APPENDIX C

Transport Assessment

Health Infrastructure

St George Hospital Redevelopment - Acute Services Building

Transport Assessment

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Job number 238593

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ARUP

Executive Summary

Introduction

This report outlines the traffic and transport impacts of changes proposed as part of the St George Hospital Acute Services Building (ASB) Redevelopment. The study addresses the following key elements arising from the proposed development:

- Site access;
- Road network operations;
- Public transport access;
- Traffic generation;
- On-Site parking;
- Public transport;
- Pedestrian network; and
- Travel demand management measures

The report specifically addresses the transport related issues summarised in the Secretary's Environmental Assessment Requirements (SEARs) for the project application SSD 7024 – key issues 5 (transport and accessibility).

Existing Transport Conditions

The St George Hospital campus is located between the Princes Highway to the east and the Illawarra rail line to the west. The Princes Highway is the primary traffic route serving the precinct, carrying over 2,000 vehicles in both directions. Gray Street, on the western boundary of the campus, carries more than 800 vehicles (two-way) in both the AM and PM peak hours.

Approximately 1,150 parking spaces are provided within the St George hospital campus. Of these on-site parking bays, 673 are currently reserved for St George Hospital staff at any one time during the day. In addition, approximately 2,000 all day on-street parking spaces (not subject to parking restrictions) are available within a 10 minute walk (800m) of the campus.

The campus is well served by public transport services, with Kogarah rail and bus interchange located approximately 350m north of the campus. Train services run to Kogarah Station every 10 minutes in both directions during peak hours, while four Sydney Bus routes currently service the site. Dedicated pedestrian crossing facilities are provided across major roads and intersections, including three connections across the Illawarra railway line.

Proposed Works

The project comprises construction of a new Acute Services Building (ASB) over the new ED building. In addition to the ASB, works will also include refurbishment of some areas in the existing Clinical Services Building (CSB) and Tower Ward Block (TWB), and expansion of kitchen, linen stores, etc. in the recently completed Services Centre. The project will generate up to an additional 402 staff on site at any one time (i.e. headcount).

Transport Assessment

No additional vehicular access points are required to service the proposed development. As part of the enabling works for the project (subject to a separate approvals process), the main entrance forecourt is to be reconstructed which will improve traffic circulation and increase capacity along the main entry road.

Based on the anticipated levels of activity to be generated by the development, there is forecast to be an increase of 25 rail trips and 3 bus trips in the peak hour. This increase is not considered to be at a level to warrant any additional infrastructure or services, as existing public transport routes provide high capacity services.

The proposed development generally has a positive impact on pedestrians by providing a new pedestrian through site link, facilitating a legible internal connection between Kensington Street and the main hospital entrance accessed off Gray Street. This new connection will reduce walking times and distances between the campus and Kogarah railway station – improving the attractiveness of public transport as a mode of travel to the site.

The development is forecast to generate approximately 200 traffic movements in the AM and PM commuter peak hours, and approximately 1,850 vehicle movements over the course of a typical day. Traffic modelling which considers impacts arising from the proposed development was undertaken at seven key intersections serving the site for the commuter peak hours. The modelling demonstrates little difference in the road network performance due to the traffic increases arising from the proposed development. Changes in vehicle delays are forecast to be relatively minor in both peak hours.

The level of traffic activity at the Kensington Street / Montgomery Street intersection is forecast to increase following the proposed development. To ameliorate the traffic impacts forecast at this location, it is proposed to provide additional capacity by extending the existing no stopping zone by approximately 30m on the northern side of Kensington Street (between Montgomery Street and Moorefield Lane) during peak hours.

Figure 1 Proposed Improvements – Kensington Street / Montgomery Street Intersection

The anticipated level of parking generated by users of the development is summarised below:

- 209 cars in total in 2018; and
- 349 cars in total in 2022

The above numbers include provision for both staff and public users, and represent the *maximum* parking demand generated by the development. Over the course of the day however, the level of parking demand will fluctuate according to the arrival and departure patterns of staff, patients and visitors, as is illustrated in Figure 24 below.

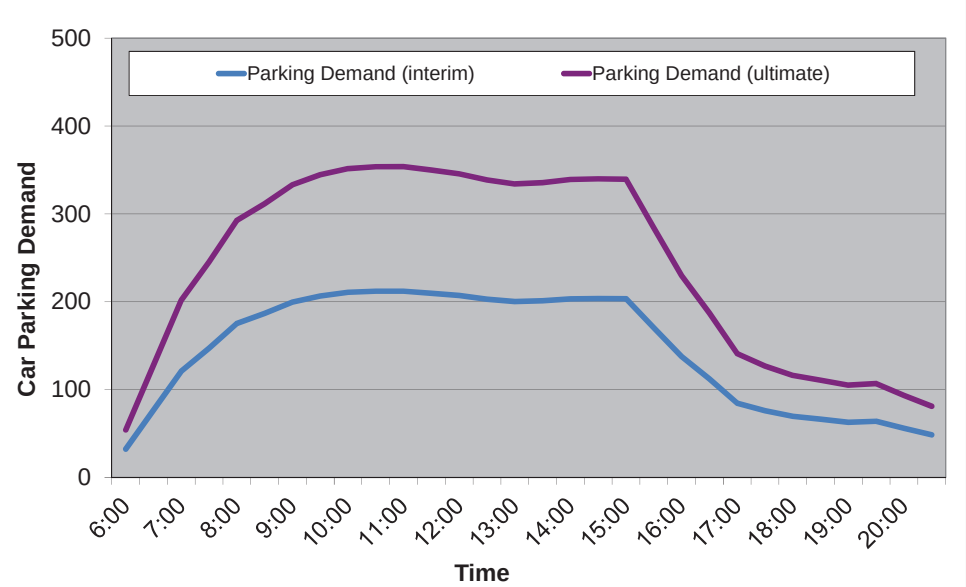

Figure 2 Forecast Car Parking Demand

199 additional on-site parking spaces are to be provided on the St George Hospital campus, comprised of new parking spaces gained in the Kensington Street at-grade car park (51 spaces), Gray Street at-grade car park (16 spaces) and Gray Street multi-storey car park (136 spaces), with four existing spaces in the northern at-grade car park to be remove to accommodate northern egress stairs from the ASB. This level of supply is commensurate with the anticipated level of peak demand initially generated by the development, up to the year 2022. Beyond 2022, the forecast level of peak parking demand will exceed the on-site supply. This is summarised in Table 9.

Table 1 Future Parking Demand vs Supply

Stage	Year	Peak Parking Demand	Additional Supply	Balance
Interim	2018 - 2022	209	199	-10
Ultimate	2022 onwards	349	199	- 150

An updated parking strategy will need to be considered when the peak parking demand exceeds the on-site supply.

To complement the parking and traffic strategy, a number of travel demand management measures are recommended to better manage staff parking. This includes development of a green travel plan, encouragement of carpooling by staff, additional bicycle parking and promotion of public transport measures.

Construction of the development is estimated to occur over a two year period. As the project is in its preliminary stages, this timeframe is approximate only and may vary once a contractor is appointed. Construction vehicles would be restricted the state road network and vehicles will likely originate from this network, with movements along local streets prohibited. Prior to the commencement of construction, a Construction Traffic Management Plan (CTMP) is to be prepared to ensure the safest possible management of construction access. The CMTP would address:

- The likely construction vehicle numbers and frequency;
- Approach and departure routes;
- Parking access arrangements during construction; and
- Provision of acceptable pedestrian management measures.

In summary, it is considered the transport impacts arising from the proposed works can be appropriately managed.

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Figures

1 Introduction

1.1 Study Background

Arup was engaged by Health Infrastructure to prepare a transport study which assesses the impacts of changes proposed as part of the St George Hospital Acute Services Building (ASB) redevelopment.

1.2 Study Objectives

The transport study addresses the following key elements arising from the proposed development:

- Site access;
- Road network operations;
- Public transport access;
- Traffic generation;
- On-Site parking;
- Public transport;
- Pedestrian network; and
- Travel demand management measures

2 Existing Transport Context

2.1 Site Access

Vehicular access to the St George hospital campus is primarily achieved via the main access road off Gray Street, from which vehicles can park in the adjacent multi-storey Gray Street car park. A number of additional site access points are provided, which allow access to and from a number of at-grade parking areas scattered throughout the campus. A new loading dock was recently constructed on the corner of South Street and Belgrave Street.

Ambulance activity has recently been relocated from the old Kensington Street Emergency Department (ED) building to the newly opened Emergency Department (ED) fronting Gray Street. Ambulance access to the covered ED ambulance bay is provided by a dedicated entry and exit point set apart from the main entrance driveway to the hospital.

2.2 Staff Travel Patterns

2.2.1 Mode Split

A travel survey was developed by Arup and issued to all St George Hospital staff (both full and part time) on Wednesday 9 April 2014. 745 responses to the survey were received, representing approximately one third of all staff members.

The significant majority (over 90%) of St George Hospital staff typically travel to the campus by car, either as car driver or passenger. Despite the limited on-site parking and nearby availability of bus and train services, only 5.6% of staff utilise public transport. This mode share is however reflective of a typical hospital campus in Sydney. Recent travel surveys undertaken at The Sutherland Hospital demonstrated over 95% of staff drive to the campus.

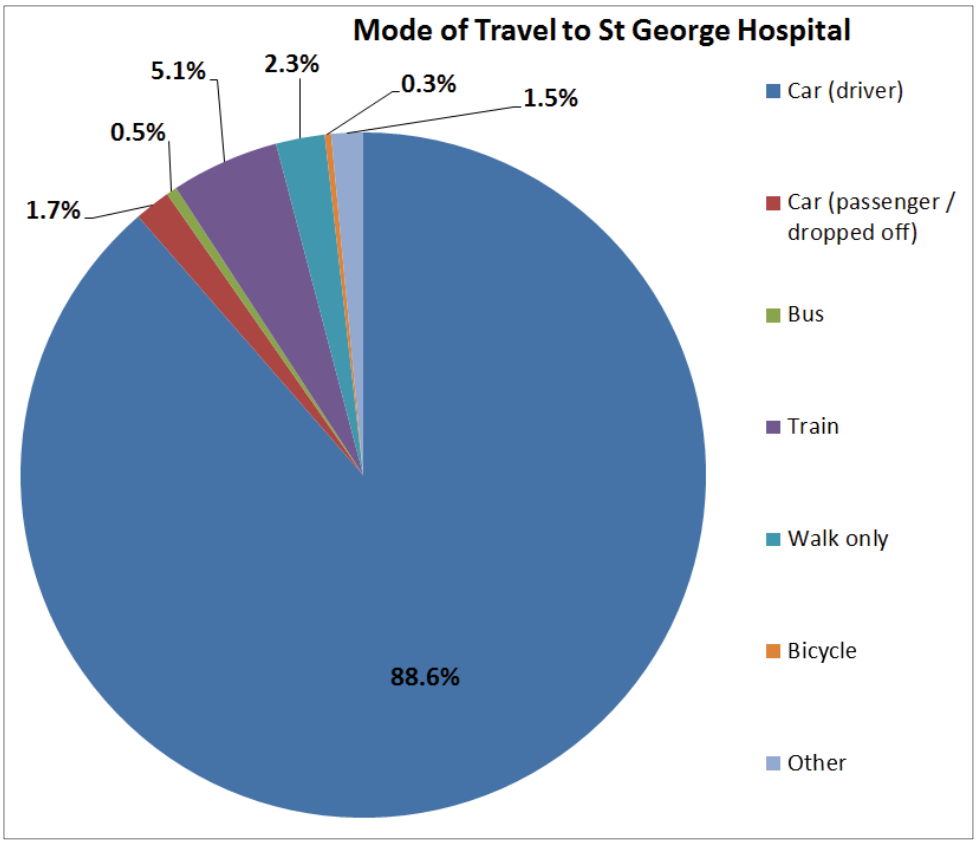

Figure 3 Existing Staff Mode Share

2.2.2 Arrival / Departure Profiles

46% of staff noted that they arrive to the St George hospital campus between 7.30am and 8.30am, coinciding with the road network peak hour. A large number of respondents indicated their arrival and departure times varied depending on their shift times, and may be either in the morning, afternoon or evening. Approximately half of all staff depart the campus between 4.30pm and 5.30pm.

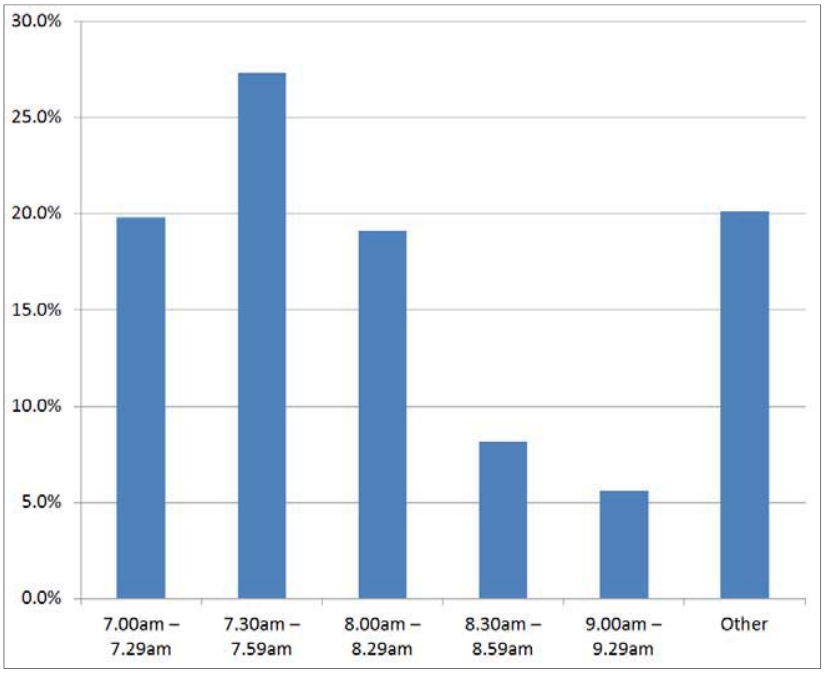

Figure 4 Staff Arrival Times

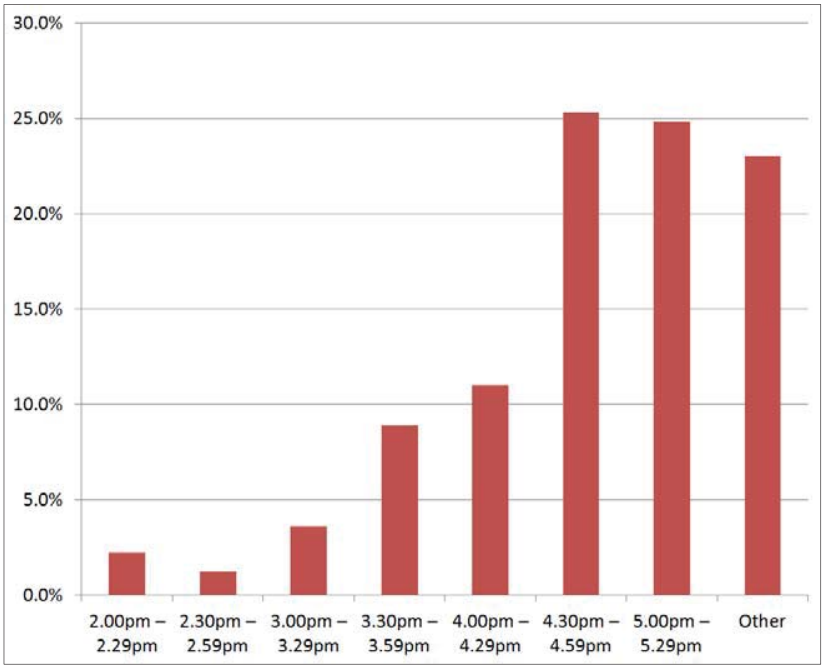

Figure 5 Staff Departure Times

2.3 Road Network

The St George Hospital campus is located between the Princes Highway to the east and the Illawarra rail line to the west as shown in Figure 6. Two major (RMS controlled) State roads adjacent to the campus, those being the Princes Highway and Rocky Point Road, provide the predominant vehicular routes into the precinct. These roads carry significant traffic volumes and typically operate close to their operation capacity, particularly during commuter peak hours. Railway Parade to the north of the campus is an RMS controlled regional road, providing a connection between Kogarah and Hurstville (running parallel to the railway line). Gray Street runs along the western perimeter of the campus and acts as a collector road, connecting Rocky Point Road with Railway Parade.

A number of intersections in the immediate vicinity of the campus are controlled by traffic signals, due to the heavy local and regional traffic volumes in the area. A roundabout is in place at the Kensington Street / Gray Street intersection adjacent to the campus.

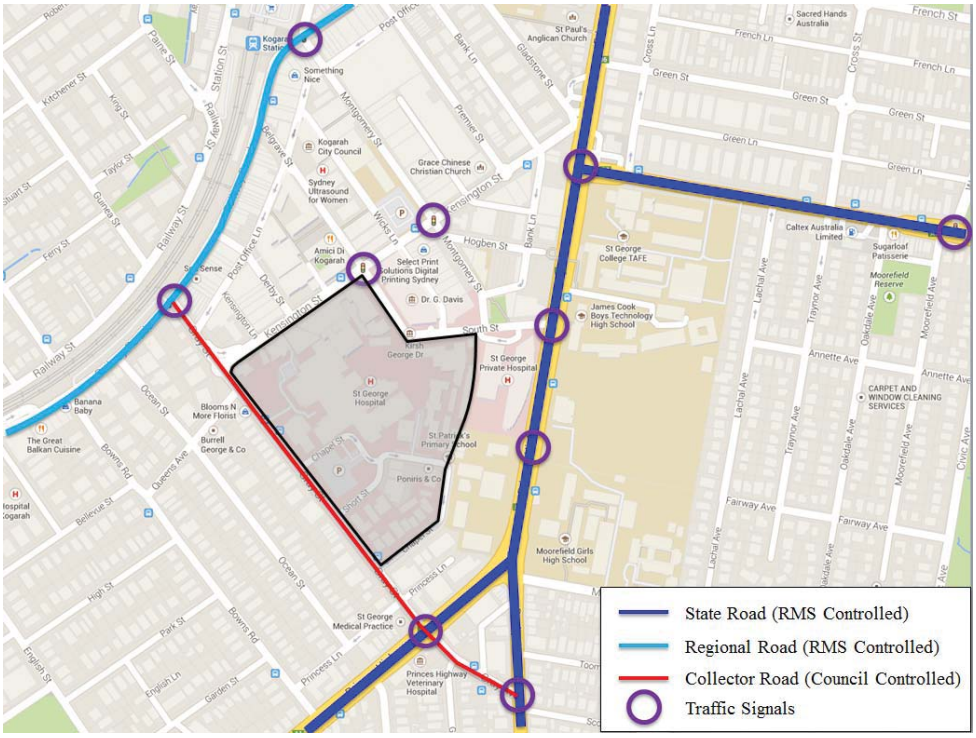

Figure 6 Existing Road Network

2.4 Traffic Volumes

Traffic counts at intersections serving the campus were undertaken during both the AM (7am – 9am) and PM (4pm – 6pm) commuter peak periods in April 2014 at three following intersections:

- Kensington Street / Gray Street;
- Kensington Street / Montgomery Street; and
- Kensington Street / Princes Highway

In addition to these surveys, traffic data for a further four intersections was previously collected as part of the new ED building on Gray Street. These intersections were as follows:

- Princes Highway/ Gray Street;
- Princes Highway / South Street;
- Railway Parade / Gray Street; and
- Kensington Street / Belgrave Street

The identified peak hour periods from the survey were 8am – 9am (AM peak hour) and 4.30pm – 5.30pm (PM peak hour). The Princes Highway is the primary traffic route serving the precinct, carrying over 2,000 vehicles in both directions. Gray Street, on the western boundary of the campus, carries more than 800 vehicles (two-way) in both the AM and PM peak hours.

These intersection counts have been used as the basis for the traffic modelling undertaken in later sections of this report. Traffic volumes for both peak hours are illustrated in the figures on the following pages in Figure 7 and Figure 8

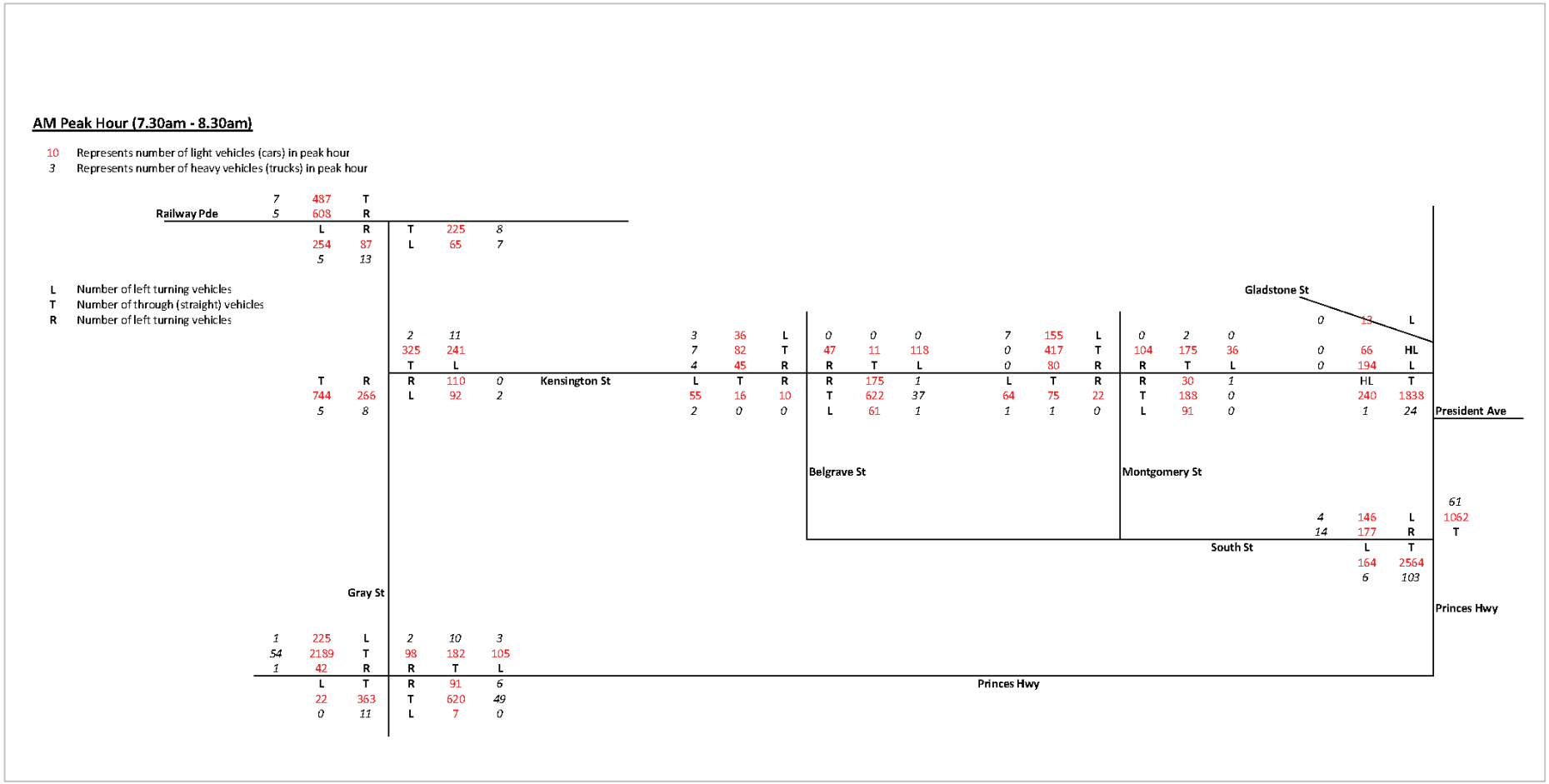

Figure 7 AM Peak Hour Traffic Volumes

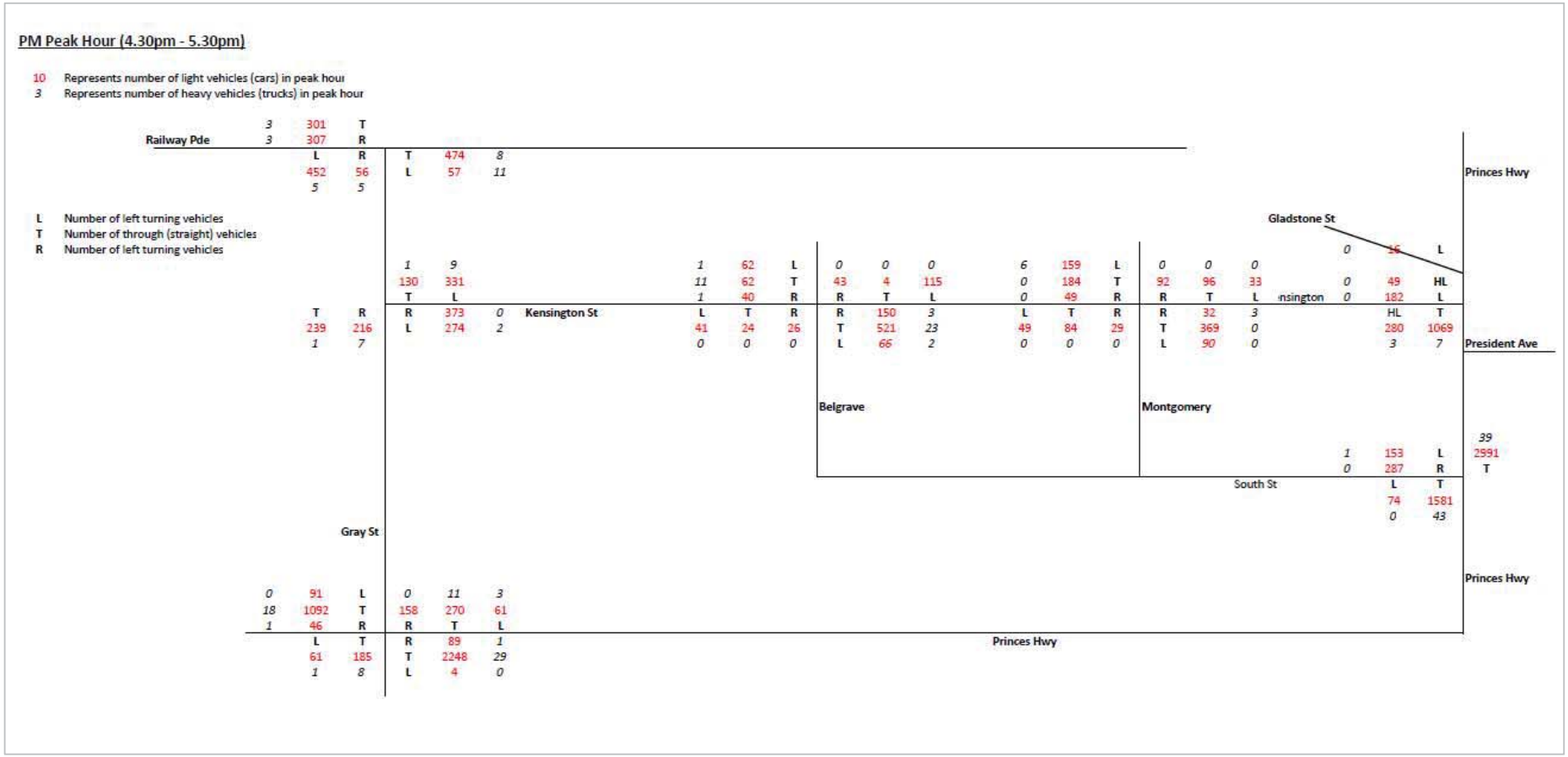

Figure 8 PM Peak Hour Traffic Volumes

2.5 Parking

2.5.1 On-Site Parking

There are presently two major multi-storey car parks serving the St. George Hospital Campus, located off Belgrave Street and Gray Street. In addition to these multi-storey car parks, there are a number of at-grade car parking areas within the campus.

A summary of these on-site parking areas is provided in the table below:

Table 2 Existing Car Parking Arrangements

Car Park Location	**Type**	**Capacity**
Belgrave Street	Multi-Storey	586
Gray Street	Multi-Storey	468
Sub-Total: Multi-Storey Car Parks		***1,054***
Adjacent to Gray Street multi-level	At-grade	16
Chapel Street (gate 9)	At-grade	19
Chapel Street (gate 10)	At-grade	23
South Street adjacent to Private Hospital	At-grade	9
Adjacent to Kogarah Fire Station	At-grade	25
Sub-Total: At-grade Car Parks		***92***
Total Existing Car Parking Provision		**1,146**

Of these on-site parking bays, 673 are currently reserved for St George Hospital staff at any one time during the day. The remainder are utilised by visitors to the hospital. Staff from Metro-Parking regularly monitor the occupancy of each multi-storey car park to ensure a space is always available for those with parking permits. There are occasions the car parks will be closed off for public users, even when some spare capacity may exist, to ensure staff members with permits are guaranteed a parking space. Parking bays are not marked as either staff or public. There are however a number of spaces in the Belgrave Street car park which are only available after 9am daily.

On Monday mornings from 7.30am, five day parking permits are issued. These permits are available to all staff at the public hospital upon presentation of their Staff ID.

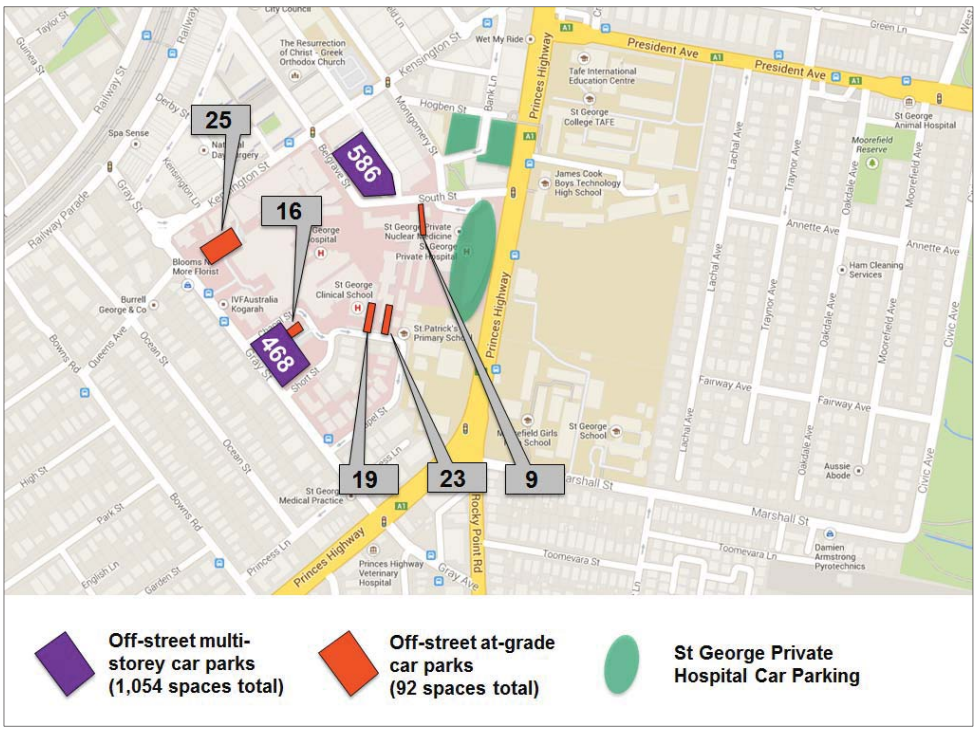

Figure 9 Existing Parking Arrangements

Staff members with a permit (either permanent of five day pass) will be guaranteed a parking space in either the Belgrave Street or Gray Street car parks. The operators of the car parks monitor the occupancy over the course of the day, and close the car parks to casual users if the car parks are approaching capacity.

Casual parking is also available in both the Belgrave Street and Gray Street car parks, at $8/hour for the first 2.5 hours. A maximum daily parking rate of $30 is in place for vehicles who stay longer than 6 hours

Parking surveys were undertaken on Wednesday 2 April 2014 to understand the level of on-site parking demand currently generated at St George Hospital campus. The parking survey demonstrated that demand for the 1,146 parking spaces peaked at around midday, with 97% of all spaces occupied. Between 10 and 4pm, the car parks surveyed were more than 90% full. After 4pm occupancy dropped significantly – reflecting the departure times of workers

As demonstrated in Figure 10, both the Belgrave Street and Gray Street multi-storey car parks reached 100% occupancy between 11am and 1pm on the surveyed day.

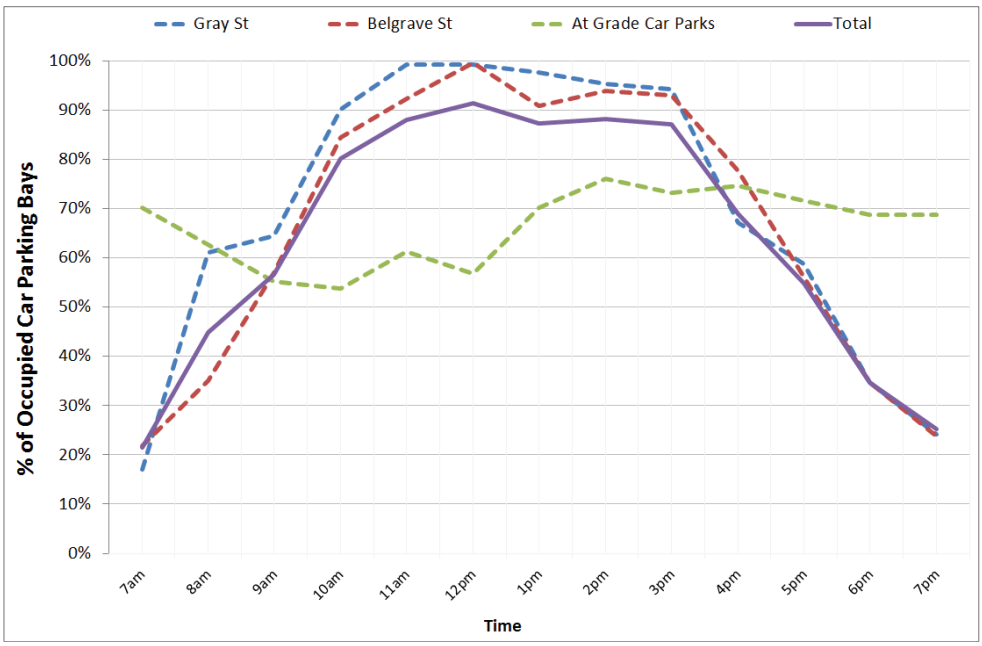

Figure 10 On-Site Parking Demand

2.5.2 Off-Site Parking

Off-site parking surveys were undertaken on Wednesday 25 June 2014 to understand the level of available on-street parking within a 10 minute walk (800m) of the campus. Streets in this catchment containing all day, unrestricted parking (either on one side or both sides of the street) were surveyed hourly between 7am and 7pm, as shown in Figure 11. 2,029 unrestricted parking spaces were surveyed within the catchment area.

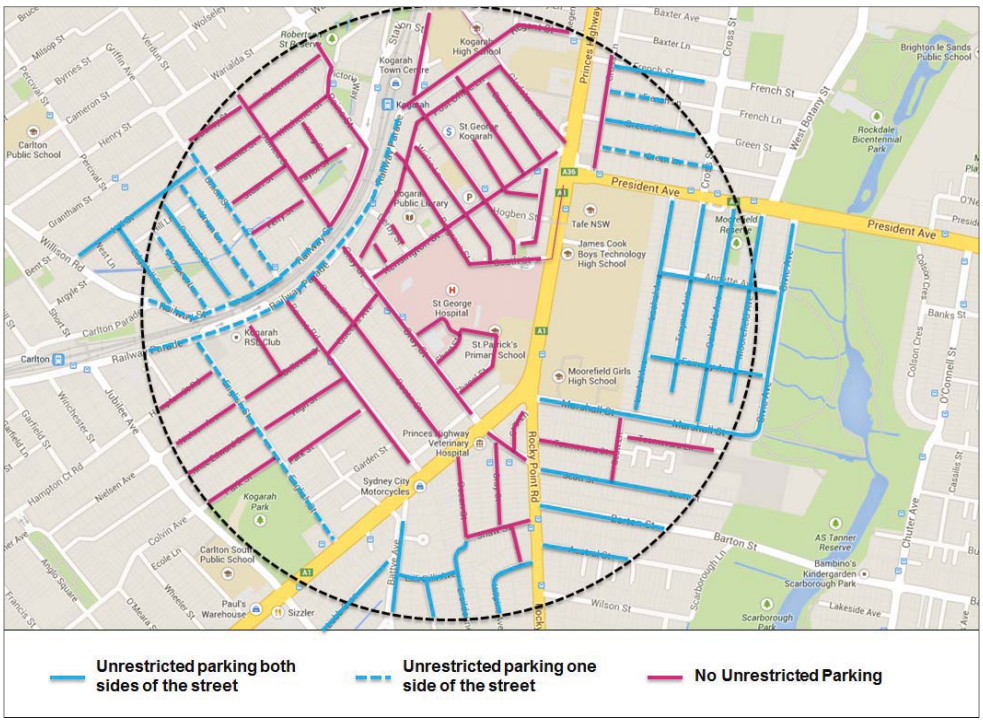

Figure 11 On-Street Parking Survey Scope – June 2014

The results, shown in Table 3 and Figure 12, demonstrated peak occupancy of streets occurred at 12pm with 58% of all spaces occupied – equating to 845 unoccupied parking bays. Similar to the parking survey of April 2014, streets closest to the hospital and railway station experienced the highest occupancy levels – as illustrated in Figure 13.

Table 3 On-Street Parking SurveyResults

	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm
Occupied Spaces	1,014	1,070	1,143	1,177	1,168	1,184	1,181	1,150	1,118	1,018	946	889	849
Unoccupied Spaces	1,015	959	886	852	861	845	848	879	911	1,011	1,083	1,140	1,180
% Occupied	50%	53%	56%	58%	58%	58%	58%	57%	55%	50%	47%	44%	42%

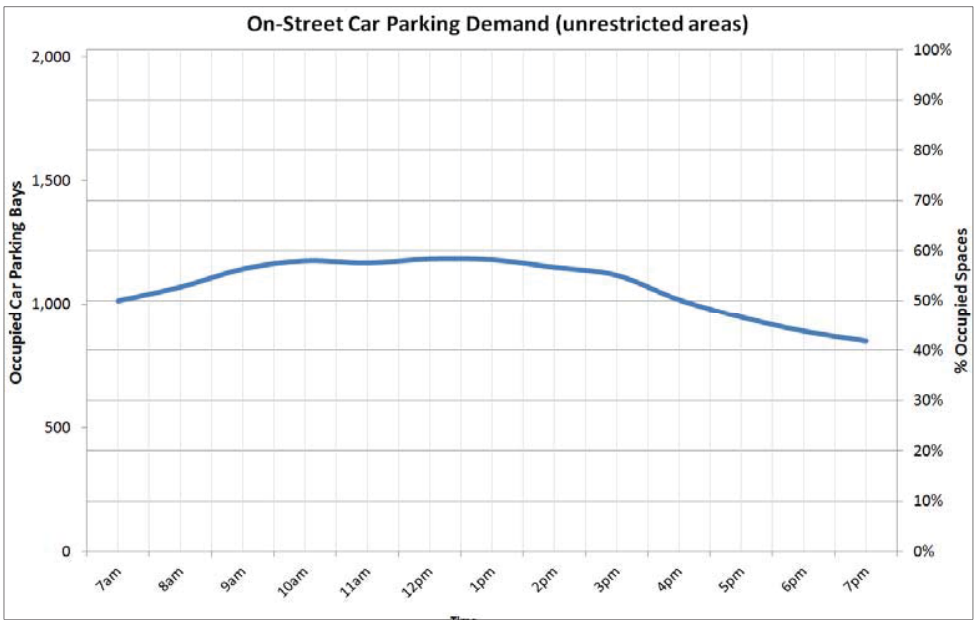

Figure 12 On-Street Parking Survey Results

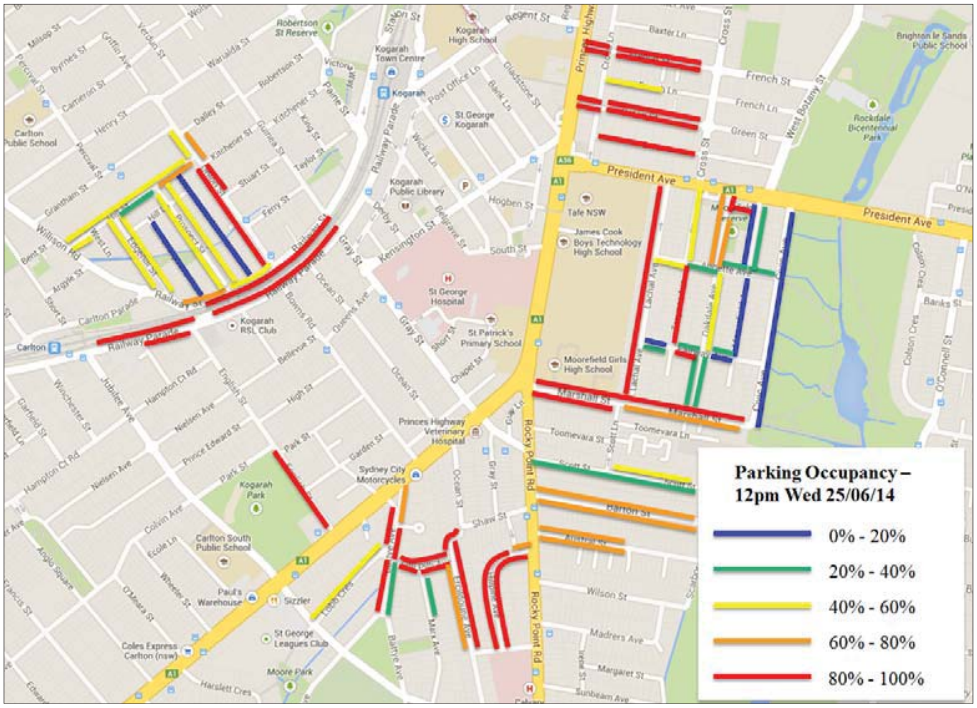

Figure 13 Parking Occupancy by Street

2.6 Public Transport

The campus is well served by public transport services, with Kogarah rail and bus interchange located approximately 350m north of the campus as shown in Figure 14.

Kogarah railway station is on the T4 Eastern Suburbs and Illawarra line which runs between Waterfall/Cronulla into Central and Town Hall and through to Bondi Junction. Services run to Kogarah Station every 10 minutes in both directions during peak hours. The station was recently equipped with Opal Card ticket readers as part of the implementation of Sydney's new integrated public transport ticketing system.

A number of bus stops are provided in the immediate proximity of the campus. The bus routes servicing these stops are as follows:

- 422: Kogarah to City via Newtown
- 430: Kogarah Local Loop Service
- 476: Rockdale to Dolls Point Loop
- 477: Rockdale to Miranda

Service frequencies vary for each of these routes, with the 422 service running at 15 minute intervals throughout the day. The remaining three routes typically run at less frequent 30 minute intervals.

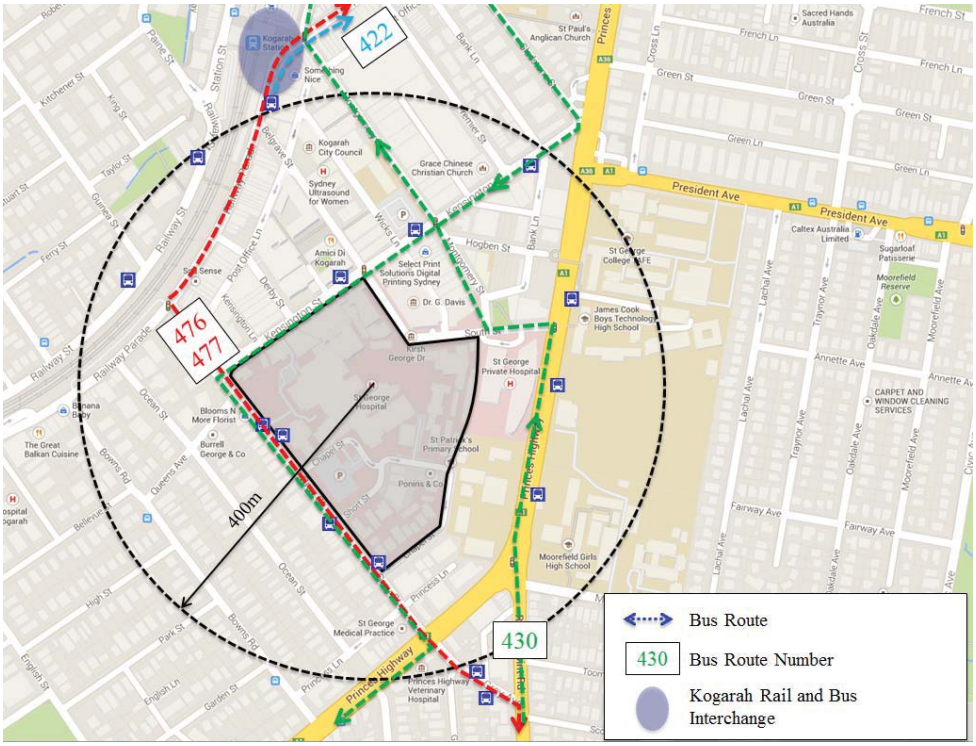

Figure 14 Public Transport

2.7 Pedestrians

The campus is well served by a series of pedestrian facilities. Signalised intersections generally contain pedestrian crossing legs on all key approaches, with the exception of the junction of Rocky Point Road and the Princess Highway, where no pedestrian crossing facilities are present. Some pedestrians were observed to cross the road unsafely at this location, rather than walk to the nearby crossing provided at Gray Street.

A pedestrian overbridge is in place across the Princess Highway south of President Avenue. This overbridge is complemented by a number of at-grade crossings. Zebra crossings are also provided adjacent to the campus, including one on Chapel Street outside the main hospital entrance. Footpaths in the area are typically of a good quality, with paths wide enough to accommodate all users.

There are opportunities at three locations for pedestrians to cross the Illawarra railway line, via:

- An overpass at Kogarah railway station;
- A pedestrian subway north of Derby Street; and
- A vehicle/pedestrian underpass opposite Prospect Street.

Pedestrian facilities in the vicinity of the site are shown in Figure 15.

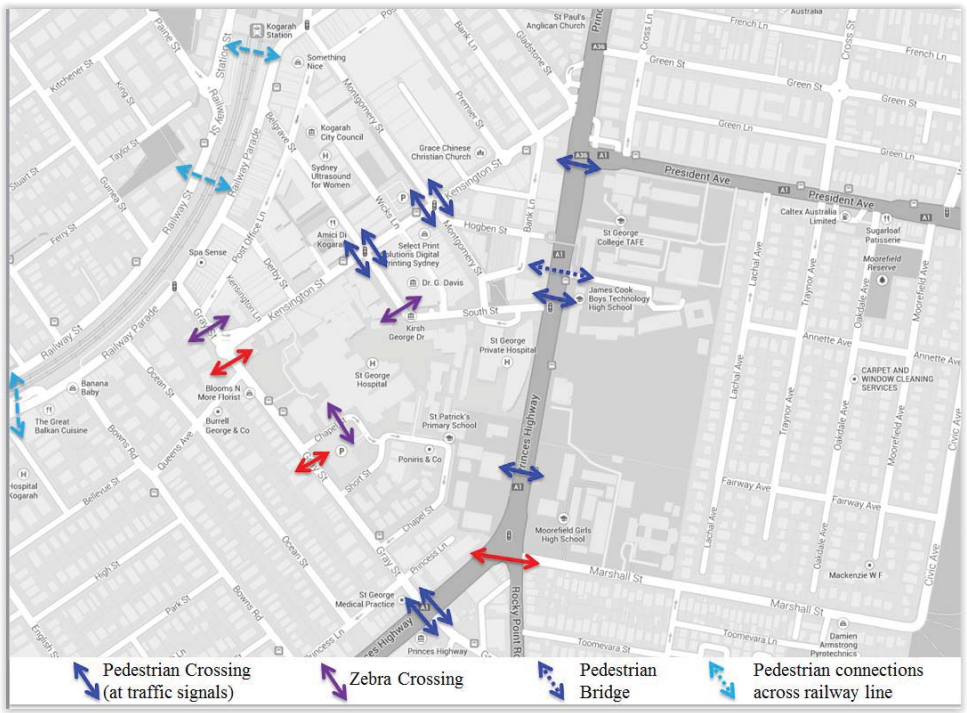

Figure 15 Pedestrian Facilities

3 Proposed Works

3.1 Proposed Development

The redevelopment is an important follow-on to the opening of the new Emergency Department (ED). It is the next step in a series of progressive changes to the campus, establishing expansion zones and new facility development opportunities that provide the platform and environment in which new and more integrated models of care can be realised. It enables a significant improvement in capacity to respond to current and projected demand

The project comprises construction of a new Acute Services Building (ASB) over the new ED building. Interfaces between the existing facilities and the new ASB are a critical feature of the design strategy. In addition to the ASB, works will also include refurbishment of some areas in the existing CSB and TWB, and expansion of kitchen, linen stores, etc. in the new Services Centre.

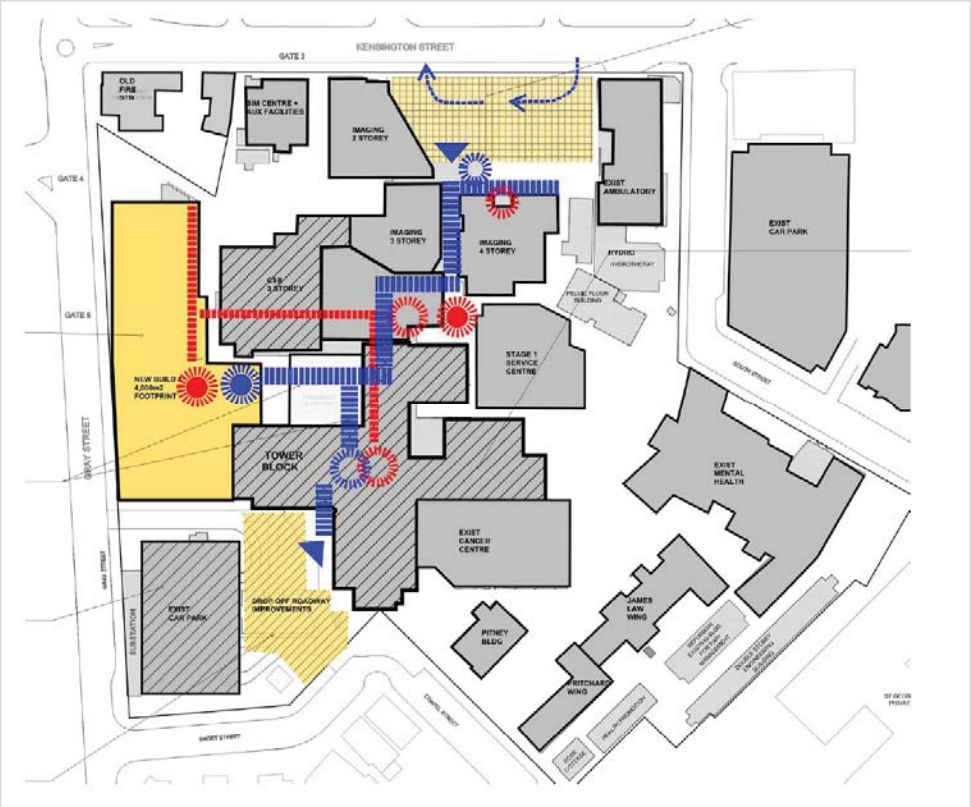

Figure 16 Site Master Plan

3.2 Forecast Levels of Activity

The anticipated additional hospital bed numbers resulting from the proposed development are outlined below. Additional clinical / support service activity will ramp up between 2018 and 2022, and therefore the assumptions are reflective of the likely levels of additional activity on the St George Hospital campus.

- 130 additional Acute Overnight inpatient unit beds
  - *80 fully operational in 2018,*
  - *Balance of 50 beds in 2022*
- 18 additional ICU/HDU beds
  - *10 fully operational in 2018,*
  - *Balance of 8 beds in 2022.*
- 7 additional operating theatres
  - *5 fully operational in 2018*
  - *Balance in 2022.*
- 1 additional Procedure Room which will be fully operational in 2018.
- 35 additional recovery beds
  - *20 fully operational in 2018*
  - *Balance of 15 beds in 2022*

Functional briefs for the various departments within the ASB were developed to estimate future staff numbers associated with the proposal. These briefs outlined the projected additional staff on the campus (those on-site at any one time), and are summarised in Table 4.

Table 4 Staff Growth Assumptions – ASB Project

Unit	**Additional Staff On-Site* (Head Count)**
Surgical / Theatres / Procedures	121
Inpatient Units	90
Intensive Care Services	115
Sterilising Services Department	14
Back of House / Hotel	16
Admin/Security/Misc (including contingency)	46
Total	**402**

* maximum on site at any one time

These assumptions in relation to hospital bed numbers and staff forecasts have been utilised in the traffic and parking assessment detailed in Section 4 of this report.

4 Transport Assessment

4.1 Site Access

4.1.1 Overview

An overview of the site access arrangements on completion of the development is illustrated in Figure 17. This includes:

- Vehicle access;
- Pedestrian access;
- Ambulance access; and
- Vehicle drop off and pick up

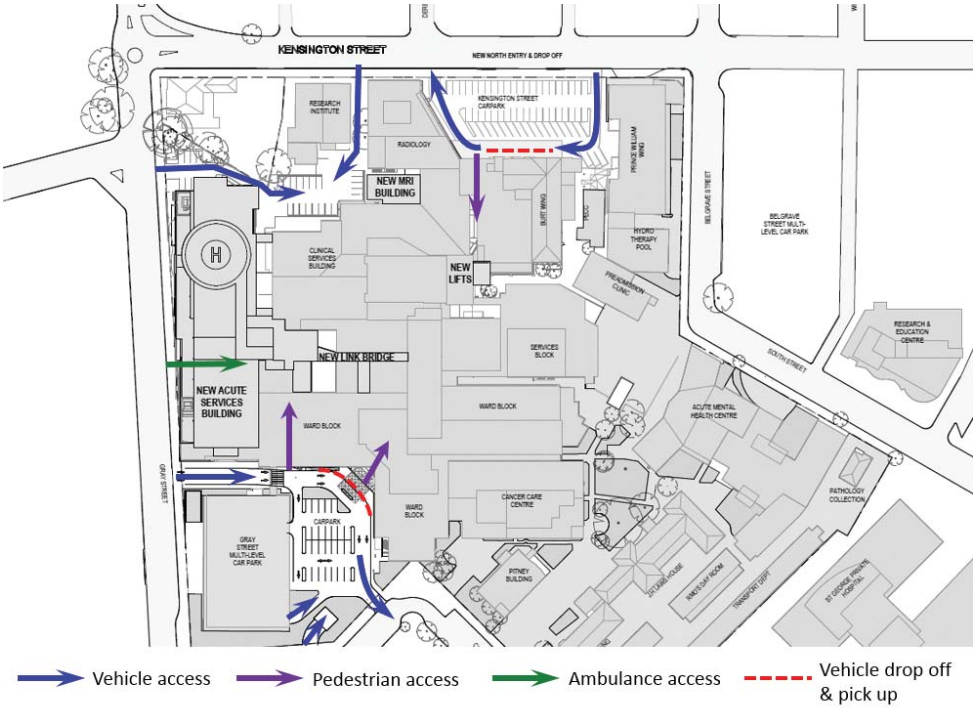

Figure 17 Site Access

4.1.2 Main Entrance Road

As part of the enabling works for the project (subject to a separate approvals process), the main entrance forecourt is to be reconstructed to increase parking and provide a two lane vehicular entry, as shown in Figure 18. This will improve traffic circulation and increase capacity along the main entry road.

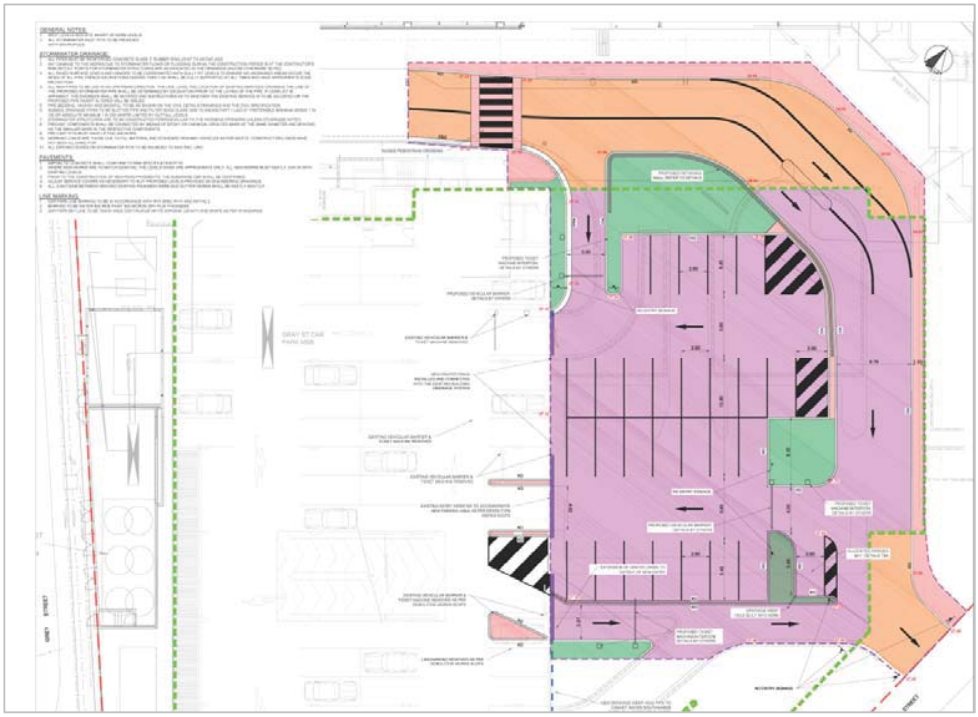

Figure 18 Proposed works – main entry road

Specific elements of the proposed works include:

- Removal of the existing pedestrian ramp, to be replaced by a DDA compliant footpath (maximum 1:20 grade);
- Creation of two continuous traffic lanes within the site;
- Construction of a raised pedestrian (zebra) crossing;
- Closure of existing southern entry point to Gray Street multi-storey car park;
- Relocation of existing northern exit point from Gray Street multi-storey car park;
- Reconfiguration of existing at-grade car park, increasing parking capacity from 16 to 28 spaces; and
- 4 additional parking bays on the ground floor of the Gray Street car park.

4.2 Emergency Access

Emergency Access to the ASB is via the newly constructed ED building, which is already completed. Public pedestrian, or 'walking wounded' access is via a dedicated entry facing the entrance road on the south side of the TWB. This entry leads to the ED public reception area. Ambulance emergency access is via the vehicular entranceway at Ground Level in the middle of the Gray Street ED façade. The covered ambulance bay and associated circulation zone is separated from public circulation areas. Emergency egress from the building is via the fire enclosed stairwells at the north and south ends of the ASB.

4.3 Service Vehicle Access

The ASB is connected to the hospital's Service Centre through the CSB at Ground Level. The extensive loading dock facilities already completed at the Service Centre have been designed with the ASB in mind and service trolleys will be able to move easily between the two buildings on staff-only corridors.

4.4 Public Transport

As noted previously, the campus is well served by public transport infrastructure, with Kogarah rail and bus interchange located only 350m from the campus. Based on the anticipated levels of activity to be generated by the ASB, and existing travel patterns as outlined in Section 2.2, the forecast increase in public transport trips is as follows:

- 25 rail trips in the peak hour; and
- 3 bus trips in the peak hour.

This increase is not considered to be at a level to warrant any additional infrastructure or services, as existing public transport routes provide high capacity services.

The 2014/2015 NSW Budget allocated $7 million to undertake detailed planning work on the new Sydney Rapid Transit rail network, including a second Harbour rail crossing. Stage 3 of this network includes planning for an extension of the rapid transit network to Bankstown and Hurstville, servicing Kogarah railway station. Sydney Rail Futures, prepared by Transport for NSW in 2012, notes that "*the stations from Hurstville to Wolli Creek will be connected to the rapid transit sector and provide a frequent and rapid connection across to the North Shore and allow up to an additional 10 trains per hour*."

Provision of this enhanced rail network would improve public transport access to the St George Hospital campus and reduce the reliance on private vehicles.

4.5 Pedestrians

Future development of the St George Hospital campus provides the opportunity to enhance pedestrian connectivity to key destinations in the surrounding precinct. It will be particularly important to ensure good quality linkages to Kogarah railway station are provided to encourage staff and visitors to travel to the site by public transport. Provision of a legible internal circulation network will play an important role in achieving this objective.

A key deficiency in the existing pedestrian network is the lack of internal connectivity between the hospital entry points on Kensington Street and Gray Street (main entry). Pedestrians walking from Kogarah station and travelling to the main entry must walk down Gray Street before turning left into the campus.

The development proposes a new pedestrian through site link, providing a legible internal connection between Kensington Street and the main hospital entrance. This new connection will reduce walking times and distances between the campus and Kogarah railway station – improving the attractiveness of public transport as a mode of travel to the site. The new connection will also provide a link to the existing bus stops located on Kensington Street.

These pedestrian connections provide appropriate linkages for users of the campus parking north of the railway line and walking to the site.

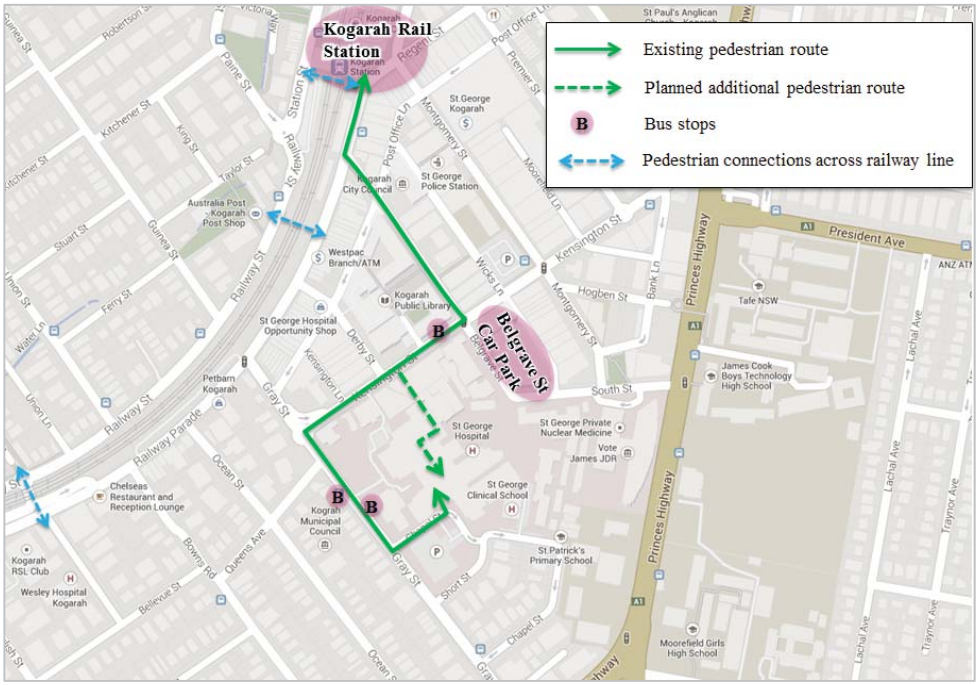

Figure 19 Pedestrian Circulation

4.6 Traffic Generation and Distribution

Based on the current arrival and departure profiles and forecast levels of hospital activity, the volume of additional traffic movements attributable to the development can be estimated. This is summarised in Table 3 below.

Table 5 Forecast Traffic Generation

Time Period	Inbound Traffic	Outbound Traffic	Total Traffic
AM Peak Hour (7.30am – 8.30am)	148	50	198
PM Peak Hour (4.30pm – 5.30pm)	31	177	208
Daily	926	926	1,852

2011 Journey to Work Census data has been utilised to determine the arrival routes of vehicular traffic related to the hospital campus. A number of access routes have assumed to be utilised, as follows:

- President Avenue / Kensington Street: 20%
- Rocky Point Road / Gray Street: 10%
- Princes Highway (west): 25%
- Railway Parade / Gray Street: 10%
- Princes Highway /(north) Regent Street / Montgomery Street: 30%
- Princes Highway (north) / Gray Street: 5%

The departure routes are assumed to be the reverse of the arrival routes, with the exception of those entering at Kensington Street which will turn left from South Street onto the Princes Highway, before turning right onto President Avenue.

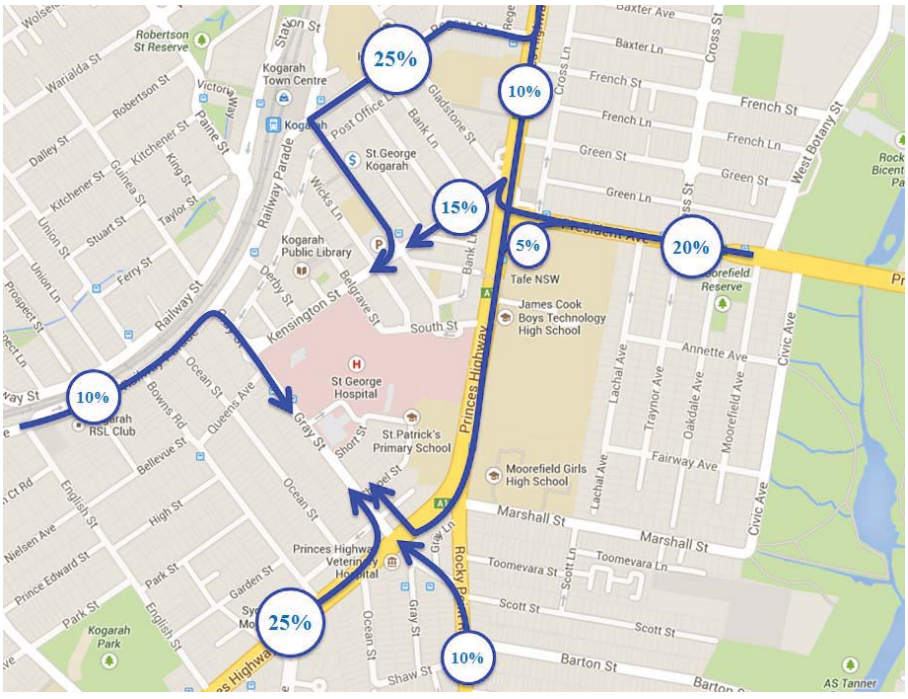

Figure 20 Forecast Traffic Distribution

4.7 Traffic Impacts

The road network performance has been assessed using the RMS approved SIDRA software. Seven intersections in the vicinity of the campus have been assessed. This is summarised below.

- **Location 1:** Princes Highway/ Gray Street;
- **Location 2:** Princes Highway / South Street;
- **Location 3:** Princes Highway / Kensington Street;
- **Location 4:** Kensington Street / Montgomery Street;
- **Location 5:** Kensington Street / Belgrave Street;
- **Location 6:** Kensington Street / Gray Street; and
- **Location 7:** Railway Parade / Gray Street;

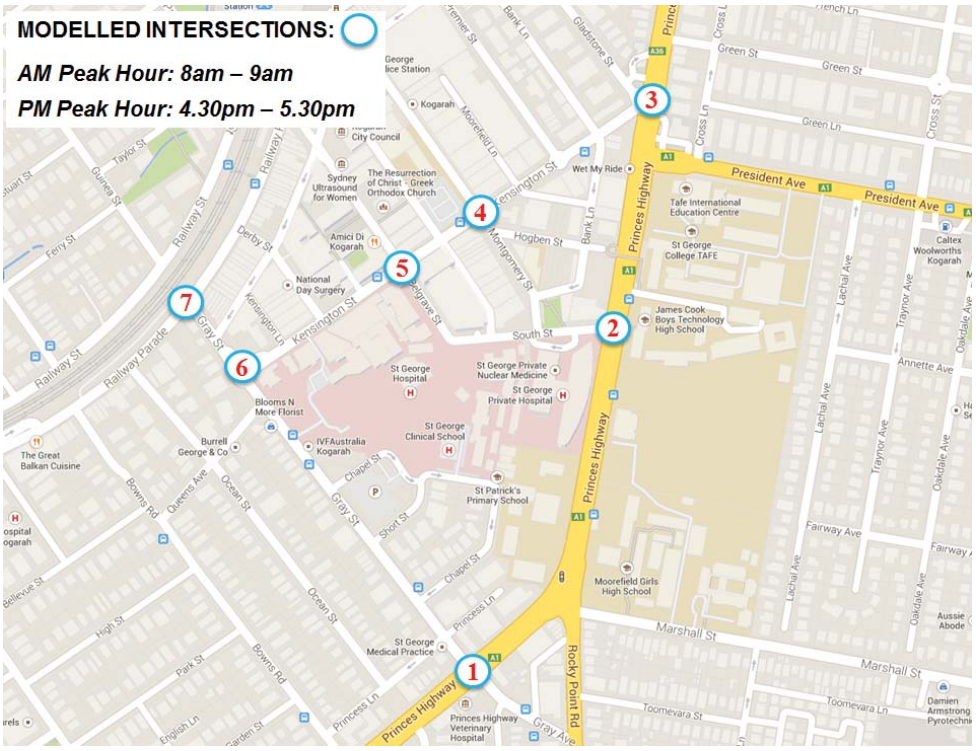

Figure 21 Modelled Intersections

Traffic conditions at these intersections are summarised in terms of:

- Level of Service (LOS);
- Degree of Saturation (DOS); and
- Maximum Queue Length

The performance of intersections in urban areas is quantified in terms of the Level of Service, which is based on the average delay per vehicle. LOS criteria is summarised in Table 6, and ranges from A = very good to F = unsatisfactory. Across the Sydney road network, it is not uncommon for intersections along arterial roads (e.g. Princes Highway) to operate at Level of Service E (at capacity) or above during commuter peak hours.

Table 6 Level of Service Criteria for Intersections

Level of Service	Average Delay (seconds per vehicle)	Description
A	Less than 14	Good operation
B	15 to 28	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Operating near capacity.
E	57 to 70	At Capacity. At signals, incidents will cause excessive delays. Roundabouts require other control mode
F	Greater than 71	Unsatisfactory with excessive queuing

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 desirable maximum degree of saturation for an intersection with traffic signals is 0.9.

The results of the traffic modelling for the existing situation is summarised in Table 7 below and Figure 22.

Table 7 Existing Intersection Operation

Location Number	Intersection	Intersection Control	Peak Hour	Degree of Saturation	Ave Delay (s)	Level of Service	Degree of Saturation	Ave Delay (s)	Level of Service
				Existing			Future (Following full development of ASB)		
1	Princes Highway/ Gray Street	Traffic signals	AM Peak	0.95	40	C	0.95	52	D
			PM Peak	1.25	176	F	1.32	214	F
2	Princes Highway / South Street	Traffic signals	AM Peak	0.70	13	A	0.70	13	A
			PM Peak	0.75	15	B	0.77	16	B
3	Princes Highway / Kensington Street	Give-Way	AM Peak	0.59	1	A	0.60	2	A
			PM Peak	0.38	2	A	0.39	2	A
4	Kensington Street / Montgomery Street	Traffic signals	AM Peak	0.55	21	B	1.34	130	F
			PM Peak	0.42	18	B	0.48	19	B
5	Kensington Street / Belgrave Street	Traffic signals	AM Peak	0.79	18	B	0.93	35	C
			PM Peak	0.58	15	B	0.65	14	A
6	Kensington Street / Gray Street	Roundabout	AM Peak	0.83	6	A	0.83	6	A
			PM Peak	0.55	7	A	0.58	7	A
7	Railway Parade / Gray Street	Traffic signals	AM Peak	0.96	41	C	0.99	47	D
			PM Peak	0.93	31	C	0.89	27	B

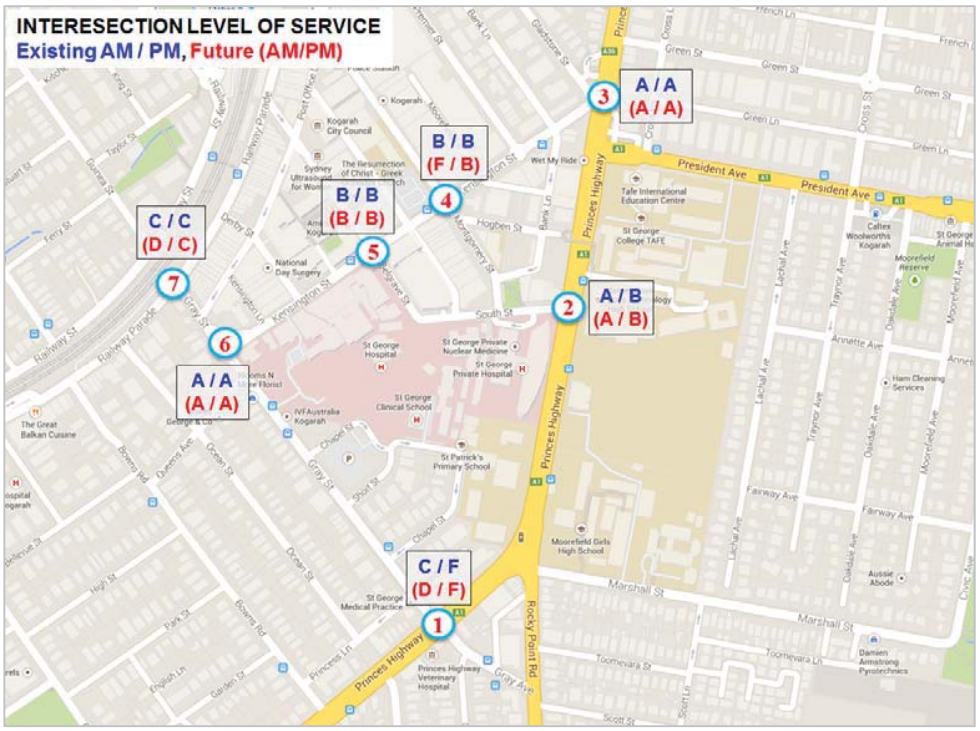

Figure 22 Future Intersection Level of Service

The analysis indicates the intersections serving the St George Hospital campus typically operate satisfactorily during commuter peak hours. Queues develop on the Princes Highway in both peaks as commuters make their way to and from the Sydney CBD, however these queues generally clear in a single signal cycle. On side streets fronting the Princes Highway (e.g. South Street, Gray Street), vehicle delays can extend up to two minutes due to the long phase times provided to north-south traffic on the highway. Observations however indicate vehicle queues from these side streets would clear over a single cycle.

The Princes Highway / Gray Street intersection was modelled to be operating above its capacity during the PM peak hour. This is largely the result of high southbound traffic flows stemming from adjacent arterial roads such as Rocky Point Road, President Avenue and the Princes Highway. Vehicles departing the hospital campus on Gray Street, particularly those turning right onto the Princes Highway, can experience significant delays as vehicle queues extend back from the upstream and downstream intersections.

The traffic modelling demonstrates little difference in the road network performance due to the traffic increases arising from the proposed development. Changes in vehicle delays are forecast to be relatively minor in both the AM and PM commuter peak hours. All intersections will operate satisfactorily with the exception of Kensington Street / Montgomery Street in the AM peak hour. The remaining intersections are forecast at similar levels to existing, including the Princes Highway/ Gray Street intersection which will continue to operate at Level of Service F.

The Kensington Street / Montgomery Street intersection is forecast to operate at Level of Service F in the AM peak hour following the completion of the ASB development. This is largely the result of a lack of storage capacity on the departure side of the intersection for eastbound vehicles (i.e. Kensington Street east). On-street parking provided on Kensington Street, approximately 10m from the intersection, restricts the flow of vehicles travelling towards the Princes Highway.

To ameliorate the traffic impacts forecast at this location, it is proposed to provide additional storage capacity by extending the existing no stopping zone by approximately 30m on the northern side of Kensington Street (between Montgomery Street and Moorefield Lane) during peak hours. Implementation of these restrictions improves the operation of the intersection to Level of Service B (acceptable) following the ASB development. This improvement measure is illustrated in Figure 23 below.

Figure 23 Proposed Improvements – Kensington Street / Montgomery Street Intersection

4.8 Parking Impacts

4.8.1 Future Demand

Based on the anticipated level of hospital activity as outlined in Section 3.2, the parking demand generated by the ASB development has been forecast.

It has been assumed that, as a result of measures implemented by the hospital to encourage alternate modes of transport for staff (further described in section (iii)), 10% of staff, visitors and patients who currently drive to the campus will choose other modes of transport. This is applicable to daytime staff only, with staff arriving after hours to continue to primarily travel by car. This equates to a car mode split for staff of 78% and patients/visitors of 86%.

The anticipated level of parking generated by users of the ASB development is summarised below:

- 209 cars in total in 2018; and
- 349 cars in total in 2022

The above numbers include provision for both staff and public users. It is important to recognise however that the above numbers represent the *maximum* parking demand generated by the development, expected to occur at approximately 11am on a typical weekday. Over the course of the day however, the level of parking demand will fluctuate according to the arrival and departure patterns of staff, patients and visitors. This is illustrated in Figure 24 below.

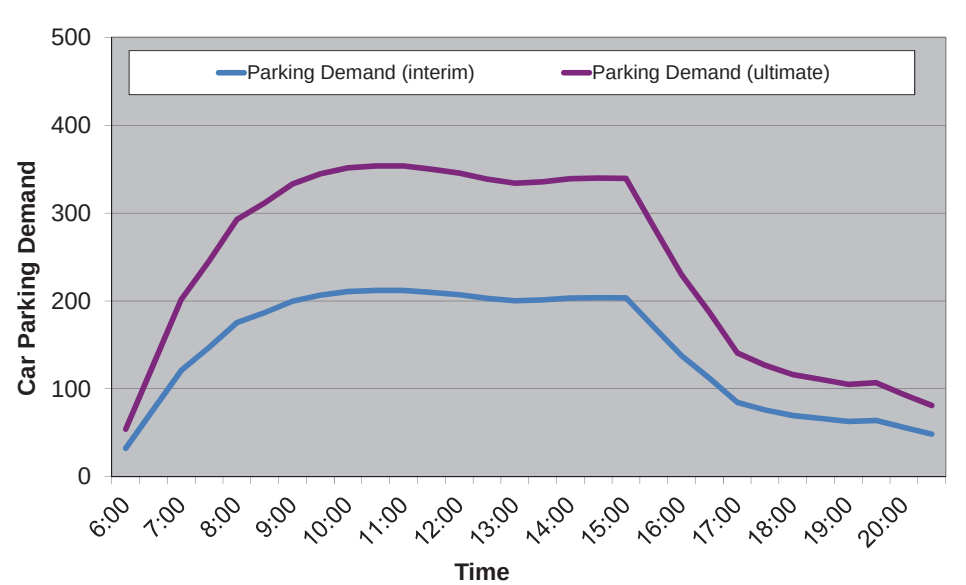

Figure 24 Forecast Car Parking Demand

4.8.2 Additional Supply

As the hospital campus grows and develops, additional parking will need to be provided to accommodate future users. A number of additional on-site parking opportunities will be provided for campus users which respond to the increased demands generated by the ASB development. These new parking opportunities are described below.

(i) Kensington Street At-Grade Car Park

In association with the demolition of the existing ED building on Kensington Street, a new at-grade car parking area is to be constructed. The proposed layout is shown below in Figure 25, and includes provision for 51 at-grade parking bays, comprised of:

- 39 ninety degree parking bays (5.4m * 2.6m);
- 10 sixty degree parking bays (6.0m * 3.0m); and
- 2 disabled parking bays (6.0m * 3.0m included shared area)

In addition, 3 parking bays will be allocated to patient transport vehicles.

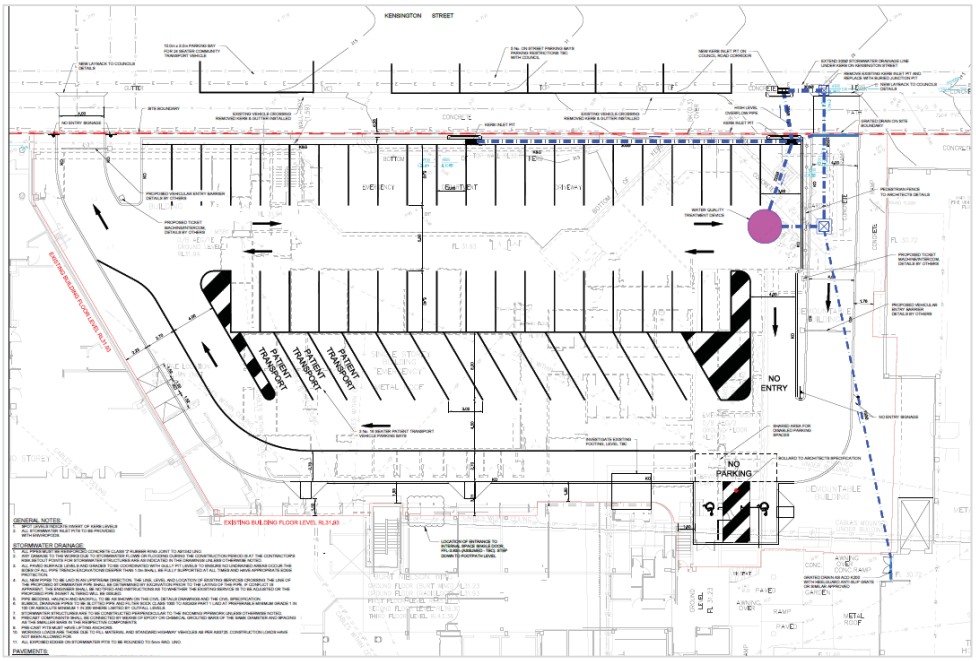

Figure 25 Kensington Street car park

(ii) Gray Street At-Grade Car Park

A reconfiguration of the Gray Street at-grade parking area is to be undertaken which will provide 32 parking bays (28 within the at-grade parking area and 4 in the ground floor of the multi-storey car park) for hospital users. This is an increase of 16 spaces relative to the current provision.

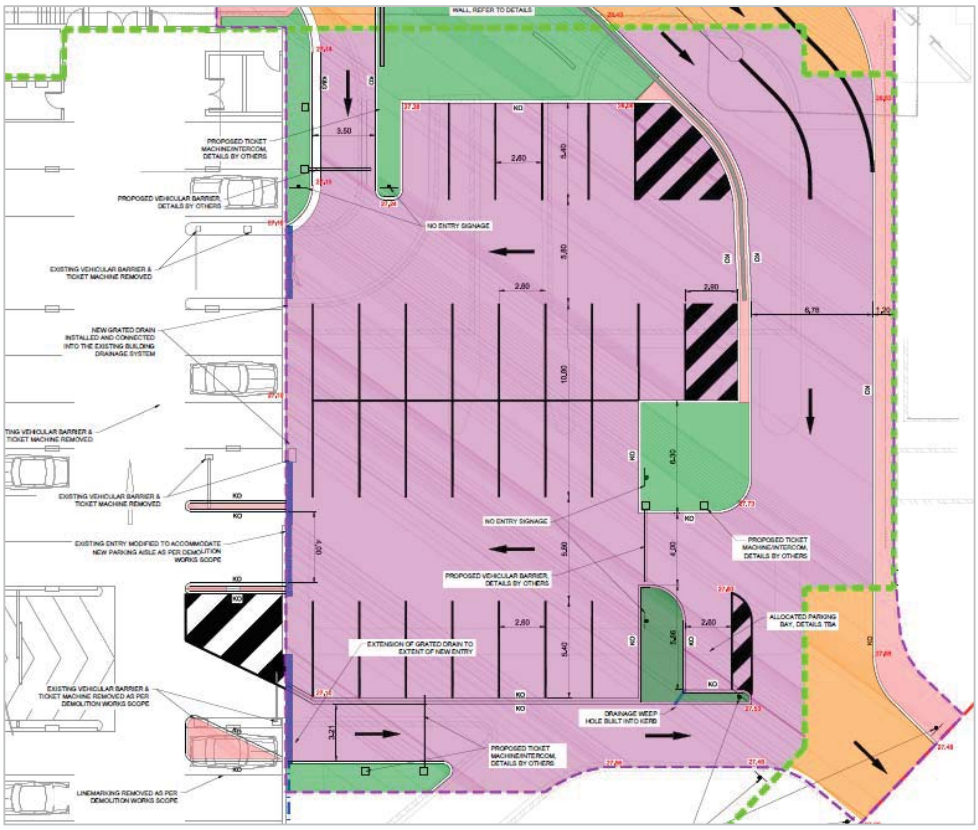

Figure 26 Gray Street At-Grade Car Park

(iii) Gray Street Multi-Storey Car Park

With the ASB development to include a rooftop helipad above the new Acute Services Building, an opportunity exists to add a further two levels of parking capacity to the existing Gray Street multi-storey car park. This will achieve an additional 136 parking bays over two levels.

A summary of the additional on-site parking to be provided is outlined in Table 8.

Table 8 Additional On-Site Parking

Parking Facility	Change in Parking Spaces
Kensington Street at-grade car park	51
Gray Street at-grade car park	16
Gray Street multi-storey car park	136
Total Additional On-Site Parking	***203***
Northern at-grade car park	-4*
Total Change in On-Site Parking	199

* Spaces lost as a result of the construction of north egress stairs for the ASB

4.8.3 Assessment

200 additional on-site parking spaces are to be provided on the St George Hospital campus. This level of supply is commensurate with the anticipated level of peak demand initially generated by the ASB development (209 spaces), up to the year 2022. From 2022 onwards, the forecast level of peak parking demand will exceed the on-site supply by 150 spaces. This is summarised in Table 9.

Table 9 Future Parking Demand vs Supply

Stage	Year	Peak Parking Demand	Additional Supply	Balance
Interim	2018 - 2022	209	199	-10
Ultimate	2022 onwards	349	199	- 150

Beyond the year 2022, an updated car parking strategy will need to be considered when the peak parking demand exceeds the on-site supply. This may be in the form of leasing off-site car parking areas in the vicinity of the hospital campus.

Another alternative would be for Health Infrastructure to provide additional parking infrastructure in association with a third party parking operator.

It is also important to note that, as identified in Section 2.5.2 of this report, there are currently 845 all day, unrestricted parking spaces unoccupied on streets within a 10 minute walk of the campus. The off-site parking balance of 146 spaces beyond the year 2022 represents only 15% of these presently unoccupied parking bays. Outside of peak periods, the parking requirements generated by hospital users reduce significantly as previously identified in Figure 24.

The key factor in mitigating the parking impacts arising from the proposed development is to encourage a greater use of public transport as a mode of access to the campus, particularly by staff. This is outlined further in Section 4.9.

4.9 Travel Demand Management Measures

To complement the parking and traffic strategy, a number of non-infrastructure measures are recommended to better manage staff parking. Management of staff parking is a major issue for hospital campuses across NSW. Staff travel surveys for St George Hospital staff indicate close to 90% choose to drive to the campus (despite the restricted availability on-site parking). Some of the key factors identified in the travel survey resulting in a high car mode share include:

- Staff working shifts which do not necessarily correlate with periods of good public transport availability.
- Afternoon and night shift staff in particular have concerns about safety and security when travelling to/from work in evenings and/or early morning.
- The reduction in direct train services stopping at Kogarah Station following the Sydney Trains timetable modification in October 2013
- Staff living in areas with poor public transport accessibility

The parking demand assessment completed for the ASB development has assumed a 10% reduction in private vehicle mode share as the traffic and parking environment surrounding the campus becomes more constrained in future years. However, there are further opportunities to reduce car dependency to encourage travel to the campus by alternative modes – taking particularly advantage of the site's close proximity to Kogarah rail and bus interchange. These travel demand measures complement the objectives of the NSW 2021 plan to develop an integrated transport system which ensures different transport modes work together so that the interests of the travelling public are put first.

4.9.1 Green Transport Plan

With the numerous transport options available to staff and visitors to access the site, St George Hospital could establish a green transport plan. A green transport plan is a package of measures introduced to promote the use of public transport, walking and cycling by patrons and employees for travel to and from work and for business related trips. Some specific measures that could be incorporated in this travel plan include:

- Public transport timetables and maps
- Key local walking and cycling routes
- Improvement of current website detailing transport options for both staff and patients
- Establishment of transport information packs to new staff explaining the various ways (other than motor vehicle) of travelling to the site
- Development of a travel plan booklet for staff and visitors
- Liaising with staff, either face to face or via email/telephone, providing them with advice where needed about travelling to work

Provision of good bus services, complemented with the implementation of a green travel plan will reduce the reliance on private vehicle for St George Hospital staff and patients.

Arup understands that the hospital is developing a Transport Access Guide to address the above the key recommendation for the development of a Green Transport Plan.

4.9.2 Car Pooling

Staff travel surveys indicate that only a small number of staff who drive to the site carry a passenger with them. Staff demographic information already indicates that a high proportion of staff already reside in the St George area, making the site conducive to potential car pooling programs. This could involve a simple poster on the noticeboard or staff intranet page where staff would register their interest in car pooling by indicating where they live and their shift times.

A website has recently been established (www.hospitalcarshare.com.au) which allows staff members at a number of hospitals across Victoria to connect with each other to encourage sharing a lift to work each day.

The hospital could actively promote car pooling through the creation of a designated parking area where car pool vehicles have a guaranteed space. The area would be controlled so that only car pooling staff can park there. Staff would have to register to a car pool scheme established by the hospital so that they receive a sticker identifying their car as a car pool vehicle.

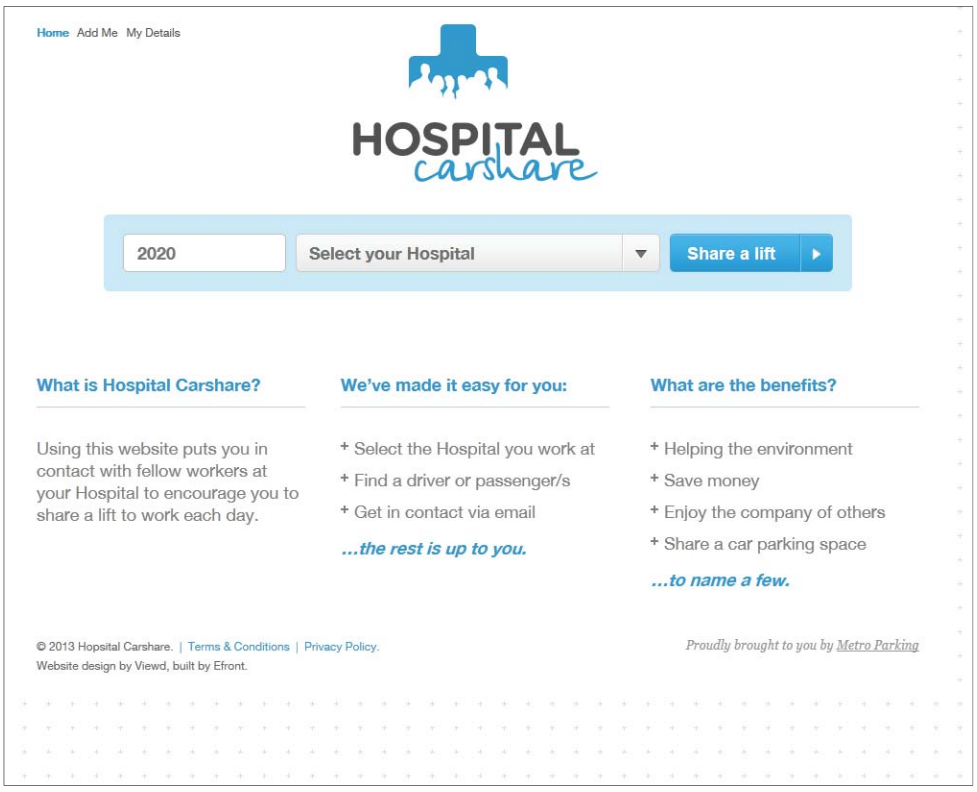

Figure 27 Hospital Car Share Website

4.9.3 Renting a Residential Car Space

Land uses within walking distance of the site are typically low to medium density residential dwellings. A communications exercise could be undertaken to local residents to gauge the potential for renting by staff of off-street residential car spaces. Some of these spaces may be vacant during working hours as residents drive their vehicles to other parts of Sydney for work – potentially suiting day shift and/or administration staff. In some circumstances these spaces may be available for longer periods (and therefore potentially attractive to afternoon shift staff).

4.9.4 Bicycle Parking and End of Trip Facilities

Only two respondents to the staff travel survey (0.3% of staff) noted that they arrive to the campus via bicycle. Presently a small number of dedicated secure bicycle parking, with associated end of trip facilities (change rooms, toilet and shower facilities) is provided on the campus on lower ground floor TWB. Provision of additional facilities may encourage some staff to alter their mode of travel from private vehicle to bicycle. There may be the potential to make use of vacated areas within the existing hospital building (once the ASB is operational) and convert these to dedicated bicycle storage areas with complementary end of trip facilities.

No dedicated cycling paths (on road or off road) are located in the immediate vicinity of the campus. This currently acts as a barrier to increased use of cycling as a mode of transport, particularly by staff. The hospital is working with Kogarah Council to investigate opportunities to provide dedicated cycle facilities connecting to the campus. An appropriate route would run along Railway Parade and Montgomery Street, providing a connection between the campus and the newly constructed bicycle route (by Rockdale Council) on Rockdale Plaza Drive.

4.9.5 Promotion of Public Transport

Despite being located within close walking distance of Kogarah rail and bus interchange, less than 6% of staff currently travel by public transport to the campus. Key reasons for this low public transport mode share, identified by staff in the travel survey, include:

- The reduction in direct train services stopping at Kogarah Station following the Sydney Trains timetable modification in October 2013;
- Takes longer by public transport compared with private vehicle; and
- There is no direct public transport route to/from the hospital

Despite these barriers, there is considered significant scope to increase the proportion of staff travelling to the campus by public transport – particularly administration staff and those working day shifts.

Potential measures that could be introduced to promote greater public transport usage by staff include commencing discussions with Transport for NSW to once again provide direct, express train services to Kogarah Station. The timetable changes implemented in October 2013 reduced the accessibility of Kogarah Station. While train services are still provided at 10 minute frequencies during the AM and PM peak hours, passengers are now required to change at either Hurstville or Wolli Creek and travel on an all stops service to Kogarah. Previous train services ran express from Central through Redfern, Sydenham, Wolli Creek, Rockdale and Kogarah. A number of hospital staff noted in the travel survey that they no longer travel by train to the campus for this reason.

Arup understands that the Minister for Health is in dialogue with the Minister for Transport to bring forward the promotion of Public Transport by staff and visitors to the hospital.

4.10 Construction Traffic Management

The following section provides an assessment of the construction traffic impacts associated with the development.

4.10.1 Construction Programme

Construction activities are estimated to occur over a two year period. The project is in its preliminary stages however, hence this timeframe will be updated once a Principal Contractor is appointed.

4.10.2 Construction Traffic Routes

Construction vehicles would be restricted the state road network and vehicles will likely originate from this network, with movements along local streets prohibited. It is envisaged the key traffic routes for construction vehicles would be via the Princes Highway, President Avenue and Rocky Point Road. Gray Street and Kensington Street would form the local access roads. This is shown in Figure 28.

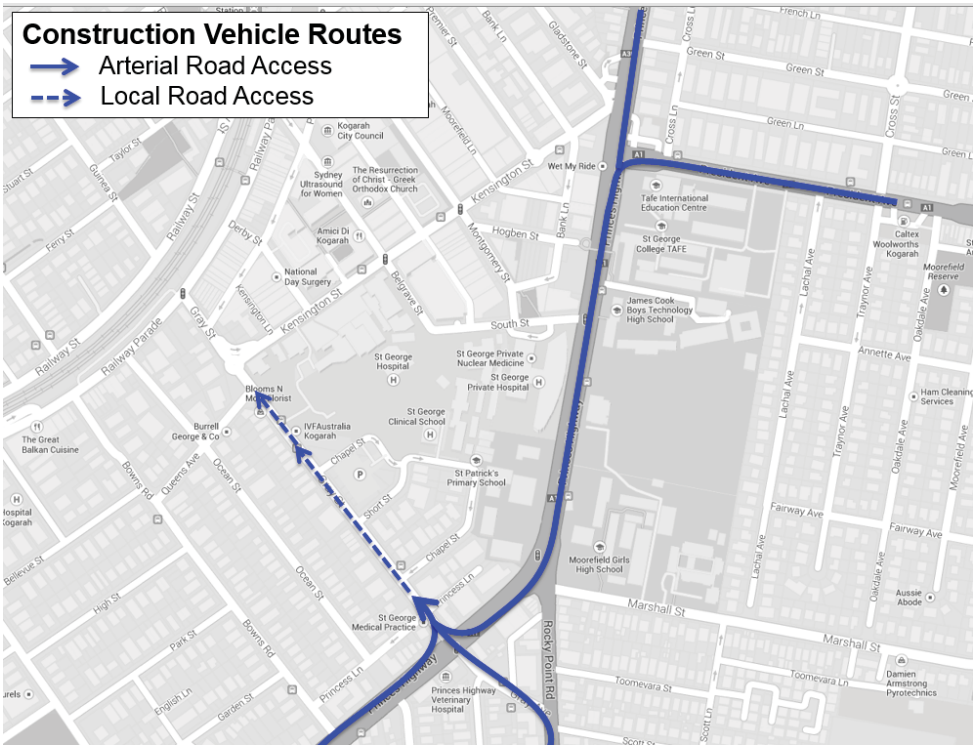

Figure 28 Construction Vehicle Access Routes

Heavy vehicles including Articulated Vehicles (AV) such as precast delivery trucks and Heavy Rigid (HR) such as concrete trucks are expected to access the site. These different types of vehicles may access the site at the same time. Other heavy machinery plants such as cranes will be delivered to site in the early stages of site establishment. All heavy goods such as girders or machinery plants are likely to be delivered outside of peak traffic hours.

4.10.3 Construction Traffic

Workers will generate additional traffic to the site. Road network impacts will be mitigated by the fact that construction workers generally start earlier and finish earlier than the commuter peak periods, and would likely not coincide with the hospital peak periods. Construction workers driving to sites in constrained parking environments such as at St George Hospital typically carpool – further reducing the impact on the road network. The good availability of public transport in the precinct, with Kogarah railway station close walking distance, will encourage workers to minimise private vehicle use which will further reduce the impacts on the local road network.

The impact of construction traffic will be further developed once a Principal Contractor has been appointed, however volumes are expected to be low and in the order of 100 vehicles per day. The traffic generation of this magnitude is less than the amount of trips generated and assessed for the operational phase of the development and therefore the potential temporary impacts are anticipated to be minimal.

4.10.4 Parking

Minimal (if any) on-site parking will be provided for construction traffic due to physical site constraints for amenities, scaffolding and materials handling. Off-street parking opportunities in the area have previously been identified in Section 2.5 of this report.

4.10.5 Driver Code of Conduct

Traffic Controllers will be used to stop traffic on the public street(s) to allow trucks to enter or leave the site. Where possible, vehicles must enter and exit the site in a forward direction. They must wait until a suitable gap in traffic allows them to assist trucks to enter or exit the site. The Roads Act does not give any special treatment to trucks leaving a construction site - the vehicles already on the road have right-of-way. Vehicles entering, exiting and driving around the site will be required to give way to pedestrians at all times.

4.10.6 Construction traffic provisions made for emergency vehicles, heavy vehicles, cyclists and pedestrians

Construction works and vehicle storage would be mainly confined to the site. As such, no additional specific provisions for emergency vehicles, heavy vehicles, cyclists or pedestrians have been identified on the surrounding road network. Access for ambulance vehicles to the new ED building will be maintained at all times throughout the construction period.

4.10.7 Measures to ameliorate impacts

Mitigation measures would be adopted during the construction phase to ensure traffic movements have minimal impact on surrounding land uses and the community in general, and would include the following:

- Truck loads would be covered during transportation off-site
- Establishment and enforcement of appropriate on-site vehicle speed limits (20km/h), which would be reviewed depending on weather conditions or safety requirements
- Neighbouring properties would be notified of construction works and timing. Any comments would be recorded and taken into consideration when planning construction activities.
- All activities, including the delivery of materials would not impede traffic flow along local roads
- Materials would be delivered and spoil removed during standard construction hours
- Avoid idling trucks alongside sensitive receivers
- Deliveries would be planned to ensure a consistent and minimal number of trucks arriving at site at any one time

4.10.8 Construction Traffic Management Plan

Prior to the commencement of construction, a Construction Traffic Management Plan (CTMP) is to be prepared by the Principal Contractor to ensure the safest possible management of construction access. The CMTP would address:

- The likely construction vehicle numbers and frequency;
- Vehicle approach and departure routes;
- Anticipated special out of hours or escorted deliveries;
- Parking access arrangements during construction; and
- Provision of acceptable pedestrian management measures.

5 Summary

This report outlines the traffic and transport impacts of changes proposed as part of the St George Hospital ASB development. The study addresses the following key elements arising from the proposed development:

- Site access;
- Road network operations;
- Public transport access;
- Traffic generation;
- On-Site parking;
- Public transport;
- Pedestrian network; and
- Travel demand management measures

The proposed redevelopment generally has a positive impact on pedestrians by providing a new pedestrian through site link, facilitating a legible internal connection between Kensington Street and the main hospital entrance. This new connection will reduce walking times and distances between the campus and Kogarah railway station – improving the attractiveness of public transport as a mode of travel to the site.

Traffic modelling which considers impacts arising from the proposed development demonstrates little difference in the road network performance due to the traffic increases arising from the proposed ASB development. Changes in vehicle delays are forecast to be relatively minor in both the AM and PM commuter peak hours.

The performance of the Kensington Street / Montgomery Street intersection is forecast to deteriorate following the proposed development. To ameliorate the traffic impacts forecast at this location, it is proposed to provide additional capacity by extending the existing no stopping zone by approximately 30m on the northern side of Kensington Street (between Montgomery Street and Moorefield Lane) during peak hours.

The anticipated level of parking generated by users of the ASB development is expected to be 209 cars in 2018 and 349 cars in 2022. To meet this demand, 199 additional on-site parking spaces are to be provided on the St George Hospital campus. This level of supply is commensurate with the anticipated level of peak demand initially generated by the ASB development, up to the year 2022. Beyond 2022, the forecast level of peak parking demand will exceed the on-site supply. An updated parking strategy will need to be considered when the peak parking demand exceeds the on-site supply.

To complement the parking and traffic strategy, a number of travel demand management measures are recommended to better manage staff parking. This includes development of a green travel plan, encouragement of car pooling by staff, bicycle parking and promotion of public transport.

In summary, it is considered that the transport impacts arising from the proposed works can be appropriately managed.