DRAFT - THIS REPORT IS IN DRAFT AND - COMPLETE SAFETY AUDIT AND RISK REVIEW IS ONGOING.

CBD & SOUTH EAST LIGHT RAIL PROJECT

(AUSTRALIAN TURF CLUB – ROYAL RANDWICK PRECINCT)

TECHNICAL REVIEW

(DECEMBER 2013)

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APPENDICES

Nil.

Our Reference: G16042R-01A

VERSION HISTORY

Version	Date	Type	Prepared By	Approved By
A	09/12/2013	Draft Report	A. Coyle / N. Green	A. Coyle

1 INTRODUCTION

Traffix Group Pty Ltd has been engaged by the Australian Turf Club (ATC) to provide independent technical advice regarding the proposed CBD & South East Light Rail project.

2 ASSIGNMENT SCOPE

The purpose of this assignment is to provide independent technical advice regarding the proposed CBD & South East Light Rail project to ensure that the project best meets the objectives and vision of the Australian Turf Club (ATC) for the Royal Randwick Precinct.

The plans prepared by Transport for New South Wales have been reviewed and the sites inspected.

In particular, the review focussed on key issues such as:

- Layout - Platform Size, Storage, Swept Paths.
- Access - Crossing Points, Ramps, Illegal Access, Safety, Footpath / Shared Path, Vehicle.
- Intermodal - Sharing of Tracks, Bus Stops, Bus / LRV Transfer, Bus Priority.
- Signal Operation – Overview, LRV Movements, Bus Movements, Pedestrian Movements, Traffic Impacts.

3 CBD & SOUTH EAST LIGHT RAIL PROJECT

The CBD & South East Light Rail Project (the 'Project') is a new light rail line extending 12 kilometres from Circular Quay along George Street to Central Station, then to Kingsford via Anzac Parade and Randwick via Alison Road.

Key features of the project include:[1]

- nine stops between Circular Quay and Central Station.
- seven stops between Kingsford and Central Station, including the University of NSW at Anzac Parade and Moore Park.
- six stops between Central Station and Randwick, serving the Prince of Wales Hospital, University of NSW at Wansey Road, Royal Randwick Precinct and Moore Park.
- interchanges located at major rail stations – Central Station, Town Hall, Wynyard and Circular Quay and bus interchanges at both Randwick and Kingsford.
- pedestrian zone from Bathurst Street to Hunter Street with light rail operating through the centre.
- segregated traffic and light rail lanes between Central Station and Bathurst Street and between Hunter Street and Circular Quay.

Key benefits include:

- Increased capacity:
  - space for 300 commuters on each 45 metre long light rail service – equivalent to five standard length buses.
  - reduced crowding and congestion.
  - buses freed up to service other destinations.
- Faster, simpler, more reliable services:
  - 'turn up and go' services every two to three minutes in peak times.
  - 97 per cent reliability.
  - services that are on time and fast.
  - real time information at all stops and on vehicles, showing route and stop locations.
  - simple to navigate.
  - effective wayfinding at stops and interchanges, to help you transfer to bus, ferry or heavy rail.
- Urban renewal opportunities:
  - pedestrian friendly streets, open spaces and revitalised public areas
  - reduced congestion at the heart of the CBD
  - a more attractive, accessible environment for visitors, businesses and workers
  - improved connections where people live, work and visit.
- Improved amenity:
  - integrated, electronic ticketing available at outlets or on-board
  - light rail stops maximise accessibility, with multiple doors available to alight at your stop
  - smooth, comfortable and quiet services, with air-conditioned vehicles
  - safe, clean, accessible and comfortable environment.

An overview of the project is shown in Figure 1. The study areas for this investigation are highlighted in red.

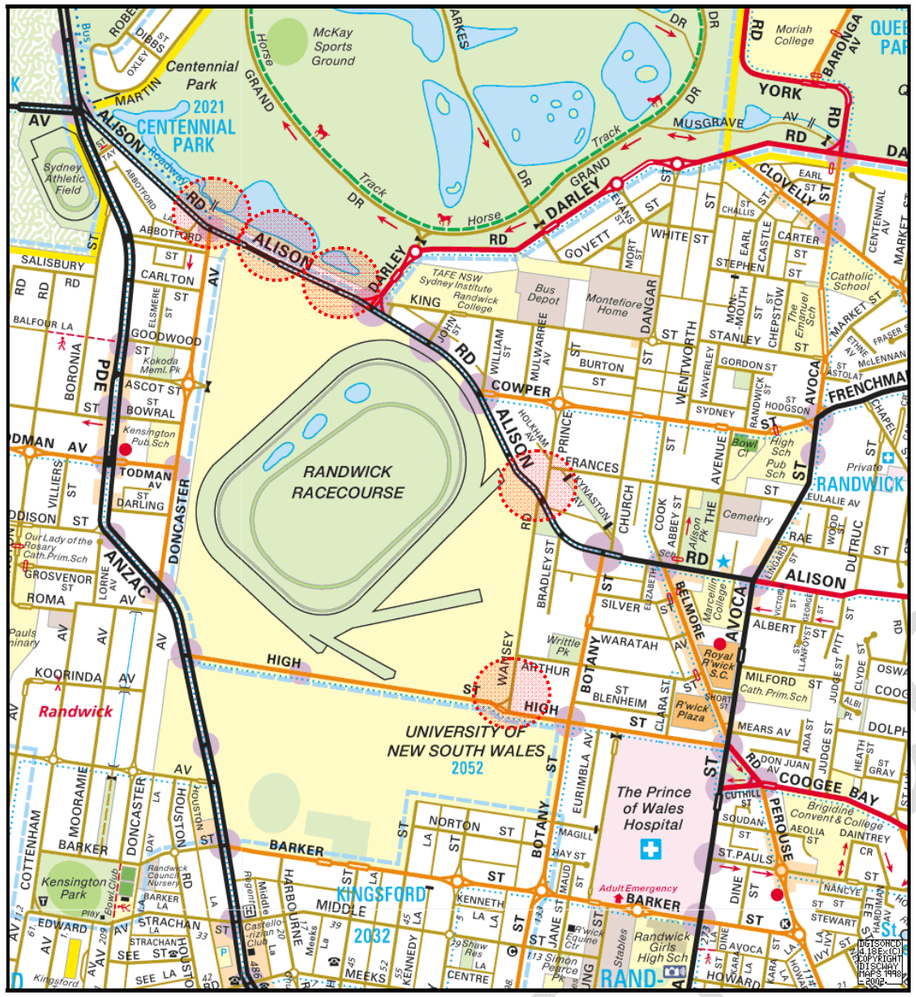
Source: http://www.transport.nsw.gov.au/lightrail-program/cbd-and-south-east-light-rail

Figure 1: Project Overview and Study Areas

[1] Source: http://www.transport.nsw.gov.au/lightrail-program/cbd-and-south-east-light-rail

4 ROYAL RANDWICK PRECINCT

The Royal Randwick Precinct is bounded by Alison Road, Wansey Road, High Street and Doncaster Avenue, as shown below in Figure 2.



Source: Ausway Publishing

Figure 2: Road Network and Study Areas

The proposed City and South East Light Rail Project will involve the construction of light rail tracks along the northern and eastern boundaries of the Royal Randwick Precinct, as shown below in Figure 3.

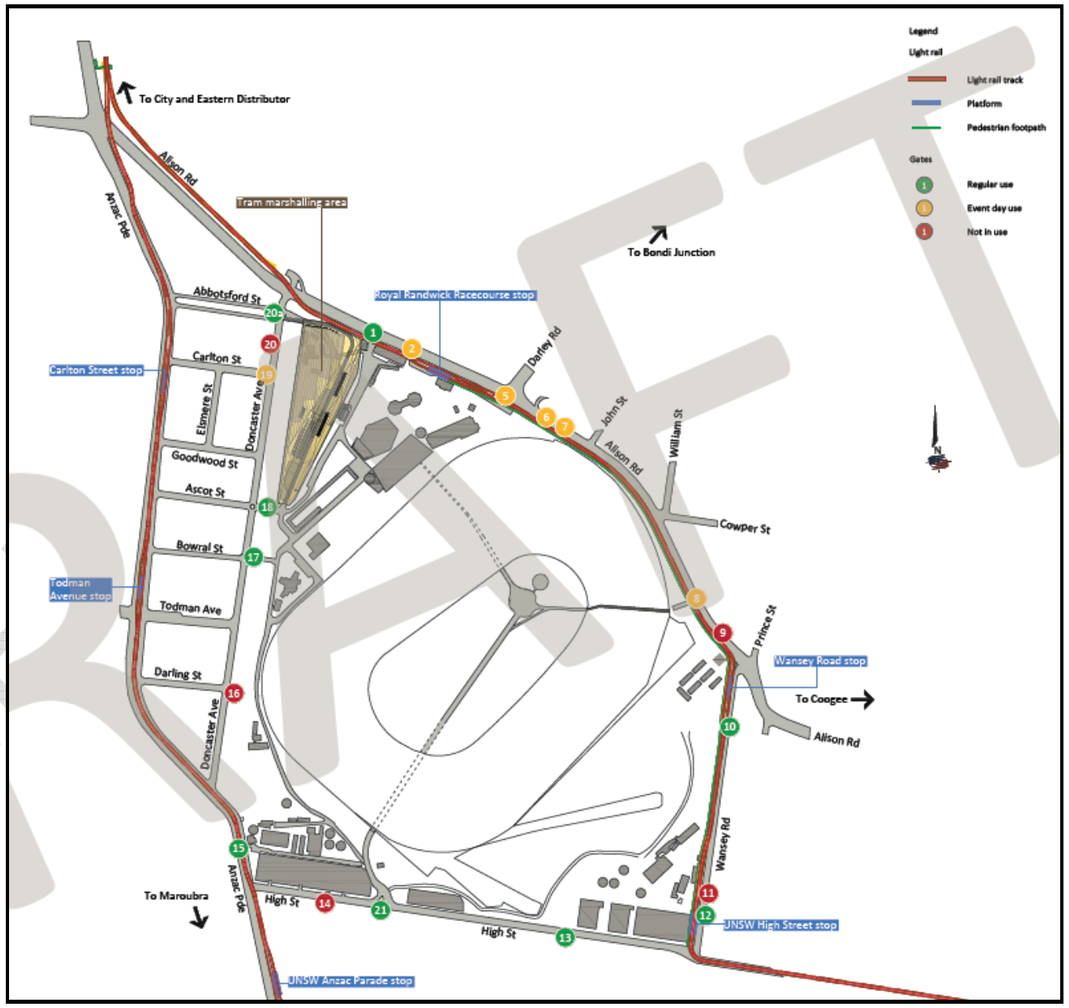


Figure 3: Royal Randwick Precinct – Impacts on Access Locations

In addition, a master plan is in place to further transform Royal Randwick into a world class destination for racing, events and entertainment. The scale of the project includes an approved hotel, stabling complex, convention centre and centre of excellence.

5 REFERENCE DOCUMENTS

The following documents were reviewed during the preparation of this report:

- Transport Operations Report, Final Report, Transport for NSW, 8 October 2013, Sydney.
- CBD and South East Light Rail Engineering, Light Rail Systems and Urban Design Definition Design - Volume 3 - Part 1 - South East Corridor, Final, CSELR-00WP-GN-R-0019, prepared for Transport for NSW, 16 August 2013.
- CBD & South East Light Rail Engineering, Light Rail Systems and Urban Design Definition Design Report - Volume 4 - Urban Design, CSELR-OOWP-GN-R-OO20, Final, prepared for Transport for NSW, 16 August 2013.

6 PASSENGER BOARDING & ALIGHTING VOLUMES

The 'Transport Operations Report, Final Report, Transport for NSW, 8 October 2013, Sydney' provides information regarding predicted passenger boarding and alighting numbers as well as bus transfers and walk ups. A summary of this data is provided in Table 1.

Table 1: Predicted Passenger Boarding & Alighting Volumes

Location	Transport Operations Report Predicted Volumes (AM Peak Hour*)
Alison Road / Royal Randwick Precinct	Precinct Access Plan (Table 7-19) states: 921 boardings & 316 alightings forecast for 2021 (total – 1,237 per hour). 1,029 boardings & 358 alightings forecast for 2036 (total – 1,387 per hour).
Alison Road / Wansey Road	Precinct Access Plan (Table 7-20) states: 691 boardings & 187 alightings forecast for 2021 (total – 878 per hour). 802 boardings & 213 alightings forecast for 2036 (total – 1,015 per hour).
Wansey Road / High Street Stop (UNSW)	Precinct Access Plan (Table 7-21) states: 749 boardings & 2,188 alightings forecast for 2021 (total – 2,937 per hour). 842 boardings & 2,803 alightings forecast for 2036 (total – 3,645 per hour).

* It is noted that it has been assumed that the patronage stated in the tables are from Tables 7-16, 7-17, 7-18 and 7-21 are AM Peak Hourly Volumes although it is not stated in the table.

In addition, the Alison Road / Royal Randwick Precinct stop will be the main access point for passengers during events at the Royal Randwick Precinct.

7 ALISON ROAD / DONCASTER AVENUE

The light rail will transition from the north side of Alison Road to the south side at the Doncaster Avenue intersection.

7.1 EXISTING CONDITIONS

The existing conditions are shown in Figure 4 and Figure 5 and are summarised as follows:

- Signalised cross-intersection with entry/exit to busway on north side of intersection. Pedestrian crosswalsk on west and south legs.
- Bus routes along Alison Road (some of which use busway).
- Shared path along north side of Alison Road.

Source: http://maps.six.nsw.gov.au/

Figure 4: Alison Road / Doncaster Avenue – Existing Conditions

Doncaster Avenue – View North to Alison Road

Alison Road – View East to Doncaster Avenue

Alison Road – View West to Doncaster Avenue

Busway – View South East to Alison Road

Figure 5: Alison Road / Doncaster Avenue – Photographs

7.2 PROPOSED CONDITIONS

It is proposed to construct (as shown in Figure 6):

- new light rail tracks transition from the north-west corner to the south-east corner of the intersection.
- relocated stop lines on Alison Road.

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Source: Transport for NSW

Figure 6: Proposed Conditions - Alison Road / Doncaster Avenue

7.3 TECHNICAL REVIEW

The findings from the review of this location are included in Table 2.

Table 2: Alison Road / Doncaster Avenue

Category	Sub-Category	Proposed Conditions	Discussion / Comment	Road Safety Risk/s
Consistency	-	-	-	-
Layout	Track Location	Light rail tracks transition from the north-west corner to the south-east corner of the intersection.	Light rail tracks cross the traffic lanes at a 'shallow' angle. Light trail tracks are slippery when wet and pose a significant risk to on-road cyclists due to the shallow angle. However, it is noted that there is an existing shared path along the north side of Alison Road.	Bicycle tyres may be caught in light rail tracks when crossing at angles less than 90 degrees. Light rail tracks are slippery when wet.
	Platform Size	-	-	-
	Storage	-	-	-
	Swept Paths	-	-	-
Access	Crossing Points	Pedestrian crosswalk on Alison Road west of Doncaster Avenue relocated 20m west.	The relocation of the pedestrian crosswalk on Alison Road west of Doncaster Avenue 20m west significantly reduces the visibility of pedestrians by drivers turning left from Doncaster Avenue. In addition, the proposed double left turn increases the risk that the driver from the right hand left turn lane will not see a pedestrian.	Reduced visibility to pedestrians using the pedestrian crosswalk on Alison Road west of Doncaster Avenue by drivers turning left from Doncaster Avenue.
	Ramps	-		
	Illegal Access	-		
	Safety	-	-	-
	Footpath / Shared Path	Existing shared path retained along northern side of Alison Road. LRV tracks cross footpath on southern side of Alison Road.	n/a No details are provided as to how pedestrians using the southern footpath of Alison Road east of Doncaster Avenue will cross the light rail tracks. All other pedestrian movements at this location are signalised.	n/a Pedestrian and LRV conflict on southern side of Alison Road east of Doncaster Avenue.
	Vehicle	Bus movements to and from the busway will be retained.	n/a	n/a
Intermodal	Sharing of Tracks	Buses and LRV will shared existing busway west of Doncaster Road.	Refer comment below regarding bus and LRV conflicts.	n/a
	Bus Stops	No detail provided regarding existing bus stops.	Existing bus stops on Alison Road and on busway in vicinity of intersection.	Location and access to bus stops.
	Bus / LRV Transfer	No light rail stop proposed at this location.	n/a	n/a
	Bus Priority	Bus phase to and from the busway retained.	n/a	n/a
Signal Operation	Overview	Additional light rail phase to be added to intersection.	It is understood that signals operate in a three phase arrangement – Alison Road, Doncaster Avenue and Bus Movements. The intersection will be widened from 25m to 75m along Alison Road. The removal of the median will also decrease delineation along Alison Road.	Wide intersection with minimal delineation for traffic along Alison Road.
	LRV Movements	Separate phase for LRV movements.	There is no detail regarding the management of conflicts between LRV and buses on the northern side of Alison Road. Eastbound LRV waiting at the intersection will block the busway, and westbound LRV will merge with westbound buses on to the busway.	Bus and LRV conflict on the northern side of Alison Road
	Bus Movements	Bus phase to and from the busway retained.	Buses will be required to wait within the middle of the intersection to perform a right turn.	Buses required to wait within middle of wide intersection that has poor delineation. Consider extension of red pavement through intersection to improve delineation and to provide a clear area for buses to wait.
	Pedestrian Movements	All existing movements retained.	n/a	n/a
	Traffic Impacts	Report indicates minimal impacts on traffic.	Impacts on traffic due to additional light rail phase, and wider intersection.	n/a

8 ALISON ROAD / STABLING YARD

The proposed stabling yard will be located on Alison Road at the main 'administration' entrance to Royal Randwick Precinct.

8.1 EXISTING CONDITIONS

The existing conditions are shown in Figure 7 and Figure 8 and are summarised as follows:

- Unsignalised T-intersection (priority along Alison Road) with right turn lane in to driveway.
- Three traffic lanes in each direction along Alison Road with 70km/h speed limit.

Source: http://maps.six.nsw.gov.au/

Figure 7: Alison Road / Stabling Yard – Existing Conditions

Alison Road – View East from Access

Alison Road – View West across Access

Figure 8: Alison Road / Stabling Yard – Photographs

8.2 PROPOSED CONDITIONS

It is proposed to construct (as shown in Figure 9):

- new light rail tracks along southern side of Alison Road.
- new light rail track junction to access stabling facilities on southern side of Alison Road.
- pedestrian walkway between roadway and rail.

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8.3 TECHNICAL REVIEW

The findings from the review of this location are included in Table 3.

Table 3: Alison Road / Stabling Yard

Category	Sub-Category	Proposed Conditions	Discussion / Comment	Road Safety Risk/s
Consistency	-	-	-	-
Layout	Track Location	Light rail tracks located on southern side of Alison Road.	n/a	n/a
	Platform Size	-	-	-
	Storage	-	-	-
	Swept Paths	-	-	-
Access	Crossing Points	-	-	-
	Ramps	-	-	-
	Illegal Access	-	-	-
	Safety	-	-	-
	Footpath / Shared Path	Existing shared path retained along northern side of Alison Road. LRV tracks separate footpath on southern side of Alison Road and Royal Randwick Precinct. Pedestrian walkway located between light rail tracks and Alison Road.	n/a No details are provided as to how pedestrians using the southern footpath of Alison Road will cross the light rail tracks (NB: To access Administration Building, etc.). Narrow (approx. 3m) footpath located between eastbound light rail tracks and westbound carriageway of Alison Road. This is a very constrained pedestrian environment with high speed vehicles passing on both sides. No details are provided regarding fencing.	n/a Pedestrians crossing light rail tracks to access Royal Randwick Precinct. Narrow walkway between light trail tracks and Alison Road with high speed vehicles passing both sides.
	Vehicle	No details provided regarding vehicle access.	Existing unsignalised intersection used as main 'non-event' access point to Royal Randwick Precinct. Unsignalised vehicle movements are high risk due to the high speed (70km/h) Alison Road traffic, various light rail movements (eastbound, westbound, left in, left out, right in, right out) and pedestrian movements.	If unsignalised, high risk of collisions between vehicles, light rail vehicles and pedestrians. Consider the siganlisation of the intersection.
Intermodal	Sharing of Tracks	-	-	-
	Bus Stops	-	-	-
	Bus / LRV Transfer	-	-	-
	Bus Priority	-	-	-
Signal Operation	Overview	As indicated above, consider signalisation of intersection.	n/a	n/a
	LRV Movements	-	-	-
	Bus Movements	-	-	-
	Pedestrian Movements	-	-	-
	Traffic Impacts	-	-	-

9 ALISON ROAD / ROYAL RANDWICK PRECINCT STOP

The proposed Wansey Road / High Street stop will service the upper campus of UNSW.

9.1 EXISTING CONDITIONS

The existing conditions are shown in Figure 10 and Figure 11 and are summarised as follows:

- Bus interchange to the west of Darley Road for event operation.
- Three traffic lanes in each direction along Alison Road with 70km/h speed limit.

Source: http://maps.six.nsw.gov.au/

Figure 10: Alison Road / Royal Randwick Precinct – Existing Conditions

Alison Road – View West to Darley Road

Alison Road – View North to Darley Road

Bus Interchange – View West from Darley Road

Bus Interchange – View West from Darley Road

Bus Interchange – View West from Darley Road

Bus Interchange – View West from Darley Road

Figure 11: Alison Road / Royal Randwick Precinct – Photographs

9.2 PROPOSED CONDITIONS

It is proposed to construct (as shown in Figure 12):

- new centre island platform stop (normal operation).
- new side platform (westbound) and pocket track for post-event loading.
- bus and taxi parking areas in kerbside lane along Alison Road.

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Source: Transport for NSW

Figure 12: Proposed Conditions – Alison Road / Royal Randwick Precinct

9.3 TECHNICAL REVIEW

The findings from the review of this location are included in Table 4.

Table 4: Alison Road / Royal Randwick Precinct

Category	Sub-Category	Proposed Conditions	Discussion / Comment	Road Safety Risk/s
Consistency	-	-	-	-
Layout	Track Location	Light rail tracks located on southern side of Alison Road.	n/a	n/a
	Platform Size	Centre platform – 45.0m x 5.25m Side platform – 45.0m x 3.20m	No details are provided regarding predicted event boarding and alighting numbers so it is difficult to assess the ability of the platforms to cater for the expected patronage. The proposed side platform (for post-event boarding) is supported to minimise the number of crossings of the tracks. If the platforms are not large enough, passengers will queue down the ramps and across the tracks. Any overflow will block access across the tracks for passengers going to and from the walkway between the tracks and Alison Road. It is understood that provision for longer LRV may be required. The proposed layout does not appear to make provision for the longer LRV.	Request additional information regarding event boarding and alighting numbers.
	Storage	Ramps proposed at each end of platforms can provide additional storage area.	n/a	n/a
	Swept Paths	Proposed track cross-over located immediately east of platform stops.	Additional clearance may be required at the eastern end of the stops to allow for the swept paths of LRV.	Clearances of LRV to pedestrian waiting areas.
Access	Crossing Points	Proposed LRV priority pedestrian crossings at both ends of stop.	These types of crossings should work satisfactorily in this environment.	n/a
	Ramps	Ramps proposed at both ends of stops.	In the cross sections, tracks appear to be lowered.	n/a
	Illegal Access	Existing fencing along Alison Road centre median to be retained.	Existing fencing along Alison Road centre median will discourage illegal movements across Alison Road.	n/a
	Safety	-	-	-
	Footpath / Shared Path	Shared path along southern side of Alison Road up to proposed platform stops.	There is an existing shared path on the northern side of Alison Road west of Darley Road. It is proposed to provide a narrow footpath between the light rail tracks and Alison Road between Darley Road and Doncaster Avenue which is unlikely to be suitable as a shared path. It is considered that the benefits of extending the shared path to the platform stops is minimal, and will create conflicts, especially during events.	Shared path between Darley Road and platform stops expected to create conflicts between cyclists and pedestrians, and encourage cyclists to use narrow footpath further west rather than existing shared path on the north side of Alison Road.
	Vehicle	-	-	-
Intermodal	Sharing of Tracks	-	-	-
	Bus Stops	Buses and taxis proposed to stop in kerbside lane during events 'under traffic control conditions'.	Prior to the construction of the bus interchange in 2009, buses and taxis stopped in the kerbside lane. There are only two westbound lanes in Alison Road east of Darley Road. There are three right turn lanes out of Darley Road. The third right turn lane will conflict with the kerbside bus/taxi lane. If traffic control is to be used to manage westbound traffic in Alison Road during events, this creates on ongoing resource requirement for the ATC to provide the required traffic management. The 3.0m wide footpath between the tracks and Alison Road may become very congested at each of the bus stop locations which may make it difficult for other pedestrians to move along the footpath.	Conflicts between buses and taxis with westbound traffic on Alison Road when entering and exiting the kerbside lane. As Alison Road will effectively be reduced to a four lane divided road, consider the removal of the third right turn lane from Darley Road to create an exclusive lane for buses and taxis during events.
	Bus / LRV Transfer	The proposed location of existing bus stops is not shown on the plans.	There is expected to be some transfer between buses and LRV at this location.	Provide safe access between bus stops and light rail stop.
	Bus Priority	-	-	-
Signal Operation	Overview	-	-	-
	LRV Movements	-	-	-

Category	Sub-Category	Proposed Conditions	Discussion / Comment	Road Safety Risk/s
	Bus Movements	-	-	-
	Pedestrian Movements	-	-	-
	Traffic Impacts	It is proposed to retain the six traffic lanes in Alison Road west of Darley Road.	n/a	n/a

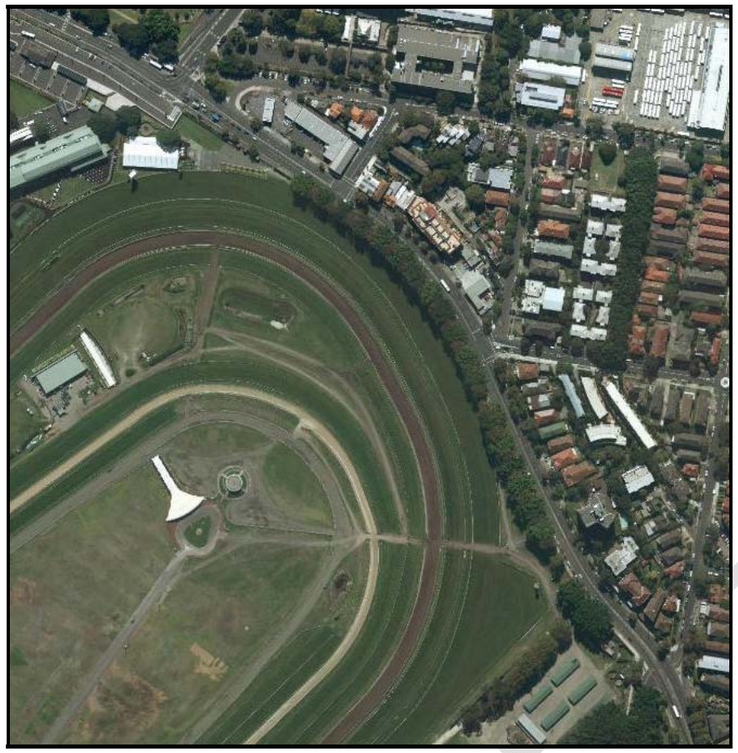
10 ALISON ROAD – DARLEY ROAD TO WANSEY ROAD

Alison Road between Darley Road and Wansey Road will be modified to accommodate the new light rail tracks and shared path along the southern side.

10.1 EXISTING CONDITIONS

The existing conditions are shown in Figure 13 and Figure 14 and are summarised as follows:

- two or three traffic lanes in each direction, with kerbside parking in some locations.
- signalised intersections at Cowper Street, John Street and Darley Road.
- footpaths along both sides.



Source: http://maps.six.nsw.gov.au/

Figure 13: Alison Road - Darley Road to Wansey Road – Existing Conditions

Alison Road – View West from Wansey Road

Alison Road – View West from Wansey Road

Alison Road – View West to Cowper Street

Alison Road – View West to John Street

Alison Road – View West to Darley Road

Alison Road – View East from Darley Road

Figure 14: Alison Road (Darley Road to Wansey Road) – Photographs

10.2 PROPOSED CONDITIONS

It is proposed to construct (as shown in Figure 15):

- new light rail tracks on the southern side of Alison Road.
- new shared path on the southern side of the light rail tracks.
- reduced numbers of traffic lanes to accommodate light rail tracks and shared path.

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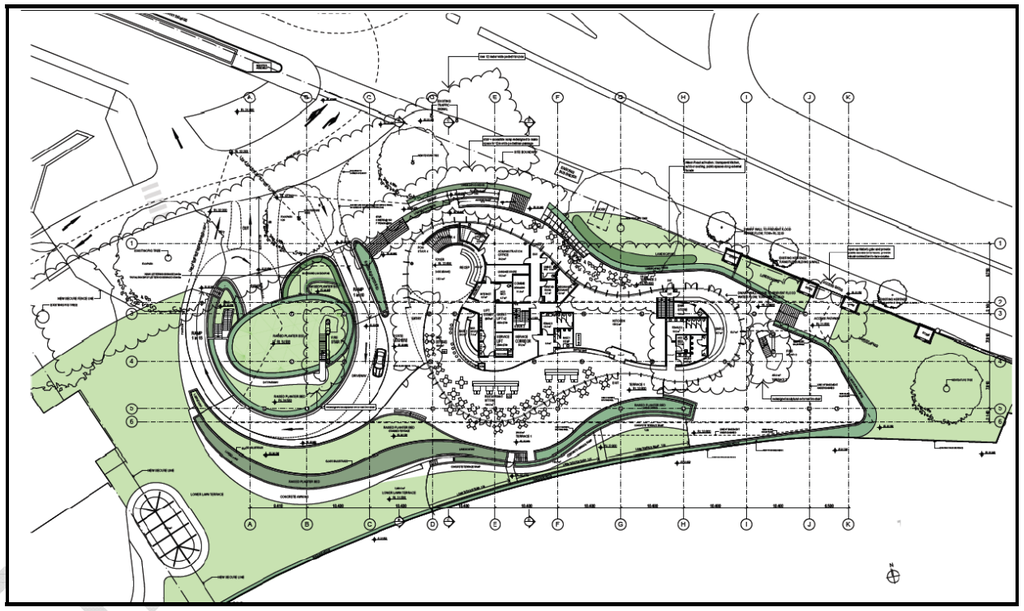
Figure 15: Proposed Conditions – Alison Road (Darley Road to Wansey Road)

There is also a proposed hotel development on the south side of Alison Road at the Darley Road intersection as shown below in Figure 16.



Source: ATC

Figure 16: Proposed Hotel Development

10.3 TECHNICAL REVIEW

The findings from the review of this location are included in Table 5.

Table 5: Alison Road (Darley Road to Wansey Road)

Category	Sub-Category	Proposed Conditions	Discussion / Comment	Road Safety Risk/s
Consistency	-	-	-	-
Layout	Track Location	Light rail tracks located on southern side of Alison Road.	n/a	n/a
	Platform Size	-	-	-
	Storage	-	-	-
	Swept Paths	-	-	-
Access	Crossing Points	No details of how pedestrians will cross light rail tracks.	At Darley Road, John Street and Cowper Street, there are no details of how pedestrians will cross the light rail tracks. In addition, there is no storage area between the Alison Road traffic lanes and the light rail tracks, nor between the shared path and the light rail tracks.	No pedestrian storage areas between traffic lanes, light rail tracks and shared path.
	Ramps	-	-	-
	Illegal Access	No indication of any proposed fencing between Alison Road, tracks and shared path.	Existing busway along Alison Road has fencing on both sides with openings at bus stops. Fencing may be required along Alison Road due to high speed LRV passing pedestrians and cyclists in the opposite direction. Openings could be provided at intersections.	Conflicts between high speed LRV and pedestrians and cyclists using shared path.
	Safety	-	-	-
	Footpath / Shared Path	Proposed shared path on south side of tracks.	Separated shared path will provide a high standard facility in terms of safety and operation.	n/a
	Vehicle	There are a number of existing access gates to the Royal Randwick Precinct.	There are no details regarding the retention or removal of these access gates, and if retained, how vehicles will be able to cross the light rail tracks and shared path.	Safe crossings of the light rail tracks and shared path at access gates.
Intermodal	Sharing of Tracks	-	-	-
	Bus Stops	There is an existing bus stop on the south side of Alison Road near Darley Road.	There is no indication if the bus stop will be retained (and there is no room between the tracks and Alison Road).	Location and access to bus stop.
	Bus / LRV Transfer	-	-	-
	Bus Priority	-	-	-
Signal Operation	Overview	-	-	-
	LRV Movements	-	-	-
	Bus Movements	-	-	-
	Pedestrian Movements	-	-	-
	Traffic Impacts	Alison Road reduced from a 6 lane divided road to a 4 lane divded road.	Reduction in the number of traffic lanes, particularly at intersections, will reduce the capacity of Alison Road. Parking will also be removed along both sides of Alison Road which impacts on existing bus and coach parking along the south side on event days.	n/a

11 ALISON ROAD / WANSEY ROAD STOP

The proposed Alison Road / Wansey Road stop will service residential area surrounding the intersection.

11.1 EXISTING CONDITIONS

The existing conditions are shown in Figure 17 and Figure 18 and are summarised as follows:

- Unsignalised Cross-intersection (priority along Alison Road) with skewed approaches.
- Shared path along west side of Wansey Road and south side of Alison Road.
- Residential catchments to north of Alison Road.

Source: http://maps.six.nsw.gov.au/

Figure 17: Alison Road / Wansey Road – Existing Conditions

Wansey Road - View North to Alison Road

Wansey Road - View North to Alison Road

Alison Road - View South from Wansey Road

Wansey Road - View North to Prince Street

Wansey Road - View South from Alison Road

Alison Road - View South across Wansey Road

Figure 18: Alison Road / Wansey Road – Photographs

11.2 PROPOSED CONDITIONS

It is proposed to construct (as shown in Figure 19):

- new light rail tracks on the west and south legs of the intersection.
- centre island tram platform stop on south leg.
- traffic signals.

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Figure 19: Proposed Conditions – Alison Road / Wansey Road

11.3 TECHNICAL REVIEW

The findings from the review of this location are included in Table 6.

Table 6: Alison Road / Wansey Road

Category	Sub-Category	Proposed Conditions	Discussion / Comment	Road Safety Risk/s
Consistency	-	-	-	-
Layout	Track Location	Light rail tracks located on southern side of Alison Road and western side of Wansey Road.	n/a	n/a
	Platform Size	Centre island 45.0m x 4.4m		
	Storage			
	Swept Paths	LRV turning corner will swing wider than shown on plan.	LRV will swing 'further out' when turning the corner between Alison Road and Wansey Road. The swept paths of the LRV may encroach in to the shared path and also the pedestrian waiting area between the tracks and the intersection.	Conflict between LRV and pedestrians / cyclists at intersection.
Access	Crossing Points	Crosswalks are proposed on the north, west and south legs of the intersection. LRV priority crossing proposed of tracks.	Proposed crosswalks are supported provided that there is adequate storage area (clear of the swept paths of LRV) between Alison Road and the tracks and on the shared path.	Conflict between pedestrians and LRV between Alison Road and tracks, and between pedestrians, LRV and cyclists on shared path.
	Ramps	Ramp provided at northern end of stop.	n/a	n/a
	Illegal Access	No formal access at southern end of stops.	It is expected that there will be illegal access to / from the northern end of the stop.	Illegal access to / from southern end of the stop.
	Safety	-	-	-
	Footpath / Shared Path	New shared path to be installed (cantilvered due to height differences).	Replacement of existing shared path. High speed northbound cyclists down the Wansey Road hill. If existing fence retained, limited sight distance around corner at the intersection.	Sight distance and speed around curve for northbound cyclists.
	Vehicle	No vehicle access to Royal Randwick Precinct shown on plan.	Existing access driveway to stables not shown on plans. Access will cross tracks and shared path. Existing 'traffic signal' system to warn approaching shared path users when access gate is open.	Vehicles accessing stables crossing tracks and shared path.
Intermodal	Sharing of Tracks	-	-	-
	Bus Stops	-	-	-
	Bus / LRV Transfer	No details provided regarding bus stop locations.	n/a	Location and access to bus stop.
	Bus Priority	-	-	-
Signal Operation	Overview	As tracks are separated from the roads, the LRV's can operate 'outside' of the traffic signals.	n/a	n/a
	LRV Movements	-	-	-
	Bus Movements	-	-	-
	Pedestrian Movements	Pedestrian crosswalks and crossing will provide safe pedestrian access.	n/a	n/a
	Traffic Impacts	The traffic signals will provide safer access to and from the side streets.	There is no separated right turn from Alison Road in to Wansey Road. There is a significant lateral shift for westbound traffic on Alison Road through the intersection.	No right turn lane from Alison Road in to Wansey Road. Westbound lateral shift on Alison Road.

12 WANSEY ROAD / HIGH STREET STOP

The proposed Wansey Road / High Street stop will service the upper campus of UNSW.

12.1 EXISTING CONDITIONS

The existing conditions are shown in Figure 20 and Figure 21 and are summarised as follows:

- Unsignalised T-intersection (priority along High Street). Left turn slip lane on west leg. University vehicle access immediately east of intersection.
- Pedestrian 'zebra crossing' on east leg. Pedestrian refuges on west leg. Existing shared path along west side of Wansey Road.
- Bus routes along High Street. Bus stops located to the east and west of the intersection.
- Pedestrian access to UNSW's upper campus.
- Large numbers of public transport (bus) passenger accessing bus stops on High Street.

Source: http://maps.six.nsw.gov.au/

Figure 20: Wansey Road / High Street – Existing Conditions

View North to Wansey Road

View West along High Street

View East along High Street

View West to High Street Pedestrian Crossing

View South to UNSW Entrance

View North from UNSW Entrance to High Street

Figure 21: Wansey Road / High Street – Photographs

Daily pedestrian movement data (by location and mode at each of the main access points) was provided by UNSW and are presented in Figure 22. This shows the high number of arrivals (11,958) from the existing bus stops in High Street near Wansey Road, with approximately 80% (9,500) by public transport. There is also a high number of departures (9,607) to the existing bus stops in High Street, with approximately 74% (7,100) by public transport.

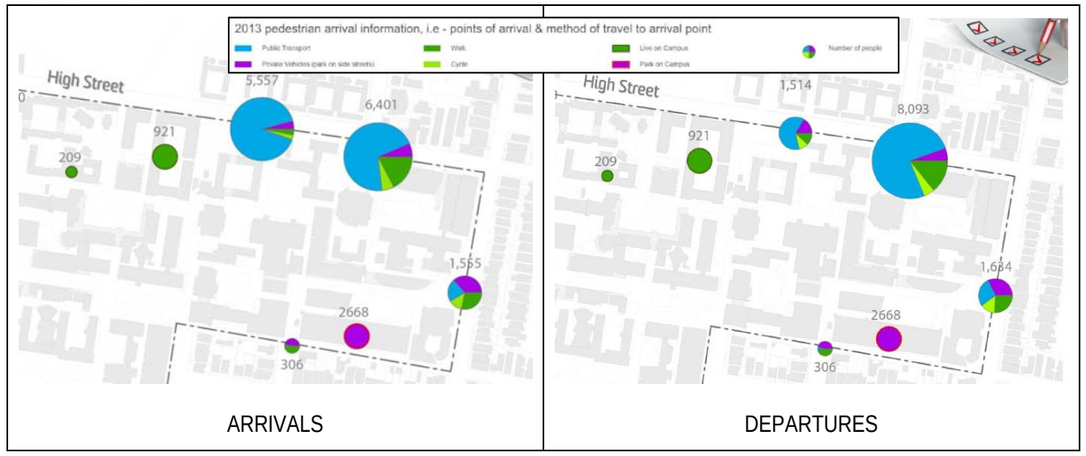

Figure 22: UNSW Daily Pedestrian Movements - by location by mode

Figure 23 presents the breakdown of pedestrian movements in 15 minute intervals.

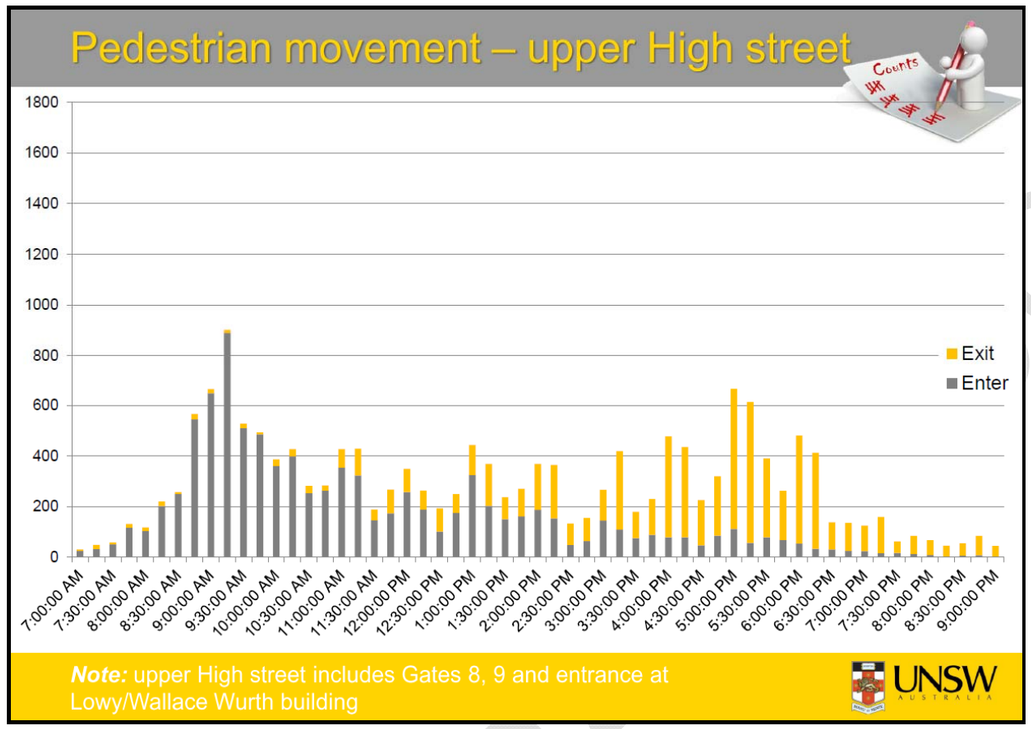

Figure 23: UNSW Pedestrian Movements – 15 minute intervals

12.2 PROPOSED CONDITIONS

It is proposed to construct (as shown in Figure 24):

- new light rail tracks on the north and east legs of the intersection.
- tram platform stops on the north leg.
- traffic signals.

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Figure 24: Proposed Conditions - Wansey Road / High Street

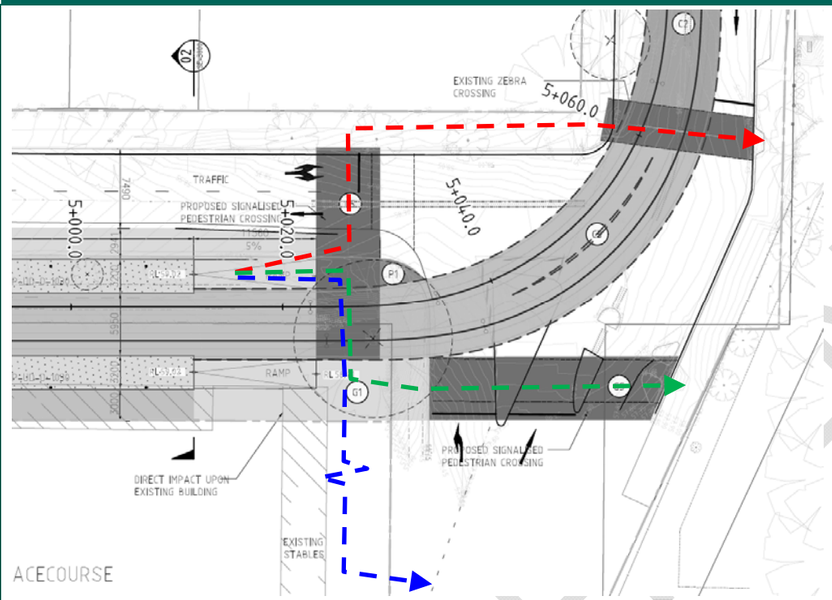
12.3 TECHNICAL REVIEW

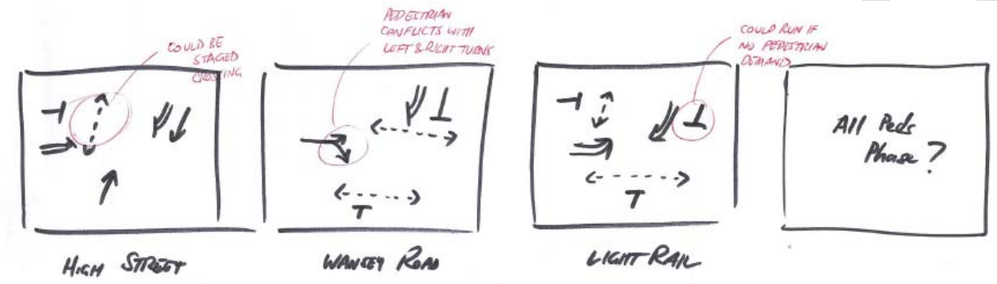
The findings from the review of this location are included in Table 7.

Table 7: Wansey Road / High Street

Category	Sub-Category	Proposed Conditions	Discussion / Comment	Road Safety Risk/s
Consistency	-	-	The 'Road Engineering' plans and the 'Stop Plans' show different configurations for the pedestrian crossings. It has been assumed that the Stop Plans are the basis for comment.	Update plans to be consistent.
Location	Surrounding Land Uses	Located at north east corner of UNSW campus, on north side of High Street.	Proposed stop is located adjacent to UNSW campus, a major passenger generator.	Not enough room in High Street to locate tracks, stops and traffic lanes.
	Land Acquisition	Required from Royal Randwick Precinct on west side of Wansey Road.	n/a	n/a
Layout	Track Location	Tracks located on west side of Wansey Rd and centre of High Street.	Track curves require tracks to be located on west side of Wansey Road. Additional land acquisition would be required from residential properties on north east corner of intersection to realign track curves.	n/a
	Platform Size	Both platforms 45.0m x 3.2m = 144.0 sqm.	Assumption: LRV at 2-3 minute frequencies at CBD end will result in LRV at 4-6 minute frequencies at this location. Assume approximately 3 LRV each 15 minute period. Alighting: Assuming a capacity of 300 pax per LRV, should be no more than 300 pax alighting at any one time. Capacity of platforms to cater for peak alighting numbers (approx. 632 pax in 15 minute period). Using the Fruin Level of Service criteria, the ramp (average flow rate of 42 pax per minute) is expected to operate with a Level of Service of A. However, if 211 pax alighted from one LRV, the Level of Service would drop to E. Boarding: Capacity of platforms to cater for peak boarding numbers (approx. 480 pax in 15 minute period). Using the Fruin Level of Service criteria, this platform is expected to operate with a Level of Service of D (129 pax waiting for LRV). The ramp (average flow rate of 26 pax per minute) is expected to operate with a Level of Service of A. However, the signalised crossings will meter the flows of pedestrians.	Alighting: Proposed outbound platform ramp will restrict flow off the stop and will 'meter' pedestrians reaching the crossing points. However, predicted flow rates are expected to be within capacity. Boarding: Proposed citybound platform will be very congested (Level of Service F) with some pax being required to wait on ramp and approaches.
	Storage	Ramps provided at both north and south ends to provide access.	Ramps and approaches will provide additional storage if stops are congested. Road safety risk is if pax cannot clear light rail tracks or roads. As the citybound stop will have the highest boarding numbers, the ramp and large storage area is expected to accommodate all required pax without queuing across the light rail tracks and roads.	n/a
	Swept Paths	The proposed tracks and stops will reduce the width of Wansey Road and High Street.	North to east left turns (from Wansey in to High) – very tight radius, turning vehicles may encroach on to citybound light rail tracks.	Ensure design vehicles able to undertake turn. If cannot undertake turn, stop line on east leg of intersection may need to be set back.
			West to north left turns (from High in to Wansey) – very tight radius, turning vehicles may encroach on to southbound traffic lane or mount footpath, potential conflict with pedestrians if right turners allowed turn at same time as pedestrians.	Ensure design vehicles able to undertake turn. If cannot undertake turn, consider removal of the left turn slip lane and allow left turns from the eastbound 'through' lane. The left

Category	Sub-Category	Proposed Conditions	Discussion / Comment	Road Safety Risk/s
				turn slip lane could then be used as a larger pedestrian area and reduce the width of the crossing across the west leg of the intersection. The Wansey Road stop line could then also be moved further south.
			North to east right turns (from Wansey in to High) – very tight radius, turning vehicles may encroach on to waiting areas, may impact on parking along High Street, potential conflict with pedestrians if right turners allowed turn at same time as pedestrians.	Ensure design vehicles able to undertake turn. Review conflict with pedestrians – consider early start for pedestrians on crossing.
			LRV clearances increase around tight radii. Turning LRV may encroach in to pedestrian crosswalks and waiting areas.	Ensure adequate clearances to turning LRV around curves and modify crosswalks and waiting areas to suit.
			Westbound through movements have poor delineation through intersection.	Build out southern side of High Street out to existing kerb outstand.
Access	Crossing Points	The 'Road Engineering' plans and the 'Stop Plans' show different configurations for the pedestrian crossings. Signalised Pedestrian Crossings are proposed at Wansey Rd/High St intersection, across Light rail tracks (at north and south ends) and also across Wansey Rd at north end of stops.	A key design consideration must be the movement of pedestrians to and from the stops. In the AM Peak, there will be a very high movement of pedestrians from the southbound platform, down the ramp, and then across the roads at the signalised access points. Even though these movements are to be controlled by signals, it is expected that pedestrians will cross the tracks and roads against the signals. Therefore, although signalised crossings are required for the road crossings, the crossings of the tracks should be 'LRV priority crossings' which will allow pedestrians to cross as required except for when LRV are present. As the stops are located on the north side of High Street, pedestrians to UNSW will be required to either: ▪ cross Wansey Road and High Street, ▪ cross tracks then High Street, or ▪ cross tracks, walk westbound along High Street then cross at zebra crossing.	Agree that road crossings should be signalised. Recommend that crossings of the tracks should be unsignalised with priority given to LRV. Electronic signs could be used to provide increased warning of an approaching LRV e.g. 'GIVE WAY TO LIGHT RAIL VEHICLE' The removal of the left turn slip lane could increase the storage areas for pedestrians and reduce the crossing width. The southbound shared path ends just north of High Street. Shared path users will need to share this space with large numbers of pedestrians. Provide a surface treatment that clearly delineates the end of the shared path and warns of pedestrians. Consider an alternative access down northern side of High Street to a new pedestrian overpass to provide direct connection in to UNSW campus.

Category	Sub-Category	Proposed Conditions	Discussion / Comment	Road Safety Risk/s
			 It is noted that the existing zebra crossing on High Street to the west of the Wansey Road intersection(as shown in Figure 21) is used by a large number of pedestrians (mostly bus passengers) and UNSW has safety concerns regarding its operation. Adjacent to this zebra crossing is a raised walkway into UNSW's grounds. A potential future option is to create a pedestrian overpass (to replace the zebra crossing) that connects directly to the raised walkway within UNSW. This option would mean that a significant number of LRV pax would only have to cross the tracks and no roads.	
	Ramps	DDA compliant ramps provided at both north and south ends to provide access.	The ramps end at the crossing points which may create congestion as pedestrians wait to cross the tracks or Wansey Rd.	Shorten ramps if possible to create larger waiting areas prior to cross points.
	Illegal Access	No fencing has been shown.	The crossing at northern end important to provide access to from residential area and park and ride. Illegal or undesirable crossings are expected to occur between the shared path, track and park and ride footpath (especially during the AM Peak).	Install fence between shared path and tracks (to protect shared path uses from opposing LRV), and between park and ride footpath and tracks (to prevent pedestrians crossing tracks away from formal crossing points.
	Safety	-	Illegal access is the main safety issue as discussed above.	n/a
	Footpath / Shared Path	4.0m shared path on Wansey Road narrows to 3.0m past platform.	Shared path ends at southern end of platform. Shared path users, especially cyclists, will enter an area with significant numbers of pedestrians.	Nil – 3.0m is desirable width for shared path. Ensure path material and signage indicate end of shared path. Consider installation of bicycle lanterns for crossing of High Street to allow cyclists to cross without dismounting.
	Vehicle	No vehicle access proposed.	University access restricted to left in/left out. No vehicle access to Royal Randwick Precinct shown on plan.	Access to Royal Randwick Precinct.
Intermodal	Sharing of Tracks	-	n/a	n/a
	Bus Stops	Westbound bus stops (indented bays) proposed on south side of High Street east of intersection.	Proposed stop will replace a number of existing bus stops in High Street.	n/a
		Eastbound bus stops retained on north side of High Street west of intersection.	Nil.	n/a
	Bus / LRV	-	It is noted that some bus stops will be retained, and passengers may transfer to LRV. These passengers likely to	n/a

Category	Sub-Category	Proposed Conditions	Discussion / Comment	Road Safety Risk/s
	Transfer		cross High Street then Wansey Road.	
	Bus Priority	No bus priority shown on plans.	LRV and pedestrian priority likely to be highest priorities, so unlikely to be able to also provide bus priority. In addition, buses will not be located in separate lanes so additional priority unlikely to be effective.	n/a
Signal Operation	Overview	No details provided.	Separate phases likely to be required for High Street throughs, Wansey Road left/right, and tram movements. Some other movements (vehicle and pedestrian) could run with LRV phases. Some traffic movements conflict with pedestrian movements. 	Review phasing to determine optimal operation for LRV and pedestrians.
	LRV Movements		Signalised left and right turn movements. LRV movements could run separately. May not want green for pedestrians across Wansey Road at same time as LRV movements as pedestrians may observe green walk signal and think it applies to the crossing of the tracks. Need to determine southbound trams 'trigger' signals. The time at stops is variable and only want to provide time to LRV phases when needed. Providing advance detection of east leg will be possible. Advance detection on north leg not possible due to proximity of stop. So when LRV detected, need to be able to 'close' down other phases as quickly as possible. The restriction on closing down phases will be pedestrian crossing clearance times. If pedestrian crossing can be as short as possible, this reduces the time required to 'stop' the pedestrian phase and switch to the LRV phase.	If crossing of Wansey Road is signalised and crossing of tracks is not, stagger the crossings so that pedestrians are required to change direction. Modify intersection to increase distance between light rail stop and crossing point to allow detection of southbound LRV. Modify intersection to reduce length of the pedestrian crossings. Signal operation should be set up to allow LRV phase to run between other phases to reduce delays.
	Bus Movements	Bus movements eastbound and westbound through intersection.	No additional priority.	n/a
	Pedestrian Movements	Pedestrian Operated Signals and LRV Priority Crossings.	Some traffic and tram movements conflict, need to consider how they will be undertaken safely. One option may be to run an all pedestrian phase which allows pedestrians to cross in all directions at one time.	Consider an all pedestrian phase which allows pedestrians to cross in all directions at one time.
	Traffic Impacts	Right turn movement from east to north removed.	Northbound (left turn) and eastbound (through) traffic will share High Street with LRV. Although light rail tracks are separated midblock, right turning vehicles share the tracks.	Consider some form of traffic metering, especially in High Street east of intersection, to hold traffic in Wansey and/or High to reduce congestion for eastbound LRV. Note this may impact on High Street bus services.