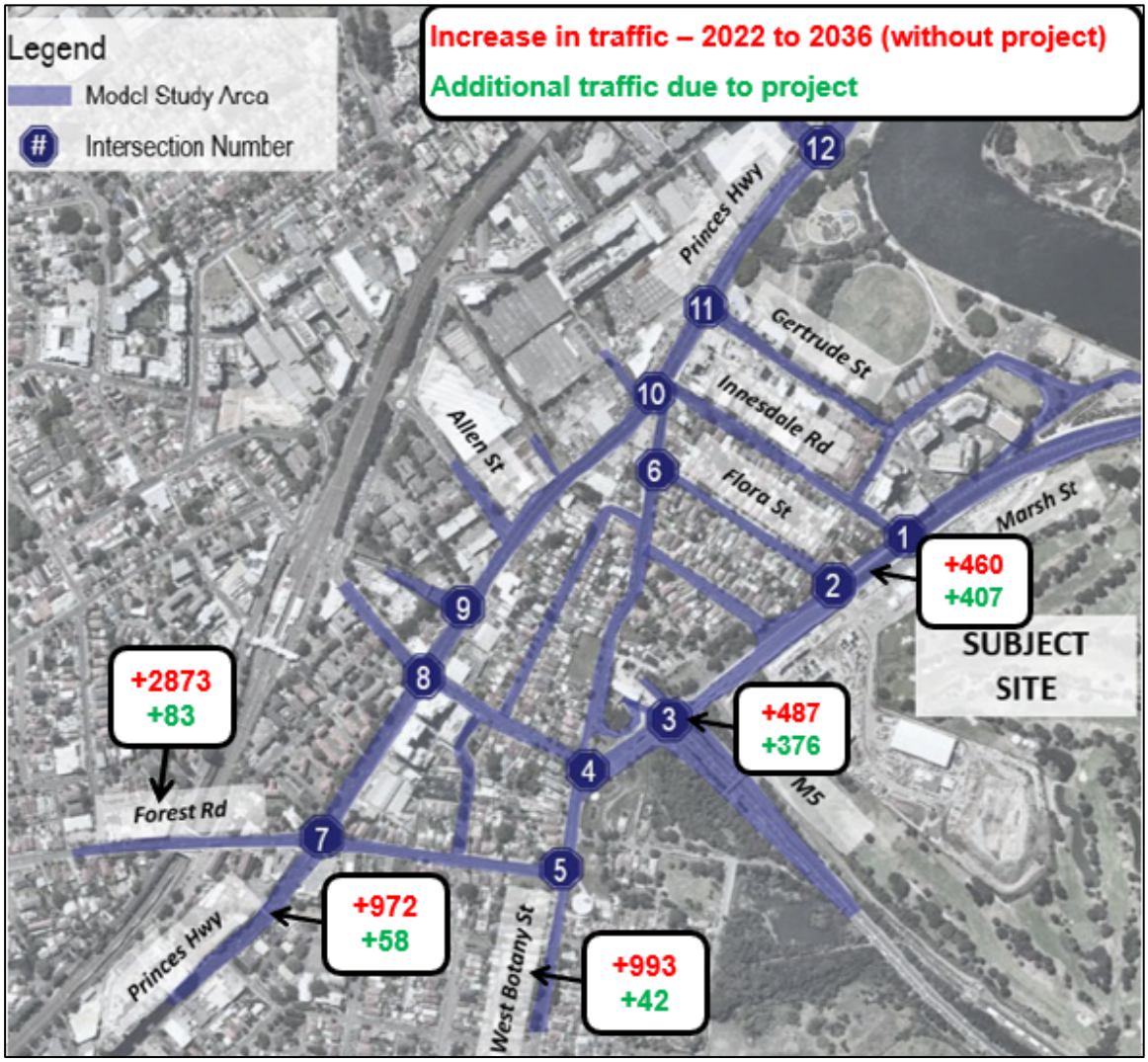


Figure 38 Relative change in traffic growth

As a sensitivity test a scenario has been modelled where one of the major external capacity constraints on Forest Road was removed in order to better understand the incremental impact of the Cooks Cove project and reduce the

sensitivities being displayed by the model. This analysis indicates that across the modelled network travel speeds reduce by less than 10% and unreleased demand remains consistent – indicating the Cooks Cove project itself does not cause significant impacts on the broader road network.

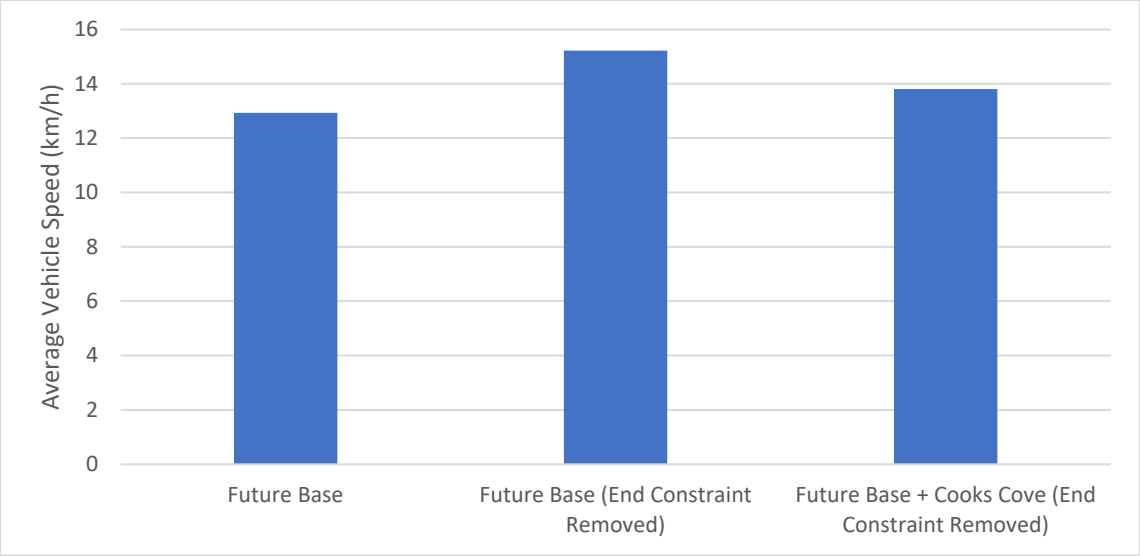


Figure 39 Average travel speeds (sensitivity test, removal of end constraint)

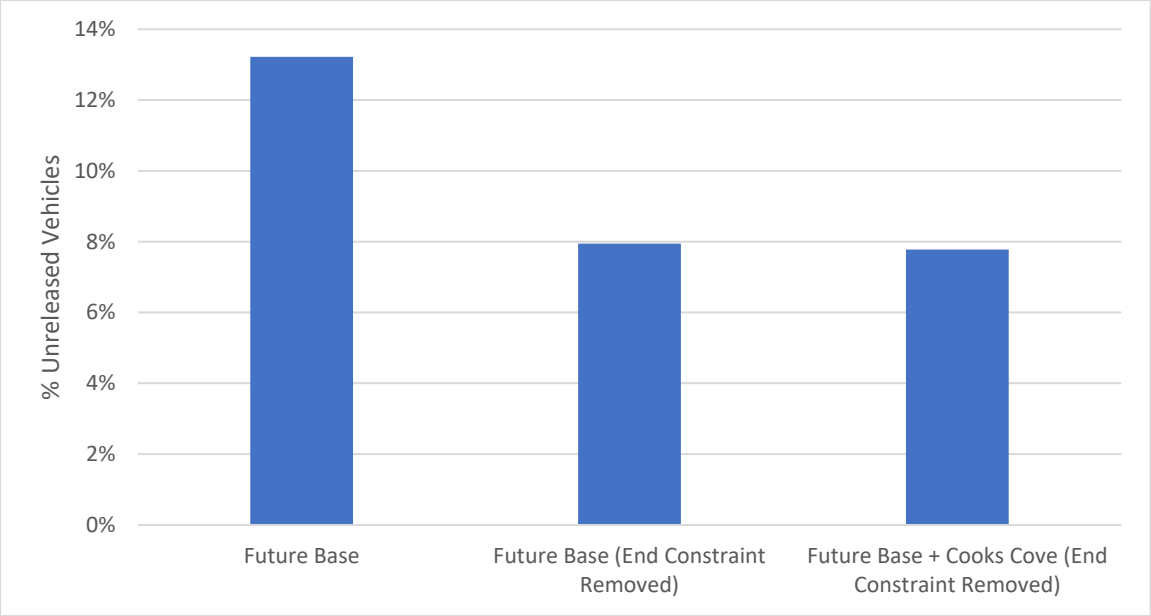


Figure 40 Unreleased demand (sensitivity test, removal of end constraint)

Another sensitivity test was conducted to understand whether the yield of the Cooks Cove site was contributing to the performance of the broader road network. This analysis considered the effect of a reduced development yield of 270,000m^2 GFA on the site – consistent with the previously approved master plan. The modelling for this sensitivity test, as shown in Figure 41, demonstrates that a reduced yield on the Cooks Cove site does not influence overall road

network performance – confirming the constraints sit outside of the project boundaries and the relative traffic impact of the proposal is minor.

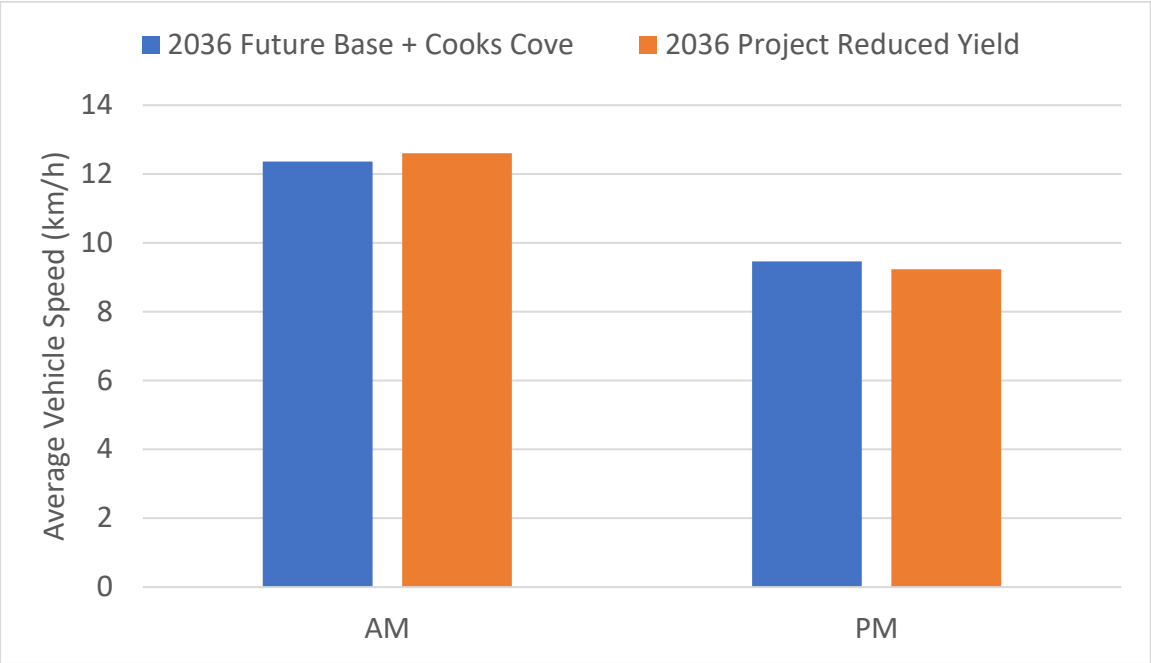


Figure 41 Average travel speeds (sensitivity test, reduced yield)

A further analysis was undertaken to understand the effect of a new set of traffic lights on Marsh Street at Gertrude Street to understand the influence of this project – refer to Figure 42. The modelling shows that a new set of traffic lights does not in themselves contribute to the traffic congestion observed in the future base models as previously shown in Section 5.10.3.

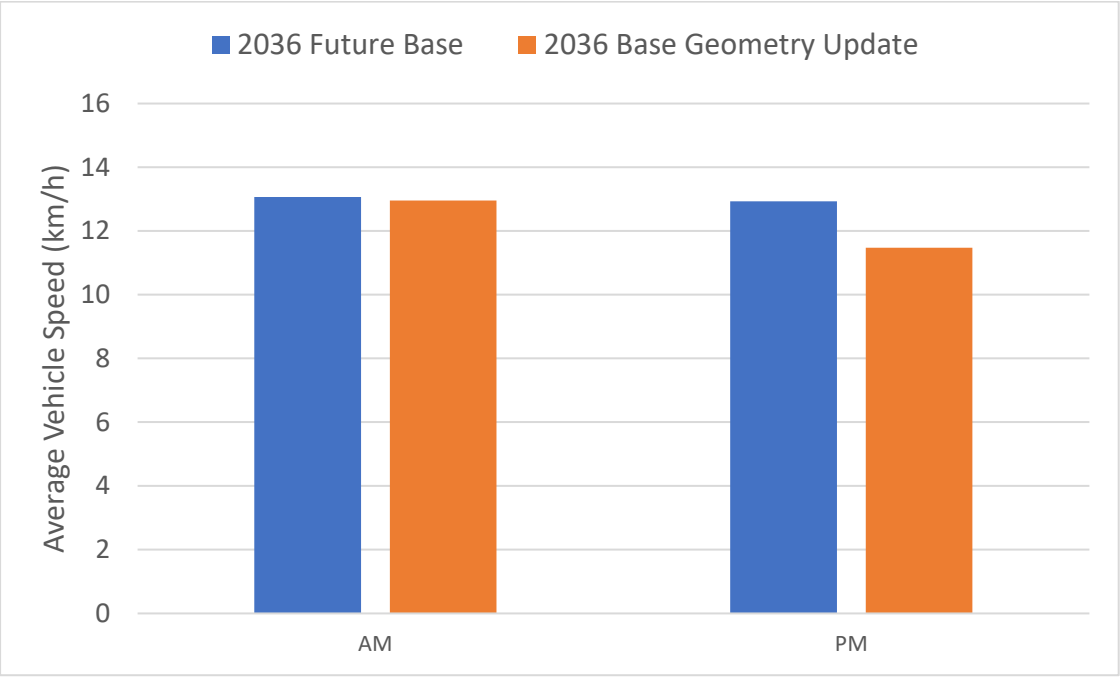


Figure 42 Average travel speeds (sensitivity test, removal of Gertrude St lights)

5.11 Summary – traffic impact assessment

- Detailed micro-simulation traffic modelling has been undertaken in accordance with the requirements outlined by TfNSW
- The modelling assumes considerable levels of traffic growth on the surface road network based on the STFM outputs provided by TfNSW
- The modelling indicates:
  - The proposed Marsh Street signalised intersections function well with the Cooks Cove development in place
  - Access to Sydney Airport via Marsh Street remains unimpacted by the proposal
  - Constraints away from the Cooks Cove site indicate significant congestion and delays on the broader road network without the project in place.
  - If these external constraints were resolved then modelling shows the project itself does not cause significant impacts on the broader road network

5.12 Traffic signal warrants

Transport for NSW has specific requirements relating to vehicular and pedestrian volumes where it will consider the installation of traffic signals at an intersection. These are commonly referred to as signal warrants. Section 2 of the RMS Traffic Signal Design Manual outlines five different warrants for the installation of traffic signals at intersections. These are summarised in Table 4.

Table 4 Traffic signal warrants description

Warrant	Description
Traffic Demand	For each of the four one-hour periods of an average day: (i) The major road exceeds 600 vehicles/hour in each direction; and (ii) The minor road exceeds 200 vehicles/hour in one direction
Continuous Traffic	For each of the four one-hour periods of an average day: (i) The major road flow exceeds 900 vehicles/hour in each direction; and (ii) The minor road exceeds 100 vehicles/hour in one direction; and (iii) The speed of traffic on the major road or limited sight distance from the minor road causes undue delay/hazards to the minor road vehicles; and (iv) There is no other nearby traffic signal site easily accessible to the minor road vehicles
Pedestrian Safety	For each of the four one-hour periods of an average day: (i) The pedestrian flow crossing the major road exceeds 150 persons/hour; and (ii) The major road exceeds 600 vehicles/hour in each direction or, where there is a central median at least 1.2m wide, 1000 vehicles/hour in each direction
Pedestrian Safety – high speed road	For each of the four one-hour periods of an average day: (i) The pedestrian flow crossing the major road exceeds 150 persons/hour; and (ii) The major road exceeds 450 vehicles/hour in each direction or, where there is a central median at least 1.2m wide, 750 vehicles/hour in each direction; and (iii) The 85th percentile speed on the major road exceeds 75km/hr
Crashes	(i) The intersection has been the site of an average three or more reported tow-away or casualty traffic accidents per year over a three year period, where traffic signals could have prevented the accidents; and (ii) The traffic flows are at least 80% of the appropriate flow warrants

In accordance with the TfNSW recommendation an assessment has been undertaken which considers whether traffic signal warrants would be met for the proposed new signalised intersections.

Review of existing and future traffic volume data indicates that the Marsh Street / Gertrude Street intersection comfortably meets both the 'traffic demand' and 'continuous traffic' warrants – with over 1,500 vehicles per hour in each direction on Marsh Street and approximately 500 vehicles per hour in one direction on Gertrude Street.

An assessment of traffic flows through the Gertrude Street / Levey Street intersection indicates that forecast traffic movements in the year 2036 fall short of the warrants. It should be noted that volumes on Gertrude Street during the PM peak hour are anticipated to be approximately 500 vehicles per hour while flows on Levey Street are approximately 400 vehicles per hour – therefore coming close to meeting the 'continuous traffic' warrants.

It is also important to recognise however that traffic signal warrants are something that should be considered but is only one of several factors when determining suitable intersection layouts. One of the key considerations for the Cooks Cove project, as detailed in the Gateway Determination issued by DPE, is to "*deliver a safe road network and enhance walking and cycling connectivity and the use of public transport*". The introduction of traffic signals at the Gertrude Street / Levey Street intersection would meet these objectives by:

- Providing an intersection layout best suited to accommodate future traffic demands and manage the efficiency of the road network;
- Deliver new pedestrian crossing facilities through the intersection which provide connections between the Cooks Cove site, Cahill Park and Wolli Creek (including Wolli Creek train station); and
- Improve road safety, with traffic lights (more than any other form of intersection control) providing the best road safety outcome for all road users (vehicles, cyclists, public transport and pedestrians).

As an alternative to traffic lights the retention of the existing roundabout control at the Levey Street / Gertrude Street intersection was investigated during the design process. While the retention of the roundabout control at this intersection would not fundamentally alter the operation of the local or classified road network, this option was not considered to provide as strong a transport outcome compared to traffic lights given:

- A roundabout control would not provide for a formalised and safe pedestrian connection between the Cooks Cove site, Cahill Park and Wolli Creek Station. The introduction of traffic lights, by providing for formal pedestrian crossings on all intersection approaches as proposed, would provide a superior transport outcome in terms of road safety and active transport accessibility.

- Design investigations determined that it would be challenging to provide a compliant roundabout geometry without impacting on third party lands that sit outside of the project boundary – see Figure 43. The introduction of two traffic lanes in each direction on Gertrude Street would require the existing roundabout geometry to be amended, with traffic lights requiring a smaller intersection footprint in comparison.

Figure 43 Roundabout intersection layout – Gertrude Street / Levey Street

- Vehicle swept path analysis shown in Figure 44 indicates that large vehicles would have to drive over the centre of the roundabout to safely manoeuvre through the intersection.

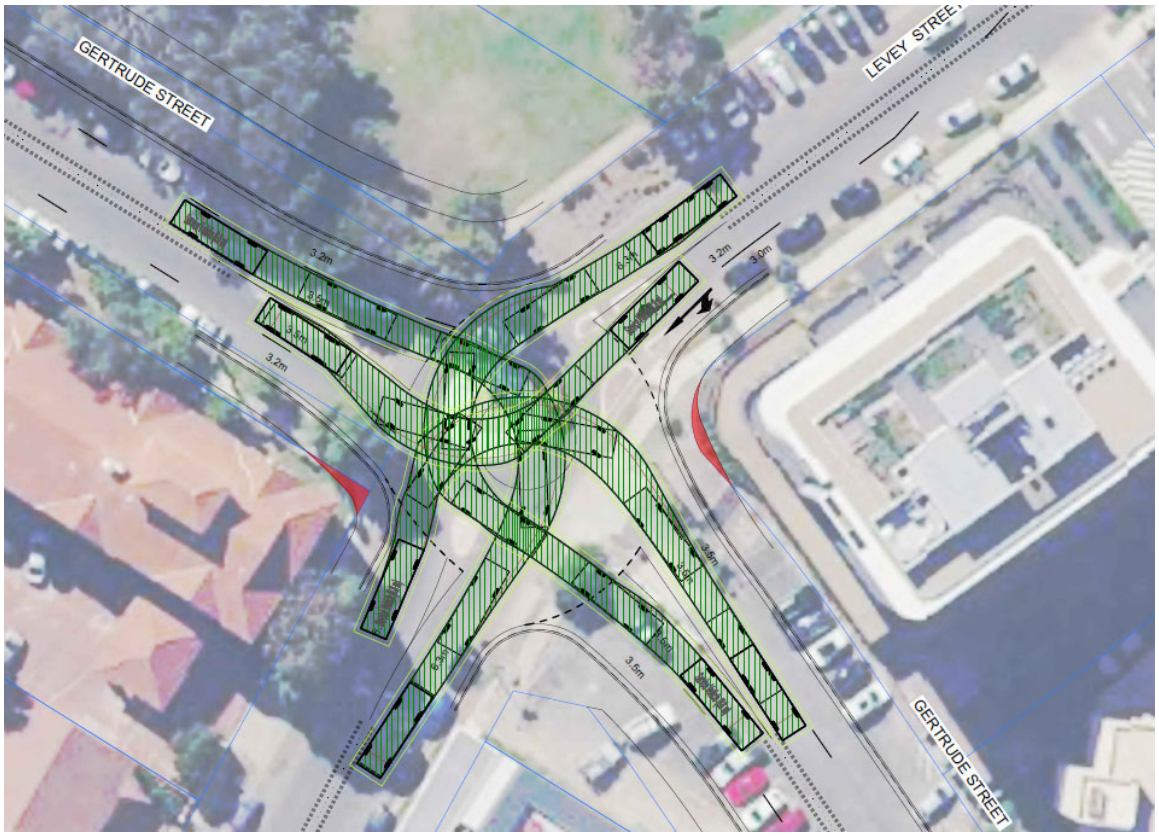


Figure 44 Vehicle swept paths – Gertrude Street / Levey Street (roundabout control)

As noted in AUSTROADS *Guide to Traffic Management Part 10: Traffic Control and Communication Devices* – the issue of closely spaced signalised intersections can be addressed by introducing the following measures:

- Provision of the *prepare to stop* warning signs with flashing lights (as illustrated in AS 1742.2)
- Providing larger aspects on the first set of signals
- Using louvres and long visors to focus the visibility of the far lanterns to specific drivers in the field of view

In addition to the above, 'No Stopping' restrictions would be in place along Gertrude Street between Levey Street and Marsh Street to ensure effective traffic flow and traffic signal operations with the signalised intersections on Gertrude Street.

6 Infrastructure Schedule

6.1 Works in kind infrastructure

The following works in kind infrastructure elements are to be delivered prior to the first occupation certificate being issued:

- Gertrude Street extension (Levey Street to Marsh Street),
- Levey Street / Gertrude Street signalised intersection,
- Gertrude Street widening (Levey Street to Princes Highway),
- Marsh Street / Gertrude Street signalised intersection,
- Marsh Street / Flora Street intersection enhancement,
- Gertrude Street East extension,
- Flora Street East extension, and
- New Marsh Street bus stops.

These works are shown visually in Figure 45.

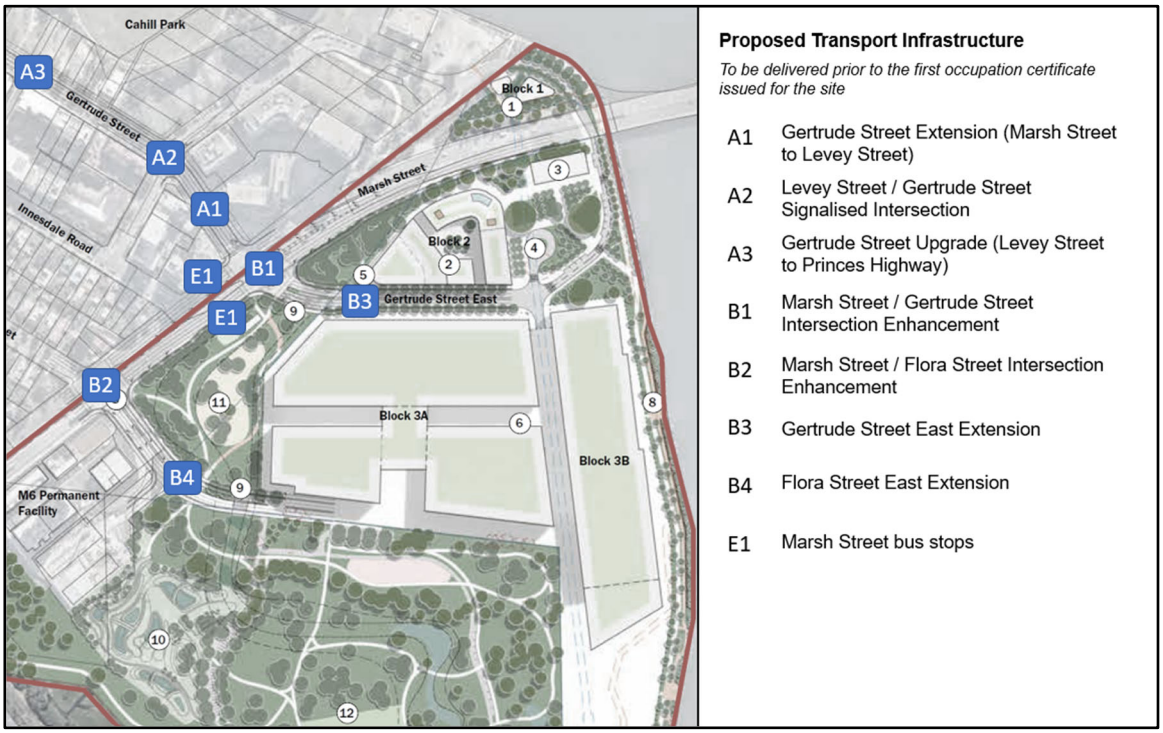


Figure 45 Summary of proposed infrastructure

The value of the total work-in-kind contribution will be validated in consultation with TfNSW. Works will include improvements to adjoining Local and State infrastructure and as a consequence an appropriate methodology is to be identified to facilitate the efficient delivery of infrastructure improvements to the benefit of Bayside Council and the State of NSW. Subject to TfNSW's endorsement, works will be divided into separable planning agreements to enable delivery between stakeholders, as required.

A detailed summary of the scope of the works in kind infrastructure contributions is provided in Table 5.

Table 5 Proposed works in kind contributions

Description	Ref	Scope
Gertrude Street Extension (Marsh Street to Levey Street)	A1	- Construction of new link road with two lanes in each direction between Levey Street and Marsh Street. - Road base, drainage, subsurface utility relocation. - New kerb and gutter, footpaths, fencing, basic landscaping, signage, lighting
Levey Street / Gertrude Street Signalised Intersection	A2	- Conversion of existing roundabout to 4-way intersection - Installation of traffic signals, line marking, signage, and lighting - Utility relocations and adjustments - Amendments to on-street parking in Levey Street.
Gertrude Street Upgrade (Levey Street to Princes Highway)	A3	- Widening of marked two lane road to four lanes, between Levey Street to the approach of Princes Highway. - Line marking and realignment of northern footpath, kerb and gutter, basic landscaping - Utility relocations and adjustment to lighting
Marsh Street / Gertrude Street Intersection Enhancement	B1	- Revision to concrete medians to create northbound dual right turn bay into Gertrude Street East and southbound dual right turn bay into Gertrude Street Extension. - Construction of Marsh Street southbound deceleration lane to permit left turn into Gertrude Street East. - Installation of traffic signals, intersection, and pedestrian line marking - Remove traffic signals serving Innesdale Road and undertake necessary adjustments required to alter permitted movements to left in and left out only to/from Marsh Street - New footpaths, fencing, signage, lighting, road sheeting as required - Utility relocations and adjustments
Marsh Street / Flora Street Intersection Enhancement	B2	- Revision to concrete medians to eliminate northbound right turn bay into existing M6/M8 temporary construction compound and lengthening of southbound right turn bay to M5 Motorway - Intersection line marking and traffic signal adjustments including new pedestrian crossing - Extension of the northbound right turn bay to Gertrude Street - Construction of southbound left turn bay to Flora Street east - New kerb and gutter, footpaths, required adjustments to Marsh Street east cycleway fencing, signage, lighting, road sheeting, basic roadside landscaping as required - Utility relocations and adjustments

Description	Ref	Scope
Gertrude Street East Extension	B3	- Provision of a four-lane connector road to Marsh Street to boundary of Lot 100/DP1231954 - Integration of a southbound left turn slip lane into new Gertrude Street East. - Stormwater culvert consistent with flood mitigation strategy - Road base, drainage, subsurface utility relocation. - New medians, footpaths, fencing, signage, lighting
Flora Street East Extension	B4	- Provision of five - lane connector road to Marsh Street / Flora Street intersection - Maintain access to Arncliffe Motorway Operations Compound at all times. Integrate new road design and undertake necessary modifications to the road access arrangements arising from M6 Stage 1 to AMOC - Land dedication of part Lot 100 DP1231954 and four- lane road incorporating necessary southbound AMOC access modifications and access to Lot 1/DP108492 and 40 bay at grade car parking facility - Stormwater culvert consistent with flood mitigation strategy - Road base, drainage, subsurface utility relocation. - New medians, footpaths, line marking, fencing, signage, lighting - Pedestrian crossing to facilitate access from Lot 14 / DP213314 to Lot 1 DP108492
Bus stops	E1	- Northbound and southbound bus stops to the south of the Marsh / Gertrude Street intersection. Southbound with signage and shelter. Northbound signage only as it is believed there is insufficient area to accommodate a bus shelter within northbound Marsh Street road reserve

6.2 Monetary contributions

6.2.1 Active transport improvements to Giovanni Brunetti Bridge

A number of studies, including the Bayside West Precincts 2036 Plan, have identified that active transport improvements to this TfNSW asset would benefit the Bayside Community, the Cooks Cove project, Sydney Airport and regional pedestrian and cyclists. A commitment of a $4,000,000 progressive contribution is made, proportional to the completion of approved floorspace, to this, or an alternative active transport improvement to access between Cooks Cove and Sydney Airport.

6.2.2 State and/or regional road improvements

Notwithstanding the relatively minor impact the Cooks Cove project has on the broader road network, as summarised in Section 5.10 of this document, it is acknowledged that the proposal would generate additional traffic demands on the surrounding road network.

To this end Cook Cove Inlet Pty Ltd would offer a $4,700,000 progressive contribution, proportional to the completion of approved floorspace, to TfNSW to assist in resolving some of the capacity constraints identified in the traffic modelling. As the traffic modelling identified key capacity constraints on Forest Road west of the Princes Highway, the contribution has been proposed based on the costs previously identified for:

- The $3,200,000 previously identified by TfNSW for upgrades at the Forest Road / Princes Highway intersection; and
- The $1.5m identified in the Bayside West Precincts 2036 plan for upgrades to the intersection of Forest Road at Firth and Eden Streets.

The delivery of upgrades at these locations will relieve capacity constraints identified in the traffic modelling and contribute to an improved road network outcome. The $4,700,000 progressive contribution is not however contingent on funds being allocated to the above locations – these have been recommended as a result of traffic modelling findings. The monetary contribution may instead be allocated at alternative locations as identified by TfNSW to improve the State/Regional road network or signalised intersections in the vicinity of the Cooks Cove site.

6.3 Timing and delivery of contributions

- **Transport Infrastructure Contributions** – Cook Cove Inlet would enter into a planning agreement with TfNSW (and supplementary Bayside Council agreement as relevant) prior to the gazettal of amended planning controls the subject of this Planning Proposal.
- **Works-in-kind** – Cook Cove Inlet will facilitate the implementation of the works-in-kind components identified as A1-A3, B1-B4 and E1 prior to an Occupation Certificate being issued for floorspace the subject of this Planning Proposal within Lot 100 in DP 1231954.
- **Monetary contributions** – Cook Cove Inlet to make staged payments in relation to the monetary contributions items B7 and E2 at the rate of $25,588 per 1,000sqm (the total equivalent of $8.7m), prior to the progressive issue of Occupation Certificates for floorspace arising from the gazettal of this Planning Proposal within Lot 100 in DP 1231954.

7 Summary

This updated transport assessment has been developed by JMT Consulting to support a Planning Proposal for the Cooks Cove site. The assessment has been prepared to respond to the requirements of the Gateway Determination PP-2022-1748 and Local Planning Direction 5.2, specifically:

"*obtain approval from TfNSW that the planning proposal will not compromise future transport links, deliver a safe road network and enhance walking and cycling connectivity and the use of public transport in accordance with the requirements of the principles*"

The proposal maintains vehicle access points on Marsh Street into the site when compared to previous schemes submitted, with an internal road network to be delivered to accommodate the safe and efficient movement of people. Improvements in access for public transport and active transport users will also be delivered as part of the development of the site.

Detailed traffic modelling, undertaken in close consultation with TfNSW, demonstrates that the future Marsh Street signalised intersections function satisfactorily with the Cooks Cove development in place and do not significantly compromise the operational performance of the road network. The upgraded intersections on Marsh Street will deliver new pedestrian crossing facilities and provide for traffic lane widths in accordance with relevant TfNSW design guidelines.

In relation to enhancing walking and cycling connectivity and the use of public transport, the proposal will deliver a missing 900m long x 20 m wide landscaped waterfront contribution to the 'bay to bay' regional active transport link along the western bank of the Cooks River, incorporating pedestrian, cycling and passive recreation infrastructure.

In addition, the proposal includes new pedestrian crossing opportunities of Marsh Street and Levey Street which will strengthen pedestrian connectivity and safety between Cooks Cove, Cahill Park and Wolli Creek train station. These improved pedestrian connections will be complemented by the new Gertrude Street East extension providing new connectivity between Levey Street to a foreshore recreation precinct, to the Marsh Street (east) existing cycleway, and a new pedestrian and cycleway network within Pemulwuy Park (Marsh Street Parklands).

New bus stops in an eastbound and westbound direction on Marsh Street, subject to the assistance of TfNSW and Bayside Council, will assist servicing the public transport needs of the new Cooks Cove worker and visitor population.

A summary of the transport measures recommended in this report, and in many cases also the Bayside West Precincts 2036 Plan, is provided in Table 6.

Table 6 Summary of proposed transport measures

Description	Timing
Roads / Traffic	
New signalised intersection at Marsh Street / Gertrude Street	Prior to the first occupation certificate being issued
Gertrude Street extension (Marsh Street to Levey Street)	
Enhancement of existing signalised intersection at Marsh Street / Flora Street	
New signalised intersection at Levey Street / Gertrude Street (including two continuous traffic lanes on Gertrude Street)	
Provision of two continuous traffic lanes in each direction on Gertrude Street, between the Princes Highway and Marsh Street	
$4,700,000 contribution to improve the State/Regional road network or signalised intersections	Paid progressively per 1,000m^2 of constructed GFA
Public Transport	
New bus stops to be provided in each direction on Marsh Street	Prior to the first occupation certificate being issued
New pedestrian crossings across Marsh Street and Levey Street to provide connectivity between Cooks Cove and Wolli Creek station	
Design of internal roads to accommodate potential future public transport services.	
Active Transport	
900m long x 20m wide landscaped waterfront regional active transport link along the western bank of the Cooks River incorporating pedestrian, cycling and passive recreation infrastructure	Prior to the first occupation certificate being issued
New pedestrian crossing opportunities across Marsh Street and Levey Street, including: • New pedestrian crossing on the eastern side of the existing Marsh Street / Flora Street intersection • New pedestrian crossing on the western side of the future Marsh Street / Gertrude Street intersection • New pedestrian crossings on all approaches of the future Levey Street / Gertrude Street intersection	
Connection to and embellishment of the new shared path along the length of Marsh Street	
Provision of bicycle parking within all future development sites in Cook Cove as well as in public domain. End of trip facilities to be provided within all development sites.	
Contribution to an enhanced pedestrian/cyclist connection on the southern side of the Giovanni Brunetti Bridge	Paid progressively per 1,000m^2 of constructed GFA

Appendix A: Base Year Traffic Model Report

COOKS COVE PLANNING PROPOSAL – TRAFFIC MODELLING
Base Model Development Report

05 October 2022

Prepared for:
JMT Consulting

Prepared by:
Stantec Australia

Project Number:
300303790

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date
1	Draft report	Radhika Gopalakrishnan	02/09 /2022	Mark Stephens	02/09 /2022	Bryan Li	02/09 /2022
2	Draft report	Radhika Gopalakrishnan	05/09 /2022	Mark Stephens	05/09 /2022	Bryan Li	05/09 /2022
3	Final report	Radhika Gopalakrishnan	05/10 /2022	Mark Stephens	05/10 /2022	Bryan Li	05/10 /2022

The conclusions in the Report titled Cook Cove Traffic Modelling are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Stantec has assumed all information received from JMT Consulting (the "Client") and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

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1 Introduction

1.1 Project Background

Stantec (previously GTA Consultants) were engaged to undertake updated VISSIM microsimulation traffic modelling to assess the road network impacts of the Cooks Cove Planning Proposal which will inform the transport assessment supporting the proposal. Following consultation with Transport for NSW (Tensaw) and provision of a due diligence traffic assessment (dated 8 February 2022), an updated transport assessment, including traffic modelling, is required to inform the next phase of the Planning Proposal. The Department of Planning and Environment (DPE) issued a Gateway Determination for the proposal on 5th August 2022 which notes that the planning proposal is to be updated prior to community consultation to, amongst other things "obtain approval from TfNSW that the planning proposal will not compromise future transport links, deliver a safe road network and enhance walking and cycling connectivity and the use of public transport in accordance with the requirements of the principles".

JMT Consulting is working on revising the Planning Proposal and has requested Stantec to assist with updating the traffic modelling to support the application. The proposed approach seeks to use previously prepared VISSIM models for Cooks Cove while also considering previous concerns raised by TfNSW in their review of the models. The assessment includes the revision of the previously developed base year model to reflect the 2022 traffic conditions.

1.2 Objective of Traffic Modelling

The traffic model will be used to provide an understanding of the potential impact of the proposed Cooks Cove development on the surrounding road network, including the proposed site access arrangements and identification of whether further mitigations may be required.

1.3 Scope of Traffic Modelling

A VISSIM microsimulation traffic model of the road network surrounding the Cooks Cove Planning Proposal has been developed for the purposes of informing the transport assessment. TfNSW has previously endorsed the 2019 base model and as part of the modelling scope for this current assessment, the updated model largely reflects the endorsed 2019 base model apart from changes to signal timings and traffic flow to reflect current day (2022) operating conditions.

The modelling methodology has been documented in the Stantec report, "Cooks Cove Planning Proposal – Traffic Modelling Methodology Report", dated 11th August 2022. The scope of works for this current phase is to use the endorsed 2019 models and update them to:

1. Address any outstanding concerns raised by TfNSW in their review of the transport assessment and models outlined in the following correspondence:

    a. TfNSW Operational Traffic Modelling Team Review and Comments, Cooks Cove Operational VISSIM Model Review, dated 20 November 2020. The use of fixed time signal controls was a particular concern raised by TfNSW and in response the updated base model includes actuated signal timings.

b. TfNSW Addendum Submission to Sydney Eastern City Planning Panel Cooks Cove Revised Planning Proposal October 2021, dated 2 March 2022.

2. An update to the 2019 base year model to reflect 2022 traffic conditions, including ensuring calibration and validation targets are still being met following inclusion of any revisions made based on Item 1 (e.g. update signal controls from fixed time to actuated).

3. Update future year project models to reflect the latest Cooks Cove Planning Proposal yield and forecast traffic generation / distribution.

4. Provide an understanding of expected road network performance to inform the overall transport assessment for the latest development application, including investigation into additional mitigation measures that may be required on the adjacent road network.

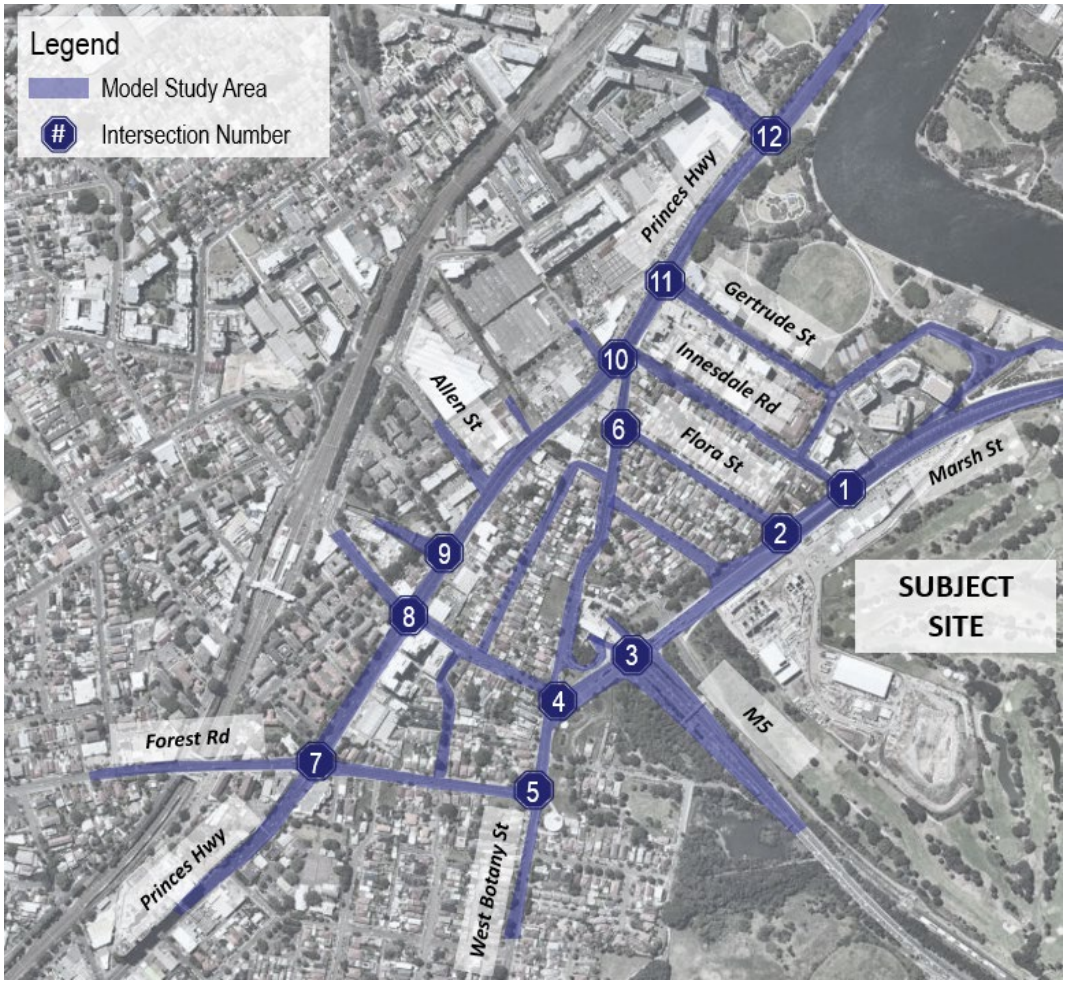
1.4 Study Area

The study area for this assessment is consistent with that used for the previously endorsed 2019 base model and includes twelve signalised intersections along Princes Highway, Marsh Street and West Botany Street. These intersections are detailed in Table 1.1 with their respective locality shown in Figure 1.1.

Table 1.1. Model signalised intersections

ID	Intersection	ID	Intersection
1	Marsh Street / Innesdale Road	**7**	Princes Highway / Wickham Street / Forest Road
2	Marsh Street / Flora Street / Construction Access	**8**	Princes Highway / Kyle Street
3	Marsh Street / M5 On & Off-Ramp	**9**	Princes Highway / M5 Off-Ramp
4	Marsh Street / West Botany Street	**10**	Princes Highway / West Botany Street
5	West Botany Street / Wickham Street	**11**	Princes Highway / Gertrude Street
6	West Botany Street / Flora Street	**12**	Princes Highway / Brodie Sparks Drive

Figure 1.1. Model study area



1.5 Report Outline

This report sets out an overview of the model development, calibration and validation process and includes the following sections:

- Data collection and existing condition (Chapter 2)
- Base year model development and assumptions (Chapter 3)
- Summary of calibration and validation criteria (Chapter 4)
- Base year model calibration and validation (Chapter 5)
- Summary of model limitations (Chapter 6).

It is noted that this report provides a detailed description of the microsimulation model development process and its calibration and validation results, and as such is predominantly aimed at a technical audience.

2 Traffic Data Collection

2.1 Overview

One of the key items raised by TfNSW in their reviews of the previous model versions was to consider re-calibrating and validating the 2019 base model to reflect current (2022) operating conditions. Subsequently, additional traffic data has been requested and obtained from TfNSW for a typical weekday (Tuesday 10th May 2022). A summary of data collected and utilised in the model development is provided in Table 2.1 below.

Table 2.1. Traffic data collection summary

Data Type	Source	Survey Date
HERE travel time data	TfNSW	Tuesday, 10th May 2022
SCATS detector volume data	TfNSW	Tuesday, 10th May 2022
SCATS signal data	TfNSW	Tuesday, 10th May 2022
Intersection counts	Austraffic[1]	Thursday, 27th October 2016 Saturday, 29th November 2016
Pedestrian counts	Austraffic[1]	Thursday, 27th October 2016

[1] Intersection and pedestrian count surveys undertaken by Austraffic but obtained from Arup.

2.2 HERE Travel Time data

HERE travel time data has been provided by TfNSW for two bi-directional routes within the identified study area for the AM and PM peak periods. The travel time routes are listed below and shown in Figure 2.1 and Figure 2.2.

- Route 1 – Princes Highway between Gannon Street and Subway Road
- Route 2 – Marsh Street / Wickham Street between Airport Drive and Firth Street.

HERE travel time data is based on GPS data consolidated into 15-minute intervals and the following limitations of the data should be considered in the review of observed vs model travel times:

- HERE data route sections at model extremities do not align exactly with the model extent. Where relevant and appropriate, these sections have been excluded from the validation assessment.
- HERE speed/travel time data is captured per section which is then aggregated for length of the entire route to be used in the model. It is understood that HERE travel time data considers travel time of vehicles entering or exiting side streets along the route, whilst the model considers vehicles that travel along the main alignment of the route (or section of the route) only. As such, potential travel time delays that may be incurred by vehicles joining the route midway is not considered in the modelled travel time results. The HERE travel time data indicates a high level of variability, and as such, the comparison of model travel times against the minimum and maximum observed travel times will also be provided.
- The sample size of HERE data is unknown.

Figure 2.1. Route 1 - Princes Highway between Gannon Street and Subway Road

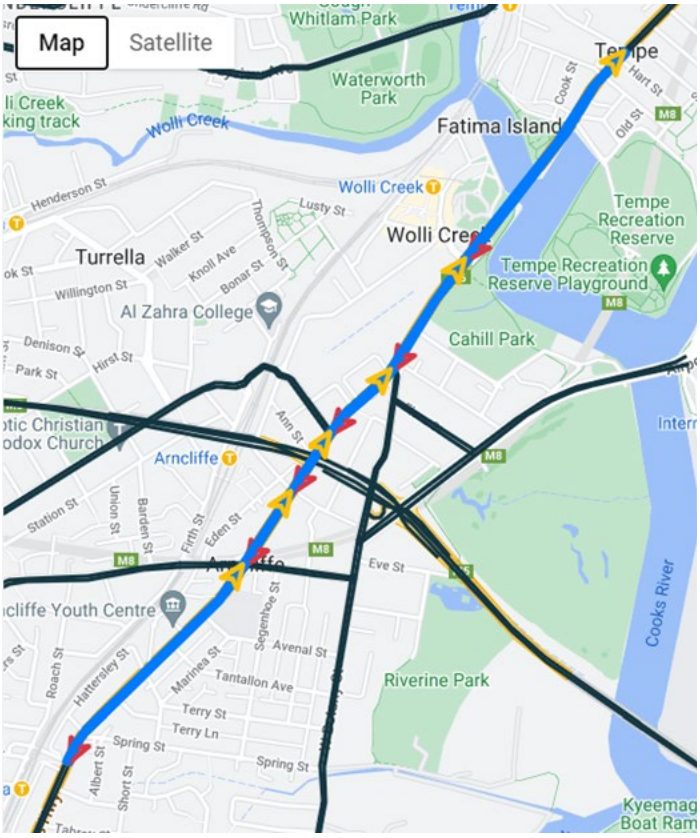
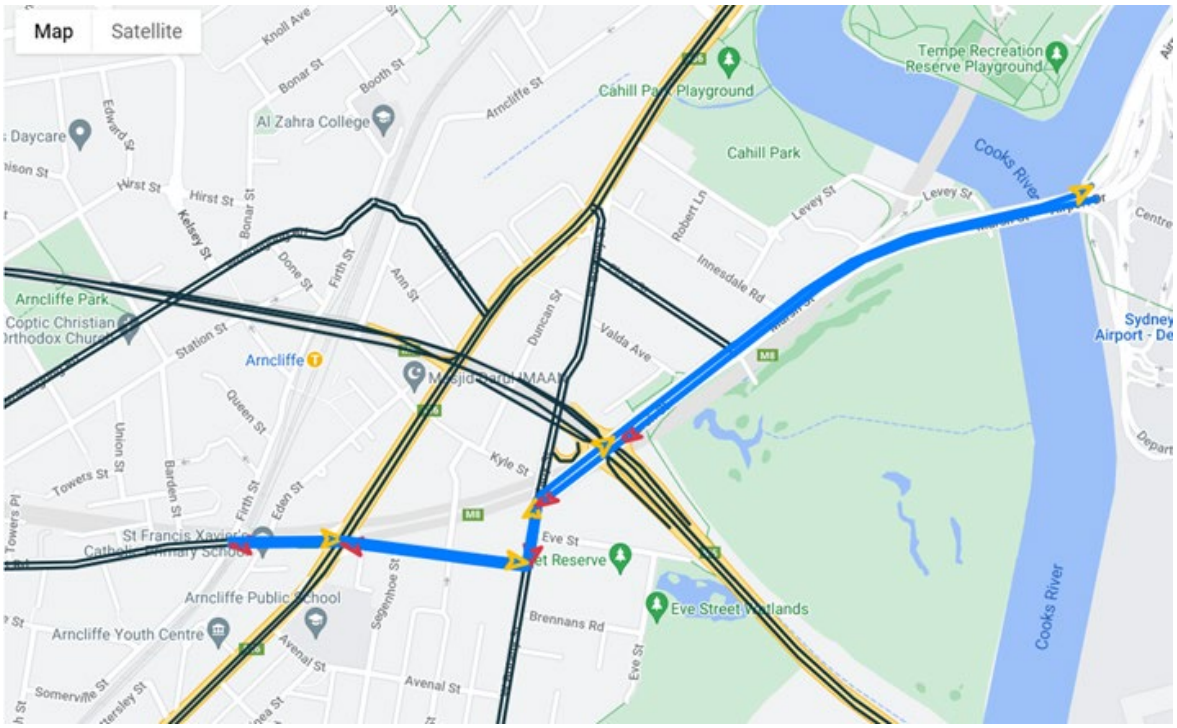


Figure 2.2. Route 2 - Marsh Street / Wickham Street between Airport Drive and Firth Street



2.3 SCATS Data

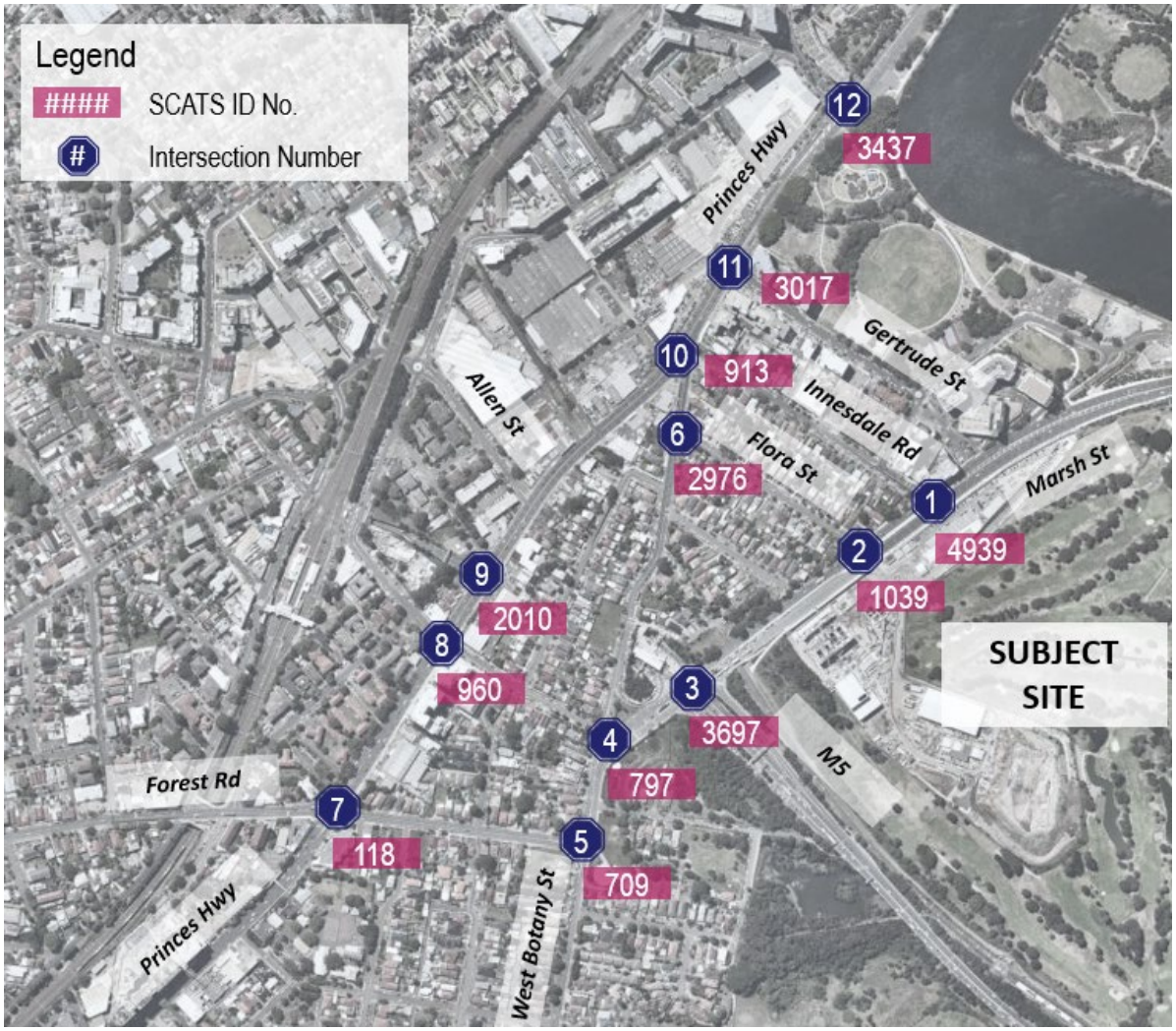
2.3.1 SCATS DETECTOR DATA

24-hour SCATS detector information has been provided by TfNSW to provide intersection volumes for the twelve signalised intersections within the model study area. The twelve signalised intersections are detailed in Table 2.2 and illustrated in Figure 2.3. For non-signalised intersections and shared lane directional proportions and movements that were un-detected by SCATS, the 2016 classified turning movement counts undertaken by Austraffic were used to supplement the 2022 data. This approach is consistent with that used for the previously endorsed 2019 base model.

Table 2.2. Model study area signalised intersection

ID	Intersection	Intersection Type	SCATS ID Number
1	Marsh Street / Innesdale Road	Signalised T-intersection	4939
2	Marsh Street / Flora Street / Construction Access	Signalised X-intersection	1039
3	Marsh Street / M5 On & Off-ramp	Signalised X-intersection	3697
4	Marsh Street / West Botany Street	Signalised T-intersection	797
5	West Botany Street / Wickham Street	Signalised T-intersection	709
6	West Botany Street / Flora Street	Signalised T-intersection	2976
7	Princes Highway / Wickham Street / Forest Road	Signalised X-intersection	118
8	Princes Highway / Kyle Street	Signalised X-intersection	960
9	Princes Highway / M5 Off-Ramp	Signalised T-intersection	2010
10	Princes Highway / West Botany Street	Signalised T-intersection	913
11	Princes Highway / Gertrude Street	Signalised T-intersection	3017
12	Princes Highway / Brodie Sparks Drive	Signalised T-intersection	3437

Figure 2.3. Signalised intersections SCATS ID Number



As SCATS detector volumes do not individually classify light and heavy vehicles, it was assumed the percentage of heavy vehicle volume for each origin-destination pair would be calculated based on 2016 classified turning movement counts undertaken by Austraffic.

2.3.2 SCATS SIGNAL DATA

SCATS signal information has been provided by TfNSW to assist with coding the signalised intersections, as well as to understand the current operation of each signalised intersection in more detail.

- SCATS history data summaries for each site were provided for the same day as the 2022 traffic data collection. The phase time data was used to setup actuated signal controls based on average peak period cycle times and phase times.
- SCATS LX file was provided to code in the linking and coordination of signals within the network.

2.3.3 EXISTING CONDITIONS ANALYSIS

As assessment was undertaken using available survey data, aerial images, and maps for the existing network conditions. Figure 2.4 and Figure 2.5 show the typical traffic conditions for the Tuesday survey day highlighting congestion issues along Princes Highway, the M5 East freeway, and Marsh Street. Observations also highlighted the use of Flora Street, Innesdale Road and Gertrude Street as available short cuts or “rat runs” for vehicles travelling between Princes Highway and Marsh Street. Large queues and constant traffic have been observed along these routes.

Figure 2.4. AM peak typical traffic conditions

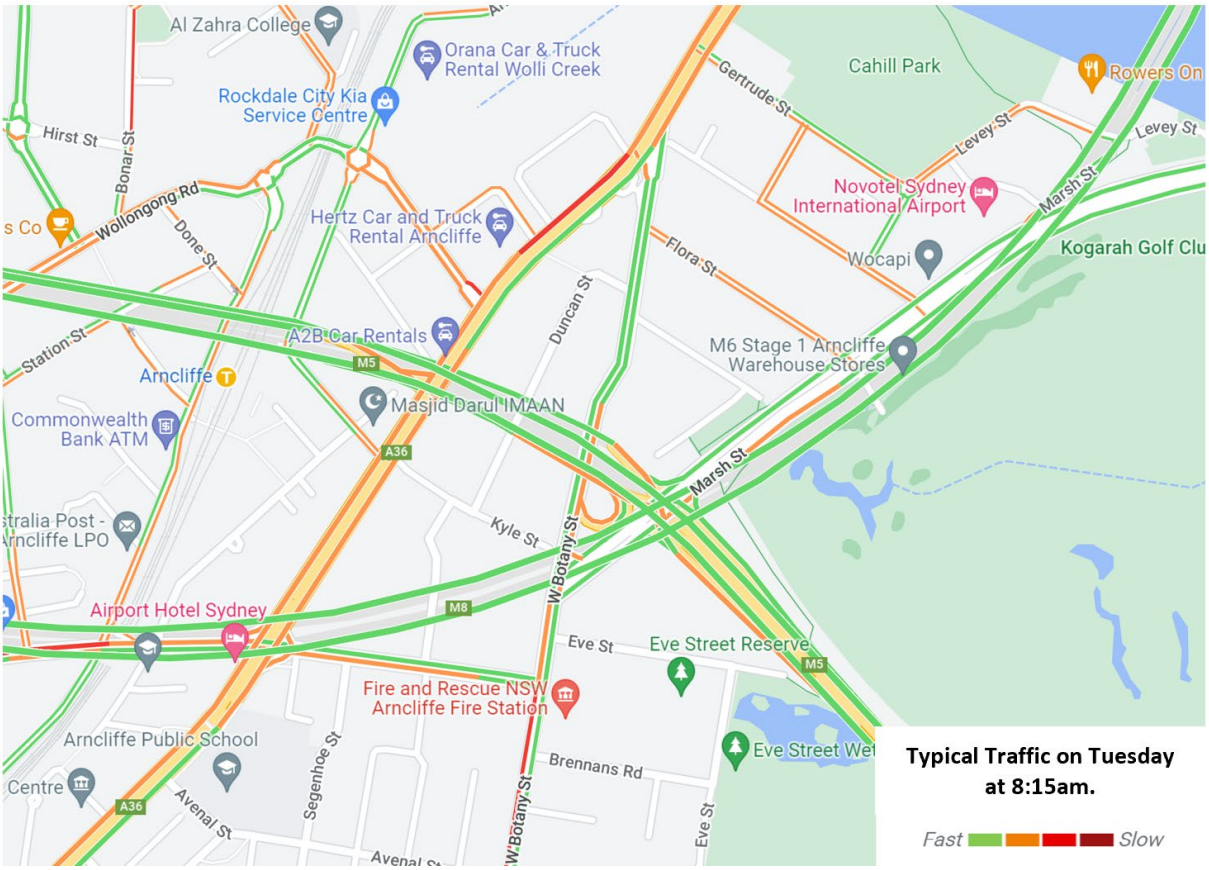
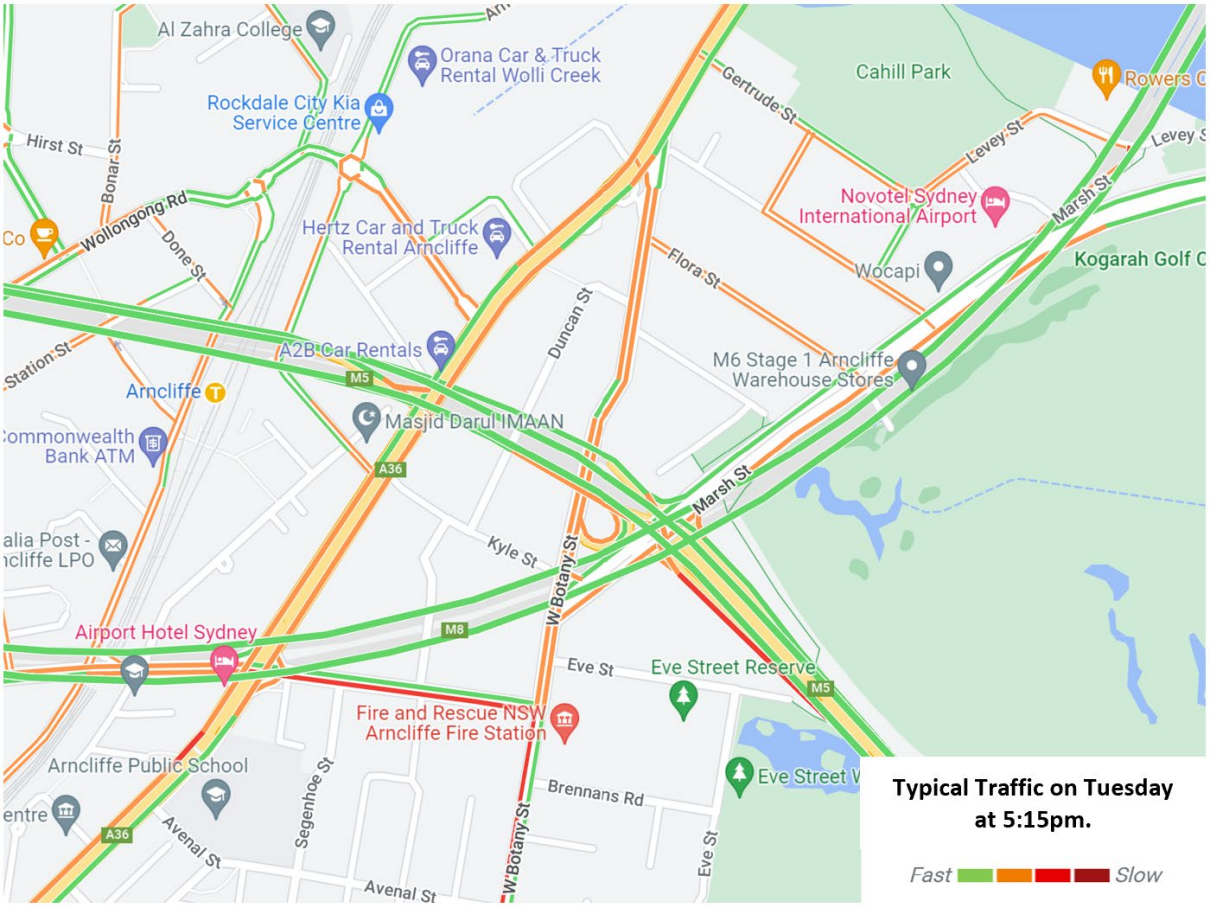


Figure 2.5. PM peak typical traffic conditions



2.4 Pedestrian Count Data

Pedestrian counts were collected at the intersections illustrated in Figure 2.3 and includes bi-directional crossing volumes at the signalised intersections. Pedestrian crossing volumes were collected every 15 minutes during the nominated AM, PM, and Saturday peak periods. It is noted that pedestrian counts were based on 2016 surveys which represented the most recent data available for the purposes of this assessment.

Pedestrian count data has been included in the model to capture the potential effects on road network performance because of pedestrian crossings at signalised intersections. The pedestrian counts utilised for this assessment are consistent with that used for the previously endorsed 2019 base model.

3 Model Development and Assumptions

3.1 Overview

The Cooks Cove model was originally developed by Arup as detailed in the report titled 'Cook Cove Northern Precinct Master Plan' dated November 13, 2017, which was revised and accepted by Bayside Council in the previous assessment. The base year model was updated in 2019/2020 to inform the Cooks Cove planning proposal transport assessment. A further update to the base year model to reflect 2022 traffic conditions (this model) has been undertaken to inform the revised Cooks Cove planning proposal with the following sections providing a summary of the 2022 base year model development. It is noted that the previous model assumptions have been retained where possible and relevant.

3.2 Model Version

VISSIM version 22.00-06 was used to develop the 2022 base model, noting that this is an updated model version from the previous 2019 base model.

3.3 Model Extent

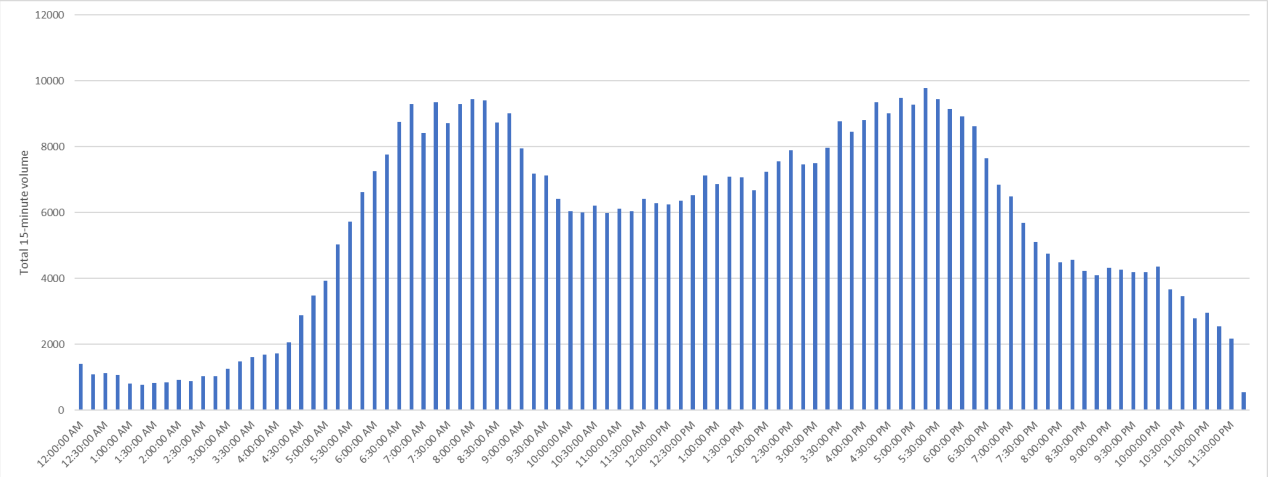
The extent of the model is described in Section 1.4 of this report, with all signalised intersections and links presented in Figure 1.1.

3.4 Modelled Time periods

The one-hour peak period adopted in the previous base year modelling has been retained as part of this study for the AM and PM peak periods with 30-min warm-up and cool-down periods. The one-hour peak period models were considered sufficient for the purpose of the development application to inform the potential road network impacts as a result of the proposed Cooks Cove development during the critical road network peak hours. This approach is consistent with that used for the previously endorsed 2019 base model.

Peak times were confirmed through the analysis of 2022 SCATS data. Total volumes recorded across the 12 signalised sites were plotted in 15-minute intervals as illustrated in Figure 3.1.

Figure 3.1. Total 15-minute volume across all sites



During the AM peak, traffic volumes peak at around 8:00am and slowly decline through the rest of the morning peak. In the PM peak, traffic volumes peak at around 5:15pm. Based on the traffic volume profile, the peak hours were calculated as 7:45am – 8:45am and 4:45pm – 5:45pm and were adopted for the traffic modelling assessment as represented in Table 3.1.

Table 3.1. Model period

Peak	Warm-up period	Peak Hour	Cool-down period
AM	7:15 – 7:45am	7:45 – 8:45am	8:45 – 9:15am
PM	4:15 – 4:45pm	4:45 – 5:45pm	5:45 – 6:15pm

3.5 Assignment Type

The traffic demand was assigned to the existing road network utilising the dynamic assignment method. Dynamic assignment utilises an iterative simulation where drivers choose their routes through the network based on travel costs they encounter during the preceding run. In the VISSIM software, simulations continue until convergence criteria is met; in this case, until travel times on specific paths do not change significantly from one iteration to the next.

Further details on model convergence of the dynamic assignment models have been provided in Section 5.

3.6 Vehicle Types

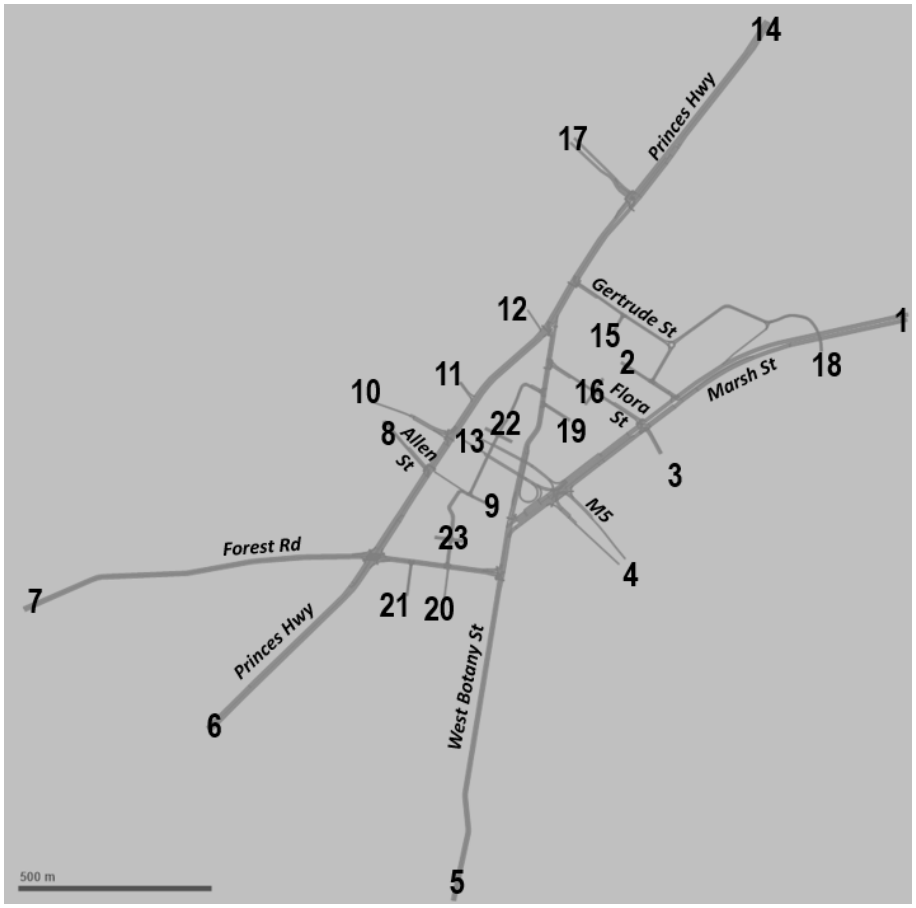
The model includes two vehicle types – Car and HGV representing light vehicles and heavy vehicles, respectively. Default vehicle dimensions and driving behaviour were used in VISSIM software.

3.7 Zone System

The zoning system in previous model versions were maintained in the 2022 base model, comprising of 23 zones shown graphically in Figure 3.2. For the purpose of microsimulation modelling, it is pertinent that wherever possible, connections are made from the zone to the road section entrance or

exit as this provides a more realistic behaviour representation of vehicle trips entering and exiting road networks.

Figure 3.2. Traffic model zoning system



3.8 Links and Connectors

Links and connectors were coded to match the current road network and intersection geometries including the correct configuration, lane designation and permitted turns. No U-turns have been coded at signalised intersections which is consistent with the previous model versions.

The base model has been constructed using “Urban” link type which has been carried forward for all network updates required. Default characteristics and driving behaviours have been adopted, which assumes that drivers can be in one of four driving modes:

- Free driving
- Approaching
- Following
- Braking

The default parameters for vehicles on this road type were maintained across the network.

3.9 Unsignalised Intersections

Conflict markers and priority rules were coded in the model to control the movement of vehicles through unsignalised intersections as per current network operation and signage, as well as for 'filtered' movements at signalised intersections. As an initial guide, minimum gap time (seconds) settings were based on the nominated times specified in Table 3.5 of the Austroads Guide to Road Design, Part 4a (2017) for the specific movement types and number of lanes crossed.

During the calibration and validation of the model, vehicle behaviour at unsignalised junctions were reviewed to ensure that the gap time (seconds) and headway (metres) parameters modelled realistic behaviour at the intersection and adjusted as required.

3.10 Signalised Intersections

All signalised intersections within the model were coded with actuated signals in accordance with TfNSW review comments from the previous 2019 modelling. The SCATS TCS graphics and history data provided by TfNSW were used to develop the signal control logic and determine key parameters including:

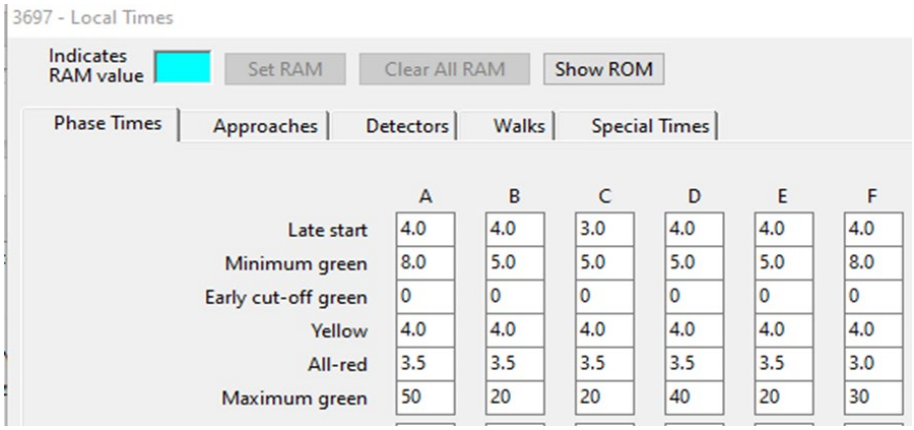
- Signal groups
- Detector numbers
- Phase transitions
- Average, minimum and maximum phase times.

All signal phasing was adopted into the model in 15-minute intervals for each peak period using the SCATS history files to inform green time allowances.

Phase intergreen time for all signals was based on the SCATS signal settings provided by TfNSW. Typically intersections were coded with a default of 6 seconds of intergreen time. However, the M5 / Marsh Street intersection has been coded with 8 seconds of intergreen time for all phases and the Princes Highway / Brodie Sparks Drive intersection was coded with 7 seconds of intergreen time for phase D as shown in the SCATS settings in Figure 3.3 and Figure 3.4.

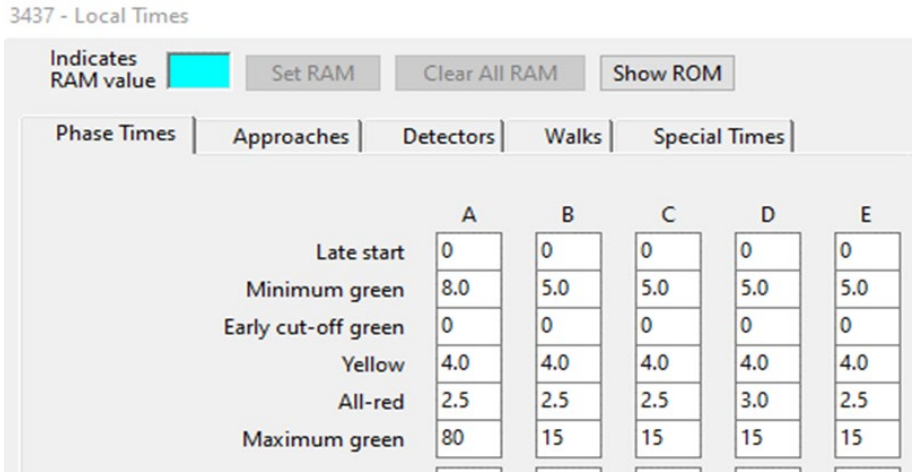
The SCATS signal linking file (.lx file) was used to setup signal coordination across the model. Travel times and visual observations of queuing conditions were then used to validate and refine signal coordination settings implemented in the signal controls.

Figure 3.3. SCATS phase timing setting for M5 / Marsh Street intersection



	A	B	C	D	E	F
Late start	4.0	4.0	3.0	4.0	4.0	4.0
Minimum green	8.0	5.0	5.0	5.0	5.0	8.0
Early cut-off green	0	0	0	0	0	0
Yellow	4.0	4.0	4.0	4.0	4.0	4.0
All-red	3.5	3.5	3.5	3.5	3.5	3.0
Maximum green	50	20	20	40	20	30

Figure 3.4. SCATS phase timing setting for Princes Highway / Brodie Sparks Drive intersection



	A	B	C	D	E
Late start	0	0	0	0	0
Minimum green	8.0	5.0	5.0	5.0	5.0
Early cut-off green	0	0	0	0	0
Yellow	4.0	4.0	4.0	4.0	4.0
All-red	2.5	2.5	2.5	3.0	2.5
Maximum green	80	15	15	15	15

3.11 Speed Limits and Restrictions

'Desired Speed Decisions' have been used throughout the model to reflect the sign posted speed limits. Similarly, 'Reduced Speed Areas' have been coded to reflect realistic speed limits due to geometric constraints (i.e. turn radius).

The "Desired Speed Decisions" and their relative speed distributions are shown in Table 3.2.

Table 3.2. Desired speed decisions and speed distributions

Sign-posted Speed Limit (km/hr)	Modelled Speed Distribution (km/hr)
40	36 - 40
50	45 - 50
60	54 - 60
80	72 - 80

3.12 School Zones

The model extent includes a school zone on Forest Road between Barden Street and Princes Highway as seen in Figure 3.5. The school zone speed limit has been replicated in the model using 'Desired Speed Decisions'. A timed speed limit of 40km/hr has been incorporated between 8:00am – 9:15am to replicate existing conditions. The PM peak does not include these desired speeds as the school zone timing (2:30pm – 4:00pm) falls outside of the modelled time period.

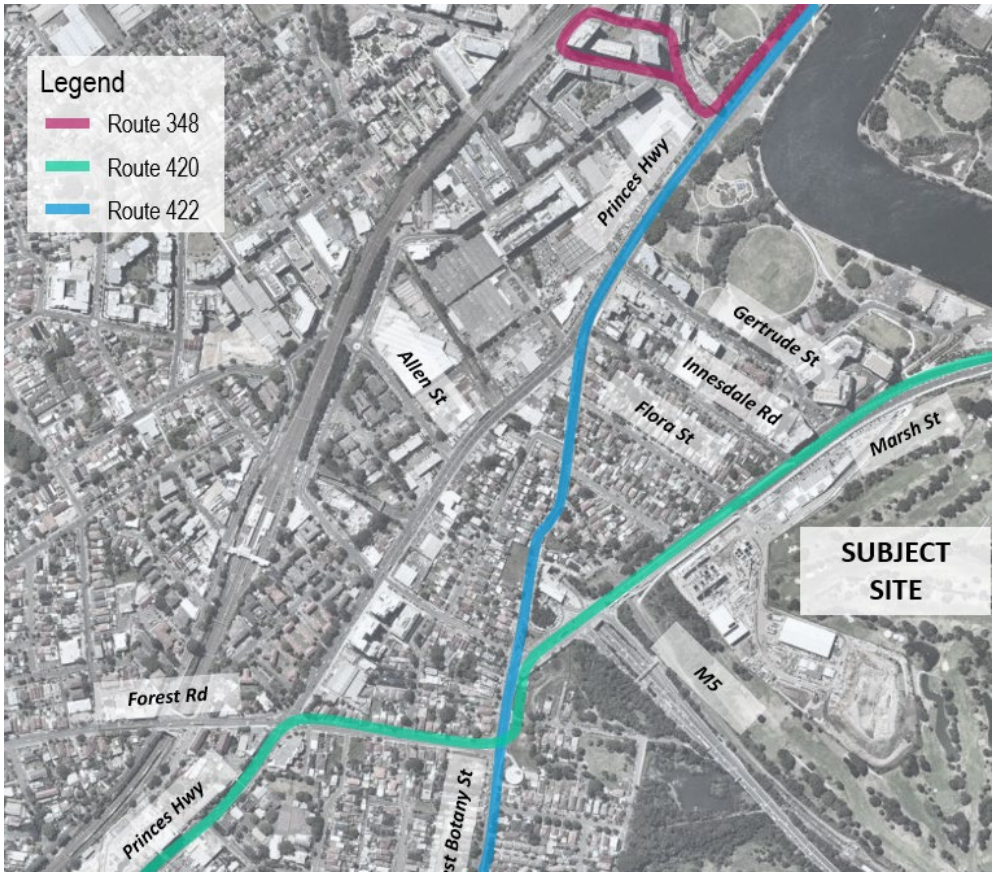
Figure 3.5. School zone on Forest Road

3.13 Public Transport

Public transport routes and frequencies were identified to have changed between 2019 and 2022. Therefore, the model was updated to include the latest frequency of the 348, 420/420N and 422 services. The respective routes and their locality have been developed from the following sources and are shown in Figure 3.6.

- Public transport routes and timetables – TfNSW website: Sydney buses network
- Public transport stops – TfNSW Trip Planner in conjunction with aerial photography.

Figure 3.6. Public transport routes



3.14 Pedestrians

Pedestrian crossing volumes have been included at all signalised intersections based on the latest available pedestrian count data as described in Section 2.4. These have been input into the model using vehicle inputs / static route assignment on pedestrian links crossing the relevant road sections, with pedestrian signal groups used to control the movement of pedestrians across intersections (as per the relevant actuated signal program).

Where pedestrians and vehicles interact (e.g. zebra crossings across slip lanes, left and right turn movements across pedestrian crossings), conflict areas and/or priority rules have been coded to ensure that safety and operational controls are obeyed.

3.15 External Constraints

Where extremities of the model coincide with downstream congestion due to signalised intersections or other constraints, it was necessary to replicate the deceleration and queueing that occurs. In this case, reduced speed areas were implemented on Princes Highway for vehicles exiting the model northbound. Similarly, reduced speed areas were implemented along the northbound exit of Marsh Street to simulate queueing and congestion flowing back from Airport Drive.

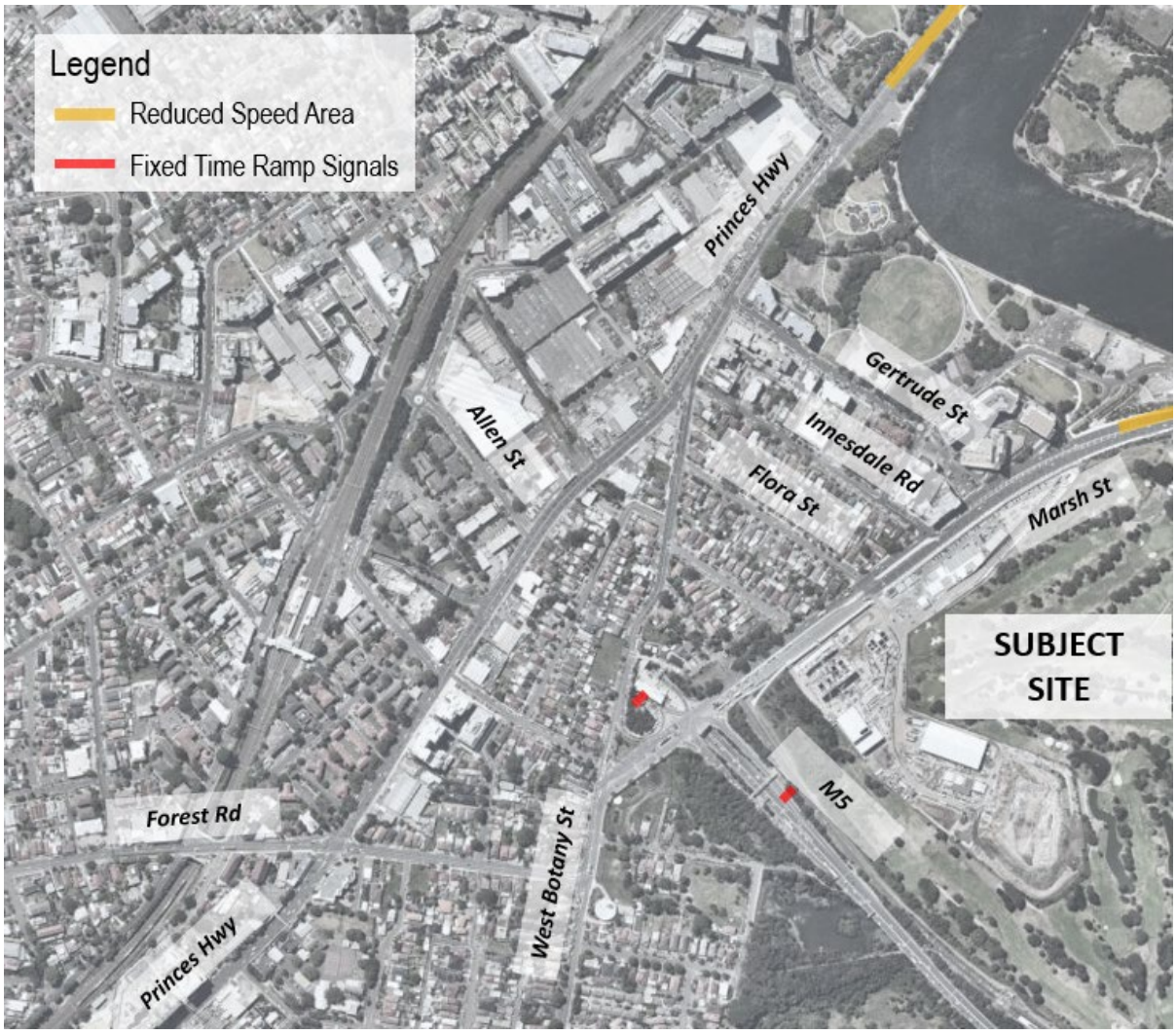
Observations of the study area showed extensive queuing resulting from the M5 East on-ramps. Although not signalised, fixed time signals were implemented at the exits of the model to introduce

this queueing. These assumptions were retained from the previous 2019 base model settings, which have been further refined based on the 2022 HERE travel time data and Google traffic data.

Figure 3.7 shows the reduced speed areas and fixed time ramp signals implemented as external constraints of the model.

It is noted that all external constraints would be retained for future year scenario models.

Figure 3.7. Model external constraints



3.16 Demand Matrices

Demand matrices have been developed based on 2022 SCATS detector volume data in conjunction with matrices developed in previous models. Matrix adjustment has been undertaken to develop demands that would match existing travel patterns and distributions. The adjustment process is an iterative process which was undertaken using the following steps:

- Step 1: Factor origin and destination totals to match the entry and exit volumes to the model network using “matrix furnessing”.

- Step 2: Model simulation and convergence to compare modelled and observed turn movements.
- Step 3: Adjust or apply local and global parameters to correct path assignment and routing decisions under dynamic traffic assignment.
- Step 4: If required, manual matrix adjustment to achieve improved calibration results or induce queues/delays on approaches (i.e. consider model demand vs throughput).
- Step 5: Model simulation and convergence to compare modelled and observed turn movements.

Steps 3 – 5 are repeated until and appropriate level of calibration is achieved.

A summary of the total demand following all adjustments is detailed in Table 3.3.

Table 3.3. Total peak hour traffic demands

Model	Peak Hour	Light Vehicles	Heavy Vehicles	Total Traffic
AM Peak	7:45am – 8:45am	8,980	720	9,700
PM Peak	4:45pm – 5:45pm	9,674	382	10,056

3.16.1 TRAFFIC PROFILE

Once the calibration of the hourly demand matrices was finalised, the one-hour matrices were individually split to a 15-minute profile to release the traffic into the modelled network at appropriate rates based on the SCATS detector volumes. Profiles are based on model matrix inputs for both light vehicles and heavy vehicles and shown graphically in Figure 3.8 and Figure 3.9.

Figure 3.8. AM peak model traffic demand profile

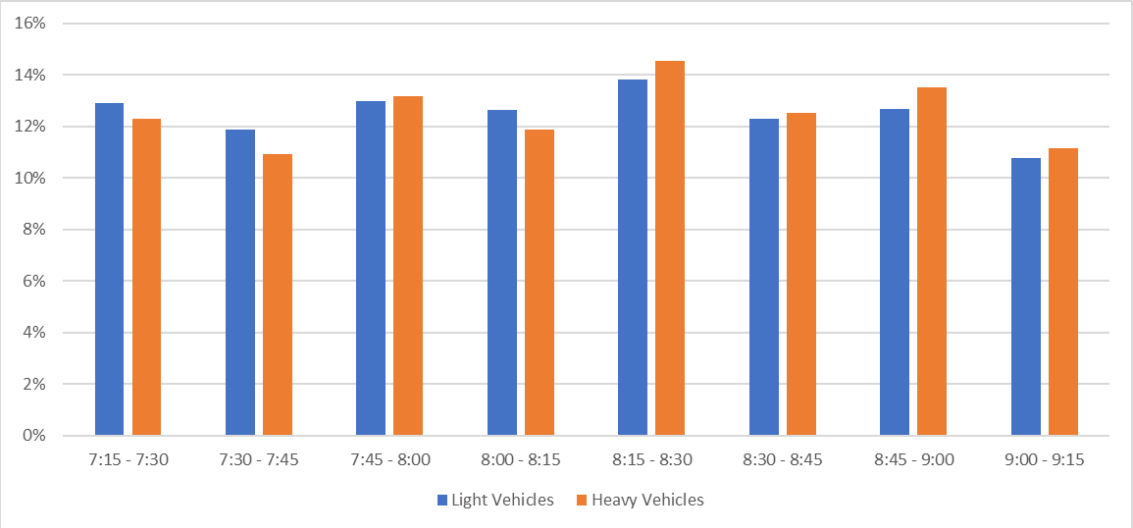
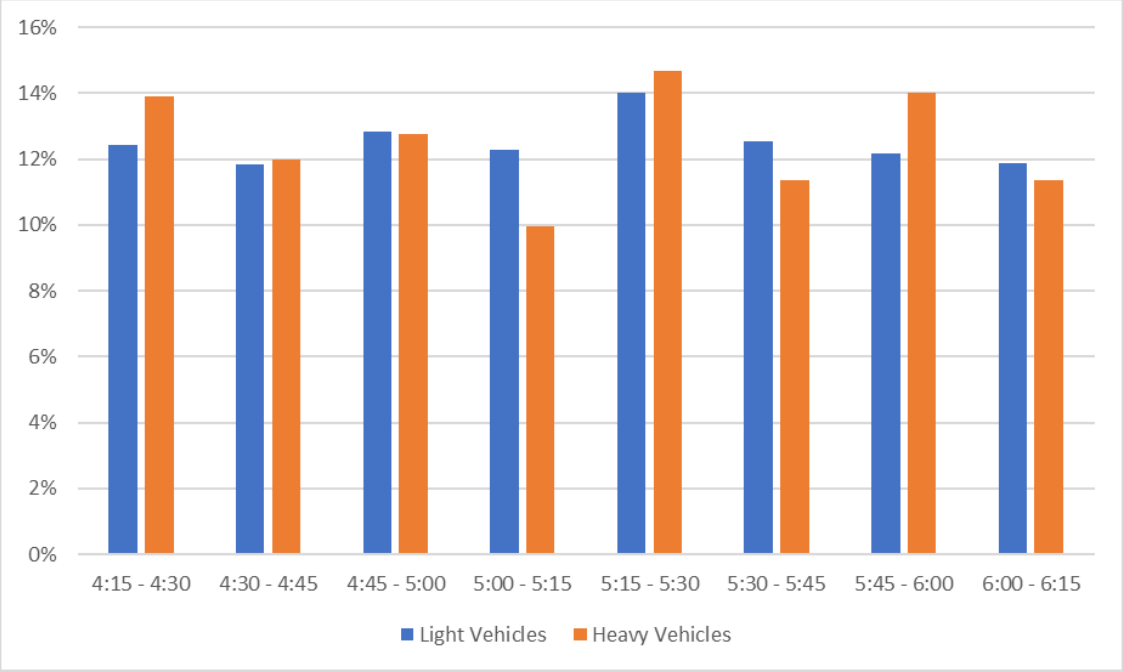


Figure 3.9. PM peak model traffic demand profile



4 Calibration and Validation Criteria

4.1 Overview

The calibration and validation process is critical to verify that the model operation is reflective of typical real-world operation. This ensures the conclusions of the modelling are reliable and accurate for basing planning and infrastructure decisions upon.

4.2 Targets

The Roads and Maritime Services (now TfNSW) Traffic Modelling Guidelines, February 2013, were used for the development of this model. The calibration and validation criteria for microsimulation modelling is set out in Chapter 11 of the TfNSW Traffic Modelling Guidelines and summarised in Table 4.1.

Table 4.1. TfNSW traffic modelling calibration and validation guidelines

Item	Criteria
Turn volumes (Network wide)	Tolerance limits for turn volumes • GEH < 5 for at least 85% of link and turn flows • Where link or turn GEH < 10 an explanation is required • R2 value for Observed vs. Modelled plots to be >0.9
Turn volumes (Core Area)	Tolerance for Core Area: • Flows < 99 – to be within 10 vehicles of observed value • Flows 100 to 999 – to be within 10 per cent of observed value • Flows 1000 to 1999 – to be within 100 vehicles of observed value • Flows > 2000 – to be within 5 per cent of observed value • 100 per cent of observations to be within tolerance limits • R2 value to be included with plots and to be > 0.95
Travel Time Average	• Average modelled journey time to be within 15% or one minute (whichever is greater) of average observed journey time for full length of route. • Average modelled journey time to be within 15% of average observed journey time for individual sections.

4.3 Turn Movement and Link Counts

The GEH statistic is used to validate the model flows against the observed data and is best described as a standard measure of the “goodness of fit” between observed and modelled flows. Unlike comparing the percentage difference, the GEH statistic places more emphasis on larger flows rather than on small flows. The GEH statistic is defined as follows:

$$GEH = \sqrt{\frac{(M-C)^2}{\frac{(M+C)}{2}}}$$

where M and C are the modelled and observed flows respectively.

Matching link and turn counts are critical to developing a model which is fit for purpose as this ensures the model is accurately representing network flow and distribution. As a model increases in size the difficulty to match counts increases. Most turn counts will be obtained from SCATS detectors which can be less accurate than manual surveys and limits the ability to calibrate light and heavy vehicles independently. However, this approach is balanced by the fact adopting SCATS counts also provides a significant advantage to the number of link locations covered in the model. Consequently, an improved and more robust model demand structure can be achieved.

Secondary criteria, R^2 value, is used to ensure that even with some outliers the overall trend of link and turn matches is reasonable across the network.

5 Calibration and Validation Results

5.1 Overview

The VISSIM microsimulation model is stochastic in nature. As such they can produce different outcomes depending on their starting conditions. Due to this stochastic behaviour, it is necessary to assess how the model behaves under a variety of starting conditions (seeds) using the same input parameters. The ability of a model to produce consistent results for a number of seed values is referred as the model stability, which has been assessed in Section 5.2.

The running of multiple seeds also enables the selection of a single median seed, which represents the most balanced of the seed runs. By adopting the median seed for base and future model runs, variations in results driven by variations in model runs is reduced.

As outlined in the TfNSW Traffic Modelling Guidelines, five seed values are run to determine the median seed based on vehicle hours travelled (VHT). The median seed is then used to present the calibration and validation results.

The following five seeds were selected as per the Table 11.8 in the TfNSW Traffic Modelling Guidelines.

Table 5.1. Model seed values

Seed Number	Seed Value
1	560
2	28
3	7,771
4	86,524
5	2,849

5.2 Model Stability

In order to demonstrate the stability of the model over five seed runs and to determine a suitable median seed, an assessment of the five seeds was undertaken based on the VHT network statistic, as discussed below.

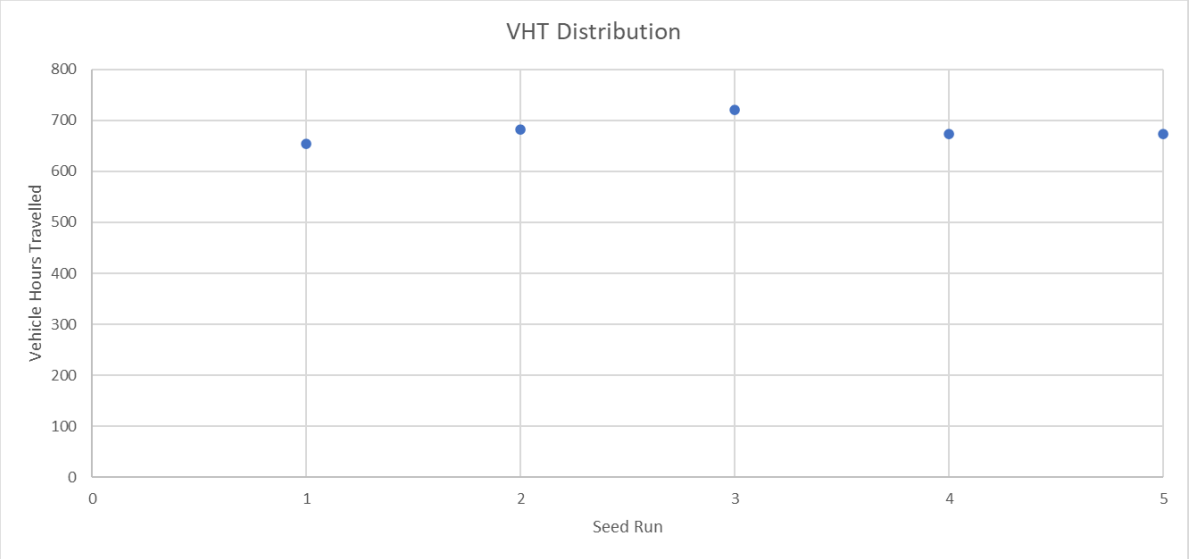
5.2.1 AM PEAK STABILITY RESULTS

The AM peak model stability results are listed in Table 5.2 with a scatter plot showing the VHT distribution in Figure 5.1.

Table 5.2. Model stability statistical results summary for VHT - AM peak

Statistic	Result
Number of Runs	5
Mean	681
Standard Deviation	24.5
Range	66.1
Minimum	655
Maximum	721
95% Confidence Interval	31
Upper Confidence Interval	711
Lower Confidence Interval	650
Median (Seed)	**673 (86,524)**

Figure 5.1. AM peak VHT distribution plot



The results of the AM peak stability test indicates minor variance in VHT amongst the five seed runs, and as such the 2022 base AM peak model is considered to be operating under stable conditions.

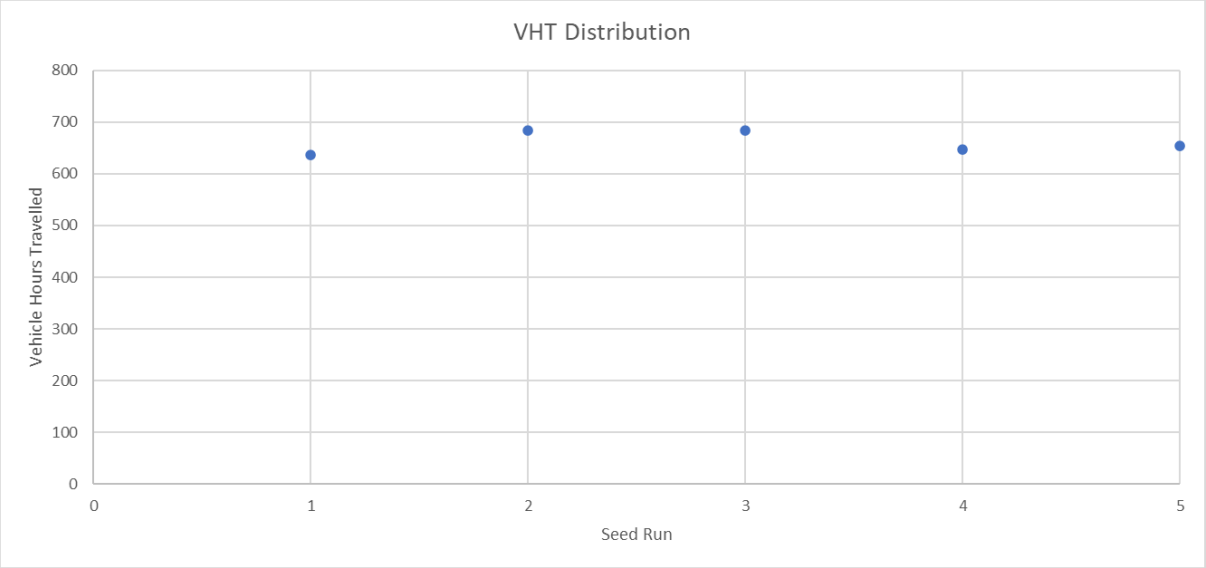
5.2.2 PM PEAK STABILITY RESULTS

The PM peak model stability results are listed in Table 5.3 with a scatter plot showing the VHT distribution in Figure 5.2.

Table 5.3. Model stability statistical results summary for VHT - PM peak

Statistic	Result
Number of Runs	5
Mean	661
Standard Deviation	22.2
Range	48.4
Minimum	636
Maximum	684
95% Confidence Interval	28
Upper Confidence Interval	688
Lower Confidence Interval	633
Median (Seed)	**653 (2,849)**

Figure 5.2. PM peak VHT distribution plot



The results of the PM peak stability test indicates minor variance in VHT amongst the five seed runs, and as such the 2022 base PM peak model is considered to be operating under stable conditions.

5.3 Model Convergence

With the updated demands and actuated signal configuration, the model had to be converged to achieve better route choice behaviour. Both the AM and PM peak models were converged at 70% demand without demand increment for 50 iterations. This is in line with the convergence process adopted for the 2019 base model. Figure 5.3 and Figure 5.4 illustrates the convergence check for path travel time for 50 iterations in AM peak and PM peak, respectively.

Figure 5.3. Path travel time convergence check in AM peak

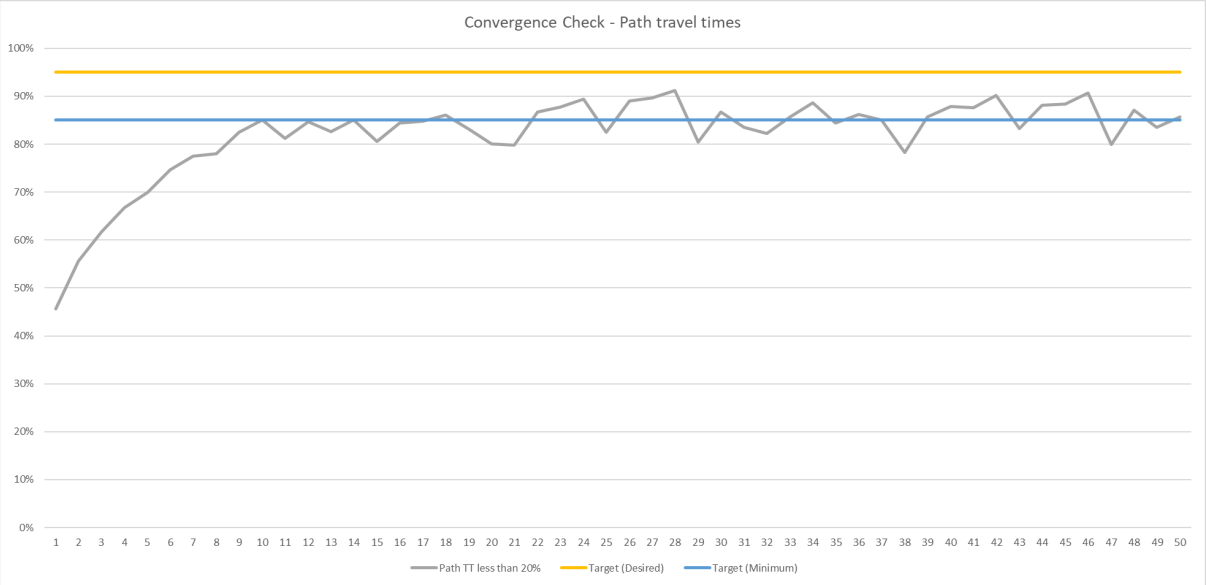
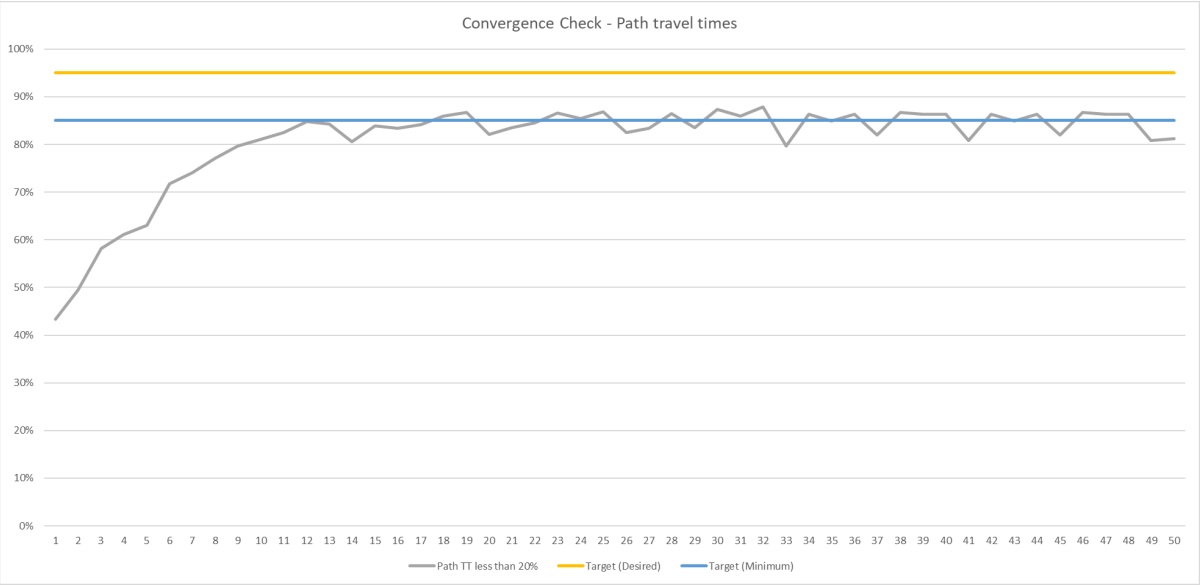


Figure 5.4. Path travel time convergence check in PM peak



The results of the model convergence process indicates that the model was able to achieve a reasonable level of convergence based on changes to travel time on paths across the network. Four (4) consecutive runs satisfying the convergence criteria was used to identify a suitable cost and path file structure for the model - noting that the AM peak model achieved 4 consecutive runs with 91% of paths with a difference in travel time within 20% and the PM peak model achieved 4 consecutive runs with 87% of paths with a difference in travel time within 20%.

A review of the resultant path assignment was undertaken to ensure that the model is capable of replicating travel paths through the network, including the use of alternate routes.

5.4 Model Calibration Results (Network Wide)

Table 5.4 shows the comparison of observed versus modelled turn volumes for the AM and PM peak periods for the entire model network. Figure 5.5 and Figure 5.6 illustrate the associated scatter plots during the critical AM and PM peak hours.

Observed vehicle turning volumes are based on 2022 SCATS detector data and therefore do not distinguish between light and heavy vehicles. As such, calibration results have been assessed for all traffic rather than individual vehicle types. In addition, 2016 intersection counts have been used to determine the turning proportions on shared lanes where SCATS detectors cannot distinguish the individual movements. This approach was agreed with TfNSW and considered appropriate for the purposes of this model update. Alternatively, should no intersection counts be available the comparison was considered as a link count or for its respective movement only.

Detailed calibration outputs are also provided in Appendix A.

Table 5.4. Model calibration results (network wide)

Peak	Hour	GEH Result			Slope	R^2
		≤ 5	≤ 10	> 10		
AM Peak	7:45am – 8:45am	93%	100%	0%	0.99	0.99
PM Peak	4:45pm – 5:45pm	94%	100%	0%	0.95	0.99

Table 5.4 indicates that the model achieves a high level of correlation to the observed traffic volumes with GEH < 5 achieved for 93% of cases in the AM peak and 94% of cases in the PM peak. Given the high level of accuracy achieved across the intersection and network, the modelled volume recorded is deemed appropriate for assessment.

The regression plots illustrated in Figure 5.5 and Figure 5.6 for the AM and PM peaks respectively also indicate a high level of correlation between modelled and observed traffic volumes

Figure 5.5. Total volume regression plot (network wide) - AM peak (7:45am - 8:45am)

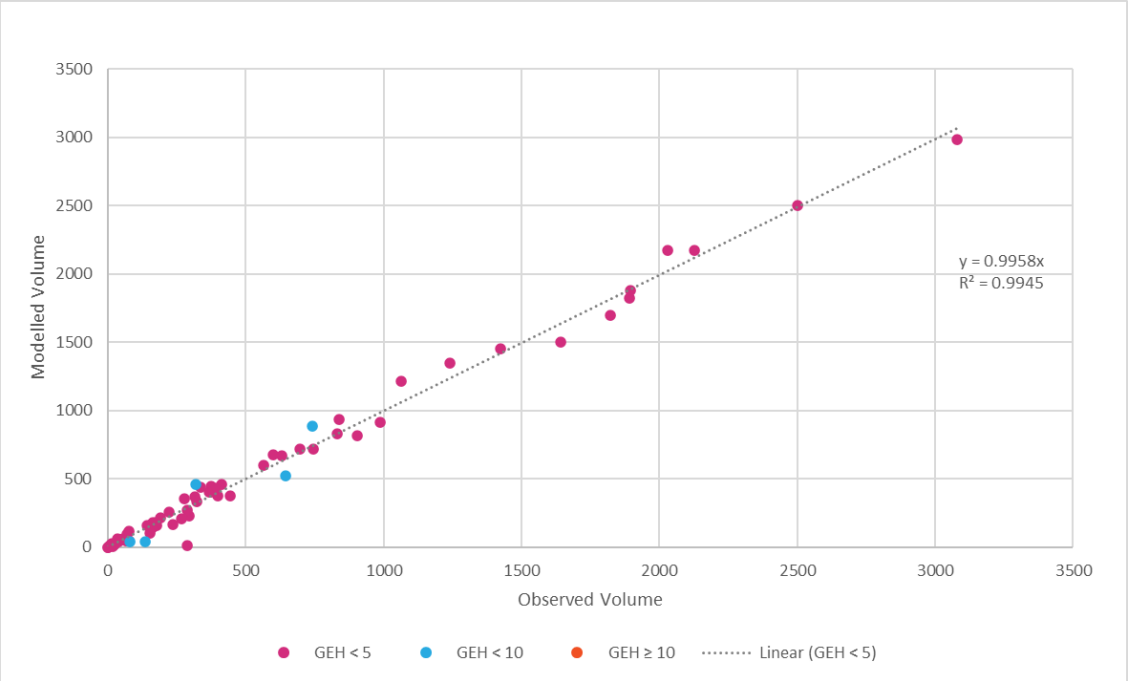
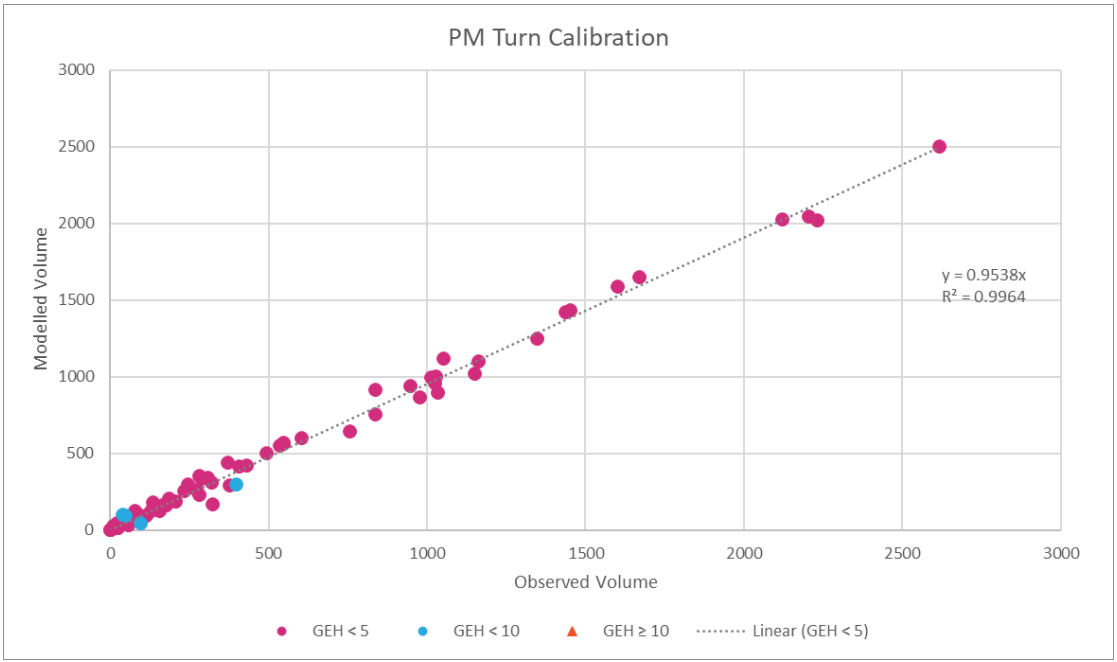


Figure 5.6. Total volume regression plot (network wide) - PM peak (4:45pm - 5:45pm)



5.5 Model Calibration Results (Core Area)

The core area of the network has been identified as those intersections along Marsh Street – i.e. intersections along the frontage of the Cook Cove site and provide direct access to the site. This includes:

- Marsh Street / Innesdale Road
- Marsh Street / Flora Street
- Marsh Street / M5 On-Off Ramps
- Marsh Street / West Botany Street

Table 5.5 shows the comparison of observed versus modelled turn volumes for the AM and PM peak periods within the core area. Figure 5.7 and Figure 5.8 illustrate the associated scatter plots during the AM and PM peak hours.

Detailed calibration outputs are also provided in Appendix A.

Table 5.5. Model calibration results (core area)

Peak	Hour	Criteria				Slope	R^2
		Flows < 99	Flows 100 to 999	Flows 1,000 to 1,999	Flows > 2,000		
AM Peak	7:45am – 8:45am	57% (4/7)	50% (7/14)	0% (0/2)	50% (1/2)	1.00	0.99
PM Peak	4:45pm – 5:45pm	17% (1/6)	38% (5/13)	83% (5/6)	-	0.97	0.99

Table 5.5 indicates that the model does not strictly adhere to the core area calibration criteria in both the AM and PM peak periods with only 48% of turn volumes in the AM peak and 44% of turn volumes in the PM peak meeting the criteria. However, it should be noted that SCATS detector volumes used for analysis provide many limitations including the miscount of vehicles and the inability to record multiple movements within shared lanes.

Notwithstanding, the comparison of modelled and observed volumes for the core area illustrated in Figure 5.7 and Figure 5.8 indicates a very high level of correlation in both the AM and PM peaks with the slope and R^2 value achieving more than adequate results further highlighting the suitability of the model turn volume calibration. The figures also indicate that within the core area, GEH targets are easily met with GEH < 5 achieved for 93% of cases in both the AM peak and PM peak (no cases with GEH greater than 10). These core area results combined with the high level of network calibration achieved, suggests that an appropriate level of model calibration has been achieved in this model.

Figure 5.7. Total volume regression plot (core area) – AM peak (7:45am - 8:45am)

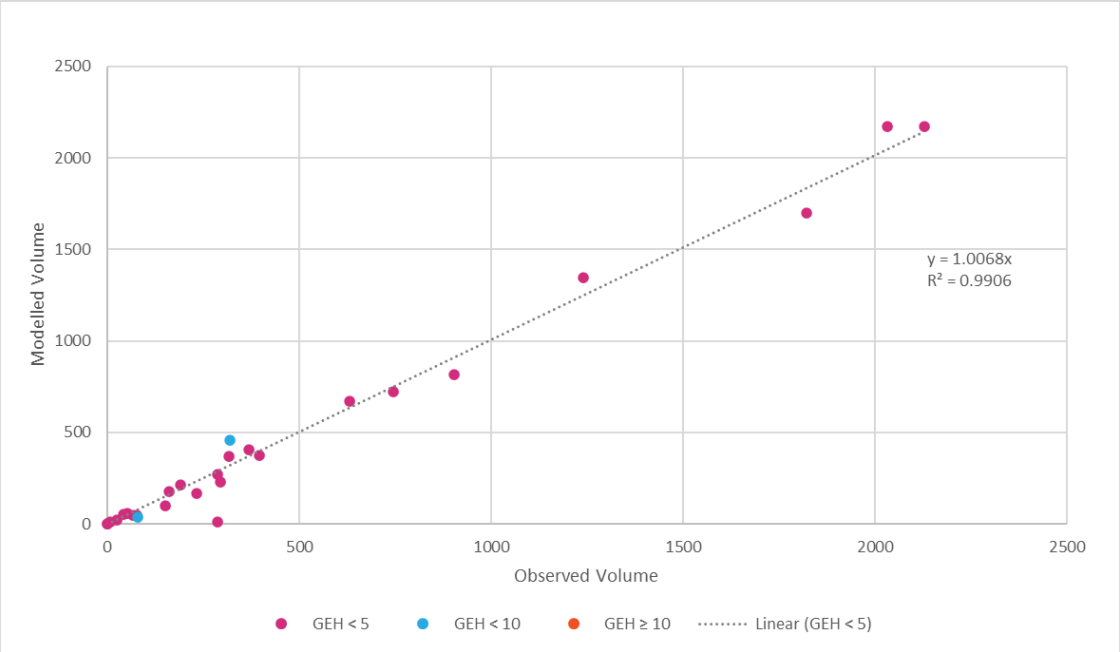
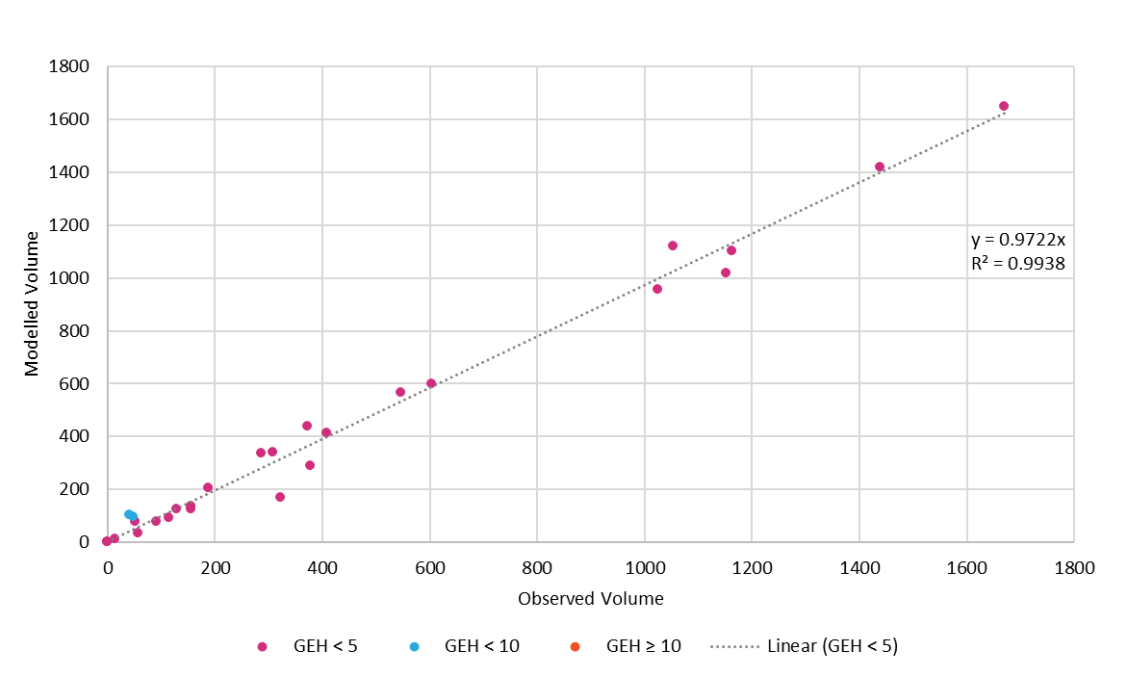


Figure 5.8. Total volume regression plot (core area) - PM peak (4:45pm - 5:45pm)



5.6 Travel Time Validation

As mentioned in Section 2.2, there are some limitations in the use of HERE travel time data for direct comparison against modelled travel times. This should be considered when reviewing the following travel time validation results. It is understood that HERE travel time data considers travel time of vehicles entering or exiting side streets along the route, whilst the model considers vehicles that travel

along the main alignment of the route (or section of the route) only. As such, potential travel time delays that may be incurred by vehicles joining the route midway is not considered in the modelled travel time results.

The comparison of the full route travel times (modelled versus observed) along Princes Highway and Marsh Street / Wickham Street is presented in Table 5.6, with full details provided in Appendix A.

Table 5.6. Travel time validation (in mm:ss)

Peak	Route	Direction	Average Observed Travel Time	Average Modelled Travel Time	Difference	Difference (%)	Meets Criteria?
AM peak (7:45am to 8:45am)	1 – Princes Highway	NB	05:41	04:51	-00:50	-15%	Yes
		SB	03:29	02:59	-00:30	-14%	Yes
	2 – Marsh Street / Wickham Street	EB	04:17	04:11	-00:06	-2%	Yes
		WB	04:17	03:51	-00:26	-10%	Yes
PM peak (4:45pm to 5:45pm)	1 – Princes Highway	NB	05:41	05:12	-00:29	-9%	Yes
		SB	03:49	03:03	-00:43	-19%	Yes
	2 – Marsh Street / Wickham Street	EB	03:26	03:44	+00:18	+9%	Yes
		WB	05:57	04:01	-01:56	-32%	No

Considering the limitations in the HERE travel time data, modelled travel times along Princes Highway are generally lower than the observed travel time but as indicated in the following cumulative travel time graphs there is a high degree of travel time variability along Princes Highway. Princes Highway modelled travel times are generally within the observed minimum and maximum range. Travel times on Marsh Street / Wickham Street are generally comparable to the observed data set.

Cumulative travel times for the AM peak period are presented in Figure 5.9 to Figure 5.12. The travel time graphs show that the model generally replicates the average speed and travel times for all routes, therefore representing the progression of delays experienced along each corridor.

Figure 5.9. AM peak cumulative travel time - Route 1 (Princes Highway) northbound

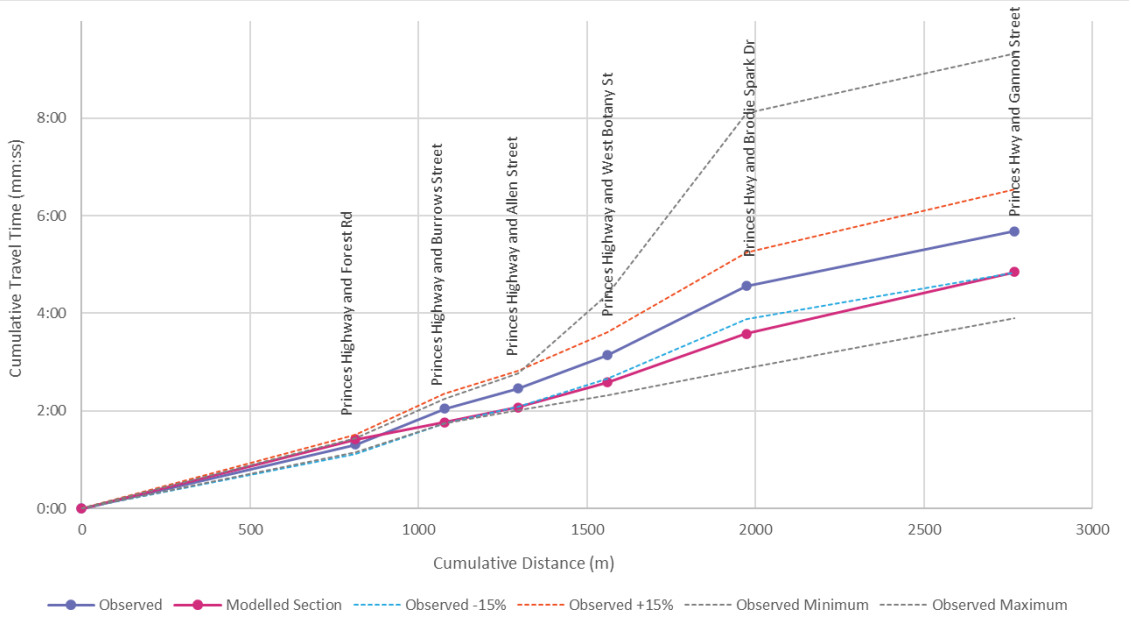


Figure 5.10. AM peak cumulative travel time - Route 2 (Princes Highway) southbound

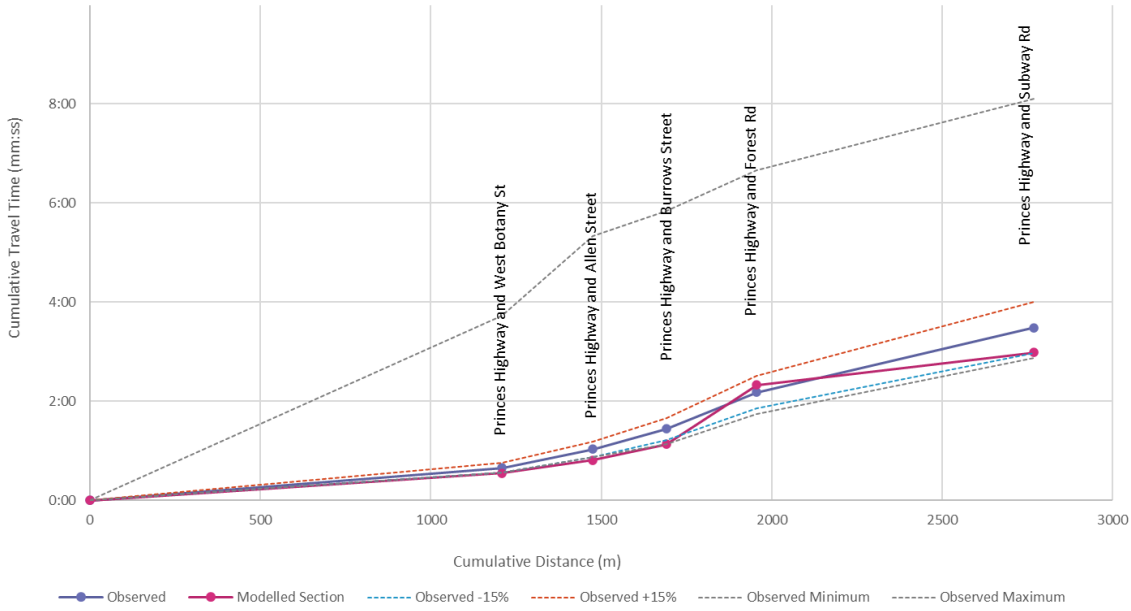


Figure 5.11. AM peak cumulative travel time - Route 3 (Marsh Street / Wickham Street) eastbound

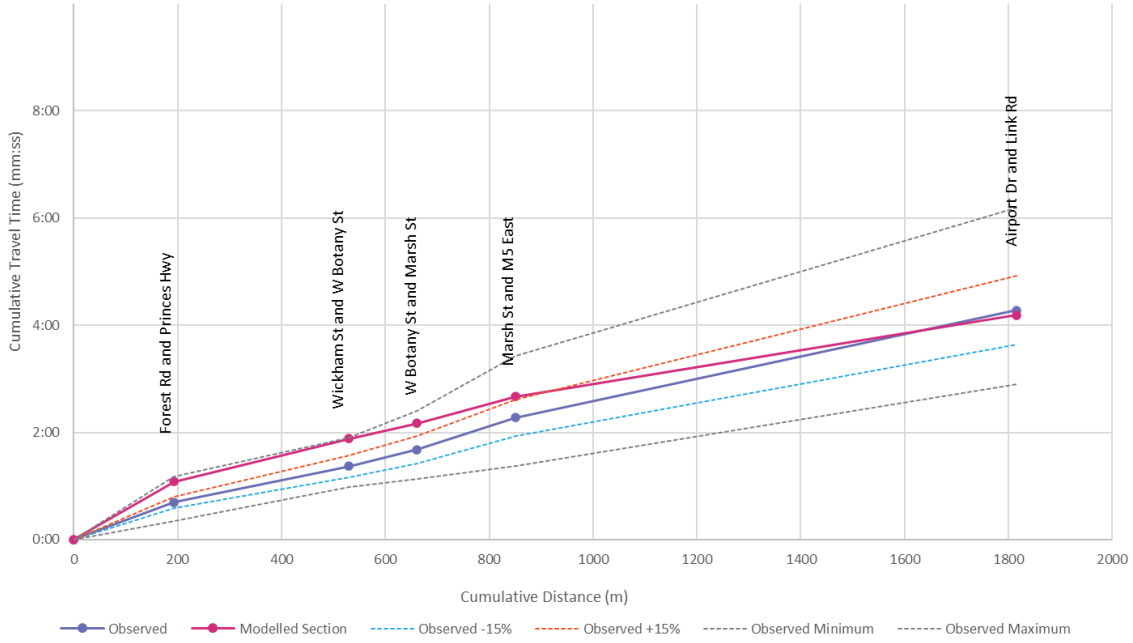
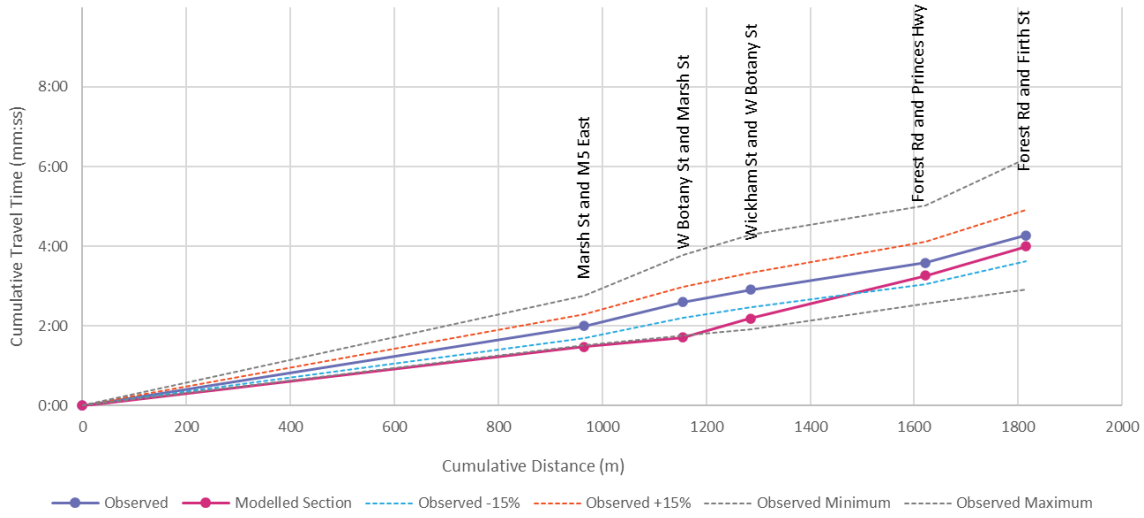


Figure 5.12. AM peak cumulative travel time - Route 4 (Marsh Street / Wickham Street) westbound



PM peak cumulative travel times are presented in Figure 5.13 to Figure 5.16. The travel time graphs show that the model is able to suitably replicate the average speed and travel times for each of the corridors.

Figure 5.13. PM peak cumulative travel time - Route 1 (Princes Highway) northbound

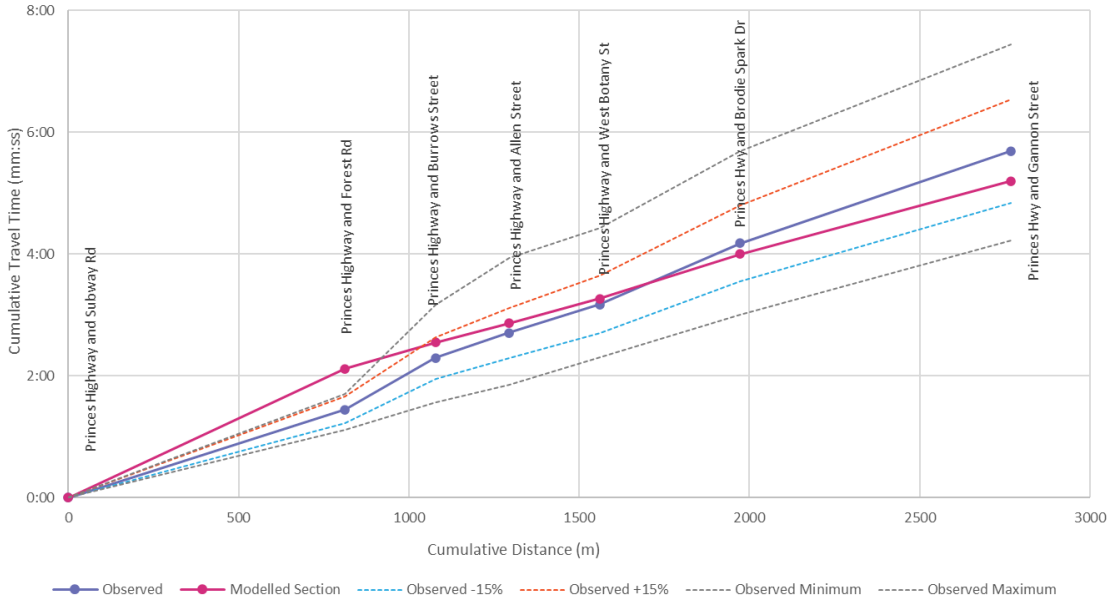


Figure 5.14. PM peak cumulative travel time - Route 2 (Princes Highway) southbound

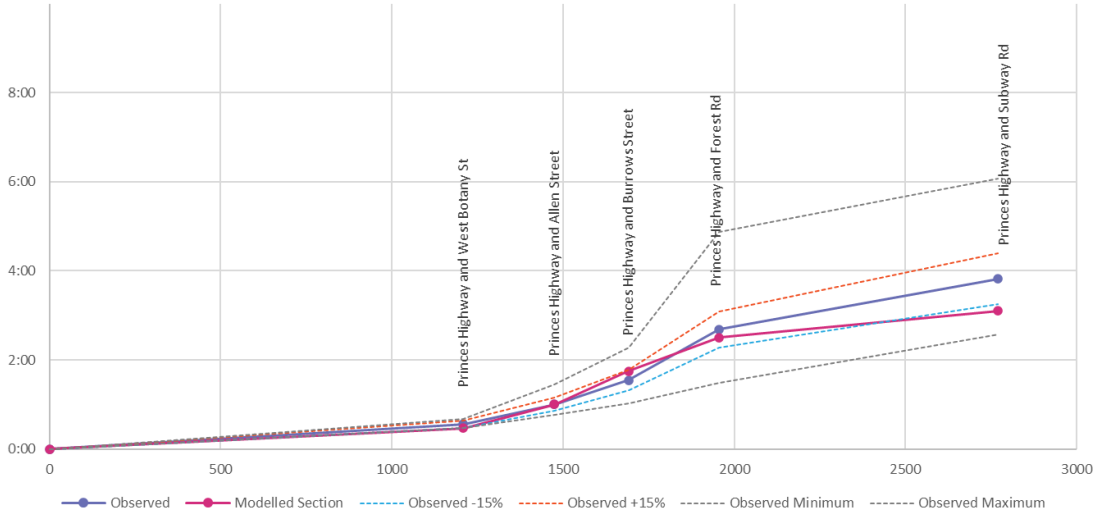


Figure 5.15. PM peak cumulative travel time - Route 3 (Marsh Street / Wickham Street) eastbound

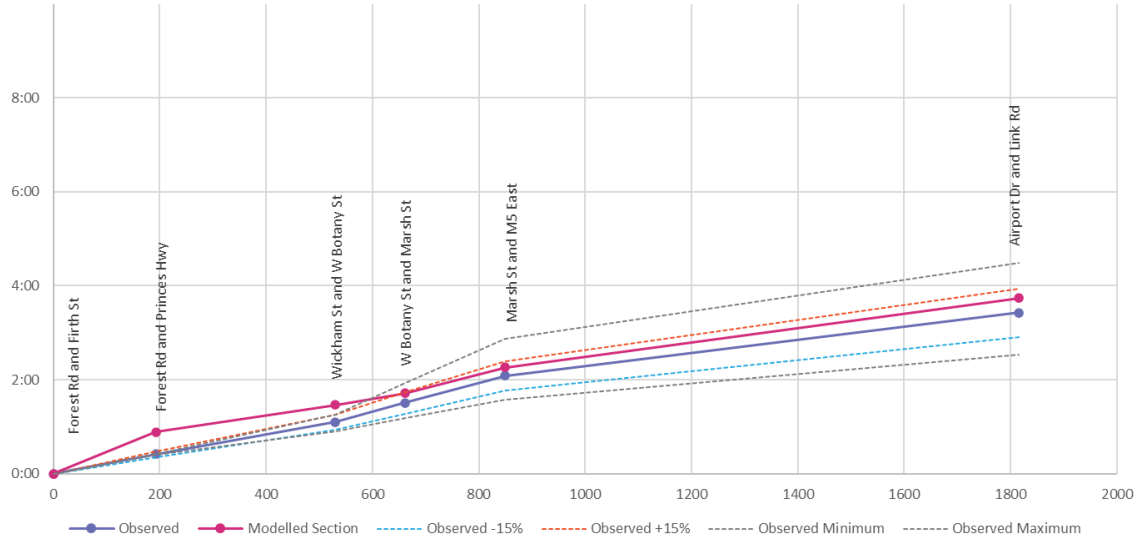
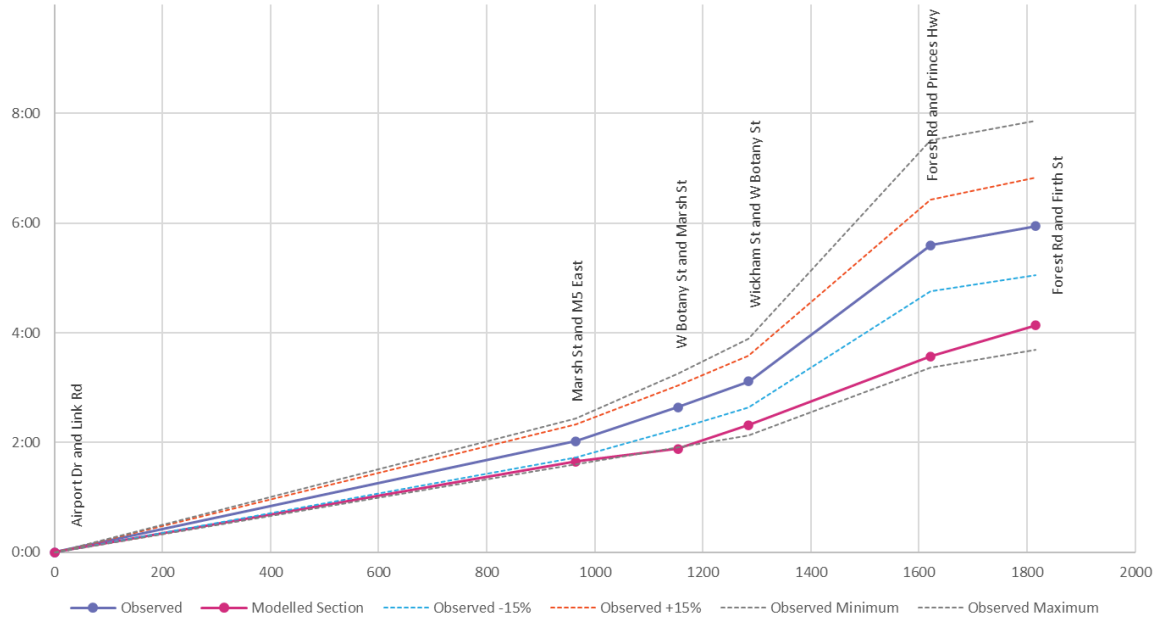


Figure 5.16. PM peak cumulative travel time - Route 4 (Marsh Street / Wickham Street) westbound



A complete assessment of all travel time route sections has been included in Appendix A. Due to the short distances between the individual travel time sections and limitations of the HERE travel time data, some discrepancies in the individual modelled travel times were observed, either slightly above or below the respective observed travel time sections.

5.7 Congestion Validation

A review of the model's congestion at a number of intersections was carried out comparing Google Maps "typical traffic" to model performance. The model is generally comparable to observed conditions for most of the main corridors and intersections.

Figure 5.17. AM peak typical congestion - Princes Highway / Forest Road intersection

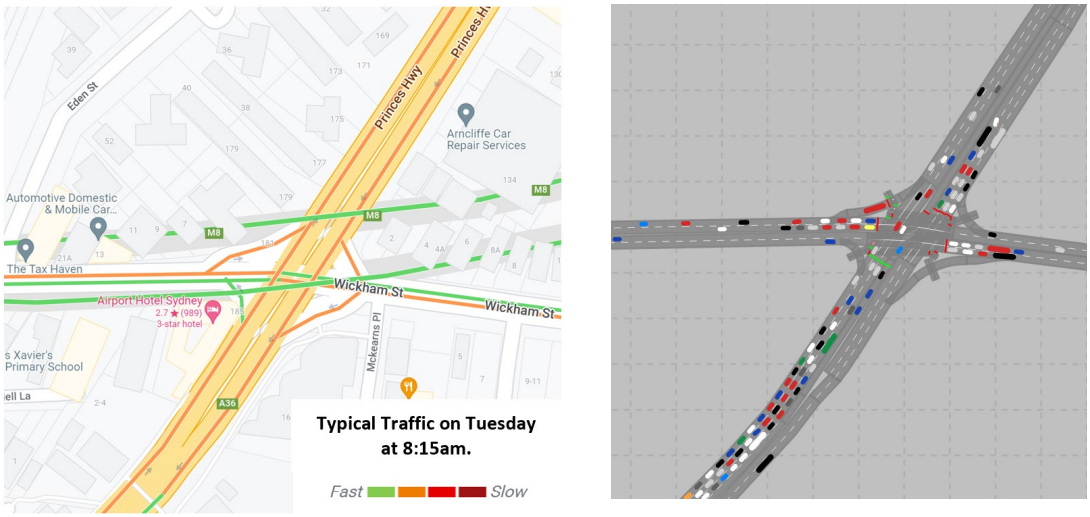


Figure 5.18. AM peak typical congestion - Wickham Street / West Botany Street intersection

Figure 5.19. PM peak typical congestion - Princes Highway / Wickham Street intersection

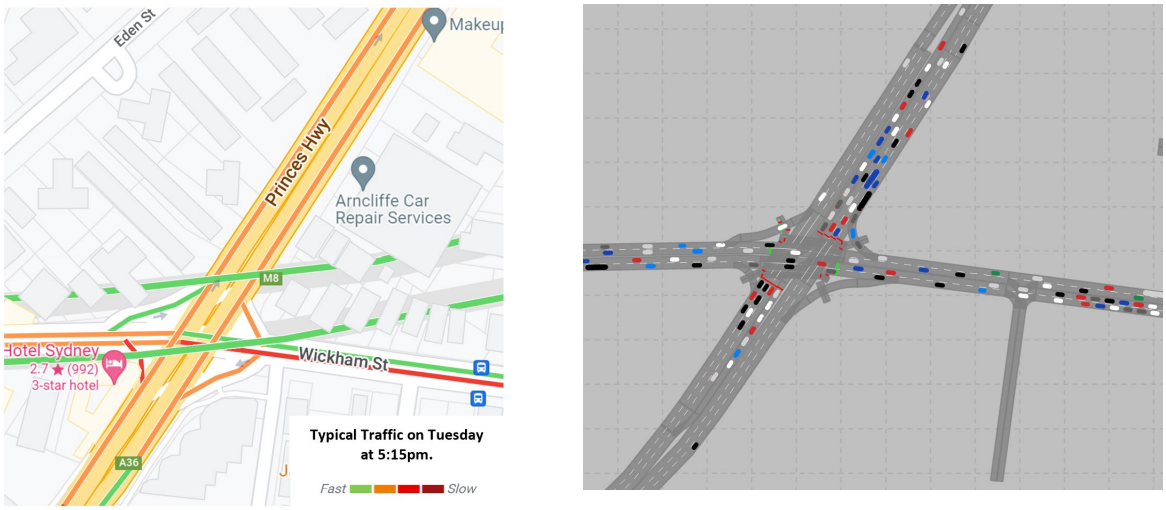
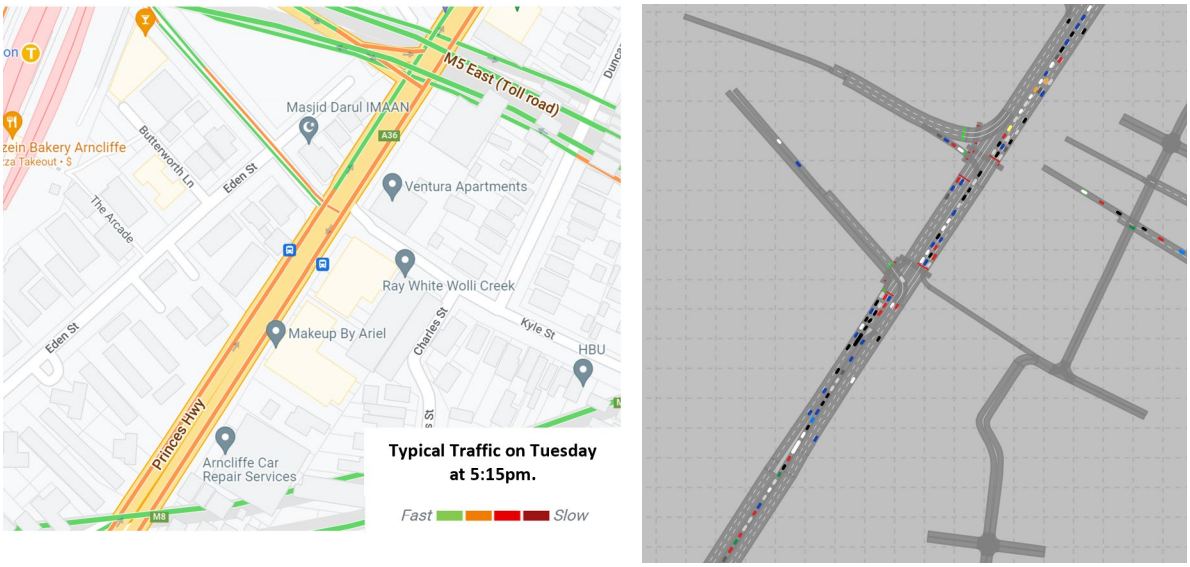


Figure 5.20. PM peak typical congestion - queues along Princes Highway southbound



5.8 Network Performance

A summary of the network performance results from the calibrated and validated 2022 base model is provided in Table 5.7.

Table 5.7. Network performance results

Network Statistics	AM Peak (7:45 AM – 8:45 AM)	PM Peak (4:45 PM – 5:45 PM)
Network statistics for all vehicles		
Total traffic demand (veh)	10,912	11,108
Total vehicle kilometres travelled through network (km)	18,037	18,385
Total vehicle travel time through the network (hours)	673	653
Total vehicles entering the network	10,908	11,105
Total number of stops	26,135	25,728
Average vehicle statistics		
Average vehicle trip length through the network (km)	1.65	1.66
Average vehicle trip time through the network (mm:ss)	03:42	03:32
Average number of stops per trip	2.40	2.32
Average trip speed (km/h)	26.80	28.15
Unreleased traffic		
Total unreleased trips	4	3
% of demand unreleased	0.0%	0.0%

Table 5.7 indicates that the overall network performance is relatively consistent in both peak periods with the AM peak operating at a slightly reduced level of performance. Average travel time in the network is just over 3.5 minutes in the AM and PM peaks. Average trip speed is approximately 27 km/h in the AM peak and 28 km/h in the PM peak.

6 Model Limitations

The development of traffic models such as this are not perfect solutions, rather they are a representation of the operating conditions on the road network. As such, it is important to acknowledge the limitations of the model, so that future applications of the model (e.g. options testing in future design year horizons) can consider these in the interpretation of the modelling outcomes.

The following outlines some of the limiting features of this model:

- The 2022 base model has been calibrated and validated to the major road network within the study area, based on the SCATS data and HERE travel time data provided.
- SCATS data does not distinguish between vehicle classes. Where required, assumptions have been made for non-signalised intersections, shared lane directional proportions and movements that were un-detected based on the 2016 classified turning movement counts survey undertaken by Austraffic.
- HERE travel time data has a number of limitations as indicated throughout this report. HERE data route sections at model extremities do not align exactly with the model extent. Where appropriate these sections have been omitted from travel time validation. HERE travel time data are consolidated to 15-minute intervals indicating a high level of variability in travel time. It is also understood that HERE travel time data considers travel time of vehicles entering or exiting side streets along the route, whilst the model considers vehicles that travel along the main alignment of the route.

7 Conclusion

This report has presented and discussed the model inputs, assumptions and calibration and validation results of the VISSIM model developed to inform the revised Cooks Cove planning proposal transport assessment.

The key calibration and validation topics that were covered include:

- Data collection
- Development of the base model network
- Development of the base model demand matrices
- Model calibration and validation
- Calibration and validation outcomes.

The results presented in this report show that the model demonstrates a 'goodness of fit' with the observed traffic conditions indicating that the model performs well and accurately replicates the current traffic conditions in the study area.

The traffic volume comparisons for each of the peaks indicate a high level of correlation between the modelled and observed traffic flows with GEH < 5 results well above the 85% threshold.

The travel time analysis illustrates a satisfactory level of correlation between the modelled and observed travel times along Princes Highway and Marsh Street / Wickham Street. The delays experienced along each travel route has generally been replicated in the AM and PM peak models, while also considering the limitations of the HERE travel time data.

Given the above, it is considered that the model in its current state has been successfully developed and is fit for its intended purpose. That is, to inform the suitability of proposed access arrangements to the Cooks Cove development, assess the impacts of the Cooks Cove development on the surrounding road network and identify potential mitigation works required to achieve satisfactory road network performance.

APPENDIX

Appendix A Calibration and Validation Results

Table A 1. AM Travel Time Assessment

Route	Direction	Section	Avg Observed TT (s)	Avg Modelled TT (s)	Absolute Diff. (s)	% Diff.	Within 15%	Under 60 sec
1 (Princes Highway)	NB	1	01:18	01:25	00:07	8%	Yes	Yes
		2	00:44	00:21	-00:23	-53%	No	Yes
		3	00:24	00:18	-00:06	-26%	No	Yes
		4	00:41	00:31	-00:10	-24%	No	Yes
		5	01:26	01:00	-00:26	-30%	No	Yes
		6	01:07	01:16	00:09	13%	Yes	Yes
		Full	05:41	04:51	-00:50	-15%	Yes	Yes
	SB	1	00:39	00:33	-00:06	-16%	No	Yes
		2	00:23	00:16	-00:07	-29%	No	Yes
		3	00:24	00:19	-00:05	-22%	No	Yes
		4	00:44	01:12	00:28	63%	No	Yes
		5	01:18	00:39	-00:39	-50%	No	Yes
		Full	03:29	02:59	-00:30	-14%	Yes	Yes
2 (Marsh Street / Wickham Street)	EB	1	00:42	01:05	00:23	56%	No	Yes
		2	00:40	00:48	00:08	19%	No	Yes
		3	00:18	00:17	-00:01	-8%	Yes	Yes
		4	00:36	00:30	-00:06	-17%	No	Yes
		5	02:00	01:31	-00:29	-24%	No	Yes
		Full	04:17	04:11	-00:06	-2%	Yes	Yes
	WB	1	02:00	01:20	-00:40	-33%	No	Yes
		2	00:36	00:14	-00:22	-61%	No	Yes
		3	00:18	00:29	00:11	57%	No	Yes
		4	00:40	01:04	00:24	59%	No	Yes
		5	00:42	00:44	00:02	6%	Yes	Yes
		Full	04:17	03:51	-00:26	-10%	Yes	Yes

Table A 2. PM Travel Time Assessment

Route	Direction	Section	Avg Observed TT (s)	Avg Modelled TT (s)	Absolute Diff. (s)	% Diff.	Within 15%	Under 60 sec
1 (Princes Highway)	NB	1	01:27	02:07	00:40	46%	No	Yes
		2	00:51	00:26	-00:25	-49%	No	Yes
		3	00:25	00:19	-00:06	-23%	No	Yes
		4	00:28	00:24	-00:04	-15%	No	Yes
		5	01:00	00:44	-00:16	-27%	No	Yes
		6	01:31	01:12	-00:19	-21%	No	Yes
		Full	05:41	05:12	-00:29	-9%	Yes	Yes
	SB	1	00:34	00:28	-00:06	-17%	No	Yes
		2	00:27	00:32	00:05	20%	No	Yes
		3	00:33	00:45	00:12	38%	No	Yes
		4	01:08	00:45	-00:23	-34%	No	Yes
		5	01:08	00:36	-00:32	-47%	No	Yes
		Full	03:49	03:06	-00:43	-19%	No	Yes
2 (Marsh Street / Wickham Street)	EB	1	00:25	00:53	00:28	112%	No	Yes
		2	00:41	00:35	-00:06	-14%	Yes	Yes
		3	00:25	00:15	-00:10	-39%	No	Yes
		4	00:34	00:33	-00:01	-4%	Yes	Yes
		5	01:21	01:28	00:07	9%	Yes	Yes
		Full	03:26	03:44	00:18	9%	Yes	Yes
	WB	1	02:01	01:32	-00:29	-24%	No	Yes
		2	00:37	00:14	-00:23	-62%	No	Yes
		3	00:28	00:26	-00:02	-8%	Yes	Yes
		4	02:29	01:15	-01:14	-50%	No	No
		5	00:21	00:34	00:13	63%	No	Yes
		Full	05:57	04:01	-01:56	-32%	No	No

Table A 3. AM Calibration Results – All vehicles (7:45am – 8:45am)

Intersection	Movement	Approach	Direction	Volume		GEH		
				Observed	Modelled	Turn	Approach	Intersection
Marsh Street / Innesdale Road	1_NE_R	NE	R	192	213	1.48	1.48	3.13
	1_NE_T	NE	T	0	0	0.00		
	1_NE_L	NE	L	0	0	0.00		
	1_E_R	E	R	0	0	0.00	0.00	
	1_E_T	E	T	0	0	0.00		
	1_E_L	E	L	0	0	0.00		
	1_SW_R	SW	R	0	0	0.00	3.14	
	1_SW_T	SW	T	2031	2174	3.11		
	1_SW_L	SW	L	77	47	3.78		
	1_NW_R	NW	R	0	0	0.00	4.14	
	1_NW_T	NW	T	0	0	0.00		
	1_NW_L	NW	L	296	229	4.14		
Marsh St / Flora St	2_NE_R	NE	R	44	50	0.88	0.92	0.97
	2_NE_T	NE	T	745	720	0.92		
	2_NE_L	NE	L	0	0	0.00		
	2_E_R	E	R	0	0	0.00	0.00	
	2_E_T	E	T	0	0	0.00		
	2_E_L	E	L	0	0	0.00		
	2_SW_R	SW	R	8	9	0.34	0.94	
	2_SW_T	SW	T	2128	2172	0.94		
	2_SW_L	SW	L	26	19	1.41		
	2_NW_R	NW	R	54	60	0.79	1.74	
	2_NW_T	NW	T	0	0	0.00		
	2_NW_L	NW	L	67	48	2.51		
Marsh St / M5 On & Offramps	3_NE_R	NE	R	289	272	1.02	2.09	2.15
	3_NE_T	NE	T	369	406	1.88		
	3_NE_L	NE	L	151	99	4.65		
	3_SE_R	SE	R	162	177	1.15	1.24	
	3_SE_T	SE	T	0	0	0.00		
	3_SE_L	SE	L	397	372	1.27		
	3_SW_R	SW	R	317	371	2.91	2.53	
	3_SW_T	SW	T	1240	1345	2.92		
	3_SW_L	SW	L	288	295	0.41		
	3_SW_L	SW	L	0	0	0.00		
	3_NW_R	NW	R	80	39	5.32	1.95	
	3_NW_T	NW	T	0	0	0.00		
	3_NW_L	NW	L	632	671	1.53		

Intersection	Movement	Approach	Direction	Volume		GEH		
				Observed	Modelled	Turn	Approach	Intersection
Marsh St / West Botany St	4_N_R	N	R	0	0	0.00	4.65	3.49
	4_N_T	N	T	234	168	4.66		
	4_N_L	N	L	0	0	0.00		
	4_E_R	E	R	0	0	0.00	3.07	
	4_E_T	E	T	0	0	0.00		
	4_E_L	E	L	905	815	3.07		
	4_S_R	S	R	1821	1698	2.93	3.55	
	4_S_T	S	T	320	460	7.07		
	4_S_L	S	L	0	0	0.00		
	4_W_R	W	R	0	0	0.00	0.00	
	4_W_T	W	T	0	0	0.00		
	4_W_L	W	L	0	0	0.00		
West Botany St / Wickham St	5_N_R	N	R	564	599	1.47	2.22	1.27
	5_N_T	N	T	442	378	3.18		
	5_N_L	N	L	0	0	0.00		
	5_E_R	E	R	0	0	0.00	0.00	
	5_E_T	E	T	0	0	0.00		
	5_E_L	E	L	0	0	0.00		
	5_S_R	S	R	0	0	0.00	0.73	
	5_S_T	S	T	696	714	0.69		
	5_S_L	S	L	13	26	2.85		
	5_W_R	W	R	75	117	4.29	0.89	
	5_W_T	W	T	0	0	0.00		
	5_W_L	W	L	1424	1451	0.71		
West Botany St / Flora St	6_N_R	N	R	0	0	0.00	3.73	3.45
	6_N_T	N	T	376	405	1.49		
	6_N_L	N	L	134	41	9.98		
	6_E_R	E	R	49	51	0.33	0.35	
	6_E_T	E	T	0	0	0.00		
	6_E_L	E	L	15	17	0.41		
	6_S_R	S	R	36	60	3.48	3.58	
	6_S_T	S	T	375	448	3.59		
	6_S_L	S	L	0	0	0.00		
	6_W_R	W	R	0	0	0.00	0.00	
	6_W_T	W	T	0	0	0.00		
	6_W_L	W	L	0	0	0.00		

Intersection	Movement	Approach	Direction	Volume		GEH		
				Observed	Modelled	Turn	Approach	Intersection
Princes Hwy / Wickham St	7_N_R	N	R	223	255	2.07	2.67	3.31
	7_N_T	N	T	601	674	2.89		
	7_N_L	N	L	0	0	0.00		
	7_E_R	E	R	0	0	0.00	5.14	
	7_E_T	E	T	643	519	5.14		
	7_E_L	E	L	0	0	0.00		
	7_S_R	S	R	412	458	2.21	3.35	
	7_S_T	S	T	1642	1498	3.63		
	7_S_L	S	L	0	0	0.00		
	7_W_R	W	R	0	0	0.00	2.75	
	7_W_T	W	T	987	916	2.30		
	7_W_L	W	L	278	355	4.33		
Princes Hwy / Kyle St	8_N_R	N	R	0	0	0.00	3.13	2.02
	8_N_T	N	T	838	931	3.14		
	8_N_L	N	L	16	6	3.07		
	8_E_R	E	R	0	0	0.00	0.00	
	8_E_T	E	T	0	0	0.00		
	8_E_L	E	L	0	0	0.00		
	8_S_R	S	R	0	0	0.00	1.57	
	8_S_T	S	T	1892	1823	1.60		
	8_S_L	S	L	38	38	0.01		
	8_W_R	W	R	175	156	1.48	1.64	
	8_W_T	W	T	0	0	0.00		
	8_W_L	W	L	39	55	2.35		
Princes Hwy / M5 Off-Ramps	9_N_R	N	R	0	0	0.00	5.15	1.57
	9_N_T	N	T	741	888	5.15		
	9_N_L	N	L	0	0	0.00		
	9_E_R	E	R	0	0	0.00	0.00	
	9_E_T	E	T	0	0	0.00		
	9_E_L	E	L	0	0	0.00		
	9_S_R	S	R	0	0	0.00	0.30	
	9_S_T	S	T	1893	1880	0.30		
	9_S_L	S	L	0	0	0.00		
	9_W_R	W	R	68	47	2.77	0.94	
	9_W_T	W	T	0	0	0.00		
	9_W_L	W	L	322	332	0.55		

Intersection	Movement	Approach	Direction	Volume		GEH		
				Observed	Modelled	Turn	Approach	Intersection
Princes Hwy / West Botany St	11_N_R	N	R	0	0	0.00	0.21	0.30
	11_N_T	N	T	833	827	0.21		
	11_N_L	N	L	0	0	0.00		
	11_E_R	E	R	391	429	1.88	1.88	
	11_E_T	E	T	0	0	0.00		
	11_E_L	E	L	0	0	0.00		
	11_S_R	S	R	0	0	0.00	0.08	
	11_S_T	S	T	2502	2498	0.08		
	11_S_L	S	L	0	0	0.00		
	11_W_R	W	R	0	0	0.00	0.00	
	11_W_T	W	T	0	0	0.00		
	11_W_L	W	L	0	0	0.00		
Princes Hwy / Gertrude St	12_N_R	N	R	0	0	0.00	0.00	3.94
	12_N_T	N	T	0	0	0.00		
	12_N_L	N	L	0	0	0.00		
	12_E_R	E	R	267	204	4.12	3.94	
	12_E_T	E	T	0	0	0.00		
	12_E_L	E	L	68	97	3.22		
	12_S_R	S	R	0	0	0.00	0.00	
	12_S_T	S	T	0	0	0.00		
	12_S_L	S	L	0	0	0.00		
	12_W_R	W	R	0	0	0.00	0.00	
	12_W_T	W	T	0	0	0.00		
	12_W_L	W	L	0	0	0.00		
Princes Hwy / Brodie Sparks Dr	13_N_R	N	R	163	144	1.53	4.11	2.49
	13_N_T	N	T	1063	1215	4.50		
	13_N_L	N	L	0	0	0.00		
	13_E_R	E	R	0	0	0.00	0.00	
	13_E_T	E	T	0	0	0.00		
	13_E_L	E	L	0	0	0.00		
	13_S_R	S	R	0	0	0.00	1.72	
	13_S_T	S	T	3078	2983	1.73		
	13_S_L	S	L	141	161	1.63		
	13_W_R	W	R	172	177	0.38	3.43	
	13_W_T	W	T	0	0	0.00		
	13_W_L	W	L	337	435	4.99		

Table A 4. PM Calibration Results – All vehicles (4:45pm – 5:45pm)

Intersection	Movement	Approach	Direction	Volume		GEH		
				Observed	Modelled	Turn	Approach	Intersection
Marsh Street / Innesdale Road	1_NE_R	NE	R	286	337	2.89	2.89	2.25
	1_NE_T	NE	T	0	0	0.00		
	1_NE_L	NE	L	0	0	0.00		
	1_E_R	E	R	0	0	0.00	0.00	
	1_E_T	E	T	0	0	0.00		
	1_E_L	E	L	0	0	0.00		
	1_SW_R	SW	R	0	0	0.00	2.03	
	1_SW_T	SW	T	1053	1121	2.07		
	1_SW_L	SW	L	90	77	1.46		
	1_NW_R	NW	R	0	0	0.00	2.70	
	1_NW_T	NW	T	0	0	0.00		
	1_NW_L	NW	L	156	124	2.70		
Marsh St / Flora St	2_NE_R	NE	R	48	95	5.56	0.64	1.32
	2_NE_T	NE	T	1438	1420	0.48		
	2_NE_L	NE	L	0	0	0.00		
	2_E_R	E	R	0	0	0.00	0.00	
	2_E_T	E	T	0	0	0.00		
	2_E_L	E	L	0	0	0.00		
	2_SW_R	SW	R	14	14	0.00	1.86	
	2_SW_T	SW	T	1162	1101	1.81		
	2_SW_L	SW	L	57	34	3.42		
	2_NW_R	NW	R	52	79	3.34	5.08	
	2_NW_T	NW	T	0	0	0.00		
	2_NW_L	NW	L	40	102	7.36		
Marsh St / M5 On & Offramps	3_NE_R	NE	R	372	440	3.37	2.46	1.52
	3_NE_T	NE	T	1025	957	2.16		
	3_NE_L	NE	L	114	92	2.17		
	3_SE_R	SE	R	156	136	1.66	0.99	
	3_SE_T	SE	T	0	0	0.00		
	3_SE_L	SE	L	546	565	0.81		
	3_SW_R	SW	R	308	341	1.83	1.19	
	3_SW_T	SW	T	603	598	0.20		
	3_SW_L	SW	L	323	168	2.42		
	3_SW_L	SW	L	0	200	0.00		
	3_NW_R	NW	R	128	124	0.36	0.35	
	3_NW_T	NW	T	0	0	0.00		
	3_NW_L	NW	L	408	415	0.35		

Intersection	Movement	Approach	Direction	Volume		GEH		
				Observed	Modelled	Turn	Approach	Intersection
Marsh St / West Botany St	4_N_R	N	R	0	0	0.00	1.29	2.21
	4_N_T	N	T	187	205	1.29		
	4_N_L	N	L	0	0	0.00		
	4_E_R	E	R	0	0	0.00	0.49	
	4_E_T	E	T	0	0	0.00		
	4_E_L	E	L	1669	1649	0.49		
	4_S_R	S	R	1152	1020	4.01	4.19	
	4_S_T	S	T	378	291	4.76		
	4_S_L	S	L	0	0	0.00		
	4_W_R	W	R	0	0	0.00	0.00	
	4_W_T	W	T	0	0	0.00		
	4_W_L	W	L	0	0	0.00		
West Botany St / Wickham St	5_N_R	N	R	837	914	2.60	1.37	2.30
	5_N_T	N	T	948	939	0.29		
	5_N_L	N	L	0	0	0.00		
	5_E_R	E	R	0	0	0.00	0.00	
	5_E_T	E	T	0	0	0.00		
	5_E_L	E	L	0	0	0.00		
	5_S_R	S	R	0	0	0.00	0.69	
	5_S_T	S	T	430	420	0.47		
	5_S_L	S	L	67	86	2.12		
	5_W_R	W	R	135	181	3.66	4.41	
	5_W_T	W	T	0	0	0.00		
	5_W_L	W	L	1034	894	4.51		
West Botany St / Flora St	6_N_R	N	R	0	0	0.00	0.88	1.69
	6_N_T	N	T	492	499	0.30		
	6_N_L	N	L	80	125	4.49		
	6_E_R	E	R	91	101	1.03	1.23	
	6_E_T	E	T	0	0	0.00		
	6_E_L	E	L	11	23	2.89		
	6_S_R	S	R	21	46	4.28	3.38	
	6_S_T	S	T	281	228	3.31		
	6_S_L	S	L	0	0	0.00		
	6_W_R	W	R	0	0	0.00	0.00	
	6_W_T	W	T	0	0	0.00		
	6_W_L	W	L	0	0	0.00		

Intersection	Movement	Approach	Direction	Volume		GEH		
				Observed	Modelled	Turn	Approach	Intersection
Princes Hwy / Wickham St	7_N_R	N	R	548	569	0.89	0.61	2.27
	7_N_T	N	T	1453	1434	0.50		
	7_N_L	N	L	0	0	0.00		
	7_E_R	E	R	0	0	0.00	3.41	
	7_E_T	E	T	977	866	3.66		
	7_E_L	E	L	71	112			
	7_S_R	S	R	176	163	1.00	3.24	
	7_S_T	S	T	755	644	4.20		
	7_S_L	S	L	101	127	0.00		
	7_W_R	W	R	0	0	0.00	3.30	
	7_W_T	W	T	838	753	3.01		
	7_W_L	W	L	280	354	4.16		
Princes Hwy / Kyle St	8_N_R	N	R	0	0	0.00	3.39	2.48
	8_N_T	N	T	2204	2047	3.41		
	8_N_L	N	L	26	16	2.17		
	8_E_R	E	R	0	0	0.00	0.00	
	8_E_T	E	T	0	0	0.00		
	8_E_L	E	L	0	0	0.00		
	8_S_R	S	R	0	0	0.00	0.91	
	8_S_T	S	T	1028	998	0.93		
	8_S_L	S	L	18	19	0.13		
	8_W_R	W	R	172	170	0.17	0.19	
	8_W_T	W	T	0	0	0.00		
	8_W_L	W	L	8	6	0.67		
Princes Hwy / M5 Off-Ramps	9_N_R	N	R	0	0	0.00	2.13	1.87
	9_N_T	N	T	2121	2024	2.13		
	9_N_L	N	L	0	0	0.00		
	9_E_R	E	R	0	0	0.00	0.00	
	9_E_T	E	T	0	0	0.00		
	9_E_L	E	L	0	0	0.00		
	9_S_R	S	R	0	0	0.00	0.57	
	9_S_T	S	T	1013	995	0.57		
	9_S_L	S	L	0	0	0.00		
	9_W_R	W	R	97	43	6.45	4.08	
	9_W_T	W	T	0	0	0.00		
	9_W_L	W	L	247	299	3.15		

Intersection	Movement	Approach	Direction	Volume		GEH		
				Observed	Modelled	Turn	Approach	Intersection
Princes Hwy / West Botany St	11_N_R	N	R	0	0	0.00	4.58	3.66
	11_N_T	N	T	2232	2021	4.58		
	11_N_L	N	L	0	0	0.00		
	11_E_R	E	R	320	308	0.68	0.68	
	11_E_T	E	T	0	0	0.00		
	11_E_L	E	L	0	0	0.00		
	11_S_R	S	R	0	0	0.00	2.86	
	11_S_T	S	T	1349	1246	2.86		
	11_S_L	S	L	0	0	0.00		
	11_W_R	W	R	0	0	0.00	0.00	
	11_W_T	W	T	0	0	0.00		
	11_W_L	W	L	0	0	0.00		
Princes Hwy / Gertrude St	12_N_R	N	R	0	0	0.00	0.00	4.74
	12_N_T	N	T	0	0	0.00		
	12_N_L	N	L	0	0	0.00		
	12_E_R	E	R	398	299	5.28	4.74	
	12_E_T	E	T	0	0	0.00		
	12_E_L	E	L	52	48	0.62		
	12_S_R	S	R	0	0	0.00	0.00	
	12_S_T	S	T	0	0	0.00		
	12_S_L	S	L	0	0	0.00		
	12_W_R	W	R	0	0	0.00	0.00	
	12_W_T	W	T	0	0	0.00		
	12_W_L	W	L	0	0	0.00		
Princes Hwy / Brodie Sparks Dr	13_N_R	N	R	535	552	0.73	2.06	1.45
	13_N_T	N	T	2618	2500	2.33		
	13_N_L	N	L	0	0	0.00		
	13_E_R	E	R	0	0	0.00	0.00	
	13_E_T	E	T	0	0	0.00		
	13_E_L	E	L	0	0	0.00		
	13_S_R	S	R	0	0	0.00	0.45	
	13_S_T	S	T	1602	1585	0.43		
	13_S_L	S	L	271	261	0.61		
	13_W_R	W	R	207	188	1.35	1.32	
	13_W_T	W	T	0	0	0.00		
	13_W_L	W	L	233	253	1.28		

Appendix B: Detailed Traffic Modelling Outputs

Intersection / Scenario			2022 AM Base				2022 PM Base				2036 AM Base				2036 PM Base				2036 AM Project Case				2036 PM Project Case			
Intersection	**Approach**	**Movement**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**
Marsh Street / Flora Street	Marsh St SB	Left	0	LOS_A	0	5.56	0	LOS_A	0	11.81	0	LOS_A	0	15.39	0	LOS_A	0	38.16	159	LOS_A	8.94	11.95	66	LOS_B	19.33	92.42
		Through	720	LOS_A	2.87	5.56	1420	LOS_A	4.35	11.81	773	LOS_A	6.97	15.39	1540	LOS_C	31.46	38.16	956	LOS_A	9.2	11.95	1309	LOS_E	63.5	92.42
		Right	50	LOS_E	57.13	5.56	95	LOS_E	63.16	11.81	147	LOS_E	57.36	15.39	168	LOS_E	65.73	38.16	95	LOS_E	62.32	11.95	107	LOS_E	75.28	92.42
	Marsh St NB	Left	19	LOS_B	12.56	16.44	34	LOS_A	8.27	9.16	24	LOS_A	9.58	16.88	19	LOS_B	14.81	15.48	36	LOS_C	24.07	35.29	21	LOS_D	35.57	12.72
		Through	2172	LOS_A	9.57	16.44	1101	LOS_A	8.34	9.16	1972	LOS_B	10.3	16.88	1011	LOS_B	13.52	15.48	2101	LOS_C	20.35	35.29	1151	LOS_B	15.48	12.72
		Right	9	LOS_F	144.24	16.44	14	LOS_F	119.47	9.16	24	LOS_E	71.2	16.88	50	LOS_F	81.49	15.48	0	0	0	0	0	0	0	0
	Flora Street West	Left	48	LOS_D	39.1	7.26	102	LOS_D	41.33	9.4	72	LOS_C	32.8	23.71	117	LOS_C	28.17	8.43	134	LOS_D	44.3	38.73	96	LOS_D	42.79	9.02
		Through	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	LOS_E	71.4	38.73	4	LOS_E	68.45	9.02
		Right	60	LOS_E	58.13	7.22	79	LOS_D	42.4	9.36	125	LOS_F	102.68	23.65	63	LOS_E	57.04	8.4	114	LOS_F	144.97	38.73	63	LOS_E	66.11	9.02
	Flora Street East	Left	0	LOS_A	0	0	0	LOS_A	0	0	57	LOS_F	159.63	12.98	45	LOS_F	110.34	7.42	132	LOS_D	51.52	15.88	153	LOS_E	64.05	19.78
		Through	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	LOS_E	67.52	15.88	20	LOS_E	61.4	19.78
		Right	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62	LOS_D	54.18	15.88	79	LOS_E	62.78	19.78
	Intersection		**3078**	**LOS_B**	**10.59**	**7.3**	**2845**	**LOS_B**	**10.85**	**7.95**	**3194**	**LOS_B**	**18.9**	**18.52**	**3013**	**LOS_C**	**29.66**	**15.58**	**3859**	**LOS_C**	**25.21**	**25.46**	**3069**	**LOS_D**	**44.17**	**33.49**
Marsh Street / Gertrude Street	Marsh St SB	Left																	190	LOS_B	11.55	6.56	124	LOS_D	37.83	470.89
		Through																	1167	LOS_A	9.18	6.56	1379	LOS_F	99.12	470.89
		Right																	118	LOS_E	66.53	8.06	441	LOS_D	42	16.28
	Marsh St NB	Left																	78	LOS_A	5.33	21.66	85	LOS_B	10.5	19.29
		Through																	2149	LOS_A	4.86	21.66	1287	LOS_A	9.51	19.29
		Right																	209	LOS_D	52.62	21.66	112	LOS_E	64.92	19.29
	Gertrude Street West	Left																	179	LOS_D	40.11	14.75	201	LOS_C	24.65	8.83
		Through																	79	LOS_E	75.26	14.72	37	LOS_E	77.75	8.81
		Right																	0	0	0	0	0	0	0	0
	Gertrude Street East	Left																	38	LOS_D	36.79	13.56	87	LOS_E	78.63	22.72
		Through																	77	LOS_E	56.04	11.8	108	LOS_E	62.75	20.25
		Right																	0	0	0	0	0	0	0	0
	Intersection																		**4284**	**LOS_B**	**14.34**	**13.02**	**3861**	**LOS_D**	**52.25**	**81.01**
Marsh Street / Innesdale Street	Marsh St SB	Left	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Through	770	LOS_A	0.07	0	1508	LOS_A	0.18	0	928	LOS_A	0.11	0	1686	LOS_B	10.78	11.44	1210	LOS_A	0.51	0	1490	LOS_E	47.34	34.34
		Right	213	LOS_E	60.61	17.04	337	LOS_E	60.77	31.9	211	LOS_E	65.11	18.59	541	LOS_E	58.07	67.91	0	0	0	0	0	0	0	0
	Marsh St NB	Left	47	LOS_A	8.47	5.45	77	LOS_A	5.19	4.18	55	LOS_A	6.22	5.2	110	LOS_A	7.53	7.99	39	LOS_A	3.9	1.75	66	LOS_A	2.48	0.58
		Through	2174	LOS_A	3.43	5.45	1121	LOS_A	4.66	4.18	1991	LOS_A	3.77	5.2	1006	LOS_A	8.12	7.99	2257	LOS_A	5.04	3.49	1257	LOS_A	2.83	1.23
		Right	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Innesdale Street	Left	229	LOS_E	57.52	13.49	124	LOS_D	46.67	6.27	175	LOS_E	59.73	10.59	149	LOS_D	39.36	6.1	192	LOS_C	24.84	6.64	234	LOS_B	10.46	1.15
		Through	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Right	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Intersection		**3433**	**LOS_A**	**9.9**	**8.99**	**3167**	**LOS_B**	**10.15**	**10.59**	**3360**	**LOS_A**	**9.57**	**8.6**	**3492**	**LOS_B**	**18.46**	**23.36**	**3698**	**LOS_A**	**4.58**	**2.97**	**3047**	**LOS_D**	**25.17**	**9.32**

Intersection / Scenario			2022 AM Base				2022 PM Base				2036 AM Base				2036 PM Base				2036 AM Project Case				2036 PM Project Case			
Intersection	**Approach**	**Movement**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**
Gertrude Street / Levey Street	Levey Street SB	Left	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61	LOS_E	56.73	9.02	138	LOS_D	48.7	33.62
		Through	0	LOS_A	0	0.01	0	LOS_A	0	0.01	0	LOS_A	0	0.01	0	LOS_A	0	0.01	26	LOS_E	55.74	9.02	129	LOS_E	57.59	33.62
		Right	28	LOS_A	1.13	0.01	81	LOS_A	1.36	0.01	20	LOS_A	2.27	0.01	133	LOS_A	1.44	0.01	37	LOS_E	60.63	9.02	140	LOS_D	50.93	33.62
	Levey Street NB	Left	284	LOS_A	1.21	0	334	LOS_A	2.19	0	355	LOS_A	2.14	0.14	532	LOS_A	3.14	0.76	99	LOS_E	59.56	15.61	58	LOS_C	25.94	2.25
		Through	0	LOS_A	0	0	52	LOS_A	2.46	0	0	LOS_A	0	0.14	57	LOS_A	3.94	0.76	0	LOS_A	0	15.61	0	LOS_A	0	2.25
		Right	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	LOS_E	62.15	15.61	1	LOS_A	2.85	2.25
	Gertrude St EB	Left	10	LOS_A	1.38	0.57	0	LOS_A	0	0.01	34	LOS_A	1.19	0.57	0	LOS_A	0	0.08	52	LOS_A	5.52	0.47	12	LOS_A	8.88	0.9
		Through	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	151	LOS_A	1.61	0.47	97	LOS_A	5.1	0.9
		Right	216	LOS_A	2.81	0.57	88	LOS_A	0.94	0.01	154	LOS_A	3.12	0.57	91	LOS_A	2.01	0.08	0	LOS_A	0	0.47	11	LOS_C	22.27	0.9
	Gertrude St WB	Left	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	LOS_A	4.07	1.12	38	LOS_A	3.41	10.41
		Through	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	259	LOS_A	4.28	1.12	542	LOS_B	11.77	10.41
		Right	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	LOS_A	0	1.12	56	LOS_A	7.5	10.41
	Intersection		**538**	**LOS_A**	**1.85**	**0.19**	**555**	**LOS_A**	**1.89**	**0.01**	**563**	**LOS_A**	**2.36**	**0.24**	**813**	**LOS_A**	**2.79**	**0.29**	**740**	**LOS_C**	**23.6**	**6.56**	**1222**	**LOS_C**	**25.01**	**11.79**
Marsh Street / M5	Marsh St SB	Left	99	LOS_A	1.88	3.03	92	LOS_B	19.87	22.66	107	LOS_B	15.38	24.06	185	LOS_E	69.2	169.86	161	LOS_B	10.98	21.55	225	LOS_F	96.63	217.36
		Through	406	LOS_C	25.93	7.01	957	LOS_D	36.99	25.81	679	LOS_E	61.58	29.77	1334	LOS_F	100.83	171.65	827	LOS_D	49.39	27.29	1056	LOS_F	164.55	218.88
		Right	272	LOS_E	62.88	16.61	440	LOS_D	52.78	21.19	172	LOS_E	60.41	9.73	199	LOS_D	54.52	8.84	210	LOS_E	77.6	15.7	226	LOS_E	69.04	16.84
	M5 South	Left	372	LOS_C	30.55	20.7	565	LOS_D	46.02	65.78	750	LOS_D	46.38	135.61	537	LOS_F	88.27	165.88	709	LOS_D	51.4	140.64	499	LOS_F	100.38	172.6
		Through	0	0	0	0	0	0	0	0				0				0				0				0
		Right	177	LOS_E	59.77	24.09	136	LOS_E	61.51	66.41	227	LOS_E	76.81	140.54	171	LOS_F	96.77	171.28	275	LOS_F	87.56	146.21	146	LOS_F	98.32	177.8
	Marsh St NB	Left	9	LOS_A	3.34	5.26	168	LOS_A	9.7	3.4	1	LOS_A	1.29	8.8	59	LOS_A	4.68	1.95	2	LOS_A	4.7	11.37	64	LOS_A	4.63	5.04
		Through	1345	LOS_B	19.84	20.18	598	LOS_C	24.56	9.5	1524	LOS_C	21.28	25.26	769	LOS_B	15.61	9.23	1509	LOS_C	23.26	26.73	843	LOS_B	16.58	11.23
		Right	371	LOS_C	30.68	20.83	341	LOS_C	28.06	10.55	370	LOS_C	22.64	25.37	506	LOS_C	30.98	15.92	351	LOS_C	21.54	24.33	544	LOS_C	31.28	16.29
	M5 North	Left	671	LOS_A	2.31	0	415	LOS_A	1.89	0.03	270	LOS_A	1.71	0	163	LOS_A	1.52	0	328	LOS_A	1.77	0	192	LOS_A	1.46	0
		Through	0	0	0	0	0	0	0	0				0				0				0				0
		Right	39	LOS_E	68.39	4.57	124	LOS_E	72.26	14.08	24	LOS_F	81.69	3.45	40	LOS_F	84.58	4.43	26	LOS_F	83.01	3.01	36	LOS_F	129.32	6.45
	Intersection		**4047**	**LOS_C**	**23.16**	**11.36**	**4036**	**LOS_C**	**32.62**	**21.94**	**4267**	**LOS_D**	**35.14**	**36.69**	**4029**	**LOS_E**	**63**	**65.38**	**4560**	**LOS_D**	**36.42**	**38.08**	**3910**	**LOS_E**	**79.78**	**76.6**
Marsh Street / W Botany Street	W Botany Street North	Left	29	LOS_C	31.57	12.37	87	LOS_C	29.81	12.84	42	LOS_F	90.2	139.25	97	LOS_E	63.54	32.51	63	LOS_F	141.27	258.05	70	LOS_F	320.09	188.46
		Through	168	LOS_E	76.76	17	205	LOS_E	70.66	16.79	371	LOS_F	207.38	142.72	189	LOS_F	149.15	36.25	243	LOS_F	283.25	259.66	148	LOS_F	568.06	191.91
	Marsh St East	Left	815	LOS_A	2.05	0.69	1649	LOS_A	3.59	2.03	1442	LOS_C	21.46	25.76	1892	LOS_C	32.15	55.42	1523	LOS_D	40.16	52.96	1579	LOS_E	56.83	75.76
		Through	460	LOS_A	2.71	11.17	291	LOS_A	3.27	5.33	337	LOS_A	4.98	28.36	287	LOS_A	4.5	6.5	320	LOS_A	5.26	25.54	250	LOS_A	2.92	5.82
		Right	1698	LOS_A	5.75	11.14	1020	LOS_A	4.14	5.31	1846	LOS_A	9.53	28.32	1210	LOS_A	4.78	6.47	1784	LOS_B	10.04	25.49	1375	LOS_A	4.35	5.8
	Intersection		**3170**	**LOS_A**	**8.36**	**10.47**	**3252**	**LOS_A**	**8.66**	**8.46**	**4038**	**LOS_C**	**32.43**	**72.88**	**3675**	**LOS_C**	**27.83**	**27.43**	**3933**	**LOS_D**	**40.29**	**124.34**	**3422**	**LOS_E**	**59.3**	**93.55**
W Botany Street / Wickham Street	W Botany Street North	Through	378	LOS_A	3.1	11.06	939	LOS_A	6.7	18.53	484	LOS_B	16.01	50.57	941	LOS_B	18.48	69.8	415	LOS_C	30.18	70.55	782	LOS_C	30.85	84.16
		Right	599	LOS_B	17.81	10.98	914	LOS_B	15.29	18.44	1335	LOS_D	38.46	50.42	1160	LOS_D	54.52	69.62	1305	LOS_D	51.89	70.37	939	LOS_F	86.98	83.96
	Wickham Street West	Left	1451	LOS_C	20.91	32.3	894	LOS_B	10.22	36.53	1524	LOS_C	30.46	63.09	1111	LOS_B	15.24	64.69	1517	LOS_C	32.93	65.1	1220	LOS_B	16.15	81.07
		Right	117	LOS_F	100.54	27.59	181	LOS_F	187.12	64.11	145	LOS_F	137.45	54.62	180	LOS_F	192.78	71.88	145	LOS_F	132.22	59.07	190	LOS_F	227	87.33
	W Botany Street South	Left	26	LOS_F	115.16	122.17	86	LOS_F	126.09	66.14	39	LOS_F	143.65	481.5	101	LOS_F	233.99	491.72	33	LOS_F	189.2	485.92	99	LOS_F	229.93	492.19
		Through	714	LOS_F	100.76	122.17	420	LOS_F	92.9	66.14	668	LOS_F	140.48	481.5	386	LOS_F	208.93	491.72	601	LOS_F	156.07	485.92	406	LOS_F	199.35	492.19
	Intersection		**3285**	**LOS_D**	**39.23**	**40.82**	**3434**	**LOS_C**	**32.95**	**40.75**	**4195**	**LOS_D**	**53.61**	**140.04**	**3879**	**LOS_E**	**60.98**	**153.54**	**4016**	**LOS_E**	**62.1**	**150.2**	**3636**	**LOS_E**	**74.9**	**165.74**

Intersection / Scenario			2022 AM Base				2022 PM Base				2036 AM Base				2036 PM Base				2036 AM Project Case				2036 PM Project Case			
Intersection	**Approach**	**Movement**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**
Forest Road / Princess Hwy / Wickham Street	Princess Highway North	Left	154	LOS_C	29.87	26.37	203	LOS_C	20.67	32.26	41	LOS_D	52.36	100.04	76	LOS_D	45.83	23.14	45	LOS_E	65.6	103.6	236	LOS_C	30.5	49.34
		Through	674	LOS_E	55.82	30.61	1434	LOS_C	26.28	34.05	1104	LOS_F	96.44	102.74	1194	LOS_C	23.6	25.92	1074	LOS_F	100.97	106.29	1242	LOS_D	39.29	51.14
		Right	255	LOS_E	64.36	31.09	569	LOS_E	56.18	100.84	297	LOS_F	97.87	88.5	516	LOS_E	64.03	105.69	273	LOS_F	86.39	62.64	550	LOS_E	62.53	101.32
	Wickham Street East	Left	151	LOS_B	11.32	1.01	112	LOS_B	16.08	0.01	580	LOS_B	15.83	22.5	164	LOS_B	17.24	0.13	532	LOS_B	18.75	14.89	129	LOS_C	26.14	2.53
		Through	519	LOS_D	37.85	22.32	866	LOS_D	35.58	36.96	880	LOS_D	44.3	56.43	1038	LOS_D	43.34	63.08	876	LOS_D	43.21	59.14	901	LOS_E	68.78	70.73
	Princess Highway South	Left	159	LOS_C	34.62	62.74	127	LOS_E	64.02	50.66	292	LOS_D	53.31	427.84	200	LOS_F	115.78	225.33	273	LOS_D	49.76	400.8	101	LOS_F	310.94	473.3
		Through	1498	LOS_D	41.88	65.33	644	LOS_F	87.5	53.58	1560	LOS_D	54.76	430.09	814	LOS_F	123.67	228.19	1505	LOS_E	60.84	402.7	412	LOS_F	319.38	474.18
		Right	458	LOS_C	31.76	43.12	163	LOS_F	102.77	29.79	524	LOS_F	90.49	431.07	257	LOS_F	161.34	225.04	526	LOS_F	88.65	403.45	188	LOS_F	138.22	473.11
	Forest Road West	Left	355	LOS_C	34.02	10.87	354	LOS_C	28.13	4.93	350	LOS_D	47.18	0	397	LOS_E	58.68	444.28	335	LOS_D	51.2	0	413	LOS_D	52.27	0
		Through	916	LOS_D	47.52	65.82	753	LOS_D	40.58	42.85	1094	LOS_E	69.07	456.23	1045	LOS_E	74.55	444.67	1088	LOS_E	71.41	458.17	1083	LOS_E	73.77	453.89
	Intersection		**5139**	**LOS_D**	**42.5**	**35.93**	**5225**	**LOS_D**	**43.68**	**38.59**	**6722**	**LOS_E**	**63.42**	**211.54**	**5701**	**LOS_E**	**66.48**	**178.55**	**6527**	**LOS_E**	**65.79**	**201.17**	**5255**	**LOS_F**	**84.91**	**214.95**
Burrows Street / Princess Hwy / Kyle Street	Princess Highway North	Left	6	LOS_A	3.76	4.08	16	LOS_B	11.38	32.87	5	LOS_E	64.47	61.98	21	LOS_B	14.65	66.84	8	LOS_D	41.35	60.9	29	LOS_B	10.49	67.09
		Through	931	LOS_A	5.41	4.08	2047	LOS_B	15.76	32.87	1409	LOS_E	75.62	61.98	1717	LOS_D	44.74	66.84	1371	LOS_E	79.67	60.9	1798	LOS_D	41.97	67.09
	Kyle Street East (departure only)	Left																								
		Through																								
		Right																								
	Princess Highway South	Left	38	LOS_A	6.59	6.24	19	LOS_A	5.41	3.7	68	LOS_C	23	35.35	36	LOS_A	1.49	0.68	68	LOS_C	22.38	34.24	19	LOS_B	10.53	3.92
		Through	1823	LOS_A	4.2	6.24	998	LOS_A	5.65	3.7	1857	LOS_C	21.6	35.35	1179	LOS_A	1.45	0.68	1784	LOS_C	22.21	34.24	828	LOS_A	7.06	3.92
	Burrows Street West	Left	55	LOS_E	60.75	12.81	6	LOS_E	57.8	9.96	2	LOS_F	2312.26	134.96	1	LOS_F	249.23	135.49	3	LOS_F	3718.15	136.16	5	LOS_F	484.77	112.94
		Right	156	LOS_E	56.97	12.81	170	LOS_E	61.65	9.96	47	LOS_F	1528.34	134.96	66	LOS_F	406.02	135.49	29	LOS_F	2257.78	136.16	221	LOS_F	319.67	112.94
	Intersection		**3009**	**LOS_A**	**8.38**	**7.71**	**3256**	**LOS_B**	**15.05**	**15.51**	**3388**	**LOS_E**	**66.42**	**77.43**	**3020**	**LOS_D**	**35.08**	**67.67**	**3263**	**LOS_E**	**69.67**	**77.1**	**2900**	**LOS_D**	**53.41**	**61.32**
Princess Hwy / M5	Princess Highway North	Through	888	LOS_A	1.57	0.92	2024	LOS_B	18.7	62.44	1408	LOS_F	98.16	123.77	1735	LOS_E	57.39	135.69	1376	LOS_F	97.5	115.48	1831	LOS_E	56.2	134.68
	M5 West	Left	332	LOS_D	45.64	15.6	299	LOS_E	55.54	13	45	LOS_D	35.6	60.68	42	LOS_D	49.78	2.66	45	LOS_D	35.66	63.69	41	LOS_D	40.98	1.91
		Right	47	LOS_E	70.16	8.2	43	LOS_F	83.71	5.5	2	LOS_F	3612.11	68.81	8	LOS_F	108.69	1.19	3	LOS_F	3607.75	69.8	8	LOS_F	382.67	4.39
		Through	1880	LOS_A	3.71	5.19	995	LOS_A	4.9	3.27	1881	LOS_A	5.18	6.23	1180	LOS_A	0.81	0.57	1804	LOS_A	4.88	5.45	830	LOS_A	2.64	1.54
	Intersection		**3147**	**LOS_A**	**8.52**	**7.48**	**3361**	**LOS_B**	**18.72**	**21.05**	**3336**	**LOS_D**	**47**	**64.87**	**2965**	**LOS_C**	**34.9**	**35.03**	**3228**	**LOS_D**	**48.14**	**63.6**	**2710**	**LOS_D**	**40.53**	**35.63**
Princess Hwy / Allen Street	Princess Highway North	Through	891	LOS_A	0.22	0	2020	LOS_B	12.44	61.02	1410	LOS_F	112.07	181.06	1759	LOS_F	64.05	217.84	1396	LOS_F	105.67	164.6	1845	LOS_F	66.98	232.89
	Allen Street West	Left	311	LOS_D	30.78	17.03	54	LOS_A	9.63	0.58	674	LOS_C	18.54	22.77	111	LOS_B	10.5	1.69	683	LOS_C	16.67	21.22	113	LOS_A	8.24	1.27
		Through	2183	LOS_A	0.41	0.34	1217	LOS_A	0.3	0.1	1880	LOS_A	1.05	1.7	1089	LOS_A	0.38	0.29	1806	LOS_A	0.7	0.59	774	LOS_A	0.45	0.39
	Intersection		**3415**	**LOS_A**	**3.14**	**4.4**	**3357**	**LOS_A**	**7.77**	**15.43**	**4010**	**LOS_E**	**43.06**	**51.65**	**3093**	**LOS_E**	**36.98**	**54.96**	**3928**	**LOS_E**	**40.8**	**46.74**	**2829**	**LOS_E**	**44.18**	**58.65**
Princess Hwy / W Botany Street	Princess Highway North	Left	447	LOS_A	3.92	2.37	619	LOS_A	2.7	0.74	426	LOS_B	10.9	2.93	451	LOS_A	8.15	3.52	564	LOS_B	15.13	6.98	523	LOS_A	7.34	23
		Through	827	LOS_A	3.55	2.12	2021	LOS_A	2.4	1.15	1261	LOS_D	47.4	40.79	1795	LOS_D	43.14	61.85	1318	LOS_C	26.04	20.8	1856	LOS_D	46.7	69
	W Botany Street East	Left	65	LOS_B	19.17	43.29	27	LOS_B	17.2	11.94	206	LOS_E	60.91	46.15	26	LOS_D	35.98	7.48	131	LOS_C	20.98	27.86	17	LOS_D	49.47	12.03
		Right	429	LOS_F	94.89	48.32	308	LOS_D	50.54	15.77	338	LOS_F	83.36	51.21	265	LOS_D	42.67	11.02	364	LOS_E	78.49	32.43	313	LOS_D	48.98	16.09
		Through	2498	LOS_B	16.88	31.71	1246	LOS_A	7.58	5.77	2542	LOS_A	5.61	6.03	1158	LOS_A	3.31	1.86	2485	LOS_A	9	15.95	864	LOS_A	6.75	3.05
	Intersection		**4276**	**LOS_C**	**20.81**	**24.53**	**4238**	**LOS_A**	**7.57**	**6.15**	**4786**	**LOS_C**	**24.95**	**24.61**	**3731**	**LOS_C**	**26.07**	**14.3**	**4873**	**LOS_B**	**19.82**	**18.69**	**3598**	**LOS_C**	**31.31**	**20.59**

Intersection / Scenario			2022 AM Base				2022 PM Base				2036 AM Base				2036 PM Base				2036 AM Project Case				2036 PM Project Case			
Intersection	**Approach**	**Movement**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**	**Volume**	**LOS**	**Vehicle Delay**	**Queue Length (m)**
Princess Hwy / Gertrude Street	Princess Highway North	Through	220	LOS_A	6.94	7.56	86	LOS_A	2.64	6.81	153	LOS_B	16.8	43.89	90	LOS_B	13.37	98.06	170	LOS_A	8.68	13.07	118	LOS_B	15.47	100.27
		Right	1176	LOS_A	6	7.64	2601	LOS_A	4.07	6.74	1596	LOS_C	27.03	43.72	2191	LOS_C	30.64	97.79	1781	LOS_A	7.97	12.97	2282	LOS_C	29.51	100.71
	Gertrude Street East	Left	97	LOS_D	45.75	7.69	48	LOS_D	43.95	16.8	149	LOS_E	74.06	41.14	91	LOS_E	60.24	25.17	140	LOS_D	49	19.24	120	LOS_E	71.49	61.56
		Right	204	LOS_B	11.33	7.69	299	LOS_D	51.27	16.8	161	LOS_E	74.8	41.14	407	LOS_D	47.92	25.17	224	LOS_D	42.94	19.24	546	LOS_E	62.71	61.56
		Through	2933	LOS_B	11.66	41.19	1549	LOS_A	2.68	2.26	2879	LOS_A	9.74	20.63	1422	LOS_A	3.2	2.51	2825	LOS_B	12.79	31.19	1175	LOS_A	5.97	4.18
	Intersection		**4630**	**LOS_B**	**10.7**	**16.02**	**4583**	**LOS_A**	**7.07**	**8.15**	**4938**	**LOS_B**	**19.61**	**37.34**	**4201**	**LOS_C**	**23.3**	**55.88**	**5140**	**LOS_B**	**13.28**	**19.12**	**4241**	**LOS_C**	**28.06**	**66.68**
Princess Hwy / Brodie Spark Drive	Princess Highway North	Through	1215	LOS_A	9.4	10.82	2500	LOS_B	12.76	29.85	1524	LOS_B	11.9	13.01	2074	LOS_D	39.91	180.2	1646	LOS_B	11.39	15.19	2176	LOS_D	36.51	186.41
		Right	144	LOS_D	45.74	7.57	552	LOS_E	55.42	28.64	141	LOS_D	47.84	7.46	457	LOS_E	55.19	23.5	141	LOS_D	46.35	7.43	466	LOS_D	53.08	22.71
	Brodie Spark Drive West	Left	435	LOS_D	37.3	17.2	253	LOS_C	33.7	8.49	282	LOS_F	97.48	136.38	249	LOS_F	100.73	109.31	269	LOS_F	113.17	132.55	270	LOS_E	65.98	83.74
		Right	177	LOS_E	71.7	12.7	188	LOS_E	67.88	13.95	293	LOS_F	203.81	153.31	266	LOS_F	234.06	158.97	294	LOS_F	214.96	164.96	286	LOS_F	175.26	110.09
	Princess Highway South	Left	161	LOS_B	10.91	0.37	261	LOS_A	7.78	1	269	LOS_A	5.04	0.06	369	LOS_B	13.46	5.73	259	LOS_A	6.65	0.96	270	LOS_A	6.5	0.47
		Through	2983	LOS_B	15.15	77.91	1585	LOS_B	16.53	18.8	2756	LOS_B	15.01	72.68	1458	LOS_B	16.58	17.36	2757	LOS_B	16.59	78.62	1427	LOS_B	11.11	9.21
	Intersection		**5115**	**LOS_B**	**18.35**	**21.09**	**5339**	**LOS_C**	**20.98**	**16.79**	**5265**	**LOS_C**	**29.4**	**63.81**	**4873**	**LOS_D**	**46.07**	**82.51**	**5366**	**LOS_C**	**31.01**	**66.62**	**4895**	**LOS_D**	**38.76**	**68.77**
W Botany Street / Flora Street	W Botany Street North	Left	41	LOS_A	0.21	0.34	125	LOS_A	2.72	1.91	61	LOS_A	0.25	0.22	104	LOS_A	2.14	1.13	155	LOS_B	18.65	11.96	147	LOS_A	2.88	1.65
		Through	405	LOS_A	1.37	0.34	499	LOS_A	4.84	1.91	365	LOS_A	1.1	0.22	351	LOS_A	4.32	1.13	408	LOS_B	18.78	11.96	381	LOS_A	4.65	1.65
	Flora Street East	Left	17	LOS_F	181.96	13.47	23	LOS_D	42.16	3.78	27	LOS_F	123.77	26.02	65	LOS_C	31.97	5.18	47	LOS_F	183.02	37.68	28	LOS_E	78.17	13.52
		Right	51	LOS_F	149.11	13.47	101	LOS_C	32.21	3.78	149	LOS_F	103.6	26.02	108	LOS_C	27.8	5.18	127	LOS_F	160.84	37.68	116	LOS_F	96.43	13.52
	Flora Street West	Through	448	LOS_D	53.49	23.31	228	LOS_A	4.77	1.26	412	LOS_D	37.52	22.7	181	LOS_A	7.81	2.39	364	LOS_C	23.12	23.54	213	LOS_A	5.02	0.83
		Right	60	LOS_E	60.85	23.31	46	LOS_B	13.93	1.26	87	LOS_D	44.06	22.7	67	LOS_C	22.39	2.39	96	LOS_F	85.56	23.54	8	LOS_B	17.12	0.83
	Intersection		**1022**	**LOS_D**	**38.04**	**12.37**	**1022**	**LOS_A**	**8.52**	**2.32**	**1101**	**LOS_C**	**34.95**	**16.32**	**876**	**LOS_B**	**11.11**	**2.9**	**1197**	**LOS_D**	**46.96**	**24.39**	**893**	**LOS_B**	**18.79**	**5.33**