Traffic and Transport Impact Assessment

North Eveleigh Development

April, 2008

Redfern Waterloo Authority

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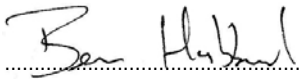
Signed:  .....

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Executive summary

The Redfern-Waterloo Authority (RWA) set out its proposal for the redevelopment of the former rail yards at North Eveleigh in its Preliminary Environmental Assessment Report which was prepared under Part Part 3(A) of the Planning Act. The proposal provides for a high quality residential, retail and commercial development at the eastern portion of the site; a new residential development at the western end and provision for additional floor space in the existing Carriage Workshop and Blacksmiths Shop in the centre of the site.

The Director-General Requirements which were issued in response to the Application stipulates that a Traffic Impact Assessment (TIA) is to be prepared for the Environmental Assessment Report. The TIA is to consider the cumulative traffic impacts of RWA's North Eveleigh development; the University of Sydney's Business School expansion and upgrade proposed for the Abercrombie precinct, as well as RTA 's forecast future traffic growth.

PB has worked closely with the North Eveleigh project team to ensure that all roadways and intersections within the site, and any access to the site, can be constructed to meet with City of Sydney Council's design standards. Particular attention has been paid to ensure that motorists and pedestrians have good line of sight at the access points and that all traffic is able to leave the site in a forward direction. Other traffic designs have been checked to ensure traffic is able to circulate unimpeded through the site, that suitable provision have been made for turning heavy vehicles on internal roads and that routes for articulated truck movements and loading bays have sufficient capacity.

RWA and the University of Sydney jointly appointed PB to develop a micro-simulation model (Paramics) to test current and future traffic conditions. The model simulated traffic performance of roads and intersections in the vicinity of the proposed developments with and without the two developments.

The proposal at North Eveleigh seeks approval for the following elements, the traffic aspects of which are discussed within the report:

- use of the Western section of the site for residential purposes
- use of the Eastern section of the site for Residential, Commercial, Community and Retail purposes
- additional commercial/cultural floor space within the central portion of the site, including 12,000m^2 for the Carriage Workshop and 1,000m^2 for the Blacksmiths' Shop.
- modification of the existing access at the western end of the site to Wilson Street, between Forbes and Golden Grove, to improve line of sight for all road users and to provide for full movement by all vehicles expected to use this access, including articulated vehicles
- modification to the existing roundabout at the intersection of Wilson Street and Shepherd Street to accommodate an access into the site on its south and provide for straight through, right in, left out movements from Wilson Street and Shepherd Street for articulated vehicles and full movement for all other vehicles likely to use this intersection.

The remaining summary has been structured to relate to traffic and transport aspects of the requirements issued by the Director-General of Planning (shown in bold).

Traffic generation including daily and various peak traffic movements, determining and identifying modal split targets for peak periods, and the increase in the level and type of traffic associated with the proposal.

The TIA is based on the approach outlined in RTA's *Guide to Traffic Generating Developments*. RTA suggested rates were discounted to account for the excellent level and coverage of transit and proximity to the major rail and bus hub at Redfern Station and the short travel distances suitable for walking and cycling travel. The resultant traffic increases are discussed in Section 4.2 of this report, which also sets out PB's assumptions on traffic mix and how this traffic would be distributed.

Impacts and resultant upgrades to street parking, the road network including laneways, arterial roads, intersections, signage and road capacity resulting from the project; cumulative impacts of adjoining and adjacent developments, where appropriate

PB developed a cumulative traffic model for future year 2016 to study the likely level of service at all intersections within the study area.

In its development of the model PB identified that the following intersection improvements would be required in order for traffic model, and therefore the road system, to function appropriately:

- Abercrombie Street and Lawson Street. The proposed improvements provide extended turning lanes for left and right turning traffic into and out of Abercrombie Street and changes to signal phasing and timings

- Cleveland Street and Shepherd Street. Improvements works include extending the existing right turning bay from 30 to 70m and extending the cycle time for those turns

- Abercrombie and Shepherd Street. Replacing the scramble phase with normal pedestrian staging and adjusting signal timings is intended from 60 seconds all day to 70 seconds in the AM and 80 seconds in the PM.

These improvements, and the expected traffic growth of 0.9 percent per year, established the 2016 Future Base Case. Additional traffic growth from the North Eveleigh and Abercrombie Precinct (Sydney University) developments established the Future 2016 with developments Case.

The traffic model identified that with the developments, additional intersection improvements would be required at the Shepherd and Abercrombie intersection. The suggested adjustment consisted of extending the signal timings for the intersection to 90 seconds. With these improvements undertaken the intersection is expected function at a Level of Service of B, considered Good with acceptable delays and spare capacity.

The lowest peak hour performance in 2016 would be level of service of C, considered Satisfactory, at the three intersections of Cleveland Street with City Road, Abercrombie and Shepherd Streets. It is expected that these intersections would have sufficient capacity to perform at urban standards for years beyond 2016 with the above intersection improvements undertaken.

The loss of on-street parking as a result of the implementation of the intersection improvement works and from the provision of the new access for the North Eveleigh development is expected to be minimal and will be exceeded by increased opportunities for kerbside parking within the North Eveleigh development.

Measures to be implemented to mitigate any impacts identified

Improvements to intersections, as follows, would need to be undertaken prior to completion of both developments:

- Abercrombie Street and Lawson Street. The proposed improvements provide extended turning lanes for left and right turning traffic into and out of Abercrombie Street and changes to signal phasing and timings

- Cleveland Street and Shepherd Street. Improvements works include extending the existing right turning bay from 30 to 70m and extending the cycle time for those turns

- Abercrombie and Shepherd Street. Replacing the scramble phase and adjusting signal timings is intended from 60 seconds all day to 90 seconds. Alternatively, additional turning lanes could be introduced at the expense of on street car parking.

With these works undertaken all intersection would function at acceptable levels.

The loss of on-street car parking spaces at Wilson Street will be augmented by the provision of spaces on public thoroughfares within the development. Notwithstanding, consideration should be given by Council to restricting car parking spaces to ¼ P outside the shops near the intersection of Shepherd and Abercrombie Streets to better manage parking turnover at this location and ensure customer access. Details of measures to be undertaken to mitigate impacts are discussed in Section 6.1.

Any required upgrading of roads and improvement works to ameliorate impacts associated with the development and the proposed source of associated funding

Provision for access to the eastern end of the North Eveleigh site will require a new southern access to the roundabout at Wilson and Shepherd Streets. The roundabout will need to be enlarged to accommodate the right turning movement of articulated trucks or semi trailers. The Concept Plan provides space for the improvements to be undertaken within the subject site. These works will be funded by the North Eveleigh site developer.

Improvements to intersection works required due to the developments will be funded at a rate of 90% by the North Eveleigh developer and 10% by the Abercrombie Precinct developer.

- ***Cumulative impacts on the local and subregional area including the future development by University of Sydney, and develop a traffic netork model to determine impact(s)***

To assess the likely impacts of both developments on the subregional road network, PB developed a micro-simulation model using the Paramics software suite with RTA-developed add-ins tailored to traffic conditions in metropolitan Sydney. The area of the model extended to the State road network surrounding the site (Gibbons Street, Cleveland Street and City Road). Refer to Figure 4-1 in the traffic report. The development of the model and its assumptions are discussed in Section 4 of the traffic report.

Details of public transport accessibility and strategies to encourage public transport patronage, including pedestrian and cyclist flows, links to Redfern Railway Station and the future bridge link, connections to existing cycle network(s)

The strategies to manage growth in car travel to the site are set out in the draft Traffic and Transport Context Report for the Built Environment Plan. North Eveleigh is situated in close proximity to Redfern Railway Station, which connects to most of the rail network and is a major transit hub. Two major bus service corridors operate nearby, in City Road and in the one-way pair of Gibbons and Regent Streets. The latter is a strategic bus corridor between Miranda and the CBD, via the Airport and Green Square. Details of public transport provision are contained in Section 2.5.

Wilson Street is a major cycle route, which will be enhanced by the proposed pedestrian and cycle bridge to be built over the railway tracks linking Redfern Station and the Town Centre to Darlington and North Eveleigh (See section 6.3). The bridge (by separate application) is proposed to be a full sized shared path (4 m wide) and it will provide a direct route that avoids the narrow and heavily congested section at the Station entrance/exit to Lawson Street. Access for cycles to and from the North Eveleigh site will be provided through ramps at key locations.

Details of provisions for service and delivery vehicles movements / loading

PB has worked closely with the Concept Plan team to ensure deliveries and servicing of the site can be carried out efficiently. The site is not expected to generate significant heavy vehicle movements, and the proportion of heavy vehicles in local traffic is unlikely to change. Two articulated vehicle routes within the site have been identified. To the west of the site, a route using the proposed main east/west access and a service road to the rear of the site will provide a through route for deliveries to the CarriageWorks without the need to turn trucks. The east end of the site is served by the internal roads leading to a loading and manoeuvring zone designed to turn articulated vehicles. Truck routes to the site have also been identified and are detailed in Section 5.4.3. Turning facilities have been designed at the ends of roads and tested using the Autotrack software package to demonstrate their capacity.

Vehicular access, car parking and bicycle arrangements, and details proposed access points, parking spaces including compliance with relevant parking code(s)

Parking arrangements within the site are based on the earlier draft Traffic and Transport Context report and are intended to manage growth in car travel (refer Section 6.8). Parking provision is based on rates taken from the City of Sydney Local Environment Plan and the former South Sydney Development Control Plan 11. A transit mode share of 60% across the site is nominated due to its proximity to public transport, the nature of landuses and the proposed density intended for the site. Parking is to be predominantly provided in basement car parks associated with each building. The design of these car parks accords with Australian Standards. The car parks serving commercial land uses will include parking for disabled drivers and cycle facilities that meet or exceed the DCPs.

The site is proposed to have two accesses to Wilson Street. Improvements are proposed at both accesses, which include enlarging the existing roundabout at Wilson and Shepherd Streets, along with the widening and line of sight improvements to the existing western access to the site. The existing barrier free pedestrian access at Codrington and Wilson Streets will also serve this expanded development.

The studies undertaken by PB have assumed that the total parking provision on the North Eveleigh site would be approximately 2000 spaces.

Parking is currently proposed to be allocated as follows:

Number of Dwellings	Dwelling Type	Car Parking Rate	Number Provided
111	Studio	0.25	28
391	1 bed	0.50	196
571	2 bed	1.20	685
185	3 bed	2.00	370
Other			
53,280m^2	Commercial, Retail and Cultural use	0.008/m^2	426
31,468m^2	Commercial/Cultural (CarriageWorks)	0.006m^2	187.
3,120m^2	Car Park (Blacksmiths)		51
Total			**1,943**

A proportion of these spaces would be provided for visitor car parking.

The site provides good cycle provision on its internal roads and is intended to connect with the City of Sydney cycle network along Wilson Street and via the new bridge to Redfern Street and the city. Pedestrian and cycle routes and facility improvements were also considered and are discussed in Section 6.4 of this report.

Details of adequate emergency vehicle access

In developing the concept plan, PB ensured that satisfactory access to the site for emergency services was designed. The site avoids using traffic management features that would restrict full access. The road layout and two access points make the site permeable. There is direct road frontage to every building within the development. Turning facilities have been included within the design so that all standard fire and other emergency vehicles could manoeuvre quickly and safely.

1. Introduction

1.1 Overview of proposal

Redfern-Waterloo Authority (RWA) has prepared a Concept Plan for the redevelopment of the former railway yards at North Eveleigh. *Figure 1-1* shows the Concept Plan layout for the site. The proposal provides a mix of high quality residential, commercial, cultural and retail spaces supported by the necessary roads, footways and transport infrastructure.

The rail activities on the site peaked in the first half of last century, and much of the site has not been generating traffic as it had in the past. The Victorian street and housing environment in the surrounding area has seen gradual change over time, but currently there are significant investment and refurbishment proposals in the vicinity. As well as the RWA proposals for North Eveleigh, the University of Sydney is proposing an upgrade of its properties in Darlington, and both of these projects are served by the same local street network. The arterial roads serving the area are also serving nearby developments such as the Kent Brewery and Australian Technology Park. However, this is an inner-urban site with many travel options and potential travel choices.

The RWA proposals can broadly be divided into 3 areas: a predominantly residential area to the west of the Carriage Workshop; the CarriageWorks performing arts centre (developed previously) and Blacksmiths' Workshop; and a mixed use area including residential, commercial and retail to the east and immediately adjacent to Redfern Station.

The eastern end of the development is proposed to be mostly commercial and retail, which would provide a density of employment close to Redfern Railway Station where it should attract the highest potential use of public transport for commuter and business-related travel. The western end of the site is proposed to be predominantly residential. Residents are prepared to walk further to a rail interchange, however, the western part of the site will still benefit from good linkages to public transport in the King Street Bus Corridor and at Redfern Station.

The development, bounded by Wilson Street to the north and the main interstate rail lines to the south, features several large and historically significant buildings, including the Carriage Workshop and the Paint Shop, industrial buildings associated with the former Rail Yard use. The location of the historic buildings, along with the grade difference between Wilson Street and ground level on the site, has influenced the alignment of the internal road network.

The development has two proposed access points to Wilson Street. To serve traffic to the east of the site, and truck traffic to the retail space within the Paint Shop, an access is proposed at the roundabout at Wilson Street and Shepherd Street, making this a 4-way intersection. The western section of the site, and low volume truck traffic for the Carriage Works Centre, is proposed to be served by the current access at Wilson Street, between the Queen Street and Forbes Street intersections.

1.2 Application for approval

The application seeks approval for the following elements which constitute the development and associated road works for the project:

- use of the Western section of the site for residential purposes
- use of the Eastern section of the site for Residential, Commercial, Community and Retail purposes
- additional commercial/cultural floor space within the central portion of the site, including 12,000m^2 for the Carriage Workshop and 1,000m^2 for the Blacksmiths' Shop.
- modification of the existing access at the western end of the site to Wilson Street, between Forbes and Golden Grove, to improve line of sight for all road users and to provide for full movement by all vehicles expected to use this access, including articulated vehicles
- modification to the existing roundabout at the intersection of Wilson Street and Shepherd Street to accommodate an access into the site on its south and provide for straight through, right in, left out movements from Wilson Street and Shepherd Street for articulated vehicles and full movement for all other vehicles likely to use this intersection.

1.3 Highway and traffic design standards

PB worked closely with the project team throughout the development of the proposal to ensure that all roadways, loading bays, loading docks, turning facilities, facilities for parking, cycling and walking all meet or exceed the minimum standards set out by Council, Australian Standards or other appropriate design guidance.

Sketch plans for both accesses are included within section 5.3, these sketches indicate the extents of land required to provide accesses of a standard suitable for future adoption by Council as local roads. The accesses have been designed to provide sufficient forward visibility for a 50kph road and the capacity to accommodate articulated vehicles, this being the maximum size of vehicle expected and the maximum size of vehicle the surrounding network can accommodate.

PB was also involved with determining the parking control standards to be applied and ensuring car parking for the site would meet demand without encouraging car use or creating parking overspill onto neighbouring roads, particularly Wilson Street.

PB considers that the proposal provides sufficient parking and land to provide roadways, footways, turning facilities an other highway infrastructure needed to meet the standards required by Council for the future adoption of the road and to provide a good level of amenity for all road users including emergency services, waste disposal vehicles, cyclists, pedestrians and disabled drivers.

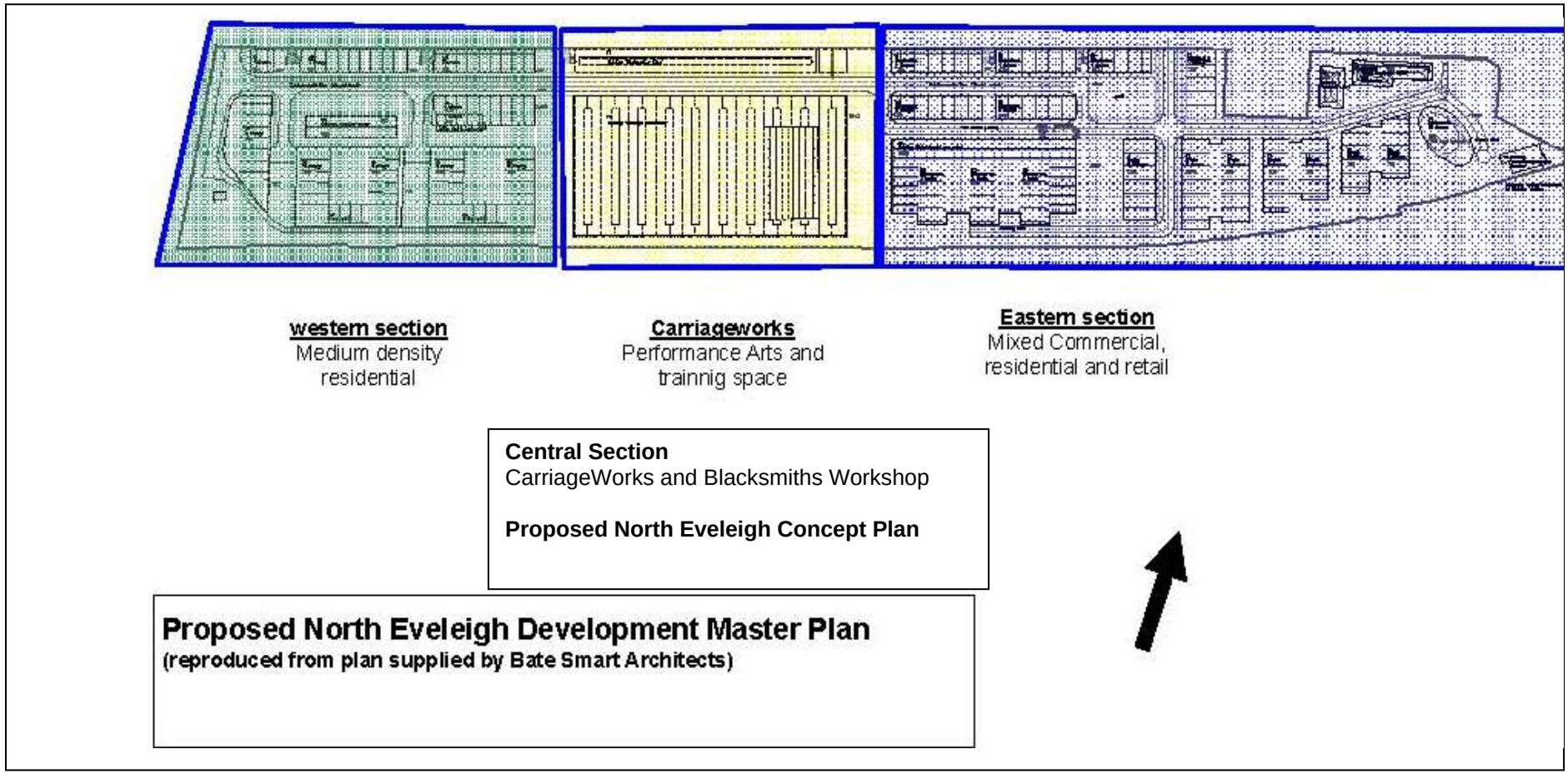


Figure 1-1 North Eveleigh Concept Plan

1.4 Study objectives

This report sets out to investigate what traffic impacts that the development of the North Eveleigh former rail yards may generate, and how they should be treated so the project can be accommodated within the locality without inappropriate environmental or social impact. The study outlines the traffic and transport issues that will arise and need to be addressed as part of the development of this site; describes the strategies for encouraging public transport, managing freight, providing for emergency service vehicle access and promoting cycle and pedestrian use. It also addresses the Director-General's requirements as they relate to traffic and transport matters.

1.4.1 Objectives of Redfern Waterloo Authority

Redfern-Waterloo Authority's objectives for transport are set out in the Built Environment Plan and the traffic and transport context report previously prepared by PB. Broadly, the objectives of the Redfern-Waterloo Authority are to provide a sustainable development in line with the amended SEPP (Major Projects) for the RWA Strategic Sites. The sustainable objectives have been set out in detail in previous reports and are summarised here:

To improve the economic viability of the area - by encouraging high quality developments where retail, commercial and cultural developments can provide employment for local residents and the wider metropolitan area. The focus on providing local jobs close to major transport hubs will reduce trip numbers and duration and encourage greater inward investment in the community and local places and spaces.

To achieve an improved social and cultural environment – by providing an urban density that encourages the use of public transport and walking and cycling; provides choice and affordability of housing; focuses on increasing local activity and interest; fosters retail and employment opportunities; provides a safe and secure environment and reactivates areas that are currently underutilised and degraded.

To achieve an improved physical environment – by providing a high quality built form and civic spaces that provide best practice solutions for energy, water consumption and waste management. Private car use equates to approximately a quarter of the current energy demand so a key focus will be the promotion of public transit, cycling and walking. Transport and traffic strategies will need to plan infrastructure to make transit use more attractive, and work with service providers to ensure service levels are maintained at attractive levels. A direct, safe and accessible pedestrian network is critical.

To achieve a strong governance structure - the draft BEP is supported by a SEPP which will provide the guidelines for future development, and the initiatives of the Human Services Plan and the Employment and Enterprise Plan. On-going governance will be needed to maintain excellence in transit management. An outcome may be delegation to a local transport agency to promote use of non-vehicular modes through direct action and perhaps through service levels.

1.4.2 Director-General's requirements

A preliminary Part 3(a) application was submitted by Redfern-Waterloo Authority to the Director-General for Planning. This set out the context for the redevelopment of the North Eveleigh former rail repair and maintenance yards in Darlington. The preliminary application broadly demonstrated that the land, surrounding road network and infrastructure had the capacity to accommodate this development. Following on from the preliminary application, the Director-General for Planning required that an Environmental Assessment (EA) be included with the Development Application along with a Traffic Impact Study. The Traffic Impact Study was to be prepared in accord with the RTA's *Guide to Traffic Generating Developments* and was to include:

- traffic generation by the site and how this is distributed to the accesses
- impacts on the road network and on-street parking and any mitigating measures and amelioration resulting from the site
- the cumulative impacts, examined using a micro simulation model, of developing the North Eveleigh rail yards and the University site at Abercrombie precinct
- measures to mitigate the cumulative impacts
- details of a transport strategy to encourage public transport use and walking and cycling
- details on provisions for vehicular access, heavy vehicle manouevering, and access for emergency services and waste disposal
- details of facilities for pedestrians and cyclists, including the proposed new pedestrian link to Redfern Town Centre, via the Station and across the rail lines.

A copy of the Director General's Requirements (DGR's) is included in Appendix A.

1.5 Study process

PB has had a long involvement in this area of complex traffic movements. This now extends to almost 10 years of working in the area. This study follows from work undertaken by PB for the CarriageWorks performance arts development for the Arts Ministry, then for RWA which defined the traffic and transit context for the study area as it relates to the RWA built environment strategy. PB was also engaged in preparatory work for the preliminary DA for the North Eveleigh site from which this project is derived.

The core of this investigation was the development of a local area traffic simulation model which was then available to be used to assess the current and future road network performance and impacts with, and without, other developments proposed in the local area. The work-flow diagram, *Figure 1-2,* shows the key tasks undertaken to complete this study.

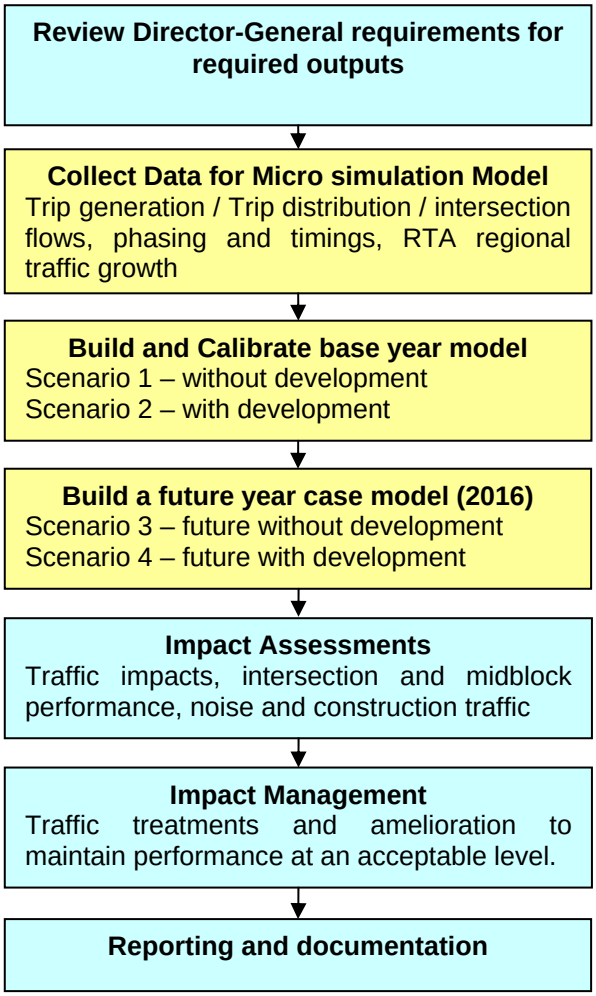


Figure 1-2 Flow diagram showing key task stages

1.6 Scope of report

This report documents the methodology and findings of an investigation by traffic simulation modelling undertaken by PB for Redfern-Waterloo Authority and the University of Sydney to understand the likely cumulative effects on traffic and transit resulting from the development of the North Eveleigh site and the redevelopment of Abercrombie precinct.

To understand the likely impacts on traffic and transit, and to meet the requirements set out by the Director-General of Planning, PB constructed a traffic micro-simulation model for the Darlington Area using the modelling software package Paramics V5.2. A future case model for the year 2016 was created, and this has been used to review future intersection and midblock performance.

This report has been prepared specifically for Redfern-Waterloo Authority for inclusion with its Concept Plan Application for North Eveleigh. However, much of the content particularly Chapters 2 and 3 are common to both sites. The report is organised into Chapters as follows:

Chapter 1: *Introduction* describes the background to the proposal and the objectives and process of this study

Chapter 2: *Existing traffic and road network* describes existing traffic flows and patterns, including general origin and destination, truck movement and accident history.

Chapter 3: *Cumulative traffic model for Darlington* describes the modelling process, assumptions, calibration and results

Chapter 4: *Impact Assessment* describes the likely impacts of the proposed development on traffic and transit during and after construction.

Chapter 5: *Management of impacts* describes measures to minimise and mitigate the cumulative effects of development

Chapter 6: *Main findings* summarises the findings and draws out the key points and how these are to be addressed by the proposal

1.7 Relationship between key stakeholders

The redevelopment of the former rail yards at North Eveleigh was a strategic site under SEPP 26 for which the Minister of Planning is the consent authority under part 3(a) of the Environmental Planning Act. The key stakeholders and roles are outlined here:

Redfern-Waterloo Authority, the planning authority for the Redfern and Waterloo Administrative Area. The authority was set up by State primarily to manage the redevelopment of former state lands and to oversee a sustainable improvement in the locality. RWA is the proponent of the Concept Plan.

City of Sydney provides the local civic services for the Redfern Waterloo area, excluding planning, and manages the local road network, footways and associated transit infrastructure.

Department of Planning is the assessing authority for the Part 3(a) application. The Department coordinates all Part 3A applications in tranches and issues Director General Requirements for Part 3(a) Applications. The DGR's for the North Eveleigh site are set out in section 1.4.2 and in Appendix A.

NSW Roads and Traffic Authority is the principal authority with responsibility for ensuring the safety and effectiveness of the highway. The RTA is primarily concerned with the management of State and Regional roads with responsibility for local roads delegated to Local Authorities. RTA is a key agency for consultation in the DA process.

2. Existing traffic and road network

2.1 Location and recent developments

The North Eveleigh development site is located on the former North Eveleigh Railway yards. It is located on the northern side of the main rail corridor into Sydney close to Redfern Station; *Figure 2-1* shows the location of the site and the location of the Darlington precinct site. The figure also shows other recent developments in the locality.

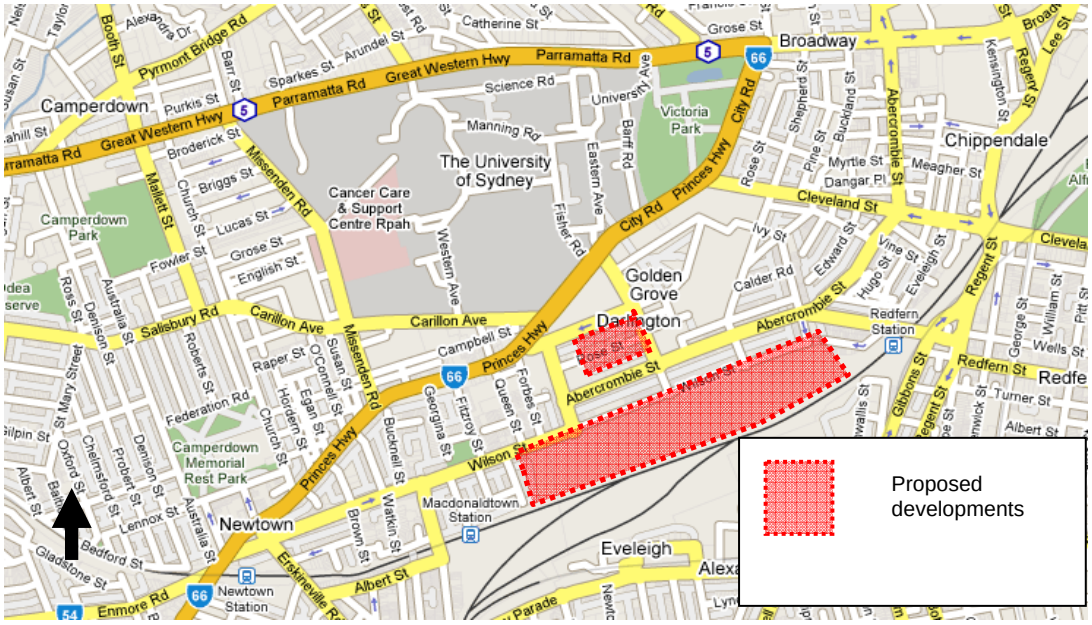


Figure 2-1 Location of development sites

2.2 Road network hierarchy

Roads within a network are classified according to a road hierarchy relating closely to their functional role within the road network and the volume of traffic they carry. The Roads and Traffic Authority (RTA) has defined four classes within the hierarchy of roads:

Arterial Roads – predominately carry through traffic from one region to another forming the principal avenues for urban traffic movements. Typically traffic volumes would be in excess of 15,000 vehicles per day (vpd);

Sub-arterial Roads – connect the arterial roads to areas of development or carry traffic directly from one part of a region to another, they may also relieve traffic on arterial roads in some circumstances. Typically traffic volumes would range from 5,000 vpd to 20,000 vpd;

Collector Roads – connect the sub-arterial roads to the local road system in developed areas. Typically traffic volumes would be in the range from 2,000 vpd to 10,000 vpd, but residential amenity would begin to decline with volumes in excess of 5,000 vpd;

Local Roads – are the sub-divisional roads within a particular developed area. These are used solely to provide local access, and typically carry low volumes, usually less than 2,000 vpd.

The existing road network in the study includes Regent Street, Gibbons Street, Cleveland Street, Lawson Street, Abercrombie Street, Shepherd Street, Wilson Street, Forbes Street, Golden Grove Street and Ivy Street. A road network hierarchy has not been defined by Council for this area of Sydney, however, applying the hierarchy criteria a de facto road hierarchy can be assumed, as shown in *Figure 2-2*. This hierarchy is derived from the measured traffic volumes as they relate to the RTA classification. There is a separate classification of roads which relates not to use, but to responsibility. State roads are usually the high order routes, but they are built and maintained by the RTA. Regional roads are important traffic routes that are maintained by local government, but in recognition of their traffic role, RTA makes a payment to local government for their maintenance based on the total kilometres of regional roads in the municipality. Local roads are the sole responsibility of local government.

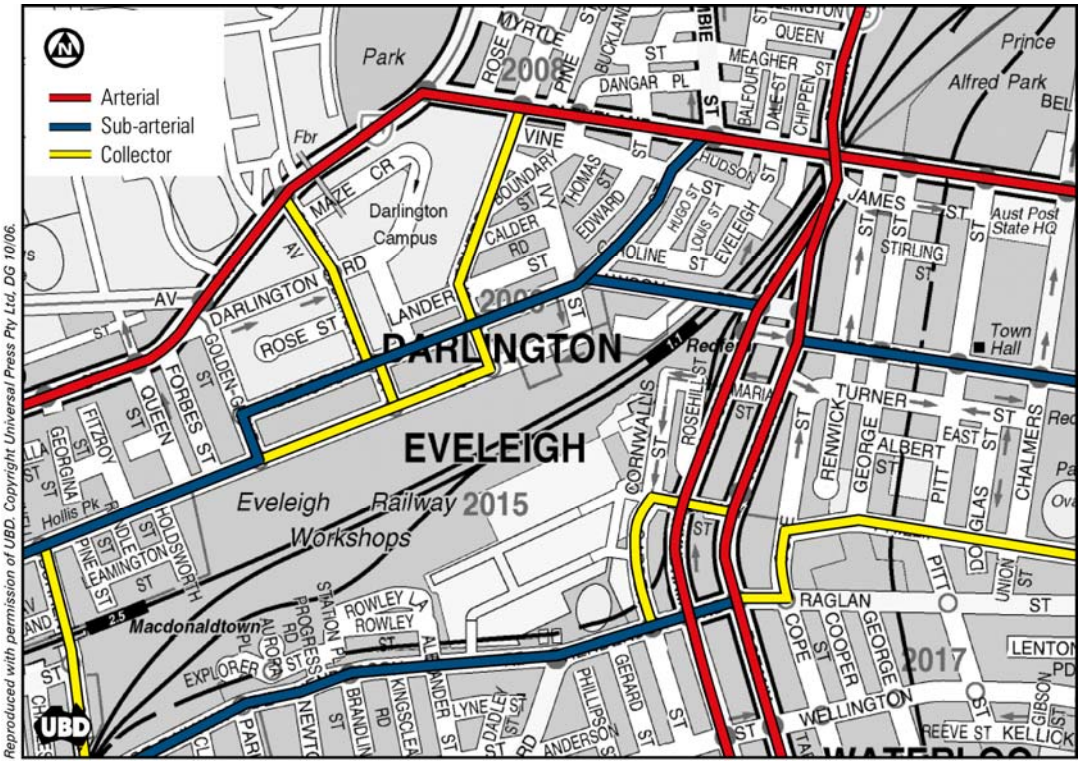


Figure 2-2 Road Hierarchy in 2006

Cleveland Street is a State road, where RTA provides 100% of the funding towards its maintenance. Cleveland Street is a major **arterial** to the inner city and the eastern suburbs. Cleveland Street is a higher order arterial road and can be expected to carry in excess of 56,000 vpd. It is generally a four-lane, two-way undivided road with the posted speed limit of 60km/h with typical urban road cross section (i.e. kerb and gutter on either side of the road). On-street parking is generally not permitted on Cleveland Street during peak periods. It carries a high percentage of heavy vehicles. Its footpaths are not well used in this vicinity due to high traffic levels on the kerbside and limited land uses along the route that generate pedestrians.

Lawson Street is classified as a local road. Council provides 100% of the funding towards maintenance. It is a higher order local road, given it is one of the few connections across the main rail lines into the city, and provides access to the University of Sydney from the east and south. Lawson Street can be expected to carry traffic in the range of 7,000 vpd to 10,000 vpd which classifies it as a **sub-arterial** route. It is generally a two-lane, two-way undivided road with typical urban road cross section. The posted speed limit on Lawson Street is 50km/h. On-street parking is generally not allowed between Regent Street and Eveleigh Street, but is available between Eveleigh Street and Abercrombie Street. It plays a significant role in the pedestrian network, connecting Redfern Station, the University of Sydney and Redfern Town Centre. It is part of the cycleway that connects Wilson Street to Redfern Street.

Abercrombie Street is classified as a local road south of Cleveland Street, but an arterial road north of it. It is a connector between Cleveland Street and Golden Grove Street. Abercrombie Street can be expected to carry traffic in the range of 5,000 vpd to 8,000 vpd which classifies it as a **sub-arterial** route. It is generally a two-lane, two-way undivided road with typical urban road cross section. The posted speed limit on Abercrombie Street is 50km/h. On-street parking is generally available on Abercrombie Street. South of Lawson Street, it carries large numbers of pedestrians.

Shepherd Street is a local road under Council jurisdiction. It provides a connection to Cleveland Street and Wilson Street. Shepherd Street is a two-lane, two-way road with the posted speed limit of 50km/h, but some sections, particularly near Cleveland Street, are of sub-standard width. It carries in the range of 3,000 vpd to 5,000 vpd, classifying it as a **collector** road. On-street parking is generally available, and in heavy demand, on Shepherd Street.

Wilson Street is a local road under Council jurisdiction. It provides access to residential and commercial properties. Wilson Street is generally a two-lane, two-way road with the posted speed limit of 50km/h. Given it parallels the rail lines, there is little cross traffic. It can be expected to carry traffic in the range of 3,000 vpd to 5,000 vpd between Ivy Street and Golden Grove Street, classifying it as a **collector** road, but south of Golden Grove it carries traffic to Erskineville and Newtown from Abercrombie Road, so its function changes to **sub-arterial**. On-street parking is generally available, and is heavily used. Wilson Street contains an on-street cycleway which is popular and connects the Inner Western suburbs to the University of Sydney and the CBD.

Forbes Street is a local road under Council jurisdiction. It provides access to adjacent properties. It appears to carry less than 2000 cars a day, so it is a **local** road in the hierarchy, too. Forbes Street is a two-lane, two-way road with the posted speed limit of 50km/h, and is relatively wide in comparison with other streets in the area. It connects King Street with Wilson Street.

Golden Grove Street is a local distributor road under Council jurisdiction. It provides access to frontage properties. Golden Grove Street provides for two-way traffic with a relatively wide cross-section and connects King Street with Wilson Street, and carries traffic flows at the **sub-arterial** level along that section between Abercrombie and Wilson.

Ivy Street is a local road under Council jurisdiction. It provides access to adjacent properties and carries much less than 2000 cars a day. It is a **local** road. Ivy Street between Abercrombie Street and Wilson Street is a three-lane, one-way road with on-street parking available on both sides of the road.

There are also a number of laneways in the area that are significant links in the pedestrian, property access and bicycle circulation network.

Butlin Avenue is a collector road under the control of the University with a traffic volume of approximately 6000vpd. This road, which becomes Codrington Road when it passes to the control of the City of Sydney, is a major through route for university traffic. At its northern end it intersects with City Road with a signalised junction providing full movement access on to the arterial road network.

2.3 Pedestrian network

Generally, the pedestrian network in the study area provides for a high level of movement and accessibility but with little protection from the sun, wind or rain. The presence of the railway lines does, however, restrict the number of east to west routes available. Pedestrian facilities, including pram crossings, are provided on most of the walking routes and pedestrian signal phases are installed in a number of key locations.

The main pedestrian movement corridor in the study area is along Lawson Street and Abercrombie Street with significant university pedestrian traffic moving between the Redfern railway station and the Darlington and Camperdown Campuses of the University of Sydney. This key route has a narrow pavement on both sides of Abercrombie Street between Shepherd Street and Ivy Street that at peak times can lead to the pedestrians walking in the road. Pedestrians mostly use the southern side of Lawson Street and then Abercrombie Street crossing to the north side of the street at the scatter crossing on the intersection of Abercrombie Street and Shepherd Street. At the Abercrombie / Shepherd intersection pedestrian traffic divides with pedestrians continuing along Abercrombie to Codrington Street and pedestrians travelling north along Shepherd and via a walkway on to the Camperdown Campus. A map of the area showing the key pedestrian attractors and routes is shown in Figure 2-3.

The main attractors of pedestrian traffic in the study area are as follows:

- Redfern Railway Station provides fast convenient travel to the city CBD and to the wider Sydney area. Most trains travelling on the RailCorp network stop at this station
- University of Sydney is a major employer, and as an educational establishment, attracts a significant number of pedestrians, walking generally being the student's mode of choice. A university travel survey carried out in 2006 indicated that approximately 3% of students came to the university by car with approximately 15% cycling and the remaining 82% travelling by transit and walking to the campus or walking directly to the campus
- Darlington Public School, located on the corner of Golden Grove and Abercrombie Street is also a significant pedestrian attractor
- Abercrombie Street shopping precinct between Shepherd and Codrington Street, this area has a number of shops, cafes and small businesses that attract pedestrians
- the CarriageWorks Performing Arts Centre, the proximity of the Centre to the arts community in the Inner West and to Redfern Station makes walking a viable alternative for performers and audiences. The pedestrian path to the Station tends to be via Little Eveleigh Street and Wilson Street which provide a good pedestrian environment

- Newtown centre along King Street, the restaurants, shops and services along City road / King Street are a significant attractor to pedestrian traffic out of the study area. This precinct provides larger stores and a number of small businesses and is served by good pedestrian connections via Darlington Road, Queen Street and Butlin Avenue.

The proposed North Eveleigh development is likely to be a significant pedestrian attractor in the area and could result in new pedestrian routes being established. The mix of residential, commercial and retail will attract trips both within the site and from the local area. The mode share targets for this site imply that pedestrian movements will be significant, particularly to the newly created employment spaces.

The most significant pedestrian routes are likely to be between the North Eveleigh site and Redfern Station, and the wider Redfern area via Wilson Street and Little Eveleigh Street, and the route between North Eveleigh and Redfern, via the proposed pedestrian and cycle bridge over the railway lines.

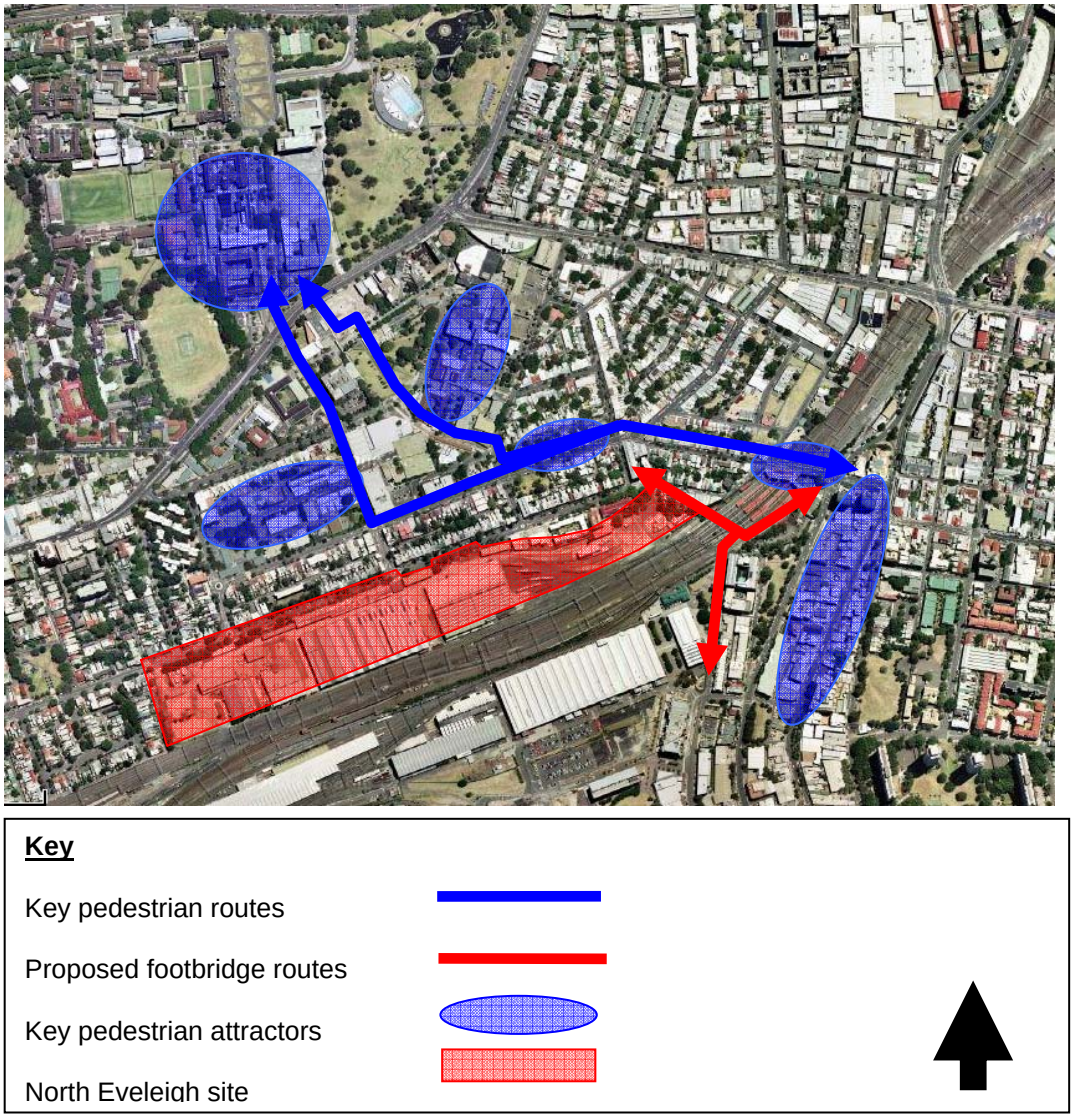


Figure 2-3 Key pedestrian routes and attractors

2.4 Cycle network

Cycle provisions within the study area are good with the area being served by an extensive network of cycle routes which have been provided by the City of Sydney. The cycle network in the study area is predominantly on street. The main cycle route, route 3, traverses the study area from east to west along Little Eveleigh Street and Wilson Street. It joins the new facilities recently upgraded on Redfern Street. Cycle routes are also provided on Codrington Street / Butlin Street, Shepherd Street and Queen Street. *Figure 2-4* shows the extent of the cycle network in the south of Sydney.

The standard of cycle routes in the area is varied with sections of route providing narrower widths than would be considered best practice. Potential conflicts between heavy vehicles and parked vehicles also are an issue on several sections of cycle way.

Cycle parking provision is limited. Some cycle parking has been provided at the University campus but no dedicated cycle parking is available at Redfern Station, this party due to a lack of footway width. Cycle parking is provided at the CarriageWorks performance arts centre.

RWA proposes a cycle and pedestrian bridge be built linking the end of Little Eveleigh Street with Cornwallis Street. This bridge would provide a useful facility for access to the North Eveleigh site, as well as extending both the local and regional cycle networks in accord with the RTA regional bicycle plan and the City of Sydney bike plan.

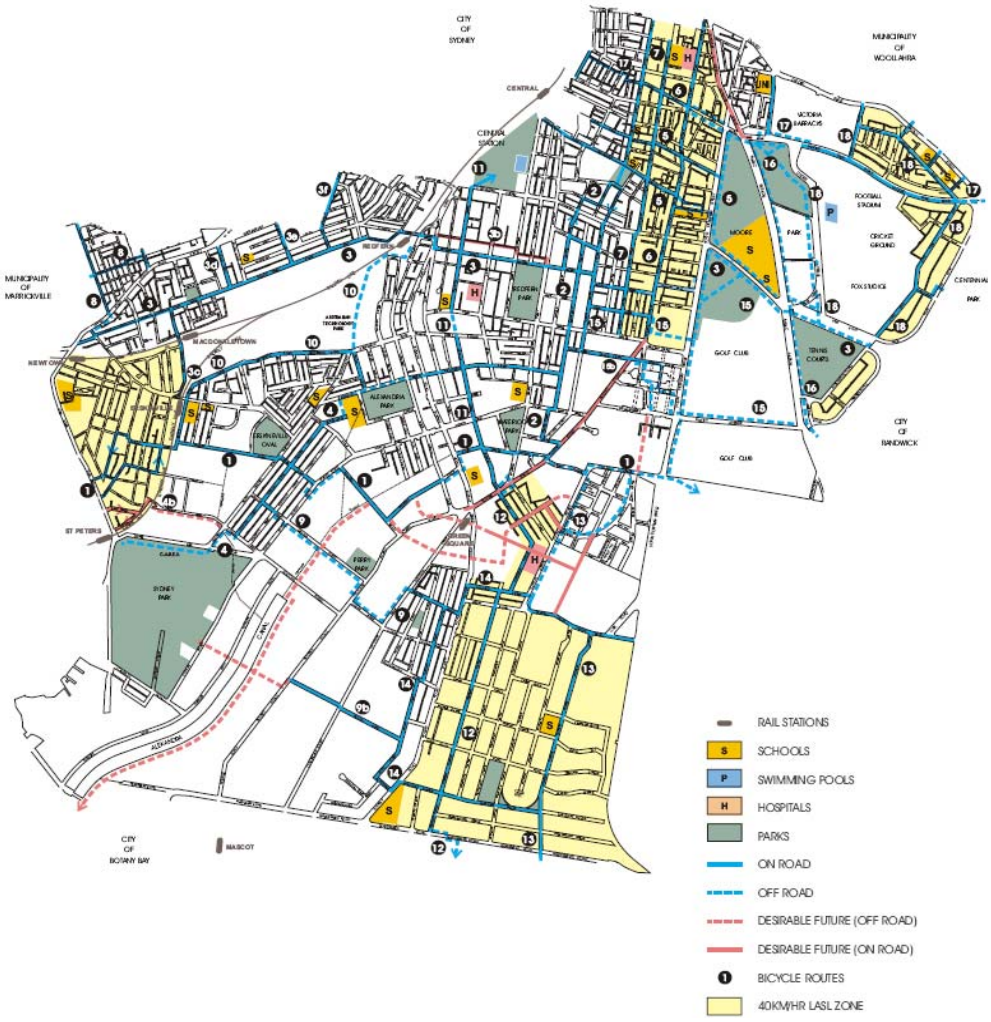


Figure 2-4 Sydney South cycle network map

2.5 Public transport

2.5.1 Rail

Redfern Railway Station is the tenth busiest in the Sydney Rail network, and is directly linked to all radial services to the CBD except the Airport Rail Link which passes underground to the east of the Station. The highest passenger loads are carried in the morning peak hour. Services are frequent and some inter-urban services also stop here. Trains arriving in the morning peak are carrying their peak loads, but as many passengers disembark for the University, bus transfer and employment, there is generally capacity for passengers waiting at Redfern to board trains travelling in all directions.

The main passenger access to the Station is via Lawson Street, with a side entrance on Gibbons Street, opposite the pedestrianised extension of Redfern Street. Fencing prevents mid-block crossings. From counts, the main pedestrian flow is west toward the University. East of the Station, the main road crossing is north/south across Lawson Street at Gibbons Street, in both the AM and PM peaks. Surveys undertaken by State Rail in 2001 revealed that during the morning peak (6:00 am to 9:30 am) up to 62 percent of passengers (2,209 people) exiting Redfern station - travelled west along Lawson Street in the direction of the university. The east/west crossing of Gibbons Street is split between the Lawson Street traffic signals and the signals opposite the closed end of Redfern Street. Passengers may also enter the station from Marian Street directly to the south end of the easternmost surface platform if they possess a rail ticket, although there is no ticket barrier until the main concourse is reached.

Passenger facilities are basic in the older part of the Station, with no wheelchair access, and only partial shelter for passengers waiting on the platforms.

2.5.2 Bus

The study area connects to a network of bus routes, mainly on the arterial roads, and all operated by the publicly owned Sydney Buses (State Transit). The routes are predominantly on the arterial roads to the south east of the study area or on City Road and Cleveland Street. The service levels on Gibbons/Regent Streets are split due to traffic being directed onto a one-way arterial pair, but are regionally important enough for the route to be considered part of Strategic Bus Corridor 21, linking the CBD to Miranda. This means the RTA will be preparing a program for improving the speed and reliability of buses along this corridor, but this tranche of improvements is not scheduled to begin until 2009.

There is another very important, frequent service corridor in the vicinity of North Eveleigh which is King Street/City Road. The route structure and its relationship to the Station are shown in *Figure 2-5.*

Figure 2-5 Sydney Bus services adjacent to key sites

Table 2-1 State Transit bus routes in Study Area

Route No.	Origin and Destination	AM Peak Frequency (services / hour, 8-9 am)
352	Marrickville Metro – Bondi Junction	3
308	Marrickville Metro – Millers Point	3
309	Port Botany – Circular Quay	4
310	East Gardens – Circular Quay	4
422	Tempe – Circular Quay	4
423	Kingsgrove – Circular Quay	6
426	Dulwich Hill – Circular Quay	5
428	Canterbury – Circular Quay	6
370	Leichhardt – Coogee	6

The bus passengers are predominantly through passengers to the CBD, but significant interchange with rail does occur here, particularly for employees travelling to the South Central Industrial areas between Redfern and the Airport, such as Beaconsfield, Mascot, Banksmeadow and Botany. Peak movement occurs between 7 and 8 AM. The road network, however, is not well suited for interchange or the convenient placement of bus stops for passengers. Over the years, several proposals have been put forward to improve transfer conditions for passengers, but cost, lack of suitable land and a falling demand for interchange as industrial areas redevelop have lead to few improvements. As well as the CBD, major destinations served by the buses in the strategic bus corridor include the Rocks, Newtown, Marrickville, Eastgardens, Mascot, and Port Botany. Along Cleveland Street, there is service to East Sydney and Bondi Junction, Newtown and Marrickville. City Road/King Street contains services to Coogee, UNSW, Glebe, Leichhardt, Kingsgrove, and Canterbury.

This area is well served by transit services, although the passenger facilities are generally poor for waiting and identifying service points. Although there has been a recent upgrade to the inbound facilities at the Main City Road access to the University. Considerable benefits to passenger comfort and the attractiveness of bus travel could be achieved by looking at the passenger infrastructure, as the service levels are already in place. Traffic demands have caused some stops to be poorly placed for safe pedestrian access, especially in regard to crossing streets. Splitting the buses between Gibbons and Regent Streets does reduce the legibility of the system. There are connecting laneways, and distances are not burdensome, but passenger wayfinding to the stops can be difficult.

2.5.3 Taxis

Taxis are easily obtained in the area during business hours, although it can be difficult to hail one at night. Due to the number of demands on kerb-space close to the Station, taxis are difficult to flag close to the station exits. There is a taxi rank in Gibbons Street at Redfern Station.

2.6 Traffic

PB undertook a comprehensive study of the existing traffic conditions within the study area for the *Draft Preliminary Traffic and Transport Strategy for Draft Built Environment Plan (Stage1)* produced in 2007 for the RWA. The key findings are reproduced below.

2.6.1 Historic Growth

Historical intersection traffic volumes were obtained from the previous study, Eveleigh CarriageWorks Transport Management Plan (PB, 2003). Those traffic surveys were conducted in November 2001. The earlier figures were compared to the new set of intersection surveys to calculate an indicative traffic growth rate per annum. Table 2-2 summarises the traffic volume by directions. A pattern to the traffic growth is difficult to determine. Generally, it can be observed from the table that traffic declined between 2001 and 2006.

The intersection of Abercrombie Street and Shepherd Street shows a 2% increase per annum during the morning peak hour for the east-west direction and 5.4% increase per annum during the afternoon peak hour for the north-south direction. Cleveland Street-Shepherd Street intersection shows approximately 3% increase per annum in the morning peak hour and 2% decrease per annum in the afternoon peak hour. In the last five years, there has not been a measurable change in traffic conditions on local streets.

Annual average daily traffic (AADT) volumes in the vicinity of the study area were obtained from the RTA's Traffic Volume Data 2002 (Sydney Region). Five RTA station locations are shown in Table 2-3 for the survey year of 1999 and 2002. This table, again, shows a general decrease in traffic volumes. This may be partly attributable to the opening of the Eastern Distributor (from late 1999). Subsequently, diversions to the Cross City Tunnel and high petrol prices would have been expected to support this trend until the present.

Table 2-2 Historical traffic volume data

Intersection	Peak hour	November 2001		April 2006		Growth rate per annum (%)	
		N-S	E-W	N-S	E-W	N-S	E-W
Wilson St-Forbes St	Morning	10	600	25	601	30.0%	0.1%
	Afternoon	24	581	12	629	-10.0%	1.7%
Wilson St-Golden Grove St	Morning	141	535	119	560	-3.1%	0.9%
	Afternoon	222	431	216	423	-0.5%	-0.4%
Abercrombie St-Shepherd St	Morning	225	824	100	905	-11.1%	2.0%
	Afternoon	130	1,002	165	898	5.4%	-2.1%
Cleveland St-Shepherd St	Morning	215	2,254	242	2,601	2.5%	3.1%
	Afternoon	400	2,778	349	2,582	-2.6%	-1.4%

NOTE: N-S – North-South direction; E-W – East-West direction

Table 2-3 RTA traffic volume data

RTA station no.	Road name	Location	AADT		Growth rate per annum (%)
			1999	2002	
02.015	City Road	South of Cleveland Street	44,998	41,411	-2.66%
02.385	Regent Street	South of Cleveland Street	53,834	48,856	-3.08%
00.340	Cleveland Street	At Boundary St intersection	38,377	34,161	-3.66%
00.222	Lawson Street	At Abercrombie Street intersection	6,810	5,515	-6.34%
00.222	Abercrombie Street	At Lawson Street intersection	4,587	3,833	-5.48%

Source: RTA Counting program

The large proportional growth, 30%, shown on the Wilson Street at the Forbes Street intersection is due to the low numbers involved. The actual increase of 15 vehicles in the peak hour over the five year period, or one every four minutes, is not large or expected to be an impact when compared with traffic in this urban area.

2.6.2 Heavy vehicles

The percentages of heavy vehicles captured during the surveys are shown in *Table 2-4*. Generally, within the urban area arterial roads could be expected to carry up to 15% heavy vehicles with a typical flow composition of between 3% and 8%. On local roads the general composition should be lower at between 1% and 5%. The percentage of heavy vehicles using the roads within the study area can be considered typical for this type of environment.

Table 2-4 Percentage of heavy vehicles

Road approach	AM peak hour	PM peak hour
Gibbons St, south of Lawson St	9%	4%
Lawson St, west of Regent St	7%	5%
Lawson St, east of Abercrombie St	1%	2%
Regent St, north of Lawson St	6%	2%
Cleveland St, east of Shepherd St	5%	2%
Shepherd St, south of Cleveland St	6%	<1%
Shepherd St, north of Abercrombie St	<1%	<1%
Abercrombie St, north of Lawson St	4%	1%
Abercrombie St, east of Shepherd St	2%	<1%
Wilson St, east of Golden Grove St	3%	<1%
Golden Grove St, north of Wilson St	3%	<1%
Ivy St, north of Wilson St	3%	4%
Forbes St, north of Wilson St	<1%	<1%

2.6.3 Peak hour and design hour

The traffic surveys were conducted on Tuesday, 11th of April 2006 for a morning and afternoon peak period at each intersection shown in *Table 2-5*. The morning peak period surveys were conducted from 6:30AM to 9:00AM, and the afternoon peak period from 4:00PM to 6:00PM. The table shows the hours identified as having the highest flows. It can be seen that the morning peak occurs between 8am and 9am and that the afternoon peak occurs between 5pm and 6 pm. The results of the survey also showed that the maximum peak occurred during the morning.

It is usual to use a design hour that represents the worst case in terms of traffic conditions. This is usually, but not always the am peak. From this table PB has concluded that the appropriate design hour is 8am to 9am. For the traffic model and to fit with the RTA models of surrounding areas PB has used the AM peak 7am to 9am.

Table 2-5 Survey peak hours at eight key intersections

Intersections	Survey peak hours	
	Morning peak hour	**Afternoon peak hour**
Wilson Street/ Forbes Street	7:45AM – 8:45AM	5:00PM – 6:00PM
Wilson Street/ Golden Grove Street	7:30AM – 8:30AM	5:00PM – 6:00PM
Wilson Street/ Ivy Street	7:45AM – 8:45AM	5:00PM – 6:00PM
Abercrombie Street/ Shepherd Street	8:00AM – 9:00AM	5:00PM – 6:00PM
Abercrombie Street/ Lawson Street	8:00AM – 9:00AM	5:00PM – 6:00PM
Lawson Street/ Gibbons Street	8:00AM – 9:00AM	5:00PM – 6:00PM
Lawson Street/ Regent Street	7:45AM – 8:45AM	5:00PM – 6:00PM
Cleveland Street/ Shepherd Street	8:00AM – 9:00AM	4:30PM – 5:30PM

2.7 Network performance

Existing network performance and levels of service along with traffic generation and trip distribution are discussed in chapter 3 as part of the cumulative network model.

2.8 Parking

The study area is typified by having a large proportion of Victorian terrace housing stock. Most of the area's houses where built before the advent of the motorcar, so provision for off street car parking is limited and reliance on on-street parking is high.

Wilson Street has parking along both sides of the road in the study area, excepting for entrances and close to intersections. The site was visited on various occasions including at night and a consistent portion of parking spaces where found to be available along the street. The housing on Wilson Street mainly relies on street parking. For this reason, the access proposed to the site has been designed to have the least impact on parking supply. The North Eveleigh development will use one existing entrance into the site and create a new access at the roundabout at Wilson Street and Shepherd Street. The Shepherd Street access is located at an existing access into former rail buildings, and due to the proximity of the existing roundabout, is posted as "no stopping". The modifications to both accesses and associated visibility envelopes will require the loss of approximately 4 parking spaces.

The development is being built on a predominantly unused "brown field" site which currently has no parking demand or provision, except for the existing CarriageWorks performance art centre which provides approximately 116 off street parking spaces within the site.

3. Cumulative traffic model for Darlington

3.1 Introduction

The purpose of the traffic modelling was to provide a joint, robust analysis on the traffic impacts of the redevelopment plans proposed for the Abercrombie Precinct and the North Eveleigh Rail Yards.

The Director General's requirements ask for "cumulative impacts on the local and subregional area including the future development proposed by University of Sydney, and develop a traffic network model to determine impact(s)."

One of the modelling objectives was to distinguish the impacts from the two redevelopment sites on the road network and to provide assessment results as part of the Traffic Impact Assessment process in the Authority and University's Concept Plan Applications.

At the outset of this project, PB reviewed two models provided by the NSW RTA (namely, the Eveleigh Paramics model and the South Sydney Paramics model). The review concluded that the geographic coverage of the two RTA models focused on the south / east side of the railway line and not the study area of interest in this project.

As a result, PB had to develop a new traffic micro-simulation model for the study area by using Paramics V5.2, with its specifically developed plug-ins for RTA generated data. PB believes that Paramics modelling is a good tool for traffic impact assessment of land re-development projects in dense urban areas and using Paramics can provide the necessary accuracy and consistency by benchmarking against the RTA modelling standards and assumptions.

This technical report summarises the process and results of the Paramics modelling, including development and calibration of a base model, estimation of existing and future traffic demand, and assessment of traffic performance at key intersections.

3.2 Base model

The Paramics modelling started with the development of a base model for the AM peak period (7:00 am – 9:00 am) for the year 2006. The base model aimed to represent the existing traffic situation of the study area within a reasonable level to provide credibility for the forecasts generated by future models.

3.2.1 Study area

The base model covers the study area as presented in *Figure 3-1*. It is bound by City Road / King Street in the northwest, Cleveland Street in the northeast, the railway line in the southeast, Burren Street and Queen Street in the southwest. The two proposed re-development sites of North Eveleigh (RWA) and the Abercrombie precinct (University of Sydney) are encompassed in the study area.

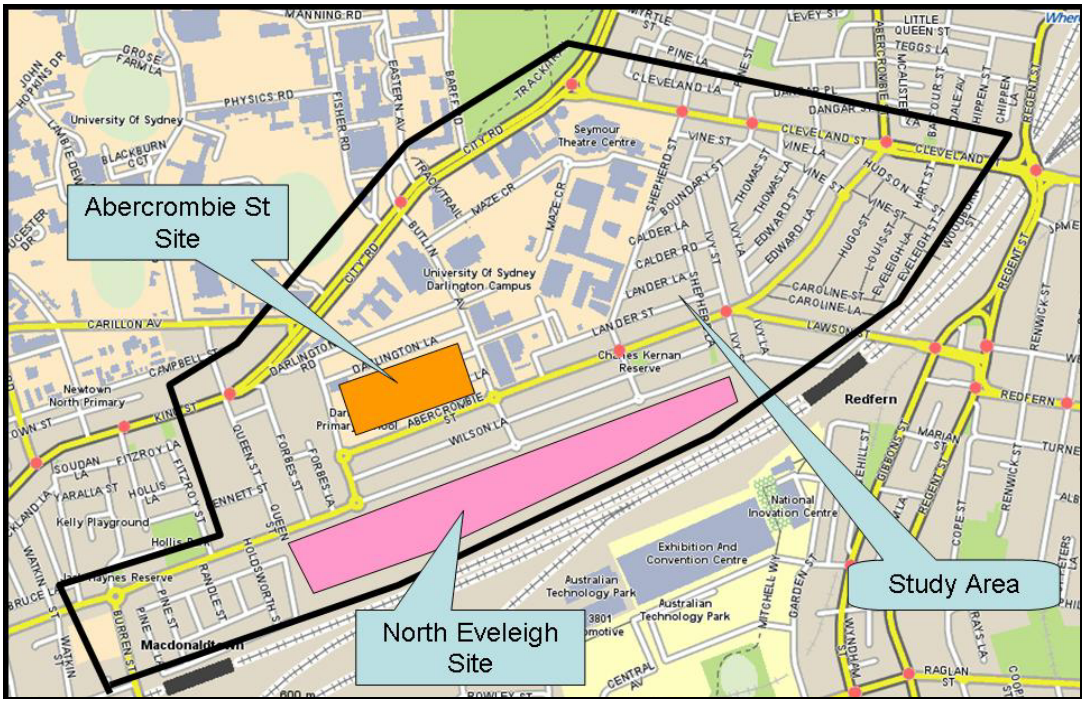


Figure 3-1 The Darlington Model area

3.2.2 North Eveleigh

The North Eveleigh site is approximately 11 hectares, bounded by Wilson Street to the north and the railway line to the south, and it has been split into three sections for general land use planning consideration:

- the eastern section, which currently has some workshop buildings, is proposed to be developed for commercial, retail, community and residential purposes
- the central section including CarriageWorks and the Blacksmiths' Workshop, has been the subject of development approvals for performing arts, markets and car parking uses. Additional floor space is proposed to be created within the existing buildings
- the western section, currently unoccupied, is proposed to be developed for residential purposes.

The total development proposed for the North Eveleigh site involves 180,007m^2 of cultural, residential, commercial and retail floor space. This includes 21,588m^2 of development approved for the Carriage Workshop and Blacksmiths' Shop and 158,419 m^2 of development in existing heritage buildings and new building forms. Two access points are proposed:

- the existing access at the western end of the site, between Queen and Forbes Streets, will be upgraded to provide the line of sight and capacity for turning movements required to accommodate a semi-trailer. The access will be designed in accord with good design practice as if it were a T-intersection so that it would comply with Council standards and requirements and can be adopted by council in the future. This access will act as the main access to the proposed residential section and provide access to the CarriageWorks performing arts centre

- a new access onto Wilson Street, joining the roundabout at Shepherd Street, will be constructed. This will require that the roundabout is enlarged and an extra approach introduced. The design of the roundabout will ensure that semi trailers can manoeuvre between Wilson Street and Shepherd Street into and out of the site within the space provided to meet the standards for turning and visibility. This will primarily serve the eastern end of the site which is intended to contain a mix of commercial, retail and housing uses.
- Preliminary plans of these improvements are located in Section 5.3.6.

3.2.3 The Abercrombie precinct

The Abercrombie precinct is bounded by Darlington Road to the north, Codrington Street to the east, Abercrombie Street to the south and Golden Grove Street to the west but excludes the current site of Darlington Public School. The site is currently occupied by several university buildings including; the main IT server building and hub which has been relocated elsewhere on campus, various teaching buildings and the Central Sydney Pre-school. The redevelopment will provide the University of Sydney with a world class School of Business and Economics, and co-locate this currently dispersed faculty onto a single site.

3.2.4 Assessment locations

The traffic performance was assessed on the road intersections considered most critical to traffic efficiently and potentially affected by the traffic generation from the re-development sites. This was influenced by earlier work and the preliminary 3(a) assessment report prepared by PB. The model area was designed to cover all the key intersections in the immediate area of the development sites. The following intersections were the focus of the assessment:

- City Road - Cleveland Street*
- City Road - Butlin Avenue*
- City Road - Darlington Road*
- City Road - Queen Street*
- Abercrombie Street - Golden Grove
- Abercrombie Street - Codrington Street
- Abercrombie Street - Shepherd Street
- Abercrombie Street - Lawson Street
- Abercrombie Street - Cleveland Street*.

* Denotes intersections with at least one State Road.

3.2.5 Existing traffic situation

The existing traffic was analysed using SCATS data for 13 March 2007 (Tuesday), provided by the RTA at the key signalised intersections. The date was chosen to be representative of a normal day when students would be attending the University. The date also fell within the time of year earlier counts were available. March is generally considered a peak season of AM peak traffic movements.

Two representative locations were chosen for analysis and the results are presented in *Figure 3-2* and *Figure 3-3*. The figures show that the highest hourly volume reached 1,800 vehicles from 8:00 am to 9:00 am on City Road eastbound considering all 3 lanes, and Abercrombie Street, which is a sub-arterial road at this point, carried a maximum of 450 vehicles in the same period and direction over 1 lane. The results confirm that the AM peak is the peak demand period on the local road system.

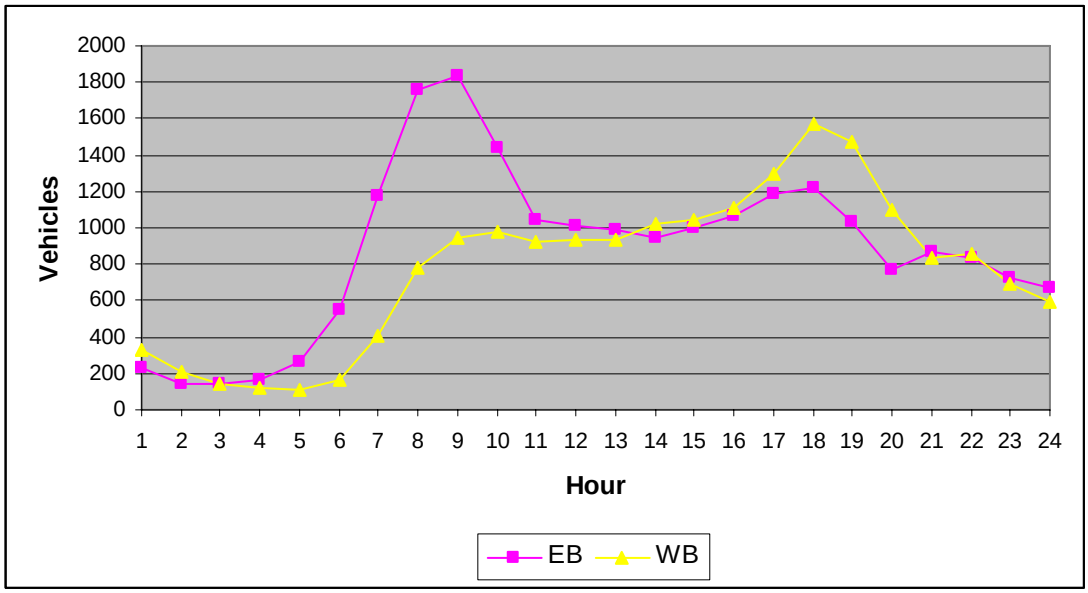


Figure 3-2 Daily traffic on City Road at Butlin Street

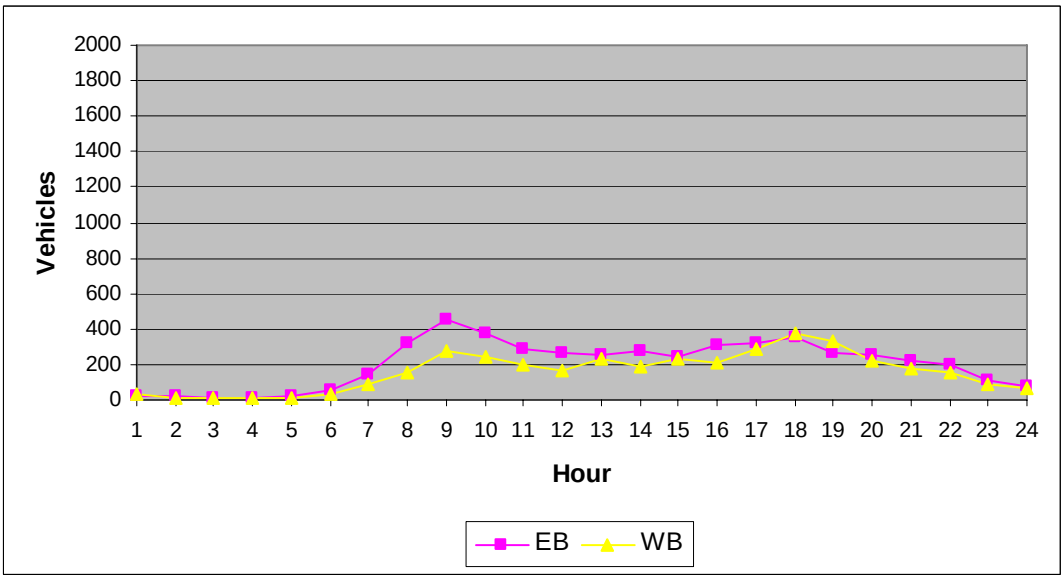


Figure 3-3 Daily traffic at Abercrombie Street and Shepherd Street

3.3 Road network

PB used high resolution aerial photographs taken in April 2005 covering the study area to develop the base model road network within Paramics. The photo provided adequate information for the road link coding task including road length, lane width, number of lanes, the direction and position of each road, and the intersection configuration. PB undertook two morning site visits to collect count information at the roundabouts, observe adherence to speed limits and confirm the latest road and intersection configuration with the aerial photographic information.

In Paramics simulations, roads are classified into major and minor roads, corresponding to main roads and local roads in the RTA road classifications. All the main roads have been included in the Paramics model as major roads. These include City Road and Cleveland Street which have Clearway restrictions during the AM peak period. The external traffic from the re-development areas would eventually be distributed to these main roads.

The local roads which are critical in this precinct include Wilson Street and Abercrombie Street which are also part of the road frontage of the two re-development sites. Other important local roads such as Lawson Street, Shepherd Street, Codrington Street and Golden Grove Street, provide connections and alternative routes, are also included in the model network.

On-street parking is permitted on some local roads during the AM peak period. The capacity of these roads was adjusted to account for this restriction on through-traffic capacity.

A total of 10 sets of traffic signals are within the study area. PB coded all the signals into the model. The signal-phase plans provided by the RTA were used to build in the signal capacity in the model.

Paramics does not currently have the functionality to incorporate dynamic phasing (without using the SCATS plug-in). The coordination of signals was considered in the Paramics model through off-set times between signals. But a condition for the coordination is that all intersections should have an identical cycle time. To meet this condition, the maximum cycle time was adopted at each subject intersection.

A total of 39 trip demand zones were created for traffic generation and attraction, including those to accommodate external and internal traffic. Around the network periphery, zones were associated with each external link, representing connection with external traffic.

The developed Paramics road network is presented in *Figure 3-4*.

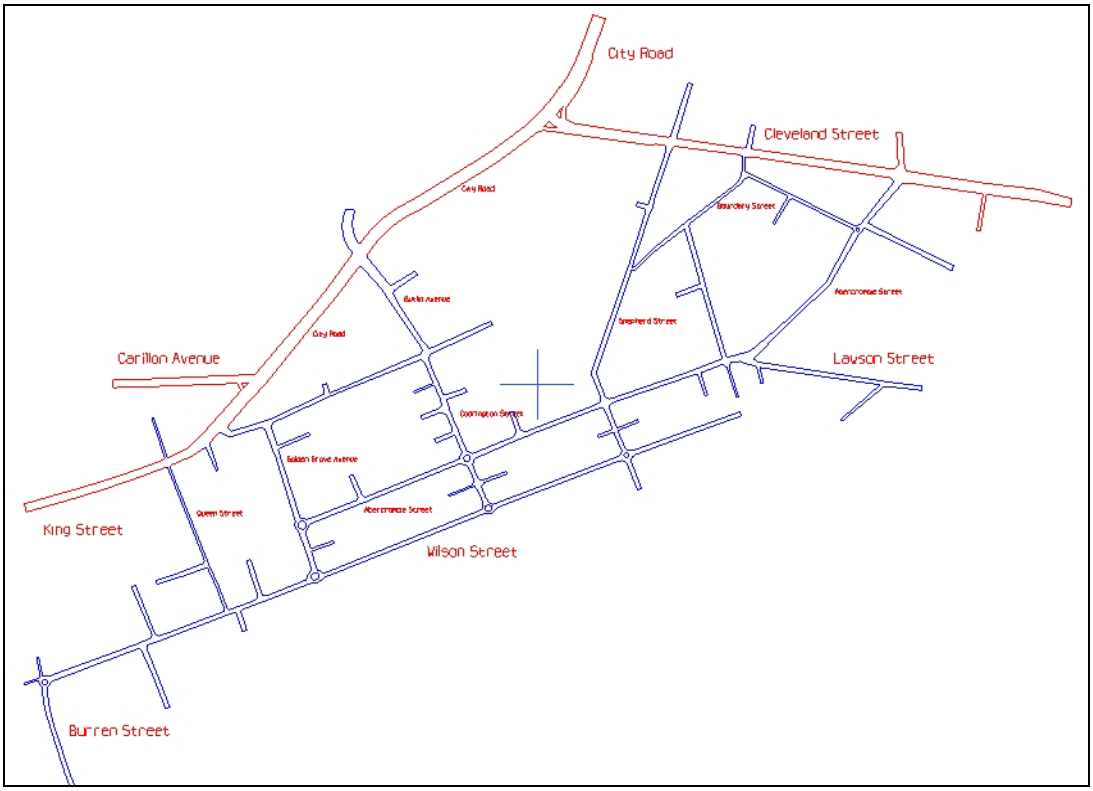


Figure 3-4 Road network in Paramics model

3.4 Bus routes

The NSW State Transit Authority (STA) operates a number of bus services through the study area. They are bus routes 422, 423, 426, 428, 352, 370, L23 and L28. They were all developed as fixed routes into the base model with buses dispatched at certain intervals or at scheduled times. The service frequencies were derived from the timetables published on the STA website, matching the period between 7:00 am and 9:00 am. Paramics default boarding rate (12 persons/hr), alighting rate (10 persons /hr) and pay time (2 seconds) were used as the parameters for each bus stop.

3.5 Demand estimation

The estimation of the traffic demand was based on the three data sources:

- RTA SCATS counts on Tuesday, 13 March 2007. They were organised in a 15 minute interval over 24 hours, but not all turning movements could be distinguished in SCATS due to some shared lanes. There was also no information for vehicle type. The data were mainly used for developing the demand profile to show the demand variation over the AM peak period in a 15 minute interval and to provide mid-block traffic flow information. The SCATS locations were:

- TCS 662: King Street – Queen Street
- TCS 661: City Road – Carillon Avenue
- TCS 660: City Road - Butlin Street
- TCS 521: Cleveland Street – City Road
- TCS 522: Cleveland Street – Shepherd Street
- TCS 523: Cleveland Street – Boundary Street
- TCS 524: Cleveland Street – Abercrombie Street
- TCS 1141: Abercrombie Street - Lawson Street
- TCS 1707: Abercrombie Street - Shepherd Street
- TCS 260: Butlin Avenue – Maze Crescent

- PB site visits undertaken on 12 and 13 February 2008 during the 7:00 am – 9:00 am period. Traffic counts by vehicle type (car and heavy vehicle) over a 15 minute period were collected at non-signalised intersections and roundabouts. The traffic information was critical to distinguishing vehicle demand by type. The locations included:
  - Darlington Road – Butlin Avenue – Codrington Street
  - Abercrombie Street – Codrington Street
  - Abercrombie Street – Golden Grove Street
  - Wilson Street – Burren Street.

  During the visits, PB also counted the traffic at the key signalised intersections along City Road and Cleveland Street to complement the information on vehicle type and turning movements within the SCATS data.
- Historic traffic counts by vehicle type and turning movements collected on Tuesday, 11 April 2006 for the period from 6:30 AM to 9:00 am. The locations included:
  - Wilson Street – Forbes Street
  - Wilson Street - Golden Grove Street
  - Abercrombie Street – Shepherd Street
  - Abercrombie Street – Lawson Street
  - Cleveland Street – Shepherd Street.

PB processed this data into link flows and turning movements by vehicle type (car and heavy vehicle) in Microsoft Excel.

The demand estimation was taken in an EMME/3 model developed by PB, which covers the study area. The EMME/3 model is a strategic modelling tool, which has the capability to estimate demand based on traffic counts and turning movements at intersections. PB used a seed demand matrix in the estimation to make sure the demand in terms of trip length can reasonably reflect the travel pattern. The outcome of the process is the base demand matrices separated by car and heavy vehicle, and the results show a good fit for the traffic counts, as presented in *Figure 3-5* and *Figure 3-6*.

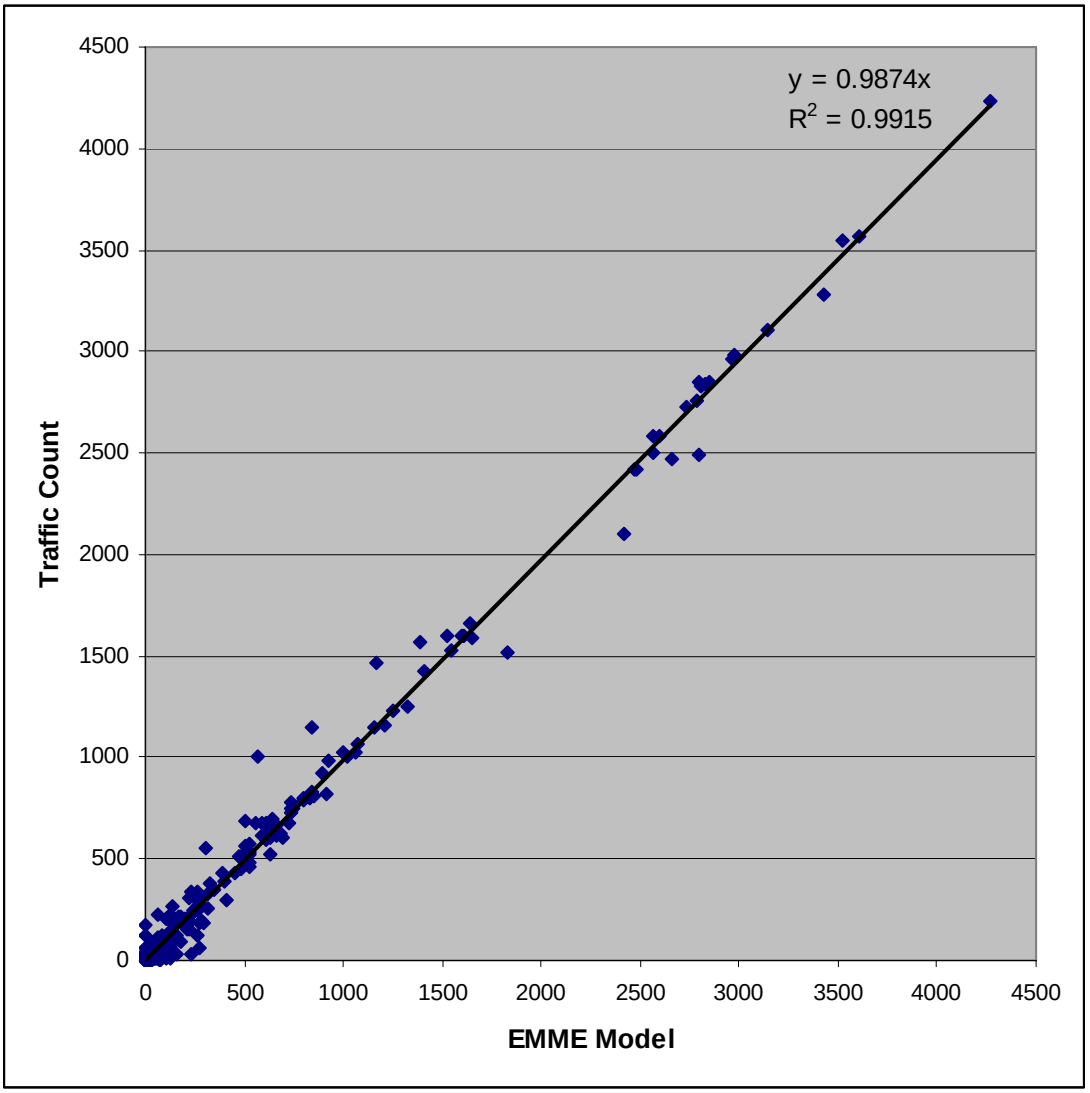


Figure 3-5 Base demand estimation – goodness of fit for car counts

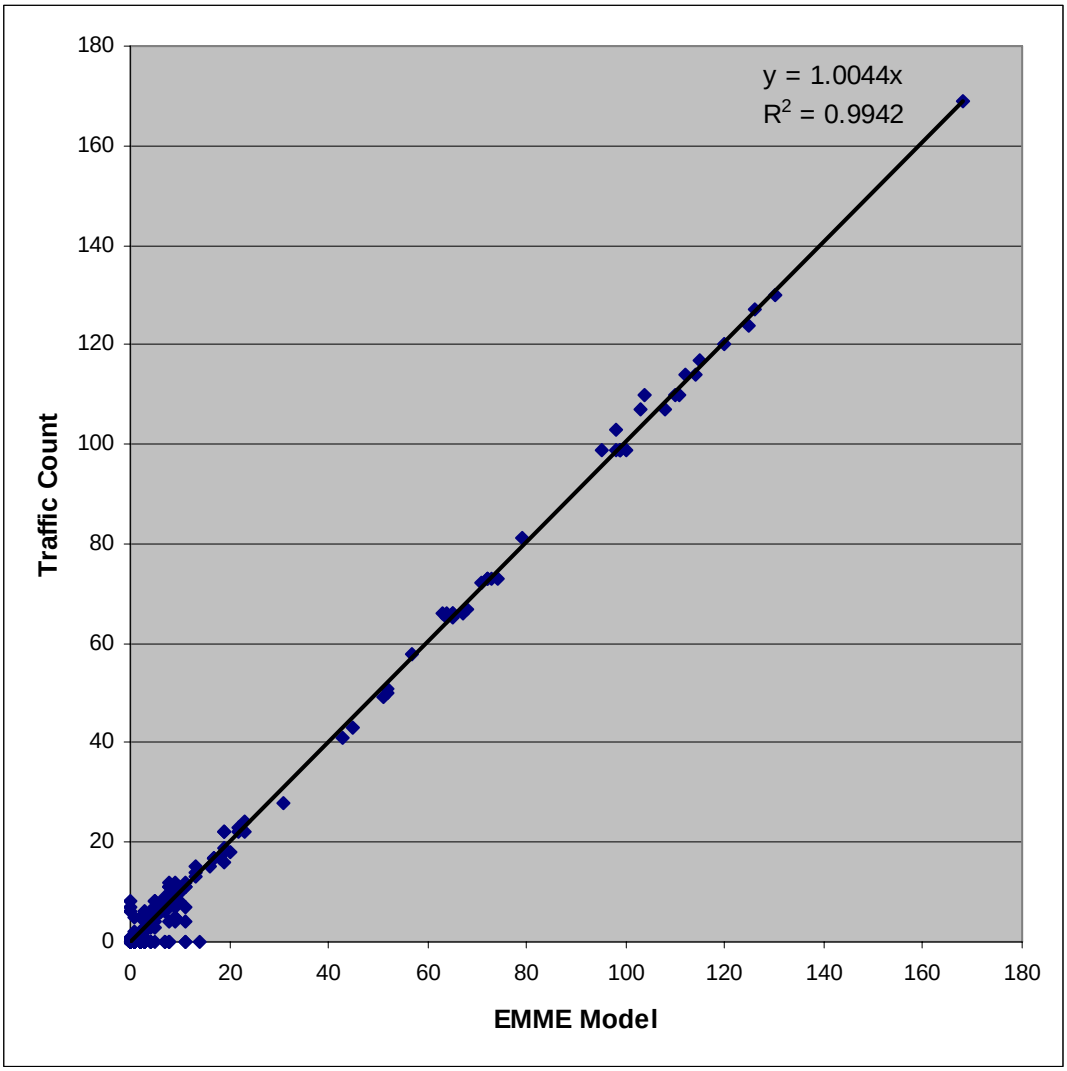


Figure 3-6 Base demand estimation – goodness of fit for heavy vehicle counts

3.6 Base model calibration

The calibration of the base model was considered an important task in the model development. It involved the review of the overall model operation including adjusting model parameters, checking network coding and undertaking statistic calibration.

3.6.1 Model parameters

A Paramics model needs input from a range of parameters. Key parameters included:

- demand profile
- vehicle profile
- assignment method
- link cost factor
- headway and reaction time.

3.6.2 Demand profile

The demand profile controls the vehicle demand release into the network to reflect the variation of traffic flow over the modelling period. PB analysed the SCATS data along a selected key road to develop a demand profile for this project at 15 minute intervals.

Traffic counts (vehicles) on City Road at Cleveland Street where analysed. This intersection was considered the most critical intersection within this study area. The analysis is presented in *Table 3-1*. The percentages listed in the *Table 3-1* were used as the demand profile over the 7:00 am – 9:00 am period.

Table 3-1 Traffic counts on City Road at Cleveland Street (vehicles)

City Road	City Inbound	City Outbound	Combined	Percentage
7:00 AM – 7:15 AM	367	179	546	10%
7:15 AM – 7:30 AM	435	165	600	11%
7:30 AM – 7:45 AM	533	229	762	14%
7:45 AM – 8:00 AM	427	208	635	12%
8:00 AM – 8:15 AM	521	207	728	14%
8:15 AM – 8:30 AM	485	252	737	14%
8:30 AM – 8:45 AM	464	238	702	13%
8:45 AM – 9:00 AM	362	253	615	12%
Total	3,594	1,731	5,325	100%

3.6.3 Vehicle profile

The vehicle profile specifies the vehicle characteristics and composition in the traffic flow. PB adopted the RTA Paramics Vehicle Profile standard for this model. The RTA vehicle profile was only modified to suit the percentage of vehicle type in the two demand matrices created: one for cars and the other for heavy vehicles.

3.6.4 Assignment method

Paramics provides three types of traffic assignment methods. They are “all or nothing”, stochastic and dynamic. Each type affects the vehicle route choice. Vehicle assignment is based on the minimum generalised cost between the origin zone and the destination zone. The generalised cost is normally a combination of time, distance (and toll). When congestion occurs, the travel time will vary from the free-flow travel time, and this means the generalised cost may vary over time. As a result, the initially less attractive routes may be chosen when congestion occurs on shorter alternatives.

The study area allows multiple routes between individual origins and destinations. PB adopted the dynamic feedback assignment method with 5 minute feedback. The generalised cost would then be calculated at 5 minute updates to feed into the route choice for vehicles. The feedback file generated from the dynamic assignment, which recorded the turning cost, was re-used in the new model run with the “all or nothing” assignment method. The advantage of this combination of the assignment methods is the allowance for road traffic congestion impacts on route choice and stability of model operation. The results from the new model run were used for analysis.

3.6.5 Link cost factor

The generalised cost for a route also depends on the link cost factor. The default cost factor for all links is 1. As drivers are categorised into “familiar” and “unfamiliar”, “familiar” drivers perceive all links with the cost factor of 1, whereas minor links have a double link cost factor (2) to “unfamiliar” drivers. The model assumed that all AM peak drivers were “familiar” and used the default link cost factor of 1.0 for all links.

3.6.6 Headway and reaction time

The vehicle headway and driver reaction time affects interactions between vehicles and hence vehicle flows along roads and at intersections. They have effects on reducing unrealistic network congestion and improving traffic flows in the model. PB adopted the recommended (default) headway and reaction time (1 second) in this project.

Apart from the parameters mentioned above, the Paramics default values for other parameters such as “awareness” and “aggression” (normal distribution) were kept.

3.6.7 Network coding

Network coding refers to the coding of roads and intersection signals in the model and it covers:

- road category
- signal adjustment
- other techniques to describe the network.

3.6.8 Road category file

In Paramics, the road category also influences route choice. The priority of routing is based upon most drivers tend to use major links first.

The routing order is:

1. Shortest Major Links
2. Alternative Major Links
3. Shortest Minor Links
4. Alternative Minor Links.

PB adopted the RTA standard category file in this project and used the correct road category to match each link in the model in terms of number of lanes, speed limit, urban major vs urban minor.

3.6.9 Signal adjustment

The intersection signals coded in the model were based on the RTA signal and phase plans. In congested intersections such as City Road – Carillon Avenue, the initial green phase time in one approach did not let all vehicles through the intersection. To compromise the green phase times demanded by different approaches at one location, the green phase times are adjusted in order to match the vehicle demand in each approach, aiming to improve the LOS for the intersection as a whole. During the adjustment, the cycle time and number of phases are kept the same.

3.6.10 Other techniques

Other Paramics techniques have also been used to improve the traffic operation of the model.

Those techniques included:

- *Next Lanes* – Forcing vehicles into the correct lanes and avoiding the attractive but incorrect lanes which the vehicles should not move into
- *Sign Posting* – Increasing the signposting distance as long as possible, which is often subject to the link length to improve earlier lane changes and reduce unrealistic congestion
- *Node Blocking* – Avoiding vehicles staying at signalised intersections when congestion occurs
- *Stacked Turns* – Allowing right-turning vehicles to move into the intersections and either wait for a suitable gap in the oncoming traffic, or make the right-turn at the end of the phase; and
- *Force Merge / Across* – Forcing right-turning vehicles to cross the oncoming traffic after they have been delayed for some time when oncoming traffic leaves a gap at non-signalised intersections.

Importantly, the plug-ins of Level of Service and Lane Choice were used in the modelling process to help measure the intersection performance and assist vehicles to choose appropriate lanes.

3.7 Statistical calibration

3.7.1 Demand release

The demand release percentage is used to validate the modelling results in terms of the amount of vehicle demand being modelled. The rates during the two separate hours reached 100% release, which means all vehicle demand was incorporated into the simulation.

3.7.2 Model stability

Model stability was investigated by the model's sensitivity to a seed used in generating randomness which is a key characteristic of traffic micro-simulation. PB ran the model with 5

random seeds (560, 28, 7771, 86524, and 2849) and the number of "Current Vehicles" in the model for the five runs is presented in *Figure 3-7*.

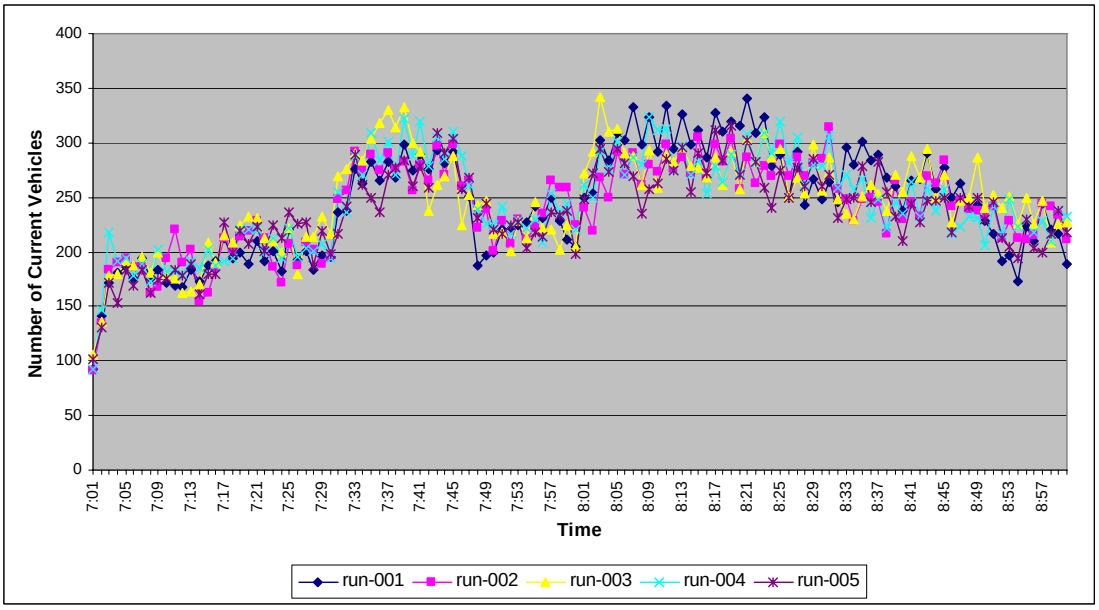


Figure 3-7 Number of "Current Vehicles"

The result shows that the model is stable regardless of the seed number used. Please note the "dip" in the graph was due to a dip in the demand profile of 12% demand for this period of the day.

3.7.3 Flow calibration criterion

PB adopted the GEH[1] as the criterion for traffic flow calibration. The GEH statistic is a form of the Chi-squared statistic that incorporates both relative and absolute errors between the observed and the modelled. GEH values are often calculated for individual links or screenlines. Its form is as follows:

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

Where: GEH is the GEH statistic
M is the modelled flow
C is the observed flow

Acceptability guidelines are recommended for model calibration:

- individual link flows: GEH < 5 for greater than 85% cases
- screenline totals: GEH < 4 for all screenlines.

PB adopted the GEH statistic and its acceptability guidelines for the link flow calibration in this project.

[1] UK Traffic Appraisal Advice, Volume 12, Section 2, Part 1 Traffic Appraisal in Urban Areas – Chapter 4 Traffic Model Development

3.7.4 Link flow calibration

PB selected the key links for the calibration. The locations are presented in *Figure 3-8* and they capture most traffic using most vehicle routes through the study area.

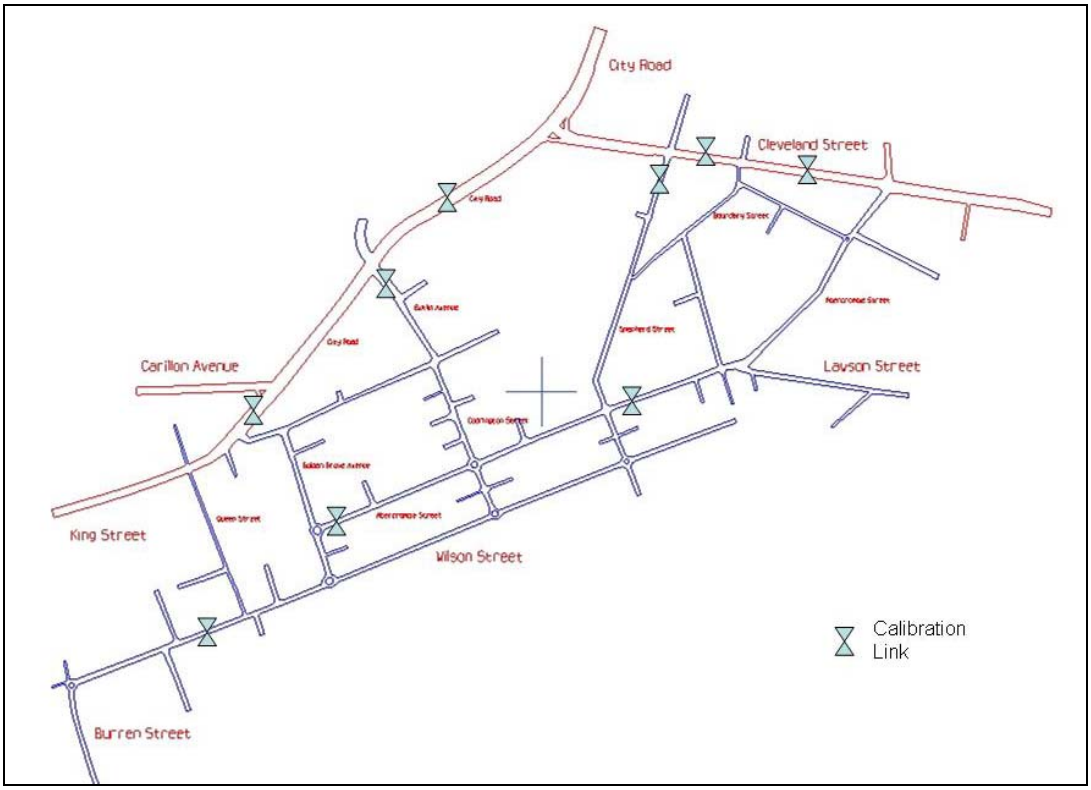


Figure 3-8 Calibration link location

The data resources used for the calibration were those mentioned in section 3.5. The calibration result is presented in *Table 3-2*, which shows all the GEH statistics were under 5.0 and the modelled link flows were satisfactorily close to the observed flows.

Table 3-2 Link flow calibration (in pcus), 8:00 am – 9:00 am

Location	Counts	Model	GEH
NB/EB			
City Road, north of Butlin Av	2,408	2,419	0.2
City Road, south of Carillon Av	1,574	1,653	2.0
Cleveland St, west of Abercrombie St	1,743	1,602	3.4
Cleveland St, east of Shepherd St	1,583	1,615	0.8
Lawson St, west of Little Eveleigh St	423	457	1.6
Abercrombie St, east of Shepherd St	449	458	0.4
Abercrombie St, east of Golden Grove St	376	455	3.9
Wilson St, west of Queen St	495	503	0.4
Butlin Av, south of City Rd	360	379	1.0
Shepherd St, south of Cleveland St	91	141	4.6
SB/WB			
City Road, north of Butlin Av	888	1,013	4.1
City Road, south of Carillon Av	755	788	1.2
Cleveland St, west of Abercrombie St	960	946	0.5
Cleveland St, east of Shepherd St	972	888	2.8
Lawson St, west of Little Eveleigh St	353	342	0.6
Abercrombie St, east of Shepherd St	363	387	1.2
Abercrombie St, east of Golden Grove St	140	106	3.1
Wilson St, west of Queen St	141	147	0.5
Butlin Av, south of City Rd	288	312	1.4
Shepherd St, south of Cleveland St	147	130	1.4

To check the cross-study area travel patterns, a screenline was established for the model calibration, as presented in *Figure 3-9*. The results are presented in *Table 3-3*. The GEH statistics at the screenline were below 4.0. The base model was found to reasonably represent the cross-study area travel pattern.

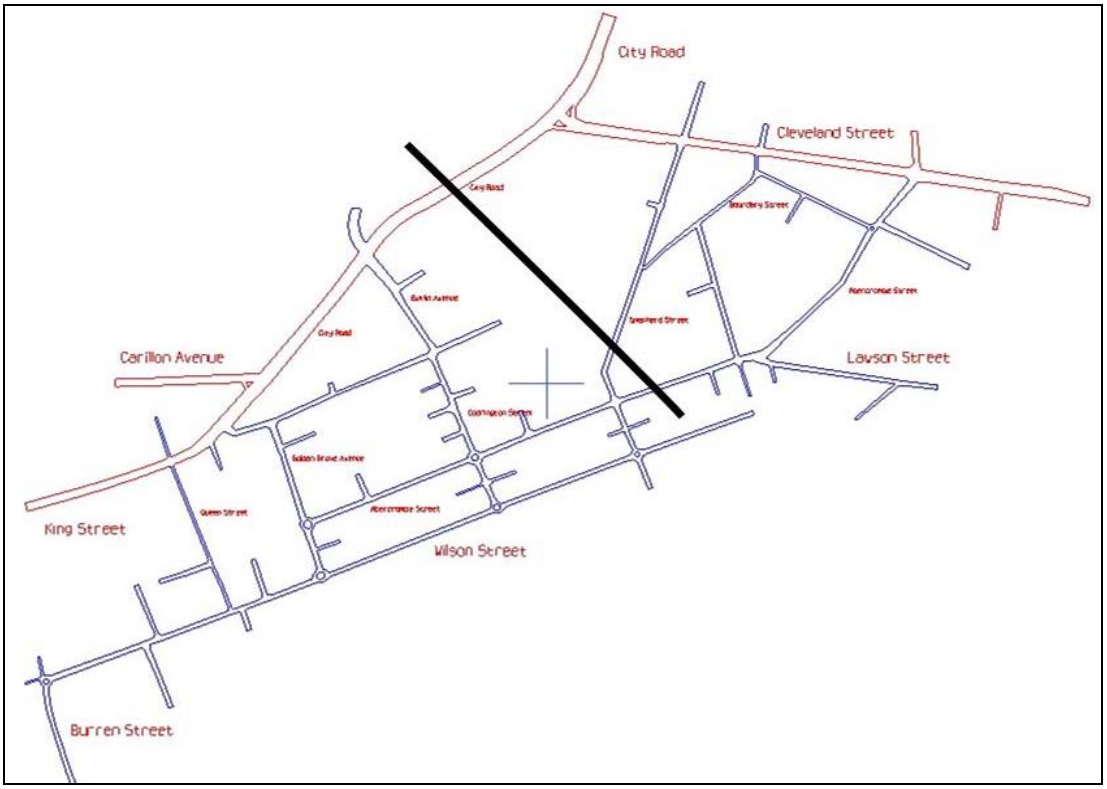


Figure 3-9 Calibration screenline location

Table 3-3 Screenline calibration (pcus, 8:00 am – 9:00 am)

Location	Counts	Model	GEH
NB/EB			
City Road, north of Butlin Av	2408	2419	
Shepherd St, north of Abercrombie St	213	185	
Abercrombie St, east of Shepherd St	449	458	
Total	**3,070**	**3,062**	**0.1**
SB/WB			
City Road, north of Butlin Av	888	1013	
Shepherd St, north of Abercrombie St	71	69	
Abercrombie St, east of Shepherd St	363	387	
Total	**1,322**	**1,469**	**3.9**

3.7.5 Turning movement calibration

To complement the link flow calibration, the turning movements were compared with the modelled movements at the key intersection as mentioned in section 3.2.4. *Figure 3-10* shows the key intersections in the study area. A total of 68 turning movements from the 10 intersections were assessed during the calibration.

Figure 3-11 presents a plot of the correlation between the modelled and the observed values of turning movements at the intersections. The correlation coefficient gives a measure of the goodness of model fit and acceptable values would exceed 0.95. The modelled turning movements at these locations were within the acceptable range of the observed.

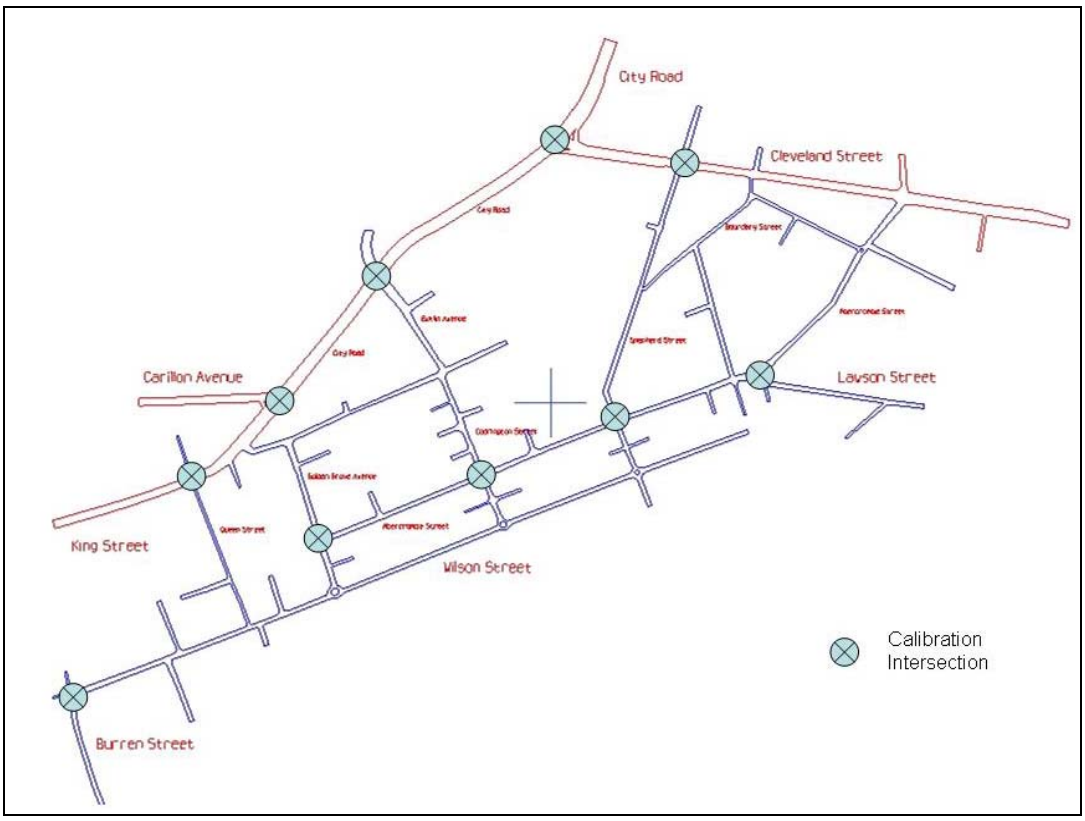


Figure 3-10 Calibration intersection location

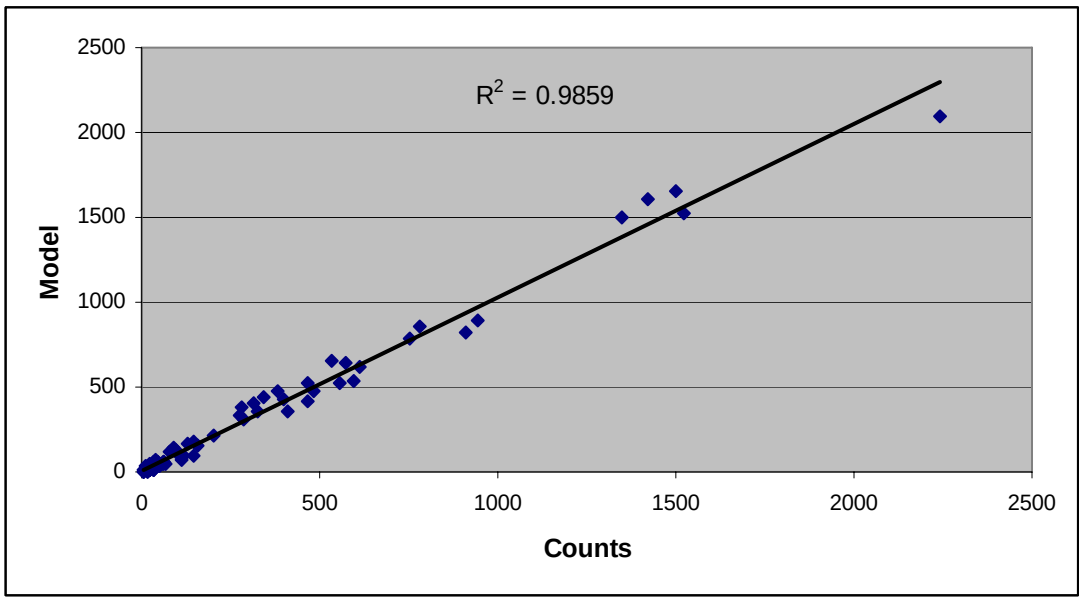


Figure 3-11 Turning movement calibration

Therefore, through the adjustment of model parameters, checking of network coding and undertaking of statistical assessment, the 2006 AM peak base model for the study area was calibrated.

4. Future model development and assessment

The future models were developed to reflect the traffic situation at a time corresponding to the full and established operation of the proposed two re-development sites in 2016. The development of the future models was based on the calibrated base model and they were to be used to assess and distinguish the traffic impacts from the two sites.

The road network and bus services in the future models were assumed to be the same as in the base model. The changes were the future demand which consists of the background traffic growth to 2016 and the traffic generated from the two re-development sites.

The future model also assumed that following intersections were upgraded:

- Abercrombie Street and Lawson Street. The proposed improvements provide extended turning lanes for left and right turning traffic into and out of Abercrombie Street and changes to signal phasing and timings
- Cleveland Street and Shepherd Street. Improvements works include extending the existing right turning bay from 30 to 70m and extending the cycle time
- Abercrombie and Shepherd Street. Replacing the scramble phase with normal pedestrian staging and adjusting signal timings is intended from 60 seconds all day to 70 seconds in the AM peak and 80 seconds in the PM peak.

4.1 Background traffic growth

PB used information provided by the RTA from its strategic metro road model in EMME to gauge the background traffic growth through the study area. The elements of background traffic relate to the regional traffic flow growth pattern which the RTA model has assumed from regional land use growth as derived from State Metro planning, to generate traffic forecasts for 2016.

The relationship of the study area with the travel zones in the RTA model is presented in *Figure 4-1*. The regional land use pattern is organised to the travel zone level.

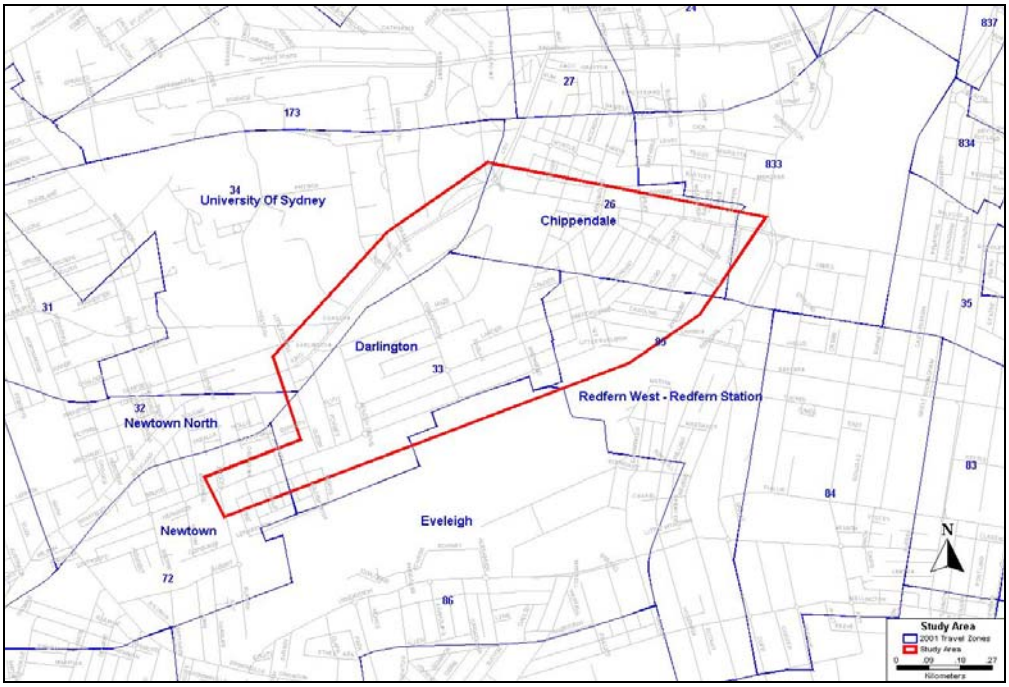


Figure 4-1 The study area relationship to RTA travel zones

The study area geographically overlaps 3 travel zones: 26, 33, and 85. The land use assumptions made in the RTA model in terms of population and employment for the study area are analysed in *Table 4-1*. The analysis indicated that the RTA model only represented the natural growth of present land use in the study area, and it had not included either of the land use changes proposed.

Table 4-1 Land use assumptions in the RTA model

Study Area	2006	2016	Change %
Population	4,664	5,591	20%
Employment	4,369	5,298	21%

PB further analysed the traffic growth along key roads within the study area, as forecast in the RTA model. The results are presented in *Table 4-2*.

Table 4-2 Traffic growth in the RTA model (vehicles in AM peak 2 hour period)

Road	Direction	2007	2016	Change %	Annual Growth
City Rd	NB/EB	5,563	5,524	-1%	-0.1%
	SB/WB	2,071	1,712	-17%	-1.9%
King St	NB/EB	3,012	3,236	7%	0.8%
	SB/WB	950	1,189	25%	2.8%
Cleveland St	NB/EB	3,691	3,773	2%	0.2%
	SB/WB	1,152	1,335	16%	1.8%
2nd section	NB/EB	2,705	3,048	13%	1.4%
	SB/WB	2,047	2,181	7%	0.7%
Carillon Av	NB/EB	2,872	2,668	-7%	-0.8%
	SB/WB	1,121	1,448	29%	3.2%
Abercrombie St	NB/EB	1,143	1,236	8%	0.9%
	SB/WB	30	49	63%	7.0%
2nd section	NB/EB	2,050	2,239	9%	1.0%
	SB/WB	587	711	21%	2.3%
3rd section	NB/EB	1,991	2,253	13%	1.5%
	SB/WB	602	757	26%	2.9%
Wilson St	NB/EB	1,841	1,995	8%	0.9%
	SB/WB	135	354	162%	18.0%
Codrington St	NB/EB	1,188	1,634	38%	4.2%
	SB/WB	1,506	1,778	18%	2.0%
Lawson St	NB/EB	1,319	1,465	11%	1.2%
	SB/WB	968	1,125	16%	1.8%
Total		**40,551**	**43,726**	**8%**	**0.9%**

The traffic difference between 2007 and 2016 varied between locations and a trend of traffic growth for all the key roads as a whole was identified. As a result, PB adopted the average annual growth rate of 0.9% to estimate the background traffic growth from the base model to 2016. Not all traffic changes in the area are growth. This finding is based on assumptions made by the RTA regarding the future regional road network. PB's model is consistent with the level of growth and traffic demand forecast in the RTA Strategic Model for 2016.

4.2 Re-development traffic generation

The traffic generated from the two re-development sites was added to the background traffic growth as the future demand used in the 2016 models. The re-development traffic generation relates directly to the re-development of plans to accommodate the number of residents and employment floor space on each site.

4.2.1 North Eveleigh site

PB processed the re-development plan proposed for the site and organised it into three sections: East, Central and West, and for the three re-development purposes: residential, commercial and retail. Existing floorspace in the CarriageWorks development was not considered, as the associated traffic movements are considered within the Base case.

The RTA *Guidelines for Re-development Traffic Generation* was used to calculate the trip generation rates for each of the redevelopment purposes. The resultant daily trips for the site were estimated and presented in *Table 4-3*. Trip rates where later adjusted by applying factors to account for the mode split targets and to discount for multiple and linked trips.

Table 4-3 North Eveleigh re-development plan

Type	Estimated Quantity	Unit	RTA Trip Rate / Day	Trips Per Day
Residential				
East	486	dwellings	6.5	3,224
Central	0	dwellings	6.5	0
West	772	dwellings	6.5	5,018
Commercial/cultural				
East	49,280[1]	gross floor area	0.14	6899
Central	15,120[1]	gross floor area	0.14	2117
West	0	gross floor area	0.14	
Retail				
East	4000[1]	gross leasable floor area	3.1	12400
Central	0	gross leasable floor area	3.1	0
West	0	gross leasable floor area	3.1	0

Table 4-3 uses gross floor areas and land use provided by RWA. It generates a total of 29,658 trips per day from the site per day.

PB then distributed the 29,658 trips across modes considering the relatively high accessibility of transit and the likely destinations of many trips being within a walkable or cyclable average distance. These daily trips were converted into the AM peak period trips (2 hours) by applying a factor of 0.18. The resulting future demand is presented in *Table 4-4*.

Table 4-4 North Eveleigh traffic modal split

Mode	Modal Split	Total trips	Trips in AM peak 2 hours
Car	40%	11,863	2,135
Walk	10%	2,966	534
Cycle	5%	1,483	267
Public Transport	45%	13,346	2402

A discount of 0.25 for multi-occupant car users was applied to the car trips estimated in *Table 4-4*. That is, 25% of car users were assumed to be car passengers. The final estimate of generated car trips from the North Eveleigh re-development was 1,601 vehicle trips by car during the AM peak period. As there are two access points to the site, an assumption of 80% of the car trips coming to the site and 20% leaving the site during the AM peak period was made and the distribution over the access points is presented in *Table 4-5*.

Table 4-5 North Eveleigh AM peak period car access assignment

Wilson Street Access	In	Out
Near Queen/Forbes Streets	27	108
At Shepherd Street	1004	462

4.2.2 Abercrombie site

The re-development plan for the Abercrombie Precinct focuses on the Sydney University School of Economics and Child Care Centre. The RTA *Guidelines for Re-development Traffic Generation* was used in calculating the trip generation rates to and from the proposed land uses. The resultant daily trip forecast is presented in *Table 4-6*.

Table 4-6 Abercrombie Precinct daily trip generation

Location	Number of People	RTA Trip Rate / Day	Trips Per Day
School of Economics			
Academic Staff	800	2.4	1,920
Students	10,000	2.4[1]	24,000
Child Care Centre			
Staff	30	2.4	72
Students (parents)	200	3[2]	600

[1] Assumed from observed behaviours and not based on RTA guide

[2] Assumed from observed behaviours and not based on RTA guide

PB assigned the trips to modes and converted the daily trips into the AM peak period (2 hours), with the assumption that 40% of staff would use a car and 3% of students would use the same mode, leading to the average car modal share of 7%, this percentage is a reflection of the high number of students compared to academic staff. The results of applying these assumptions are presented in *Table 4-7*. The results of a travel survey conducted by the University of Sydney have been used to calculate the student car share mode split. For Academic staff the mode share target of 40% used. Given the proximity of transit services to the Abercrombie site this mode share was considered achievable.

Table 4-7 Abercrombie Precinct AM peak period trips by mode

Mode	Modal Split	Total trips	Trips in AM peak 2 hours
Car	7%	1,757	439
Walk	19%	5,059	1,265
Cycle	19%	4,949	1,237
Public Transport	56%	14,827	3,707

A discount of 0.52 for multi-occupant car users was applied to the car trips estimated in *Table 4-7*. That is, 52% of car users are assumed to be sharing their car trip, such as students going to the Campus and parents sending children to the Child Care Centre. The final estimate for the Abercrombie Precinct was 213 trips by car during the AM peak period. As there are two access points to the site, a similar assumption of 80% of the car trips coming to the site and 20% leaving the site during the AM peak period was made and the distribution over the two access points is presented in *Table 4-8*. This assumption was made as a result of the access arrangements which would make the Rose Street access less appealing to drivers.

Table 4-8 Abercrombie Precinct distribution to access

Access	In	Out
Access via Abercrombie Street	133	15
Access via Codrington Street	57	8

The total vehicle demand to be modelled in the 2016 models is presented in *Table 4-9*, with the future base case excluding the redevelopment traffic and the future case including the redevelopment traffic, in comparison with the existing base case.

Table 4-9 Total model vehicle demand

	Existing Base Model	Future Base Model	Future Model
Car (96%)	14,674	15,828	17,642
Truck (4%)	628	668	735

So in the two hours of the AM peak in 2016 based on the above scenarios of development, about 2,968 more vehicles would be using the local road network. About three-fifths of these would be generated by the two proposed developments.

The project schedule for the University of Sydney project is lagging the RWA program in terms of lodging an application to the Department of Planning. As a result the design for Abercrombie precinct is less advanced and more subject to change. The University of Sydney also had a number of options for the road network it wished to test that have not been included in the assumptions of the current modelling. One option the University wished to consider was closure of Butlin Avenue to through vehicle traffic in accord with the University Master Plan.

As traffic generation forecasts for the Abercrombie precinct were

- based on expected staff and student numbers, and not derived from gross floor area
- the layout of roads will determine future access proposals.

Modifications to the precinct design should impact little on the conclusions of the cumulative study.

4.3 Traffic performance assessment

The traffic assessment criteria adopted for this project are based on Level of service (LoS) as described in *Table 4-10*. LoS is one of the indicators used to measure intersection traffic performance. According to *Table 4-10*, the levels of service range from "A" (indicating good intersection operation) to "F" (indicating over saturated conditions with long delay and queues). The LoS criteria are related to average vehicle delay (seconds per vehicle) at signal controlled intersections. At priority controlled intersections, the LoS on the movement with the worst average vehicle delay is examined to represent the performance for that intersection.

Table 4-10 Level of service criteria for intersections

Level of service	Average delay (seconds per vehicle)	Traffic signals, roundabout	Give way and stop signs
A	Less than 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	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: RTA Guide to Traffic Generating Developments

PB performed the future model runs in terms of the two scenarios with the future base case demand and with the future case demand with both major developments. The results of the Level of Service assessments at the key intersections within the study area are presented in *Table 4-11*, in comparison with the existing base case.

Table 4-11 Intersection level of service (average seconds delay per vehicle)

Intersection	Base LoS (delay)	Future Base 2016 LoS (delay)	Future 2016 with developments LoS (delay)
Cleveland & City	B (27.9)	C (30.8)	C (38.6)
City & Butlin	B (16.0)	B (17.9)	B (18.6)
City & Queen	A (4.9)	A (4.6)	A (6.1)
Lawson & Abercrombie	B (18.8)	B* (17.7)	B (21.1)
Shepherd & Abercrombie	B (19.4)	B* (19.6)	B* (23.1)
Cleveland & Abercrombie	C (30.8)	C (32.2)	C (33.8)
Codrington & Abercrombie	A (6.6)	A (7.8)	A (9.0)
Golden Grove & Abercrombie	A (2.2)	A (2.3)	A (3.2)
Shepherd & Cleveland	C(42.0)	C*(43.0)	C(43.6)
City & Darlington	A (6.1)	A (6.7)	A (8.7)

* Assumes intersection improvements undertaken by 2016

The assumptions made in the Future Base 2016 case included the increase in cycle times from 60 seconds all day to 70 seconds in the AM peak and 80 seconds in the PM peak. With development it will be necessary to increase cycle time to 90 seconds periods and to replace the scramble phase with normal pedestrian staging, as without improvement this intersection would fail and the model would not work properly.

The assessment results, based on an estimated 29,658 trips per day from the development site, suggest that:

- in the existing traffic situation, the worst traffic performance occurred at the signalised intersection of City Road and Cleveland Street, with a LoS of “C”, which is still at a satisfactory level although it will show signs of stress under unusually heavy conditions. On most days this will be satisfactory even during most of the peak hours. For an urban arterial, this is not a sign of undue constraint, but an alert to watch the intersection in the medium term beyond the 2016 forecast period
- in the future base case without the proposed re-development projects but including the intersection improvements identified in earlier reports, the traffic performance at all the intersections was reduced, but with just with a slight increase in vehicle delay due to the natural growth of background traffic
- the road network will be impacted upon by the combined increased traffic from both proposed developments, however, the impact will not greatly effect the level of service afforded to the key intersections and that the reduction in level of service where this occurs will not reduce the Level of Service below a satisfactory level of C.

4.4 Traffic contribution

As discussed earlier, the intersection of Shepherd Street – Abercrombie Street was identified due to much of its current capacity utilised by the two re-development sites, and this was indicated by the change from the LoS of "B" in the future base case without the developments, to a case where the model would not function without further adjusting the signal timing, and extending it to 90 second phases.

Table 4-12 AM peak period traffic forecasts at Shepherd Street – Abercrombie Street

Site	Inbound	Outbound	Sum	% of Total
Abercrombie Precinct	62	11	73	9%
North Eveleigh	540	180	720	91%
Total	602	191	793	-

Table 4-12 presents the number of vehicles (in pcus) coming and leaving each of the two sites through the intersection of Shepherd Street – Abercrombie Street. The forecast turning movement flows associated with the two re-development sites at the intersection are detailed in Appendix B.

The analysis indicates that at the Shepherd Street – Abercrombie Street intersection, 91% of the traffic increase was generated by the North Eveleigh re-development site and 9% was associated with the Abercrombie Street re-development site.

5. Impact Assessment

5.1 Overview

This proposal is to develop approximately 10.7 hectares of former railway yards north of the railway and to the west of Redfern Station. The proposal will include construction of new residential, commercial and retail space; the removal of contaminated soils; construction of new roadways and accesses; renovation and conversion of existing buildings; the installation of services and utilities and both hard and soft landscaping. A Concept Plan layout of the proposal can be seen in *Figure 1-1*. The site will connect with the existing road network via two new vehicular accesses, 6 sets of pedestrian stairs, two pedestrian footway ramps and a new pedestrian and cycle bridge at the eastern end of the site.

The impact of this proposal is discussed below in three parts:

- cumulative impacts resulting from construction of both the North Eveleigh and Abercrombie precinct developments
- operational impacts that can be expected once the development is completed and occupied
- construction period impacts on the road network resulting from building of the development.

PB worked with the Concept Plan team throughout the development of the concept plan to ensure that all roadways, accesses, turning and loading zones and facilities for parking, cycling and pedestrians where designed in accord with Council standards and good practice. Appropriate cross-sections and layouts have been achieved for all internal roads, intersections and access points. Construction will be required to a standard that delivers a safe, effective and efficient road network and asset.

5.2 Cumulative traffic network impacts

5.2.1 Key intersection performance

The performance of 10 key intersections within the study area has been considered. The current average delay and level of service are reported in section 4.6. The majority of the intersections assessed will have sufficient capacity to accommodate the proposed development at its expected levels of traffic generation. With development, the intersection of Shepherd and Abercrombie Streets will not function at an appropriate level of service without improvements. These improvements include adjusting signal timings to 90 second phases, or alternatively, additional turning lanes could be introduced at the expense of on-street parking.

5.2.2 Contribution of North Eveleigh development to future traffic and capacity utilisation

The redevelopment of the Abercrombie precinct, while having a net increase on the surrounding network, is a minor contributor to the overall traffic increase expected. Comparing the traffic flows originating from Abercrombie precinct and the North Eveleigh site suggests that approximately 10% of the traffic growth at the three intersections that require upgrading is attributable to the Abercrombie Precinct development so that the intersections perform satisfactorily.

5.2.3 On-street parking supply impacts

The development of North Eveleigh will have a limited impact on on-street parking. With approximately 75 on street car spaces to be provided on the North Eveleigh site the development is providing adequate, but not car traffic inducing levels of off road parking facilities for all new buildings. The access arrangements proposed for the site were aimed at minimising the impact on on-street parking supply. A limited number of spaces may be lost adjacent to the accesses to the site and at intersection improvements at Abercrombie and Shepherd Street, Abercrombie and Lawson Street, and Cleveland and Shepherd Streets. However, the increase in road kerb space available for on-street parking in the study area from the creation of new roads within the development should maintain the current on-street parking supply.

5.3 Operational impacts

5.3.1 Traffic impacts

The traffic model showed that the traffic impact of the two developments could be accommodated within the existing road network provided that improvement works are in place with the opening of occupancy of the developments. This was assumed in the network tested in the Paramics modelling and included:

- for the Shepherd Street intersection with Abercrombie Street, removal of the scramble pedestrian crossing phase and increasing the cycle time to 90 seconds. Alternatively, additional turning lanes could be introduced at the expense of on-street car parking
- for Cleveland Street and Shepherd Street, extending the left turn bay from 30m to 70m to increase storage capacity for cars waiting for the signal changes
- Abercrombie and Lawson Streets, provide 30m of left turn bay and 30m of right turn bays on Abercrombie and Lawson Streets respectively.

With these measures implemented, all intersections will have an acceptable level of service up to 2016. Given the forecast growth of traffic in this area, performance levels may remain acceptable for many years beyond this. Approvals to traffic signal phasings and layouts would need to be agreed with the RTA and carried out by them as required.

5.3.2 Heavy truck traffic

The site currently generates very few truck movements, just those serving the CarriageWorks performance arts centre and for railway maintenance.

The site will generate an increase in heavy truck traffic, particularly on Shepherd Street, Golden Grove Street and Wilson Streets, but in accord with the mix of traffic in the area generally. The amount of trucks generated will be dependant on the nature of the businesses that take up the retail and commercial spaces. As the roads in study area currently have a low percentage of heavy vehicles, the increase may be perceptible to residents but should not constitute a nuisance, however, in real terms the future proportion of heavy traffic will still be low when compared to other parts of the inner city.

5.3.3 Amenity impacts

Amenity impacts are of concern on roads within residential areas, where the road network contains predominately local roads. Amenity, while hard to define and subjective, is a measure of the safety, security and ability for residents to use and enjoy their street environment. Amenity is reduced if traffic volumes are excessive for the class of road or speeds too high, as both these factors decrease the ability for a community to integrate and cause severance. The amenity of a road is also affected by other factors including the types of vehicle using the road (the percentage heavy vehicles in the traffic flow), road widths and footway widths, gradients and building setback from road reserve.

Based on considerations of the amenity and safety, the proposed development is not expected to create traffic conditions that adversely impact upon the amenity and safety of the surrounding environments as:

- traffic flows will be well within the local road capacities
- traffic is calmed by the roundabouts along Wilson Street, and most other streets are narrow, subject to roadside parking and have turn restrictions which also reduce speeding behaviours
- no widening of road carriageways are proposed
- the established residential area is relatively flat with low levels of heavy vehicle use.

5.3.4 Parking

As discussed in section 7.8, the permanent impacts on on-street parking are associated with construction of the access ways and associated works to accommodate changes to there intersections and the works required to upgrade the critical intersection as a result of the development. In terms of off-street parking, the parking principles set out in the City of Sydney LEP 2005 Chapter 2 Part 5 and the controls from the former South Sydney DCP 11 were applied to the development. These would supply sufficient parking off street to cater with expected car travel without encouraging car travel. Some parking capacity will be added on street for casual use in the new streets through the area. In accord with the objectives of the draft metropolitan parking strategy, as described by MoT and RTA officers, parking provisions have taken into account the high level of transit available to residents and workers on the site, and that many of the retail uses are primarily to serve the local community and not attractors of large numbers of car trips, especially during peak traffic periods.

5.3.5 Local access and emergency access

The proposed road layout for the North Eveleigh development, with two access points suitable for all traffic and a permeable road system that allows vehicles to enter and exit by either access should not present access issues for local or emergency access. Both access-ways will became part of the Council's road network in time and will be constructed to appropriate standards. Any areas that are designed for pedestrians only will be constructed so that emergency vehicles can mount or remove barriers and bollards with emergency access keys.

5.3.6 Vehicle access to site

The site accesses will be designed to accommodate turning by articulated vehicles and will in time form part of the council's road network. The western access near Queens Street will be widened and located to provide at least the minimum forward visibility required by road authority guidelines. The Shepherd Street access will require the existing roundabout to be widened and deflected to the south. On completion, the accesses will be of a standard to afford a high level of service, minimise conflicts for pedestrians and will allow general traffic movement in all directions.

Two vehicle accesses are proposed. At the western end, the existing access will be widened, and the entry radius increased, to improve forward visibility and allow for movement by semi trailers. The eastern access will join a remodelled roundabout at the intersection of Wilson Street with Shepherd Street.

The western entrance (shown in Figure 5-1) will be formalised with kerb and gutter. The entrance will form a T intersection with Wilson Road. The access is proposed to be moved approximately 4m to the west and widened to approximately 10m to provide good forward visibility and accommodate the movement of semi trailers without the need to straddle the centre line of the road. The kerb space needed to the proposed access is currently not used for parking. However, to achieve good forward visibility it may be likely that up to 4 parking spaces either side of the access will need to be removed.

The eastern access (shown in Figure 5-2) is proposed to join into a remodelled roundabout at the intersection of Wilson Street and Shepherd Street. This roundabout will be enlarged to accommodate turning movements of semi-trailers. The additional space needed to accommodate the roundabout being provided from within the site. The existing roundabout restricts parking in this area so the remodelling of the roundabout and adding the extra leg to form an access into the site will remove few parking spaces.

Access for semi-trailers will be limited to left in, right out, at both accesses as exiting movements via left turns would take semi-trailers onto weight limited routes.

The introduction of two new site access points will introduce additional conflict points for pedestrians and cyclists, particularly the more vulnerable pedestrians. Careful design, lighting and provision of pram ramps will mitigate this concern.

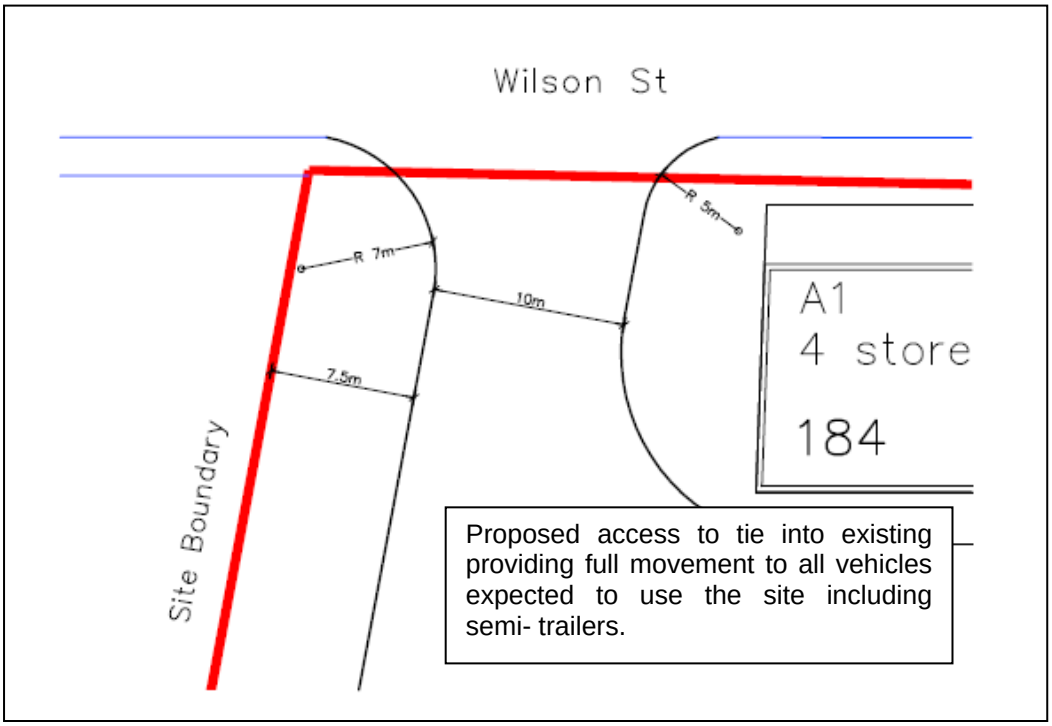


Figure 5-1 Western Access to the North Eveleigh Site

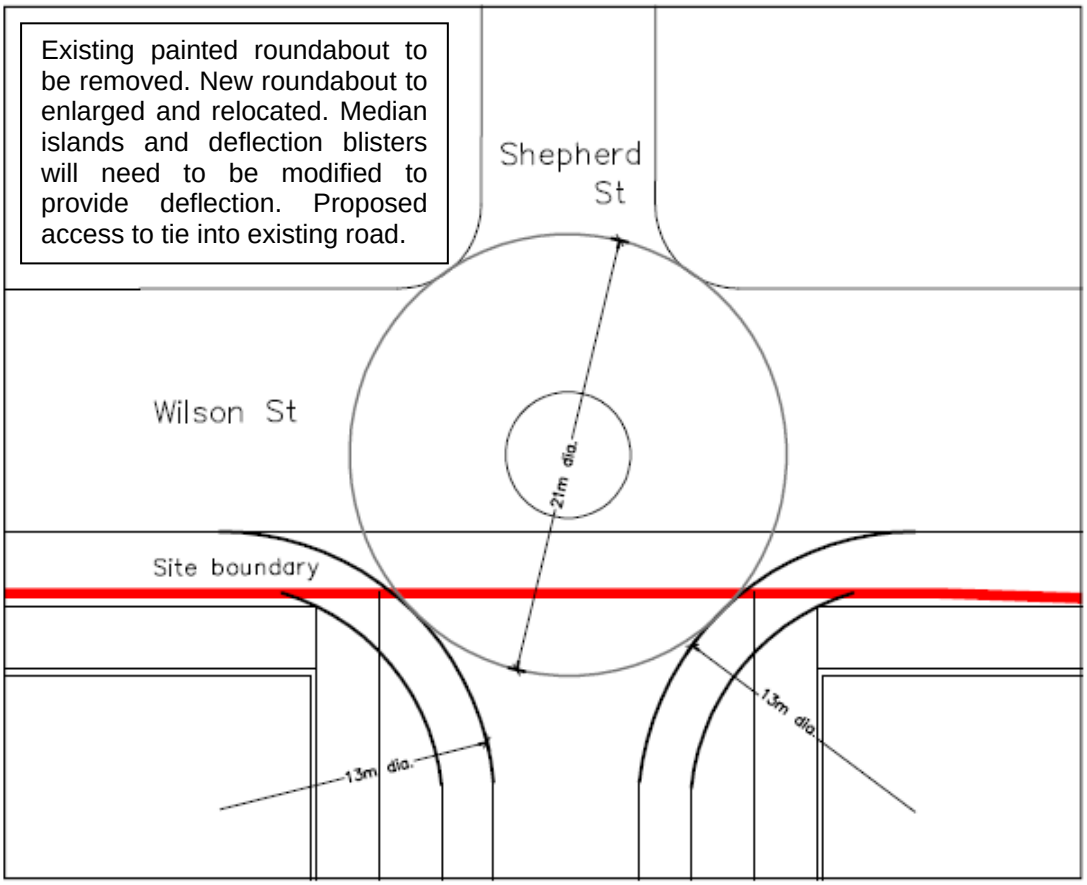


Figure 5-2 Eastern access to North Eveleigh Site at the intersection of Wilson Street with Shepherd Street

5.4 Construction impacts

5.4.1 Proposed construction method

The construction method and staging adopted by the principal contractor will need to give consideration to:

- the needs of residents
- the existing traffic levels and road network constraints
- management of traffic generation
- the needs and constraints of the site and site access.

The contractor will need to prepare detailed Traffic Management Plans for all activities that will impact on the road network. These may include construction of the access improvements and removal of contaminated soils and transportation of oversized loads including cranes to the site. The main impacts caused by the construction are likely to arise from site traffic, as it should be feasible to park and store all materials on site.

5.4.2 Traffic

Traffic to the site during the construction phase will include heavy vehicles delivering and removing plant and materials and the traffic conveying site construction staff. It is suggested that the first undertakings of the principal contractor are:

- to modify the access at the western end of site to provide sufficient forward visibility and accommodate entry for semi-trailers
- to modify the roundabout at Shepherd Street and Wilson street and provide the access way into the western part of site.

Works to improve accesses into the site will need to be phased to retain access to properties in Wilson Street. When the two access points are complete, the site should have the capacity to park and store all site related staff and traffic and thus should not impact on parking in local streets. Many construction staff not providing their own tools are likely to travel by train to reach the site.

Construction works in the early stages will include demolition, ground works and contaminated land remediation. This phase will include significant truck movements. The number of movements, there impact on the road network and how they are managed would need to be described in a Traffic Management Plan developed and submitted by the principal contractor. Early stages are machine intensive and tend to require a small but highly mechanised work force.

Later stages of the construction will involve trades people and their assistants. This tends to generate significantly greater traffic than the earlier stages. However, construction workers are often keen to get started before the heat of the day. If the usual work commencement time of 0700 applied to weekday, travel would be before the morning peak hour rush and could be accommodated without impact on the performance of the traffic network.

5.4.3 Heavy Vehicles

As discussed above the construction of the proposal will attract heavy vehicle activity at key times in the stages of work. These peak periods will need to be especially managed under a TMP for the site.

The proposed truck routes are

- from City Road via Golden Grove Street to Wilson Street in both directions
- from City Road to Wilson Street inbound and outbound via Golden Grove Street
- from City Road via Butlin Avenue, Codrington Street and Wilson Street inbound
- from Cleveland Street Shepherd Street in both directions.

All these routes have sufficient capacity to accommodate a significant amount of traffic during the off peak periods. As with traffic generated by site staff, it is recommended that deliveries are avoided during the peak commuter hours.

5.4.4 Noise and dust

The construction of the development will involve both demolition of buildings and decontamination of land, mostly containing heavy metals and oils as a result of rail work such as cleaning and painting trains and train carriages. This may generate dust which could have an unacceptable risk of hazard to the community. The contractor will need to prepare a work method statement for how the above works will be undertaken minimising the creation and escape of dust.

Construction activities, particularly demolition and piling, can cause uncomfortable levels of noise. These activities should be minimised and undertaken during the day when background noise is greatest. Given the proximity of the railway, background noise will be high so general truck and site traffic should not have a great impact on receptors in the surrounding environment. Noise monitoring along with a noise level intervention plan should be developed by the contractor to ensure the impact from noise is minimised. The noise intervention plan should also give consideration to the hours of working.

5.4.5 Days and hours of working

The days and hours of working will be dictated by the project program, concerns of residents and the phasing of works. The development consent standard conditions for the City of Sydney suggest that for a non CBD area the hours of working should be between 7am to 5.30pm.

PB would recommend that the working day should start and end either before or after the peak hours these being from 8am to 9am in the morning and from 4pm to 5pm in the afternoon. Traffic on the weekend and during university and school holidays is significantly lighter so the working day in these periods could start and end during the peak hours if required.

6. Management of impacts

Throughout the development of this proposal the planning team have sought to minimise the impact of increased traffic on the neighbouring road network by developing a proposal that takes advantage of good connections and the existing available capacity of the local public transport infrastructure and in particular to Redfern Railway Station.

6.1 Traffic

In the ten year period between the two model years, traffic on all the roads within the study area could gradually increase by approximately 3,000 vehicles. The road network generally has sufficient capacity to accommodate this increase, however, these increases will have an impact, particularly during peak periods, on the three identified intersections. To ensure that the level of service on these intersections remains satisfactory, capacity modifications are proposed.

Traffic may be an issue during the construction and PB would recommend that the principal contractor be required to prepare a TMP as discussed next.

6.1.1 Traffic management plans

It is recommended that the principal contractor for the proposed development be required to produce a traffic management plan (TMP) in accord with RTA guidelines. This TMP would need to set out the likely impacts on the road network, nature and timing of works and how site traffic will be managed. Particular attention will need to be given to identifying routes for heavy traffic, suitable delivery times, arrangements to minimise noise and dust and arrangements for parking and travel to the construction site. The CarriageWorks project TMP could guide the developers on the likely conditions. This report should be sufficient background for the underlying traffic conditions. A TMP will need to be prepared by the principal contractor at the project application stage to confirm the details of its mitigation process.

The construction method and timing are not known at this time, however, construction would be undertaken in stages with the western section of site likely to be the first built. It is recommended that the access way and road link to the south of the site be constructed early in the construction program to provide a safe access and egress for all vehicles including trucks and semi-trailers. The enlargement of the existing roundabout at Shepherd Street and Wilson Street and connection into the site should also be undertaken early in the construction program.

PB recommends that the working day starts and finishes outside the peak hours of 8am to 9am and then 4pm to 5pm to minimise conflicts with commuter peaks.

6.1.2 Key intersection improvements

The Paramics model has confirmed that intersection improvements are required for the three intersections. These improvements involve:.

- for the Shepherd Street intersection with Abercrombie Street, removal of the scramble pedestrian crossing phase and increasing the cycle time to 90 seconds. Alternatively, additional turning lanes could be introduced at the expense of on-street car parking
- for Cleveland Street and Shepherd Street, extending the left turn bay from 30m to 70m to increase storage capacity for cars waiting for the signal changes
- Abercrombie and Lawson Streets, provide 30m of left turn bay and 30m of right turn bays on Abercrombie and Lawson Streets respectively.

Given the general predicted annual traffic growth of 0.9%, it is likely that this intersection could continue to function adequately for years beyond 2016 before it reached capacity.

PB recommends that the any intersection improvements required as a result of the developments be funded by the developments on a 90% North Eveleigh development and 10% Abercrombie precinct basis.

Improvements will not involve construction, but alterations to signs, lines and signal phasing.

6.2 Public transport

6.2.1 Public transport strategy

The public transport strategy for this proposed site has been set out in the Traffic and Transport context to the draft Built Environment Plan prepared for RWA by PB. The key to this strategy is achieving a 60 percent non-car mode share for commuters. Given the potential for short travel distances and transit infrastructure in the locality, this is achievable.

The site has adopted a parking standard combining the residential parking rates provided in City of Sydney LEP 2005 Chapter 2 Part 5 and the commercial parking controls from the former South Sydney DCP 11, the reasoning for this is explained later in this report. The adopted parking uses the existing standards and fits with the intent and objectives of the LEP to constrain traffic growth while ensuring sufficient parking provision to prevent excessive demand for on street kerb space. Studies around the world have shown that for new developments where good public transport infrastructure exists, providing information at the point of purchase and within a ‘home owners’ pack and within green commuter travel plans can greatly improve non-car mode share. Experience also shows that once travel by public transport or by car is established, there is significant resistance to changing mode. It is thus imperative to achieve a good level of connection to public transit at the outset.

6.2.2 Redfern Station upgrade

RailCorp have recognised the need for the Redfern Station to be upgraded in its Easy Access program and perhaps with some further enhancements. The RWA and RailCorp recently commissioned a study of potential upgrade plans for the Station. The results are awaiting government guidance on funds available, but it is clear that the more accessible the final plan to the surrounding area available for redevelopment, the better the area can achieve the objectives of the Metro Strategy. Despite, the very high accessibility and frequency of service to the train station, the site is compromised. This site has inadequate cycle facilities, poor access and capacity for pedestrians, only partial protection from sun and rain.

The rail bridge at Lawson Street constrains all the suburban and country rail lines within a tight corridor. The difficulty of working and operating in this dense area restricts the options available to RailCorp. PB spoke with RailCorp in 2007 who confirmed it had begun the process of redesigning this station, but that no time scale has yet been set for the anticipated improvement works.

Redfern Station is crucial to achieving the mode share target for the North Eveleigh Development and improvements to the station would assist. However, findings from earlier work undertaken by PB would suggest that the station has spare capacity and will be able to accommodate the increased patronage resulting from both the North Eveleigh and Abercrombie proposals.

6.2.3 Bus routes and pubic transport improvements

Bus routes on Lawson Street, City Road and Gibson Street are within 800m of the site and within an easy walking distance. It is not proposed that Bus routes be diverted to get closer to the site as this would slow current routes and existing infrastructure and bus stops should accommodate the increased demand. Demand for bus and transit from the university and the North Eveleigh sites is estimated to increase by 7,000 trips a day in the AM peak.

6.3 Pedestrian facilities and network

6.3.1 Pedestrian and cycle bridge over railway

The Redfern-Waterloo Authority propose a pedestrian and cycle bridge to connect Little Eveleigh Street where it joins with Wilson Street with Cornwallis Street as a separate application. This facility would provide a significantly improved route from Redfern and Redfern Station to North Eveleigh and Darlington. The route would provide pedestrians with an alternative to the narrow footway in Lawson Street, and be more direct to the rail, bus and taxi services to be found along Gibbons Street. The pedestrian and cycle bridge would extend and increase connectivity and directness in the cycle network and provide a valuable link in accord with the RTA regional bike plan and the City of Sydney's bike plan.

6.3.2 Pedestrian access improvements

The site has considered pedestrian access and will provide a good level of pedestrian permeability onto the site via a number of new footpaths, ramps and flights of stairs. Footways within the site will be of a good width and the walking and cycle routes generally follow desire lines. A road safety audit of all plans for cycle and pedestrian facilities within the site is recommended at the appropriate stage.

A key pedestrian route to the site is likely to be from the railway station gateway on Lawson Street via Little Eveleigh Street to Wilson Street. This route is a signed cycle route. It is generally quiet and has good footway widths, except for a section of footway in part of Little Eveleigh Street which is narrowed because of tree planting in the footway. The section of Little Eveleigh with a narrow footway does, however, have a low traffic speed and volume so walking in the road is not uncomfortable for pedestrians although greater care is needed.

The route from the railway station entrance in Lawson Street to the landing of the proposed foot bridge is approximately 140m. From the southern entrance of the railway station to the landing of the proposed footbridge via the proposed bridge is approximately 190m.

Other routes will include the new pedestrian bridge and a route to the university via Shepherd Street and Codrington Street. The pedestrian bridge is discussed above. The route to the university has good, unobstructed, well lit footways with the only significant hazard being the signalised crossing at the intersection of Abercrombie and Shepherd. This intersection needs to be upgraded and the needs of pedestrians at this intersection are an important part of the final design. PB recommends that the improvements needed to ensure the intersection of Abercrombie and Shepherd Streets functions with a reasonable level of service for traffic flow should include improved pedestrian facilities, too, as this is a key pedestrian crossing point.

6.3.3 Wayfinding and directional signing

The provision of adequate directional signs can reduce the recirculation of traffic by up to 5% according to studies by the Department for Transport in the UK. Directional signing can also be used to influence drivers' choice of route onto the wider road network.

Wayfinding signs and information boards within the site for cyclists and pedestrians can greatly improve the legibility of their networks and be of significant assistance in promoting mode shift away from the car to more sustainable travel modes.

6.4 Cycle facilities and Network

6.4.1 Cycle facilities

The road network within the site has been designed to be cycle friendly with good, level and direct access to most buildings within the site. Egress and access to the site does include ascending and descending slopes with a grade of approximately 1 in 20, however, the distance is short and the network both internal and external to the site is generally level. Cycle parking within the site should be provided at different locations and of different standards of security. Low security cycle racks such as cycle stands should be provided in front of the retail areas and in communal areas for casual use by office staff in the commercial areas. Secure cycle parking, in the form of cycle lockers or cycle cages should be provided in each of the proposed underground car parks.

The former South Sydney DCP 11 provides rates for cycle parking provision for commercial and domestic buildings. Additional to these showers and changing rooms should also be considered.

6.4.2 Integration and supplementation of cycle network

A dedicated cycle network within the site has not been proposed and indeed is unnecessary given the low traffic levels and proximity to major regional routes. Signing at the access points to the site should inform cyclists they are joining a dedicated cycle route along Wilson Street and in warn motorists that cyclists are likely to be present.

All the internal roads have sufficient width to accommodate the expected level of cycle use. The internal roads, with the exception of the access roads immediately adjacent to Wilson Street, being flat and level are ideally suited for cycling.

The proposed cycle and pedestrian bridge at the eastern end of the site will provide a safer and more convenient route for cyclists between the site and Redfern. This proposed route will enhance connectivity of the existing City cycle network and accords with the RTA's regional bike plan.

6.5 Provision for emergency services

All accesses to site and roads within the site will be constructed to a standard suitable to support the loads and widths associated with the heavy vehicles deployed by the NSW fire and rescue service. The site has been designed so that fire appliances, turn tables and ladders can access all buildings in an emergency. The location of hydrants, booster valves and fire control rooms is beyond the scope of this report however, emergency vehicles will be able to stand within 20m of all buildings in the development.

PB has worked with the Concept Plan team to ensure that all the internal roads, turning and loading zones can accommodate any emergency vehicle likely to be called to the site. The main routes into the site can accommodate vehicles up to, and including, semi trailers so they can accommodate any vehicle currently used by the NSW Fire and Rescue Service.

The site has been designed to be sufficiently permeable to traffic, allowing emergency vehicles free movement to any part of site from either access. This allows emergency services to enter via the nearest access regardless of direction of approach.

6.6 Provision for heavy vehicles

The design for the development has given consideration to the needs of heavy goods vehicles including for the construction phase where heavy vehicles will be transporting materials and plant to the site and removing unsuitable materials and contaminated ground from the site; and the operational phase where heavies will be required to serve the CarriageWorks and retail stores, collect waste, provide commercial deliveries along with casual deliveries and removals from residential properties.

The construction phase traffic is considered in detail in section 5.4, with this section focusing on the needs of future operational traffic.

Consideration has been given to providing suitable facilities for the movement and turning of trucks including for waste disposal vehicle movement and normal deliveries. PB contacted the City of Sydney regarding the disposal of waste from this site and was informed that the most likely vehicle size that would be used in this area was a Medium Rigid Vehicle (MRV) 8.5m long, 2.0 wide and 3.5m in height. With the exception of the two truck routes, described in the next section, all truck facilities have been design to accommodate a MRV.

All heavy traffic approaching the site is anticipated to be coming from the west along Wilson Street or via Golden Grove then Wilson Street. Truck traffic will also leave along the same route. Within the site, two articulated vehicle routes are to be provided. Details of these are provided below.

6.6.1 Turning and manoeuvring within development

The turning heads within the site have been designed to accommodate an MRV with the exception of the loading and turning area to the rear of the Paint Shop which was designed for articulated vehicles. Autotrack software package was used to ensure trucks could turn at each cul-de-sac and traverse the road network within the site. Sketches of the tracked roadways and turning heads are included in Appendix C and demonstrate that the site provides good facilities and adequate turning for all likely truck traffic.

6.6.2 Articulated vehicle routes

At the centre of the proposed North Eveleigh site are two large heritage buildings the Carriage Workshop and the Paint Shop. Both require access for articulated vehicles (AV) or semi trailers at some time. PB has undertaken analysis of the routes to both buildings using Auto-track software which uses vehicle templates based on Australian Standard and AustRoads vehicle types.

The Carriage Workshop is an existing heritage building that had been converted into performing arts centre, known as CarriageWorks. It requires access for occasional AV traffic for delivery and transport of exhibitions, staging and scenery. The proposed route for AV traffic to the Carriage Workshop will be via the internal road parallel to Iverys Lane, the main east-west access road, an access road across Traverser No.2 and a one way access road along the rear boundary of the site.

Figure 6-1 Articulated vehicle route to Carriageworks Centre

Prior to the conversion of the CarriageWorks, PB undertook a study to determine the requirements for AV traffic. This concluded that traffic would be light and that as a result the existing traffic situation would be acceptable despite reduced visibility for traffic exiting onto Wilson Street. The development of the western end of the site will include the upgrading of the access as described earlier in this report. The upgraded access will provide line of sight for drivers and other road users and allow for semi trailers to track around the junction without crossing the centre line. The access will be built to a standard acceptable to Council.

The Paint Shop is proposed to be converted into a retail area to serve the local community and is likely to require regular, possibly twice daily, deliveries. Articulated vehicle traffic for the Paint Shop is proposed to be routed via the Shepherd Street access to the rear of the Paint Shop as shown in *Figure 6-2*. To accommodate articulated vehicles the internal kerb radii for each bend and intersection should be at least 10m along the length of this route. PB has worked with the design team to ensure than on routes potentially used by semi trailers all roads are of sufficient width with appropriate turning capacity so that vehicles can remain wholly within the roadway and not overrun kerbs or overhang footways.

Figure 6-2 Articulated vehicle route to loading dock at the rear of Paint Shop

Commercial vehicles must enter and exit a site facing forward. To achieve this, a vehicle either has to be able to turn within the site or must be able to travel around a loop.

Following initial discussions with the RWA project manager, the option of tacking an articulated vehicle around the Paint Shop was discarded. PB was asked to investigate 3 options for turning articulated vehicles to serve the rear of the Paint Shop. These options are shown on sketch plans 5a, 5b and 5c in Appendix C. The preferred option is to provide a reverse entry service area into the Paint Shop, as shown on sketch plan 5c.

A single loading dock is sufficient given the Concept Plan understanding of the retail space, however, no study or analysis was provided or undertaken to support this. If additional loading docks are needed once a given retail operator is identified, then the turning areas would need to be increased accordingly.

6.7 Provision for waste disposal vehicles

Provision has been made within the site for waste disposal vehicles to access and service the site. Both accesses have been designed to accommodate articulated vehicles and are suitable for the size of waste disposal vehicles expected. Waste collections from domestic and commercial sources have been considered with turning heads and sufficient road widths provided.

6.7.1 Policy and guidance

The following policies for providing for providing for waste disposal vehicles are considered in the development of the Concept Plan including:

- the South Sydney Development Control Plan 11 – Transport Guidelines for Development 1996. This document sets out general information on all transport issues a development must consider and defaults to the Australian Standards for detailed design considerations. This document while still current, is due to be updated
- Australian Standard AS 2890.2 – 2002 Parking facilities, Part 2 Off-street commercial vehicle facilities. This document sets out the design criteria for a range of commercial vehicles and issues that should be considered by the designer
- Council of the City of Sydney Policy for Waste Minimisation in New Developments, 2005. This document sets out the measures a new development must take to control waste production. The document also provides information on the design of roads for waste collection vehicles.

PB has worked with the project team to ensure that the waste policy and guidance were applied. Turning facilities are provided where needed to ensure that all vehicles can manoeuvre within the internal roads, and enter and exit the site in a forward direction. Road widths and intersection radii were checked to ensure vehicles can pass and manoeuvre about the site safely and efficiently.

It is recommended that all new developments prepare a waste management plan (WMP). This plan would need to provide the detailed information on how waste was to be minimised and how collection services would need to operate. It is recommended that a WMP for the North Eveleigh would specify a MRV as the maximum size of waste disposal vehicle to be used within the site.

6.7.2 Size of waste collection vehicle

The size of waste collection vehicles in use within the City of Sydney and by private operators depends on the type of service provided. Best practice is to design pavements, accesses and turning provisions to cater for the least favourable vehicle size regardless of the sizes of vehicles currently in use. This approach provides scope for future changes to the operation of the waste collection services. The least favourable size of waste collection vehicle is a heavy rigid vehicle (HRV) as defined by AS 2890.2. This has a turning radius of 12.5m a vehicle length of 12.5m, width of 2.5m and height of 4.5m. This size of vehicle is currently not used in this part of Sydney.

Site constraints and the need for waste disposal from within buildings make a Medium Rigid Vehicle (MRV) the most suitable size for waste disposal. This vehicle size has been used throughout the design of the roadways and turning heads in the development, with the exception of the articulated vehicle routes, as the maximum sized design vehicle. An MRV has a length of 8.5m, width of 2.5m and height of 3.6m and an inside turning radius of 6m.

6.7.3 Access and turning provisions

Best practice is to design a development to provide separate entrance and exit so that a collection vehicle can travel in a forward direction at all times. Generally, with all commercial vehicles, the need for reversing movements should be avoided, but where reversing is required this should be a single movement.

Guidance does not preclude the use of cul-de-sacs or suggest that their use should be avoided, however, it is required that where cul-de-sacs are included within a development, and are expected to be used by waste collection vehicles, suitable turning provision in the form of a Y, T or bowl-turning facility be provided.

The turning heads at the two cul-de-sacs shown for the western residential development portion of the site would need at least 38m by 3m, with 10m radii, to accommodate an HRV. This is reduced significantly for an MRV, to approximately 18m by 3m with 8m radius. As well as the turning heads within the western end of the site, an additional turning head has been provided to the rear of building P1 to facilitate turning of waste disposal trucks and other heavy vehicles.

PB has tested all the turning heads within the site. All the turning heads can accommodate vehicles up to the size of an MRV.

6.8 Parking

Parking is provided both on and off street within the site. The site has been designed to provide sufficient parking to meet the needs of residents and commercial activity without encouraging excessive use of on street parking and limiting available parking to constrain travel demand.

6.8.1 Parking standards

PB undertook a comprehensive review of available parking standards as part of the draft Traffic and Transport Strategy for the Draft Built Environment Plan. This report concluded that the most appropriate standard for the RWA to adopt, at that time, was the controls set out in the South Sydney DCP 11 modified to account for the proximity of the Redfern Railway Station and the good provision of transit into the city CBD area.

At the time of writing this report, the City of Sydney was updating its parking controls, however, the intent of these controls can be understood from the objectives contained within Chapter 5, Section 2, of the City's LEP. It states that parking rates should constrain car use and encourage the use of transit, while keeping the cities streets clear of excess parking.

PB and RWA have adopted the parking control rates set out in Table 6. These are based on the rates for residential development proposed as maximums within the City of Sydney LEP and reflect RWA's mode share target of 60% for non car travel within its area and the wider mode share targets of the City of Sydney. For commercial development, the South Sydney DCP 11 rates have been adopted as these provide simple rates in keeping with the LEP objectives and the objectives of the RWA to constrain demand for commuter car travel while providing a sufficient level of parking to prevent excessive on street parking. Similarly rates adopted for retail development are designed to reflect the accessibility of the site to public transport, and also intention to serve the local population.

The existing CarriageWorks development includes approximately 116 spaces, as required as a condition of consent by City of Sydney Council. This reflects a rate of approximately 1 space per 0.006m^2. For consistency this rate has been applied to the remainder of the Carriage Workshop development. The Blacksmith's Shop has an approved use as a car park for 51 spaces.

These car parking rates and the number proposed are included in the table below.

Table 6-1 Car Parking for the Development

Number of Dwellings	Dwelling Type	Car Parking Rate	Number Provided
111	Studio	0.25	28
391	1 bed	0.50	196
571	2 bed	1.20	685
185	3 bed	2.00	370
Other			
53,280m^2	Commercial, Retail and Cultural use	0.008/m^2	426
31,468m^2	Commercial/Cultural (CarriageWorks)	0.006m^2	187.
3,120m^2	Car Park (Blacksmiths')		51
Total			**1,943**

The proposal provides for a total of 1,943 car parking spaces. A total of 1,279 of these will be associated with residential development for residents and visitors, 426 with retail, commercial and cultural development and 238 spaces with the cultural, commercial and car parking uses in the centre of the site.

6.8.2 Parking for disabled drivers and passengers

Australian Standard 1428.1:2001 sets out the required parking spaces for disabled people.

The former South Sydney DCP 11 requires that for parking areas with more than 50 spaces, 2% of spaces are provided for people with disabilities. The total parking required for commercial, retail and cultural uses in the eastern end of the site is 426 spaces, of which 9 spaces should be dedicated to parking for the disabled.

Priority will be given to providing these spaces as close to entrances or lifts as practical. Disabled spaces need to accommodate ease of entry into the bay and should provide sufficient space for the unloading of wheelchairs and other equipment. The minimum size of bay suitable for a disabled person is 3.2m in width by 5.5m in length. Additionally, a vertical clearance of 2.5 meters from the entrance of the space to 2.16m from the front of the vehicle is required to accommodate a wheelchair roof hoist.

6.8.3 Special parking spaces

In addition to parking generated by residential, commercial, cultural and retail land use, spaces will be required for setting down, for taxis and for other special uses. These could include dedicated spaces on street for car share clubs, medical practitioners and other exceptional uses. Consideration should be given to sitting taxi and set-down areas in locations that are common to several blocks; this reduces internal vehicle circulation and provides a more legible system. Space immediately fronting entrances to buildings should be reserved for disabled drivers and for setting down and unloading.

6.8.4 Deliveries and loading

Dedicated bays may be required within the development for loading and unloading into the commercial blocks within the development. Where practical, the loading facility should be located centrally so that it can serve several blocks and thus reduce the need to internal trips within the site. The location of these bays should ideally be on the same grade as service entrances into the buildings. The exact location of loading bays for the commercial buildings will depend on the nature of the businesses occupying the buildings. The roadways do provide sufficient width to accommodate loading bays. The positions of these bays should be confirmed at the project approval stage, with appropriate regulation applied by Council .

7. Main findings

This report builds on work undertaken previously by PB to assess the capacity of the North Eveleigh site to accommodate the development proposed. It addresses each of the specific areas raised by the Director General of Planning's Requirements (the DGR's are reproduced in Appendix A). To understand the likely future traffic in the study area PB, has constructed a micro simulation model using the Paramics modelling software suite with specifically designed plug-ins for NSW conditions. The model was designed to encompass the area bounded by City Road and Lawson Street these being the state roads forming a discrete boundary and included the likely traffic generation from both the North Eveleigh development and the redevelopment of the Abercrombie Precinct. The RTA *Guide to Traffic Generating Developments*, along with the City of Sydney LEP and South Sydney DCP 11 were used to estimate traffic generation.

7.1 Circulation on site

The site is divided into two parts by the existing CarriageWorks performing arts centre and the area between the Blacksmiths' Shop and Carriage Workshop which will principally be for pedestrians and cyclists. However, having two accesses will afford good utilisation of the internal road network. Road widths are generally 7m, with a 11m wide road running parallel with Wilson Street. Dedicated semi-trailer routes have been identified to provide access to the North Eveleigh site from the eastern site entrance. This includes a dedicated one-way 3m wide roadway to the rear of the site to allow trucks deliver to the CarriageWorks and exit in a forward direction. A second route from the Shepherd Street access to the Paint Shop has been developed to link to the loading dock and turning area for deliveries to the retail development.

7.2 Parking

The project design team have adopted a parking standard based on the City of Sydney LEP for residential development and the parking rates set out in the former South Sydney DCP 11 for commercial development. This standard was adopted because the controls best fit with the mode-share aspirations and objectives of the RWA. A review of parking standards was undertaken by PB (2006) in an earlier draft report for RWA supporting the BEP (Stage One) which concluded that these standards best addressed the RWA objectives for transport and traffic. These standards propose adequate parking within the site for residents and workers. Internal roads within the development should, therefore, be largely free of parked cars, providing a significant amount of spare parking capacity in the area.

7.3 Access

The proposal provides two points of access to the site. RWA propose these and the internal road system will become Council roads once construction is complete. The design of the Wilson Street accesses will be in accord with RTA and AustRoads standards and will be to a suitable construction standard for adoption by council. Two access points allow for a good level of utilisation of internal roads. Improvement works will be needed at both accesses to accommodate the movement of semi trailers in to the site.

7.4 Provisions for emergency services

The site roads and access ways provide adequate facilities for the manoeuvring of all emergency service vehicles that could be expected to use the site. The site has two access points which should afford any emergency service rapid access to the site. The roads within the site do not have impedances in the form of Local Area Management Scheme.

7.5 Provisions for waste disposal vehicles

PB has contacted the City of Sydney as discussed the requirements for waste disposal vehicles. This discussion concluded that a waste disposal vehicles of the size of a medium rigid vehicle (MRV) having a length of 8.5m, width 2.5m and a height of 3.5m was a suitable design vehicle for this site. All proposed roads and turning heads within the site have been tested using Autotracks software to accommodate a vehicle of this size.

7.6 Pedestrians and Cyclists

The site provides good connection for pedestrians and cyclists to Wilson Street. The proposed cycle and footbridge linking Little Eveleigh Street to Cornwallis Street (by separate application) would provide a better pedestrian and cycle access to Redfern Station and Redfern Street. Provided adequate wayfinding is installed, the new bridge should attract many users and reduce the number of pedestrians travelling to the University currently using the narrow footways on Lawson and Abercrombie Streets.

7.7 Traffic and transport impacts

7.7.1 Cumulative traffic model

The cumulative traffic model demonstrated that the road network within the study area has the capacity to accommodate the increase in traffic volumes expected both in the short term and in 2016 if the proposed minor works for intersection capacity improvements are undertaken at the three identified intersections.

Using RTA and local trend data, PB estimated that an annual growth of 0.9% was a reasonable (indeed the highest potential) estimate of local traffic growth without the proposed RWA and University developments. With natural growth and these proposals local traffic demand would increase by approximately 4,000 vehicles on the road network by 2016, about two thirds of which would be due to the RWA and University proposals.

7.7.2 Key intersection improvements

Intersection improvements are recommended as follows:

- for the Shepherd Street intersection with Abercrombie Street, removal of the scramble pedestrian crossing phase and increasing the cycle time to 90 seconds. Alternatively, additional turning lanes could be introduced at the expense of on-street car parking
- for Cleveland Street and Shepherd Street, extending the left turn bay from 30m to 70m to increase storage capacity for cars waiting for the signal changes

- Abercrombie and Lawson Streets, provide 30m of left turn bay and 30m of right turn bays on Abercrombie and Lawson Streets respectively.

With these improvements undertaken the road network and intersections within the study area will function at a good level of service with most intersections having a Level of Service greater than level C.

7.7.3 Contribution of each development to traffic impact

PB has calculated that on a basis of contribution to the traffic volume increases, that 10% of the demand is attributable to the Abercrombie Precinct and 90% to the North Eveleigh site.

7.7.4 Parking impacts

Parking impacts from the development should be minimal. The development has adopted a parking standard that matches the intent of the City of Sydney LEP 2005 and which should ensure off-street parking provisions on the site adequately meet demand. No appreciable increase in demand for on-street parking is expected from North Eveleigh users, although neighbourhood parking schemes may need to be extended to discourage commuting students.

The adjacent established areas are already regulated under local parking schemes.

Loss of parking from new access points and from improvement works to the Shepherd Street and Abercrombie Street intersection should be minimal, in the order of 10 spaces (this is subject to detailed design) and these spaces are more than made up for in the additional kerb-space that will become available within the North Eveleigh site.

Parking will also be lost as a result of the works needed to ensure performance is maintained at the 3 intersections identified and discussed above.

7.7.5 Mitigation for loss of parking

The parking lost from close to the accesses in Wilson Street will more than be mitigated by the increase in available kerb space within the development. Should loss of parking at Abercrombie Street and Shepherd Street occur as a result of any increase in turning it is recommended that consideration be given to providing additional ¼ hour parking spaces close to the existing shops on the corner to ensure turnover of parking and prevent loss of trade.

7.7.6 Access impacts and mitigation

The site proposes two vehicular accesses one at the eastern end of the site and one at the intersection of Shepherd Street with Wilson Street. The eastern end access is an existing access into the site that will require widening to ensure a safe line of sight for motorists. This can be accommodated without loss of trees but will require the removal of 4 parking spaces to achieve a good level of forward visibility. The Shepherd Street Access is proposed to join an upgraded roundabout at Wilson Street. The existing roundabout at this location means that there is no parking loss at this location.

It is recommended that to ensure construction impacts are minimised, that the improvements to these access points be undertaken at an early stage of the development so truck and site workers access is unimpeded.

7.7.7 Public transport strategy

The principles of Public transport are set out in the Traffic and Transport Context to the Draft Built Environment Plan produced by PB for Redfern-Waterloo Authority. The strategy is predicated on achieving a mode share target of 60% non car, this is similar to the levels of mode share being achieved in other CBD areas within the city. The strategy seeks to constraining car user through adopting stringent parking standards and providing effective connections to transit. This is achieved by providing good pedestrian and cycle permeability through the site, way finding and a new pedestrian/cycle bridge link from Little Eveleigh to Cornwallis Street (by separate application).

It is recommended that future employers within the commercial developments be encouraged to develop green commuter plans and provide information to new starters about access to public transport.

7.7.8 Cycling and walking

The site provides good foot and cycle access a number of pedestrian links through to Wilson Street are proposed and consideration has been given to the needs of disabled and vulnerable pedestrians.

It is recommended that way finding for the site be considered and included in the detailed design so ensure that the site integrates into the wider community and to promote legibility of public transit systems.

It is also recommended that the cycle provisions of the Green Star building scheme be considered for all commercial buildings. This includes providing secure cycle parking and changing and showering facilities.

7.7.9 Construction phase impact and mitigation

The construction phase will create impacts on the road network, however, with careful planning these can be minimised. Early construction of the access improvements and the internal road network will greatly reduce likely impacts.

Impacts on the road network could include parking by site workers on Wilson Street, increased heavy vehicle traffic, increased traffic from site workers along with dust and noise from site traffic.

It is recommended that the principal contractor prepare a Traffic Management Plan in accord with RTA and relevant Australian Standards. This plan will need to give consideration to:

- times and days of working. It is recommended that the times of work give consideration to avoiding the peak AM and PM hours as doing so would allow the site to attract a significant number of workers with little impact on the road network or intersections
- project duration and resources

- delivery routes for heavy vehicles, this needs to include for oversized and weight loads. PB has made an assessment of suitable routes and would recommend that all heavy vehicle traffic should be directed from City road via Golden Grove Street into Wilson Street
- minimising waste from site minimises waste to be removed from site
- parking and storage of workers vehicles, plant and materials on site
- minimising noise and dust from site vehicles and arrangement to keep adjacent road network clear of mud and dust from site.

8. References

1. City of Sydney South Sydney DCP 11 Transport Guidelines for Developers, 1996

2. RTA, Guide to Traffic Generating Developments, October 2002

3. PB, Draft preliminary Traffic and Transport Strategy for the Built Environment Plan (Stage 1), September 2006

4. PB, Preliminary 3(a) Environmental Assessment Traffic and Transportation, Dec 2007

5. PB, RWA North Eveleigh Site vehicle paths for articulated vehicles and collection vehicles, Dec 2007

6. Australian Standards, 2890 Part 1, Car parking facilities, 2002

7. Australian Standards, 2890 Part 1, Commercial vehicle facilities, 2002

8. Australian Standards, 2890 Part 1, Bicycle parking facilities, 1993

Appendix A

Director-General of Planning's Requirements

Director-General's Requirements –

Section 75F of the *Environmental Planning and Assessment Act 1979*

Application number	MP 08_0015
Project	Concept Plan for North Eveleigh redevelopment for the purposes of residential, commercial, retail and cultural uses.
Location	Part Lot 4 and Part Lot 5 in DP 862514, Wilson Street, North Eveleigh
Proponent	Redfern-Waterloo Authority
Date issued	
Expiry date	2 years from date of issue
Key issues	The Environmental Assessment (EA) must address the following key issues: **1. Relevant EPI's, Policies and Guidelines to be addressed** Planning provisions applying to the site, including permissibility and the provisions of all plans and policies including: • SEPP (Major Projects) 2005 Schedule 3, The Redfern-Waterloo Authority Sites • Standard Instrument (Local Environmental Plans) Order 2006 • SEPP (Building Sustainability Index: BASIX) 2004 • SEPP 55 – Remediation of Contaminated Sites • SEPP 65 – Design Quality of Residential Flat Development • Draft SEPP No. 66 – Integration of Land Use and Transport • SEPP (Infrastructure) 2007 • Sydney Metropolitan Strategy (and any relevant draft or endorsed Subregional Strategy) • The Redfern-Waterloo Built Environment Plan (Stage One) • Provision of public infrastructure having regard to the Redfern Waterloo Authority Contributions Plan • Provision of affordable housing in accordance with the Redfern Waterloo Authority Affordable Housing Contributions Plan • Nature and extent of any non-compliance with relevant environmental planning instruments, plans and guidelines and justification for any non-compliance **2. Land Use** • Maximise opportunities due to nearby university in determining final proposed land uses, including consideration of their location, planning and access. • Demonstrate suitability of proposed land uses in the context of the surrounding area. **3. Built Form / Urban Design** • The proposal must be capable of exhibiting design excellence in accordance with the provisions contained in Schedule 3, Part 5, Clause 22 of the SEPP Major Projects (2005) - The Redfern-Waterloo Authority Sites. • Location of plant equipment to minimise the visual and acoustic impacts. • Demonstrate that the proposed buildings will satisfy the requirements of SEPP 65 – Design Quality of Residential Flat Development. • Provide street level connections between the proposed development and the existing built form in Wilson Street **4. Environmental and Residential Amenity** • Address solar access, acoustic privacy, visual privacy, view loss and wind impacts and achieve a high level of environmental and residential amenity. The proposal must demonstrate that the proposed siting of buildings does not have unacceptable level of

impacts on overshadowing, privacy and views of buildings within the site and on adjoining sites.

5. Safety / Public domain / Landscaping

- Demonstrate how the proposed building envelopes, building design and treatment of the public domain will:
  - maximise safety, security and public surveillance within the public areas including disabled access and car park access. Specific regard should be given to the Department of Planning's Guideline; *Crime prevention and assessment of development applications,* 2001;
  - address linkages within and between other public domain spaces, including Redfern train station;
  - ensure access for people with disabilities;
  - minimise potential for vehicle and pedestrian conflicts.
- Provide an aborist's report to assess the condition of existing trees proposed to be removed and methods of protection during construction.
- Provide landscaping plan in particular for the public domain.

6. Car parking / Traffic Impacts (Construction and Operational)

Demonstrate the provision of sufficient on-site car parking for the proposal having regard to local planning controls and RTA guidelines. The EA shall also provide a Traffic Impact Study prepared in accordance with the RTA's Guide to Traffic Generating Developments, considering traffic generation, any required road / intersection upgrades, access, loading dock(s), car parking arrangements, measures to promote public transport usage and pedestrian and bicycle linkages. The Traffic Impact Study shall address and assess:

- traffic generation including daily and various peak traffic movements, determining and identifying modal split targets for peak periods, and the increase in the level and type of traffic associated with the proposal;
- impacts and resultant upgrades to street parking, the road network including laneways, arterial roads, intersections, signage and road capacity resulting from the project; cumulative impacts of adjoining and adjacent developments, where appropriate;
- measures to be implemented to mitigate any impacts identified;
- any required upgrading of roads and improvement works to ameliorate impacts associated with the development and the proposed source of associated funding;
- cumulative impacts on the local and subregional area including the future development by University of Sydney, and develop a traffic network model to determine impact(s);
- details of public transport accessibility and strategies to encourage public transport patronage, including pedestrian and cyclist flows; links to Redfern Railway Station and the future bridge link; connections to existing cycle network(s);
- details of provisions for service and delivery vehicles movements/loading;
- vehicular access, car parking and bicycle arrangements, and detail proposed access points, parking spaces including compliance with relevant parking code(s);
- details of adequate emergency vehicle access.

7. Ecologically Sustainable Development (ESD)

Detail how the development will incorporate ESD principles in the design, construction and ongoing operation phases of the development.

8. Heritage

- Identify any items of European (including rail) heritage significance and provide a heritage impact statement in accordance with the *Heritage Manual*, (NSW Heritage Office & DUAP 1996). Specifically, the design and form of the proposal needs to respond, and assess any impacts on the character of the surrounding conservation area and nearby heritage items. The Heritage Impact Statement should address:

- the impact of the proposed demolitions on the significance of the subject heritage item as a whole (as a group of buildings with related uses); and
- whether proposed works comply with policies contained in the Conservation Management Plan (CMP) (endorsed by Heritage Council with conditions on 27 June 2003).

- Identify whether the site has significance to Aboriginal cultural heritage and where applicable prepare an independent Archaeological report in accordance with the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment & Community Consultation*, DEC, July 2005.
- The proposal must have regard for the character of the Golden Grove Conservation Area, as listed in the South Sydney LEP with particular consideration to development along Wilson Street.
- The CMP and its subsequent review should also be attached to the EA to allow adequate consideration of the proposal's impact on the heritage significance of the subject item.

9. Rail Impacts

- Address noise and vibration impacts from adjacent rail activities, including mitigation and monitoring measures where appropriate, consistent with guidelines published by Rail Corp including *Interim Guidelines for Applicants – Consideration of Rail Noise* and *Vibration in the Planning Process and Interim Guidelines for Councils – Consideration of Rail Noise and Vibration in the Planning Process*.
- Address the impact(s) of the proposed North Eveleigh Dive Alignment (future underground rail connection), along the southern boundary of the subject site.
- Identify the existence of any existing RailCorp services (such as pipes and cables) and structures within the development area by initiating the appropriate service searches. Where RailCorp services exist, an agreement must be made with RailCorp regarding the accommodation of the services.

10. Social and Economic Impact Assessment

- Identify cultural, social and residential opportunities that will be provided to support the development of a sustainable community within the broader Redfern-Waterloo area. Address social impacts of the proposal.
- The Plan must address long term social sustainability issues and address impacts on community safety, the local community impacts, and measures to ensure the minimisation of crime and anti-social behaviour.
- Address impacts on the Aboriginal and European community within Redfern.
- Address the economic impact of the proposal and include an investigation into the impact upon the retail, commercial and residential industry within the locality and have regard to the hierarchy of centres in the relevant regional and sub-regional strategy.

11. Staging

Include details regarding any proposed staging of the development.

12. Dedication

Details of any proposed dedication of open space and roads to Council / ownership and maintenance proposals of public domain.

13. Drainage and Flooding

- Address drainage/flooding issues associated with the development/site, including: stormwater, drainage infrastructure and incorporation of Water Sensitive Urban Design measures.
- Address the issue of managing the downstream impacts of stormwater on Sydney Water's stormwater network, including a stormwater management system and the capture and reuse of rainwater.
- Explore non-potable water supply sources, including onsite recycling of grey water,

	rainwater and stormwater harvesting. **14. Contamination** The EA is to demonstrate compliance that the site is suitable for the proposed use in accordance with SEPP 55. **15. Utilities** • In consultation with relevant agencies, address the existing capacity and requirements of the development for the provision of utilities including staging of infrastructure works. **16. Consultation** During the preparation of the Environmental Assessment you should undertake, in accordance with the Department's *Major Project Community Consultation Guidelines October 2007,* an appropriate and justified level of consultation with relevant local, State or Commonwealth government authorities, service providers, community groups or affected landowners, including the University of Sydney and Australian Technology Park. The consultation process and the issues raised should be described in the Environmental Assessment.
Deemed refusal period	120 days

Attachment 1: Plans and Documents to accompany the Application

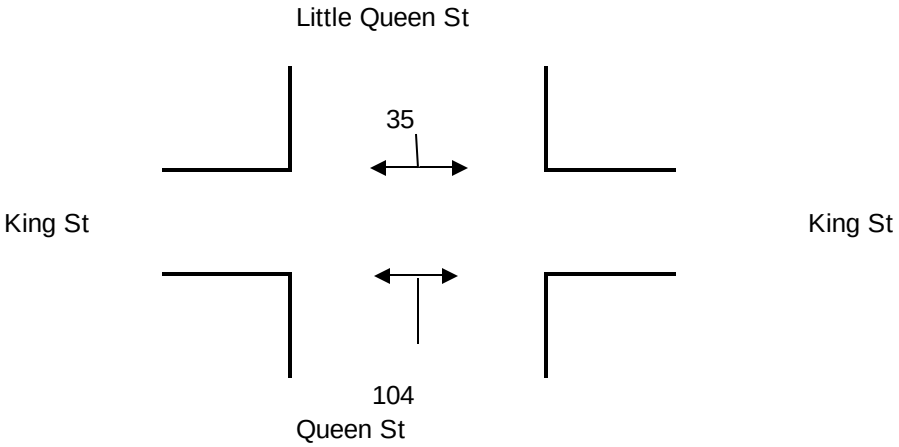
General	The Environmental Assessment (EA) must include: 1. An executive summary; 2. A thorough site analysis including site plans, aerial photographs and a description of the existing and surrounding environment; 3. Description of the site, including cadastre, title details, existing easements (including sewer mains, and/or encumbrances) and the surrounds; 4. A thorough description of the proposed development, including details of the proposed layout, built form, land uses, size and scale of the main components of the development, FSR, height (AHD); 5. Details of the methodology used for the calculation of the FSR in accordance with the relevant Environmental Planning Instruments (EPI); 6. An assessment of the environmental impacts of the project with particular focus on the key assessment requirements specified above and a table outlining how these key assessment requirements have been addressed; 7. An assessment of the potential impacts of the project and a draft Statement of Commitments, outlining environmental management, mitigation and monitoring measures to be implemented to minimise any potential impacts of the project; 8. A description of the measures that would be implemented to avoid, minimise, mitigate, offset, manage, and/or monitor the impacts of the project; 9. Demonstration as to how the development, when completed, will achieve the objectives and provisions of the relevant EPI's; 10. The plans and documents outlined below; 11. A signed statement from the author of the Environmental Assessment certifying that the information contained in the report is neither false nor misleading; 12. A quantity surveyor's cost estimate report to verify the capital investment value of the project, calculated in accordance with the definition of 'CIV' in accordance with SEPP Major Projects (2005) - this definition should be quoted in the QS letter/report; and 13. A conclusion justifying the project, taking into consideration the environmental impacts of the proposal, the suitability of the site, and whether or not the project is in the public interest.
Plans and Documents	The following plans, architectural drawings, diagrams and relevant documentation shall be submitted: 1. An **existing site survey plan** drawn at an appropriate scale illustrating; • the location of the land, boundary measurements, area (sq.m) and north point; • the existing levels of the land in relation to buildings and roads; • location and height of existing structures on the site; and • location and height of adjacent buildings and private open space. • all levels to be to Australian Height Datum. 2. A **Site Analysis Plan** must be provided which identifies existing natural elements of the site (including all hazards and constraints), existing vegetation, footpath crossing levels and alignments, existing pedestrian and vehicular access points and other facilities, slope and topography, utility services, boundaries, orientation, view corridors and all structures on neighbouring properties where relevant to the application (including windows, driveways, private open space, etc). 3. A **locality/context plan** drawn at an appropriate scale should be submitted indicating: • significant local features such as parks, community facilities and open space and heritage items; • the location and uses of existing buildings, shopping and employment areas; • traffic and road patterns, pedestrian routes and public transport nodes. 4. **Architectural drawings** at an appropriate scale illustrating:

	• the location of any existing building envelopes or structures on the land in relation to the boundaries of the land and any development on adjoining land; • detailed floor plans, sections and elevations of the proposed buildings; • elevation plans providing details of external building materials and colours proposed; • fenestrations, balconies and other features; • accessibility requirements of the Building Code of Australia and the Disability Discrimination Act; • the height (AHD) of the proposed development in relation to the land; • the level of the lowest floor, the level of any unbuilt area and the level of the ground; • any changes that will be made to the level of the land by excavation, filling or otherwise. 5. Visual aids such as 3 dimensional rendering should be used to demonstrate visual impacts of the proposal and architectural composition, in particular having regard to siting and design, bulk and scale relationships, appropriate relationship with the heritage fabric of the building(s) on site and in the surrounding area. 6. **Other plans**: • **Stormwater Concept Plan** - illustrating the concept for stormwater management; • **Geotechnical Report** – prepared by a recognised professional which assesses the risk of Geotechnical failure on the site and identifies design solutions and works to be carried out to ensure the stability of the land and structures and safety of persons; • **View Analysis -** Visual aids such as a photomontage must be used to demonstrate visual impacts of the proposed building envelopes in particular having regard to the siting, bulk and scale relationships from key areas; • **Landscape plan** - illustrating treatment of open space areas on the site, screen planting along common boundaries and tree protection measures both on and off the site. • **Shadow diagrams** showing solar access to the site and adjacent properties at summer solstice (Dec 21), winter solstice (June 21) and the equinox (March 21 and September 21) at 9.00 am, 12.00 midday and 3.00 pm. Plans/elevations and shadow diagrams are to be provided demonstrating the impacts of the proposal within the site and on adjoining sites, including additional overshadowing.
<u>Documents to be submitted</u>	• 1 copy of the EA, plans and documentation for the Test of Adequacy; • 12 hard copies of the EA (once the EA has been determined adequate); • 12 sets of architectural and landscape plans to scale, including one (1) set at A3 size (to scale); and • 1 copy of the Environmental Assessment and plans on CD-ROM (PDF format), not exceeding 5Mb in size.

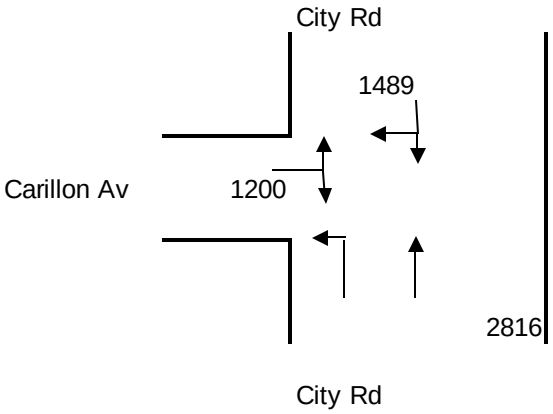
Appendix B

Forecast turning movements

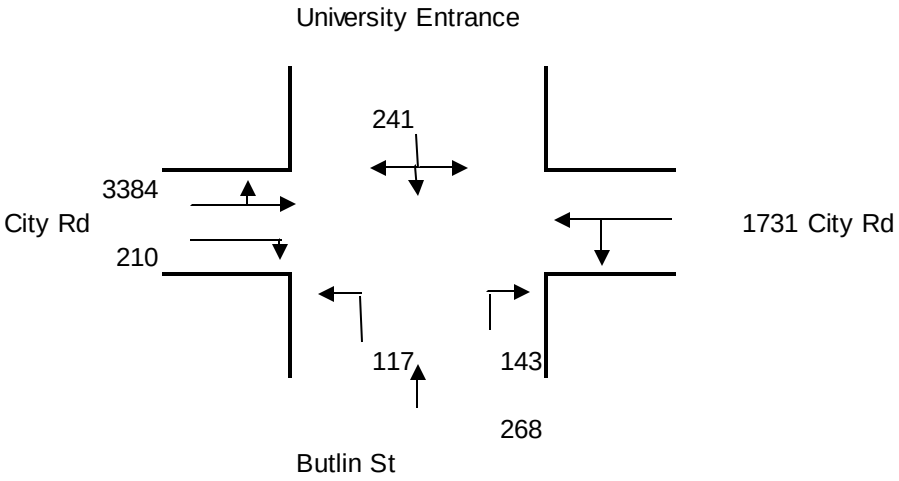
TCS 662 - King St / Queen St



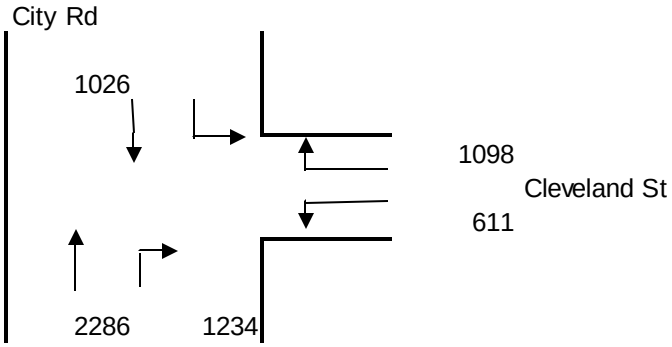
TCS 661 - Carillon Av / City Rd



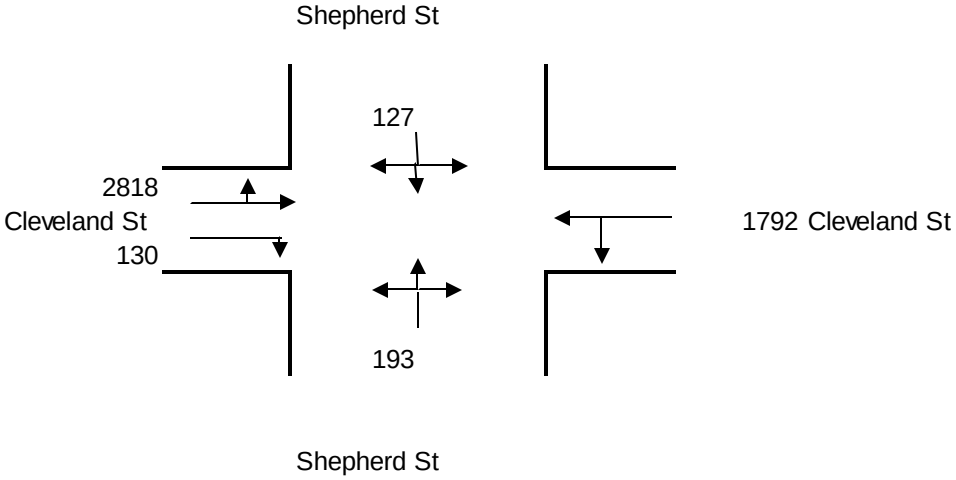
TCS 660 - City Rd / Butlin St



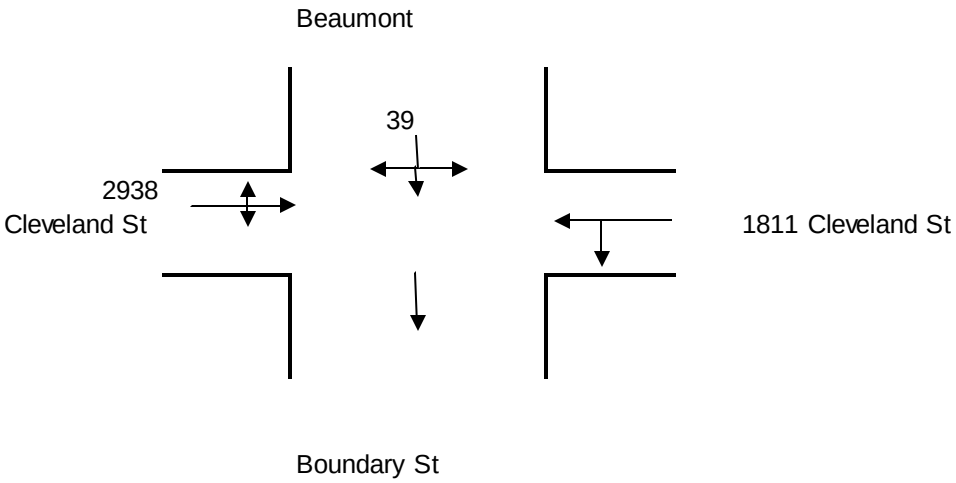
TCS 521 - City Rd / Cleveland St



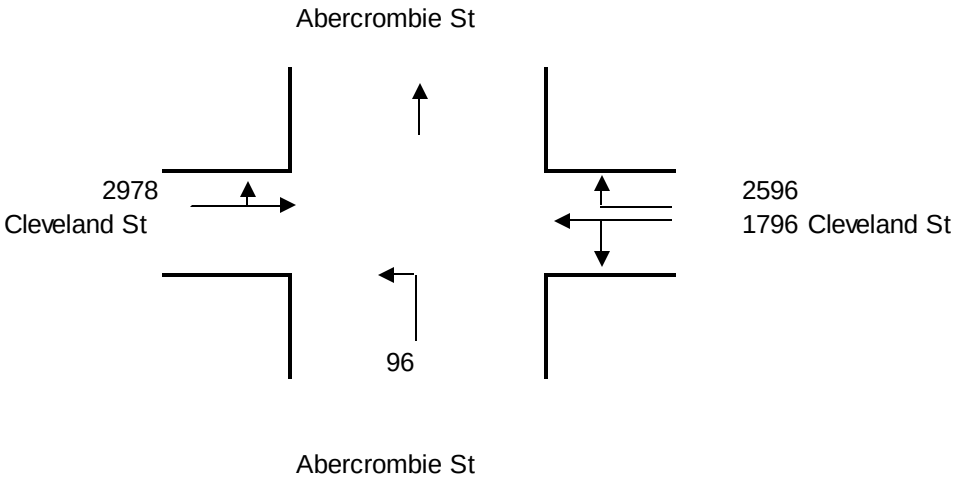
TCS 522 - Cleveland St / Shepherd St



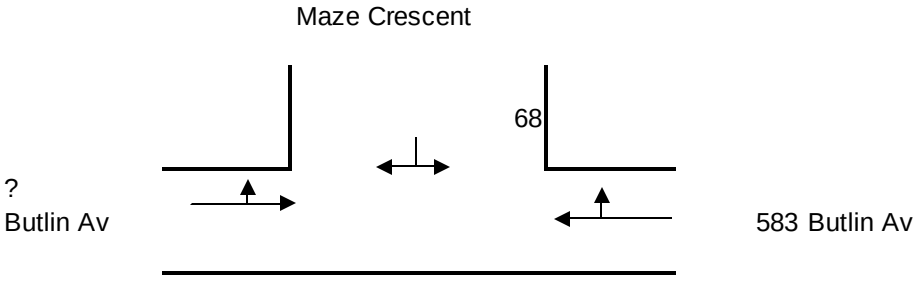
TCS 523 - Cleveland St / Beaumont St



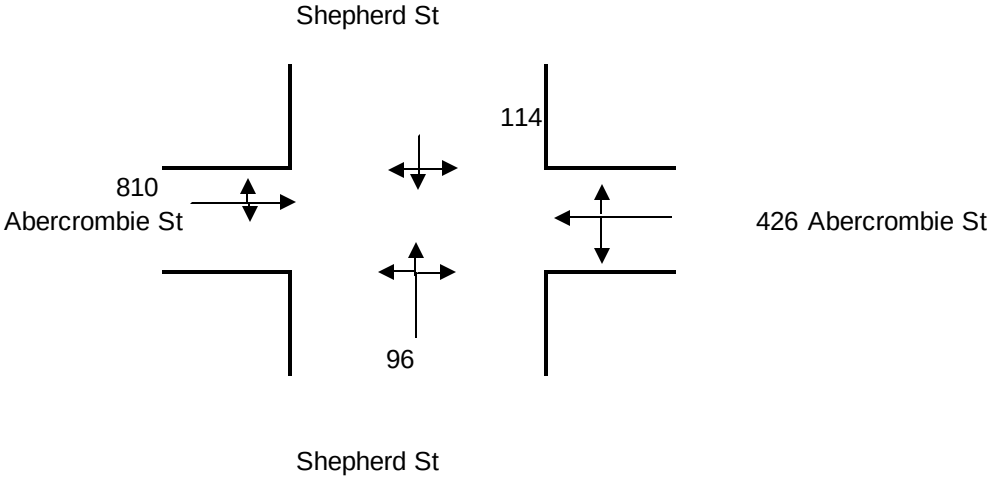
TCS 524 - Cleveland St / Abercrombie St



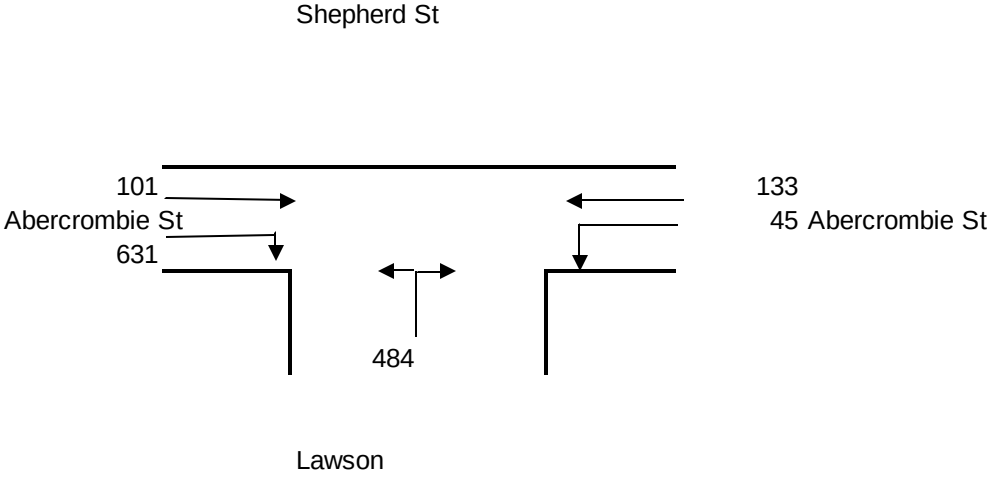
TCS 260 - Butlin Av / Maze Crescent



TCS 1707 - Abercrombie St / Shepherd St

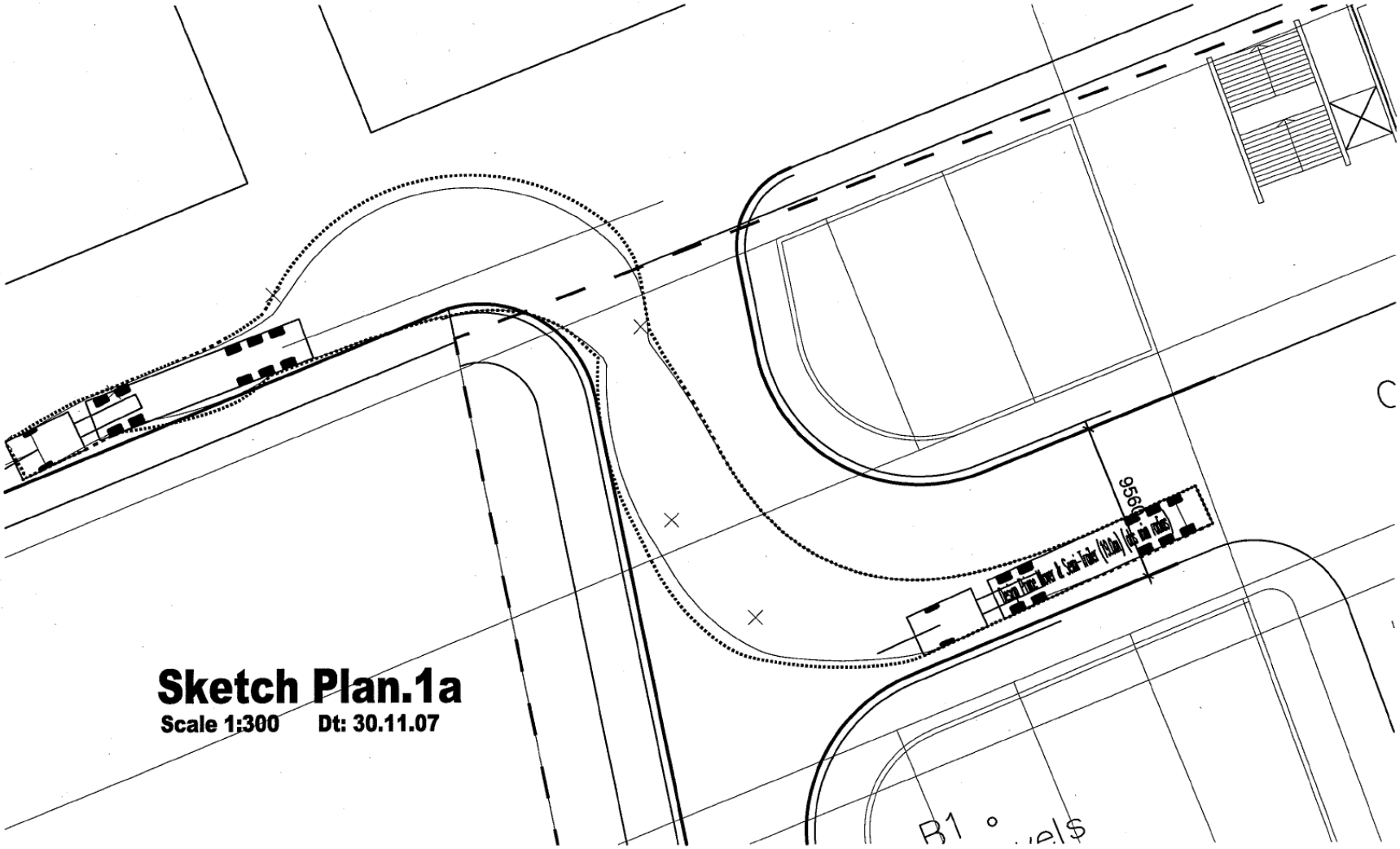


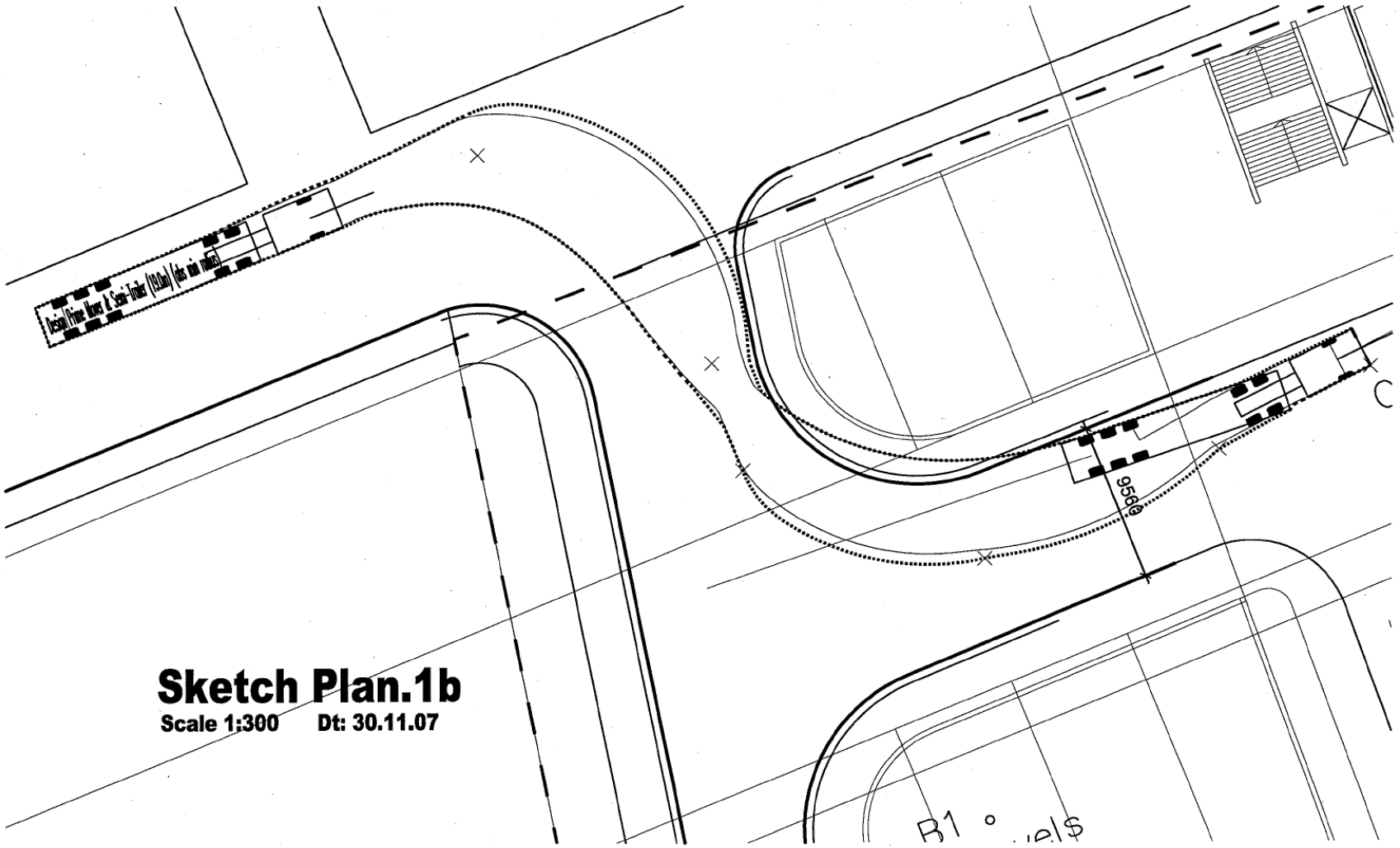
TCS 1141 - Abercrombie St / Lawson St



Appendix C

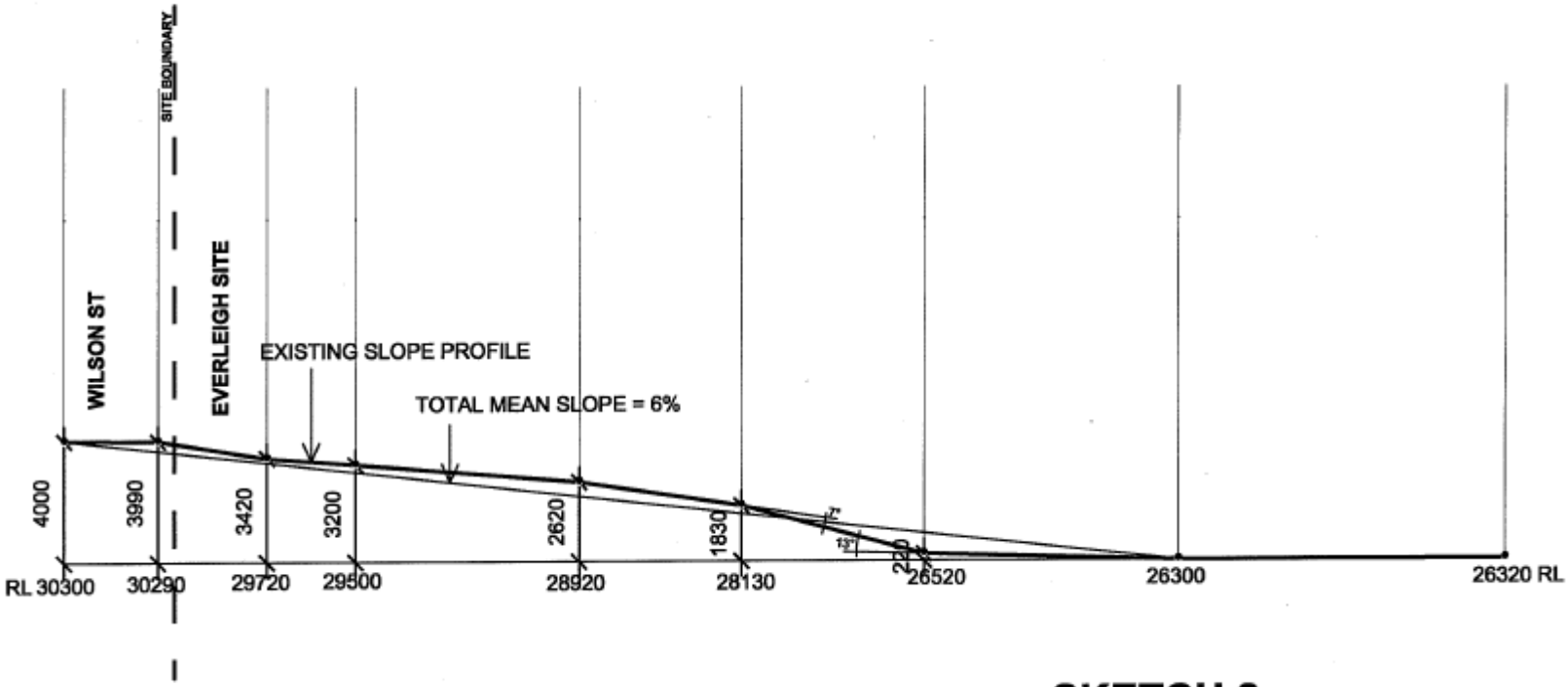
Swept path sketches


Sketch Plan.1a
Scale 1:300 Dt: 30.11.07



Sketch Plan.1b

Scale 1:300 Dt: 30.11.07



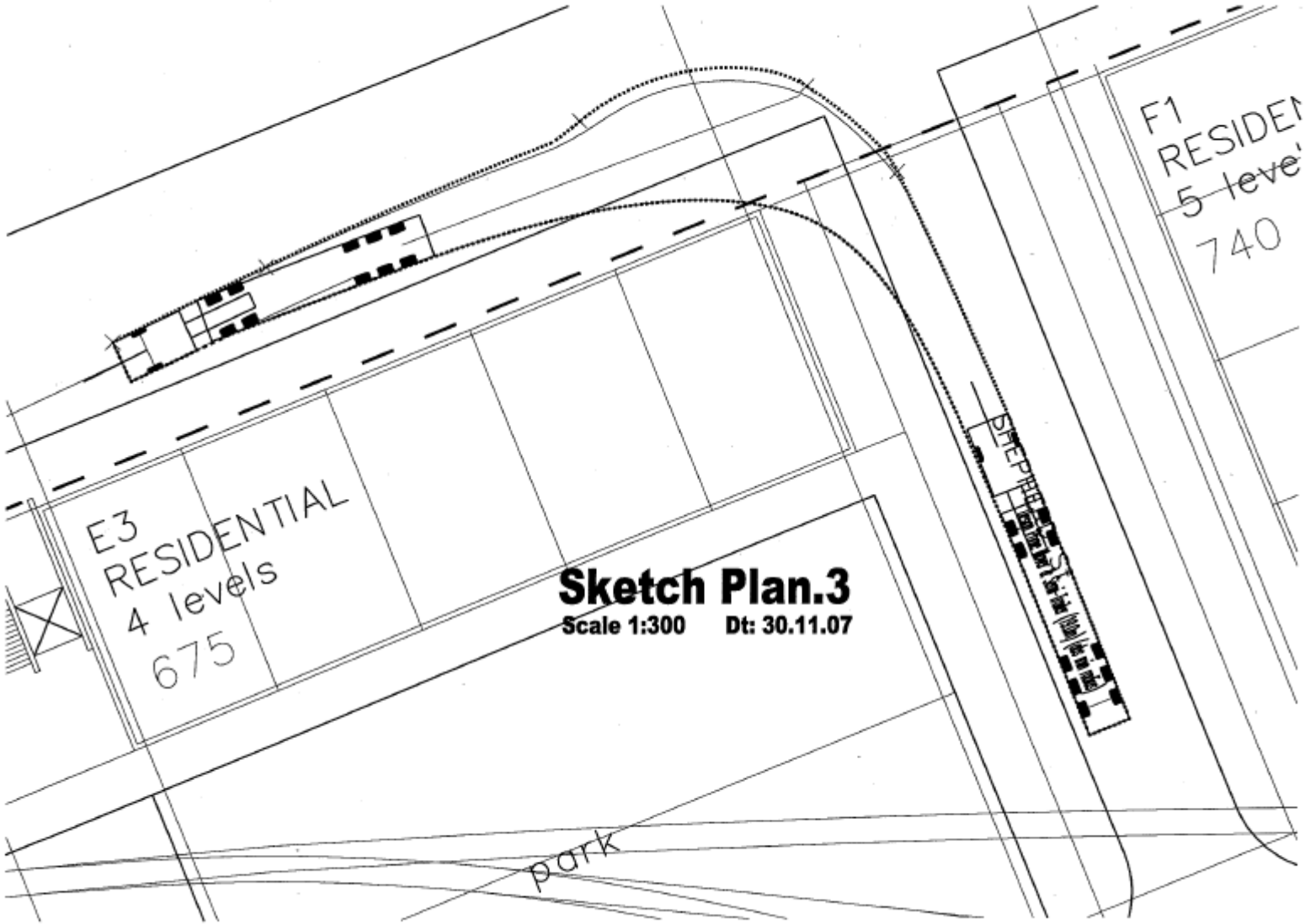
SKETCH 2

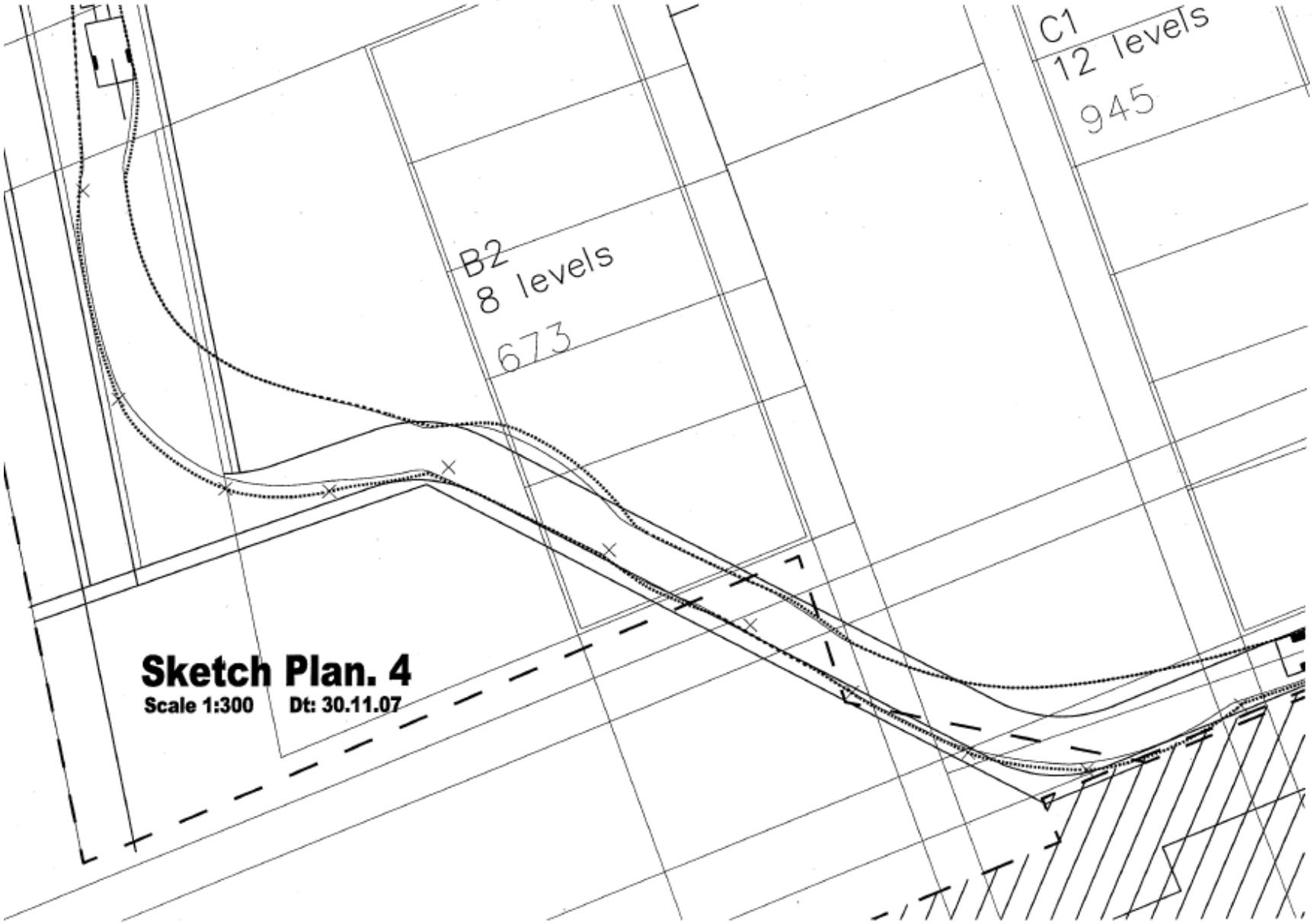
LONG SECTION

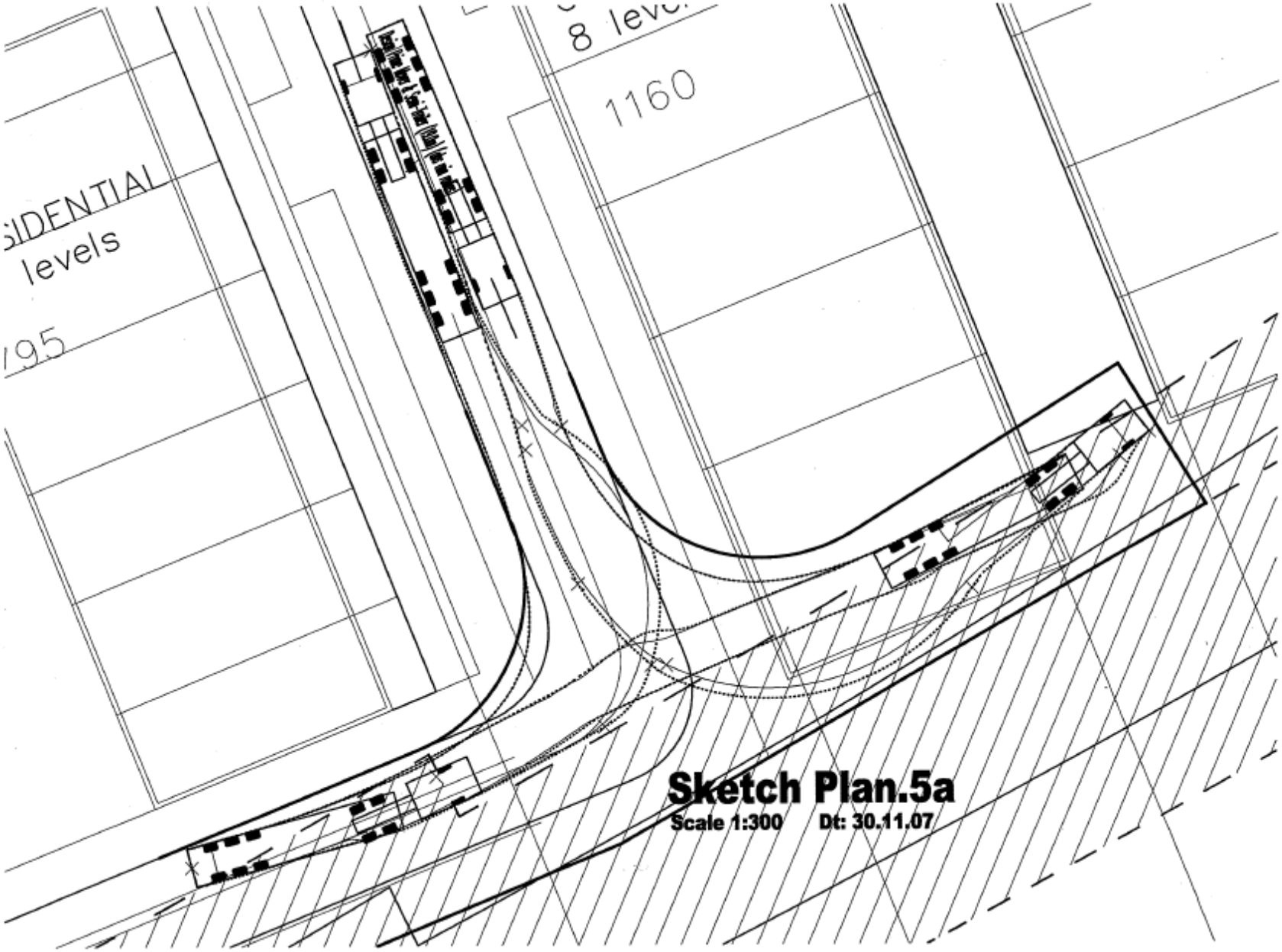
FROM WILSON ST INTO CARRIAGEWORKS WAY

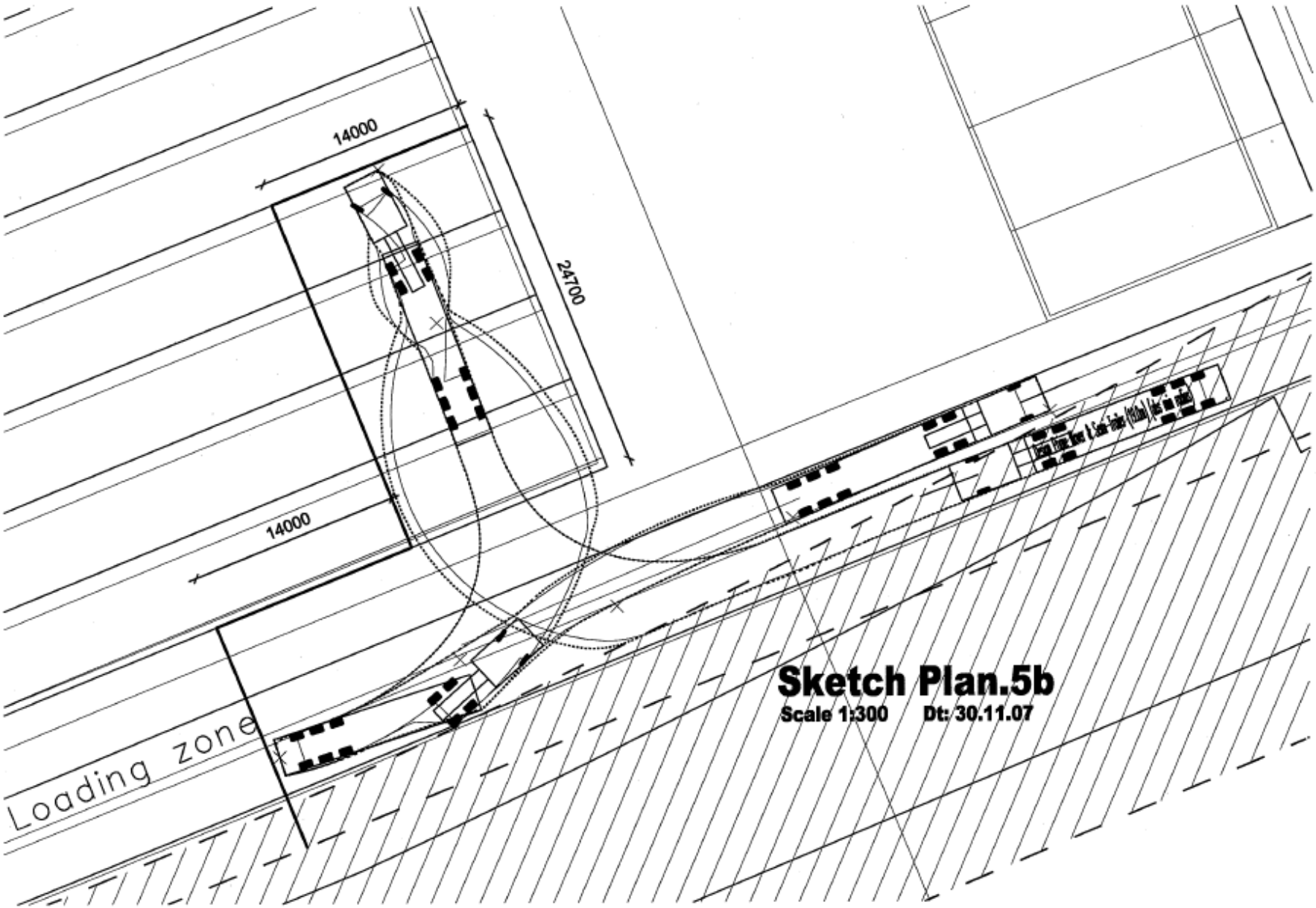
SCALE 1: 200

Dt : 30.11.07


E3
RESIDENTIAL
4 levels
675
Sketch Plan.3
Scale 1:300 Dt: 30.11.07
park
F1
740

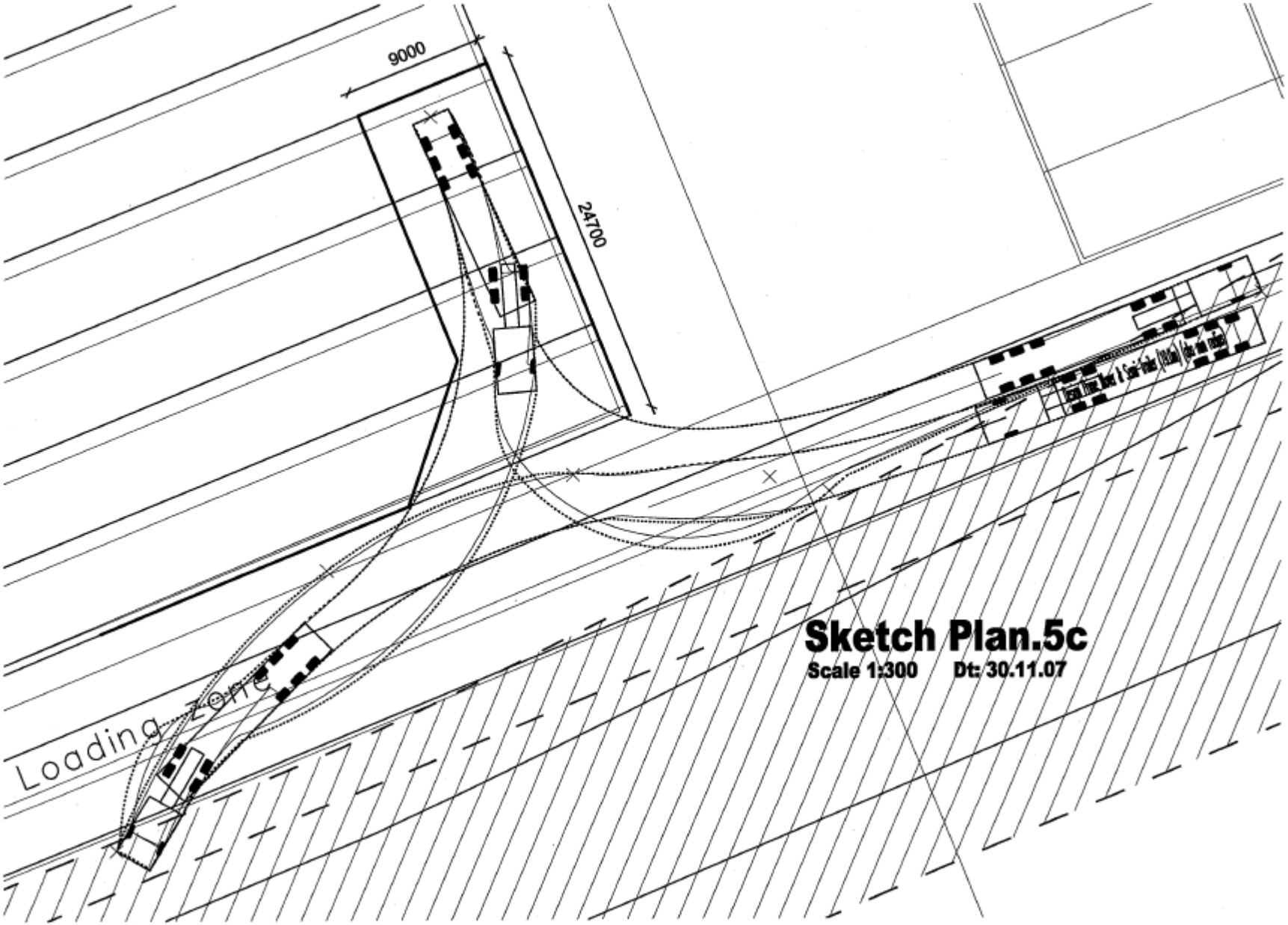

B2
8 levels
673
C1
12 levels
945
Sketch Plan. 4
Scale 1:300
Dt: 30.11.07

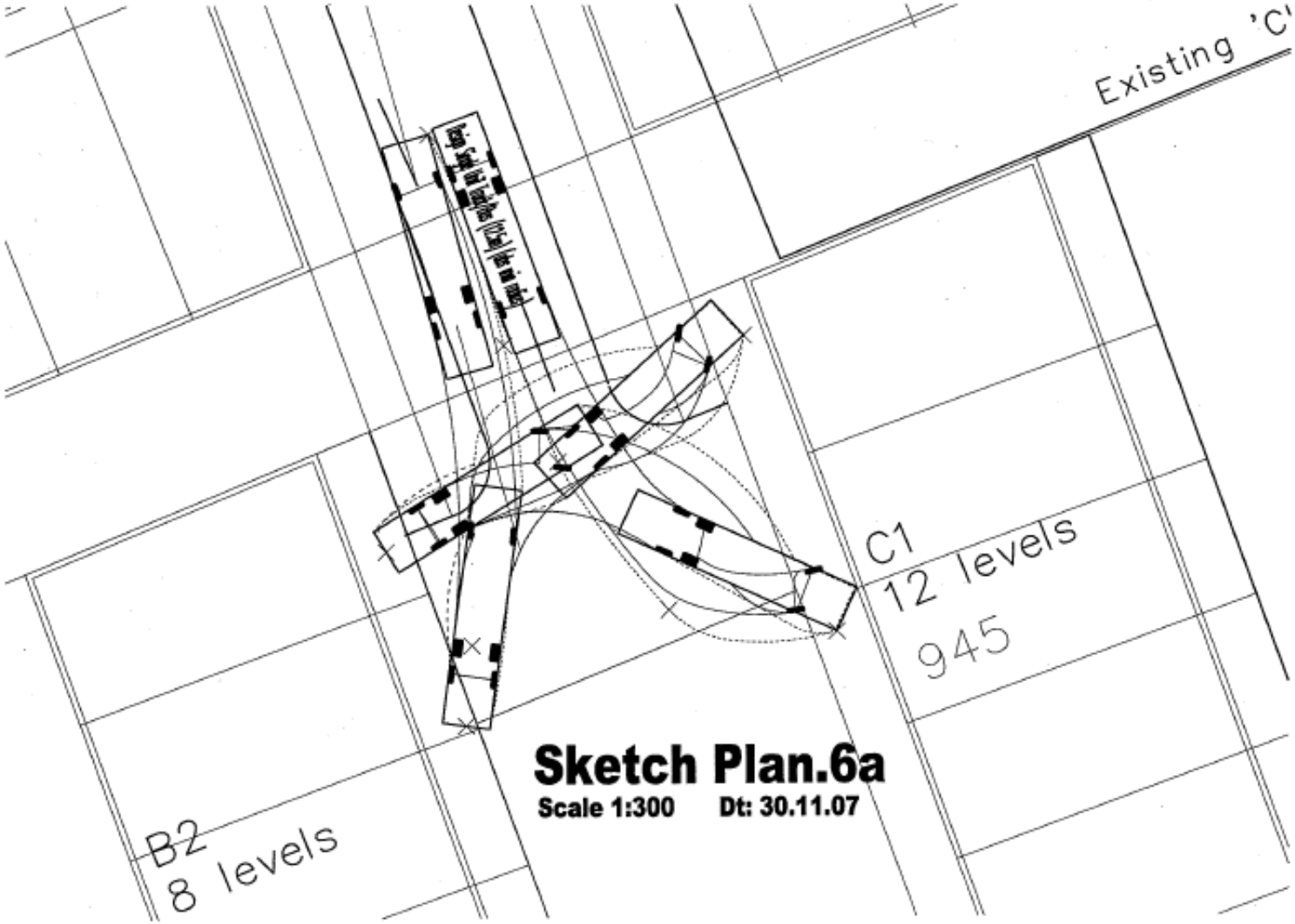

8 level
1160
SIDENTIAL
levels
95
Sketch Plan.5a
Scale 1:300 Dt: 30.11.07

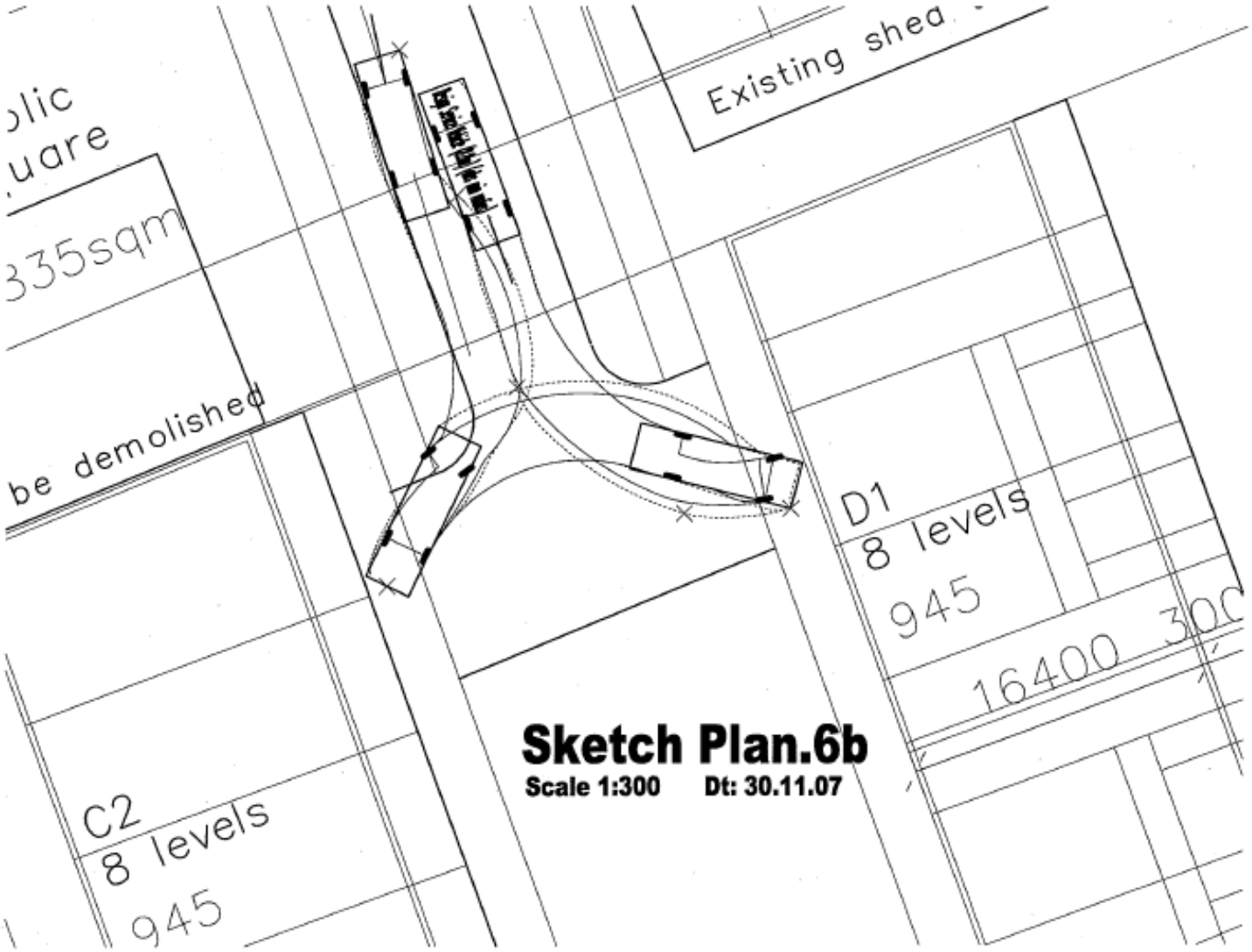


Sketch Plan.5b

Scale 1:300 Dt: 30.11.07


9000
24700
Loading Zone
Sketch Plan.5c
Scale 1:300 Dt: 30.11.07


Existing 'C'
C1
12 levels
945
B2
8 levels
Sketch Plan.6a
Scale 1:300 Dt: 30.11.07


Existing shea
olic
uare
335sqm
be demolished
D1
8 levels
945
16400
C2
8 levels
945
Sketch Plan.6b
Scale 1:300 Dt: 30.11.07