

Lend Lease

**One Sydney Harbour - State
Significant Development 6964**

**Building R4A - Transport
Management and Accessibility Plan
(TMAP)**

Rev D | 28 July 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 222061-19

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LinSig Modelling Outputs

1 Introduction

This Transport Management and Accessibility Plan (TMAP) supports a State Significant Development Application (SSD 6964) submitted to the Minister for Planning pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Development Application (DA) seeks approval for construction of a residential flat building (known as Residential Building R4A) and associated works at Barangaroo South as described in the Overview of Proposed Development section of this report. The findings and methodology in this report is consistent with the site wide TMAP developed for the Barangaroo South Concept Plan.

1.1 Overview of Proposed Development

The Residential Building R4A DA seeks approval for the construction and use of residential flat building comprising 327 apartments, ground floor retail, the allocation of car parking, services, plant and storage within the Stage 1B Basement (subject of a separate concurrent DA), and the construction of ancillary landscaping and temporary public domain.

Approval for the construction of Residential Building R4A's core and associated plant and services within the basement is being sought as part of the concurrent Stage 1B Basement DA and do not form part of this DA.

1.2 Site Location

Barangaroo is located on the north western edge of the Sydney Central Business District, bounded by Sydney Harbour to the west and north, the historic precinct of Millers Point (for the northern half), The Rocks and the Sydney Harbour Bridge approach to the east; and bounded to the south by a range of new development dominated by large CBD commercial tenants to the south.

The Barangaroo site has been divided into three distinct redevelopment areas (from north to south) – the Barangaroo Reserve, Barangaroo Central and Barangaroo South.

The R4A DA Site area is located within Barangaroo South as shown in Figure 1. The DA Site is located on land generally known and identified in the approved Concept Plan as Block 4A



Figure 1 Indicative Site Location plan

2 Study Background

2.1 Scope of the Report

This report assesses the forecast construction and operational traffic generated during all stages of the development of the site and its likely impact to the road network, as well as pedestrian safety and amenity issues during the construction and operation of the subject development. It assesses the cumulative traffic impacts associated with the construction of Building R4A and the following surrounding developments:

Works directly related to Barangaroo South

- Stage 1A Basement Construction
- C4 Commercial Building
- C3 Commercial Building
- C5 Commercial Building
- R8/R9 Residential Buildings
- Concrete Batch Plant Operation
- Block 4 remediation works
- Block 5 remediation works
- Hickson Road remediation works
- City Walk Bridge
- R1 Building
- R7 Building
- C2/C6 kiosk
- Crown Sydney
- Stage 1B basement
- Stage 1B residential towers (buildings R4A, R4B, R5)

Works external to Barangaroo South

- Wynyard Walk
- Barangaroo Reserve and Northern Cove
- Barangaroo Ferry Wharf
- Sydney Metro

With respect to construction work external to Barangaroo South, assumptions have been made regarding expected vehicular activity based on documents submitted as part of the planning applications for each of these works.

As the anticipated construction period (and level of vehicle activity) for the Barangaroo Central precinct is currently unclear, these works have been excluded from the analysis.

2.2 Study Objectives

Specific issues addressed in the report respond to the Secretary's Environmental Assessment Requirements (SEARs) in relation to traffic and transport for the planning application, those being:

- *Demonstrate consistency with the Barangaroo Integrated Transport Plan and the Sydney City Centre Access Strategy.*
- *The EIS shall include a Traffic and Transport Impact Assessment that provides, but is not limited to, the following:*
 - *current daily and peak hour vehicle, public transport, pedestrian and bicycle movements and existing traffic and transport facilities provided on the road network;*
 - *daily and peak traffic movements likely to be generated by the development, including peak traffic movements;*
 - *assessment of the existing and future performance of key intersections providing access to the site, and any upgrades (road/intersections) required as a result of the development. The assessment of the existing and future road network operations needs to consider the cumulative impacts of traffic volumes and focus on intersections in the north-west quadrant of the CBD in the vicinity of Barangaroo. The assessment needs to be supported by appropriate modelling and analysis to the satisfaction of Roads and Maritime Services;*
 - *details of the proposed number of car parking spaces and compliance with appropriate parking codes. It should demonstrate a minimalist approach to the provision of on-site parking, and how traffic generation (number of vehicles and time of access) will be managed in response to capacity limitations on the road network;*
 - *pedestrian and cycle connections/circulation and required upgrades to meet the likely future demand within the precinct and connections to the external networks, particularly the cycle network identified in the Sydney City Centre Access Strategy;*
 - *existing public transport services and opportunities for greater usage for residents, workers and visitors;*
 - *details of sustainable travel initiatives for residents, workers and visitors, particularly for the provision of end-of-trip facilities;*
 - *assessment of proposed loading dock provisions and access arrangements to loading docks*
 - *details of existing and proposed vehicular access and car parking arrangements for residents, workers and visitors (cars, coaches/buses & taxi ranks), including compliance with parking codes and Australian Standards, and measures to mitigate any associated traffic impacts and impacts on public transport, pedestrian and cycle networks; and*
 - *details of access arrangements for emergency and service vehicles (including vehicle type and likely arrival and departure times of service vehicles).*

The EIS shall include an updated Transport Management and Accessibility Plan.

- *In relation to construction traffic:*
 - *assessment of cumulative impacts associated with other construction activities on the Barangaroo and Wynyard Precincts;*
 - *details of anticipated truck movements to and from the site;*
 - *details of access arrangements for workers to/from the site, emergency vehicles and service vehicle movements;*
 - *details of temporary cycling and pedestrian access during construction;*
 - *details of proposed construction vehicle access arrangements at all stages of construction; and*
 - *assessment of traffic and transport impacts during construction and how these impacts will be mitigated for any associated traffic, pedestrian, cyclist and public transport, including the preparation of a draft Construction Traffic Management Plan to demonstrate the proposed management of impact. This Plan needs to include vehicle routes, number of trucks, hours of operation, access arrangements and traffic control measures for all demolition/construction activities.*

3 Existing Traffic Conditions

3.1 Road Network

Sussex Street / Hickson Road form a wide road that runs along the western side of Sydney CBD, and bounds the east of the Barangaroo Stage 1A site. The Sussex Street section continues south from Napoleon Street to Hay Street. It is two-way north of King Street and one way southbound, south of King Street. Hickson Road forms the northern extension of Sussex Street and continues north from Napoleon Street to George Street at Dawes Point.

Napoleon Street provides a connection between Hickson Road and Kent Street / Margaret Street. It is a relatively wide road and has moderate downward slope from Kent Street to Hickson Road. Traffic signals were recently installed at the Hickson Road / Napoleon Street intersection, which provides for controlled vehicle movements out of the Barangaroo Stage 1A basement.

Shelley Street provides a connection between Sussex Street (to the north) and Erskine Street (to the south). Shelley Street also forms a northbound connection from Harbour Street.

Lime Street is located south of the construction site in a north-south direction and currently provides limited local access from priority controlled Erskine Street.

3.2 Pedestrian Conditions

There are a number of existing dedicated pedestrian facilities adjacent to the Barangaroo South site, including:

- Signal controlled pedestrian crossings across all approaches of the Sussex Street / Shelley Street intersection
- Signal controlled pedestrian crossings across all approaches of Hickson Road / Napoleon Street intersection
- Adequate footpaths on both sides of Hickson Road

3.3 Traffic Volumes

Traffic counts were undertaken in the Barangaroo precinct on Thursday 26 November 2015 and are presented in Table 1. These counts were compared with those undertaken by Arup on 25 July 2013 over the same time period.

Revised traffic counts were commissioned given the number of changes in the transport environment since the previous traffic counts were undertaken in July 2013, in particular the partial closure of George Street to accommodate the Sydney Light Rail construction. At the time of the traffic surveys, George Street was closed to general traffic between King Street and Market Street.

Other changes to the road environment since the previous July 2013 counts are as follows:

- Closure of Shelley Street north of Lime Street

- Opening of Barangaroo South Stage 1A public domain, including extension of Lime Street to connect with Watermans Quay and Hickson Road
- Signalisation of Hickson Road / Napoleon Street
- New bus routes on Hickson Road
- Occupation of Barangaroo South Stage 1A public domain and occupancy of T2 commercial building
- Opening of Barangaroo Point Reserve
- Changes to the CBD bus network associated with the construction of the light rail

Five signalised intersections in the vicinity of the Barangaroo worksite were surveyed. It should be noted that the survey was conducted on a Thursday outside of school holiday periods, and are therefore representative of traffic volumes in the precinct.

The locations of the intersections surveyed are displayed in Figure 2 below.

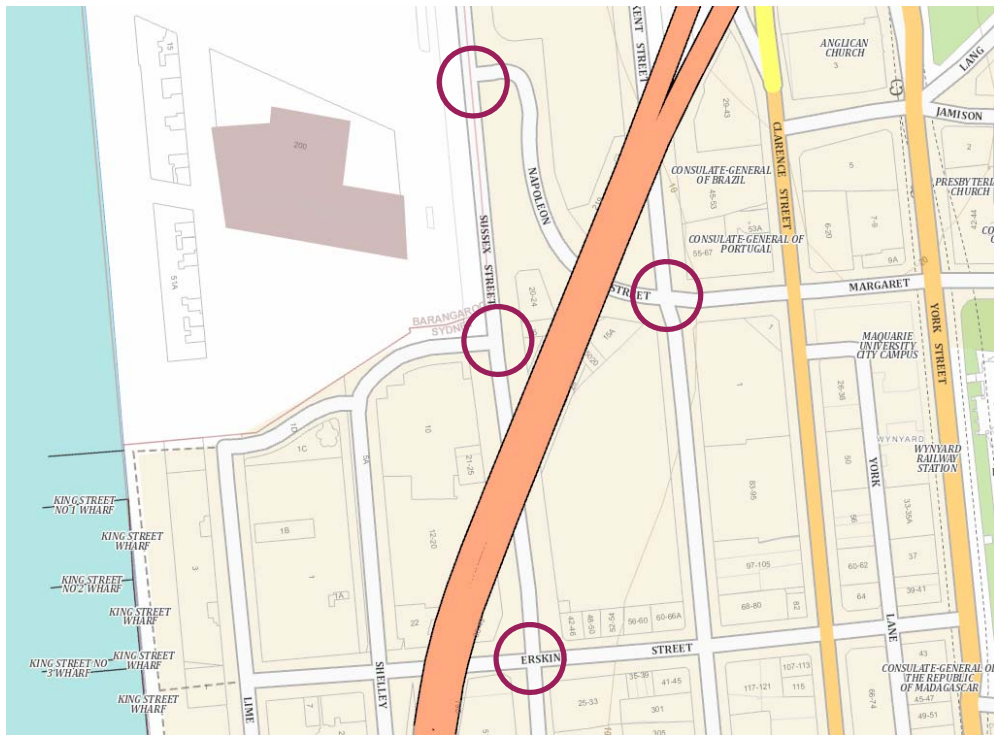


Figure 2 Traffic count locations

Table 1: Hickson Road / Sussex Traffic Volumes

Traffic Count Date	Road	Location	AM Peak Hour			PM Peak Hour		
			NB	SB	Total	NB	SB	Total
Nov 2015	Hickson Road	North of Napoleon Street	564	237	801	418	573	991
Jul 2013			601	254	855	380	606	986
% Change from 2013 to 2015			-6%	-7%	-6%	10%	-5%	1%
Nov 2015	Sussex Street	North of Shelley Street	698	474	1,172	512	569	1,081
Jul 2013			926	556	1,482	569	714	1,283
% Change from 2013 to 2015			-25%	-15%	-21%	-10%	-20%	-16%
Nov 2015	Sussex Street	North of Erskine Street	684	413	1,097	512	622	1,134
Jul 2013			650	518	1168	409	845	1,254
% Change from 2013 to 2015			5%	-20%	-6%	25%	-26%	-10%
Nov 2015	Sussex Street	South of Erskine Street	401	950	1,351	352	1,275	1,627
Jul 2013			578	907	1,485	316	1,364	1,680
% Change from 2013 to 2015			-31%	5%	-9%	11%	-7%	-3%

The results of the survey undertaken in November 2015 indicate that two-way traffic volumes in the Barangaroo precinct, specifically along Hickson Road, Napoleon Street and Sussex Street, have decreased compared to those surveyed in July 2013. This is the case for both the AM and PM commuter peak hours, and is illustrated in Figure 3 below.

When the directional traffic flows are reviewed, the northbound traffic along Sussex Street and Hickson Road has increased by between 10 and 25% in the PM peak but reduced in the AM Peak.

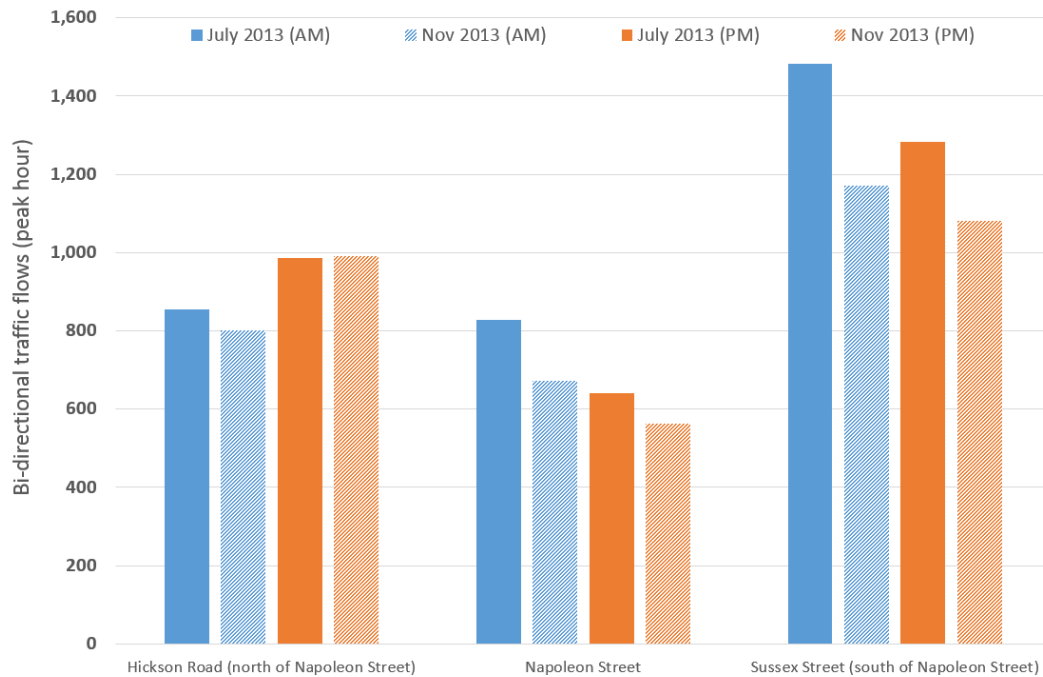


Figure 3 Changes in traffic volumes – 2013 vs 2015

The traffic surveys demonstrate that the partial closure of George Street (along with other changes in the road environment) has not resulted in any increases in traffic volumes along the Hickson Road corridor. Traffic volumes have instead declined in the key southbound direction – despite the reduced road capacity of George Street.

To ensure the traffic counts of November 2015 were reflective of current conditions, Arup undertook further traffic surveys on Wednesday 4 May 2016, coinciding with the closure of George Street between Bridge Street and Margaret Street. The results of the survey undertaken in May 2016 indicate traffic volumes in the Barangaroo precinct, specifically along Hickson Road, Napoleon Street and Sussex Street, have decreased compared to those surveyed in November 2015.

This is the case for both the AM and PM commuter peak hours, and is illustrated in Figure 3 below.

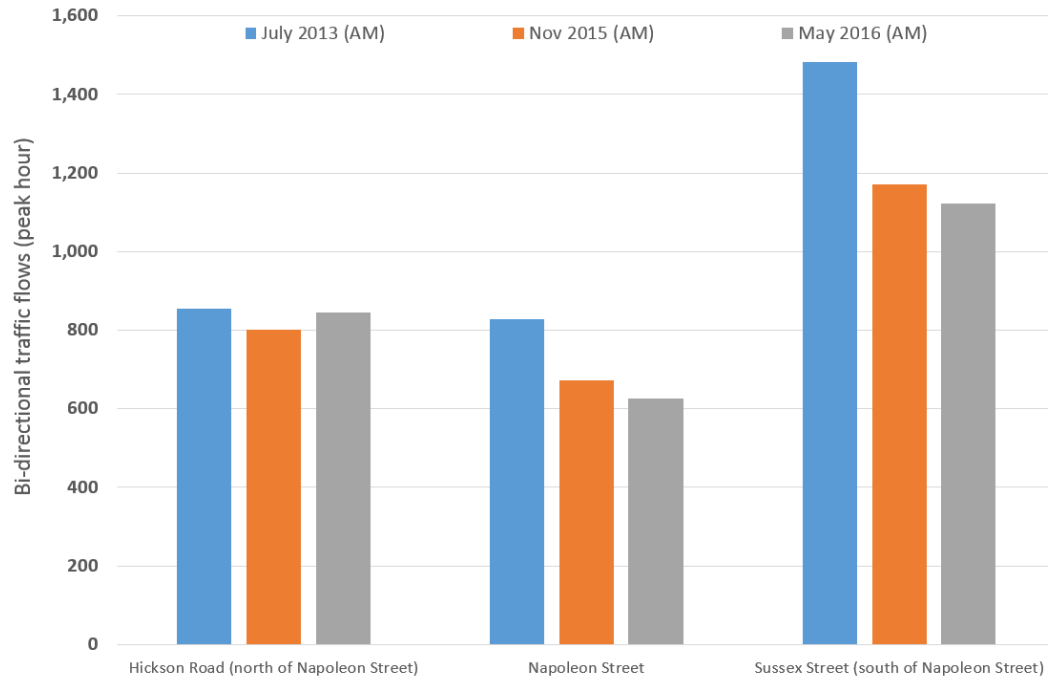


Figure 4 Changes in traffic volumes – AM Peak Hour

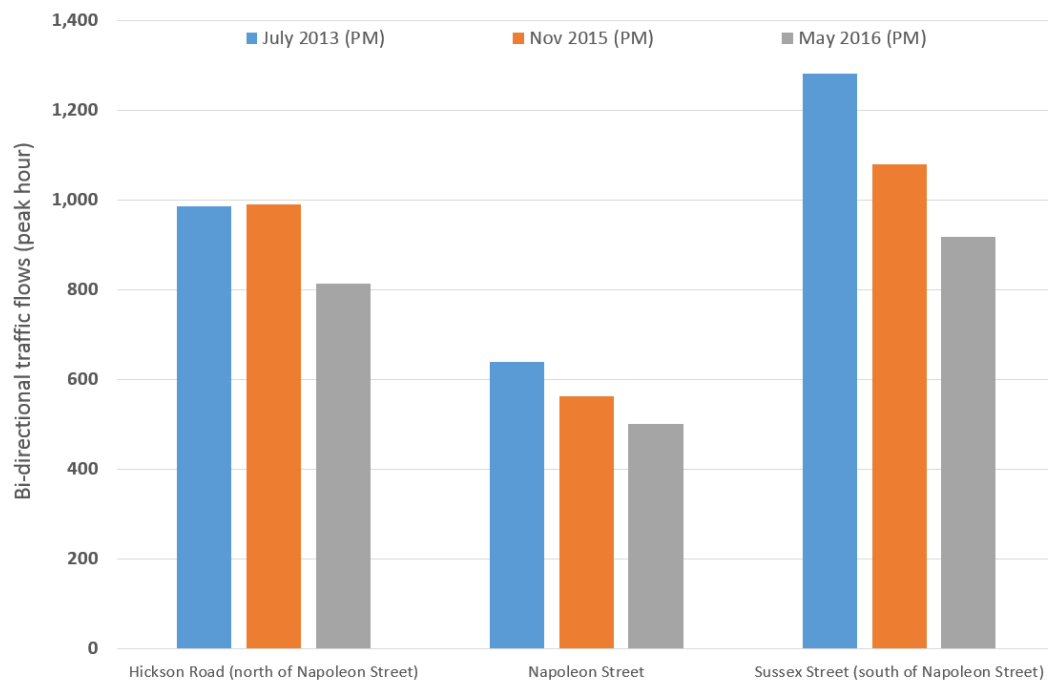


Figure 5 Changes in traffic volumes – PM Peak Hour

Significantly, since in the closure of the northern end of George Street in April 2016, traffic flows on Hickson Road have further declined compared to those recorded in November 2015. This indicates there has not been a redistribution of traffic away from George Street towards the Hickson Road corridor.

3.4 Existing Construction Activity

The number of construction vehicles generated by the Barangaroo site over the course of a typical weekday is shown in Figure 6 below.

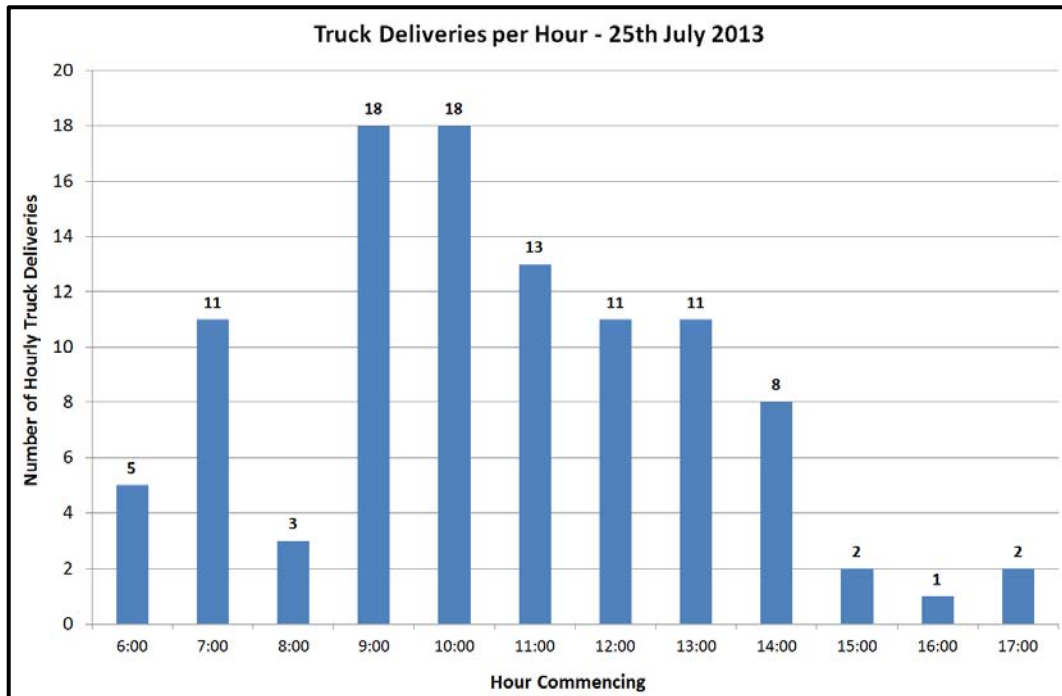


Figure 6 Typical daily profile of construction vehicle activity for Barangaroo South

This existing profile demonstrates the majority of vehicle activity takes place outside the commuter peak hours of 8am-9am and 5pm-6pm. Most notably, construction activity dissipates significantly after 3pm, with only 5% of the day's total trucks arriving after this time. 2 truck deliveries were recorded during the PM peak hour of 5pm – 6pm, equating to 2% of the daily vehicle activity.

4 Construction Traffic Assessment

4.1 Construction Program

4.1.1 Barangaroo South Works

Table 2 below outlines the concurrent developments within the Barangaroo South site, noting the start and finish dates by annual quarters.

Table 2: Construction Details of Barangaroo South Works

Project	Project Duration*		Overlaps with Stage 1B residential towers works?
	Start	Finish	
Stage 1a Basement Construction	Oct 2011	Sept 2015	✗
C3 Commercial Building	Mar 2014	Sept 2016	✗
C4 Commercial Building	May 2013	Oct 2015	✗
C5 Commercial Building	Oct 2013	June 2016	✗
C2 Building	Feb 2016	Apr 2017	✗
C1 Buildings	Sep 2017	Dec 2018	✗
R8/R9 Residential Buildings	Jun 2014	Nov 2015	✗
Batch Plant Operation	Sept 2013	Sept 2015	✗
Block 4 Remediation Works	May 2016	Mar 2019	✗
Block 5 Remediation Works	Sep 2016	Mar 2019	✗
Stage 1a Public Domain Works	Jul 2014	Mar 2016	✗
City Walk Link Bridge	Oct 2014	Jun 2015	✗
Building R1	July 2016	Mar 2017	✗
Building R7	Dec 2015	Oct 2016	✗
Stage 1C Remediation and Earthworks	Dec 2015	Mar 2018	✗
Crown Sydney	June 2016	Sep 2020	✓
Hickson Road Remediation	Nov 2016	Oct 2018	✗
Stage 1B basement	Jun 2017	Mar 2021	✓
Stage 1B residential towers	Dec 2019	Jul 2023	✓

* The above dates are indicative only and allow for future tenant fit out works within the individual buildings

4.1.2 Works External to Barangaroo South

The construction staging for works external to the Barangaroo South site are outlined in Table 3 below. None of these works coincide with the Stage 1B construction.

Table 3: Construction Details of Works Adjacent to Barangaroo South

Project	Project Duration		Overlaps with Stage 1B residential towers works?
	Start	Finish	
Wynyard Walk Bridge and Tunnel	Apr 2013	Dec 2016	✗
Barangaroo Reserve Main Works	Apr 2013	Jul 2015	✗
Barangaroo Ferry Wharf	Feb 2016	Nov 2016	✗
Sydney Metro	Jul 2017*	Dec 2023*	✓

* Indicative only

4.2 Construction Traffic Principles

The overall construction traffic management principles will be to ensure:

- Construction access driveways are designed to allow trucks to enter and leave the site in a forward direction;
- Construction access driveways are managed and controlled by site personnel;
- Safety for works and the public in the vicinity of the worksite is maintained;
- Designated truck routes for all access points are developed which minimises the impacts on the local road network;
- A safe, convenient and appropriate environment is established for pedestrians and cyclists at all times; and
- Appropriate capacity for pedestrians along the Hickson Road footpath is maintained

4.3 Traffic Routes

The predominant traffic routes that construction vehicles utilise to Barangaroo are presented in Figure 7 through Figure 9 on the following pages, and summarised below.

From the north and north-west:

- Harbour Bridge – Western Distributor – Bathurst Street – Liverpool Street – Harbour Street – Shelley Street – Erskine Street – Sussex Street (inbound); and
- Hickson Road – Napoleon Street – Kent Street – Western Distributor – Harbour Bridge (outbound)

This southbound truck activity would occur during peak hours as there is no access for general traffic from the Harbour Bridge to York Street between 6.30am – 9.30am (Monday – Friday).

From the west and south-west:

- Anzac Bridge – Western Distributor – Sussex Street – Hickson Road (inbound); and
- Hickson Road – Sussex Street – Western Distributor – Anzac Bridge (outbound)

From the south and east:

- Eastern Distributor – Cross City Tunnel – Western Distributor – Wattle Street – Western Distributor – Sussex Street – Hickson Road (inbound); and
- Sussex Street – Harbour Street – Cross City Tunnel (outbound)

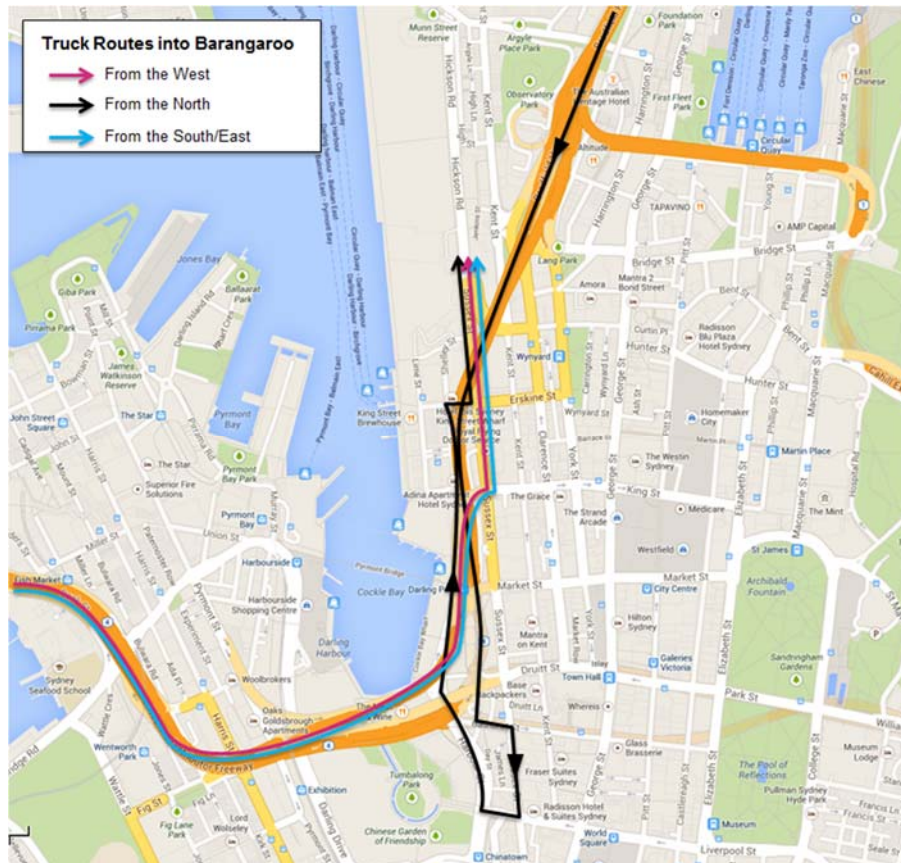


Figure 7: Inbound Traffic Routes to Barangaroo

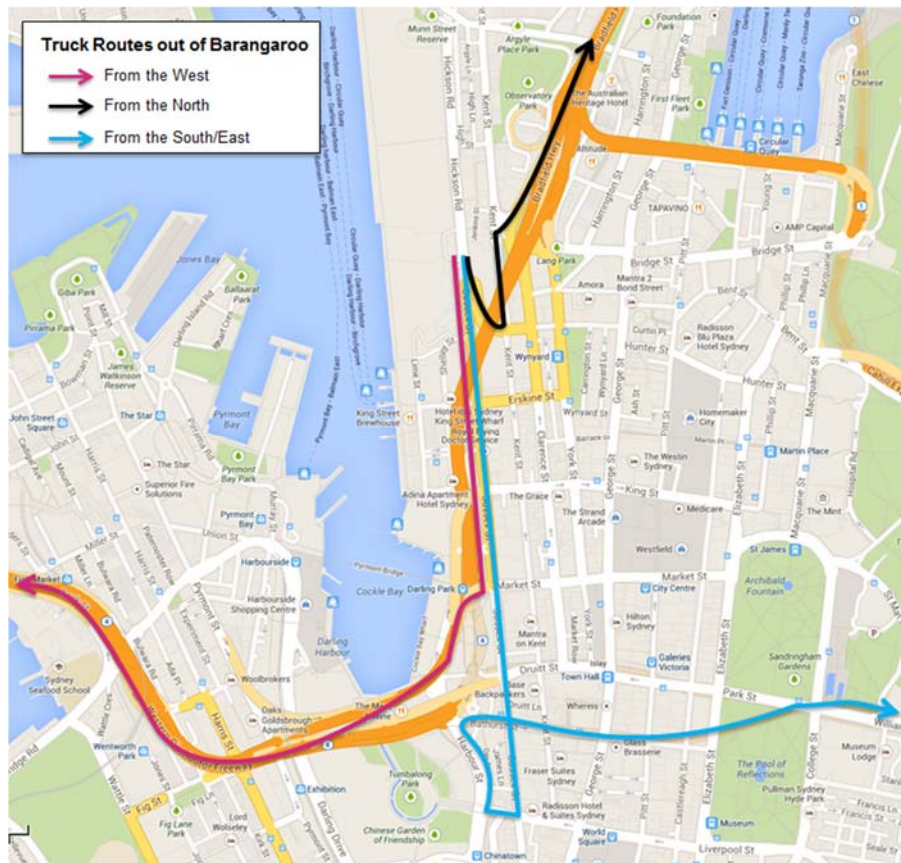


Figure 8: Outbound Traffic Routes from Barangaroo

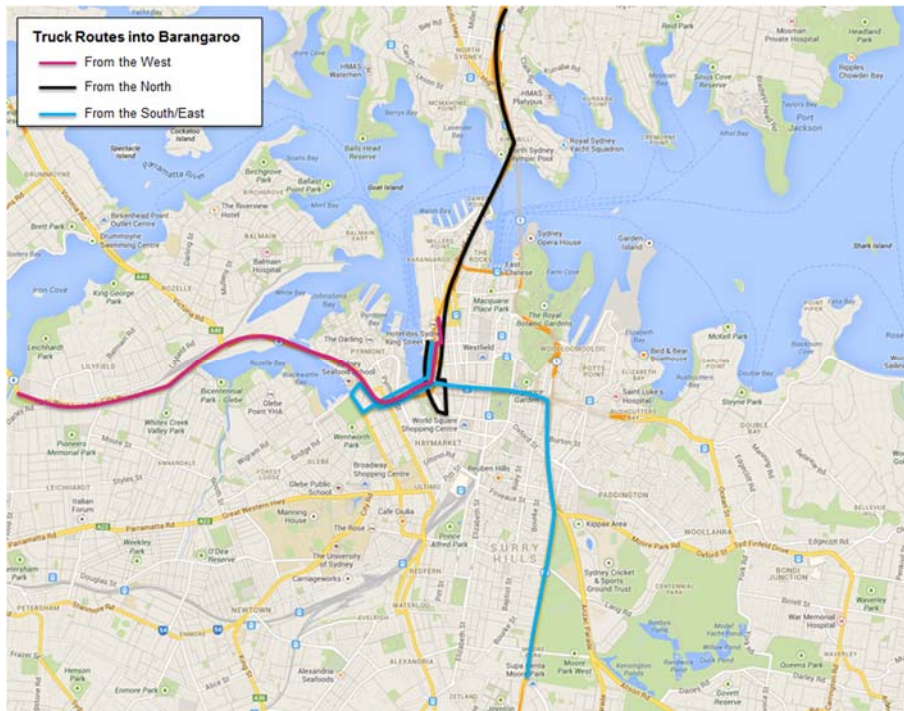


Figure 9: Construction Traffic Routes through the Sydney CBD

4.4 Forecast Traffic Movements

An assessment has been made of the cumulative impacts of construction activities in the precinct, based on the works described in Section of this report.

The proposed construction timeframe for the construction of Building R4A will extend into the period of the occupation of the Barangaroo South Stage 1A development and the opening of Barangaroo Reserve. As such, an assessment of the road network impact of these works during this time has also been undertaken.

4.4.1 Stage 1B Basement and Tower Construction

The works associated with the construction of the Stage 1B basement and towers are expected to occur between June 2017 and July 2023. Works are to be divided into stages as summarised in Table 4 below.

Table 4: Summary of Stage 1B construction works

Stage	Description	Works
A	Excavation after Remediation	Works includes excavation remaining spoil after remediation works which are conducted under the odour tents 2 Excavators, 2 Front End Loaders, 1 Dozer and 4 Anchoring rigs are assumed to operate in 15 minutes. In addition odour equipment is operational 24 hours a day, 7 days a week to maintain a negative pressure environment.
B	Rock Excavation	Works includes excavation of rock following completion of all spoil excavation & remediation works. Works will not be undertaken under an odour tent. 2 Excavators / rock-breakers, 2 Front End Loaders, 2 Diamond rock saws and 1 Dozer are assumed to operate in 15 minutes.
C	Piling Works	Works includes Piling using Auger Piling Rig on the perimeter and core for future buildings 4 Auger piling rigs, 2 attendant cranes and 2 boom truck and lift are assumed to operate in 15minutes.
D	Structure Construction	Works includes concreting and structural works. 2 concrete pumps, 2 forklifts, 2 compressors, 1 crane, a boom truck are assumed to operate in 15minutes.
E	Services / Fit-out	Works includes services reticulation, fit-out, finishes installation and commissioning.

4.4.2 Construction Traffic Movements

The number of construction vehicles generated by works within the Barangaroo South site is based on recent advice from Lend Lease. The number of vehicle movements¹ expected during the peak hours has been determined based on the existing activity profile for the Barangaroo South (Stage 1A) site. Construction vehicle activity generated by works external to Barangaroo South has been forecasted based on the supporting planning documents to each of the project applications.

4.4.3 Operational Traffic Movements

The proposed construction timeline for Building R4A coincides with the occupation of commercial and residential buildings within Barangaroo South. These include:

- C3 commercial building
- C4 commercial building
- C5 commercial building
- C2 commercial building and C6 kiosk
- R1 and R7 building
- R8/R9 residential buildings
- Barangaroo Reserve

210 cars and 50 service vehicles are anticipated to be generated from these developments during peak hours following their occupation (including associated on-street parking).

4.4.4 Cumulative Traffic Movements

Table 5 on the following page provides a detailed summary of anticipated construction and development traffic movements associated with each project in the Barangaroo precinct. This demonstrates the peak traffic activity is anticipated to occur in September 2020, with 433 additional traffic movements during the AM peak hour (compared with the existing situation).

As illustrated in Figure 6, the majority of construction truck movements occur prior to the afternoon peak commuter period (5pm – 6pm). Therefore the analysis has considered the morning peak hour (8am – 9am) to determine the impacts arising from the Stage 1B works.

¹ For the purposes of this report, a traffic movement is defined as the one-way flow of a single vehicle at a particular location. A vehicle entering the site, and departing some time later, is considered as two traffic movements.

Forecast Vehicle Activity - Vehicle Movements per Hour

433

* Anticipated construction vehicle activity generated by Barangaroo South worksites are based on recent information provided to Arup by Lend Lease Buildings.

Forecast Vehicle Activity - Vehicle Movements per Hour

4.5 Road Network Impacts

The impacts of the additional traffic movements on the local road network generated by the construction and operation of the Barangaroo site are described in the sections below.

4.5.1 Traffic Distribution

Construction Traffic

Consistent with the forecasts adopted in previous construction traffic management plans for Barangaroo South works, 70% of construction vehicles are forecast to approach the worksite from the southern and western parts of Sydney. The remainder would approach from the northern direction (i.e. via the Harbour Bridge, Western Distributor and Harbour Street). For trucks returning to the north, they would utilise Napoleon Street and then turn left onto Kent Street to approach the Harbour Bridge. Margaret Street would not be used as a construction route during peak hours.

Development Traffic.

Traffic associated with the new development has been distributed across the road network based on Journey to Work Census data, consistent with the assumptions outlined in the MWT Modified Concept Plan – Transport Report, July 2008. This is summarised in Table 6 below.

Table 6 Development Traffic Distribution

Direction	Route	Distribution
North	Harbour Bridge	40.7%
East	Eastern Distributor	22.9%
	William Street	1.5%
	Oxford Street	4.1%
South	Harbour Street	8.6%
West	Western Distributor	21.8%
Sydney Inner	-	0.4%
Total		100%

4.5.2 Road Network Layout

The traffic modelling has considered the current road network layout in the Barangaroo precinct. This includes:

- The closure of the northern section of Shelley Street to vehicular traffic.
- The installation of traffic signals at the Hickson Road / Napoleon Street intersection, including the provision of a fourth leg at the intersection which provides egress from the Stage 1A basement car park.

During the construction of the Barangaroo Stage 1B development, the Hickson Road / Watermans Quay intersection will be priority controlled.

4.5.3 Traffic Modelling

This report examines in detail the future stage traffic operations of the five nearest and most relevant intersections to Barangaroo South construction site, namely:

- Hickson Road & Watermans Quay, **Priority Controlled (Future)**
- Napoleon Street & Hickson Road, **Traffic Signals**
- Sussex Street & Shelley Street, **Traffic Signals**
- Sussex Street & Erskine Street, **Traffic Signals**
- Napoleon Street, Margaret Street & Kent Street, **Traffic Signals**

Lane saturation flows within the LinSig model have been lowered at certain locations to consider the impact of queue spillback from upstream and downstream intersections. The results of the LinSig intersection modelling are summarised in Table 7 and detailed in Appendix A.

4.5.4 Intersection Operation

The effect of the estimated additional peak hour traffic during (for the combined construction and operational activities) has been investigated for each of the affected intersections during the AM peak hour. Negligible construction traffic movements are anticipated during the PM peak hour and therefore this has not been considered in the analysis. The modelling results for the future peak hour traffic movements are summarised in Table 7.

Table 7: Intersection Analysis

Peak	Intersection	Future Traffic Peak, 2020 (Excluding Stage 1B works)			Future Traffic Peak, 2020, (Including Stage 1B works)		
		LOS	DOS	AVD (sec)	LOS	DOS	AVD (sec)
AM	Sussex St / Erskine St	C	0.91	37	C	0.91	36
	Sussex St / Shelley St	D	0.98	46	D	0.99	51
	Hickson Rd / Napoleon St	E	0.94	58	E	0.95	61
	Kent St / Margaret St	B	0.61	21	B	0.62	21
	Hickson Rd / Globe St	A	0.49	2	A	0.51	2

LOS - Intersection Traffic Level of Service, DOS - Degree of Saturation, AVD - Average Delay per vehicle

The results of the LinSig intersection analysis forecast minimal changes in the operation of key intersections as a result of the construction of the Stage 1B development, when compared with the base case scenario. The additional construction vehicles associated with the Stage1B works has a negligible impact on forecast road network performance.

During the AM peak hour, when construction vehicles attributable to Stage 1B are expected to access the site, the road network generally operates satisfactorily. The addition of construction traffic movements associated with the Stage 1B works does not impact the overall operation of the local road network, and requires no further works to accommodate the levels of construction traffic anticipated.

4.6 Construction Vehicle Management

4.6.1 Hours of Operation

The proposed site hours of operation will be similar to the existing project approvals for Barangaroo South. These hours assist the site traffic movements being generated mainly outside the normal commuter peak traffic periods, such that their impacts on the surrounding road network are minimised.

4.6.2 Restriction to Construction Routes

In addition to MP10_0023 – D4(e), which restricts trucks using York Street between 2pm and 8pm, trucks are also not able to use York Street or Clarence Street in the AM peak between 6am and 10am due to existing restrictions.

4.6.3 Emergency Vehicle Access

Site entries are to be clearly signposted for the benefit of all approaching site traffic, in particular emergency services vehicles.

4.6.4 Access for Construction Workers

To reduce the impact on the local road network associated with construction work, no on-site parking is to be provided for construction workers. In this manner it is being treated like any other CBD construction project. The constrained parking environment surrounding the site, coupled with the relatively high cost of long term parking, will ensure the majority of construction workers arrive to the site via public transport.

Construction workers through their site inductions will be provided with travel advice about public transport, walking and cycling routes to the site.

4.6.5 Traffic Control Recommendations

The site traffic control recommendations for each worksite gate entry or exit point (including all appropriate signage) will be determined by means of a Traffic Control Plan to be prepared by an RMS accredited contractor closer to construction commencement.

Truck movements are to be staged and coordinated to prevent trucks circulating CBD streets whilst awaiting access to the site.

Construction vehicles will approach the site from areas outside the CBD using major arterial routes such as the M4, M5 etc.

The size of trucks proposed to access the site will be in accordance with Clause 300-3 of the Road Rules in terms of length vehicle restrictions.

The vehicular traffic movements at each of the site entry or exit gates for traffic to and from Hickson Road will potentially need to be controlled by a flagman to ensure no potential traffic safety conflicts occur between the site truck traffic and pedestrians on the adjacent footpath.

Any activity likely to impact the operational efficiency of the state road network and/or for works within 100m of traffic lights would be the subject of an application to the Transport Management Centre for a road occupancy licence.

Access for construction vehicles to the Barangaroo Stage 1B site will be via Hickson Road at the existing gatehouse, approximately 350m north of the Sussex Street / Napoleon Street intersection. This site access will be utilised until January 2019, after which it will move approximately 25m south along Hickson Road as illustrated in Figure 10 below.



4.8 Pedestrian and Cycling Management

There are a number of existing pedestrian routes which will facilitate movement for construction workers to and from the Barangaroo South site.

In July 2015 two major improvements to the pedestrian network in the Barangaroo precinct were opened to the public, those being:

- The City Walk Bridge – providing a grade separated pedestrian connection from Napoleon Street, across Sussex Street into the Barangaroo site
- Signalisation of the Hickson Road / Napoleon Street intersection providing controlled pedestrian crossing movements across all four legs of the intersection.

Recently site access for construction workers was improved through the completion of the Wynyard Walk bridge. This provides provide safe and efficient access for construction workers walking across Sussex Street. The Wynyard Walk tunnel is scheduled to open in the second half of 2016.

The proposed works involves no changes to arrangements for pedestrians and cyclists along Hickson Road. Where works are required that may temporarily impact access for pedestrians and/or cyclists, appropriate traffic control measures will be implemented (in consultation with the road authority).

5 Operational Stage Assessment

5.1 Site Access Arrangements

Vehicular access to the Building R4A basement car park and loading dock is proposed to be via a single driveway entry/exit towards the western end of Watermans Quay. The primary vehicular access route into and out of the site will be via Sussex Street, Hickson Road and Watermans Quay.

By the completion of the development planned within Stage 1B, traffic signals will be installed at the Hickson Road / Watermans Quay intersection (subject to separate approval). This will manage traffic circulation and efficiency. The detailed design of the intersection, including the phasing and lane arrangements, will take place closer to the construction date and be subject to consultation with the Road Authority and RMS.

All internal roads within the Barangaroo precinct have been designed to accommodate emergency vehicles.

Access arrangements for Building R4A are illustrated in Figure 11.

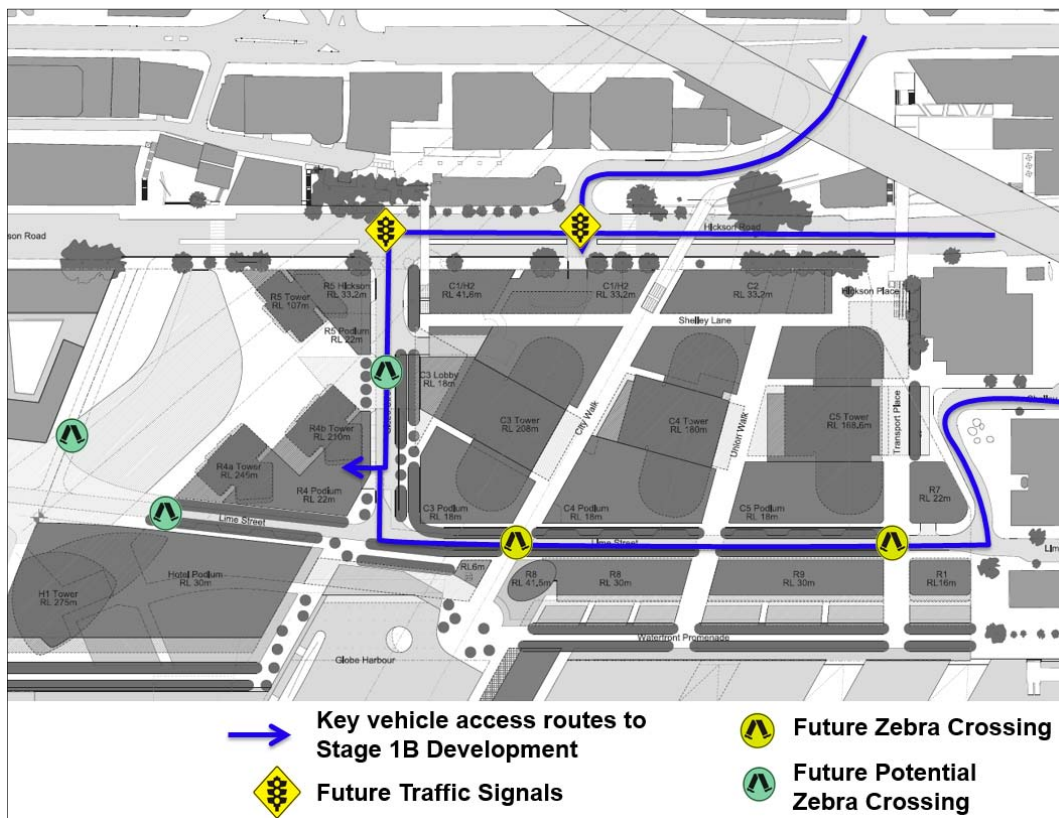


Figure 11 Site Access Arrangements

A number of formal pedestrian crossing facilities are to be provided within the Barangaroo precinct. These crossings, including two zebra crossings on Barangaroo Avenue, will provide good accessibility for pedestrians to and from the R4A building.

Vehicles entering the basement at the shared residential/loading dock access will be directed to their final location through appropriate signage and line-marking. Entry to both the loading dock and residential car park would be controlled via boom gates to prevent unauthorised vehicles accessing these areas.

5.2 Car Parking

5.2.1 Residential Car Parking

Parking rates for the residential component of Building R4A are based on the number and mix of apartments and derived via the parking rates specified in the City of Sydney LEP2005. These rates are summarised below:

Table 8: Parking Provision – Building R4A

Dwelling Type	No. of Units	Parking Rate	Total
1 Bed	112	0.5 spaces / unit	56
2 Bed	119	1.2 spaces / unit	143
3+ Bed	96	2.0 spaces / unit	192
Total			391

5.2.2 Retail Car Parking

Retail parking is proposed based on rates specified in the City of Sydney LEP2005, based on the formula below:

$$\text{Max number of cars} = \frac{(\text{Total Other FSA})}{(\text{Total FSA})} \times \frac{(\text{Site Area})}{50}$$

Based on the proposed retail floor area of 429m², 1 parking space is permissible for Building R4A.

5.3 Loading and Servicing

A loading dock is proposed to service the site with multiple points of vertical lift connections to both ground level and to each of the buildings above the basement. This provides good efficiency in terms of the layout, manoeuvring space and the ability for different sized truck spaces to be managed for appropriate use. The loading dock services the residential and retail components related to Building R4A. The proposed loading dock configuration is shown in Figure 12.

The loading dock and access ramp system has been designed in accordance with Australian Standards 2890.2- 2002, Off-street commercial vehicle facilities.

Four loading bays are to be provided which are capable of accommodating the largest design vehicle to access the basement (City of Sydney garbage vehicle). Additional service bays are to be provided for smaller vans and couriers. This arrangement offers good flexibility with respect to the variety of service vehicle movements expected within the Stage 1B site, including waste collection, furniture removal and retail servicing. The number and range of truck sizes provided for will be based on a fully shared facility with managed arrival times. A benefit of the centralised loading dock for the development is that storage areas for staging of goods delivery will enable a quick turnaround of vehicles.

A loading dock manager would be present on-site to control the movement of services vehicles within the loading dock area. All service vehicles would report to the dock manager on arrival, who would then direct them to their allocated parking space.

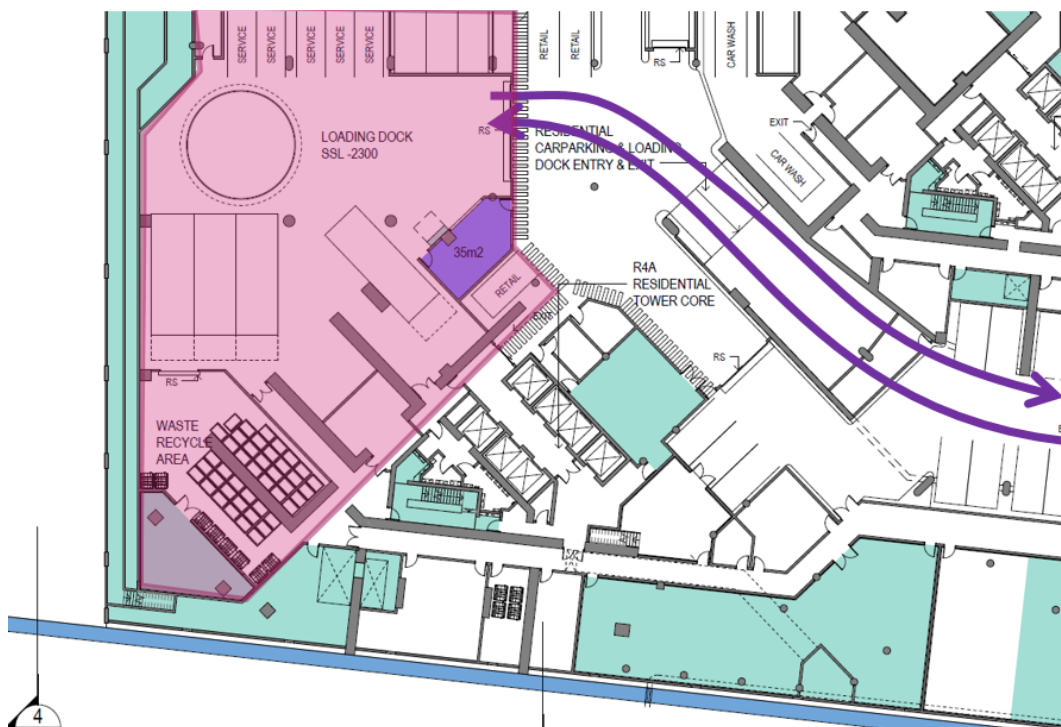


Figure 12 Indicative Loading Dock Configuration

5.4 Future Road Operations

5.4.1 Description

The operation of the road network following the full development of the Barangaroo precinct (including the Barangaroo Central and Barangaroo Reserve sites) has been modelled using the LinSig analysis software. The study has considered the operation of the following intersections:

- Hickson Road & Watermans Quay, **Traffic Signals (Future)**
- Napoleon Street & Hickson Road, **Traffic Signals**
- Sussex Street & Erskine Street, **Traffic Signals**
- Napoleon Street, Margaret Street & Kent Street, **Traffic Signals**

5.4.2 Modelling Assumptions

Existing models were calibrated to the observed situation and then forecasted to two additional scenarios for the AM and PM peak period: the future case excluding Stage 1B works and the future case including the Stage 1B works. The following points describe the key modelling assumptions made:

- A global heavy vehicle average of 4.57% was assumed across the network, as an equivalent passenger car unit (PCU) of 2.
- Coordination of intersection phasing was optimised by LinSig
- Dead green time was used in LinSig to model certain locations to incorporate the impacts of a heavily congested or restricted movement – specifically queue spillback from upstream and downstream intersections
- Base saturation flows were input based on the Austroads Guide to Traffic Management (AGTM03-09 Traffic Studies and Analysis)
 - Environment Class C assumed due to high activity nature in the CBD area surrounding the site
 - All dedicated left and right turn movements classified as a restricted turning lane (Type 3) due to high activity nature in the CBD area surrounding the site. Type 3 refers to restricted turning lanes in the Austroads Guide to Traffic Management (AGTM03-09 Traffic Studies and Analysis, pg. 75)

5.4.3 Traffic Distribution

Traffic associated with the new development has been distributed across the road network based on Journey to Work Census data, consistent with the assumptions outlined in the MWT Modified Concept Plan – Transport Report, July 2008. This is summarised in Table 9 and Figure 13,

Table 9 Development Traffic Distribution

Direction	Route	Distribution
North	Harbour Bridge	40.7%
East	Eastern Distributor	22.9%
	William Street	1.5%
	Oxford Street	4.1%
South	Harbour Street	8.6%
West	Western Distributor	21.8%
Sydney Inner	-	0.4%
Total		100%



Figure 13 Arrival and Departure Traffic Routes

Source: Barangaroo Integrated Transport Plan, Figure 7

5.4.4 Traffic Generation

Based on the adopted traffic generation rates used for previous planning applications for the Barangaroo development, the R4A building would generate 47 vehicle movements in the AM peak hour and 30 vehicle movements in the PM peak hour, as summarised in Table 10 below.

Table 10 Building R4A Traffic Generation

Land Use	Variable	Variable Number	AM Peak Hour (8am – 9am)				PM Peak Hour (5pm – 6pm)			
			trip rate	no of trips	In	Out	trip rate	no of trips	In	Out
Residential	dwelling	327	0.14	46	9	37	0.09	29	23	6
Retail	car space	1	0.40	1	1	0	0.40	1	0	1
Sub Total – Building R4A				47	10	37		30	23	7

The total peak hour traffic forecast to be generated by the entire Stage 1B development (up to three residential towers comprising approximately 775 residential units) is summarised in Table 11 below. This includes movements associated with the R4A Building as well as the two other residential towers proposed for the site. These buildings will be assessed separately and do not form part of this DA, however have been considered as part of the cumulative traffic analysis.

Table 11 Stage 1B Traffic Generation

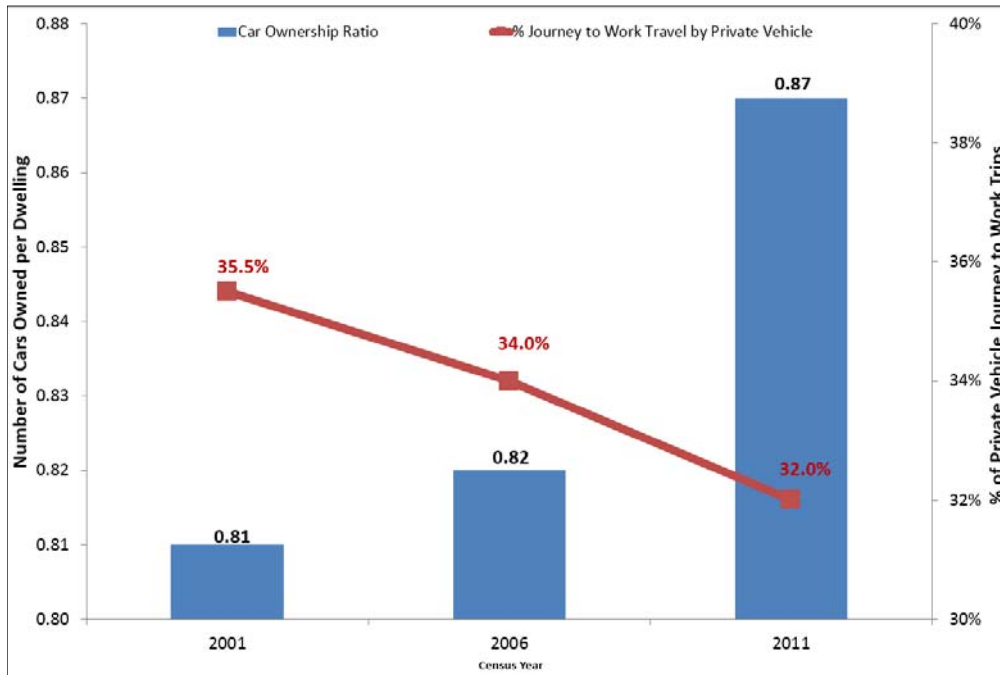
Land Use	Variable	Variable Number	AM Peak Hour (8am – 9am)				PM Peak Hour (5pm – 6pm)			
			trip rate	no of trips	In	Out	trip rate	no of trips	In	Out
Residential	dwelling	775	0.14	108	22	86	0.09	69	55	14
Retail	car space	3	0.40	1	1	0	0.40	1	0	1
Sub Total				109	23	86		70	55	15

It is important to note that the quantum of traffic generated by the residential uses is based on the total number of dwellings provided and is independent of the number of resident parking bays. The parking provision for residential uses responds to the level of car ownership expected.

Car ownership levels for residents of the Sydney Inner SLA have been steadily increasing over the past decade, rising from 0.81 cars/dwelling in 2001 to 0.87 cars/dwelling in 2011. This is similar to the trends seen across much of Sydney, with cars becoming more affordable as tariffs fall with a larger stock of cheaper new cars and increasing household income.

The census data also shows that while car ownership has risen over the past decade, private vehicle use for journey to work trips has *decreased*. This indicates that car ownership does not necessarily lead to car usage in the busy commuter peak periods, for areas well served by public transport such as Barangaroo.

This trend is illustrated in **Error! Reference source not found..**



A corridor traffic model (using the LinSig 3.2 software package) was developed to assess the future road network performance arising from the development of the Barangaroo precinct – including the development of the Stage 1B site. This modelling software allows intersections to be modelled in a single network and provides signal optimisation to reflect future traffic conditions within the Barangaroo precinct.

The road network performance has been measured against three parameters, those being:

- Level of Service (LOS)
- Degree of Saturation (DOS)
- Average Vehicle Delay (AVD)

The performance of intersections in an urban environment is measured in terms of its Level of Service (LoS). Levels of service ranges from A (very good) to F (over capacity with significant delays). This is described in the RTA Guide to Traffic Generating Developments as summarised in Table 12. Across the Sydney CBD road network, it is not uncommon for intersections to operate at Level of Service E or F (at capacity) during commuter peak hours.

Table 12 Intersection level of service

Level of Service	Average Vehicle Delay (seconds)	Traffic Signals and Roundabouts	Priority Intersections ('Stop' and 'Give Way')
A	< 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents will cause excessive delays. Roundabouts require other control mode	At capacity; requires other control mode
F	>71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Another common measure of intersection performance is the degree of saturation, which provides an overall measure of the capability of the intersection to accommodate additional traffic. A DOS of 1.0 indicates that an intersection is operating at capacity.

The results of the traffic modelling are summarised in Table 13 below. Full analysis is provided as an Appendix A.

Table 13 Traffic Modelling Results

Peak	Intersection	Without Stage 1B Development			With Stage 1B Development		
		AVD (sec)	DOS	LOS	AVD (sec)	DOS	LOS
AM	Sussex Street / Erskine Street	42	C	0.91	41	C	0.91
	Hickson Road / Napoleon Street	36	C	0.95	41	C	0.96
	Kent Street / Margaret Street	25	B	0.87	30	C	0.94
	Hickson Road / Watermans Quay	20	B	0.91	21	B	0.91
PM	Sussex Street / Erskine Street	60	E	0.98	63	E	0.98
	Hickson Road / Napoleon Street	55	D	0.98	64	E	0.99
	Kent Street / Margaret Street	45	D	0.94	47	D	0.95
	Hickson Road / Watermans Quay	8	A	0.76	8	A	0.76

LOS - Intersection Traffic Level of Service, DOS - Degree of Saturation, AVD - Average Delay per vehicle

A key finding of the analysis is that there are minimal changes in the operation of the local road network as a result of the Stage 1B development. The traffic analysis indicates the transport network in the Barangaroo precinct could accommodate the increased movements arising from the development of the site. This is consistent with the findings of the traffic modelling recently conducted for the modification of the Barangaroo Concept Plan (MP06_0162).

It is recognised that significant vehicle queuing currently occurs in the southbound direction on Sussex Street in the PM Peak hour as a result of more congested traffic operating conditions in the vicinity of the cross traffic movements at the King Street and Market Street intersections. It should be recognised that this is an existing issue which is not the direct result of the proposal.

The operation of the future signalised intersections on Hickson Road will be dependent on the operating conditions of intersections further downstream on Sussex Street. Essentially they will act as 'slave' in the Sussex Street road network, with intersections at King Street and Market Street acting as the 'masters'.

In this context, the road network impacts of the proposal are considered modest.

The site will be well serviced by a number of pedestrian routes which link with the wider Barangaroo precinct. A number of zebra crossings are proposed which are located on major pedestrian desire lines to facilitate the safe movement of pedestrians to and from the site.

The main pedestrian desire lines for residents of Building R4A will be to/from the commercial development in the southern end of the site and Wynyard public transport hub. Appropriate at-grade pedestrian crossing facilities (either pedestrian signals or zebra crossings) are planned throughout the precinct to ensure pedestrians are provided with safe and efficient road crossing opportunities along key desire lines as shown in Figure 14.



5.5.2 Pedestrian Linkages

For the ultimate Barangaroo development the following pedestrian linkages are proposed:

Wynyard Walk:

The NSW Government has commenced work on Wynyard Walk (previously Barangaroo Pedestrian Link), a direct pedestrian link between the new Barangaroo development and Wynyard Station and transport interchange. The Wynyard Walk will provide a high level of access to public transport for the growing western corridor of the CBD, including Barangaroo and the King Street Wharf. Wynyard Walk will allow people to access Barangaroo from Wynyard Station in approximately six minutes. The Wynyard Walk bridge (over Sussex Street) opened in 2015, with the new tunnel connection to open in 2016. The proposed route for Wynyard Walk is shown in Figure 15.



Figure 15 Wynyard Walk (Source: REF April 2012, Transport for NSW)

City Walk Bridge:

A new pedestrian link bridge over Sussex Street/Hickson Road located close to the intersection of Hickson Road and Napoleon Street which links into the Wynyard Walk. The facility will enhance connectivity between Barangaroo South and the Wynyard Station precinct. The bridge opened in July 2015. An overview of the City Walk Bridge alignment is presented in Figure 16.

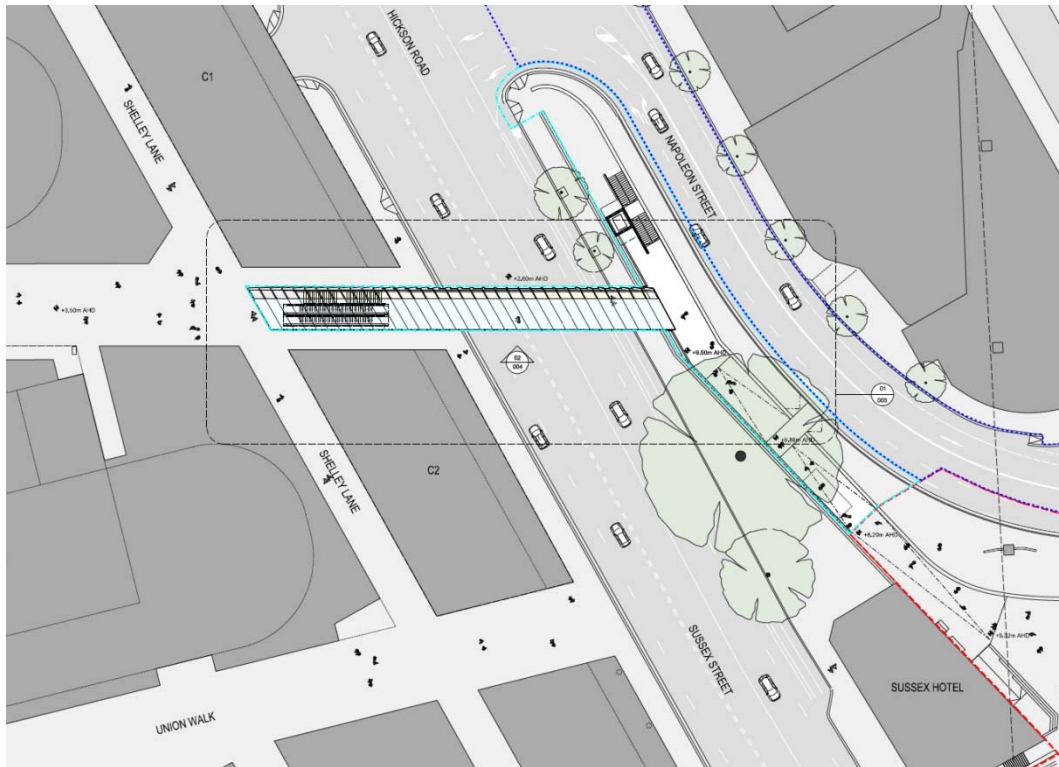


Figure 16 City Walk Bridge

A number of additional pedestrian connections are proposed to service the Barangaroo Central and Barangaroo Reserve precincts. This includes new pedestrian bridges over Hickson Road at High Street and Jenkins Street, as well as a permeable internal pedestrian network which provides connections to Barangaroo South. These are consistent with the connections identified in the Barangaroo Integrated Transport Plan as illustrated in Figure 17.

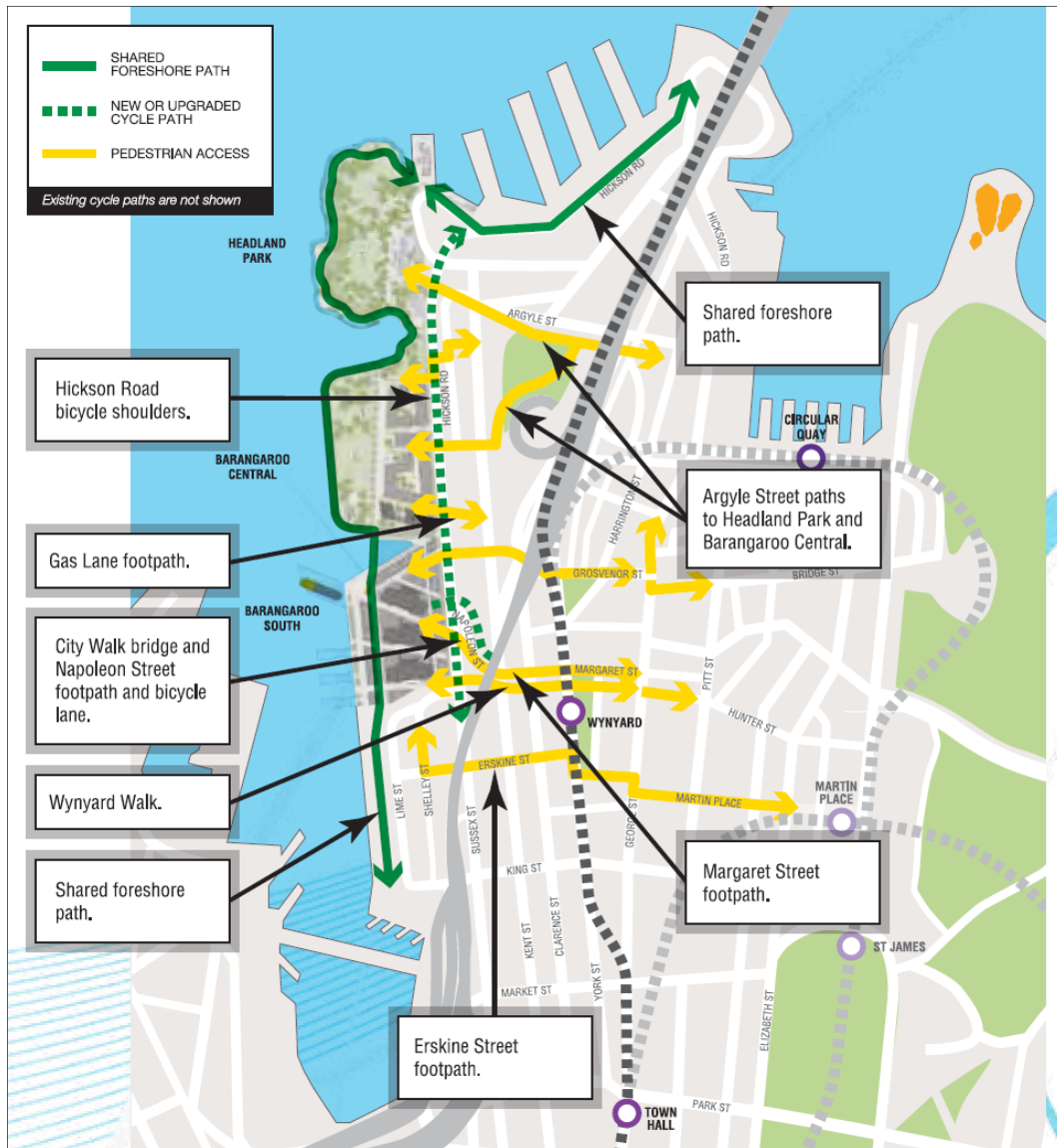


Figure 17 Pedestrian Routes

Source: Barangaroo Integrated Transport Plan, Figure 5

5.6 Cycling

5.6.1 External Bicycle Network

The Sydney City Centre Access Strategy outlines the future city centre cycleway network to encourage growth in cycling and reduce pressure on the public transport system. Measures proposed include:

- Extending the Kent Street cycleway south to Liverpool Street
- Construction of a bi-directional cycleway on Liverpool Street
- Construction of a bi-directional cycleway on Castlereagh Street and Pitt Street, providing a new north-south connection through the CBD
- Extending the existing King Street cycleway to Castlereagh Street
- Extending the east- west cycleway along Park Street to Castlereagh Street

The Strategy's strategic cycleway network map (see Figure 18) indicates future cycleway connections into Barangaroo to be via the Pyrmont Bridge cycleway and the Harbour Bridge cycleway. These new links are yet to be determined.



Figure 18 Strategic Cycleway Network Map

Source: Sydney City Centre Access Strategy (NSW Government, 2013)

The primary route for riders travelling to Building R4A from the north (via the Sydney Harbour Bridge cycleway) will be via the new cycleway along Napoleon Street. This is consistent with the City of Sydney cycling strategy. An alternative route exists via Argyle Street, Dalgety Road and Hickson Road. Many cyclists will find this route attractive given the low traffic volumes and the available road space.

Napoleon Street will form a link for cyclists travelling between the Building R4A and the existing separated cycleway on Kent Street. An on-road bicycle lane has recently been installed for eastbound riders (uphill), with a mixed traffic environment in the westbound direction.

A bi-directional separated cycleway is envisaged on the eastern side of Hickson Road, up to the intersection with Towns Place. This is currently under investigation by Lend Lease in conjunction with the road authority and other stakeholders. Beyond this point, the existing single direction on-road cycle lane will facilitate the movement of cyclists onwards towards The Rocks and Circular Quay. It is assumed the cycleway will commence at Shelley Street, which will provide a link to the new Transport Place.

5.6.2 Internal Bicycle Network

Cycling within Barangaroo will be confined to the internal road network, i.e. along Watermans Quay and Barangaroo Avenue. These will function as mixed traffic streets given the relatively low levels of vehicular traffic and anticipated 40km/hr speed limit. On-road bicycle symbols can be provided at minimum 200m intervals towards the centre of the travel lane to signify to drivers the presence of cyclists along these routes. The route along Barangaroo Avenue will connect with a recreational cycle route which continues through Barangaroo Central and into Barangaroo Reserve.

The foreshore promenade will primarily act as a pedestrian pathway however cycling will not be prohibited. A low speed environment will be promoted where cyclists will be required to give way to pedestrians at all times. This will be similar to the operation of the adjacent King Street Wharf and Darling Harbour.

Access for cyclists to Building R4A will be via the vehicle access ramp at the western end of Watermans Quay, designated as a recreational bicycle route. The low vehicle speeds (signposted speed limit expected to be 40km/h) and traffic volumes along Watermans Quay make this a suitable cycling route.

The planned internal cycle network is outlined in Figure 19.

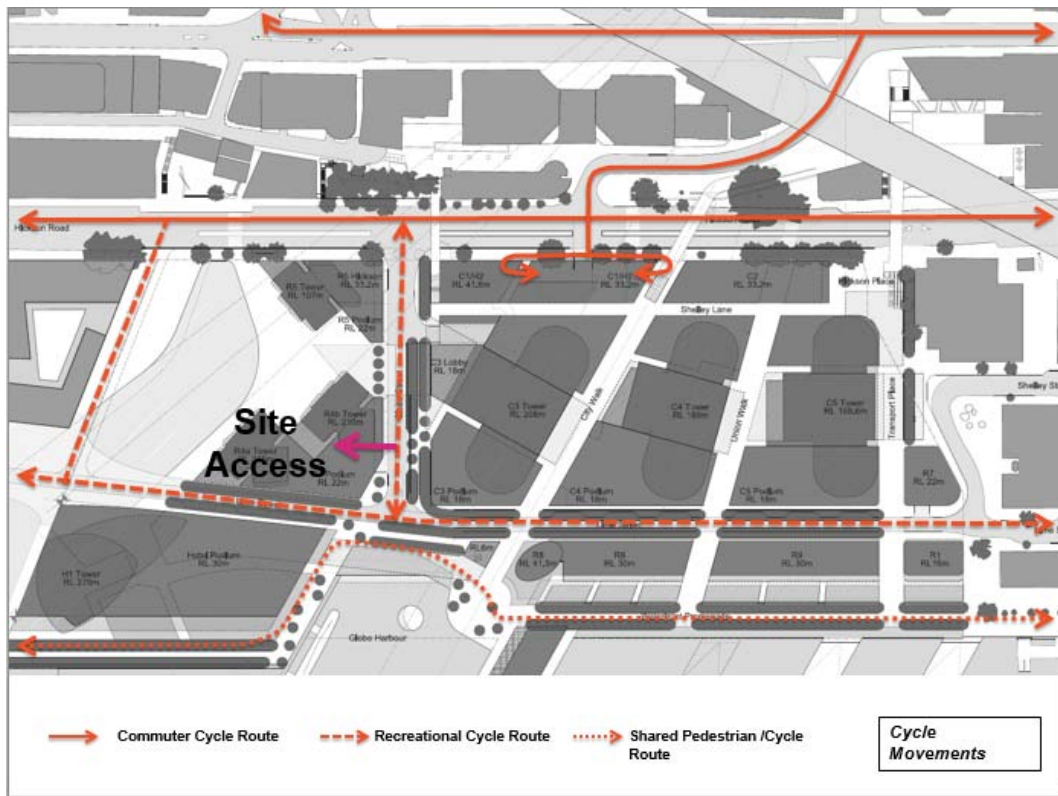


Figure 19 Internal Bicycle Network

5.7 Public Transport Accessibility

5.7.1 Heavy Rail

The NSW Long Term Transport Masterplan released in December 2012 outlines a 20 year plan and includes the following rail projects for Sydney:

- North West and South West Rail Lines
- Sydney Metro
- Wynyard Station improvement works

North West Metro

Although the Metro scheme has been cancelled by the NSW Government, the metro corridor under Barangaroo South is being maintained.

Wynyard Station

A significant number of work trips into Barangaroo are anticipated to occur by rail, with Wynyard Station to act as the major transport hub. Actions relating to Wynyard Station in the Sydney City Centre Access Strategy include:

- Better interchange facilities for rail and bus passengers at the station and at Barangaroo.
- Station refurbishment.
- Station upgrade in the longer term.

In May 2014 the NSW Government announced a \$100 million upgrade of Wynyard Station. The works include an upgrade to the CBD station's concourse and platforms, new lighting, tiling and signage to improve wayfinding.

Transport for NSW has engaged the Novo Rail Alliance to design and deliver \$10 million worth of early works for the station. Subject to planning approvals, major construction for the Wynyard Station upgrade commenced in mid 2015 and is expected to finish in 2016. Key features of the works include:

- New, premium fixtures and finishes, such as lighting, tiling and painting;
- Widened paid concourse and ticket gates;
- Reduced clutter on the concourse and platforms;
- Upgraded existing and new platform stairs to improve pedestrian circulation and reduce queuing;
- New wayfinding and signage to make it easier for customers to move in and around the Station;
- Improving operational reliability through upgraded services and removal of redundant services; and
- Renovated back of house areas, including new and relocated Station Manager's office.

South West Rail Link

The South West Rail Link opened to the public in early 2015 and includes:

- A new 11.4-kilometre rail line from Glenfield to Leppington
- Two new stations located at Edmondson Park and Leppington, including commuter car parking
- A train stabling facility at Rossmore
- An upgrade of the existing Glenfield Station and bus/rail interchange, including new commuter car parking
- construction of Glenfield North and Glenfield South rail flyovers

Sydney Metro

Sydney Metro is the next major rail project identified in Sydney's Rail Future. Sydney Metro scope has been developed to meet the Project objectives and deliver key elements of Stages 4 and 5 of Sydney's Rail Future.

In June 2014 the NSW Government announced the Sydney Metro concept, including the Sydney Harbour Crossing and Western Extension to Bankstown proposals. The project would extend rapid transit under Sydney Harbour, through the central business district (CBD) of Sydney and west to Bankstown, with capacity to run up to 30 trains per hour in each direction through the city on the new 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. Sydney Metro would significantly improve reliability across the rail network by addressing current and emerging constraints such as train crowding, platform and station crowding, and network complexity.

Sydney Metro Northwest is currently under construction and includes eight new fully accessible railway stations and 4,000 commuter car parking spaces. Metro services will start in the first half of 2019 with a train every four minutes in the peak, or 15 trains an hour.

In June 2015 the NSW Government announced a new station would be constructed at Barangaroo as part of the Sydney Metro project. Based on patronage modelling undertaken by Sydney Metro, delivery a new station at Barangaroo will in the morning peak, reduce entries and exits at both Wynyard Station and Martin Place station by approximately 5,000 passengers. This station will significantly improve public transport access for people traveling to and from the Barangaroo precinct.

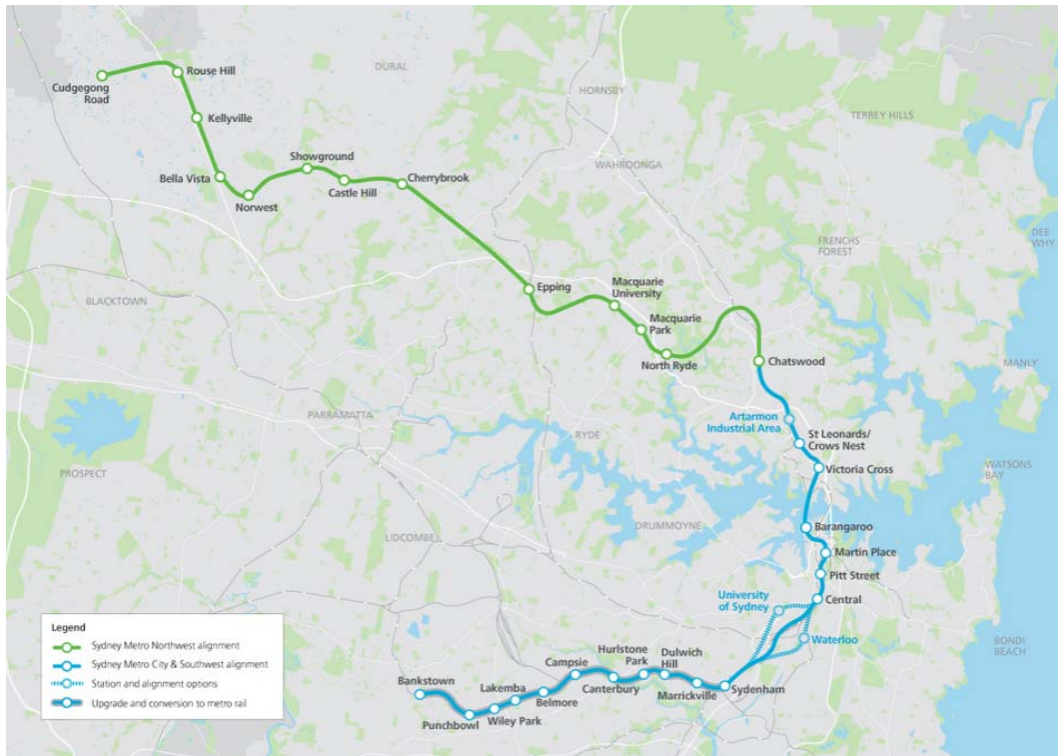


Figure 20 Sydney Metro Project

Source: Transport for NSW

5.7.2 Bus Services

The Sydney City Centre Access Strategy outlines a redesigned bus network which improves bus reliability and address congestion and capacity constraints. Some of the key proposals relevant to the Barangaroo development include:

- New bus routes will run to Barangaroo and Walsh Bay via the city centre, Napoleon Street and Hickson Road
- The major bus stop precinct serving Barangaroo will be in the area surrounding Wynyard Station on York, Clarence and Kent Streets.
- Approximately every second bus service on key Inner West bus routes entering the city centre via Broadway will only operate to Central. This will reduce the number of buses unnecessarily entering the city centre. The remaining services will continue to the northern end of the city centre via Elizabeth Street northbound and Castlereagh Street southbound.
- Bus routes servicing the Eastern Suburbs will utilise Elizabeth Street. Passengers travelling to Barangaroo will alight at Martin Place and walk through the city and across Wynyard Walk

The future city centre bus network is summarised in Figure 21.

Locations for new bus stops to serve the future routes along Hickson Road and Sussex Street are currently being investigated by Transport for NSW. These stops would be in close proximity to Barangaroo South and provide good accessibility for commuters and visitors travelling to the precinct.

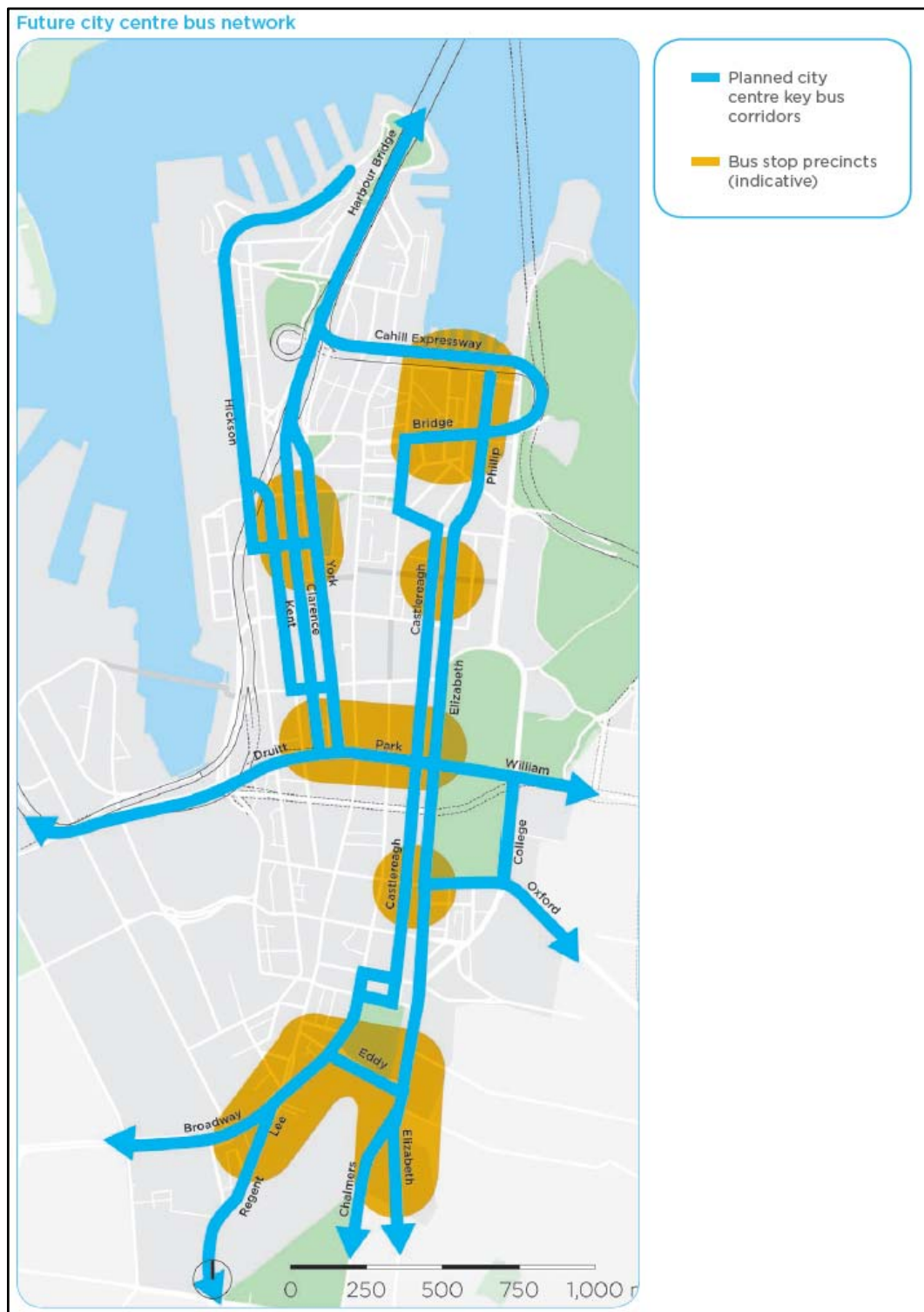


Figure 21 Future City Centre Bus Network

Source: Sydney City Centre Access Strategy (NSW Government, 2013)

In July 2015 the NSW Government announced a series of bus routes will directly service the Barangaroo precinct. These services all run along Hickson Road adjacent to Barangaroo South, terminating at Walsh Bay, and include:

- Route 311
- Route 324
- Route 325

These services are to be operational from 4 October 2015, and are illustrated in Figure 22 below.

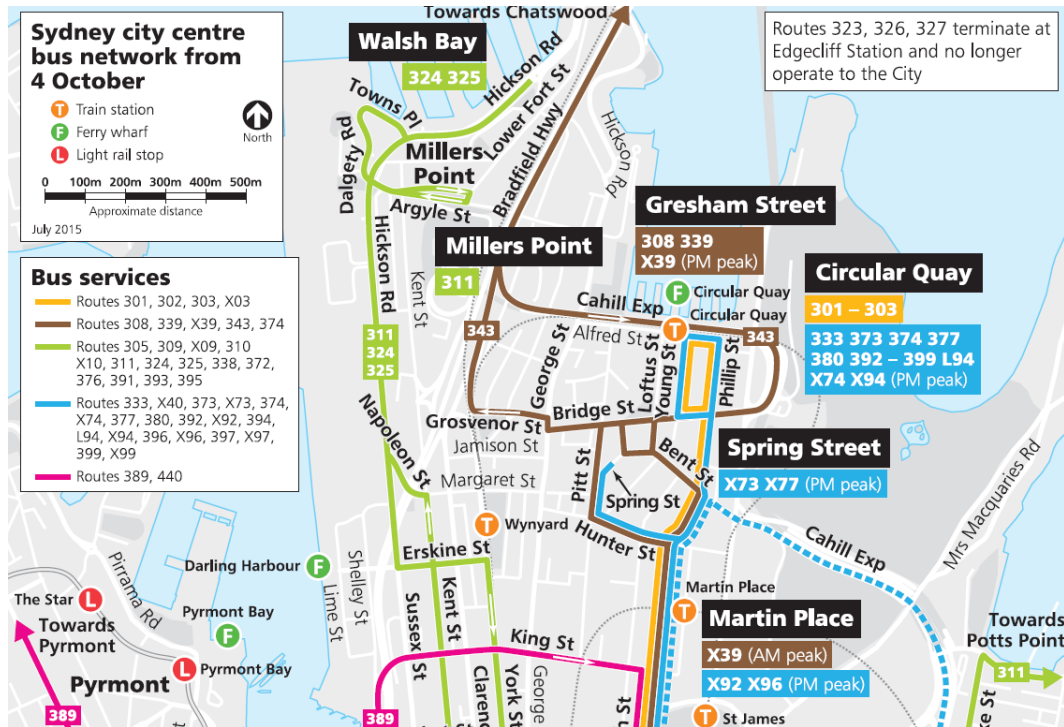


Figure 22 Bus services post 4 October 2015

5.7.3 Ferry

Existing commuter ferry services providing access to Barangaroo and the CBD arrive and depart from King Street Wharf (number 3) and Circular Quay.

The Sydney City Centre Access Strategy commits to constructing a new ferry hub at Barangaroo, delivered in time for major tenants moving in to the development. This new wharf will support the commercial development of the precinct, with new ferry services anticipated from the east and north, as well as the existing western ferry catchments.

The new ferry hub will service the new development and connect ferry users to the western and midtown parts of the city centre via the Wynyard Walk link. It will reduce capacity constraints on the Circular Quay terminal and will bring additional ferry services and routes directly to Barangaroo. The Barangaroo Ferry Hub proposal initially commits to the construction of two wharves. However provision is made within the design for the construction of a third wharf based on future demand and uptake.

A planning application for the construction and operation of a ferry hub was lodged to the Department of Planning and Environment in December 2014. The proposal was recently approved.

An illustration of the proposal is shown in Figure 23 below.

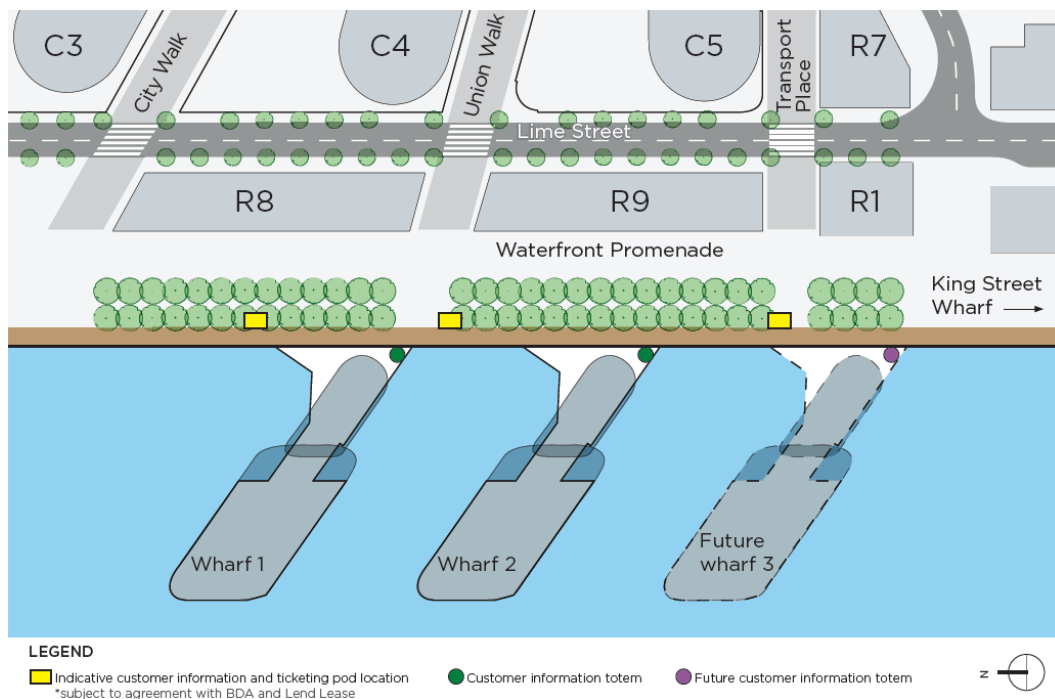


Figure 23 Barangaroo Ferry Wharf

Source: Barangaroo Ferry Hub Submission Report (Transport for NSW, 2015)

5.7.4 Light Rail

In December 2012, the NSW Government released 'Sydney's Light Rail Future'. This document details plans for expanding the existing light rail network to the Sydney CBD and South Eastern Sydney as well as the completion of the Inner West Light Rail extension. It could be expected that public transport patronage to Barangaroo from the inner west would shift mode from bus and rail as a result of these extensions.

Inner West Light Rail Extension

The first stage of the inner-west light rail extension is a 5.6km extension running between Lilyfield and Dulwich Hill as shown in Figure 24. It will run from the current light rail terminus at Lilyfield, along the disused freight rail corridor, to Dulwich Hill. The extension opened in March 2014.

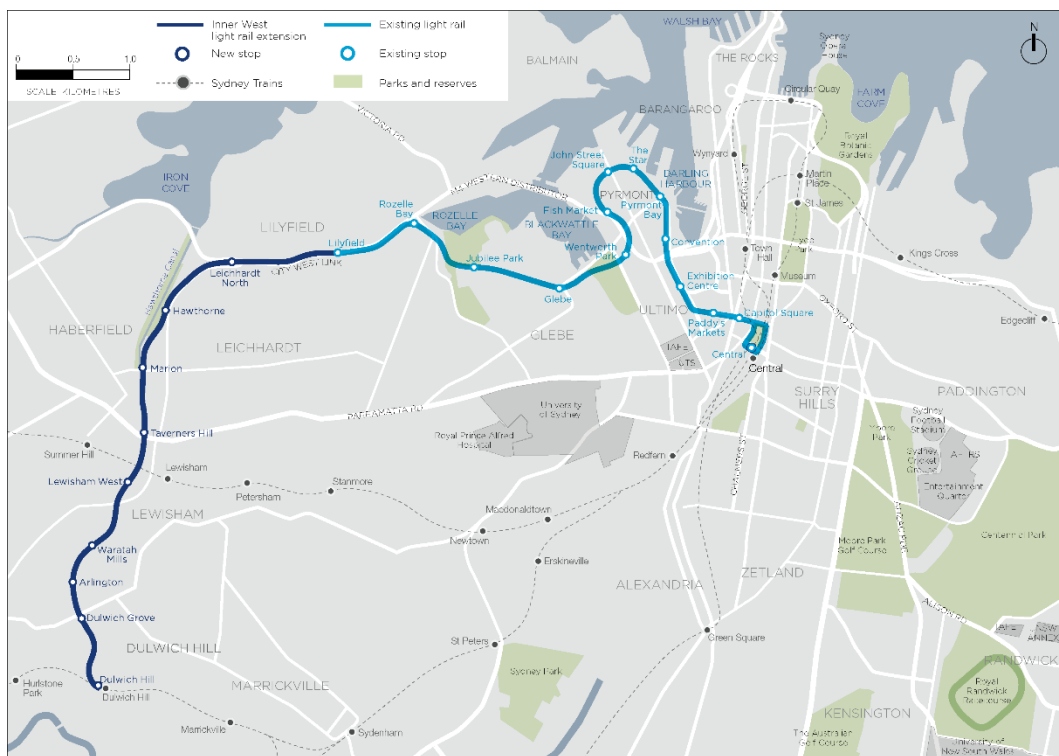


Figure 24 Inner-West Light rail extensions

CBD and South East Light Rail The CBD and South East Light Rail link will connect Circular Quay to the University of New South Wales via Anzac Parade and Alison Road. The integration of existing and planned light rail networks would further enhance patronage by this mode to Barangaroo. This link will include the pedestrianisation of a 1 kilometre section of George Street, between Bathurst and Hunter Streets. Construction commenced in 2015.



Figure 25 CBD and South East Light Rail Route Map

6 Travel Demand Management

The objectives of a Travel Demand Management Plan with respect to Building R4A within the Stage 1B development are as follows:

- **Travel Demand Management** which reduces the need for energy intensive car, taxi or air travel; and.
- The use of **more sustainable transport modes** i.e. walk, cycle, bus, motorcycle, car sharing, tram, bus and rail in place of the higher energy consumption travel modes such as single occupant car travel, taxi and air travel. This generally requires improving people's travel choices by making more travel modes available, i.e. to improve mobility for non-car drivers.

In order to meet the objectives and targets of the travel demand management plan, the following physical and management measures should be considered for implementation within the Stage 1B development (and specifically Building R4A).

6.1 Residents' Travel Packs

A new development provides an opportunity to offer residents advice on travel modes to and from the site. At this time, new travel habits are being established and people may particularly welcome information about the travel services and facilities available to them.

A travel pack could be supplied to property owners of Building R4A. The pack will include information on the development travel plan, bicycle and walking routes, bus and rail timetables, information on car sharing and membership information for the development car club. The pack could also include discount vouchers for a local bicycle retailer and a questionnaire about travel behaviour. Short term membership to a car share organisation may also be provided in the travel pack.

6.2 General Marketing and Promotion

The objectives of the travel demand management plan will only be achieved with the support of Building R4A residents. Marketing the benefits and promoting the sustainable alternatives available are therefore crucial in encouraging residents to adopt the travel plan measures. It is important that at an early stage Building R4A residents are made aware of the need for the travel plan, and that it is emphasised that the measures are being introduced to support and encourage people to use travel more wisely.

- Travel information and posters could be set up at public area, for example, lobby, notice board, or inside the elevators;
- A Green Travel Plan 'e-flyer' should be distributed to residents during the launch of the Plan. The 'e-flyer' will provide a summary of the benefits to residents of the Travel Plan, its objectives and measures. This could be distributed to residents via the managing strata corporation;
- Events such as National Bike Week, Bike2Work Days, walk to work day should be promoted to residents through notice board posters and email;

6.3 Car Sharing

Car sharing is a proven means of reducing the number of car journeys generated by a development. A recent study on the effectiveness of car sharing schemes across Sydney (e.g. GoGet) shows that every car share space replaces the need for 12 private vehicle spaces².

Consultation with car share operators such as Go Get could be undertaken by Lend Lease to provide car share vehicles within the proposed future road network. This will be dependent upon the requirements of car share operators although the development is considered to be a suitable candidate site for the provision of on-street facilities for car share vehicles. Information on local car sharing schemes would be provided in the residents travel pack.

6.4 Cycling

As described in Section 5.6, Building R4A will have good access to the cycling network. Cycling should be promoted by participating in annual events such as 'Ride to Work Day' and the City of Sydney's free community cycling training program.

6.5 Public Transport

To promote the use of public transport for travel both to and from work:

- Create and maintain an intranet 'Public Transport links page' containing useful links to journey planning websites in Sydney; and
- Provide useful public transport maps and promotional items to potential and current public transport users; and

6.6 Walking

Specific Travel Plan measures designed to encourage more walking trips for short distance trips.

- Create and maintain an e-flyer 'useful walking routes' containing useful routes to key parts of the Sydney CBD, including public transport nodes at Circular Quay, Martin Place and Town Hall rail stations;
- Improvements to (and maintenance of) the walking network and signage; and
- Participate in Walk to Work day and look into holding a 'healthy breakfast' as a reward to all those who participate.

6.7 Visitor Travel / Site Access Information

For internal site access information, consider developing an interactive map to show useful walking routes, nearby public transport terminals and popular cycling routes to Building R4A. This could be achieved via:

² SGS Economics & Planning (2012), Benefit-Cost Analysis of Car Share within the City of Sydney

- Development of a Transport Access Guide (TAG), providing customised travel information for visitors travelling to and from Building R4A using sustainable forms of transport; and
- Providing travel information on the Building R4A website, including links to public transport timetables and walking and cycling routes.

6.8 Working from Home

Lend Lease will work with suppliers to facilitate full broadband services to all residences in Building R4A. Broadband availability will encourage working from home through the provision of high-quality data transfer between the workplace and home.

6.9 Residents' Travel Plan Group

A travel plan group made up of the members of the building executive committee could be considered which would (in liaison with the building management group) take the lead in driving the strategies and initiatives contained in the travel plan. The implementation of the travel plan would form an item of discussion at every executive committee meeting, particularly in the initial stages of building occupancy. At the annual general meeting of the building, the travel plan group co-ordinator could report back to attendees on the status of the travel plan and further measures to be adopted for the coming year.

6.10 Monitoring

Monitoring is crucial to the successful implementation of any travel plan. The primary means of monitoring the travel behaviour of Building R4A's residents will be through completion of travel questionnaires. As part of the administration of the plan, it is recommended that travel surveys of Building R4A residents are undertaken periodically. An online travel plan questionnaire could be developed to investigate residents current travel patterns and use of travel plan measures. This would monitor the effectiveness of the travel plan measures. The headline findings from the monitoring exercise will be reported back to residents via email.

6.11 Targets, Indicators and Timescales

The following proposed initiatives and measures are suggestions only and will be refined closer to the initial occupancy of Building R4A.

No.	Measure/Initiative	Implementation Date	Responsibility	Indicator
Residents Travel Packs				
1	A travel pack could be supplied to all residents as they move into the building.	Launch date	Building management	Feedback from residents
2	Travel questionnaire to all residents contained in the travel pack	As residents move into the building	Building management	No. of responses
General Marketing and Promotion				
3	Travel information and poster could be set up at public area	Launch date	Building Management	Feedback from residents
4	A Green Transport Plan 'e-flyer' will be distributed to residents during the launch of the GTP.	Launch date	Building Management	Feedback from residents
5	Events such as National Bike Week, Bike2Work Days, walk to work day promoted to residents through notice board posters and email	Annually	Building Management	No. of attendees
Car Sharing				
6	Consultation with car share operators to increase provision of car share spaces nearby to the building	Prior to building occupancy	Lend Lease	No. of new car share members
Cycling				
9	Provide cycle maps to new residents	Initial building occupancy	Lend Lease	Take-up by residents
10	Come to an arrangement with a local cycle retailer for cheap servicing of resident bikes. Negotiate group buying discount on bicycle, equipment and accessories purchase	Launch date	Building Management	Take-up by residents
11	Set up 'Bike Buddies' scheme for less confident residents interested in cycling	Launch date	Lend Lease and Building Management	Take-up by residents

No.	Measure/Initiative	Implementation Date	Responsibility	Indicator
Public Transport				
12	Provide useful public transport maps and promotional items to potential and current public transport users	Launch date	Lend Lease	Feedback from residents
Walking				
13	Create and maintain an e-flyer 'useful walking routes' containing useful routes to key parts of the Sydney CBD, including public transport nodes at Circular Quay, Martin Place and Town Hall rail stations	Launch date	Lend Lease	Feedback from residents
14	Participate in Walk to Work day and look into holding a 'healthy breakfast' as a reward to all those who participate	Annually	Lend Lease	No. of attendees
Visitor Travel / Site Access Information				
15	Develop of a Transport Access Guide (TAG), providing customised travel information for visitors travelling to and from Building R4A using sustainable forms of transport	Launch date	Lend Lease	Feedback from visitors
16	Provide a dedicated travel page on the Building R4A website	Launch date	Lend Lease	Feedback from visitors

7 Summary

This transport assessment supports a State Significant Development Application (SSD 6964) seeking approval for construction of a residential flat building (known as Residential Building R4A) and associated works at Barangaroo South.

Access to the basement car park for Building R4A for all vehicle types (residential, retail and service vehicles) is to be via the western end of Watermans Quay. The primary vehicular access route into and out of the site will be via Sussex Street, Hickson Road and Watermans Quay.

Parking will be provided in this modification in accordance with the rates noted in the Barangaroo Concept Plan approval. A loading dock is proposed to service the site with multiple points of vertical goods lift connection to both ground level and to each of the buildings above the basement. Four loading bays are to be provided which may accommodate the largest design vehicle (City of Sydney garbage vehicle). Additional service bays are to be provided for smaller vans and couriers. This arrangement offers good flexibility with respect to the variety of service vehicle movements expected within the Stage 1B site, including waste collection, furniture removal and retail servicing.

The cumulative impacts of construction and development traffic activity associated with all works currently planned in the Barangaroo precinct have been assessed. The assessment concludes that the traffic impacts arising from the works proposed under the Development Application can be appropriately managed.

A number of travel demand management measures are recommended for consideration to promote use of sustainable modes of transport from residents of Building R4A. These measures include the distribution of resident travel packs, general marketing and promotion, provision of car share spaces and incentives for walking, cycling and public transport use.

Appendix A

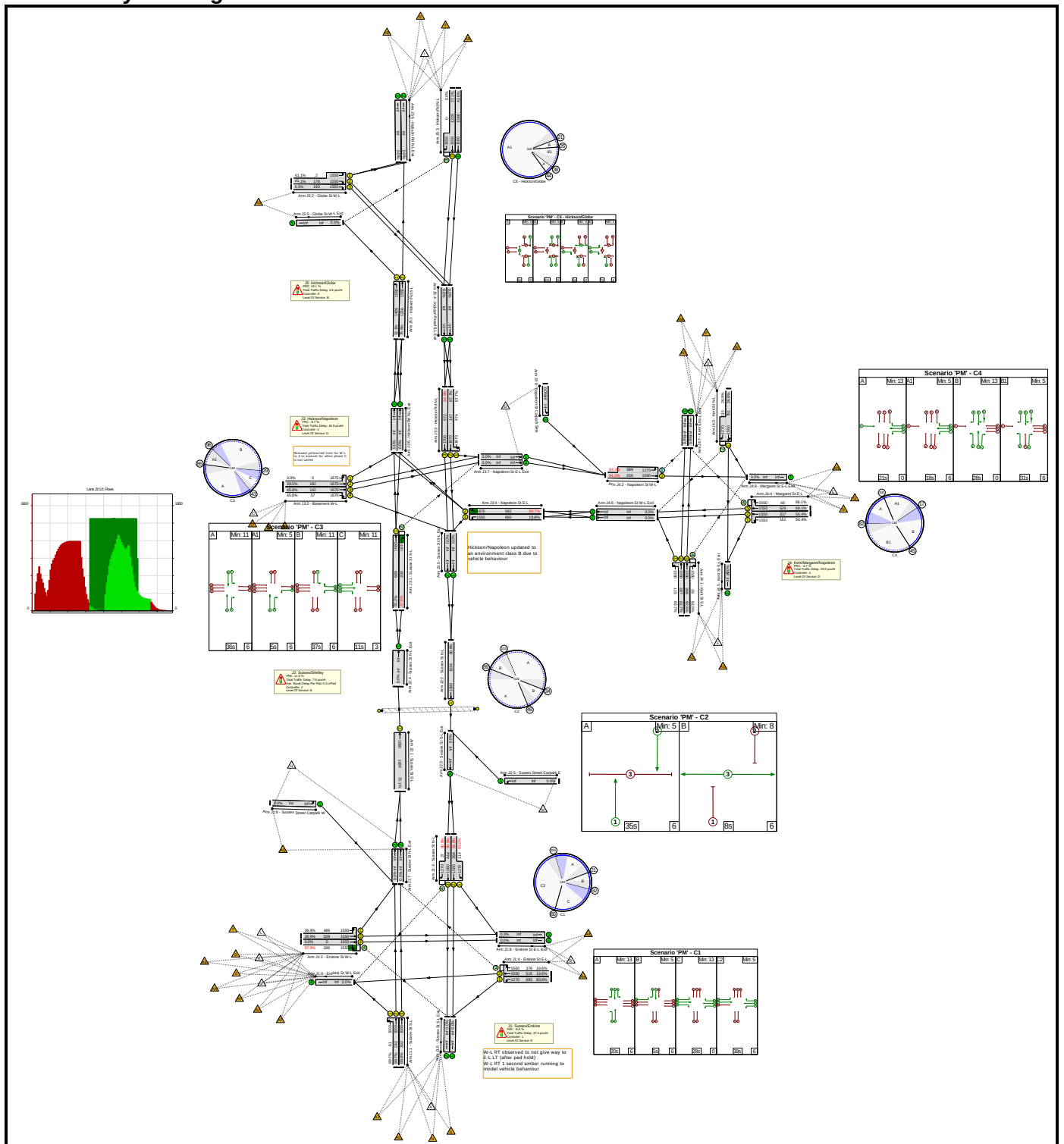
LinSig Modelling Outputs

Basic Results Summary

Basic Results Summary

Scenario 1: 'PM' (FG1: 'Flow Group 1', Plan 1: 'Network Control Plan 1')

Network Layout Diagram

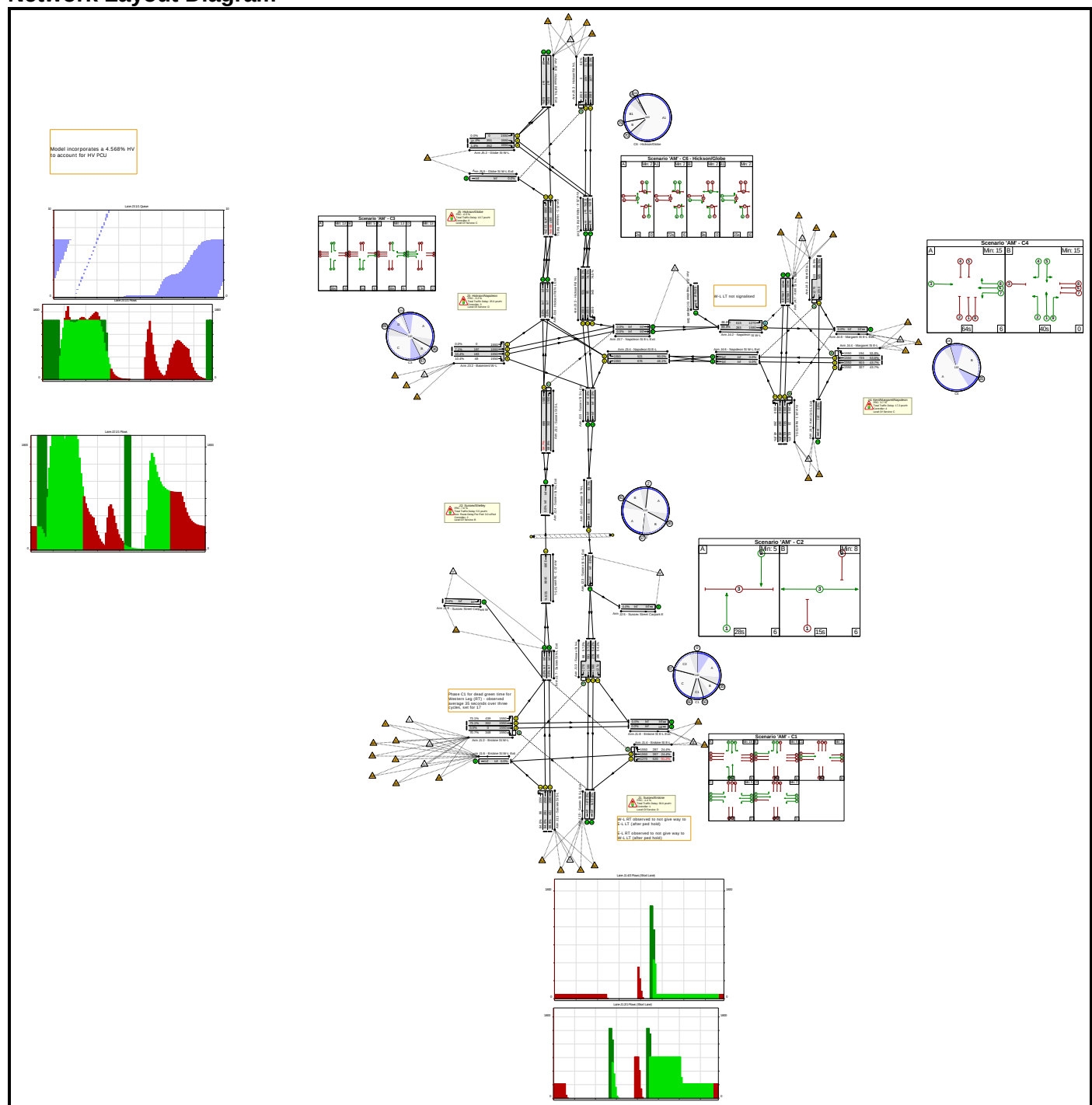


Basic Results Summary

Network Results

Item	Lane Description	Lane Type	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	-	-	-	-	97.9%	-	-
J1: Sussex/Erskine	-	-	-	-	97.9%	-	-
1/2+1/1	Sussex St S-L Left Ahead	U	272	1550:1550	89.7 : 89.7%	90.5	11.4
1/3	Sussex St S-L Ahead	U	271	1580	89.8%	91.1	11.6
2/2+2/1	Erskine St W-L Left Ahead	U	397	1550:1550	39.9 : 39.9%	11.9	5.2
2/3+2/4	Erskine St W-L Right Ahead	U+O	280	1550:1550	0.0 : 97.9%	134.5	15.5
3/2+3/1	Sussex St N-L Ahead Left	U	463	1580:1270	93.0 : 93.0%	69.9	16.4
3/3+3/4	Sussex St N-L Ahead Right	U+O	426	1580:1270	90.5 : 90.5%	59.9	15.5
4/1	Erskine St E-L Left	U	560	1270	80.8%	33.5	15.9
4/2+4/3	Erskine St E-L Ahead Right	U+O	175	1550:1550	19.6 : 19.6%	12.9	1.6
J2: Sussex/Shelley	-	-	-	-	80.6%	-	-
1/1	Sussex St S-L Ahead	U	756	1580	73.1%	16.1	7.8
2/1	Sussex St N-L Ahead	U	834	1580	80.6%	19.5	18.6
Ped Link: P1	Shelley	-	0	-	0.0%	Inf	Inf
J3: Hickson/Napoleon	-	-	-	-	97.8%	-	-
1/1	Sussex St S-L Ahead	U	560	1580	81.2%	34.1	18.5
1/2	Sussex St S-L Right	O	196	1670	97.8%	154.5	12.0
2/2+2/1	Basement W-L Left Ahead	U	72	1670:1670	39.5 : 0.0%	61.9	2.4
2/3+2/4	Basement W-L Right Ahead	U	91	1670:1670	45.8 : 45.8%	62.0	2.8
3/2+3/1	Hickson Rd N-L Ahead Left	U	545	1670:1670	87.7 : 87.7%	40.5	15.1
3/3	Hickson Rd N-L Ahead	U	542	1700	94.8%	76.8	22.5
4/1	Napoleon St E-L Left	U	137	1550	19.8%	16.9	1.8
4/2	Napoleon St E-L Right	U	537	1670	90.7%	40.4	19.8
J4: Kent/Margaret/Napoleon	-	-	-	-	94.3%	-	-
1/2+1/1	Kent St S-L Left Ahead	U	349	1550:1550	82.7 : 82.7%	58.5	11.9
1/3+1/4	Kent St S-L Ahead Right	U+O	343	1550:1550	82.5 : 82.5%	60.8	12.0
2/2+2/1	Napoleon St W-L Left Ahead	U+O	795	1580:1270	94.3 : 94.3%	45.4	27.6
3/1+3/2	Kent St N-L Ahead Right Left	U+O	233	1550:1270	26.9 : 26.9%	17.6	3.4

Scenario 1: 'AM' (FG1: 'Flow Group 1', Plan 1: 'Network Control Plan 1')
Network Layout Diagram



Basic Results Summary

Network Results

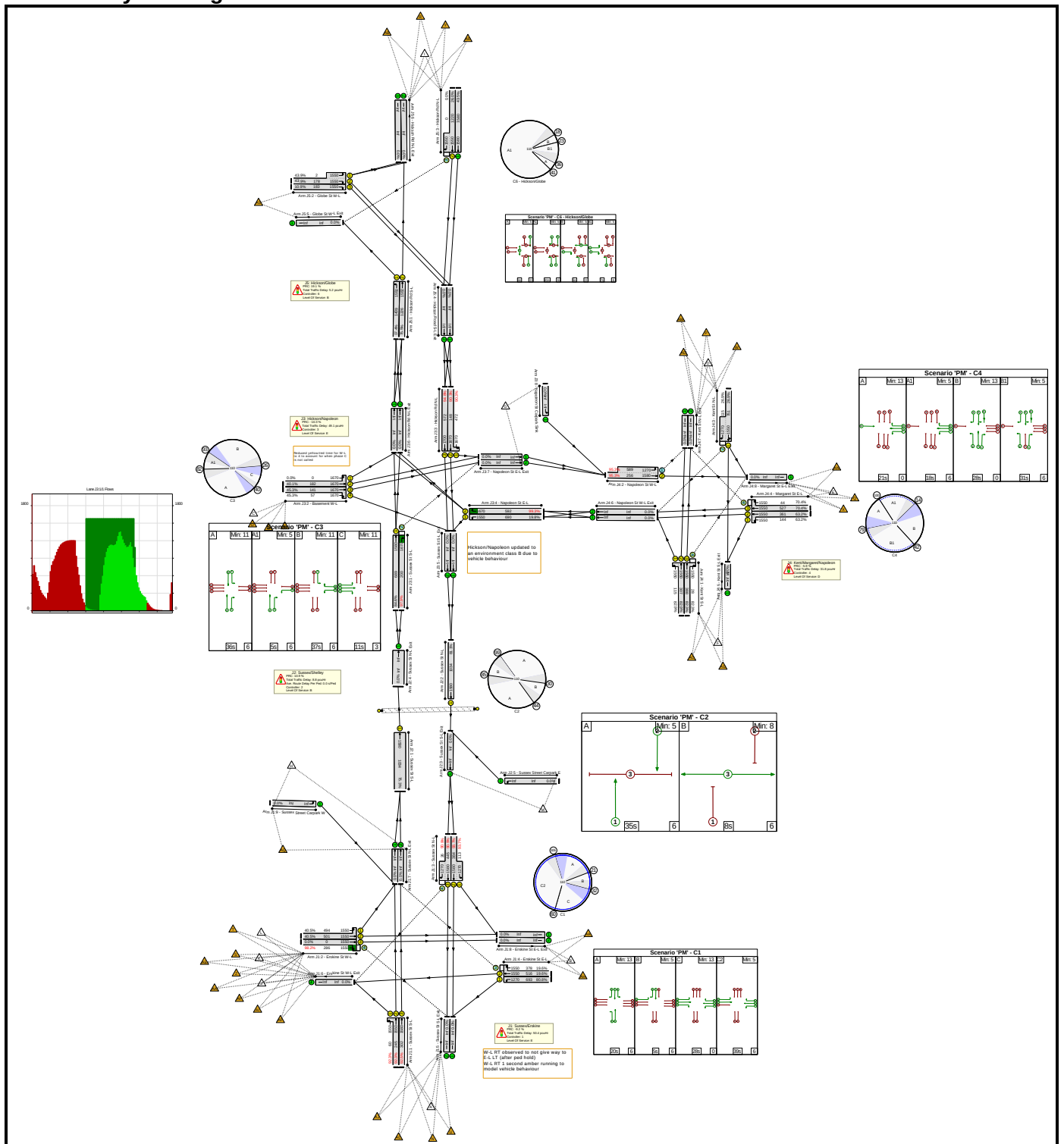
Item	Lane Description	Lane Type	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	-	-	-	-	94.7%	-	-
J1: Sussex/Erskine	-	-	-	-	91.2%	-	-
1/2+1/1	Sussex St S-L Left Ahead	U	243	1550:1550	64.0 : 64.0%	49.2	7.1
1/3	Sussex St S-L Ahead	U	297	1580	68.9%	49.1	9.2
2/2+2/1	Erskine St W-L Left Ahead	U	542	1550:1550	73.1 : 73.1%	29.9	13.1
2/3+2/4	Erskine St W-L Right Ahead	U+O	246	1550:1550	0.0 : 70.7%	55.5	7.9
3/2+3/1	Sussex St N-L Ahead Left	U	257	1580:1270	54.1 : 54.1%	34.7	2.9
3/3+3/4	Sussex St N-L Ahead Right	U+O	377	1580:1270	57.2 : 57.2%	24.2	5.2
4/1	Erskine St E-L Left	U	474	1270	91.2%	63.8	17.9
4/2+4/3	Erskine St E-L Ahead Right	U+O	167	1550:1550	24.4 : 24.4%	21.1	2.6
J2: Sussex/Shelley	-	-	-	-	83.7%	-	-
1/1	Sussex St S-L Ahead	U	882	3160	52.9%	7.6	2.9
2/1	Sussex St N-L Ahead	U	697	1580	83.7%	18.5	11.4
Ped Link: P1	Shelley	-	0	-	0.0%	Inf	Inf
J3: Hickson/Napoleon	-	-	-	-	94.7%	-	-
1/1	Sussex St S-L Ahead	U	653	1580	94.7%	47.4	18.6
1/2	Sussex St S-L Right	O	229	1550	68.9%	36.8	6.8
2/2+2/1	Basement W-L Left Ahead	U	14	1550:1550	7.1 : 0.0%	52.1	0.4
2/3+2/4	Basement W-L Right Ahead	U	22	1550:1550	10.4 : 10.4%	51.9	0.5
3/2+3/1	Hickson Rd N-L Ahead Left	U	475	1550:1550	74.5 : 74.5%	17.5	7.6
3/3	Hickson Rd N-L Ahead	U	309	1580	58.1%	31.5	8.4
4/1	Napoleon St E-L Left	U	312	1550	46.1%	18.5	5.3
4/2	Napoleon St E-L Right	U	469	1550	90.0%	53.0	17.5
J4: Kent/Margaret/Napoleon	-	-	-	-	86.8%	-	-
1/2+1/1	Kent St S-L Left Ahead	U	228	1550:1550	48.8 : 48.8%	38.1	5.4
1/3+1/4	Kent St S-L Ahead Right	U+O	373	1550:1550	63.8 : 63.8%	36.8	10.1
2/2+2/1	Napoleon St W-L Left Ahead	U+O	762	1580:1270	86.8 : 86.8%	22.4	29.6
3/1+3/2	Kent St N-L Ahead Right Left	U+O	219	1550:1270	35.5 : 35.5%	31.8	4.2

Basic Results Summary

Basic Results Summary

Scenario 1: 'PM' (FG1: 'Flow Group 1', Plan 1: 'Network Control Plan 1')

Network Layout Diagram

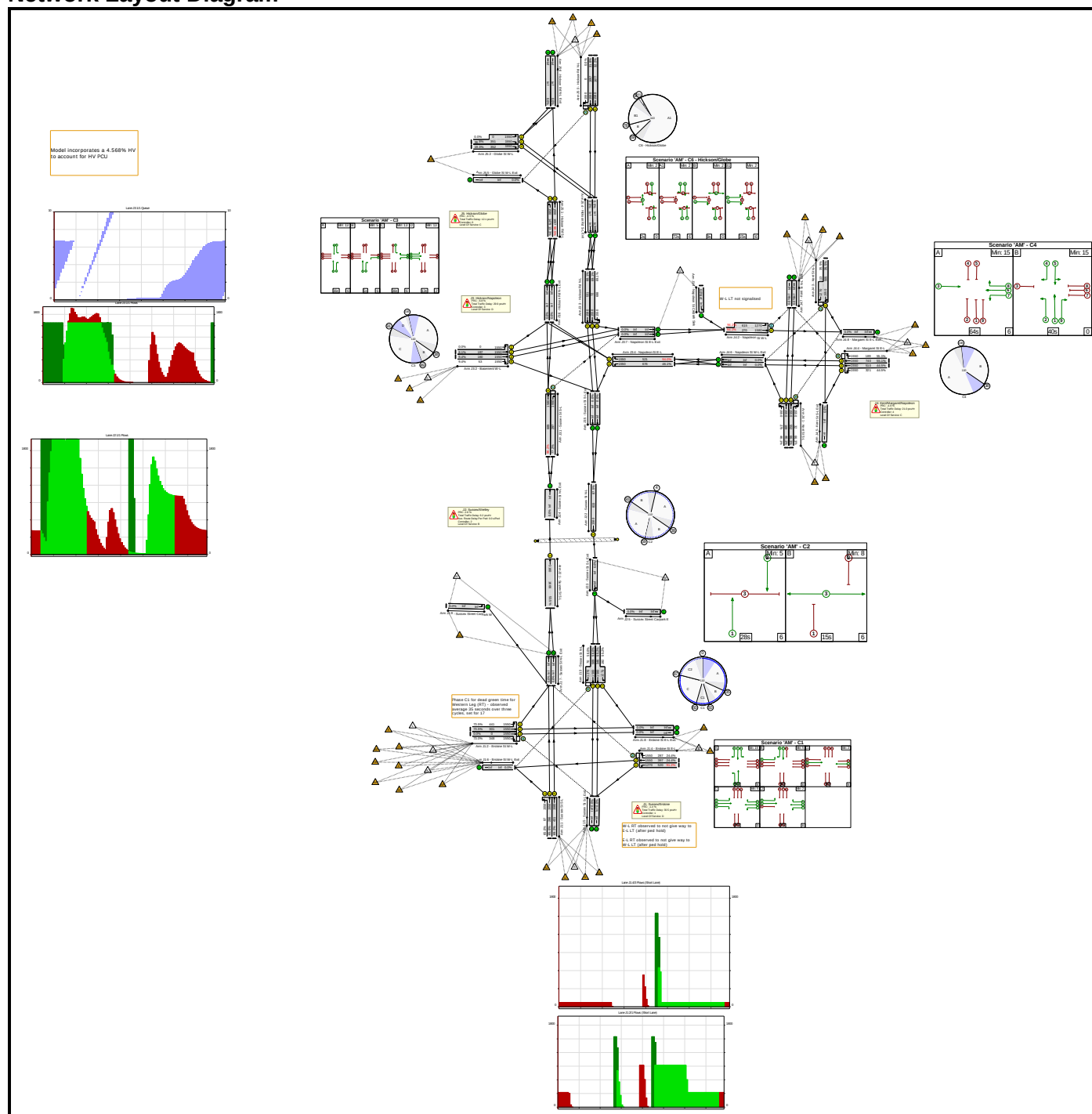


Basic Results Summary

Network Results

Item	Lane Description	Lane Type	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	-	-	-	-	99.3%	-	-
J1: Sussex/Erskine	-	-	-	-	98.2%	-	-
1/2+1/1	Sussex St S-L Left Ahead	U	281	1550:1550	92.3 : 92.3%	99.9	12.5
1/3	Sussex St S-L Ahead	U	279	1580	92.5%	100.9	12.8
2/2+2/1	Erskine St W-L Left Ahead	U	403	1550:1550	40.5 : 40.5%	11.9	5.3
2/3+2/4	Erskine St W-L Right Ahead	U+O	281	1550:1550	0.0 : 98.2%	137.1	15.7
3/2+3/1	Sussex St N-L Ahead Left	U	466	1580:1270	93.7 : 93.7%	73.3	17.6
3/3+3/4	Sussex St N-L Ahead Right	U+O	428	1580:1270	90.9 : 90.9%	62.1	16.6
4/1	Erskine St E-L Left	U	560	1270	80.8%	33.5	15.9
4/2+4/3	Erskine St E-L Ahead Right	U+O	175	1550:1550	19.6 : 19.6%	12.9	1.6
J2: Sussex/Shelley	-	-	-	-	81.1%	-	-
1/1	Sussex St S-L Ahead	U	779	1580	75.3%	18.8	7.7
2/1	Sussex St N-L Ahead	U	839	1580	81.1%	20.2	18.1
Ped Link: P1	Shelley	-	0	-	0.0%	Inf	Inf
J3: Hickson/Napoleon	-	-	-	-	99.3%	-	-
1/1	Sussex St S-L Ahead	U	583	1580	84.6%	33.2	19.4
1/2	Sussex St S-L Right	O	196	1670	97.9%	151.1	12.0
2/2+2/1	Basement W-L Left Ahead	U	73	1670:1670	40.1 : 0.0%	62.1	2.4
2/3+2/4	Basement W-L Right Ahead	U	90	1670:1670	45.3 : 45.3%	61.9	2.8
3/2+3/1	Hickson Rd N-L Ahead Left	U	560	1670:1670	90.3 : 90.3%	46.9	17.2
3/3	Hickson Rd N-L Ahead	U	542	1700	94.8%	76.8	22.5
4/1	Napoleon St E-L Left	U	137	1550	19.8%	16.9	1.8
4/2	Napoleon St E-L Right	U	588	1670	99.3%	80.8	29.0
J4: Kent/Margaret/Napoleon	-	-	-	-	95.3%	-	-
1/2+1/1	Kent St S-L Left Ahead	U	350	1550:1550	82.9 : 82.9%	58.8	11.9
1/3+1/4	Kent St S-L Ahead Right	U+O	342	1550:1550	82.3 : 82.3%	60.5	11.9
2/2+2/1	Napoleon St W-L Left Ahead	U+O	805	1580:1270	95.3 : 95.3%	49.5	28.4
3/1+3/2	Kent St N-L Ahead Right Left	U+O	233	1550:1270	26.9 : 26.9%	17.6	3.4

Scenario 1: 'AM' (FG1: 'Flow Group 1', Plan 1: 'Network Control Plan 1')
Network Layout Diagram



Basic Results Summary

Network Results

Item	Lane Description	Lane Type	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	-	-	-	-	96.2%	-	-
J1: Sussex/Erskine	-	-	-	-	91.2%	-	-
1/2+1/1	Sussex St S-L Left Ahead	U	249	1550:1550	65.0 : 65.0%	49.5	7.4
1/3	Sussex St S-L Ahead	U	298	1580	69.2%	49.2	9.2
2/2+2/1	Erskine St W-L Left Ahead	U	545	1550:1550	73.5 : 73.5%	30.1	13.2
2/3+2/4	Erskine St W-L Right Ahead	U+O	254	1550:1550	0.0 : 73.0%	57.1	8.4
3/2+3/1	Sussex St N-L Ahead Left	U	297	1580:1270	55.2 : 55.2%	33.1	3.3
3/3+3/4	Sussex St N-L Ahead Right	U+O	369	1580:1270	56.0 : 56.0%	22.7	4.9
4/1	Erskine St E-L Left	U	474	1270	91.2%	63.8	17.9
4/2+4/3	Erskine St E-L Ahead Right	U+O	167	1550:1550	24.4 : 24.4%	21.1	2.6
J2: Sussex/Shelley	-	-	-	-	87.5%	-	-
1/1	Sussex St S-L Ahead	U	892	3160	53.5%	7.1	3.0
2/1	Sussex St N-L Ahead	U	729	1580	87.5%	22.0	12.2
Ped Link: P1	Shelley	-	0	-	0.0%	Inf	Inf
J3: Hickson/Napoleon	-	-	-	-	96.2%	-	-
1/1	Sussex St S-L Ahead	U	663	1580	96.2%	54.2	20.4
1/2	Sussex St S-L Right	O	229	1550	77.2%	48.8	8.3
2/2+2/1	Basement W-L Left Ahead	U	16	1550:1550	8.1 : 0.0%	52.3	0.5
2/3+2/4	Basement W-L Right Ahead	U	20	1550:1550	9.4 : 9.4%	51.7	0.5
3/2+3/1	Hickson Rd N-L Ahead Left	U	525	1550:1550	69.1 : 69.1%	14.3	7.9
3/3	Hickson Rd N-L Ahead	U	362	1580	68.1%	36.6	10.8
4/1	Napoleon St E-L Left	U	312	1550	46.1%	18.4	5.3
4/2	Napoleon St E-L Right	U	490	1550	94.0%	65.6	20.2
J4: Kent/Margaret/Napoleon	-	-	-	-	94.1%	-	-
1/2+1/1	Kent St S-L Left Ahead	U	214	1550:1550	46.1 : 46.1%	37.7	5.0
1/3+1/4	Kent St S-L Ahead Right	U+O	387	1550:1550	66.3 : 66.3%	37.7	10.7
2/2+2/1	Napoleon St W-L Left Ahead	U+O	833	1580:1270	94.1 : 94.1%	35.6	33.2
3/1+3/2	Kent St N-L Ahead Right Left	U+O	219	1550:1270	35.5 : 35.5%	32.0	4.2

Appendix A

LinSig Modelling Outputs

Legend

- X** Movement volumes
- X** Mid block volumes

Existing Traffic Volumes
PM Peak Hour Flows (17:15 - 18:15)

Legend

- X Movement volumes
- X Mid block volumes

