Transport for NSW

Sydney Light Rail

PARSONS BRINCKERHOFF

CBD AND SOUTH EAST LIGHT RAIL PROJECT

STATE SIGNIFICANT INFRASTRUCTURE APPROVAL (SSI-6042)

MODIFICATIONS REPORT

DECEMBER 2014

NSW NOW The new state of business

DOCUMENT INFORMATION	
Client	Transport for NSW
Title:	CBD and South East Light Rail – Modifications Report
Document No:	2207525A-ENV-RPT-7646
Date:	1 December 2014

VERSION	DATE	DETAILS
Final	1 December 2014	CSELR – Modifications Report

AUTHOR, REVIEWER AND APPROVER DETAILS			
Prepared by:	Jarryd Barton	Date: 1/12/2014	
Reviewed by:	Delyth Toghill	Date: 1/12/2014	
Approved by:	Hugh Swinbourne	Date: 1/12/2014	

DISTRIBUTION
Transport for NSW, Parsons Brinckerhoff file, Parsons Brinckerhoff Library

DOCUMENT OWNER
Parsons Brinckerhoff Australia Pty Limited
ABN 80 078 004 798
Level 27 Ernst & Young Centre 680 George Street, Sydney NSW 2000 GPO Box 5394 Sydney NSW 2001 Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 Email: sydney@pb.com.au www.pbworld.com
Certified to ISO 9001, ISO 14001, AS/NZS 4801 *A GRI Rating: Sustainability Report 2011*

Contents

List of tables

List of figures

Glossary and abbreviations

APS	Aesthetic Power Solution
ARI	average recurrence interval
ATC	Australian Turf Club (property managers of the Royal Randwick Racecourse)
CBD	central business district
CSELR	CBD and South East Light Rail
dB	(decibel) unit of measurement for sound pressure level
dBA	A-weighted decibels
DDA	*Disability Discrimination Act 1992*
DP&E	(NSW) Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	(NSW) *Environmental Planning and Assessment Act 1979*
HAMU	Heritage Archaeological Management Unit
HCA	heritage conservation area
INP	*Industrial Noise Policy*
L_{Aeq}	The 'energy average noise level' evaluated over a defined time period. The L_{Aeq} can be likened to a noise dose representing the cumulative effects of all the noise events occurring in the relevant time period.
LoS	level of service, representing intersection performance on a scale of A (best performance) to F (worst performance)
LRV	light rail vehicle
OHW	overhead wire
ONVR	Operational Noise and Vibration Review
NCA	noise catchment area
Randwick LEP 2012	*Randwick Local Environmental Plan 2012*
SHR	State heritage register
SSI	State Significant Infrastructure
Sydney LEP 2012	*Sydney Local Environmental Plan 2012*

Executive summary

CSELR Project approvals

The CBD and South East Light Rail (CSELR) project was identified as a key priority transport infrastructure project for the NSW Government in the NSW *Long Term Transport Master Plan*. *Sydney's Light Rail Future* presents the NSW Government's plan to expand light rail in Sydney.

The CSELR Project was declared Critical State Significant Infrastructure (SSI) by the NSW Minister for Planning and Infrastructure (now Planning) on 25 June 2013. Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes an assessment and approval regime for SSI developments. Accordingly, an environmental impact statement was exhibited from 14 November 2013 to 16 December 2013. A subsequent Submissions Report (incorporating a preferred infrastructure report) was prepared and submitted to the Department of Planning and Infrastructure (now the Department of Planning and Environment) in March 2014. Planning approval was granted by the Minister for Planning under Part 5.1 of the EP&A Act on 4 June 2014.

Planning approvals process

Pursuant to Section 115ZI of the EP&A Act, Transport for NSW is seeking approval for the modification of the State Significant Infrastructure approval (SSI-6042), granted on 4 June 2014.

Purpose of this report

This report has been prepared to support an application by Transport for NSW to modify the existing project approval for the approved CSELR Project and is intended to assist the Minister for Planning in forming a view as to the merits of the proposed modifications. The application for modification has been prepared to:

- describe the changes to the existing project approval
- provide justification for the modifications and describe the alternatives considered
- assess the environmental and community impacts of the modifications.

Modifications to the proposal

A number of design changes have been made to the design of the approved project in response to further design investigations and ongoing consultation with stakeholders. The proposed changes and their justification are summarised in Table S.1 below. Further details, including an assessment of the potential impacts of the changes, are provided in Chapter 3 of this report.

Table S.1 Summary of modifications to the approved project

Proposed design change/ modification	Justification for the proposed change
Grosvenor Street stop arrangement	▪ Retains an additional, northbound traffic lane, specifically the existing dedicated left hand turning lane from George Street into Grosvenor Street.
Removal of World Square stop	▪ Removes a stop close to other stops and the need for substantial engineering measures to meet the requirements of the Disability Discrimination Act 1992.
Moore Park stop arrangement	▪ Reduces visual impact with improved opportunities for public domain retention, enabling the stop to better sit within the existing park character. ▪ Improves special event patronage management.
Increase in the size of LRVs and stop platforms	▪ Provides greater flexibility to respond to opening year and future capacity demands. ▪ Provides flexibility to meet future patronage demands on the network.
Realignment of light rail alignment along Alison Road, including relocation of Royal Randwick stop and height increase to the Centennial Park levee	Alison Road alignment including relocation of Royal Randwick stop: ▪ Minimises the: o potential impacts to the bus interchange area at the Alison Road entrance to Royal Randwick Racecourse o potential access issues for Gate 1 and 6 of the Royal Randwick Racecourse. ▪ Provides improved operational access to the Royal Randwick Racecourse, Gate 10. Centennial Park levee: ▪ Decreases potential flooding frequency of the Randwick stabling facility site and significantly reduces the extent of flood conveyance works that were previously proposed as part of the Randwick stabling facility site.
Realignment of light rail track at the Anzac Parade/Alison Road intersection	▪ Operational improvements including: o where an LRV heading towards Kingsford (southbound) is stopped on the northern side of the intersection the modified alignment would not block/prevent an LRV heading towards Randwick o improved right hand turning (for motorists) from Alison Road into Anzac Parade and improved left hand turning from Anzac Parade into Alison Road.
Third rail wire-free infrastructure	▪ Minimises visual impacts of the proposed overhead charging units at stops between Circular Quay and Town Hall.
Revised construction methodology for the tunnel under Anzac Parade	▪ The modified construction methodology provides reduced construction period and improved value for money.
Revised substation sites	▪ Meets the requirements of the project conditions of approval (condition of approval B12), to locate the Surry Hills substation underground. ▪ Removes approved High Street substation from within the Royal Randwick Racecourse land north of the intersection of High Street and Anzac Parade.
Height increase to the Randwick stabling facility condition of approval	▪ Fill levels across the site to achieve the required operational ground levels mean that the height of the sand silo will exceed the approved height envelope. The final height of the silo is dictated by the clearance required over the LRVs being filled.

The proposed modifications are expected to deliver significant improvements over the approved project. These include:

- Reduced visual impacts as a result of modifications to the wire free infrastructure at Circular Quay and along George Street; the reduced bulk and scale of the approved Moore Park stop; the reduced impact on Tay Reserve; and the relocation of the Surry Hills substation to a new underground location adjacent to the Moore Park west tunnel entrance.

- Improved public transport services through the provision of longer LRVs which would accommodate increased passenger capacity.

- Improved operation through the removal of the World Square stop and realignment of Alison Road/ Anzac Parade intersection.

- Reduced flooding impacts on the proposed stabling yard and downstream properties, in particular for Kensington and Kingsford by raising the existing flood levee along the southern boundary of Centennial Park.

Some potential negative environmental impacts have also been identified occurring as a result of the proposed design modifications. These include:

- An increase in the total number of planted trees to be removed along approved CSELR alignment (up to approximately 14 trees) resulting in increased planted tree/biodiversity impacts and adverse visual impacts at these locations. These impacts are generally associated with the relocation of the Alison Road track alignment and Royal Randwick Racecourse stop between Doncaster Avenue and Darley Road and the revised construction methodology for the tunnel under Anzac Parade. The proposed increase in tree impacts only represents the actual number of trees impacted and does not take into account the relative significance (i.e. species, quality, age and context) of the newly affected trees in comparison to the proposed trees to be retained.

- A minor increase in potential noise impacts at approximately 86 additional receptors across the alignment due to the increased length of the LRVs.

- Some additional impacts to Aboriginal and non-Indigenous heritage, primarily due to increased visual impacts to existing heritage items, such as the revised alignment along Alison Road and the relocated Royal Randwick Racecourse stop.

A full assessment of these design changes is presented in Chapter 3 of this report. The impacts associated with the proposed design changes would be mitigated through the application of the environmental management measures previously identified in the approved *CBD and South East Light Rail Environmental Impact Statement*. This includes the planting of replacement trees and further consideration or operational noise mitigation for affected properties along the alignment. The current conditions of approval identified in the State Significant Infrastructure approval (SSI-6042), granted on 4 June 2014 continue to apply, and would be applied to the proposed modifications, if approved.

Conclusions and next steps

This modifications report documents the proposed modifications to the approved CSELR Project. Overall, the benefits of the proposed modifications to the community, the environment and public transport customers, are expected to outweigh the potential impacts of these modifications.

The Minister for Planning will subsequently decide whether to grant approval, or to refuse the proposed modifications, under Section 115ZI of the EP&A Act. Should the proposed modifications be approved by the Minister, Transport for NSW would continue to consult with community members, government agencies and other stakeholders during the pre-construction, construction and commissioning phases.

1. Introduction

This chapter provides a background to the project and outlines the current project approval.

1.1 Purpose of this report

This report has been prepared to support an application by Transport for NSW to modify the existing project approval for the approved CSELR Project and is intended to assist the Minister for Planning in forming a view as to the merits of the proposed modifications. The application for modification has been prepared to:

- describe the changes to the existing project approval
- provide justification for the modifications and describe the alternatives considered
- assess the environmental and community impacts of the modifications.

1.2 Background

In December 2012, the NSW Government released two key strategic plans that set the framework for improving the central Sydney transport system:

- the *NSW Long Term Transport Master Plan* (NSW Government, 2012) — which is a 20 year plan to improve the NSW transport system
- *Sydney's Light Rail Future — Expanding public transport, revitalising our city* (NSW Government, 2012) — which details an integrated modal delivery plan for light rail, as one component of the *NSW Long Term Master Plan*.

In 2013, the NSW Government also released the *draft Metropolitan Strategy for Sydney 2031* (NSW Government, 2013) that provides a comprehensive plan to manage the growth of Sydney up to 2031; and the *Sydney City Centre Access Strategy* (NSW Government, 2013) that outlines a suite of initiatives to improve the way the Sydney CBD transport system operates. Together, these strategic planning documents identify a number of transport, economic and other challenges facing Sydney — including catering for a growing city, the need to generate urban renewal and global competitiveness, and unlocking capacity on Sydney's transport network.

The documents also delineate a range of strategies and projects to address these challenges. These include easing transport congestion in the Sydney CBD and improving public travel between key destinations in South East Sydney and the CBD by:

- expanding the current light rail services in inner Sydney, from Circular Quay to Randwick and Kingsford
- creating a pedestrian zone along approximately 40 per cent of George Street
- redesigning and better coordinating the Sydney CBD transport network (including buses, light rail, ferries, pedestrians and cyclists) to create an integrated public transport solution for the Sydney CBD.

The first two items in this bulleted list comprise the CBD and South East Light Rail (CSELR) project (hereafter referred to as 'the project' or 'the approved project').

1.3 CSELR Project approvals

The CBD and South East Light Rail (CSELR) project was identified as a key priority transport infrastructure project for the NSW Government in the *NSW Long Term Master Plan*. *Sydney's Light Rail Future* presents the NSW Government's plan to expand light rail in Sydney.

The CSELR Project was declared Critical State Significant Infrastructure (SSI) by the NSW Minister for Planning and Infrastructure (now Planning) on 25 June 2013. Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes an assessment and approval regime for SSI developments. Accordingly, an environmental impact statement was exhibited from 14 November 2013 to 16 December 2013. A subsequent Submissions Report (incorporating a preferred infrastructure report) was prepared and submitted to the Department of Planning and Infrastructure (now the Department of Planning and Environment (DP&E)) in March 2014. Planning approval was granted by the Minister for Planning under Part 5.1 of the EP&A Act on 4 June 2014.

Note: Indicative only. Subject to detailed design

Figure 1.1 Project overview (as described as part of the approved CSELR Project)

2. Statutory context

This chapter provides an overview of the legislative context for the proposed modifications and a summary of the existing planning approvals.

2.1 Legislation

The EP&A Act, provides the statutory framework for the CSELR planning approvals. As described in Chapter 1, the CSELR Project was declared a Critical State Significant Infrastructure project by the Minster for Planning and Infrastructure (now Planning) under Part 5.1 of the EP&A Act and accompanying regulation on 23 June 2013.

Pursuant to Section 115ZI of the EP&A Act, Transport for NSW is seeking approval for the modification of the State Significant Infrastructure approval (SSI-6042), granted on 4 June 2014.

Section 115ZI of the EP&A Act states as follows:

(1) In this section:

> ***Minister's approval*** *means an approval to carry out State significant infrastructure under this Part, and includes an approval granted on the determination of a staged infrastructure application.*
>
> ***modification*** *of an approval means changing the terms of the approval, including revoking or varying a condition of the approval or imposing an additional condition on the approval.*

(2) The proponent may request the Minister to modify the Minister's approval for State significant infrastructure. The Minister's approval for a modification is not required if the infrastructure as modified will be consistent with the existing approval under this Part.

(3) The request for the Minister's approval is to be lodged with the Director-General. The Director-General may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.

(4) The Minister may modify the approval (with or without conditions) or disapprove of the modification.

2.2 Consultation with the Department of Planning and Environment

Transport for NSW notified the DP&E regarding its intention to modify the CSELR Project approval in October 2014. This modifications report has been prepared to assist the Minister for Planning in assessing and determining the potential impacts of the proposed modifications.

2.3 CSELR Project approval modification

Transport for NSW is seeking approval from the Minister for Planning to modify the SSI approval for the CSELR Project (SSI-6042). The proposed modifications are described in detail in Chapter 3 of this modifications report:

The proposed modifications offer significant overall benefits to the CSELR Project in terms of reducing environmental impacts and providing improvements to constructability and operation of the proposed light rail network. Specific benefits of each of the proposed modifications are also discussed in Chapter 3.

3. Proposed modifications

This chapter documents and assesses the design modifications that Transport for NSW proposes to make to the approved CSELR Project. These modifications were identified as a result of ongoing design development and continued stakeholder and community consultation. An assessment of the difference in environmental impact for each design modification demonstrates that, in each case, they would represent a positive outcome for the proposal or can be adequately managed through the application of suitable environmental management measures.

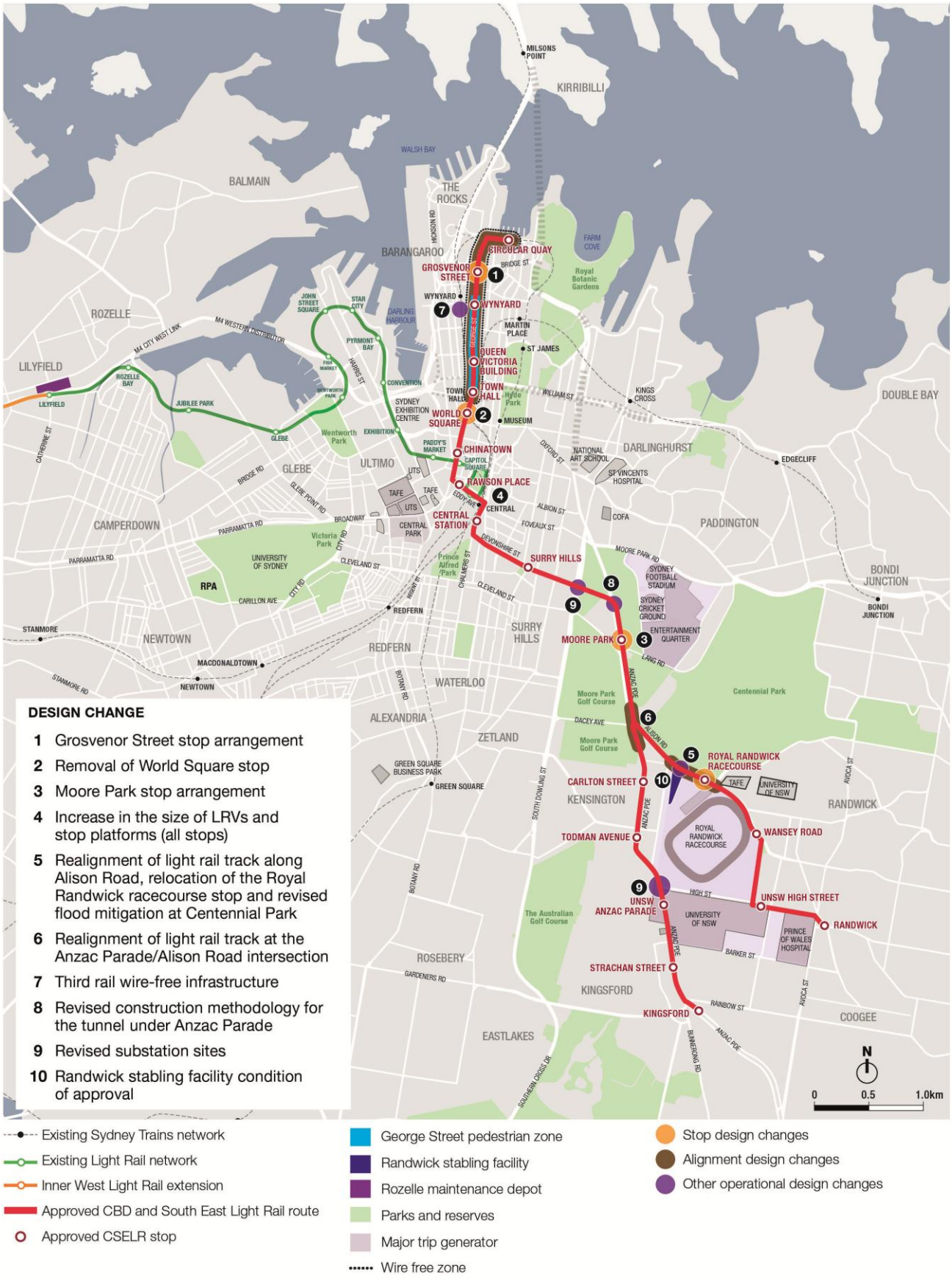
3.1 Overview

As described in Chapter 2, Section 115ZI of the EP&A Act allows for the modification of SSI planning approvals granted by the Minister under the EP&A Act. The design modifications that are proposed to the existing approval (SSI-6042) as part of this modification report include:

- Grosvenor Street stop arrangement (section 3.3)
- removal of World Square stop (section 3.4)
- Moore Park stop arrangement (section 3.5)
- increase in the size of LRVs and stop platforms (section 3.6)
- realignment of light rail along Alison Road and flood mitigation changes at Centennial Park (section 3.7)
- realignment of light rail at the Anzac Parade/Alison Road intersection (section 3.8)
- third rail wire-free infrastructure within the CBD (section 3.9)
- revised construction methodology for the tunnel under Anzac Parade (section 3.10)
- revised substation sites (section 3.11)
- Randwick stabling facility building height condition of approval (section 3.12).

The locations of the above design modifications are shown in Figure 3.1. The proposed modification would reduce the overall environmental impact of the approved CSELR Project or would provide an improved overall project outcome compared to the design of the approved project.

The following sections provide a description of each proposed modification and an assessment of the change in environmental impacts for each modification. These assessments demonstrate that the proposed changes in impact would either result in improved environmental outcomes or, in some instances minor additional impacts which would be adequately managed through application of suitable environmental management measures identified as part of the project approval.



Note: Indicative only. Subject to detailed design

Figure 3.1 Location of proposed design modifications

3.2 Assessment approach

Consideration of key and non-key environmental, social and economic issues was undertaken for each of the proposed modifications. This included an assessment of the potential changes to the environmental impacts described and discussed in the CSELR Project planning approval documents (including the EIS and Submissions Report).

A summary of the potential environmental issues affected by each of the proposed design changes is provided in Table 3.1. Only the issues that would have a different impact to that which was described in the *CBD and South East Light Rail Environmental Impact Statement* (CSELR EIS) or Submissions Report were assessed. Other issues would not result in changes to the impacts assessed in the CSELR EIS.

Table 3.1 Summary of environmental issues affected by the proposed design modifications

DESIGN CHANGE	ENVIRONMENTAL ISSUE																	
	Traffic and transport	Visual and landscape character	Planted trees	Property and land use	Noise	Vibration	Non-Indigenous heritage	Socio-economic	Hydrology, drainage and surface water	Soil and contamination	Groundwater	Aboriginal heritage	Biodiverstiy	Air quality	Utilities and services	Greenhouse gases	Hazards and risks	Privacy
Grosvenor Street stop arrangement	✓			✓	✓		✓					✓						
Removal of World Square stop	✓	✓	✓		✓													
Moore Park stop arrangement		✓	✓															
Size of LRVs and stop platforms	✓	✓	✓	✓	✓		✓					✓						
Realignment of light rail route along Alison Road, relocation of the Royal Randwick racecourse stop and revised flood mitigation at Centennial Park	✓	✓	✓	✓	✓		✓		✓			✓						
Realignment of light rail track at the Anzac Parade/Alison Road intersection	✓	✓	✓	✓			✓					✓						
Third rail wire-free infrastructure		✓					✓					✓					✓	
Revised construction methodology for the tunnel under Anzac Parade	✓	✓	✓		✓		✓				✓	✓						
Revised substation sites		✓	✓	✓	✓		✓					✓						
Randwick stabling facility condition of approval		✓																

3.2.1 Mitigation measures

Chapter 8 of the CSELR Project Submission Report (Transport for NSW, 2014) documented a range of environmental management measures proposed to reduce the identified environmental and social impacts associated with the construction and operation of the CSELR Project. All of these management measures would continue to apply to the proposed modifications Specific measures which were identified as part of the CSELR Project EIS and which are applicable to proposed modification(s) are listed in Table 4.1 to Table 4.3.

The CSELR Project, including the modifications described in this report, would be undertaken in accordance with all of the current conditions of approval identified in the State Significant Infrastructure approval (SSI-6042), granted on 4 June 2014.

3.3 Grosvenor Street stop arrangement

3.3.1 Description of the approved project

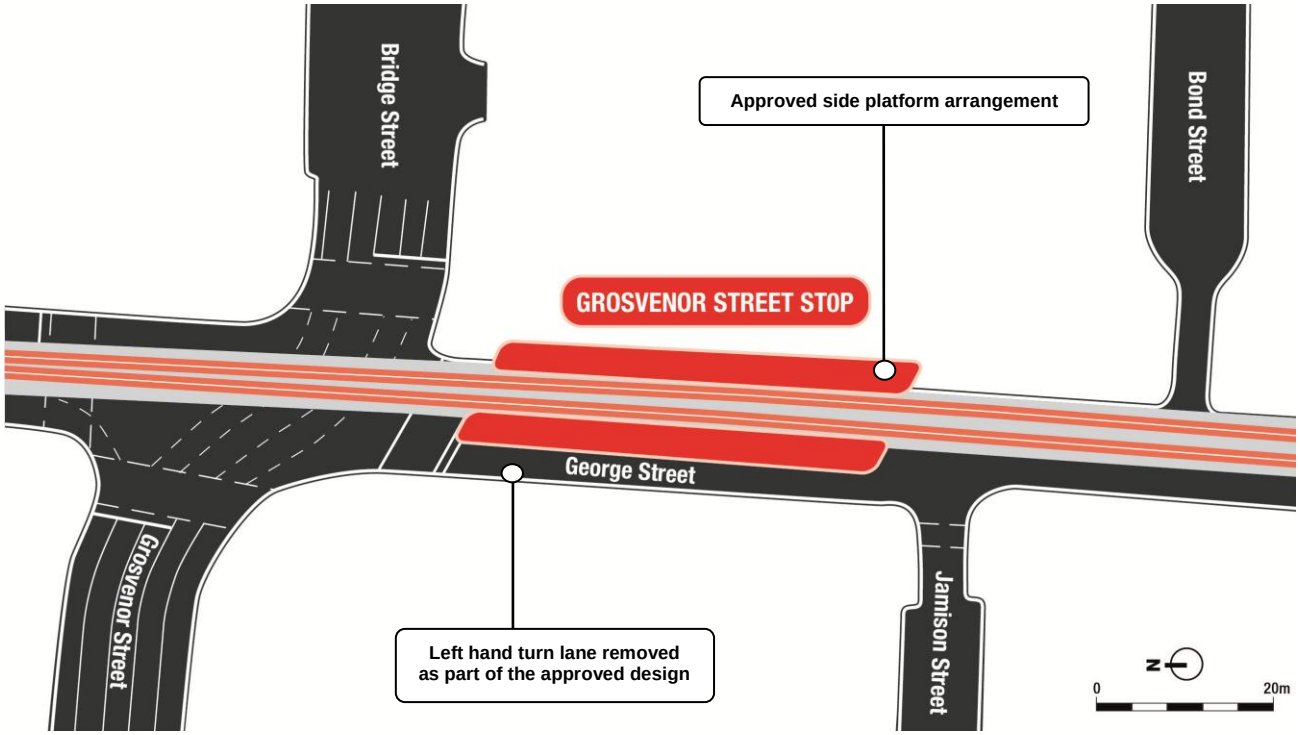
The proposed Grosvenor Street stop, described in Section 5.2.3 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013), identified a stop consisting of two, partially split side platforms. The western side platform provided a traffic-facing platform adjacent to a single northbound traffic lane along George Street. The eastern side platform provided an interface with the existing pedestrian footpath, which was widened to improve pedestrian amenity around the Grosvenor Street stop (refer to Figure 3.2).

The platforms were identified as being staggered horizontally to accommodate new six metre wide pedestrian crossings at either end of the stop.

3.3.2 Description of the modified design

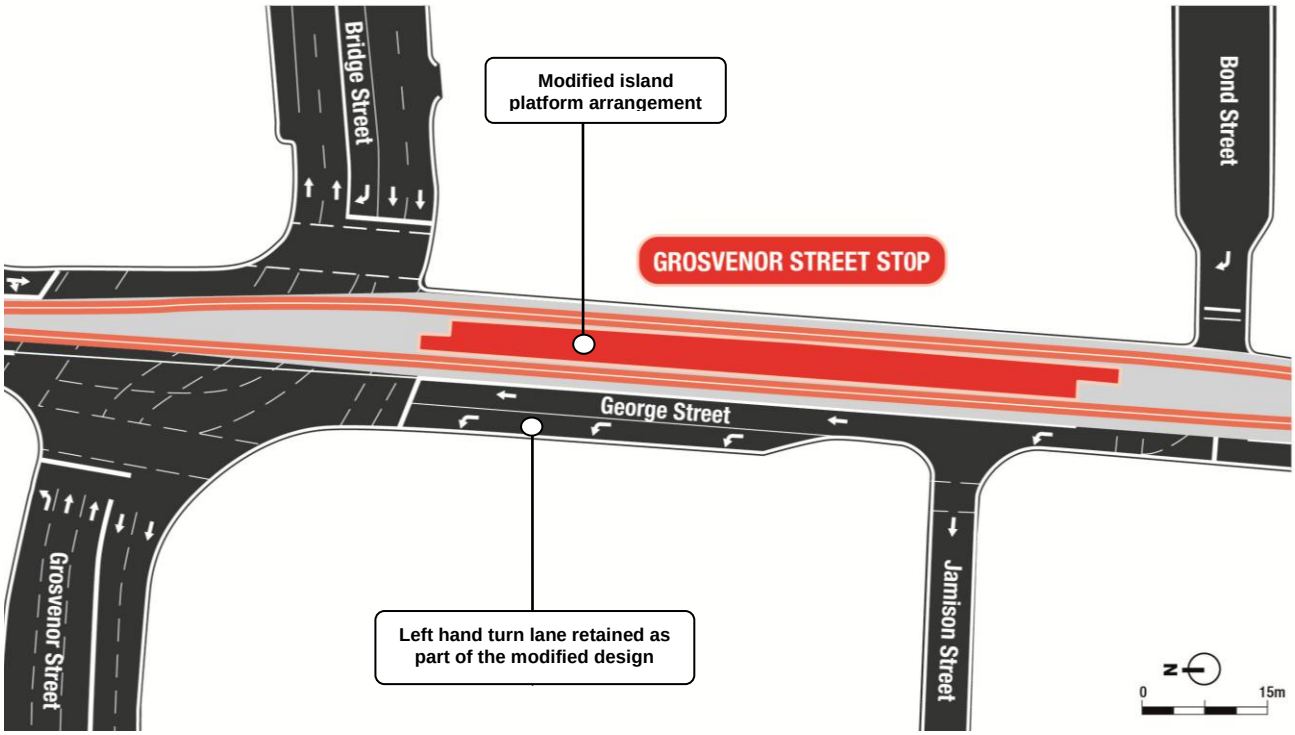
The refinement of the Grosvenor Street stop design would change the approved stop from two side platforms to an island platform. The island platform would continue to be located in the same location along George Street, between the Grosvenor Street/Bridge Street intersection to the north and Jamison Street to the south. The modified design would allow for the retention of an additional, northbound traffic lane, specifically the retention of the existing dedicated left hand turning lane from George Street into Grosvenor Street (refer to Figure 3.3). Similarly to the approved project, no southbound traffic lanes would be provided along this section of George Street.

Modified pedestrian crossings at each end of the platform would continue to provide access to the east and west sides of George Street.



Note: Indicative only.

Figure 3.2 Approved layout of the Grosvenor Street stop



Note: Indicative only. Subject to detailed design.

Figure 3.3 Proposed modification to the Grosvenor Street stop

3.3.3 Change in impact

Traffic and transport impacts

Construction assessment

No changes to construction traffic and transport impacts are anticipated as a result of this modification.

Operational assessment

Traffic Impacts

The modification of the Grosvenor Street stop to a central island platform configuration would provide some efficiencies with respect to the total width of platform required. This would allow a more compact light rail corridor between Jamison Street and Grosvenor Street, and the retention of the existing northbound left turn lane from George Street into Grosvenor Street (in addition to a single through traffic lane). This would represent a positive traffic benefit in comparison to the approved project design, with greater stop line capacity and vehicle queuing area, as well as improved traffic lane configuration through the Jamison Street intersection.

Pedestrian Impacts

In combination with the longer platforms (refer to section 3.6), the proposed two angled pedestrian crossings of George Street at Bond Street and Jamison Street have been rationalised into a single perpendicular signalised pedestrian crossing between Bond Street and Jamison Street. This would result in a shorter crossing distance, reduced variability in pedestrian desire lines and a safer pedestrian outcome.

In combination with the longer platforms (refer to section 3.6), there would be a marginally higher risk of pedestrians not complying with the pedestrian signals or crossing directly between the platform and the footpath. Appropriate educational campaigns (as identified in section 10.10 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013)) would be implemented to encourage higher levels of compliance and safety across the corridor, in addition to the provision of appropriate warning signage.

The improved George Street traffic lane geometry through the Jamison Street intersection also improves pedestrian safety at the southern end of the Grosvenor Street stop platform, reducing the need for physical pedestrian protection.

Property and land use impacts

The proposed modification to change the Grosvenor Street stop from a split side platform arrangement to an island platform would occur within the same footprint as the approved project. There would not be any additional land use and property impacts as a result of the proposed design change to those assessed in the approved project.

The existing pedestrian footpath on the eastern side of George Street would not be required to be amended to accommodate the modification. The pedestrian footpath on the western side of George Street would however no longer be directly connected to the stop platform (as per the approved project) as the northbound light rail track would be located between the new platform and pedestrian footpath. This change is not assessed as impacting on access to the stop for light rail customers, or limiting the capacity of the existing footpath for general pedestrian movements within the local area.

The proposed modification would not result in any changes to impacts on future land use beyond those identified as part of the approved project.

Noise impacts

The proposed modification would not alter the construction noise impacts identified as part of the approved project, as the overall construction footprint would not be increased. Likewise, the operational impacts of the modification would not be noticeably altered. The light rail tracks would be moved slightly further apart (to deviate around the island platform) and hence would be slightly closer to adjacent receivers; however this would result in a negligible change in operational noise impacts since the speeds arriving and departing from the stop would be low.

The CSELR Project EIS (Volume 1B) (Transport for NSW, 2013) predicted compliance with the operational noise goals at this location. The proposed modification to the Grosvenor Street stop platform arrangement would not affect the ability to meet the operational noise goals previously identified.

Aboriginal and non-Indigenous impacts

Built heritage/landscape

As part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013), a number of heritage items were identified adjacent to or within the vicinity of the Grosvenor Street stop. The approved stop was identified to have a minor/moderate impact on existing heritage items, predominantly consisting of visual impacts to the setting and appreciation of the identified heritage items.

The modification of the Grosvenor Street stop from two side platforms to an island platform would not result in any additional impacts to the approved project and is consistent with the assessment previously undertaken.

Historical archaeology

As part of the assessment of the approved project, the CSELR Project corridor was divided into a number of discrete Historical Archaeological Management Units (HAMUs). Each unit was allocated according to the nature of the potential archaeological resource in an area. These units were then allocated a particular archaeological zoning based on the significance of the potential archaeology. This zoning allowed the varying nature and significance of the archaeological resource to be managed pragmatically and consistently throughout the development of the approved project.

The proposed modification to the Grosvenor Street stop would fall within the George Street North HAMU, being within an archaeological management zone 1 (State significant archaeological resource – known or potential). Works associated with the construction of the stop were previously assessed as part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013) as having a major adverse impact on the potential historical resources in this location.

The proposed modification would result in the same level of ground disturbance as the approved project, albeit with a modified configuration of the platforms and track locations. Consequently, the modification would have a limited additional impact on the potential historical archaeological resources that may be present at this location. This is consistent with the impact of the proposal as assessed as part of the approved project. The mitigation measures previously identified for this HAMU would continue to apply, in particular measures V.1 and V.6. These are presented in Table 4.2 of this report.

Aboriginal heritage

Based on consideration of known archaeological activity, the level of nineteenth century and modern development, and the distribution of the soils landscape, the CSELR Project was assigned a series of Aboriginal archaeological potential zones (between Zone 1 and Zone 4). Zone 1 represents the highest Aboriginal archaeological potential and Zone 4 represents the least or no Aboriginal archaeological potential, usually as the result of extensive disturbance through development. As part of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013), a series of overarching mitigation measures were identified for each zone.

The Grosvenor Street stop is located within an area of Zone 3 Aboriginal archaeological potential, representing an area where Aboriginal archaeological evidence may be present, however, due to nature and extent of modern land use it is likely to be disturbed. As the proposed modification would be undertaken within the same footprint as the approved project, the existing impact assessment of this stop is considered to be unchanged, and as such, the existing mitigation measures for this zone are considered to be appropriate to manage the proposed modification (refer to Table 4.2 of this report).

3.4 Removal of World Square stop

3.4.1 Description of the approved project

As described in Section 5.2.6 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013), the World Square stop was located to the north of Liverpool Street. The World Square stop consisted of a single, central island platform within the centre of George Street, approximately 20 metres to the north of the intersection of George Street and Liverpool Street. The existing pedestrian crossings of George Street at Liverpool Street and Central Street (to the north of the proposed stop) were maintained as part of the design of the stop, to allow pedestrians to access the island platform. The approved project retained one northbound and one southbound traffic lane adjacent the stop.

3.4.2 Description of the modified design

Further investigation since the approval of the project has identified that the World Square stop would generate a lower patronage than the closest stops to the north and south (Town Hall stop is approximately 200 metres to the north and Chinatown stop is approximately 325 metres to the south).

In addition, the gradient of George Street at the proposed location of the approved World Square stop requires substantial street regrading to accommodate a fully *Disability Discrimination Act 1992* (DDA) compliant stop. This includes the need to raise the Liverpool Street and George Street intersection and other changes to the existing level of the local road network including a number of retaining walls.

The stop is therefore proposed to be removed as part of the modification to the approved project due to the low expected patronage, proximity to adjoining stops to the north and south (Town Hall stop and Chinatown stop respectively) and substantial engineering constraints. The approved centre-running alignment along George Street would be maintained in place of the proposed stop as part of the modified design.

3.4.3 Change in impact

Traffic and transport impacts

Construction assessment

The proposed modification would not alter the general construction traffic impacts identified in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013). As there would no longer be stop platforms constructed in this location, the duration of works between Bathurst Street and Liverpool Street would be slightly reduced.

Operational assessment

Traffic Impacts

The proposed road design and traffic conditions would remain unchanged. Therefore, the proposed modification would not alter the traffic impacts identified as part of the CSELR Project EIS.

The available road space that can be returned to both pedestrian and vehicles may permit a slightly increased traffic lane width and improved turn geometry/efficiency from Liverpool Street. This would be determined during the detailed design of the revised infrastructure at this location.

Removal of the World Square stop is also assessed to provide a slightly faster light rail journey time.

Pedestrian Impacts

The modification would have the potential to increase pedestrian volumes between the adjacent stops and World Square. The approved project design required minor footpath narrowing to accommodate the platform. Not only would the existing footpath widths be maintained, but the removal of the platform would provide an opportunity for minor footpath widening along both sides of George Street between Wilmot Street and Bathurst Street. This would minimise any adverse effects as a result of the change in pedestrian volumes.

The removal of the World Square stop would result in slightly greater walking distances for pedestrians who might have previously used this stop. The additional walking distances between the approved location of the World Square and the Town Hall and Chinatown stops would be approximately 200 metres to the north and 325 metres to south of this location respectively. These distances are considered to be appropriate for a CBD environment. Therefore, the modification would not result in any substantial impacts for pedestrians at World Square.

The Town Hall and Chinatown stops would experience increased patronage to cater for the removal of the World Square stop, however this increase is assessed to be manageable at each of these stops. It is noted that the larger light rail vehicles (refer to section 3.6) would also provide result in larger platforms providing additional space for customers waiting for LRVs, assisting to compensate for the increased patronage that were previously proposed to utilise the World Square stop. The need for additional pedestrian waiting areas would be considered during detailed design, based on the results of updated pedestrian modelling at these locations (refer to mitigation measure A.3 in Table 4.1).

Visual and landscape impacts

Construction assessment

The proposed modification to remove the World Square stop would result in benefits to the visual impact of the approved project during construction as the construction period required within the vicinity of the proposed stop location would be shortened to only include the construction of light rail track within this area. In addition, the construction area at this location would not be required to be as wide (due to the closer track centres at this location) providing a moderate benefit during construction.

Operational assessment

As described as part of the approved project (Transport for NSW, 2013), the World Square stop would be the dominant feature of the view along George Street at this point. The stop would add additional visual elements at street level, created by the platform, crossings and pedestrian safety barriers (associated with retaining walls) all located within the relatively narrow corridor.

With the removal of the stop, there would be a reduction in the visible infrastructure associated with the project, with the remaining elements limited to the light rail track and overhead catenary wires. In addition, the removal of the stop would not require the proposed retaining walls along the kerb side of the footpaths as part of the approved project, which were required for integration of the stop within the steep gradient of the street to achieve DDA compliance. The avoidance of these retaining walls provides a significant benefit to the streetscape in this location based on the approved project.

It is considered that there would be an overall reduction in the previously identified impact to the amenity of views surrounding the intersection of Liverpool Street and George Street as a result of the removed stop. Therefore, it is expected that there would be a significant beneficial visual impact overall during the operation of the project. This represents an overall positive change from the visual impacts assessed as part of the approved project.

Planted tree impacts

The design of the approved project was identified as potentially requiring the removal of approximately 14 trees along George Street as a result of the World Square stop. These would form part of the overall potential removal of approximately 100 trees within the wider City Centre Precinct. Planted trees impacted along George Street would generally comprise deciduous Plane Trees of varying health and condition (Transport for NSW 2013).

The proposed removal of the World Square stop would allow the retention of the existing traffic kerbs along George Street between Liverpool Street and Central Street that would otherwise have been moved as part of the approved project. The existing plane trees located along this section of George Street could therefore be retained as part of the modified design as the alignment of the light rail tracks would no longer need to deviate around the proposed island stop. This would provide an overall benefit to the urban form and amenity of the precinct.

Noise impacts

Construction assessment

The modified design would result in marginally reduced construction noise impacts at the nearest sensitive receptors, as the works associated with the construction of the World Square stop platform and other stop infrastructure would no longer take place.

Operational assessment

For this section of track, the maximum speed of the LRVs on the approach and departure to/from the World Square stop was expected to be up to 40 kilometres per hour, with LRVs slowing to a stop at the station and/or Liverpool Street signalised intersection (as part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013)). The maximum speed would be similar following the removal of the World Square stop to allow for traffic signals along this section of George Street. For the modified design, noise levels are therefore predicted to remain below the noise trigger levels at the nearest residential receptors.

In addition to the above, the removed stop would present the potential for marginally lower noise levels as the LRVs would no longer be traversing a curved rail to travel around the previously proposed island platform.

3.5 Moore Park stop arrangement

3.5.1 Description of the approved project

The Moore Park stop, as described in section 6.8 of the CSELR Project Submissions Report (Transport for NSW 2014), was located to the south of the existing AFL training oval. The Moore Park stop was configured to accommodate a 90-metre long island platform with a number of vertical access points to an above-ground elevated concourse for use during major events as a central marshalling area. The elevated concourse of the Moore Park stop also provided a connection to the proposed bridge across Anzac Parade and access to the Sydney Boys and Sydney Girls High Schools.

A centre turnback siding was also provided to the south of the Moore Park stop for LRVs during special event operations. The stop location served as a key stop for the surrounding land uses including the Sydney Cricket Ground, the Sydney Football Stadium, the Entertainment Quarter (which includes various entertainment venues such as the Hordern Pavilion) and the Sydney Boys and Sydney Girls High Schools.

3.5.2 Description of the modified design

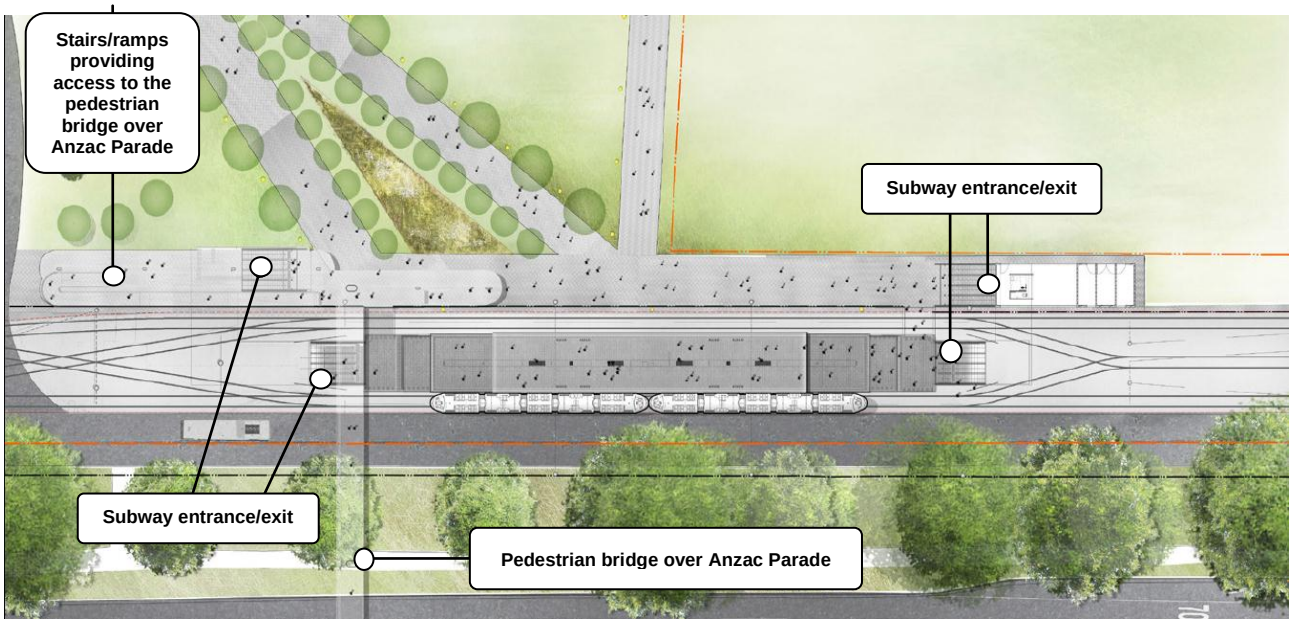
Following approval of the CSELR Project, the approved project has been refined to reduce the scale and overall visual impact of the Moore Park stop. This refinement has been undertaken with respect to the urban design strategy for the Moore Park precinct and has resulted in a modification to the design of the Moore Park stop and associated public domain to enable the stop to better sit within the existing park character.

Moore Park stop

Similar to the approved project, the modified Moore Park stop would consist of an approximately eight metre wide island platform, which is accessed from both ends (refer to Figure 3.4). The stop would be specially managed and staffed on event days when passenger capacity is significantly increased. To ensure continuous on-time operation of the light rail network, the Moore Park stop is proposed to include subway access for passengers during special events. The modified design would avoid the need for an elevated concourse level and minimises level change for passengers ensuring safe and timely operations (refer to Figure 3.5).

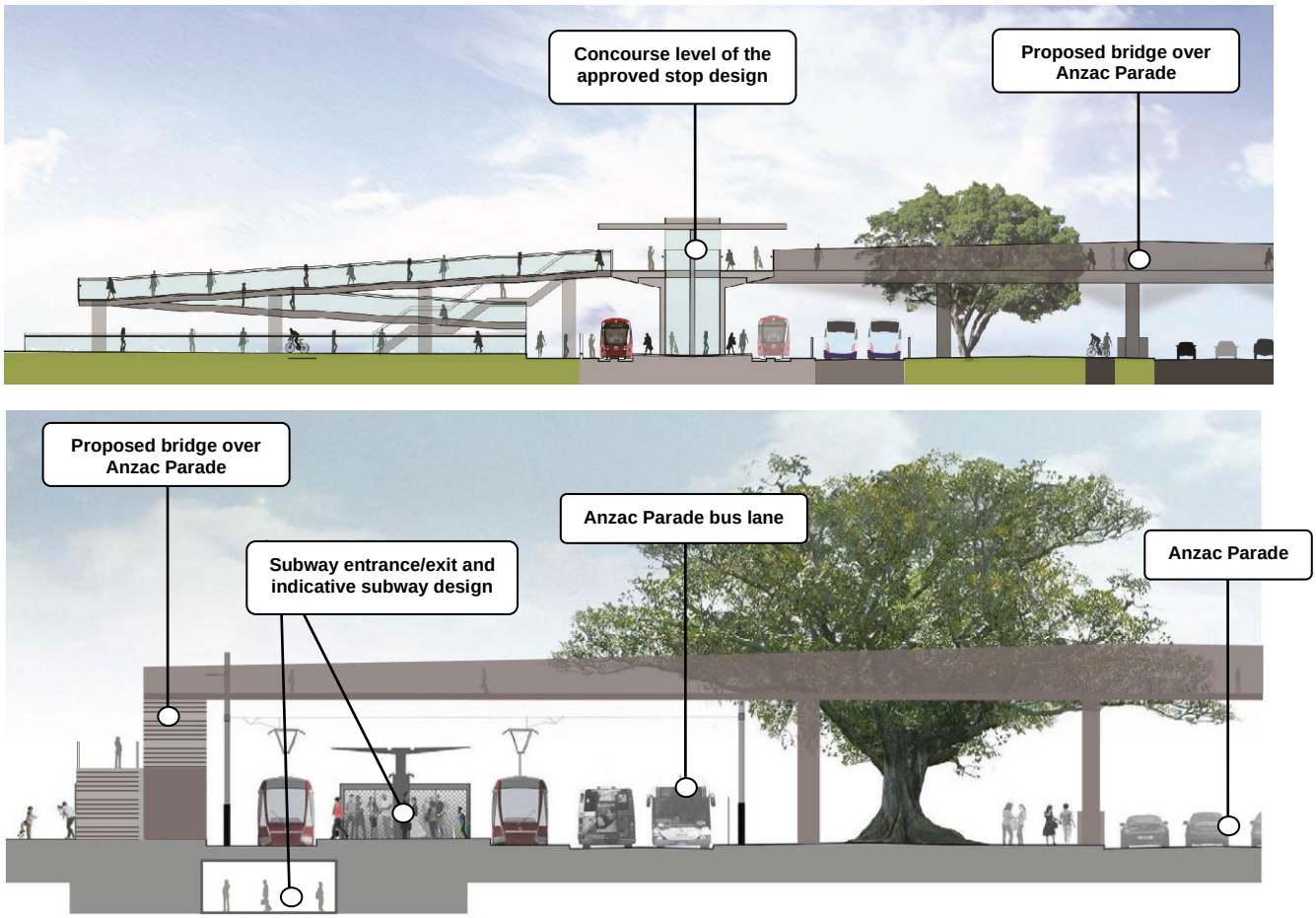
Under normal operation, the Moore Park stop would be accessed via pedestrian crossings over the light rail tracks and access ramps similar to all other stops. For special event days, an underground subway access would be utilised (refer to Figure 3.5 and Figure 3.6). The subway access would comprise wide stairways connecting Moore Park to underground passageways below the light rail tracks and up to platform level. Mobility impaired access would continue to cross over the light rail tracks managed by staff through the use of the pedestrian crossing and ramp routes. The subways would be closed when there is no special event.

Access would be controlled through the use of guard railings and gates, which would be staffed during event times. During events, passengers would be directed to the centre of the stop to enable an even distribution between the two subways minimising congestion. The design has been developed to safely manage crowds by introducing subway entrances/exits at each end of the Moore Park stop platforms. An indicative layout of the modified Moore Park stop design is provided in Figure 3.4.



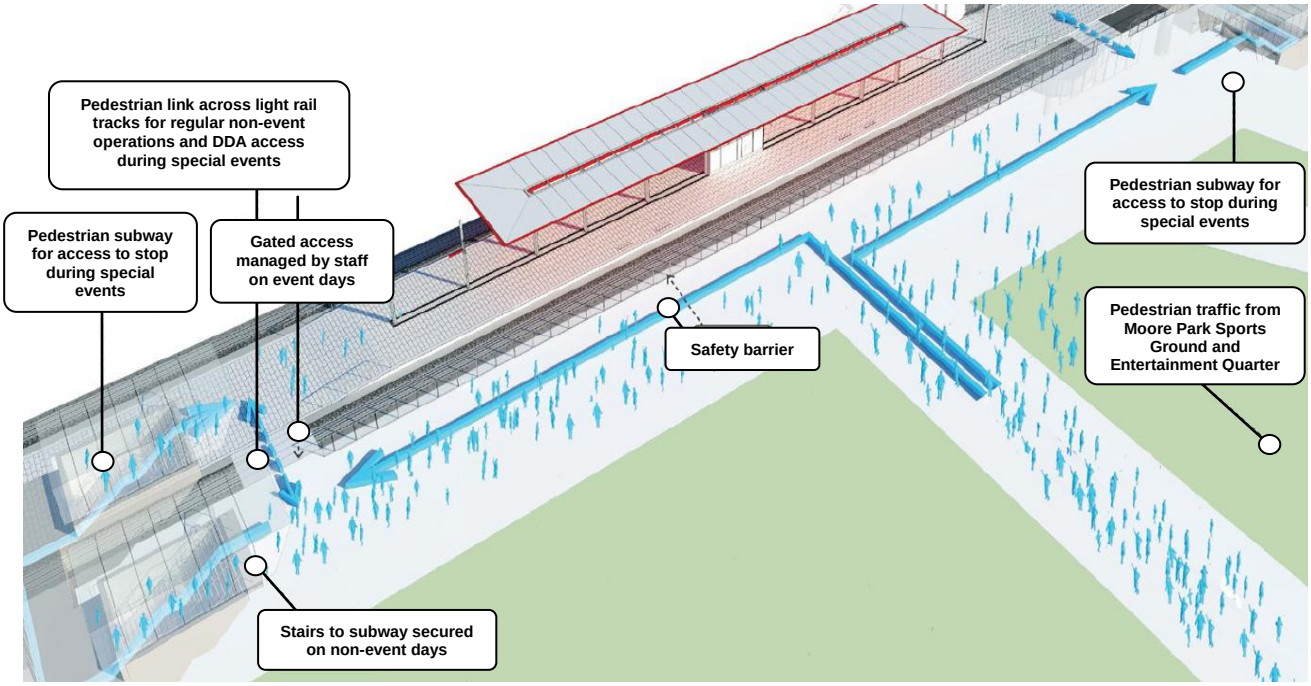
Note: Indicative only. Subject to detailed design.

Figure 3.4 Plan of the modified Moore Park stop arrangement



Note: Indicative only. Subject to detailed design.

Figure 3.5 Indicative elevation of the approved project (top, looking south) and indicative elevation of the modified Moore Park stop arrangement (bottom, looking south)



Note: Indicative only. Subject to detailed design.

Figure 3.6 Indicative pedestrian circulation for the modified Moore Park stop arrangement

Anzac Parade pedestrian bridge

Due to the proposed removal of the elevated concourse from the Moore Park stop, the modified design would require the access to the approved pedestrian bridge over Anzac Parade to be modified to incorporate new ramps and stairs at the eastern end of the pedestrian bridge. The separated public access to the pedestrian bridge over Anzac Parade would continue to enable safe crossing for pedestrians and school children from the Sydney Boys and Girls High Schools, and for the general public. The location of the proposed stairs/ramps providing access to the pedestrian bridge is shown on Figure 3.4).

3.5.3 Change in impact

Traffic and transport impacts

Construction assessment

The proposed modification would not alter the general construction traffic impacts identified in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013). The Moore Park stop would be constructed away from general traffic and would not impact on the existing busway along Moore Park East.

Operational assessment

Traffic impacts

The proposed road design and traffic conditions would remain unchanged as a result of the modified design for the Moore Park stop. Therefore, the proposed modification would not alter the traffic impacts identified as part of the CSELR Project EIS.

Pedestrian impacts

The approved project design would result in minor pedestrian impacts. Pedestrians accessing the Moore Park stop from the western side of Anzac Parade (via the proposed pedestrian bridge across Anzac Parade) would be required to travel a slightly longer route as the bridge would no longer connect directly to the elevated concourse level of the Moore Park stop. The modified design of the pedestrian bridge would mean that pedestrians would arrive to the north of the stop platform. The overall increase in pedestrian travel required is assessed to have a minimal impact.

Visual and landscape character impacts

Moore Park stop

The modified design of the Moore Park stop would be greatly reduced in both height and volume due to the removal of the elevated concourse and the associated high level shelter canopy. The modified height of the stop would be more easily integrated and sympathetically designed within the parklands environment. The stop would also be better proportioned against the tall mature fig trees that are located adjacent to it, which are considered to be of regional significance.

The proposed underground subway access as part of the modified design of the Moore Park stop is better suited and more easily integrated within the parkland environment than the ramps and stairs to the elevated concourse that were part of the approved project. The two subway entrances would result in additional structures to the Moore Park stop in comparison to the approved project, but due to their relatively small scale and close proximity to the stop and shelter, this would be viewed within overall context of the stop, and would not have a noticeable increase in the overall visual impact of the Moore Park stop.

The modified design, with its reduced scale and overall visual envelope over the approved project, is therefore assessed to have a noticeable reduction in the visual and landscape impacts of the parkland environment that it is located within. When combined with the proposed minor reduction in platform length (refer to section 3.6), the modified stop design would provide a beneficial visual impact over the approved project.

Anzac Parade pedestrian bridge

The Anzac Parade pedestrian bridge in the modified design would comprise of a stand-alone structure, as opposed to the approved project which was connected to the elevated concourse of the Moore Park stop. The only noticeable change of the modified design would be the inclusion of stairs and ramps on the eastern side of Anzac Parade associated with the bridge, which in the approved project were included in the Moore Park stop structure.

The modified design of the pedestrian bridge would have no perceptible visual change, as the stairs and ramps of the modified design were previously included in the approved design of the Moore Park stop. The overall result of the modified pedestrian bridge would therefore be a negligible visual impact.

Aboriginal and non-Indigenous heritage impacts

Built heritage/landscape

As part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013), a number of heritage items were identified adjacent to or within the vicinity of the Moore Park stop. An assessment to the changes in impacts to the key heritage items adjacent to the proposed modification are discussed below.

Centennial Park, Moore Park, Queens Park (SHR listing No. 01384)

The modified works would result in an overall reduced impact in comparison to the approved project. Whilst the design of the Moore Park stop would result in a reduced impact compared to the approved project, the proposed design would continue to result in moderate visual impact (which is consistent with the assessment presented in the CSELR Project EIS (Transport for NSW, 2013)).

Moore Park Conservation Area

The modified works would result in an overall reduced impact in comparison to the approved project. However, the proposed design would continue to result in moderate adverse visual impacts to the conservation area (which is consistent with the assessment presented in the CSELR Project EIS (Transport for NSW, 2013).

Sydney Boys High School Group and Sydney Girls High School Group

The CSELR Project EIS (Transport for NSW, 2013) assessed the construction of the approved project within the Moore Park precinct as resulting in a limited to minor visual impact, albeit temporary, on the setting of Sydney Boys High School and Sydney Girls High School. The construction of the Moore Park stop would have a limited visual impact on these schools, due to existing screening vegetation along Anzac Parade and within the schools themselves. In addition, modified parklands would be reinstated on completion of the works.

The modified design would therefore not result in additional physical or visual impacts to these heritage items.

Anzac Parade Figs

The works at the Moore Park stop would not directly impact on the stand of significant trees alongside Anzac Parade (although the overall CSELR Project route would require the removal of some of these trees which was previously assessed as part of the approved project). Continued monitoring (by a qualified arborist) of the existing Fig trees to the west of the proposed stop during the excavation works to the subway element of the stop would be required as noted in existing management measures N.2, T.1 and T.8 (refer to Chapter 4 of this report).

Historical archaeology

The proposed modification to the Moore Park stop location would fall within the Moore Park East HAMU and Zone 2 archaeological management zone (locally significant archaeological resource – known or potential) identified as part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013).

The CSELR Project EIS noted that this HAMU had moderate-high potential for historical archaeological remains to be present associated with the following:

- World War II air raid trenches including earth trenches, sandbags, iron sheets, concrete foundations, associated artefact scatters/rubbish pits
- metal tracks and wooden sleepers associated with the tram line
- evidence of early alignment of Lang Road including remains of sandstone kerbs, drains, early road surfaces (e.g. macadam and/or woodblock surfaces) and structural remains indicating the alignment of the street.

The CSELR Project EIS noted that, if discovered, the potential air raid shelters would have historical associations with Sydney's defence systems during World War II, the Australian military services and, possibly, the local community. In addition, the EIS notes that should substantial structural remains related to the World War II air raid shelters exist, they may have interpretable qualities related to their aesthetic and/or technical significance because of their ability to physically demonstrate Sydney's defence and protection responses to World War II.

The proposed modification would continue to impact the same HAMU and archaeological management zone. The proposed modifications to the Moore Park stop, including the additional pedestrian subway platform, whilst constituting a greater excavation impact, would not require additional mitigation measures. Overall, it is assessed that the proposed modification would result in minimal changes to the impacts to archaeological heritage identified as part of the approved project.

Management and mitigation measures for managing impacts to the Zone 2 archaeological management zone presented in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013) would continue to be implemented as part of the modified alignment and stop locations (refer to management measures V.1 and V.6 in Table 4.2 of this report).

Aboriginal heritage

The Moore Park stop was designated as a Zone 1 Aboriginal archaeological zone (Aboriginal archaeological potential for Aboriginal objects to be found and/or impacted and for any excavation impacts up to and over 750 millimetres in depth) as part of the approved CSELR Project EIS (Transport for NSW, 2013).

The modified alignment would result in additional and deeper subsurface excavations than the approved project. As the previous assessment of this stop identified the site as already being a Zone 1 classification, the mitigation measures that were identified for this zone would continue to apply as part of the modified stop design.

Mitigation of these works would involve additional Aboriginal archaeological investigation, most likely archaeological testing. This would be undertaken in accordance with the CSELR Project conditions of approval and OEH guidelines to mitigate potential impacts on Aboriginal objects. Overall, the management and mitigation measures for managing impacts to the Zone 1 Aboriginal archaeological potential management zone presented in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013) would be implemented as part of the modified design (refer to Table 4.2 of this report, in particular management measures AA.1, AA.2 and AA.4).

Groundwater impacts

Groundwater impacts resulting from the approved project were discussed in Section 10.4 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013). The CSELR Project EIS noted that groundwater is likely to be encountered during construction within the Moore Park precinct (in particular the construction of the Moore Park tunnel) and that dewatering would therefore be required as part of the construction methodology within this precinct. The modifications to the proposed Moore Park stop to include underground pedestrian subway access would therefore, in a similar manner to the Moore Park tunnel, be potentially affected by groundwater. Given the proximity of the Moore Park stop to the Moore Park tunnel location, it is assessed that the impacts identified as part of this project element would be similar to the potential impacts of the proposed modification to the Moore Park stop.

Construction assessment

The level of dewatering required during the construction would be dependent on the final depth of excavation for the underground pedestrian subway access (to be determined during detailed design), permeability of the aquifer and prevailing weather conditions during construction (i.e. the volume of rainfall recharging the aquifer).

The CSELR Project EIS noted (for the construction of the Moore Park tunnel to the north of the Moore Park stop) that drawdown of the groundwater table would have the potential to lead to groundwater settlement. The construction of the underground pedestrian subway access could result in a similar potential impact to the proposed trees to be retained within the vicinity of the Moore Park stop.

Settlement of the existing ground where excavation or tunnelling is proposed was also identified in the CSELR Project EIS (Transport for NSW, 2013) as a potential adverse impact. The CSELR Project EIS noted that settlement was observed during the construction of the Eastern Distributor and may be of particular concern where the Botany Sands aquifer is intersected.

Groundwater encountered during the construction of the proposal would be managed in accordance with the requirements of the *Waste Classification Guidelines* (EPA 2014) and Transport for NSW's (2012) *Water Discharge and Re-use Guideline*. The guidelines' management measures would also be applied to the construction of the underground pedestrian subway access for the Moore Park stop. During detailed design, appropriate construction methods will be selected to minimise settlement risk and groundwater impacts. Management measures for groundwater and settlement are set out in in Table 4.1 (in particular measure H.1.) and Table 4.2 (in particular measure Z.4) of this report.

Operational assessment

Significant impacts due to groundwater intersection are not anticipated to occur during the operational phase of the approved project for this structure. If required, the proposed underground pedestrian subway access to the Moore Park stop would be constructed to include sealed tunnel walls to minimise the ingress of groundwater (subject to detailed design of this structure. The addition of underground walls to seal the underground pedestrian subway access would have the potential to locally alter the groundwater flow regime as two sections of the existing aquifer would potentially be separated by the subway structure. As the subway structure would have the potential to only impact a small area of the existing aquifer, this impact is assessed to be minimal.

The proposed underground pedestrian subway access would also require a drainage system to collect and discharge any groundwater seepage into the pedestrian areas. As with the Moore Park tunnel, all groundwater encountered during the operational phase of the proposal would be managed in accordance with the requirements of the *Waste Classification Guidelines* (EPA 2014) and Transport for NSW's *Water Discharge and Re-use Guideline* (Transport for NSW, 2012) (refer to management measure Z.4 in Table 4.2 of this report). Groundwater would be disposed to ensure it does not cause the pollution of waters in accordance with Section 120 of the *Protection of the Environment Operations Act 1997*.

3.6 Size of LRVs and stop platforms

3.6.1 Description of the approved project

Light Rail Vehicles

As described in Section 5.4.1 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013), the proposed vehicle specifications for the approved project included light rail vehicles (LRVs) of approximately 45 metres in length with a capacity of approximately 300 people. The LRVs consisted of a low floor design with adequate grab rails and handles positioned for standing passengers. Signage within the LRVs identified wheelchair areas, priority seating areas and emergency procedures.

To accommodate the proposed service frequency for the CSELR Project at the commencement of operations, approximately 26 LRVs were proposed to be operated along the CSELR Project route. An additional four spare LRVs were available for use if required and to rotate into service during maintenance of the other LRVs. Each of the LRVs contained technology to allow them to operate without overhead wires in certain locations, such as the wire-free zone between Hunter Street and Bathurst Street.

Stops

As described in section 5.2.2 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013), the majority of the platforms were 45 metres long with a range of widths between 2.8 metres and 6.0 metres depending on the platform arrangement type (refer below). The Central Station stop and the Moore Park stop had 90 metre platforms to allow for special event services between these locations. To allow for access by passengers with limited mobility or in wheelchairs, the platforms were proposed to be constructed flush with the LRV floor level.

Additionally, the design of each of the stops ensured that one or more pedestrian crossings would be provided across the light rail tracks at each stop. Each crossing had a width that would allow for less mobile passengers (including wheelchairs) and other pedestrians to cross simultaneously. Paving for the platforms and paths was non-slip. Warning tactile indicators were also proposed to be installed along the stops.

3.6.2 Description of the modified design

Following approval of the CSELR Project, additional consideration of the operational requirements has identified benefits in providing additional up-front capacity and future-proofing the proposed light rail network. An alternative operating scenario is proposed that has the potential to provide increased operational capacity and allow for potential future network extensions as part of the initial construction of the project.

Infrastructure changes

The modified design would provide larger LRVs approximately 67 metres in length (allowing for an increased vehicle capacity of approximately 466 people) as well as associated increases to the length of each stop. Each of the increases to approved stop lengths would be accommodated within the approved project footprint and would retain the general design of the approved stops (i.e. island stop, side platform stop etc.). All additional facilities and infrastructure associated with each of the stops (canopies, stop furniture, signage, bike parking (if proposed)) would be maintained as part of the design for the increased stop lengths.

The increased stop length would align with the proposed 67 metre LRVs. The approved lengths of the Central Station and Moore Park stops were 90 metres (as special event platforms). The proposed length of these stops would be reduced to approximately 75 metres as part of the modification to accommodate the changed LRV sizes, whilst continuing to recognise the capacity requirements of these stops as special event platforms.

To accommodate the proposed changes in LRV length, some localised modifications to traffic lane arrangements including some turn restrictions have also been included on George Street between Rawson Place stop and Chinatown stop, and along Devonshire Street.

Operational changes

The approved service frequency (the time interval or distance between two LRVs) for the 45 metre vehicles was initially 3 minutes within the CBD and 6 minutes on each branch line during the peak period between 7.30 am and 9.30 am and between 5.00 pm and 7.00 pm). The CSELR EIS noted the potential for future frequency increase to 2 minutes in the CBD and 4 minutes on the branch lines to accommodate growth. As discussed above the longer 67 metre LRVs provide additional capacity. Consequently, it is proposed they would operate at a service frequency of 4 minutes in the CBD and 8 minutes on each of the branch lines between 7.00 am and 7.00 pm in the opening year.

Future capacity for the service frequency to increase to up to approximately 3 minutes in the CBD and 6 minutes on each branch line would also be available in response to additional patronage demand, where necessary. In these future operations (at least 10 years after opening) during the peak hour the there is potential capacity to increase to enable the movement of up to 8,620 passengers per hour (18.5 LRVs per hour each carrying up to 466 passengers). This would represent an increase of approximately 20 per cent in peak capacity against the approved project which would have enabled the movement of up to 7,200 passengers (24 LRVs per hour each carrying up to 300 passengers). This increase would provide for significant ‘future proofing’ against patronage growth and/or expansion of the network. This capacity does not include special events which would provide up to 10,800 passengers per hour.

The proposed infrastructure could further increase ultimate capacity through future service frequencies of up to 2 minutes in the CBD and 4 minutes on the branch lines. This would require a significant increase in future demand and is therefore not addressed in this report.

Table 3.2 below provides a comparison between the identified LRV service frequency (in minutes) for the approved project (as presented in the CSELR Project EIS (Transport for NSW, 2013) and the proposed LRV service frequency for the proposed modified design.

Table 3.2 Comparison of LRV service headway (in minutes) for the approved project and proposed modified design

Time of day	CBD/Surry Hills/ Moore Park		Kensington/Kingsford		Randwick	
	Opening	Future	Opening	Future	Opening	Future
LRV service frequency in minutes (approved project)						
10.00 pm to 7.30 am[1]	10	10	20	20	20	20
7.30 am to 9.30 am	3	2.5	6	5	6	5
9.30 am to 5.00 pm	4	3	8	6	8	6
5.00 pm to 7.00 pm	3	2.5	6	5	6	5
7.00 pm to 10.00 pm	5	5	10	10	10	10
LRV service frequency in minutes (proposed modification)[2]						
5.00 am to 7.00 am[1]	6	5	12	10	12	10
7.00 am to 7.00 pm	4	3.25	8	6.5	8	6.5
7.00 pm to 10.00 pm	5	5	10	10	10	10
10.00 pm to 1.00 am[2]	6	6	12	12	12	12

Note: Table above is for regular services only

Note 1: Operating hours for regular services do not include 1.00 am and 5.00 am. Special event services may occur during these times.

Note 2: With respect to slight increases between the approved and proposed headways in the early morning and late evening (such as the 10.00 pm to 1.00 am period), off-peak service were reviewed by Transport for NSW as part of the ongoing development of the proposed operation of the project and it was determined that 20 minute headways on the branch lines during the early morning and late evening were not consistent with Transport for NSW customer service obligations. As such, frequencies during this time have been increased slightly as part of the proposed modification.

Note 3: While this table shows proposed opening service frequency, more frequent services may be operated in the future where necessary. The modification has assessed the worst case from a noise impact perspective of 3.25 minutes in the peak. Future operation will be 10 or more years after opening).

3.6.3 Change in impact

The change in stop lengths associated with the proposed modification would typically not result in any additional impacts for a majority of the stops along the CSELR Project alignment to those identified in the CSELR Project EIS. Where potential impacts have been identified, these impacts are described and addressed in the relevant sections below.

Traffic and transport impacts

Construction assessment

The proposed modification, in particular the increased length of platforms at each stop would have similar construction traffic impacts to those identified in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013), as the overall construction impact footprint previously identified would not change.

Operational assessment

The longer LRVs would have an increased vehicle capacity of approximately 466 people (compared to approximately 300 people for the previously proposed 45 metre long LRVs). The LRVs would also operate at peak hour headways of up to 4 minutes (compared to 3 minutes as assessed in the CSELR Project EIS) within the CBD and 8 minutes along the branches (compared to 6 minutes as assessed in the CSELR Project EIS). This represents a reduction in the frequency of LRVs at intersections along the route, with operational benefits for the integrated transport network.

The following key traffic impact changes are required to facilitate the longer LRVs, with additional details provided below:

- altered intersection arrangements at the George Street/Ultimo Road signalised intersection and associated pedestrian crossings
- readjusted signal phasings and coordinated signal phasings to ensure adequate clearance times and corridor operation in the vicinity of the Chinatown stop, Surry Hills stop and Grosvenor Street stop.

The proposed modification would not noticeably impact on the Central Station stop and Moore Park stop as each of these stops are located outside of general traffic areas (i.e. within the Chalmers Street pedestrianised zone and within Moore Park east respectively), and is therefore not expected to have any associated traffic impacts. Additional changes to the Grosvenor Street stop, World Square stop, Moore Park stop and Royal Randwick Racecourse are also proposed and are discussed in additional detail in section 3.3, section 3.4, section 3.5 and section 3.7 respectively.

George Street/Ultimo Road intersection

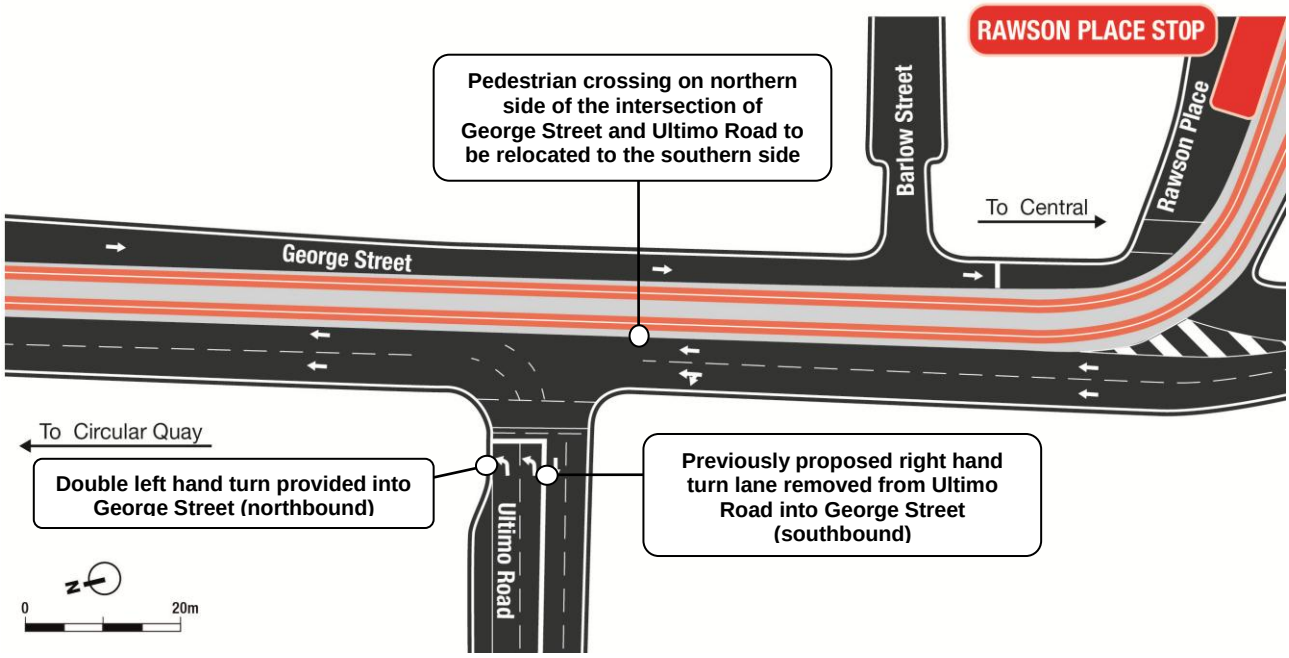
The George Street/Ultimo Road intersection would be reconfigured to provide left-in/left-out traffic operation, with the removal of the right turn movement from Ultimo Road into George Street (refer to Figure 3.7). The pedestrian crossing of George Street would be relocated to the southern side of the intersection of George Street and Ultimo Road. These changes would be required due to insufficient available storage length between Hay Street and Ultimo Road for the larger LRVs.

The modified intersection layout would maintain the existing east-west pedestrian access travel path across George Street at Ultimo Road. However, the signalised crossing would need to be coordinated with adjacent signals due to insufficient available storage length for the longer LRVs between Rawson Place and Ultimo Road.

The required traffic signal phasing arrangements would however result in pedestrians being unable to cross George Street at Ultimo Road when an LRV stops for signals at Hay Street or Rawson Place. While there are nearby pedestrian crossings to the north and south, opportunities to reduce traffic signal times at the intersection would be investigated during the detailed design of the project to provide additional crossing opportunities and reduce pedestrian delays/wait times.

A double left-turn would be provided in Ultimo Road which would improve the stop line capacity for eastbound traffic (refer to Figure 3.7). As the kerbside lane on George Street turns left at Hay Street (north of Ultimo Road), assessment of this change has identified that some merging/weaving activity would occur in George Street between Ultimo Road and Hay Street. However, given the low speed CBD road environment, and noting a reasonable demand for the left-turn at Hay Street, no significant operational or safety issues are predicted as part of the proposed modification.

Removal of the right turn from Ultimo Road into George Street would require vehicles to use Ultimo Road (westbound) and Harris Street to continue south or east. This is expected to result in some additional localised congestion on Ultimo Road between Quay Street and Harris Street. Negligible impact on Harris Street and beyond is expected, with a minor benefit associated with the reduction of traffic volumes on George Street between Ultimo Road and Pitt Street and Broadway between Pitt Street and Harris Street. Alternatively, vehicles would be able to turn left from Ultimo Road into George Street and turn right at Bathurst Street to head east. The traffic volumes expected to use this route are low, with no impact in intersection Level of Service, compared to the approved project.



Note: Indicative only. Subject to detailed design

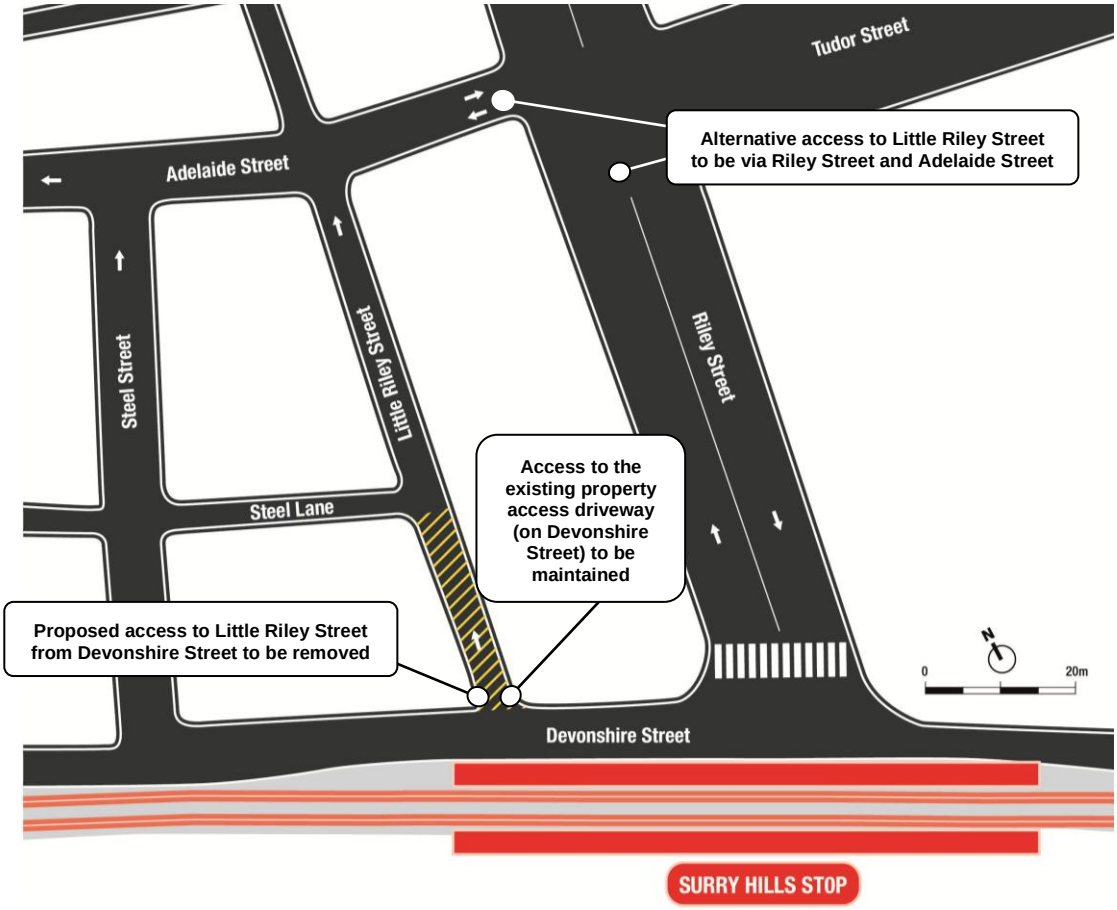
Figure 3.7 Indicative arrangement for the George Street/Ultimo Road intersection

Little Riley Street access

The increased length of the proposed light rail stop platform at the Surry Hills stop would result in the access to Little Riley Street from Devonshire Street becoming restricted and turning movements into Little Riley Street would potentially disrupt vehicular traffic heading eastbound along Devonshire Street. As a result, it is proposed that the existing access from Devonshire Street into Little Riley Street be removed (refer to Figure 3.8).

Vehicle access is not required for the properties fronting Little Riley Street between Devonshire Street and Steel Lane (there are no driveways or on-street parking in this section). As a result of the proposed modification, vehicles would be required to access Little Riley Street between Steel Lane and Adelaide Street via Steel Street and Steel Lane. Steel Street and Steel Lane carry low volumes of local traffic, with only one-way northbound traffic permitted. Therefore, the additional traffic volumes would have a minor traffic impact on Steel Street and Steel Lane. Under this scenario, Little Riley Street could be closed between Devonshire Street and Steel Lane, with the road space converted to a shared pedestrian and bicycle link. With a narrow single-lane carriageway and existing 'no stopping' restrictions, Little Riley Street is not appropriate for removalist vehicles or other large vehicles. An appropriate servicing strategy would be developed as part of the detailed design.

Access to the single property access driveway located adjacent to Little Riley Street (on Devonshire Street) is proposed to be maintained, with kerb adjustments to be made to accommodate the required swept paths (refer to Figure 3.8). The proposed design refinement would therefore not result in any impacts to the access to this property.



Note: Indicative only. Subject to detailed design.

Figure 3.8 Indicative arrangement for the Devonshire Street/Little Riley Street intersection

Other intersection impacts

Coordination of traffic signals at the Grosvenor Street/Bridge Street intersection and the Hunter Street/Margaret Street intersection (including Jamison and Bond Streets) would be required as part of the proposed modification. This would ensure that LRVs can clear both intersections at once without stopping, resulting from insufficient available storage length between these two intersections for the longer LRVs. Similarly, coordination of traffic signals at the Devonshire Street/Marlborough Street intersection and the Devonshire Street/Crown Street intersection would also be required.

It is assessed that the longer clearance times involved with the longer LRVs would result in some minor additional delays along the side streets, with lesser impacts in Surry Hills due to the local operation and lower volumes experienced along these streets. However, given that the headways between LRVs would be increased (service frequency decreased), the overall traffic impact is expected to be limited compared to the approved project. Traffic analysis undertaken during the detailed design process (in consultation with Roads and Maritime), would ensure that satisfactory traffic signal operation for all road users is achieved along the route.

Pedestrian impacts

The proposed opening headways of 4 minutes would increase the available time for pedestrian movements to and from the platform during the morning and afternoon peaks. This would also increase the number of passengers boarding and alighting each service. Passenger wait times would also increase slightly as a result of the slightly longer headways during the peak periods, but would generally be shorter outside the peaks. Given that the platforms would be proportionally longer to cater for the 67 metre LRVs, pedestrian capacity on the longer platforms is expected to be sufficient to meet the required demand. As such, no significant adverse pedestrian impacts are expected. Further detailed pedestrian modelling would be undertaken during detailed design to confirm that pedestrian amenity and safety is appropriately catered for at the stops and immediate surrounds (platform access routes).

The combination of longer platforms, reduced pedestrian waiting areas at traffic signals adjacent to some platforms, and changes to pedestrian crossing locations and/or traffic signal coordination, would potentially result in a higher risk of pedestrians not complying with the pedestrian signals, crossing away from traffic signals (mid-block) or crossing directly between the platform and the footpath.

The detailed design phase would investigate urban design opportunities to minimise mid-block crossings together with appropriate educational campaigns (as identified in section 10.10 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013)) would be implemented to encourage higher levels of compliance and safety across the corridor, in addition to the provision of appropriate warning signage.

Visual and landscape character impacts

LRVs

Consistent with the assessment presented in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013), LRVs would be visually prominent in the landscape due their length, scale and design. The proposed modification would not substantially alter this assessment, however due to the increased length of the proposed LRVs, the time that each LRV is in view at any one location would be increased slightly. This would however result in a negligible visual impact overall.

The extended LRVs would also result in a minor visual impact at each of the terminus stops (Circular Quay stop, Randwick stop and Kingsford stop) due to the longer LRVs presenting a slightly larger visual mass whilst stationary at this location and whilst staff change shifts. However this would not substantially alter the previous assessment presented in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013). However, while the longer vehicles would be more visible, they would operate less frequently during peak periods, offsetting this impact.

Stops

Consistent with the assessment presented in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013), each of the stops would become a dominant feature of the local viewpoints surrounding each stop. Each stop would add additional visual elements at street level, created by the platforms, new pedestrian crossings and roadside barriers (where proposed as part of the approved project). Similarly to the visual impacts of the increase in LRV length, the proposed modification to stop lengths would not substantially alter this assessment, resulting in a minor increase in visual impact overall.

Planted tree impacts

The design of the stops as described for the approved project has been identified as resulting in the loss of approximately 130 trees across all 20 stops. The proposed modification to increase the stop lengths by approximately 22 metres to allow for increased LRV would not result in additional trees being impacted as a result of the project with the exception of the removal of one additional tree associated with the Surry Hills stop. It is expected that, subject to detailed design, it will be possible to retain a number of trees through other modifications described in this report including at Grosvenor Street stop and through the removal of the World Square stop (refer sections 3.3 and 3.4). There will however be an overall increase in the number or trees to be removed as a result of other design modifications such as the realignment at Alison Road and at the Alison Road/Anzac Parade intersection, and changes to the construction method for the Anzac Parade tunnel. These impacts are described in sections 3.7, 3.8 and 3.10 of this report.

A summary of the approved and proposed changes to tree impacts for each of the stops is provided in Table 3.3 below.

Table 3.3 Extent of proposed tree removal as a result of the proposed modification to stop lengths

Stop	Approximate number of trees removed as part of approved stop design	Approximate number of trees removed as part of modified platform design	Change in tree impacts as a result of increase stop length
Circular Quay	9	9	No change
Grosvenor	3	0	Reduction due to platform reconfiguration. Refer to section 3.3
Wynyard	0	0	No change
Queen Victoria Building	0	0	No change
Town Hall	0	0	No change
World Square	14	0	Note. Stop removed. Refer to section 3.4
Chinatown	0	0	No change
Rawson Place	4	4	No change
Central Station	12	12	No change
Surry Hills	15	16	Increased impact by approximately 1 tree
Moore Park	3 + 10 relocated	3 + 10 relocated	No change
Royal Randwick Racecourse	7	10	Increased impact by approximately 3 trees
Wansey Road	6	6	No change
UNSW High Street	12	12	No change
Randwick	18	18	No change
Carlton Street	8	8	No change
Todman Avenue	7	7	No change
UNSW Anzac Parade	2	2	No change
Strachan Street	0	0	No change
Kingsford	8	8	No change
TOTAL	128 + 10 relocated	115 + 10 relocated	Reduced impact by approximately 13 trees as a result of changes to approved stops

Note 1: Final number of trees removed subject to detailed design.
Note 2: Tree impacts have been calculated based on stop platform length impacts and subsequent track alignment only (except for Grosvenor Street stop and World Square stop). Impacts from other design modifications have been noted where relevant within this report.

Property and land use impacts

The proposed modification, with respect to the increased stop platform lengths along the whole alignment, would occur within the same project footprint as the approved project. There would not be any additional land use and property impacts as a result of the proposed modification on existing land uses to those previously assessed in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013).

Noise impacts

Construction assessment

With respect to construction noise, the overall duration of the station construction works may be slightly longer than what was assumed as part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013). This change would not be significant compared with the assessment undertaken as part of the EIS.

Operational assessment

For 67 metre long LRVs, the maximum noise levels during a passby (the point at which an LRV passes a particular point) may be marginally higher than a 45 metre long LRV. However, this increase would last for only a few seconds and would therefore not have a noticeable change to the impact at sensitive receptors Figure 3.9 demonstrates the noise level profile for a 45 metre long LRV and a 67 metre long LRV for a measurement distance of 15 metre and speed of 60 kilometres per hour.

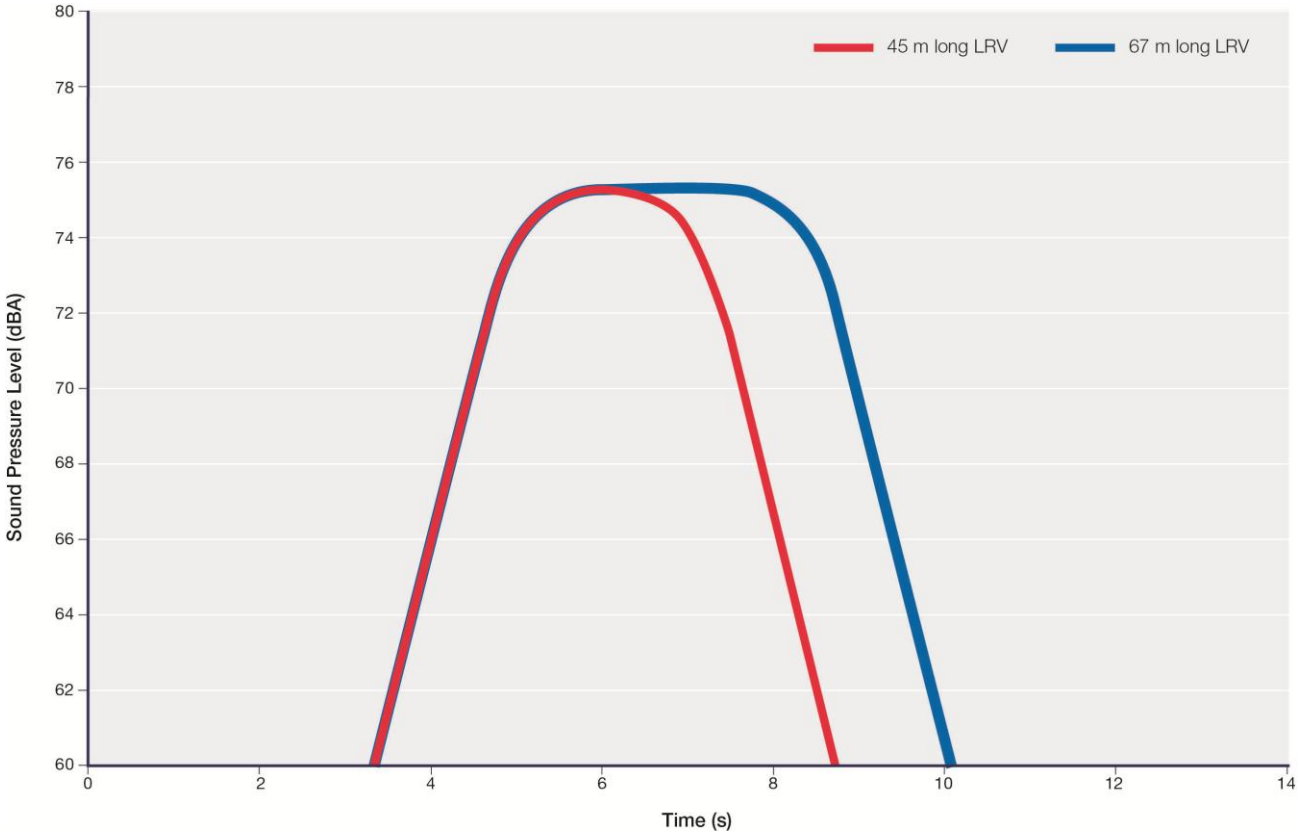


Figure 3.9 Noise level profile for 45 metre and 67 metre LRVs

In relation to the average (L_{Aeq}) noise levels during the daytime, evening and night-time periods, these are based on the number of passbys (i.e. the proposed timetable) and also the length of the LRVs. Whilst the L_{Aeq} noise level for the longer LRV is marginally higher, the plot shows that there is a negligible change in the maximum noise level and the main difference is that the passby noise level increases from approximately five seconds to six seconds.

The proposed modification also includes adjustment to the operational headways as described in Table 3.2, and graphically described in Figure 3.10 to Figure 3.13. This is expected to increase the number of LRV per hour during the off-peak periods (10.00 pm to 7.00 am) at opening and in the future scenario.

It is proposed that the during day time period there would be the same or a decrease in the number of LRVs per hour for at opening and future scenarios.

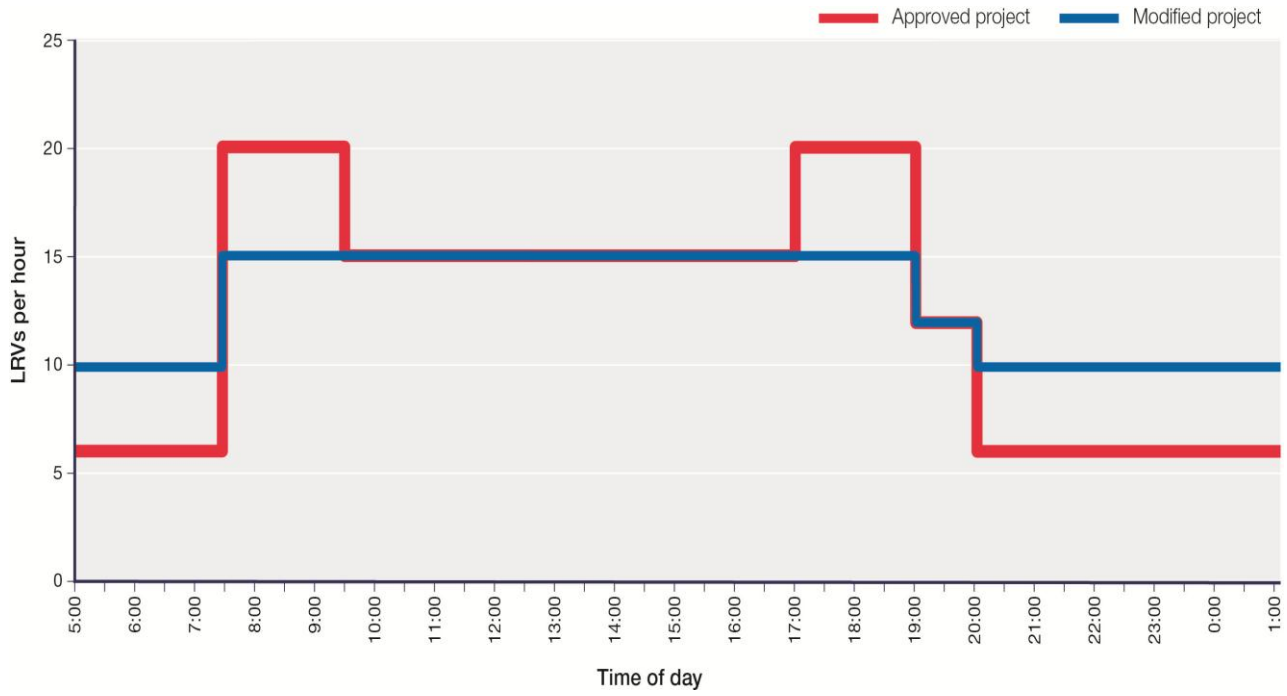


Figure 3.10 Operating frequency at opening year – City centre/Surry Hills/Moore Park

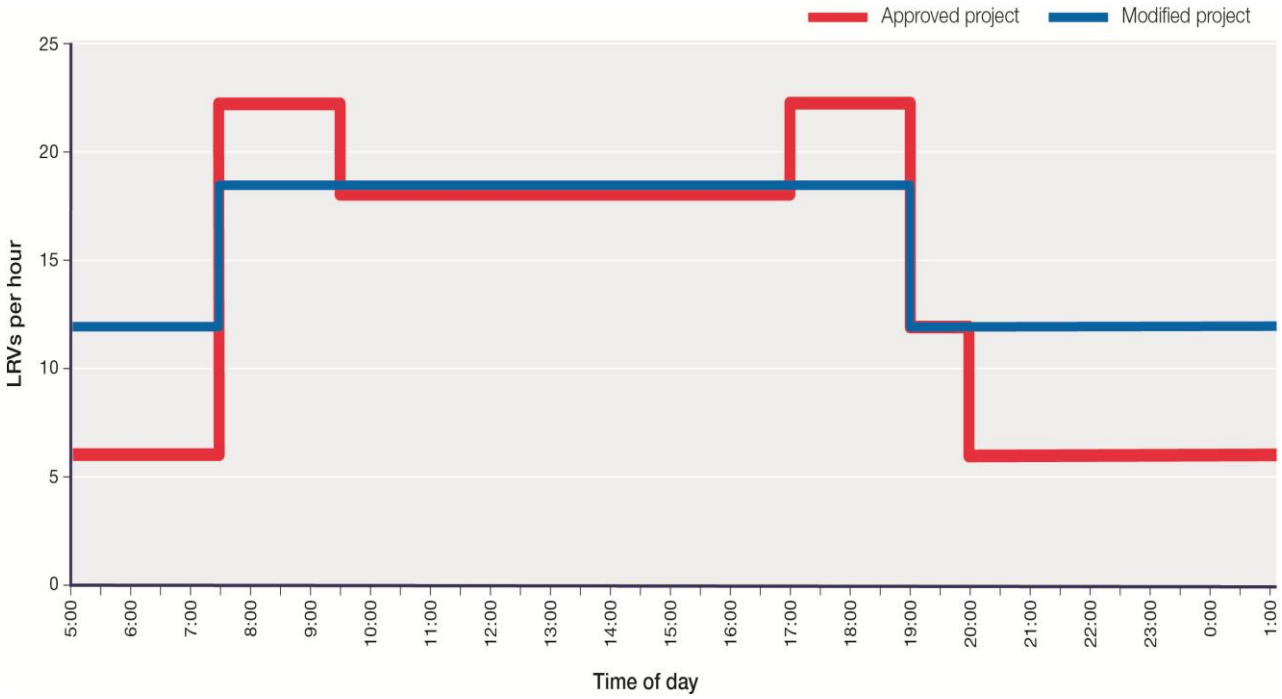


Figure 3.11 Future operating frequency – City centre/Surry Hills/Moore Park

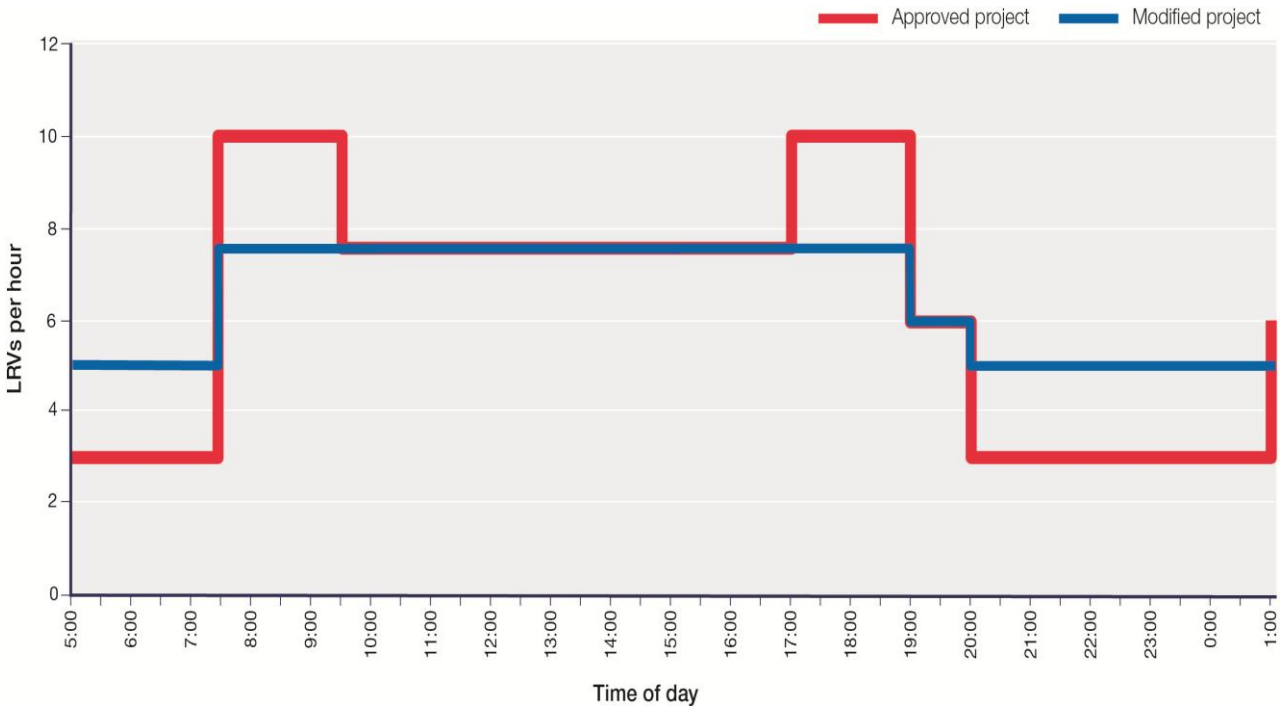


Figure 3.12 Operating frequency at opening year – Randwick and Kingsford branch lines

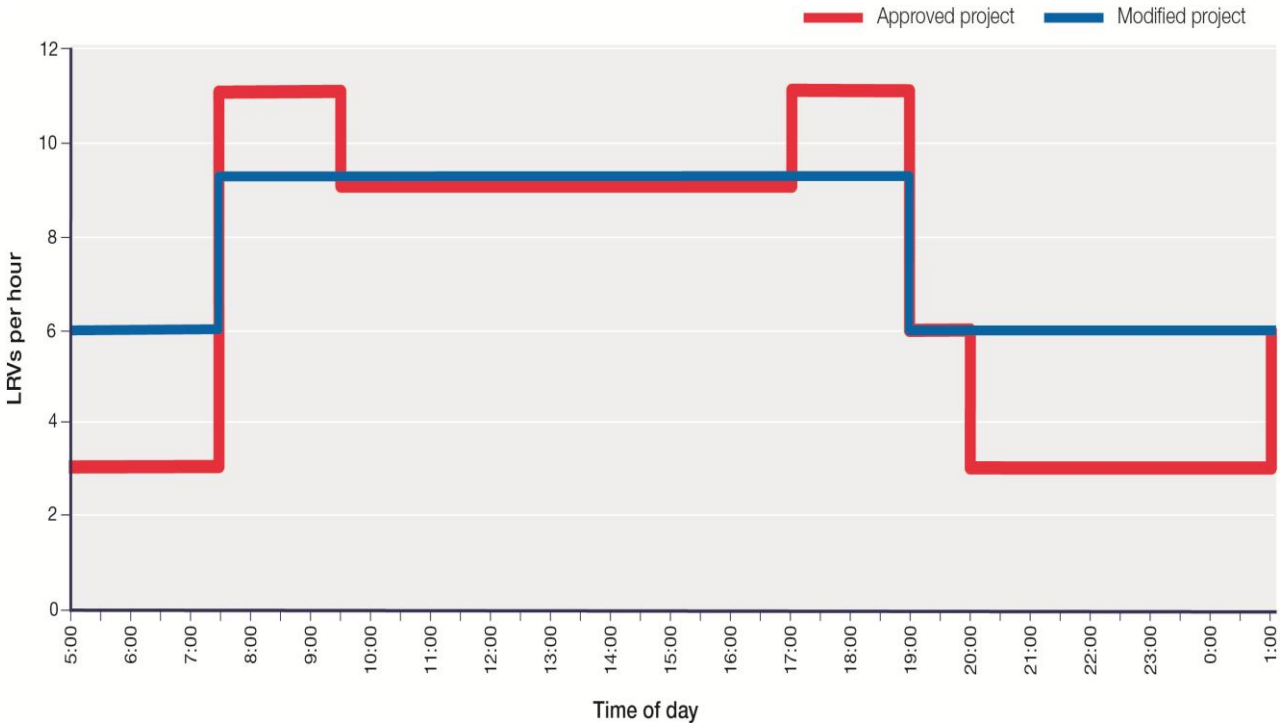


Figure 3.13 Future operating frequency – Randwick and Kingsford branch lines

In the above figures, it can be seen that the number of LRVs per hour is greater during the 5.00 am to 7.30 am and the 10.00 pm to 1.00 am night-time periods compared with the CSELR EIS. This proposed increase in the number of LRVs during the night-time, in conjunction with the longer LRVs results in the predicted noise levels exceeding the noise trigger levels at approximately 101 receptors (in comparison to the anticipated 15 receptors identified as part of the approved project).

A comparison of the previously assessed and potential additional exceedances for each of the Noise Catchment Areas (NCAs) is provided in Table 3.4 below. The location of these predicted exceedances are provided in Figure 3.14 to Figure 3.18.

Potential mitigation measures are discussed in the CSELR EIS, but the feasibility of all these options requires further investigation, including setting goals for LRV noise emissions, operational impacts of speed restrictions, durability and maintenance requirements for higher noise absorption track forms, and confirmation of the effectiveness of higher absorption trackforms. Even with a combination of mitigation measures, the CSELR EIS identifies that residual exceedances of the noise goals are likely to remain at some locations.

Subsequent to the preparation of the CSELR EIS, a noise measurement program was undertaken to quantify the existing level of road traffic noise across the project area and assist in informing the assessment of feasible and reasonable mitigation measures. This document is available on the DP&E website (Appendix 1 of *Additional Information provided to Department of Planning and Environment to support the assessment of the CBD and South East Light Rail Project* dated May 2014). The assessment identified that in many areas, the existing and future road traffic noise levels are similar to, or give rise to more high noise events during the night-time than would be introduced by the light rail. In areas where road traffic noise levels dominate the ambient noise environment, the assessment indicates that noise levels marginally higher than the noise trigger levels may be accepted.

As part of the detailed design of the project, an Operational Noise and Vibration Review (ONVR) would be required (as detailed in management measure B.1 (Table 4.1) and in accordance with condition of approval C12) which would provide an updated assessment of the potential impacts and proposed mitigation measures. This ONVR would be required to take into consideration the revised LRV lengths and timetable changes. The ONVR is required to be independently verified by a noise and vibration expert prior to operation, with the report being made publically available. Following opening, noise and vibration monitoring is required to assess the adequacy of the mitigation measures proposed in the ONVR. The conditions of approval also require additional mitigation measures to be implemented in consultation with affected property owners if the noise levels in the ONVR are not met.

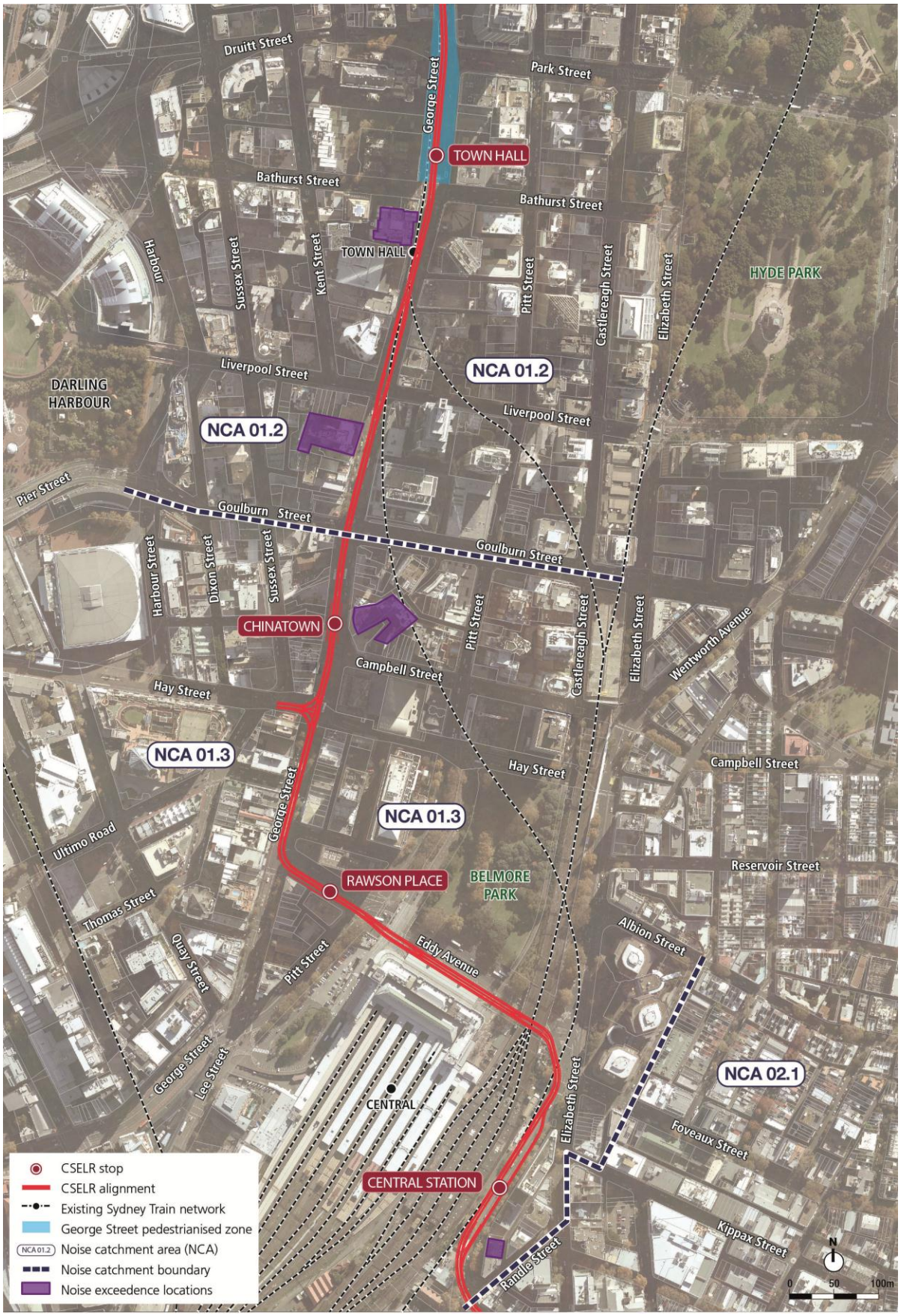
Existing measures proposed as part of the approved project would be applied to the additional receptors that are predicted to have exceedances due to the proposed modification. These measures are detailed in Table 4.1, Table 4.2 and Table 4.3 of this report.

Table 3.4 Comparison of the previously assessed and potential additional noise exceedances for each Noise Catchment Area

Area	Area description	Potential number of exceedances (approved project)	Potential number of exceedances (proposed modification)[1]	Type of receptor impacted (number of receptors impacted)[2]
NCA01.1	Northern CBD, from Wynyard to Circular Quay	0	0	No change
NCA01.2	Central city area, including World Square, Town Hall and the Queen Victoria Building (QVB)	0	2	Mixed use (1) Commercial (1)
NCA01.3	Southern CBD, including Chinatown, Haymarket and Central Station and Chalmers Street	1	2	Mixed use (2)
NCA02.1	Devonshire Street, up to South Dowling Street	9	15	Terrace (84) Unit (6) Mixed use (6) Commercial (4)
NCA03.1	Moore Park, Sydney Cricket Ground, Sydney Football Stadium and Entertainment Quarter, to Alison Road	0	0	No change
NCA04.1	Kensington between Alison Road and Todman Avenue	1	11	Separate dwelling (4) Semi-detached (6) Unit (3) Mixed use (2) Commercial (1)
NCA04.2	Kensington from Todman Avenue to beyond University of New South Wales (UNSW)	1	22	Separate dwelling (1) Unit (13) Mixed use (17) Commercial (13)
NCA04.3	Kingsford from Strachan Street to the terminus	0	2	Mixed use (4)
NCA05.1	Alison Road to Doncaster Avenue	0	1	Unit (1)
NCA05.2	Doncaster Avenue and Royal Randwick Racecourse	0	0	No change
NCA05.3	Alison Road and Wansey Road to High Street and UNSW	0	23	Separate dwelling (17) Unit (5) Commercial (1)
NCA05.4	Randwick High Street to Randwick hospital precinct and terminus	3	23	Separate dwelling (2) Unit (15) Commercial (5)
Total		**15**	**101**	

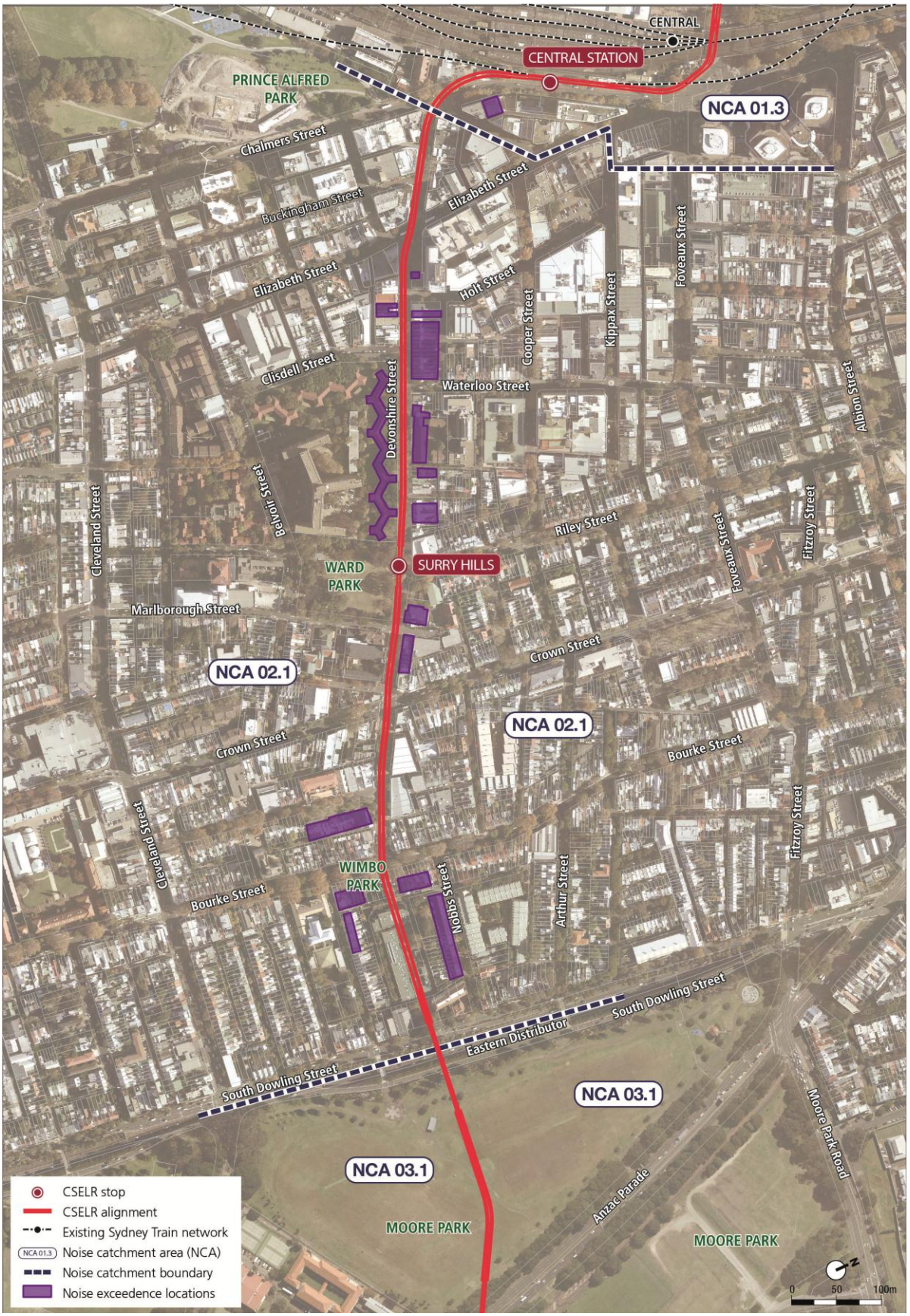
Note 1: The potential number of exceedences is represented by 'blocks' of receptors and not individual dwellings within blocks or buildings (such as individual properties within a terrace or individual units) affected by the proposed modification. These would be identified as part of the ongoing detailed design of the project.

Note 2: The potential number of receptors impacted within the identified 'blocks' or receptors.



Note: Indicative only, not to scale. Subject to detailed design.

Figure 3.14 Noise exceedance locations resulting from the proposed modification – NCA01.2 and NCA01.3

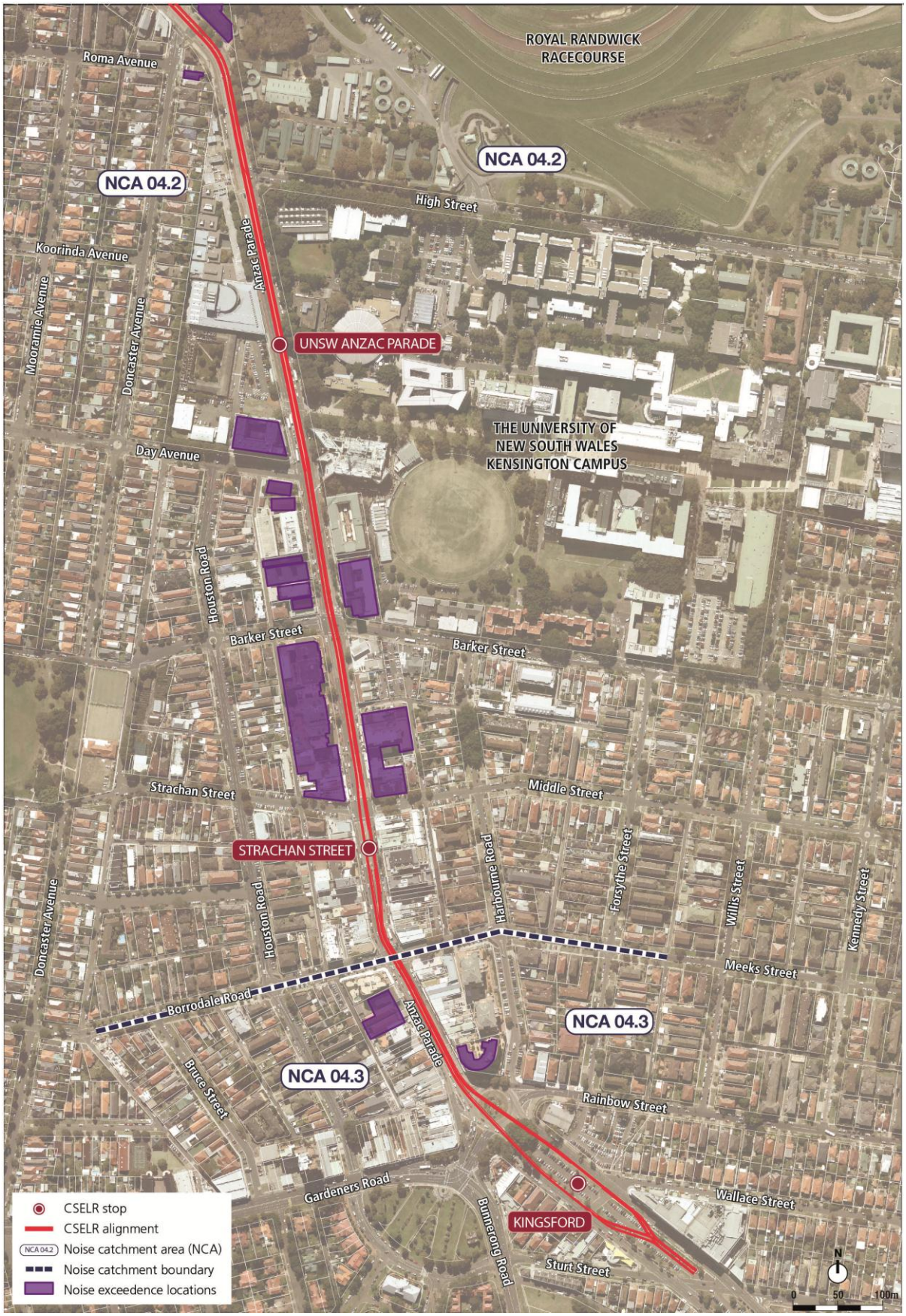


Note: Indicative only, not to scale. Subject to detailed design.

Figure 3.15 Noise exceedance locations resulting from the proposed modification – NCA02.1

Note: Indicative only, not to scale. Subject to detailed design.

Figure 3.16 Noise exceedance locations resulting from the proposed modification – NCA04.1, NCA04.2 and NCA05.1



Note: Indicative only, not to scale. Subject to detailed design.

Figure 3.17 Noise exceedance locations resulting from the proposed modification – NCA04.2 and NCA04.3

Note: Indicative only, not to scale. Subject to detailed design.

Figure 3.18 Noise exceedance locations resulting from the proposed modification – NCA05.3 and NCA05.4

Aboriginal and non-Indigenous heritage impacts

Built heritage/landscape

As part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013), a number of heritage items were identified adjacent to or within the vicinity of a number of the light rail stops. The proposed impact of the approved stops was identified to have a minor to minor/moderate adverse impact on existing heritage items or conservation areas, with the impacts predominantly consisting of visual impacts to the setting and appreciation of the identified heritage items or conservation areas. The approved stop location in High Cross Park was however identified as having a direct impact on existing heritage, being a major adverse impact to the heritage setting of the park.

The CSELR Project EIS noted that, in general, operation of the approved project would result in a range of impacts to the built and non-Indigenous heritage environment, as a result of changes to the setting, context and appreciation of heritage features. Such impacts included the infrastructure associated with the operation of the CSELR Project including, among other elements, rail tracks, stops, services and additional street furniture.

The extension of the approved stops to accommodate the longer LRVs would not result in any substantial additional impacts to the approved project. The additional length of the stops would have the same visual characteristics of the approved stops, and would therefore result in a similar impact to that previously assessed.

The extended stop lengths may however have a minor visual impact on the setting of heritage items along the length of the alignment, however given the existing setting of the proposed stop locations (within road infrastructure), this impact is assessed to be consistent with that previously assessed.

The longer LRVs themselves are not assessed to result in any additional impacts to built heritage/landscape.

Historical archaeology

The proposed modification to the stop lengths would fall across a number of the HAMUs and archaeological management zones identified as part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013). An assessment of the proposed modifications to each of the stop lengths to determine potential additional impacts to each HAMU has been undertaken.

The proposed modification would result in a minor increase to the overall footprint of each stop. This would result in a minor increase to the impact area to the HAMU to that which was identified for the approved stops. Overall, it is assessed that the proposed modification to the stop length of each of the stops along the light rail alignment would result in minimal impacts to archaeological heritage in comparison to the impacts identified in the CSELR Project EIS (Transport for NSW, 2013).

Management and mitigation measures for managing impacts to each of the identified heritage archaeological management zones were presented in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013). These management and mitigation measures would continue to be implemented as part of the modified design for each stop (refer to management measures V.1 and V.6 in Table 4.2 of this report).

Aboriginal heritage

The proposed modification to the stop lengths would fall across each of the four Aboriginal archaeological potential zones identified as part of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013). An assessment of the proposed modifications to each of the stop lengths to determine potential additional impacts to each of these zones has been undertaken.

The proposed modification would result in a minor increase to the overall footprint of each stop. This would result in a minor increase to the impact area to the Aboriginal archaeological potential zones to that which were identified for the approved stops. Overall, it is assessed that the proposed modification to the stop length of each of the stops along the light rail alignment would result in minimal impacts to these Aboriginal archaeological zones in comparison to the impacts identified in the CSELR Project EIS (Transport for NSW, 2013).

Management and mitigation measures for managing impacts to each of the identified Aboriginal archaeological potential management zones were presented in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013). These management and mitigation measures would continue to be implemented as part of the modified design for each stop (refer to Table 4.2 of this report, in particular management measures AA.1, AA.2 and AA.4).

3.7 Realignment along Alison Road and revised flood mitigation at Centennial Park

3.7.1 Description of the approved project

Alignment along Alison Road

Section 5.2.1 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013), described the approved track alignment along Alison Road. This described that from the intersection of Anzac Parade and Alison Road, the alignment of the Randwick branch travelled south-east along the existing busway (to be shared between buses and LRVs) on the northern side of Alison Road between Anzac Parade and Doncaster Avenue.

At Doncaster Avenue, the alignment crossed Alison Road and continued south-east along the southern side of Alison Road adjacent to the Royal Randwick Racecourse before turning right into Wansey Road. As part of this alignment, all traffic along Alison Road was located to the north of the proposed light rail alignment (east of Doncaster Avenue).

Royal Randwick Racecourse stop

As described in Section 5.2.3 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013), the Royal Randwick Racecourse stop was integrated into the existing Royal Randwick forecourt plaza. The stop functioned as a major event stop for horse racing carnivals, conventions and conferences, and other events that the racecourse hosts throughout the year. These events required a shuttle service (or similar) to be operated with patrons queuing in front of the light rail stop during events.

Revised flood mitigation at Centennial Park and Alison Road

The approved Randwick stabling facility provided for a structural slab and piles to elevate up to 10,000 square metres of the tracks within the Randwick stabling facility site. This elevated structure raised the facility above potential flooding as well as creating onsite flood storage. Additionally, a series of culverts were identified to permit flood conveyance through the site.

No change to the existing Centennial Parklands flood levee located on the northern side of Alison Road was proposed as part of the approved project.

Kensington Ponds

The Kensington Ponds area is a series of ponds and wetlands that consists of both perennial ponds and ephemeral mudflats and wetlands, both of which provide habitat to aquatic species and migratory bird species. The banks of the ponds and mudflats are typically vegetated by species which require intermittent inundation.

3.7.2 Description of the modified design

Following further consultation with relevant stakeholders (including Randwick City Council, Centennial Parklands Trust and the Australian Turf Club (ATC)), refinement of the alignment and stop locations between Doncaster Avenue and Wansey Road has been undertaken to address:

- potential impacts to the bus interchange area at the Alison Road entrance to Royal Randwick Racecourse
- potential issues relating to the access arrangement for Gate 1 and Gate 6 of the Royal Randwick Racecourse
- access to the Randwick TAFE
- access for Centennial Park and events held near this location.

The proposed design modifications to the alignment and stop locations between Doncaster Avenue and Wansey Road are described in greater detail below.

Alignment along Alison Road

From the intersection of Anzac Parade and Alison Road, the light rail alignment would initially follow the same alignment along the Randwick branch as the approved project, travelling south-east along the existing busway on the northern side of Alison Road between Anzac Parade and Doncaster Avenue.

From approximately 100 metres east of Doncaster Avenue, the modified design would deviate from the approved alignment and continue on the northern side of Alison Road along the former tramway alignment to Darley Road (currently consisting of open space and trees bordering the Centennial Parklands).

The modified alignment would continue adjacent to the northern side of Alison Road (partially within the footprint of the existing levee bank which will be re-engineered and raised) until the intersection of Alison Road and Darley Road. The modified location for the Royal Randwick Racecourse stop would be to the west of Darley Road, approximately halfway between Doncaster Avenue and Darley Road (refer below for details).

A modified track connection to the proposed Randwick stabling facility from the revised alignment would be provided across Alison Road approximately 130 metres to the east of Doncaster Avenue. A new entrance to the Royal Randwick Racecourse would also be provided about 35 metres to the west of the existing driveway entrance.

A new pedestrian crossing would also be provided at this location to provide access between the Royal Randwick Racecourse and the revised location of the Royal Randwick Racecourse stop. The revised Randwick stabling facility access and pedestrian crossing would be provided as a new, signalised intersection at this location.

To allow for the new alignment to be located at the same level as Alison Road whilst maintaining the existing levee, a new retaining wall, approximately 200 metres long and up to approximately three metres in height would be required along the central portion of the modified alignment (refer to Figure 3.21).

Figure 3.19 provides an overview of the modified design of the light rail alignment and Royal Randwick Racecourse stop location.

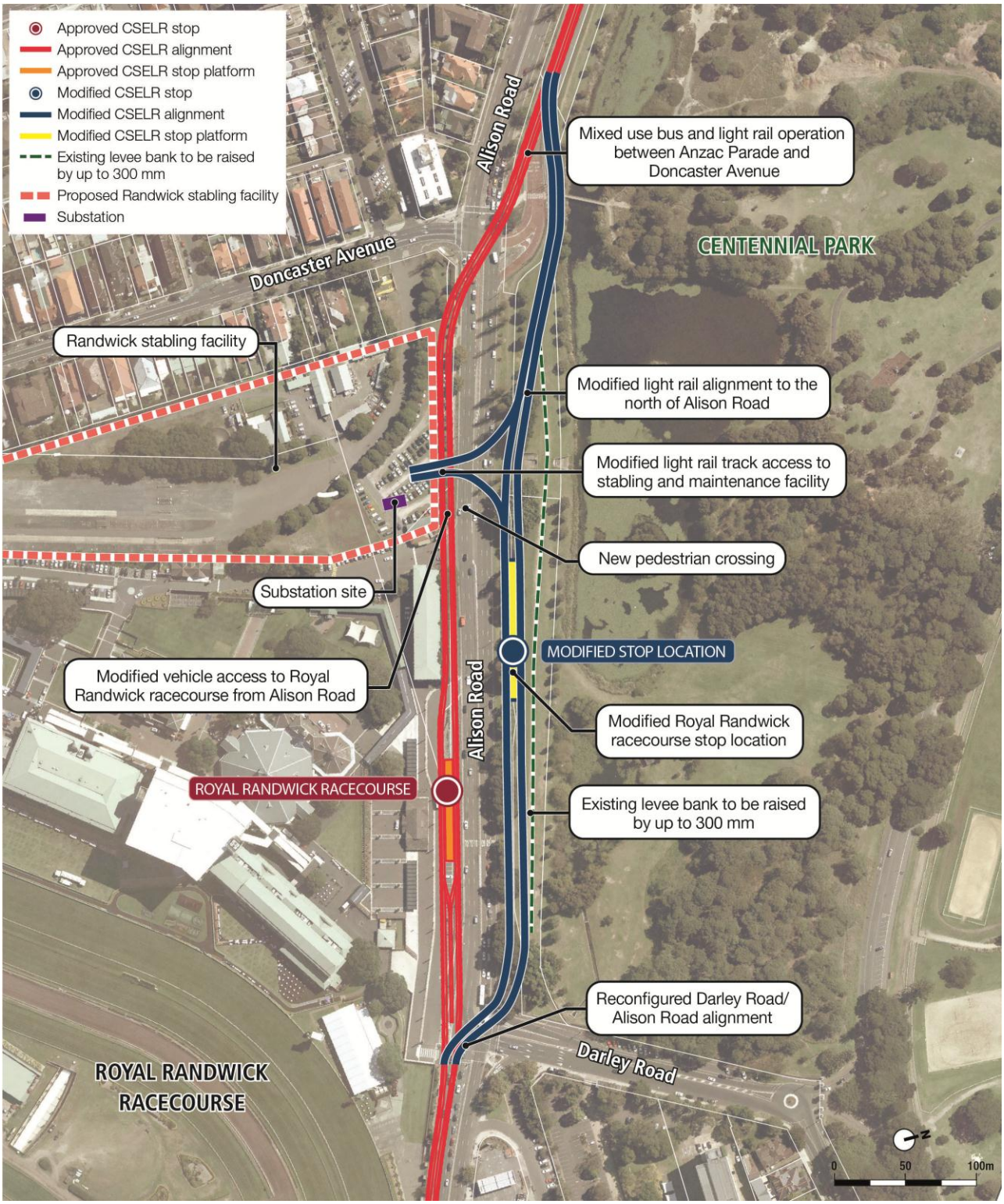
At the intersection of Alison Road and Darley Road, the modified alignment would cross through the intersection and continue to the east along the approved alignment as described in the CSELR Project Submissions Report (Transport for NSW, 2014), consisting of a side running alignment along the southern side of Alison Road and Wansey Road. This alignment would retain two eastbound and three westbound traffic lanes. Figure 3.20 shows the modified intersection design.

Royal Randwick Racecourse stop

As described above, the Royal Randwick Racecourse stop would be relocated to the northern side of Alison Road and would allow for the retention of the existing bus facilities at the racecourse during light rail construction and operation. The layout of the relocated stop would be similar to the approved project, providing a wide, single island platform which would cater for large numbers of passengers during special events at the racecourse (refer to Figure 3.19).

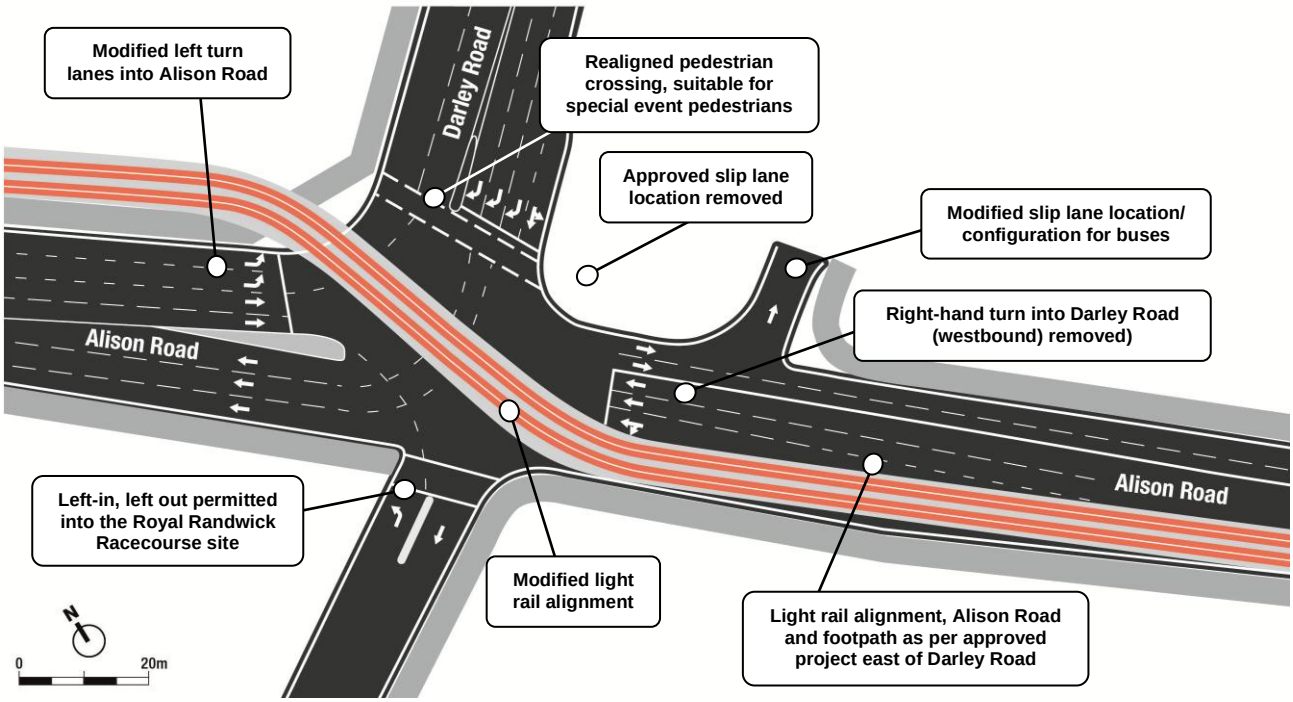
New pedestrian footpaths would be provided to the stop from the east (from Darley Road) and from the west (between the stop and Doncaster Avenue with a new, signalised pedestrian crossing provided across Alison Road (approximately 140 metres east of Doncaster Avenue). Existing fencing along Alison Road (on the southern side and within the median of Alison Road) would be maintained in order to direct passengers to the crossing points along Alison Road. On the northern side of Alison Road, new footpaths would provide access to the stop. These footpaths would also allow for queuing passengers during special event operations while waiting for LRVs.

A realigned pedestrian crossing at the intersection of Alison Road and Darley Road would also be provided to accommodate large numbers of passengers accessing the racecourse from the relocated stop (refer to Figure 3.20). The stop and access would be consistent with the Centennial Park and Moore Park trust master plan and vision.



Note: Indicative only. Subject to detailed design.

Figure 3.19 Revised Alison Road alignment and relocated Royal Randwick Racecourse stop



Note: Indicative only. Subject to detailed design.

Figure 3.20 Proposed arrangement of the Alison Road/Darley Road intersection

Revised flood mitigation at Centennial Park and Alison Road

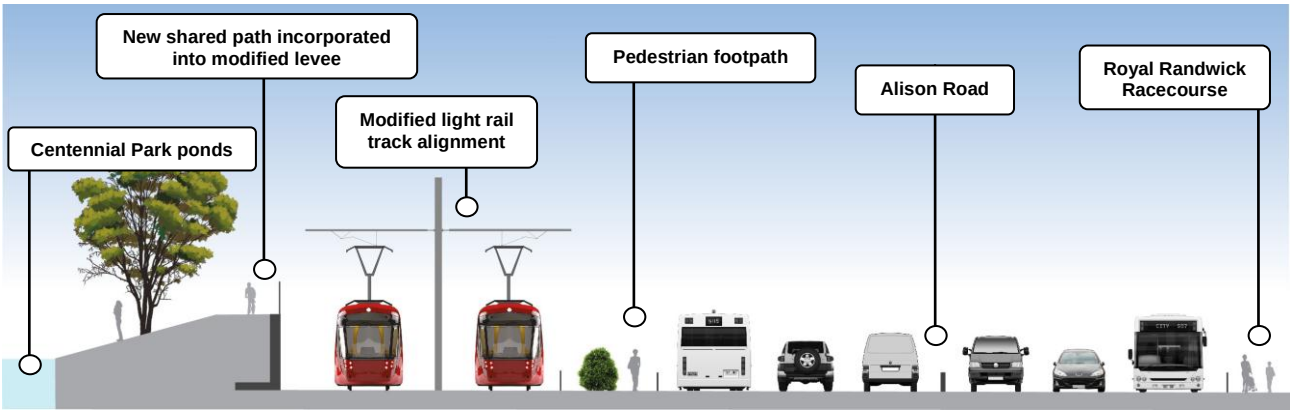
A 1,100 metre long flood levee is located between Alison Road and the Centennial Park ponds. This levee provides significant storage capacity within Centennial Park ponds during a storm event and influences the extent of flood events at the Randwick stabling facility site. The existing levee is generally at a constant level, with two slightly lower points located opposite the Randwick stabling facility site.

Additional hydrological modelling and design of potential options to mitigate potential flooding impacts on the Randwick stabling facility site has been undertaken. The modified design proposes to provide additional flood storage by raising the existing levee by approximately 300 millimetres along the length of the levee to provide improved flood mitigation (refer to Figure 3.21).

The raised levee is estimated to provide approximately 50,000 cubic metres of additional floodwater detention capacity (within the Centennial Park ponds area). This would reduce the predicted flooding frequency of the Randwick stabling facility site and downstream areas through the suburbs of Kensington and Kingsford. The raised levee would also result in anticipated reductions in flooding effects along Anzac Parade, Doncaster Avenue and adjacent streets through Kensington and Kingsford. This modification would significantly reduce the extent of flood mitigation works that were previously proposed for the Randwick stabling facility site (i.e. structural slab, piles and drainage pipes within the Randwick stabling facility site).

The proposed modification to the levee bank would provide substantial flood reduction benefits, with the preliminary flood modelling showing that the 1 in 100 year flood event would be retained within the confines of Centennial Park. The proposed modification seeks to take advantage of the existing flood detention the parkland ponds currently provide. Consequently, the modification would result in impacts to the parklands by increasing the duration of flood events against the existing situation.

The existing turf covered levee would be re-graded with a new path along the northern side of the alignment, with an approximately three metre high retaining wall used adjacent to the realigned light rail lane. Native grasses/shrubs would be planted on the re-graded embankments. The species of grasses/shrubs would be determined following consultation with Centennial Park. A typical elevation of the proposed levee arrangement is shown in Figure 3.21.



Note: Indicative only. Subject to detailed design.

Figure 3.21 Elevation of the proposed increase to the height of the existing levee including proposed light rail alignment and pathways

3.7.3 Change in impact

Traffic and transport impacts

Construction assessment

It is assessed that the construction impacts associated with the modified design would be reduced, with a greater portion of the construction works occurring outside of the road corridor between Doncaster Avenue and Darley Road. The construction traffic impacts associated with the Alison Road crossover would be transferred from Doncaster Avenue to Darley Road.

The proposed staging and the traffic management measures associated with the proposed modification would therefore be consistent with those identified in the CSELR Project EIS (Transport for NSW, 2013), including the following:

- staged intersection works would occur during weekends, when no events are scheduled
- a minimum of two lanes of travel maintained in each direction during each works stage.

Existing measures proposed as part of the approved project would continue to apply as detailed in Table 4.1 and Table 4.2 of this report.

Operational assessment

Alison Road/Darley Road intersection

Traffic analysis (using the SIDRA intersection traffic modelling tool) was undertaken using 2021 forecast traffic demands (including traffic generated by the recently approved Royal Randwick Hotel). The results of this modelling indicated that the Alison Road/ Darley Street intersection would operate at a level of service (LoS) C (moderate/stable intersection performance) and a LoS B (reasonable intersection performance) in the morning and afternoon peak periods respectively. This represents comparable performance to the approved project. Furthermore, appropriate traffic signal offsets and coordination would limit eastbound queuing on Alison Road (noting that the traffic arrival profile is largely controlled by the Anzac Parade/Alison Road intersection).

The Darley Road right turn from Alison Road (westbound) is currently used by approximately 50 vehicles in each of the morning and afternoon peak periods. To reduce the impact of the light rail on the Alison Road corridor, the right turn would be banned. Investigation of relevant origin and destination information associated with these turning vehicles indicated that the Darley Road right turn facilitates an undesirable 'rat-run' through Centennial Park. Removal of the right turn would allow for the enforcement of suitable routes to surrounding areas, including Bondi and Bronte via Avoca Street/York Road and the CBD via Alison Road westbound. On this basis, the removal of the right-turn would be expected to have a minor impact on the surrounding road network during peak periods. Suitable westbound local access would continue to be available, including via the use of Prince Street.

It is anticipated that the most significant impact of the modified design would be during the weekend peak, noting that Alison Road and Darley Road provides the most direct route to Centennial Park from the south-eastern Sydney area. The primary route to Centennial Park would be via Avoca Street and Darley Road, with negligible impact on the surrounding network operation.

Access to Royal Randwick Racecourse would be left-in (through from Darley Road) and left-out only. The removal of the left-turn slip lane from Alison Road into Darley Road, as well as from Darley Road into Alison Road, is required to accommodate the light rail corridor and appropriate stop line capacity for critical movements. The SIDRA modelling indicates that these minor modifications would have limited impact on the left-turn manoeuvres.

Given that the Anzac Parade/Alison Road intersection currently constrains traffic movements along the Alison Road corridor (whilst noting that the number of bus services travelling along Alison Road would decrease) the overall Alison Road corridor operation and associated travel times would not be significantly affected by the proposed modification.

Pedestrian impacts

The proposed relocation of the alignment and associated stop to the northern side of Alison Road would result in an improvement for pedestrians. This would include the improvement of pedestrian links between the CSELR project and Centennial Park, the Randwick TAFE campus, and the residential area to the north of Alison Road.

Royal Randwick Racecourse

The modified design would maintain existing kerbside bus stops along Alison Road and would improve the operation of the current racecourse bus facility at the Alison Road entrance to Royal Randwick Racecourse by clearly separating the bus network and light rail (and associated pedestrian activity).

Private vehicle access to Royal Randwick Racecourse would also be improved by removing the need for vehicles to cross the light rail tracks along Alison Road, including at the proposed Royal Randwick Racecourse Hotel access at Darley Road (subject to a separate development approval).

Relocation of the Royal Randwick Racecourse stop to the northern side of Alison Road from its approved location would primarily impact pedestrian amenity between the stop and the Royal Randwick access gates for special events. A suitable level of service is considered to be achievable through the implementation of appropriate special event/crowd management at the Royal Randwick Racecourse. This would include retention of the existing fencing along the southern side and within the median of Alison Road in order to direct passengers to the pedestrian crossing points.

Crowd control would only be required for special events held by Royal Randwick Racecourse and would not be required for the everyday use of the stop. The stop would be located midway between the Darley Road intersection and the new signalised pedestrian crossing of Alison Road, allowing for crowds to be dispersed to approach from either end of the platform. A management plan would be developed jointly between the Royal Randwick Racecourse, bus operators and the light rail operator as a shared responsibility in relation to special events.

Visual and landscape character impacts

Alignment along Alison Road (west of Darley Road)

The proposed modification to the light rail alignment west of Darley Road and Royal Randwick Racecourse stop on Alison Road would locate the light rail alignment and stop on the northern side of Alison Road within the verge area adjacent to the existing levee bank along the fringe of the Centennial Parklands. A retaining wall approximately 200 metres in length and up to approximately three metres in height would extend along the eastern side of the tracks within the central section of the proposed alignment, between Doncaster Avenue and Darley Road. The alignment would be positioned in a natural landscape character setting made up of lawn areas and established trees. This character setting differs from the location of the alignment and stop in the approved project, which was within the existing Alison Road street corridor and extension of the urban character of the Royal Randwick Racecourse frontage.

The landscape and visual impacts associated with the modified light rail alignment and stop within the verge area beside Alison Road would result in some adverse landscape and visual impacts. These impacts would include the removal of approximately 50 established trees located along the Alison Road verge and the lower portion of the levee bank (including all trees between Doncaster Avenue and Darley Road). These landscape impacts are associated with the proposed retaining wall, light rail tracks, single platform and shelter and associated light rail infrastructure (including catenary poles and wires).

These impacts would result in a noticeable change in the existing landscape character of this setting due to the loss of trees and soft landscaping, and the increase in hard surfaces and infrastructure equipment associated with the light rail alignment and stop location. This impact would predominantly be due to the long retaining wall running beside the tracks on the eastern side of the road. The proposed retaining wall would present a visual and physical barrier to the edge of the roadway and adjacent parklands, and combined with the other modifications, would have an overall effect in changing the landscape character of the area between Doncaster Avenue and Darley Road.

The overall landscape and visual impacts of this modified design would have a moderate adverse visual impact compared to the approved project.

Mitigation measures that would be considered during the detailed design of the project would include maximising soft landscaping areas, replacement of trees, minimising the height and length of retaining walls, and use of materials and surface treatments that are complementary to the existing landscape setting. Additional management measures to mitigate potential visual impacts are provided in Table 4.1 and Table 4.2 of this report.

Alignment along Alison Road (east of Darley Road)

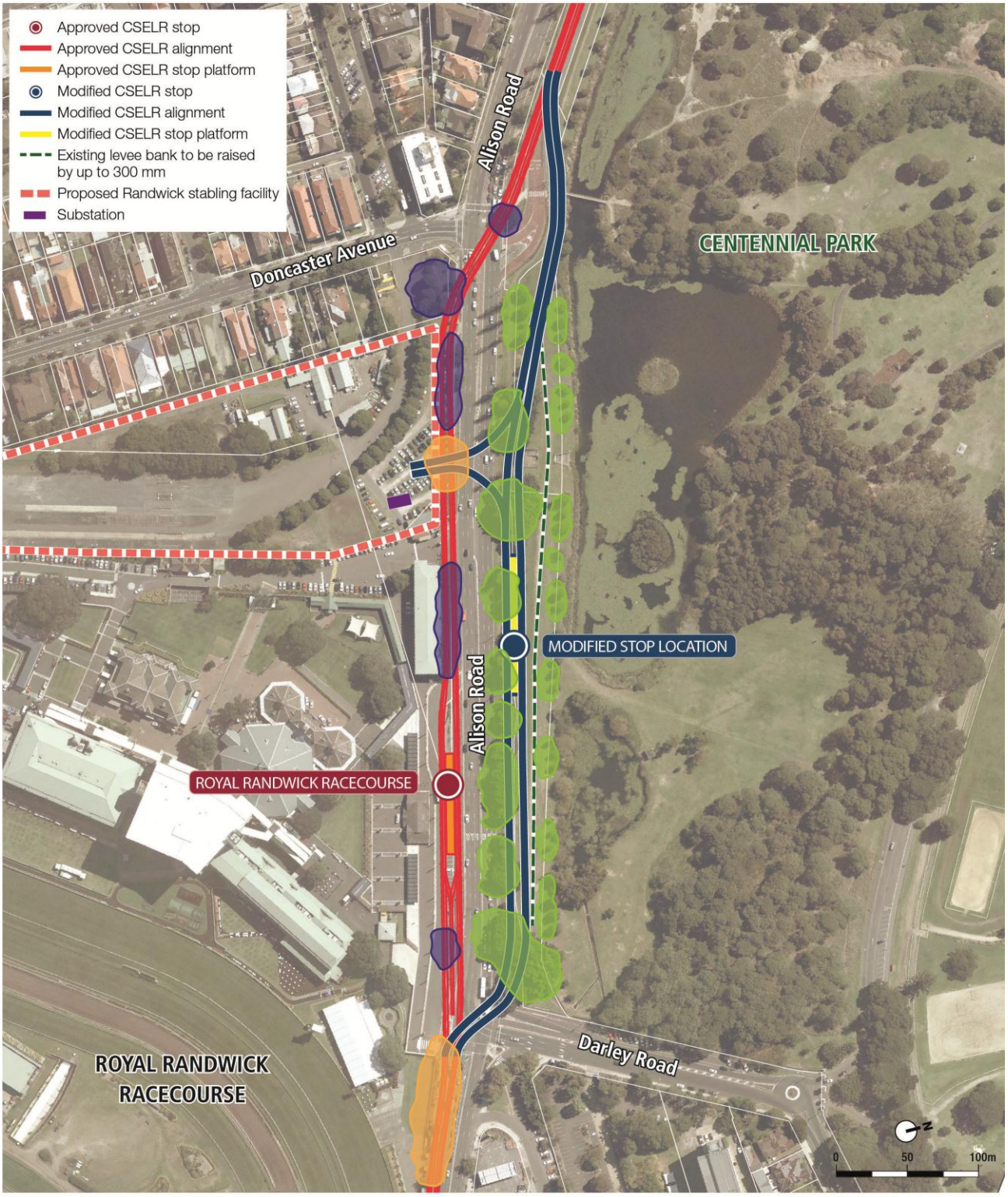
The modified Alison Road alignment east of Darley Road would be consistent with the approved alignment along this section of Alison Road (as described in the CSELR Project Submissions Report, Transport for NSW, 2014). This would include a light rail alignment to the south of Alison Road, including a shared pedestrian and cycle path to the south of the light rail alignment (approximately four metres in width).

Planted tree impacts

Alignment along Alison Road (west of Darley Road)

The modified design in this location would include the removal of approximately 50 trees along Alison Road between Doncaster Avenue and Darley Road. These include some significant fig trees and a row of smaller juvenile paperbark trees to the north of Alison Road adjacent to the Kensington Ponds (refer to Figure 3.22). The revised alignment would however no longer impact on approximately 25 trees which were previously proposed to be removed as part of the approved alignment. Therefore, the proposed modification would impact on approximately 25 additional trees compared to the approved design.

The removal of the trees on the northern side of Alison Road would change the existing landscape character of this setting and would have a noticeable impact on the landscape character of this area. However, all attempts would be made during detailed design to avoid impacts upon these trees by minimising the overall footprint of the levee bank to be raised in height (such as through the use of retaining structures). Management measures to reduce the impact to these trees are provided in Table 4.1 and Table 4.2 of this report.



Note: Indicative only. Subject to detailed design.

Figure 3.22 Revised tree impacts resulting from the modified Alison Road alignment and relocated Royal Randwick Racecourse stop location

Where the loss of trees is unable to be mitigated through the measures outlined in Table 4.1 and Table 4.2, Transport for NSW would replace trees removed as a result of the CSELR Project, in accordance with the Transport for NSW '*Vegetation Offset Guide*' (Transport for NSW, 2013d). This includes a principle of replacing 'the amenity/visual landscape value of vegetation removed' even if the vegetation may not have significant ecological value (refer to management measure T.3 in Table 4.3). Trees would be replaced at a ratio of between 2:1 and 8:1, in consultation with Randwick City Council and depending on the size of the tree to be removed. Selection of tree species, size and planting locations would be undertaken in close consultation with Randwick City Council. Vegetation offset would also be undertaken in accordance with the Revegetation Compensation Package to be prepared for the project as outlined in condition of approval B52.

Alignment along Alison Road (east of Darley Road)

The modified Alison Road alignment east of Darley Road would be consistent with the approved alignment along this section of Alison Road (as described in the CSELR Project Submissions Report, Transport for NSW, 2014). No change in the proposed tree impacts identified in the CSELR Project Submissions Report would occur as a result of the proposed modification.

Property and land use impacts

The modified design would result in a decrease to the land use and property impacts on the Royal Randwick Racecourse site as the modified design would no longer impact the bus set down and entrance area which was proposed as part of the approved project.

The proposed modifications would not result in a considerable change to the existing land use or additional property impacts. The area of land that would be impacted currently consists of grassed open space adjacent to the Centennial Park ponds which forms part of the existing levee bank for the Centennial Parklands and contains a shared pedestrian and bike path. The modified design would result in a slight change in land use adjacent to the path and existing levee as a result of additional land take for the realigned light rail, however the remaining land use would be consistent with the existing use as a levee. The location of the impact on the edge of the parkland would not result in any severance of the parklands.

With respect to land use integration and amenity, the revised location of the Royal Randwick Racecourse stop would be slightly more visually prominent due to the loss of open space at the revised stop location. However, the amenity impacts of this stop would be reduced through proposed landscaping surrounding the stop and integration with the Centennial Park and Moore Park Trusts plans for this precinct.

The proposed modification would result in some impacts to the parklands, as the modification seeks to take advantage of the existing flood detention that the parkland ponds currently provide. During flood events, the ponds may increase in extent (to accommodate the additional flood water), which may result in temporary adverse impacts on areas of the existing Centennial Parklands to the north of the current northern boundary of the ponds. Further modelling will be undertaken during detailed design of the levee works which will confirm the predicted extent of the area affected. Outside of flooding events, the impact of the proposed modification is expected to be minimal.

Noise impacts

Construction assessment

Along Alison Road, east of Darley Road, the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013) identified that the predicted noise impacts during worst-case construction activities are predicted to be in the 'Highly Intrusive' range. As the proposed alignment to the east of Darley Road would not change in comparison to the approved project, the noise impacts for the proposed modification would still be 'Highly Intrusive'.

Some additional construction impacts are however likely to occur to users of the Centennial Parklands due to the closer location of construction works to the north of Alison Road. These impacts would be temporary and limited to the construction of the light rail alignment, stop and increase to the existing levee in this area.

Consistent with the approved project, noise vibration mitigation measures would include careful equipment selection and scheduling noise intensive work to less sensitive periods as much as possible (refer to Table 4.2 of this report). The mitigation measures would be confirmed during the preparation of a Construction Noise and Vibration Management Plan for the proposed works, during the detailed design when the construction method and equipment is confirmed.

Operational assessment

In relation to operational noise, the proposed alignment to the east of Darley Road would not change in comparison to the approved project. The noise impacts for the proposed modification would therefore be consistent with the approved noise levels (as assessed for the approved project (Transport for NSW, 2013)). However, some minor adverse amenity impact may be experienced by some Centennial Park users as a result of the closer light rail alignment.

Aboriginal and non-Indigenous heritage impacts

Built heritage/landscape

As part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013), a number of heritage items were identified adjacent to or within the vicinity of the alignment along Alison Road and within the vicinity of the Royal Randwick Racecourse stop. An assessment of the changes in impacts to the key heritage items adjacent to the proposed modification are discussed below.

Centennial Park, Moore Park, Queens Park (SHR listing No. 01384)

The new alignment would require the removal of trees located on the boundary of Alison Road and Centennial Park. The alignment would also impact a path/bike way running alongside the boundary with the State Heritage Register (SHR) listed park and the Alison Road corridor. Although this element is not included within the SHR listing for the site, it is part of the accessibility of the Centennial Park, and its removal would result in the loss of some publicly accessible open space (approximately 0.5 hectares).

The removal of trees and construction of light rail along the Alison Road boundary would have a minor visual impact on the park, as the existing levee currently blocks the visual connection between the heritage item and Alison Road. Whilst these trees are not listed as part of the heritage item, they are considered to contribute to the overall aesthetic of Centennial Park.

The proposed modifications to the existing levee would constitute a minor impact on the heritage conservation area. The raising of the existing levee would have a neutral visual impact. Minor negative impacts may arise from a loss of access to the area during construction works, although these would be temporary.

The proposed design modifications would, overall, result in minor impacts to Centennial Park.

Racecourse Precinct Heritage Conservation Area

The proposed modifications to the Alison Road light rail alignment place it largely outside the curtilage of the locally significant Racecourse Precinct Heritage Conservation Area (Randwick Local Environmental Plan (RLEP), 2012), with the exception of construction of the tracks leading into the Randwick stabling facility. The modified design therefore reduces physical impact to the heritage item, including the removal of the need to demolish the Swab building. The works would continue to involve some impact on the aesthetic values of the racecourse precinct, primarily arising from the loss of vegetation and large trees on the northern side of Alison Road, as well as the light rail line itself. However, as the alignment has been moved further north and east, towards Centennial Park and away from the Racecourse itself, these impacts are reduced.

The proposed modifications to the existing levee would constitute a minor impact on the heritage conservation area. The raising of the existing levee would have a neutral visual impact on the conservation area.

Overall, the modified design would have less impact on the Randwick Precinct Heritage Conservation Area than that assessed in the approved project. The modified design would have a minor impact on the precinct.

Historical archaeology

The proposed modification to the Alison Road alignment, the stop location for Royal Randwick Racecourse stop and the increased height for the levee would fall within the Royal Randwick Racecourse HAMU and Zone 2 archaeological management zone (locally significant archaeological resource – known or potential) identified as part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013).

With respect to the impacts resulting from the modified alignment, revised stop location and levee works, the proposed modification would continue to impact the same HAMU and archaeological management zone (to the north and east of the approved alignment). Overall, it is assessed that these components of the proposed modification would result in minimal changes to the impacts to archaeological heritage that were previously identified for the approved project.

The CSELR Project EIS (Volume 1B) (Transport for NSW, 2013), recommended a number of management measures within the Zone 2 Royal Randwick Racecourse HAMU. The management measures identified (refer to Table 4.2 of this report) would continue to be applicable including undertaking a program of archaeological monitoring, although at a potentially reduced scale. Excavation for the construction of the track slab, stop shelter and associated stop infrastructure for the Royal Randwick Racecourse stop may require expansion into open area archaeological excavation.

Aboriginal heritage

The alignment along Alison Road was designated as both Zone 1 (potential for Aboriginal objects to be found and/or impacted for any excavation impacts up to and over 750 millimetres in depth) and Zone 2 in areas of the precinct identified as the locations of additional facilities such as laydown areas, plant and equipment storage and construction depot (Transport for NSW, 2013).

The modified alignment would relocate the proposed works to the north and east of the approved alignment. As subsurface impacts greater than 750 millimetres in depth are now proposed for those areas originally classified as Zone 2 (due to the proposed excavation of the existing levee for the revised track level/alignment), the modified design in this area would be required to be managed under the higher impact potential Zone 1 classification.

As the modified design is in an area that would have been subject to fewer disturbances (closer to Centennial Park), mitigation of these works would involve additional Aboriginal archaeological investigation, most likely archaeological testing, in accordance with OEH guidelines to mitigate potential impacts on Aboriginal objects.

Overall, the management and mitigation measures for managing impacts to the Zone 1 Aboriginal archaeological potential management zone presented in the CSELR EIS (Volume 1B) (Transport for NSW, 2013) would be implemented as part of the modified design (refer to Table 4.2). Testing may not be required in those areas where the light rail would be constructed on the upper slope of the modified Centennial Park levee (i.e. north of Alison Road between the intersections with Doncaster Avenue and Darley Road), as these works are unlikely to impact on unmodified or natural deposits (subject to detailed design of this alignment).

Surface water impacts

The proposed modification would affect two surface water catchments (identified in Section 10.2 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013)) being the Coogee catchment (defined as being from the corner of Anzac Parade and Alison Road to the Randwick stop) and the Randwick catchment (defined as being from the corner of Anzac Parade and Alison Road to the Kingsford stop) with the primary receiving environments for these catchments being Coogee Bay and Centennial Park.

With respect to potential flooding and drainage impacts associated with the approved project, the CSELR Project EIS noted that there are known flooding issues for a number of sections along the approved alignment, including sections of Alison Road, with flood depths of between 0.5 to 1.0 metres (5 year ARI) and 1.0 to 1.5 metres (100 year ARI) identified.

Construction assessment

The proposed modification would result in the need for additional construction works along this section of the approved alignment (predominantly earthworks to construct the higher levee bank). Water entering this additional construction area or falling directly into the construction area has the potential to cause some minor additional localised flooding issues.

The potential for additional minor impacts would be managed in accordance with the management and mitigation measures previously established within section 10.2.4 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013). With appropriate management (refer to Table 4.2 of this report), construction phase stormwater flows from the proposed

modification would not result in additional flow velocities or volumes. Consequently, no impact on the downstream drainage network is expected.

Operational assessment

With respect to operational flooding and drainage impacts resulting from the proposal, section 10.2.2 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013) noted the results of the *Centennial Park Flood Study* (WMA Water, 2013). The results showed that the location of the Randwick stabling facility is inundated in the one in five year average recurrence interval (ARI) flood event and all events beyond this. The depth of flooding across the site was identified as up to 200 millimetres in the one in five ARI flood event (based on existing ground levels).

The proposed increase in the existing levee bank would increase the flood water detention within the Centennial Parklands (in particular the Centennial Park ponds area) during operation of the light rail. As discussed in section 3.7.2, the proposed raising of the existing levee bank adjacent to the southern end of Centennial Park would provide increased flood protection for up to the 1 in 100 year flood event. This would provide an improved operational reliability for the light rail (in particular the operation of the Randwick stabling facility) in addition to wider benefits to the local road network and residential properties within the vicinity of the stabling facility.

Further design development would continue to be undertaken (including further modelling) to determine the potential flood impacts within the Centennial and Moore Park Trust lands. Detailed design of the proposed flood mitigation works would be taken to safeguard recreational areas from potential flooding impacts as far as practicable to maintain usability of these areas. Any flood mitigation works undertaken would not result in any flood inundation of private properties in Martin Road.

Changes to the extent of inundation also have the potential to extend the zone of water dependant vegetation around the ponds. This has the potential to lead to minor changes to the composition and potential increase in cover of vegetation communities in this area.
The hydrological impact as a result of the modified flood mitigation would be determined during the ongoing detailed design of the additional flood mitigation works proposed as part of this modification.

Flood mitigation works would continue to be undertaken in accordance with the requirements of condition of approval B65 regarding flooding.

3.8 Realignment of light rail track at the Anzac Parade/ Alison Road intersection

3.8.1 Description of the approved project

As described in Section 5.2.1 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013), the alignment of the light rail track branched into the two separate lines to Randwick and Kensington and Kingsford at the Anzac Parade/Alison Road intersection.

Travelling south from the Moore Park stop, the light rail alignment continued adjacent to the existing busway. As part of the approved project, the light rail alignments began to branch into their separate alignments approximately 100 metres to the south of Robertson Road. From this point, the approved alignment for the Randwick branch line was slight skewed to allow for a safe crossing point between the busway and the alignment of the Kingsford branch line.

For the Kingsford branch line the alignment crossed through the Anzac Parade/Alison Road intersection across Alison Road to the eastern side of Anzac Parade centre line. The alignment then continued on the eastern side of Anzac Parade, through the western side of Tay Reserve. To the south of the intersection of Anzac Parade and Tay Street, the approved alignment moved to the centre of Anzac Parade, remaining as a centre running alignment to the Kingsford stop and interchange.

The Alison Road/Anzac Parade intersection is one of the major intersections along Anzac Parade and accommodates over 7,000 vehicle movements during the morning peak hour (7.45–8.45 am) (Transport for NSW, 2013). This intersection is located near to the Moore Park sports and entertainment complex and the Royal Randwick Racecourse, which regularly generate large crowds during weekends.

3.8.2 Description of the modified design

To accommodate proposed longer LRV lengths described in section 3.6 of this report, modification to the light rail alignment through the Anzac Parade/Alison Road intersection is required. Under the approved project, 67 metre LRVs heading south on the Kingsford branch line would potentially block LRVs on the Randwick branch line when stopped at the traffic signals. The modified alignment is would accommodate longer LRVs without interfering with LRVs travelling along the Randwick line and the overall performance of the intersection.

For the modified design, the light rail would branch into their separate alignments at Robertson Road. The Kingsford branch line would shift west into the centre of Anzac Parade, approximately 300 metres prior to the intersection of Anzac Parade and Alison Road. The Kingsford branch would then continue through the Anzac Parade/Alison Road intersection as a centre running alignment along Anzac Parade (refer to Figure 3.23). The modified design would result in benefits to the approved project including removal of the proposed impact to Tay Reserve and improved light rail operations through the Anzac Parade/Alison Road intersection.

The operational improvements resulting from the proposed modification would include:

- where an LRV heading towards Kingsford (southbound) is stopped on the northern side of the intersection (as part of the traffic signal phasing) the modified alignment would not block/prevent an LRV heading towards Randwick which had the potential occur as part of the approved project design
- the modified intersection provides for improved right hand turning (by motorists) from Alison Road into Anzac Parade and improved left hand turning from Anzac Parade into Alison Road.

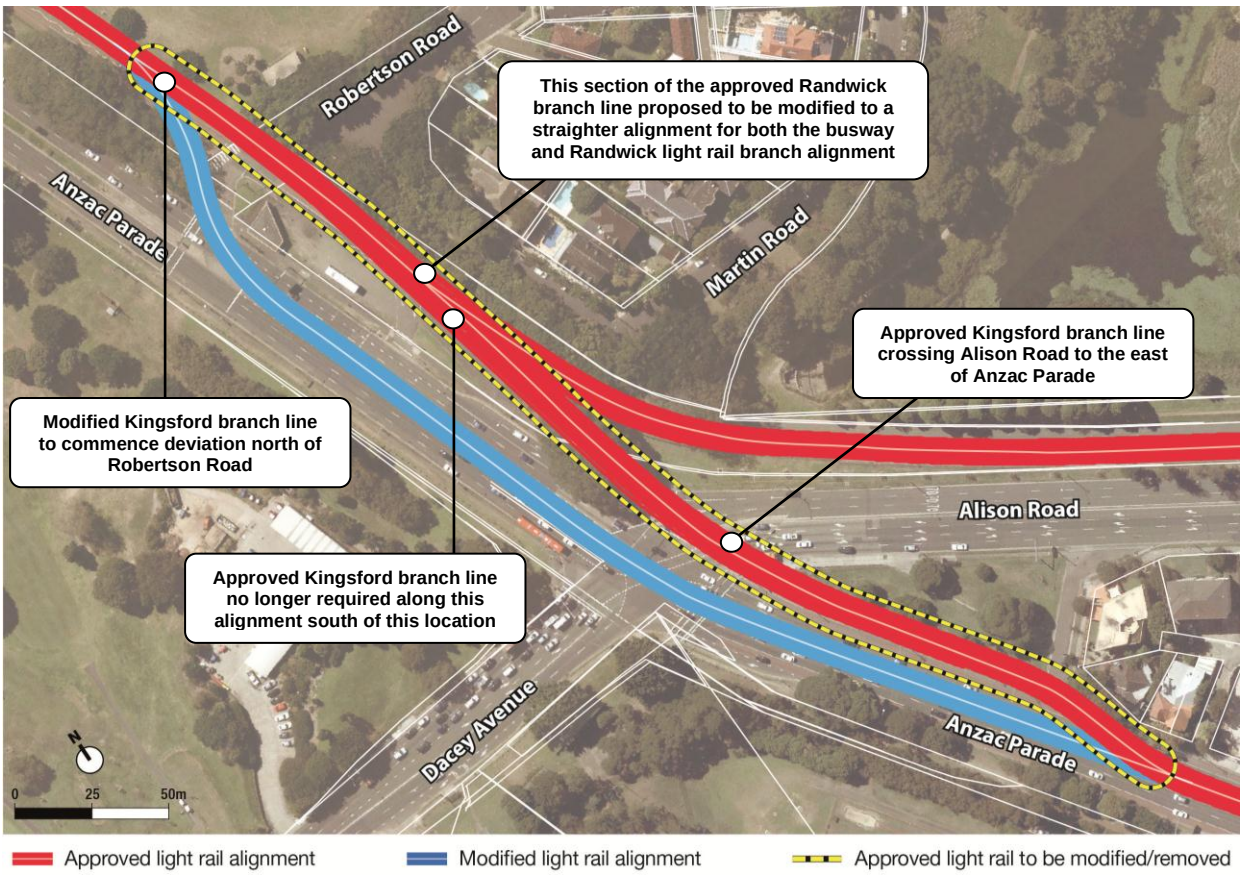
The revised alignment would require reconfiguration of the southbound traffic lanes along Anzac Parade to the north of the intersection. These modified lane configurations would be as follows:

- two left hand (eastbound) turning lanes onto Alison Road would be provided (as per the approved project)
- two southbound traffic lanes along Anzac Parade would be provided on the eastern side of the modified light rail alignment
- two right hand (westbound) turning lanes onto Dacey Avenue would be provided on the western side of the modified light rail alignment.

The alignment of the Randwick branch and adjacent busway (prior to the proposed shared running adjacent to Martin Road) would retain a similar alignment as part of the proposed

modification. The approved Randwick branch provided for a skewed alignment at this location to allow for a safe crossing point between the busway and the approved alignment of the Kingsford branch. As the crossing of the busway and the Kingsford branch line would now occur further to the north, there is no longer a requirement to skew the alignment of the busway and Randwick branch. The two left hand turning lanes will be accommodated in the road reserve adjacent to the busway.

The straightened alignment for the busway and Randwick branch would occur between Robertson Road and Martin Road, resulting in the alignment being slightly closer to Martin Road. The alignment of the shared running alignment between Anzac Parade and Tay Street (to the south-east) would not be changed as a result of the proposed modification. An indicative layout of the modified light rail alignment at the Anzac Parade/Alison Road intersection is shown in Figure 3.23.



Note: Indicative only. Subject to detailed design.

Figure 3.23 Proposed light rail alignment at the Anzac Parade/Alison Road intersection

3.8.3 Change in impact

Traffic and transport impacts

Construction assessment

Construction works at the Alison Road/Anzac Parade intersection would be staged to minimise the overall traffic and transport impact. Given that the modified light rail alignment travels through the centre of the intersection, the works are proposed to be conducted using three key traffic management stages during nights and weekends and with the following minimum requirements. These stages would include:

- at least one lane would be available for turning movements during off peak periods, except for the right turn from Alison Road to Anzac Parade (northbound) which would maintain two lanes
- all approaches to the intersection would have a minimum of two through lanes.
- construction works would not be undertaken during special/major events at Royal Randwick racecourse and the Moore Park precinct.

In addition to the above, appropriate temporary roadway geometry would be provided for buses and heavy vehicles where required. With consideration of the above, the construction impacts are expected to be similar to those presented in the CSELR Project EIS.

Operational assessment

Traffic impacts

Traffic modelling was undertaken by Parsons Brinckerhoff for the proposed changes to the approved project (including the proposed longer LRVs – refer to section 3.6). This modelling indicates that the Alison Road/Anzac Parade intersection would operate at an improved level of service (from LoS F to LoS C using 2013 traffic volumes) for general traffic during both the morning and afternoon/evening peak periods when compared to the approved project.

Northbound light rail vehicles approaching from Kingsford could experience minor delays associated with an increased likelihood of stopping at both the Alison Road/Anzac Parade intersection and the Anzac Parade/Robertson Road intersection. Detailed modelling indicates that further refinement during detailed design will be possible to optimise the light rail operation through this intersections whilst maintaining an improved traffic outcome compared to the approved project (LoS D against LoS F).

In summary, the modelling results for the modified intersection layout indicate that the Alison Road/Anzac Parade intersection would operate at a level of service no worse than the existing situation in the opening year.

Pedestrian impacts

The signal phasing at the intersection of Alison Road and Anzac Parade will retain existing pedestrian signal arrangements. As a result the pedestrian amenity at this intersection will not be affected. At Robertson Road, it is likely that the traffic signals at this location would need to be double cycled to allow for light rail priority. As a result the pedestrian amenity at this location would actually improve as pedestrians would have two opportunities to cross Anzac Parade each cycle.

Visual and landscape character impacts

As described in Section 16.7.5 of the CSELR Project EIS (Volume 2) (Transport for NSW, 2013), the approved project would result in minor adverse landscape impact at the Alison Road and Anzac Parade intersection. This was due to the proposed reduction in the overall size of Tay Reserve, the diminishment of amenity that the reserve currently provides to the area at the point where the light rail alignment was proposed to impact on the western side of the existing parkland. The approved alignment was also identified as requiring the removal of approximately five trees from Tay Reserve (refer to the planted tree impacts identified below).

As described above, the modified alignment would cross through the intersection of Anzac Parade and Alison Road/Dacey Avenue as a centre-running alignment and would no longer impact on Tay Reserve. The modified alignment would therefore provide an overall improvement to the local landscape at this location, in particular the retention of the visual character of Tay Reserve.

The proposed straightening of the alignment of the busway and Randwick branch line between Robertson Road and Martin Road would potentially impact up to four mature trees along Martin Road. This change would have an adverse impact upon the landscape and visual character of existing residential properties on Martin Road adjacent to the proposed light rail alignment. The impact would be associated with the removal of these trees and the loss of visual screening that they currently provide, resulting in a noticeable change.

Whilst the proposed modification would result in some adverse visual and landscape impacts due to the potential loss of trees adjacent to Martin Road, the reduced impact to Tay Reserve would provide a significant visual benefit for this intersection and for the local residents who utilise the open space of Tay Reserve. The proposed modification is therefore assessed to result in an overall improvement in visual impact for the intersection and result in an adverse impact to the adjoining area to the north (Martin Road).

Planted tree impacts

Section 16.6.1 of the CSELR Project EIS (Volume 2) (Transport for NSW, 2013) identified that Tay Reserve contains approximately 10 trees, which include one Kaffir-plum, four semi-mature Queensland Kauri trees and a large mature fig tree. The Kaffir-plum and semi-mature Queensland Kauri trees were noted as being in good condition, with the Kaffir-plum displaying a well formed healthy crown. The Queensland Kauri trees display characteristics typical of juvenile forms of this tree species. The large mature fig tree within the reserve is in good condition, displaying a structure and form typical of the species. This tree was also identified as providing a strong contribution to visual amenity of the locality.

The CSELR Project EIS (Volume 2) (Transport for NSW, 2013) also noted that the approved project would result in the removal of approximately seven trees at this intersection including two trees to the north of the intersection and five trees from the western side of Tay Reserve comprising the Kaffir-plum and four semi-mature Queensland Kauri trees (refer to Figure 3.24). The modified alignment would provide an overall reduction in the number trees impacted at this intersection, with all of the trees within the Tay Reserve being retained. This would provide an overall benefit for this intersection and for the local residents who utilise the open space of Tay Reserve.

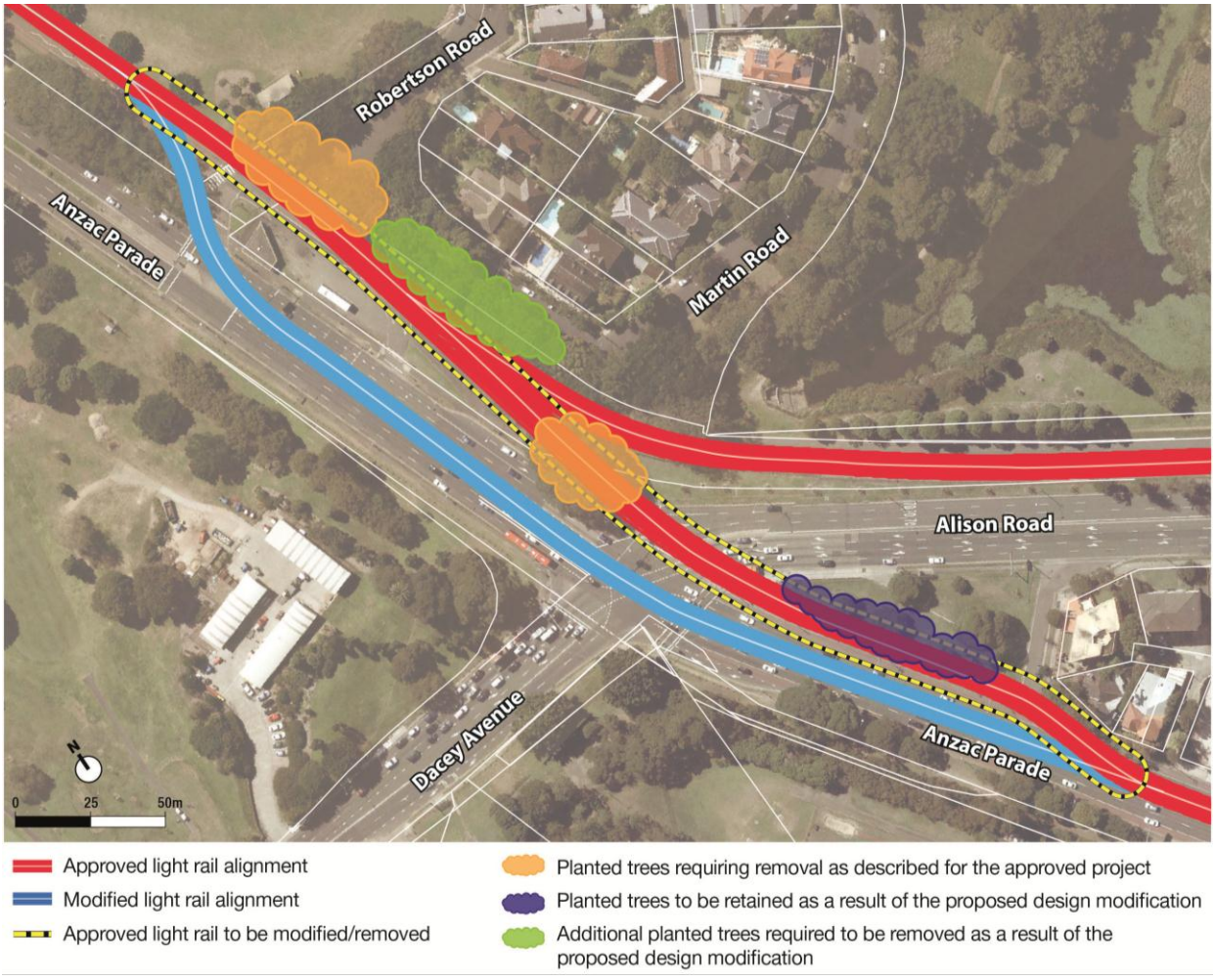
The existing trees between Anzac Parade and the slip lane into Alison Road would continue to be impacted as a result of the proposed modification. This would occur due to the revised lane configuration of Anzac Parade where the realigned eastbound slip lane into Alison Road would be constructed.

The proposed straightening of the alignment of the busway and Randwick branch line between Robertson Road and Martin Road potentially impact up to four mature trees along Martin Road (refer to Figure 3.24). As a result up to four additional mature trees and adjacent shrub planting in this location would be affected in comparison to the approved project. Transport for NSW will seek to reduce or avoid this impact through detailed design.

Potential measures to mitigate the potential impact associated with the existing trees along Martin Road would include replanting additional trees and shrubs outside of the potential impact zone of the light rail. Once established, this vegetation would provide some visual screening to the adjacent light rail alignment, bus way, and Anzac Parade roadway. Management measures to reduce the impact to these trees are provided in Table 4.1 and Table 4.2 of this report. Further detailed assessment of the existing tree root zones during the detailed design phase would be undertaken to determine potential impact to these trees with the aim of avoiding/retaining or minimising impacts to these trees (refer to management measure N.3).

Land use and property impacts

As described above, the proposed modification would result in the removal of impacts to Tay Reserve. This would provide an improvement to the ongoing use of this open space as part of the operation of the project in comparison to the approved project.



Note: Indicative only. Subject to detailed design.

Figure 3.24 Proposed tree impacts resulting from the proposed modification to the light rail alignment at the Anzac Parade/Alison Road intersection

Aboriginal and non-Indigenous heritage impacts

Section 16.8.1 of the CSELR Project EIS (Volume 2) (Transport for NSW, 2013) noted that the Tay Reserve is listed as an item of local heritage on the *Randwick Local Environmental Plan 2012* (Randwick LEP 2012). The CSELR Project EIS noted that Tay Reserve was formerly the site of the Randwick Toll Bar Cottage, demolished c1909. The reserve contains a number of significant trees that are linked to the site's former use. As part of the approved project, this heritage item was identified as being directly impacted by the alignment of the proposed tracks.

The modification of the proposed light rail tracks to a centre-running alignment through the Anzac Parade and Alison Road/Dacey Avenue intersection would remove the proposed impact on Tay Reserve, and would therefore no longer involve the need to impact on this local heritage item.

This section of the alignment is located within an area of Zone 2 Aboriginal archaeological potential. This represents an area where the upper geological levels likely to be disturbed and have nil–low Aboriginal archaeological potential for Aboriginal objects to be found and/or impacted. Due to the nature of local soils, deeper stratigraphic layers may be intact and still have Aboriginal archaeological potential.

The proposed modification would be undertaken within a similar footprint as the approved project, and would impact the same Aboriginal archaeological potential zone. Therefore, the existing impact assessment of this stop is considered to be unchanged. As such, the existing mitigation measures for this zone are considered to be appropriate to manage the proposed modification (refer to Table 4.1 and Table 4.2 of this report).

3.9 Third rail wire-free infrastructure within the CBD

3.9.1 Description of the approved project

As described in Section 5.2.6 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013) and required by the conditionals of approval, overhead wire-free operation was provided between the Circular Quay stop and the Town Hall stop, negating the need for overhead wires and poles for the power supply between these stops.

As part of the design of the overhead wire-free operation described as part of the approved CSELR Project, overhead charging units for part of the length of the platforms were necessary to charge any on-board LRV power storage at each stop within the wire-free zone in order to recharge the energy storage on-board the LRVs. The overhead charging units were located at the following stops:

- Circular Quay
- Grosvenor Street
- Wynyard
- Queen Victoria Building
- Town Hall (as part of the connection to the overhead wire (OHW) section of the project).

3.9.2 Description of the modified design

Following approval of the CSELR Project EIS, further consideration of the available technologies to provide wire-free running between the Circular Quay stop and Town Hall stop has resulted in the modification of the proposed power system to be provided as part of the project. The modified design for wire-free running between the Circular Quay stop and Town Hall stop would provide for a ground level power supply system, Alstom's Aesthetic Power Solution (APS).

The APS system consists of the provision of an electrical feeder 'rail' embedded within the track surface which provides the required power to an LRV. LRVs are continuously supplied with energy from the in-ground feeding rail. The APS has the appearance of a third rail in the centre of the two rails on which the vehicle's wheels sit (refer to Figure 3.25). As the APS system provides continuous power for LRVs along the light rail alignment, this system does not require the LRVs to have a battery or overhead charging units to be provided.

The proposed modification therefore removes the proposed overhead changing conductors at the following stops:

- Circular Quay
- Grosvenor Street
- Wynyard
- Queen Victoria Building.

The modified design would continue to require a transition between the OHWs and the APS at the Town Hall stop. At Town Hall, overlap of the OHW and APS would facilitate a transition from one system to the other. Transition between the below vehicle (APS) to above vehicle (OHW) power supply would occur within the Town Hall stop (as would have occurred as part of the approved project) where a stationary LRV would simultaneously lower the roof pantograph (connection between the LRV and OHW) and the underfloor connection point to the ground level power supply system (or reversing this procedure for outbound LRVs connecting to the OHW system).

This type of power supply represents proven technology and has been installed in a number of light rail systems within Europe, including Bordeaux and Nice, in order to minimise visual impacts and preserve the appearance of the historic cities. In addition to the aesthetic benefits, APS is also considered to be one of the most available transmission power supply technologies, reducing the impacts of poor weather on system performance and providing light rail customers with greater reliability.

The proposed modification is considered to be consistent with condition of approval B44 which requires wire-free operation between Circular Quay and the full extent of the pedestrianised zone along George Street. However, as part of the modification of the proposed wire-free infrastructure, condition of approval B44 is requested to be modified with the insertion of the following text after the existing text '…of the pedestrian zone along George Street…'

(except where transitioning between power supply sources)…

This modification is required to clarify the infrastructure required as part of the approved design to allow for the transition between wired and wire-free operations.

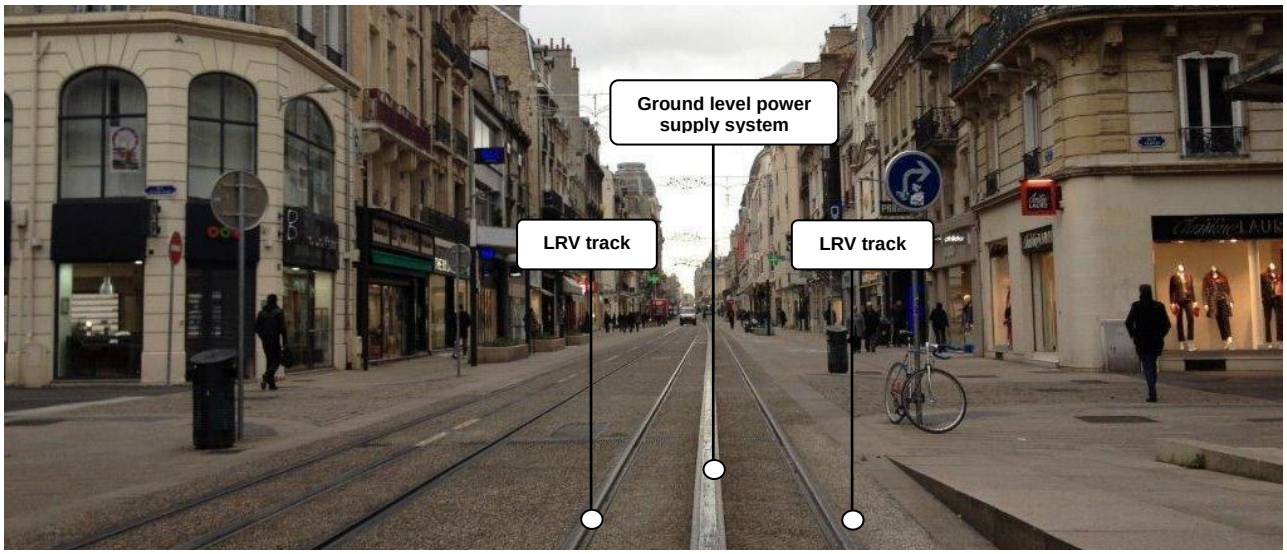


Figure 3.25 Example of a 'third rail' track power arrangement (Bordeaux)

3.9.3 Change in impact

Visual and landscape character impacts

Construction assessment

The proposed modification to the wire-free infrastructure is not expected to result in any changes to the visual impact of the approved project during construction.

Operational assessment

As described as part of the approved project, overhead charging units would be visible at each of the stops within the wire-free running sections of the CBD along George Street and Alfred Street. With the proposed modification, there would be a reduction in the visible infrastructure associated with each of the identified stops (Circular Quay; Grosvenor Street; Wynyard; and Queen Victoria Building stops) as a result of the removal of overhead wires running in-line with the stops and the removal of associated pole structures.

The removal of these poles and overhead wires would remove some of the visual elements at street level and reduce the overall visual impact of the stops. Within the pedestrianised section of George Street (i.e. at the Wynyard and Queen Victoria Building stops) this would result in a substantial improvement to the overall visual character of this zone.

It is considered that there would be an overall improvement to the amenity of views surrounding each of the identified stops for which the overhead charging units are proposed to be removed. Therefore, it is expected that there would be a moderate beneficial visual impact overall during the operation of the project. This represents an overall positive change from the visual impacts assessed as part of the approved project.

Aboriginal and Non-Indigenous heritage impacts

Built heritage/landscape

The removal of the approved overhead charging units would result in a decrease in new above ground infrastructure required to construct and operate the approved project, including the removal of catenary wires and supporting poles along George Street and Alfred Street. The removal of this infrastructure would result in minor beneficial impacts on the streetscape of George Street and Alfred Street and the various State and locally significant heritage items that define this corridor. These potential benefits would result from the cumulative reduction of light rail infrastructure in the public domain, reducing visual elements within the streetscape and opening up views of important heritage buildings.

Historical archaeology

The reduction in the approved overhead charging units would result in a minor decrease in the required ground disturbance within the George Street HAMU, the Alfred Street/Herald Square HAMU and the Tank Stream HAMU. These HAMUs have previously been defined as Zone 1 (Transport for NSW, 2013) which consists of a State significant archaeological resource (known or potential). The removal of the need to install additional support poles for the overhead charging units would slightly decrease the potential likelihood of adverse impacts on the historical archaeological resources in these HAMUs, due to reduced excavation requirements.

The proposed 'third rail' track power arrangement would be constructed within the same general rail track form base depth as the rail track slab and would not require additional excavation to that proposed as part of the approved project. It is therefore unlikely that any additional impacts to the identified HAMUs would occur as a result of the proposed modification.

Aboriginal heritage

The locations for the reduction in the approved overhead charging units are located within an area of Zone 3 Aboriginal archaeological potential, representing an area where Aboriginal archaeological evidence may be present, however, due to nature and extent of modern land use it is likely to be disturbed. The removal of the need to install additional support poles for the overhead charging units would slightly decrease the potential likelihood of adverse impacts on any potential Aboriginal archaeological resources which may be located within this zone.

Hazard and risk impacts

Use of the third rail APS would allow electrical pick-up to power the transmission of LRV only as the LRV is passing over it. Outside the presence of the LRV, the third rail 'track' is not a live power element in the system. The proposed design modification would therefore provide an improved outcome compared to the approved project.

Sustainability

The use of the third rail APS would potentially reduce the need for on-board power storage (batteries) and the subsequent disposal of these batteries once their operational life has expired.

3.10 Revised construction methodology for the tunnel under Anzac Parade

3.10.1 Description of the approved project

As described in Section 6.2.5 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013), two driven tunnel options (i.e. tunnelling options that would not directly impact the road surface of Anzac Parade) were identified for the proposed method of construction of the tunnel crossing of Anzac Parade. The preferred method of construction was proposed to be determined during detailed design. These alternative options are briefly described below.

Jack box option

This technique involved the construction of a pit with diaphragm walls on the west side of Anzac Parade, which would later be incorporated into the permanent tunnel structure. A reinforced concrete box would be cast inside the pit and progressively jacked forward and lengthened. Both tracks would be contained within a single jacked box. The base and walls of the box would be cast in situ, whereas the roof would be constructed with a precast structure. During jacking, canopy tubes would be advanced ahead of the excavation to assist with supporting the structure.

Canopy tube driven tunnel

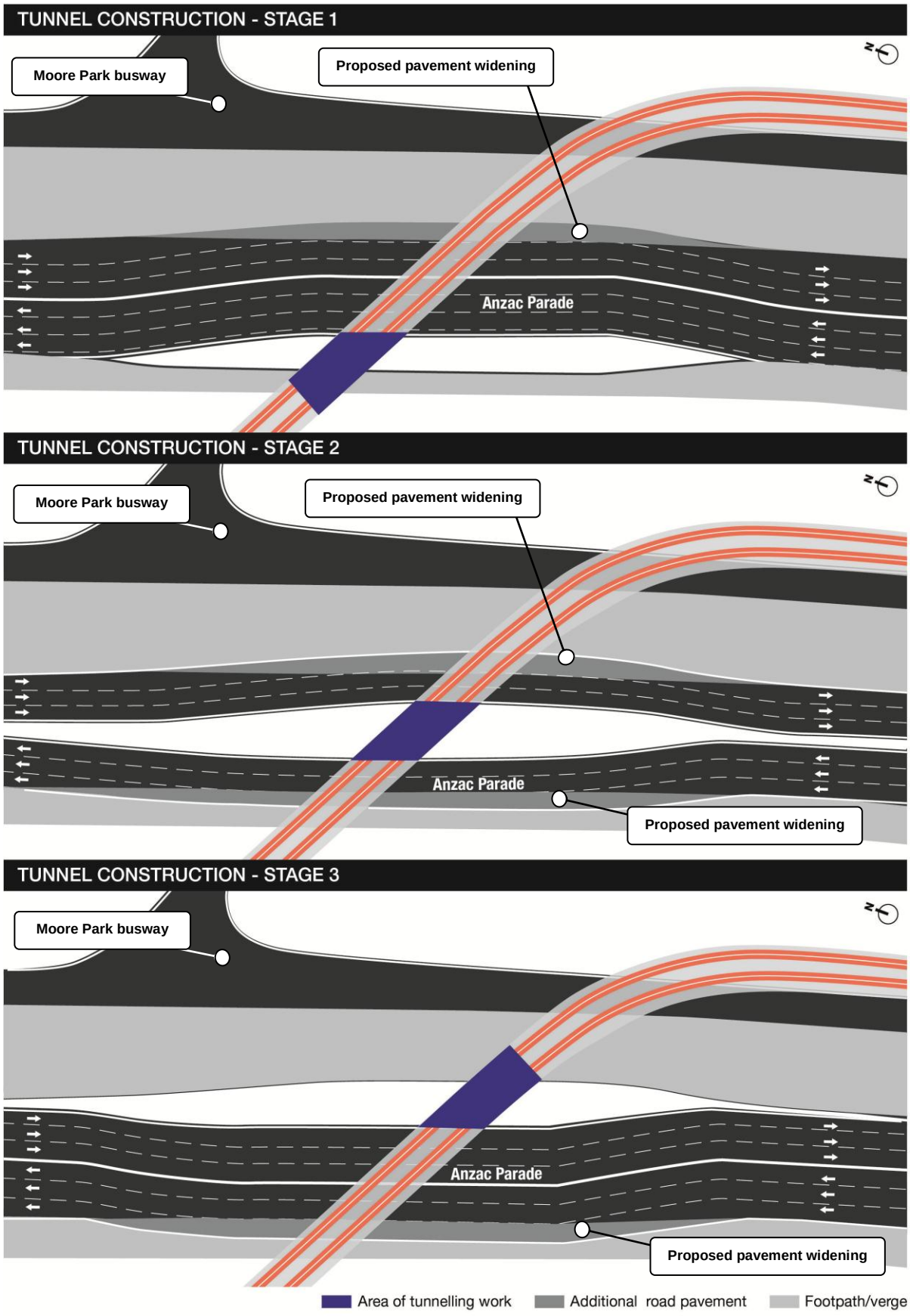
This option involved the construction of the twin rail tracks in two separate tunnels with a cover of approximately 6 metres (in order to limit settlement and ground support requirements). The approach and access to this tunnel section would require a deeper vertical alignment for the end of the cut-and-cover tunnel. In addition, the cut-and-cover tunnel would need to accommodate the widening in the overall width of the formation as it approaches the separate tunnel formation for each track in the driven tunnel section.

3.10.2 Description of the modified design

Ongoing development of the proposed construction method for the Moore Park tunnel, including the crossing of Anzac Parade has resulted in an alternative construction methodology. The revised methodology proposes to construct the crossing of Anzac Parade as a 'top-down', cut-and-cover-style tunnel. This uses a similar technique to that of the approved construction of the Moore Park tunnel through Moore Park West.

The tunnel crossing would be staged to maintain traffic capacity along Anzac Parade. This would require temporary realignment of Anzac Parade for approximately 100 metres either side of the tunnel crossing to enable the traffic to be adjusted as the tunnel advances across the roadway. This would be undertaken in three main stages (to enable three traffic lanes to be maintained in each direction for each stage of the tunnel construction). To maintain three lanes in each direction, temporary road pavement would be required to be constructed for the length of the diversions within the existing footpath areas on both the eastern and western sides of Anzac Parade. Following completion of the tunnel construction, the temporary pavement would be removed and the existing footpath and grassed verge reinstated.

An illustration of the indicative staging for the construction of the Anzac Parade tunnel and associated temporary traffic lanes is provided in Figure 3.26.



Note: Indicative only, not to scale. Subject to detailed design.

Figure 3.26 Proposed staging of the modified construction methodology for the Moore Park tunnel

The construction of the tunnel structure across Anzac Parade would comprise a combination of bored piled and sheet piled walls, with a cast in place roof slab. Once a section of roof slab has been completed, the pavement along Anzac Parade would be reinstated, any required traffic modifications would be undertaken, and the sequence would recommence for the next section of Anzac Parade. Once all lanes of Anzac Parade are crossed and the full capacity of the roadway has been reinstated, the spoil from inside the tunnel would be excavated from within and the floor slab of the tunnel cast in place.

Tunnel elements such as track elements, drainage and lighting would be installed as part of the overall construction of the Moore Park tunnel in accordance with the approved project.

Vertical alignment of the Moore Park tunnel

In addition to the change to the construction methodology for the tunnel, as part of the ongoing detailed design of the project, the vertical alignment of the tunnel would be raised by between approximately one and three metres. The refined design would avoid identified utilities in the vicinity of the tunnel and would assist in optimising the construction of the tunnel.

3.10.3 Change in impact

Traffic and transport impacts

Construction assessment

Traffic impacts

The revised top-down construction methodology would require temporary lane deviation (and associated pavement widening) along Anzac Parade to maintain the existing traffic operations. Three northbound lanes and three southbound lanes would be maintained as part of each stage of construction. The tunnel would be constructed over three stages, requiring the traffic lanes to be reconfigured for each stage, with one to two lanes provided in the existing road verge. Any changes in traffic arrangements and additional lane closures would be undertaken at night or during other lower traffic periods.

The adjacent 40 kilometre per hour School Zone speed limit would be maintained, with a 60 kilometre per hour Road Work speed limit to be implemented at all other times. In combination with peak period average travel speeds along the corridor, there would be a minor impact on travel times through the work site.

The proposed modification would also maintain access to the Sydney Boys High School (to the south of the proposed temporary pavement) throughout construction.

Bus network impacts

The modified construction methodology is not expected to have any additional impacts on the Moore Park busway. However, temporary bus stop relocations along Anzac Parade would be required as a result of the proposed lane deviations. Suitable alternate bus stops and associated facilities would be provided to mitigate any associated impacts. Construction activity at the Moore Park busway (the impacts of which are described in the CSELR Project EIS) would not commence until traffic diversions on Anzac Parade are complete, to reduce any associated impacts. Overall the duration of the impacts to the busway are expected to be reduced as a result of the modified construction method.

Pedestrian and cyclist impacts

Temporary footpaths would be provided to replace any sections displaced by the realigned Anzac Parade travel lanes or work site footprint. The proposed traffic management to be developed during detailed design would also consider appropriate cyclist provisions through and/or around the work site (refer to management measures in Table 4.1 of this report).

Operational assessment

The proposed modification to the construction methodology for the proposed tunnel under Anzac Parade would not result in any change to the operational impacts of the approved project.

Visual and landscape character impacts

Construction assessment

The proposed 'top down' construction methodology, would result in greater visual impacts during the construction stage. These visual impacts would be primarily contained within the Anzac Parade road corridor, and include the construction of temporary northbound and southbound carriageways within a widened zone of Anzac Parade on both sides of the roadway, and within the median of the road. In addition, there would be large construction machinery working closer to the roadway, as well as temporary hoarding and fencing around the construction zones. The overall effect would be an increase in visual impact during construction, resulting in a high, albeit temporary, adverse visual impact.

Operational assessment

The impacts of the modified design during operation, once construction has been completed, would be of very little perceived change. Once the 'top down' light rail tunnel has been completed under the roadway, those areas impacted by the construction, including the widening of the road on both sides and the removal of the median, would be made good and reinstated to their original state prior to construction. Therefore, the proposed modification to the construction methodology is assessed to result in a negligible visual impact overall once construction is completed and these impacts have been repaired.

Planted tree impacts

The modified design would have some additional tree impacts in comparison to the approved project which identified the removal of approximately nine trees on the eastern side of Anzac Parade and two trees on the western side of Anzac Parade. The modified construction methodology is assessed to require removal of up to four additional significant trees directly impacted on the western side of Anzac Parade compared with the approved project. In addition, the proposed temporary paving may result in potential impacts to the root zones of an additional five trees across both the eastern and western sides of Anzac Parade compared with the approved project (subject to a detailed arborist investigation of these trees during detailed design and construction of the tunnel). The proposed modification would however no longer impact on one previously impacted tree on the eastern side of Anzac Parade to the south of the proposed tunnel. Overall, the proposed modification would result in eight additional trees being impacted by the proposed crossing of Anzac Parade. The changes to potentially impacted trees as a result of the proposed modification are shown in Figure 3.27.

Note: Indicative only. Subject to detailed design.

Figure 3.27 Tree impacts resulting from the proposed modification to the Moore Park tunnel construction methodology

This impact is necessary to accommodate the construction of the tunnel and the temporary lane diversions (additional road pavement) required to maintain adequate traffic flow during construction. The removal of these additional trees would result in a change in the landscape character of this area, due to the significant size, maturity and heritage value of these trees.

Where the loss of trees cannot be avoided, Transport for NSW would replace trees removed as a result of the CSELR Project, in accordance with the Transport for NSW '*Vegetation Offset Guide*' (Transport for NSW, 2013d), which includes a principle of replacing 'the amenity/visual landscape value of vegetation removed' even if the vegetation may not have significant ecological value (refer to management measure T.3 in Table 4.3). Trees would be replaced at a ratio of between 2:1 and 8:1, in consultation with City of Sydney and depending on the size of the tree to be removed. Selection of tree species, size and planting locations would be undertaken in close consultation with City of Sydney. Vegetation offset would also be undertaken in accordance with the Revegetation Compensation Package to be prepared for the project as outlined in condition of approval B52.

Management measures to reduce the impact to these trees are provided in Table 4.1 and Table 4.2 of this report.

Noise impacts

With respect to the modified construction methodology, the majority of the proposed construction activities would be consistent with the assessment undertaken as part of the CSELR Project EIS (Transport for NSW, 2013). For the modified construction method, the potential noise impacts would depend on the proposed piling methods used during any given period during the construction of the tunnel.

For the proposed construction method involving bored piles, the potential impacts would be consistent with the assessment undertaken as part of the CSELR Project EIS, with levels likely to be below the Rating Background Levels (RBL) at the nearest sensitive receptors. For the proposed sections where sheet piling is proposed to be used, the potential noise impacts would be marginally higher than those identified in the CSELR Project EIS (Transport for NSW, 2013). For the proposed sheet piling works, the implementation of respite periods may be required to minimise the impacts at the nearby Sydney Boys and Sydney Girls high schools. In particular, these activities would be required to be scheduled outside of school examination periods in consultation with the Sydney Boys and Sydney Girls high schools.

Aboriginal and non-Indigenous heritage impacts

Built heritage/landscape

As part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013), three main heritage items and a heritage conservation area were identified within the vicinity of the proposed crossing under Anzac Parade. These items included the following:

- Sydney Boys High School (local heritage listed on the *Sydney Local Environmental Plan 2012* (Sydney LEP 2012*)*)
- Sydney Girls High School (local heritage listed on the Sydney LEP 2012)
- Centennial Park – Moore Park/Anzac Parade Significant Trees (local heritage listed on the *City of Sydney Register of Significant Trees 2013*)
- the Moore Park heritage conservation area (HCA) (local heritage listed on the Sydney LEP 2012).

The approved light rail alignment through this area was identified to have a moderate adverse impact on existing heritage items or conservation areas. This impact was, primarily due to the potential loss of the trees associated with the Centennial Park – Moore Park/Anzac Parade Significant Trees listing and the adverse impact to the overall visual and historic setting that this would create.

As identified above, the proposed 'top-down' technique would result in the loss of up to approximately four directly impacted additional trees and up to five to six additional trees whose root zones may potentially be impacted. This would result in an additional increase in the overall visual and historic adverse impact compared to the approved project.

Overall, it is assessed that the proposed modification to the construction methodology for the tunnel across Anzac Parade would result in minimal impacts to archaeological heritage. Management and mitigation measures for managing impacts to each of the identified heritage archaeological management zones were presented in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013). These management and mitigation measures would continue to be implemented as part of the modified construction methodology (refer to Table 4.1 and Table 4.2 of this report).

Historical archaeology

The proposed cut and cover tunnel for crossing Anzac Parade would fall within the Anzac Parade (Moore Park) HAMU, being within an archaeological management zone 2 (locally significant archaeological resource – known or potential). Works associated with the construction of the tunnel were previously assessed as part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013) as having a low to moderate adverse impact, with the potential for historical archaeological remains to be present including features indicating the early alignments/boundaries of Anzac Parade and Moore Park.

The proposed cut and cover tunnel would result in a similar level of ground disturbance as the approved project, albeit using a different construction methodology. Consequently, the modification would not have any additional adverse impacts on the potential historical archaeological resources that may be present at this location. This is consistent with the impact of the proposal as assessed as part of the approved project.

In accordance with the Zone 2 Moore Park HAMU recommendations of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013), a program of archaeological monitoring, with possible expansion into open area excavation, would be required for the Anzac Parade tunnel works (refer to Table 4.1 and Table 4.2 of this report).

Aboriginal heritage

The proposed cut and cover tunnel for crossing Anzac Parade was designated as a Zone 1 (Aboriginal archaeological potential for Aboriginal objects to be found and/or impacted and for any excavation impacts up to and over 750 millimetres in depth) Aboriginal archaeological management zone (Transport for NSW, 2013).

As the construction would be undertaken within the same footprint as the approved project, the existing impact assessment is considered to be largely unchanged. As such, mitigation of these works would involve Aboriginal archaeological investigation, most likely archaeological testing, in accordance with OEH guidelines to mitigate potential impacts on Aboriginal objects. Overall, the management and mitigation measures for managing impacts to the Zone 1 Aboriginal archaeological potential management zone presented in the CSELR Project EIS (Volume 1B)

(Transport for NSW, 2013) would be implemented as part of the modified design (refer to Table 4.2 of this report).

Groundwater impacts

Groundwater impacts resulting from the approved project were discussed in Section 10.4 of the CSELR Project EIS (Volume 1A) (Transport for NSW, 2013). The CSELR Project EIS noted that groundwater is likely to be encountered during the construction of the Moore Park tunnel. Dewatering would therefore be required as part of the construction of the tunnel. The level of dewatering required during the construction of the tunnel would be dependent on the final depth of excavation (to be determined during detailed design) and permeability of the aquifer and prevailing weather conditions during construction (i.e. the volume of rainfall recharging the aquifer).

The CSELR Project EIS noted that drawdown of the groundwater table would have the potential to lead to groundwater settlement. Dewatering was also identified as potentially resulting in an adverse impact to the Fig trees within the Moore Park playing fields and adjacent to Anzac Parade (without the implementation of adequate environmental management measures) due to the lowering of the water table.

The proposed top-down construction methodology for the tunnel would result in a similar level of ground disturbance as the approved project, albeit using a different construction methodology. In addition, the slight increase in the vertical height of the tunnel would mean that the tunnel would be slightly higher with respect to the existing level of the water table in this area. The new (vertical) alignment of the tunnel would therefore have the potential to have a lower impact ground water (as the tunnel would impact on less depth of the existing water table).

As noted in the CSELR Project EIS, groundwater encountered during the construction of the proposal would be managed in accordance with the requirements of the *Waste Classification Guidelines* (EPA 2014) and Transport for NSW's (2012) *Water Discharge and Re-use Guideline* (refer to Table 4.1 of this report).

3.11 Revised substation sites

3.11.1 Description of the approved project

Surry Hills substation

Section 6.14 of the CSELR Project Submissions Report (Transport for NSW 2014), identified that Surry Hills substation as an above ground substation located at the south-eastern corner of the restored Wimbo Park, near the intersection of Parkham Lane and Parkham Place (refer to Figure 3.28). Access to the substation would be via Parkham Street and Parkham Lane.

As part of the conditions of approval for the CSELR Project, the proposed Surry Hills substation in the new Wimbo Park was identified as being required to be constructed underground in consultation with the City of Sydney (condition of approval B12).

High Street substation

The CSELR Project EIS (Volume 1A) (Transport for NSW, 2013) identified that a substation was proposed to be located above ground within an area of land within the Royal Randwick Racecourse to the north of the intersection of High Street and Anzac Parade (High Street substation).

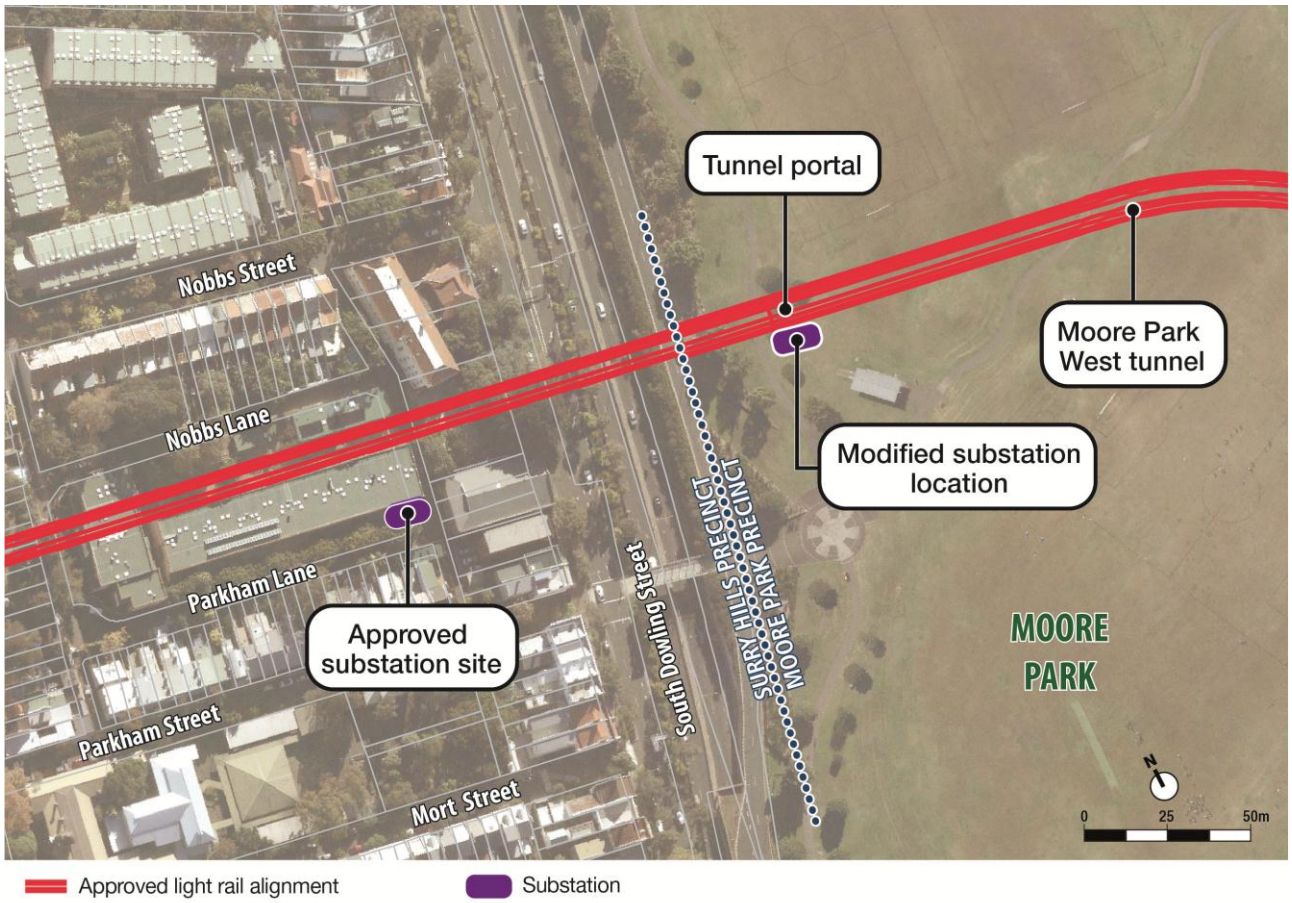
3.11.2 Description of the modified design

Surry Hills substation

Following approval of the project, the proposed location of the Surry Hills substation has been refined as part of the ongoing development of the project design to identify opportunities for reduced visual impacts.

As a result of design refinement, the location of the Surry Hills substation is proposed to be relocated underground, within the western portal of the Moore Park tunnel. The substation would be incorporated into the tunnel portal. Access to the substation would be provided by doors from within the entrance to the Moore Park tunnel.

The location of the approved substation and proposed modified location are shown in Figure 3.28.



Note: Indicative only. Subject to detailed design.

Figure 3.28 Proposed modification to the Surry Hills substation location

High Street substation

The approved High Street substation is no longer considered to be required in order to provide the required power supply for the operation of the light rail network. This substation is therefore proposed to be removed as part of the construction and operation of the project.

3.11.3 Change in impact

Visual and landscape character impacts

The proposed Surry Hills substation would be relocated from Parkham Lane, Surry Hills to an underground location within the western portal of the Moore Park light rail tunnel. As the substation would be located below ground, it would be screened from any surrounding views. The revised location of the substation would therefore have no operational visual and landscape impact. This is also consistent with the project condition of approval (B12) which required that this substation be located below ground.

Planted tree impacts

The proposed modification would not result in the loss of any additional trees beyond those that were identified for removal as part of the approved project associated with the tunnel construction.

Property and land use impacts

The revised location of the substation would therefore have a negligible impact on the ongoing use of the land during the operation of the project.

Noise impacts

Construction noise impacts

A qualitative construction noise assessment of the potential impacts of the location of the approved substations at Surry Hills was previously undertaken as part of the approved project. This considered the potential impacts of the proposed substation for daytime, evening and night-time periods relative to the background noise levels in each area during each period.

The results of this assessment were presented as part of the approved project in Section 6.14.3 of the CSELR Project Submissions Report (Transport for NSW, 2014) and Technical Paper 11 (*Noise and Vibration Impact Assessment*) in Volume 6 of the CSELR Project EIS (Transport for NSW, 2013c). This assessment identified the construction of the substations as being between 'moderately intrusive' and 'highly intrusive' for activities such as excavation, foundation preparation and delivery and placement of the substation (for its construction in its approved location).

For the revised location of the Surry Hills substation, the potential impacts would be reduced compared with the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013). As the substation would now be constructed as part of the overall construction of the Moore Park West, the construction impacts of the substation would be significantly reduced in comparison to the assessed noise impacts associated with the construction of the tunnel.

Operational noise impacts

As the proposed substation would be located underground, operational noise is predicted to be well below the recommended noise limits at the nearest sensitive receptors. This is consistent with the project condition of approval (B12) which required that this substation be located below ground to minimise noise impacts.

Aboriginal and non-Indigenous heritage impacts

Built heritage/landscape

Section 6.14.3 of the CSELR Project Submissions Report (Transport for NSW, 2014), noted that the approved location of the Surry Hills substation would be located within the Bourke Street South Heritage Conservation Area. In addition, it was noted that whilst the proposed substation would be an above-ground element in the proposed new Wimbo Park, it would be considerably smaller than the present Olivia Gardens apartments (which is proposed to be demolished as part of the approved project) and would not be a major new element in the conservation area.

Taking into account the requirements of the conditions of approval (condition of approval B12), the modified location of the Surry Hills substation would be underground adjacent to the western end of the Moore Park west tunnel. The revised location would result in a noticeable improvement and would remove any potential impacts on the Heritage Conservation Area that this infrastructure element would have had as part of the approved project design.

Historical archaeology

The location of the revised substation site would fall within the Moore Park West HAMU (Zone 2 – Locally Significant Historical Archaeological Resource) identified as part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013).

Whilst the proposed modification would result in a change from a Zone 3 (No Historical Archaeological Resource Present) to a Zone 2 location, the proposed substation would be located adjacent to the western end of the approved Moore Park West tunnel portal. This location would be subject to substantial ground impacts (during the construction of the tunnel portal). As such, the overall potential impacts of the relocated substation are considered to be negligible with respect to impacts to archaeological heritage.

Management and mitigation measures for managing impacts to each of the identified heritage archaeological management zones were presented in the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013). These management and mitigation measures would continue to be implemented as part of the modified location for the substation (refer to Table 4.1 and Table 4.2 of this report).

Aboriginal heritage

The approved location of the Surry Hills substation site within the Olivia Gardens construction site was previously defined as Zone 4 (No potential archaeological potential) in the CSELR Project Submissions Report (Transport for NSW, 2014) and was therefore would not impact on Aboriginal archaeology.

The revised location of the Surry Hills substation is located within an area identified as Zone 1 (Aboriginal archaeological potential for Aboriginal objects to be found and/or impacted). As the assessment for the substation is now within an area of Zone 1 classification, the mitigation measures that were identified for this zone (as part of the CSELR Project EIS (Volume 1B) (Transport for NSW, 2013)) would now to apply as part of the modified substation location (refer to Table 4.2 of this report).

3.12 Height increase to the Randwick stabling facility

3.12.1 Description of the approved project

Section 5.2.10 of the CSELR Project EIS (Volume 1A) (Transport for NSW 2013), provided a description of the proposed Randwick stabling facility. As described in the CSELR Project EIS, the Randwick stabling facility is to be used for the following activities:

- to temporarily store or retain LRVs overnight
- for LRV inspection and cleaning (including wash plant)
- for light maintenance or repair work, including vehicle sanding (topping up the sand boxes within the LRVs for use on wet/slippery tracks).

Subsequent to the CSELR Project EIS, the Minister for Planning's approval included a condition (B36(e)), which required the following with respect to the proposed Randwick stabling facility:

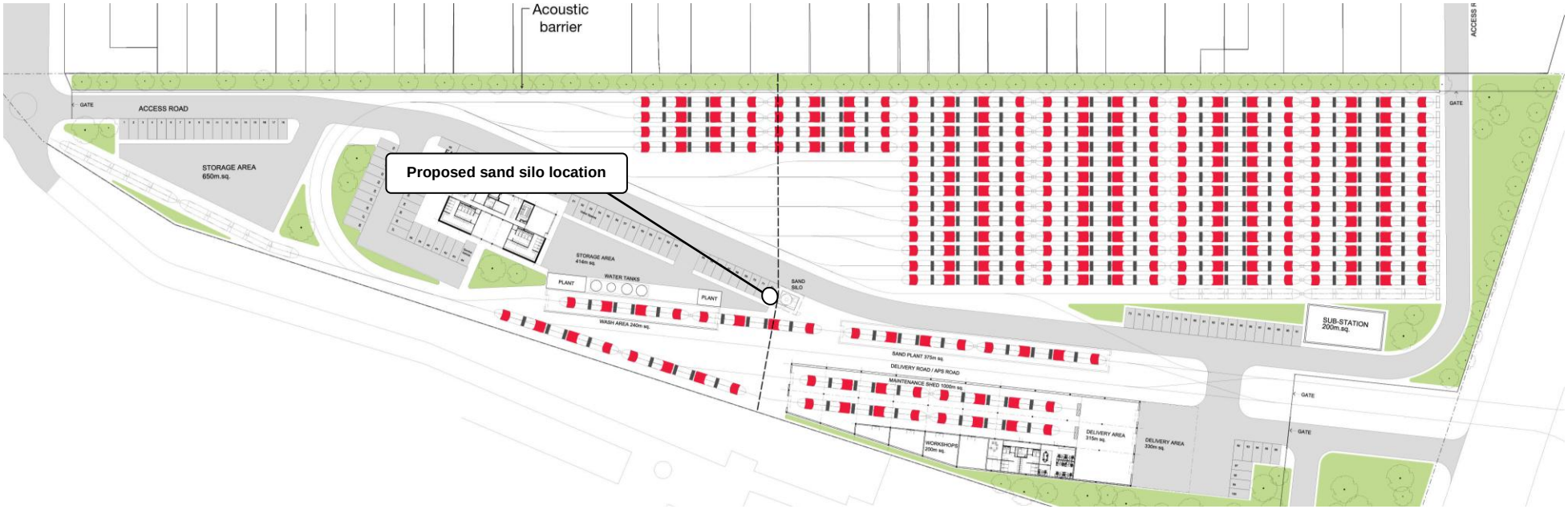
> *(e) The maximum height of any buildings or structures required as part of the stabling facility is 10.5 metres above ground level (existing).*

In addition, in order to mitigate potential flooding impacts, the approved project proposed to raise the existing ground level of the Randwick stabling facility by approximately two metres above existing ground level.

3.12.2 Description of the modified design

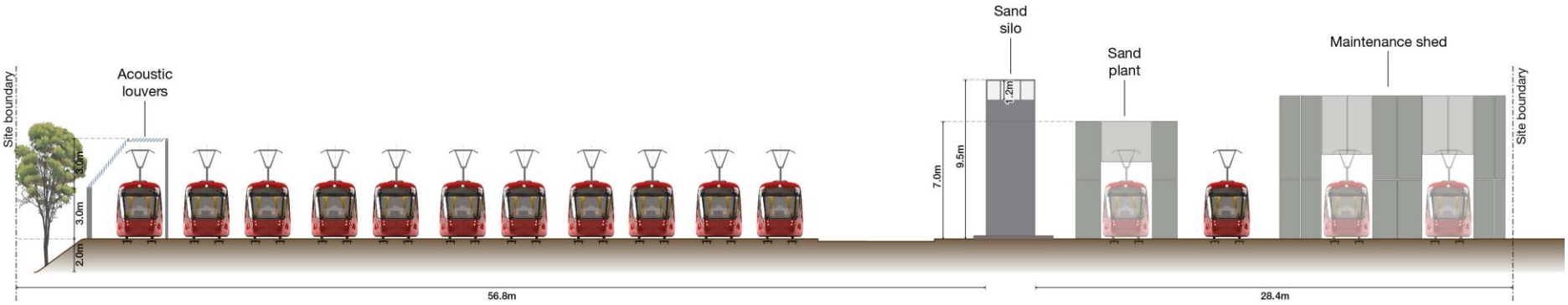
Ongoing refinement and development of the approved project has identified that up to two metres of ground fill will be required across the site to achieve the final ground levels. The final ground levels are necessary to maintain a finished ground level contiguous to Alison Road as vehicles enter and exit the stabling yard during operation. This arises from the types of maintenance activities taking place within the yard that require a level track surface. As a result the proposed sand silo (used for topping up the sand boxes within the LRVs for use on wet/slippery tracks) would extend beyond the permitted 10.5 metre height limit.

The proposed sand silo for the Randwick stabling facility is proposed to consist of a single silo stack, approximately 3.5 metres by 2.9 metres in width, with a height above the finished ground level of the site of approximately 9.5 metres. This silo will be located in a central area of the site, approximately 30 metres away from the site perimeter with the Royal Randwick Racecourse and approximately 50 metres away from the site perimeter with the residential area to the west. Taking into account the proposed fill to be provided on the site, this would result in a total height of this structure being approximately 11.5 metres above the existing ground level. This would represent an exceedance of the existing control limit identified in the conditions of approval by approximately one metre for this structure. A plan of the Randwick stabling facility is provided as Figure 3.29 and an indicative elevation of the proposed sand silo within the stabling facility is provided as Figure 3.30.



Note: Indicative only. Subject to detailed design.

Figure 3.29 Plan of the proposed Randwick stabling facility identifying the location of the proposed sand silo



Note: Indicative only. Subject to detailed design.

Figure 3.30 Indicative elevation of the proposed Randwick stabling facility identifying the location of the proposed sand silo and proposed heights

3.12.3 Change in impact

Visual and landscape character impacts

The inclusion of a taller sand silo structure would have little perceived change, due to its location in the centre of the stabling site, and its position away from the residential properties along the northern site boundary on Doncaster Road. In addition, the proposed acoustic barriers on the eastern boundary would likely provide some screening of the silo for adjoining residential properties to the west of the site, resulting in a minor overall visual impact.

4. Environmental management measures

This chapter presents the environmental management measures that are proposed to be implemented to reduce the identified environmental impacts associated with the proposed modifications.

4.1 Overview

4.1.1 Environmental management measures

Chapter 8 of the CSELR Project Submission Report (Transport for NSW, 2014) documented a range of environmental management measures that will be implemented to reduce the identified environmental and social impacts associated with the construction and operational phases of the CSELR Project.

All of these management measures would be applied to the proposed modifications to the project, which have been discussed in Chapter 3 of this report. Where relevant to the proposed modifications, these measures have been listed in Table 4.1 to Table 4.3.

New measures that are proposed have been denoted in Tables 4.1 to 4.3 with underlined text, while any environmental management measure proposed to be removed (or have text deleted from the measure) has been shown with ~~strikethrough text~~.

4.1.2 Conditions of approval

The project, including all proposed modifications, would also be undertaken in accordance with all of the current conditions of approval identified in the State Significant Infrastructure approval (SSI-6042), granted on 4 June 2014.

Following determination of these modifications (if approved), any additional conditions of approval (subsequent to the current conditions of approval for the project) would guide the subsequent phases of the project. The 'Connecting Sydney' consortium, which was announced as the preferred bidder in October 2014 would be required to undertake all works in accordance with the specified environmental management measures and conditions of approval.

4.2 Detailed design

The environmental management measures to be implemented during the detailed design phase with respect to the proposed modifications are listed in Table 4.1.

Table 4.1 Revised environmental management measures for the proposed modifications – detailed design

CSELR EIS ID	Environmental management measure – detailed design and pre-construction phase	Modification(s) to which the management measures would be applicable
Traffic, transport and accessibility		
A.3	The key actions specified in the detailed access plans for each of the proposed light rail stops, included in Section 7.3 of Technical Paper 1 (*Transport Operations Report*) of the CSELR EIS (addressing potential multimodal access, customer safety, or to improvements to access) would be further considered during detailed design.	▪ Grosvenor Street stop arrangement ▪ Moore Park stop arrangement ▪ Increase in the size of LRVs and stop platforms
A.10	Opportunities to stage construction works on the Anzac Parade and Alison Road corridors would be investigated during detailed design to provide additional capacity during construction and reduce increases to travel time.	▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Revised construction methodology for the tunnel under Anzac Parade
A.12	Tidal flow operation on Anzac Parade during construction would be considered, to provide a bus priority lane in the peak direction and protect bus journey time reliability along the corridor during construction works. This would involve further review by RMS, including traffic modelling, to assess the impacts and feasibility in more detail. The final bus priority measures to be implemented would be determined in consultation with Randwick City Council and Roads and Maritime Services.	▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Revised construction methodology for the tunnel under Anzac Parade
A.13	A single lane would be retained along the entire length of the existing Anzac Parade Busway and complementary bus priority measures on Alison Road. Potential mitigation measures would be developed to allow bus priority lanes in the peak direction during peak hours together with bus priority measures at the intersection of Anzac Parade and Alison Road. These priority measures would be explored as part of the Traffic Management Plans in consultation with the bus operators and the relevant Road Authority.	▪ Moore Park stop arrangement ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection

CSELR EIS ID	Environmental management measure – detailed design and pre-construction phase	Modification(s) to which the management measures would be applicable
Noise and vibration		
B.1	The predicted noise and vibration levels in the EIS, and the determination of as-required noise and vibration mitigation, would be verified during the detailed design phase of the proposal. An Operational Noise and Vibration Review would be prepared to determine the final design of mitigation measures.	▪ Increase in the size of LRVs and stop platforms
B.11	Additional assessment of construction road traffic noise impacts of night-time truck movements (if required) would be undertaken at detailed design stage when the finalised traffic plan is determined.	▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Revised construction methodology for the tunnel under Anzac Parade ▪ Substation locations
B.12	During detailed design, further assessment of the operational noise impacts on sensitive receivers would be undertaken in accordance with the NSW *Road Noise Policy*. This assessment would be limited to roads that result in increased traffic due to road closures or diversions directly as a result of the CSELR proposal.	▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Revised construction methodology for the tunnel under Anzac Parade ▪ Substation locations
Visual and landscape		
C.1	Detailed design would consider opportunities for siting mature Fig trees within the Royal Randwick racecourse grounds in the vicinity of the intersection of Wansey Road and Alison Road, and in the Wansey Road nature strip (between Arthur and High streets) to recreate the canopy of the lost street trees on the western side of Wansey Road in consultation with the Australian Turf Club.	▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse and stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Increase to existing levee bank in Centennial Park

CSELR EIS ID	Environmental management measure – detailed design and pre-construction phase	Modification(s) to which the management measures would be applicable
Built and non-indigenous heritage		
D.11	The detailed design of the CSELR would aim to retain as many as practicable of the significant trees along the route, where feasible without compromising rail safety, in particular at the Royal Randwick racecourse.	▪ Moore Park stop arrangement ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Increase to existing levee bank in Centennial Park ▪ Revised construction methodology for the tunnel under Anzac Parade
~~**D.13**~~	~~The following measures would be implemented for Tay Reserve:~~ ~~▪ Detailed design of the CSELR proposal would minimise the area of Tay Reserve to be removed for the cross over at Anzac Parade.~~ ~~▪ A photographic archival recording of Tay Reserve would be undertaken prior to works commencing.~~	*Note: this measure is no longer required due to the proposed realignment of the light rail tracks at the Anzac Parade/Alison Road intersection.*
D.15	Further investigation of the design of the relocated Wansey Road stop would be undertaken during detailed design with the aim of reducing or avoiding impacts on Wansey Cottage and significant trees in the racecourse.	▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop)
Safety and security and hazard and risk		
E.1	Detailed design would incorporate the principles of Crime Prevention through Environmental Design (CPTED). This would include, but not be limited to, a full review and assessment in accordance with the CPTED principles of the each of the proposed stops and the proposed pedestrian bridge over Anzac Parade.	▪ Grosvenor Street stop arrangement ▪ Moore Park stop arrangement ▪ Increase in the size of LRVs and stop platforms
Regional land use and community outcomes and property acquisition		
F.1	Where property acquisition is required, it would be acquired in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*. A Property Acquisition Plan would be prepared as part of detailed design.	▪ Moore Park stop arrangement ▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Increase to existing levee bank in Centennial Park ▪ Substation locations
F.2	Transport for NSW would consult with directly affected land owners during the detailed design of the CSELR proposal.	

CSELR EIS ID	Environmental management measure – detailed design and pre-construction phase	Modification(s) to which the management measures would be applicable
Hydrology, drainage and surface water quality		
G.1	For flood affected locations, the CSELR would be designed to ensure compliance with the *NSW Floodplain Development Manual* which includes a requirement to not increase flood levels above existing levels. Flood mitigation measures that could be considered include: ▪ increasing downstream drainage capacity ▪ diverting upstream flows around or under the track formation ▪ providing stormwater detention under or adjacent to the track formation.	▪ Increase to existing levee bank in Centennial Park
Groundwater		
H.1	Additional investigation/assessment of dewatering requirements for the construction of the Moore Park tunnel would be undertaken during detailed design and in consultation with the NSW Office of Water. Groundwater modelling would be undertaken to determine the potential impacts from the permanent interruption of groundwater flow, including the extent of the drawdown and the potential for settlement.	▪ Revised construction methodology for the tunnel under Anzac Parade
H.2	A dewatering system for excavations proposed in the Botany Sands aquifer would be developed. This could comprise the reinjection of groundwater back into the same aquifer to minimise the spatial extent of drawdown (and therefore settlement).	▪ Revised construction methodology for the tunnel under Anzac Parade
Planted trees		
N.2	The large mature Figs adjacent to Anzac Parade, Alison Road, Wansey Road, within the George Dan Reserve and within the proposed Randwick stabling facility would be reviewed by a suitably qualified arborist during detailed design to confirm if these trees could be retained and/or relocated. This review could include root zone mapping of potentially impacted Figs to determine the likely extent of their tree roots adjacent to and beneath the road surface (This would be undertaken in conjunction with the mitigation measure identified in mitigation measure C.1). Where feasible semi-mature Figs directly impacted by the construction of the CSELR proposal would be transplanted to an alternative suitable location, in consultation with Centennial Park and Moore Park Trust and Roads and Maritime Services (where Fig trees are proposed to be planted within the Anzac Parade road corridor). A detailed relocation and maintenance strategy for the impacted trees would be developed during detailed design, in consultation with Centennial Park and Moore Park Trust, Randwick City Council and the Australian Turf Club where required.	▪ Moore Park stop ▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Increase to existing levee bank in Centennial Park

CSELR EIS ID	Environmental management measure – detailed design and pre-construction phase	Modification(s) to which the management measures would be applicable
N.3	Qualified arboricultural advice would be employed during detailed design and construction to confirm the expected impacts of the CSELR proposal on planted trees and to identify appropriate mitigation measures for such impacts. The advice would include root zone mapping of potentially impacted trees to determine the likely extent of their roots. This assessment would employ the most recent methods for assessing trees and impacts. The aim of this additional assessment would be to reduce the number of planted trees that would be impacted by the CSELR proposal.	▪ Moore Park stop arrangement ▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Increase to existing levee bank in Centennial Park

4.3 Construction

The environmental management measures to be implemented during the construction phase with respect to the proposed modifications are listed in Table 4.2.

Table 4.2 Revised environmental management measures for the CSELR proposal – construction

CSELR EIS ID	Environmental management measure – construction phase	Modification(s) to which the management measures would be applicable
Traffic, transport and accessibility		
Q.4	An application to the NSW Roads and Maritime Services would be made for any proposed adjustment to speed limits whether they are temporary (such as those required for short-term road occupancies), longer term (such as for the duration of a construction stage) or permanent. No adjustments to speed limits would be undertaken without an approved speed zone authorisation.	▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Revised construction methodology for the tunnel under Anzac Parade
Q.48	An alternate path would be provided for pedestrians and cyclists at the location where the proposed CSELR route crosses over the existing shared pedestrian and cycle path located adjacent to the busway within Moore Park. This alternate path would be provided within the same segment of the intersection and would not require crossing of Anzac Parade or Alison Road.	▪ Moore Park stop arrangement ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection

CSELR EIS ID	Environmental management measure – construction phase	Modification(s) to which the management measures would be applicable
Q.51	The construction of the CSELR across Alison Road in the Randwick Precinct would be undertaken in stages to maintain a minimum of two lanes of travel in each direction during each works stage. A minimum of two traffic lanes would be retained along Anzac Parade in each direction within the Kensington/Kingsford Precinct. Where achievable, an additional city-bound lane would be provided which would operate as a peak period bus only lane and off-peak parking zone.	▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Revised construction methodology for the tunnel under Anzac Parade
Q.59	During events scheduled at Royal Randwick Racecourse, construction activities adjacent to the main entrance to the racecourse on Alison Road would be reviewed so as to not significantly impact on the roundabout operation at the intersection of Ascot Street and Doncaster Avenue, and to maintain safe pedestrian access across the worksite.	▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop)
Q.60	The proposed signalisation of the Wansey Road/Alison Road intersection would be implemented as part of the early works so that pedestrians can safely cross Alison Road during the construction phase.	▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop)
Q.66	CSELR construction works at the Alison Road/Anzac Parade intersection and within the wider Kensington/ Kingsford Precinct would be undertaken during week nights and weekends to minimise the impact on adjacent properties and the road network.	▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection
Property and land use		
R.2	Consultation would be undertaken with the Centennial and Moore Park Trust as the key land holder for a majority of the land uses impacted by the CSELR proposal within the Moore Park Precinct.	▪ Moore Park stop arrangement ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Increase to existing levee bank in Centennial Park ▪ Revised construction methodology for the tunnel under Anzac Parade
R.3	For the Randwick precinct, consultation would be undertaken with agencies such as Randwick City Council, utilities providers and other potential stakeholders such as the UNSW, the ATC and the Prince of Wales Hospital throughout construction of the proposal to minimise ongoing impacts to existing land uses.	▪ Moore Park stop arrangement ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Increase to existing levee bank in Centennial Park ▪ Revised construction methodology for the tunnel under Anzac Parade

CSELR EIS ID	Environmental management measure – construction phase	Modification(s) to which the management measures would be applicable
Noise and vibration		
S.1	A Construction Noise and Vibration Management Plan (CNVMP) would be developed to document all necessary measures to manage and mitigate potential noise and vibration levels during standard daytime and out of hours construction activities. In general this would include some or all of the following measures: ▪ For construction concentrated in a single area, such as at the stops, worksites, substation construction-sites, bridge sites and stabling/maintenance facility locations, temporary acoustic fencing/barriers around the site perimeter would be considered where feasible and reasonable to mitigate off-site noise levels. ▪ Given the potentially high noise levels at residential receptors, adherence to daytime construction hours is recommended for excavation, demolition or rock breaking activities, and for activities concentrated in a single area (i.e. activities that do not move along the alignment, and do not require out of hours activities for safety reasons or to minimise disruption to road networks). ▪ Noise generating night works should be programmed to minimise the number of consecutive nights work impacting the same receptors. ▪ Consultation would be undertaken with nearby local schools prior to noise intensive works to ensure impacts are minimised during examination periods and/or other critical periods in the school calendar (where works are predicted to exceed the relevant construction noise management level for this receiver). Consultation with nearby childcare centres to be undertaken to potentially avoid noisy works during rest periods at the centres. ▪ Where feasible, simultaneous operation of noisy plant in close proximity to sensitive receptors would be avoided. ▪ Equipment which is used intermittently is to be shut down when not in use. ▪ Where possible, the offset distance between noisy plant items and nearby noise sensitive receptors should be as great as possible. ▪ Where possible, equipment with directional noise emissions should be oriented away from sensitive receptors. ▪ Regular compliance checks on the noise emissions of plant and machinery regularly used to determine whether such plant comply with predicted noise emissions or are higher than predicted. Compliance checks would also be used to identify defective silencing equipment on the items of plant. Ongoing noise monitoring during construction at sensitive receptors during critical	▪ Moore Park stop arrangement ▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Increase to existing levee bank in Centennial Park ▪ Revised construction methodology for the tunnel under Anzac Parade ▪ Substation locations

CSELR EIS ID	Environmental management measure – construction phase	Modification(s) to which the management measures would be applicable
	periods to identify and assist in managing high risk noise events. ▪ Reversing of equipment should be minimised so as to prevent nuisance caused by reversing alarms. ▪ Loading and unloading should be carried out away from sensitive receptors, where practicable. ▪ Work should be scheduled to provide respite periods from the noisiest activities, and impacted residents should be communicated with to clearly explain the duration and noise levels for the works. ▪ Where all feasible and reasonable practices have been applied and noise would be more than 5 dB above the noise affected level, the proponent should negotiate with the community to determine the schedule for the works or provide respite to occupants where sleep disturbance is likely to occur.	
S.3	Site specific CNVMPs would be developed. These would provide a detailed assessment of potential noise levels and site specific measures to control potential noise impacts and minimise the potential for disturbance at affected receptors. A range of feasible and reasonable construction noise mitigation measures would be provided. Within the Randwick Precinct, the CNVMP would include communication with the owners of the horse stables near the proposed works to clearly explain the timing, duration and likely noise levels for the works.	▪ Moore Park stop arrangement ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Increase to existing levee bank in Centennial Park
S.6	During construction, attended measurements would be undertaken at the commencement of rockbreaking activities in the vicinity of the premises listed in Table 64 of Technical Paper 11 (*Noise and Vibration Impact Assessment*) of the EIS, to assist in evaluating and managing construction ground-borne noise impacts in conjunction with the premises operators. Alternative construction methods such as smaller rockbreakers, rock saws or respite periods would be considered if required to minimise noise impacts. In the event that lower impact equipment cannot be substituted, all efforts would be made to reschedule work to less sensitive times in consultation with affected communities.	▪ Revised construction methodology for the tunnel under Anzac Parade

CSELR EIS ID	Environmental management measure – construction phase	Modification(s) to which the management measures would be applicable
S.7	Where vibration intensive construction activities are proposed within 100 metres of sensitive receptors, these works would be confined to the less sensitive daytime period where possible. The potential impacts from vibration are to be considered in the site-specific CNVMPs. In general, mitigation measures that would be considered include: ▪ Relocate vibration generating plant and equipment to areas within the site in order to lower the vibration impacts. ▪ Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment. ▪ Use lower vibration generating items of excavation plant and equipment (e.g. smaller capacity rockbreaker hammers). ▪ Minimise consecutive works in the same locality (if applicable). ▪ Use dampened rockbreakers and/or 'city' rockbreakers to minimise the impacts associated with rockbreaking works. ▪ If vibration intensive works are required within the safe working distances, vibration monitoring or attended vibration trials would be undertaken to ensure that levels remain below the cosmetic damage criterion. ▪ Building condition surveys would be completed both before and after the works to identify existing damage and any damage due to the works. ▪ Measurements of existing ambient vibration levels would be undertaken at receptors with vibration sensitive equipment during the detailed design phase. This information would be used to inform the site-specific CNVMPs for works near these locations.	▪ Increase in the size of LRVs and stop platforms ▪ Revised construction methodology for the tunnel under Anzac Parade
Planted trees		
T.1	Trees that would not be directly impacted by the proposed CSELR permanent works (e.g. overhead wires, substations, light rail stops, kerb realignments, service relocations, etc.) — or significantly impinge on required clearances to such infrastructure, such that the tree would need to be removed to allow for the safe operation of the CSELR — would be retained. All trees to be retained would be protected prior to the commencement of construction in accordance with AS4970 the Australian Standard for *Protection of Trees on Development Sites and Adjoining Properties*. Some trees would require one-off or ongoing maintenance, for example pruning of low branches that would interfere with the overhead wiring. Where pruning of trees is required, a qualified arborist would be engaged to assess the health and condition of the tree and to plan and undertake any pruning works.	▪ Moore Park stop arrangement ▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Increase to existing levee bank in Centennial Park ▪ Revised construction methodology for the tunnel under Anzac Parade ▪ Substation locations

CSELR EIS ID	Environmental management measure – construction phase	Modification(s) to which the management measures would be applicable
T.2	Exclusion fencing would be established around the drip lines of each tree to be retained to minimise the risk of impact to the viability of the trees. Where impact to the drip line area cannot be avoided (due to space constraints), opportunities to raise construction facilities (e.g. demountable) above the ground level would be investigated so as to avoid impacting on the underlying tree roots, in accordance with *Australian Standard AS 4970 Protection of Trees on Development Sites.*	▪ Moore Park stop arrangement ▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Increase to existing levee bank in Centennial Park ▪ Revised construction methodology for the tunnel under Anzac Parade
T.3	Where the loss of trees is unable to be mitigated, trees removed as a result of the CSELR would be offset in accordance with the Transport for NSW *Vegetation Offset Guide* (Transport for NSW 2013), which includes a principle of replacing 'the amenity/visual landscape value of vegetation removed' even if the vegetation may not have significant ecological value. Replacement plantings would be agreed in accordance with the CSELR Landscape Strategy (Appendix F of the EIS) and consultation with relevant stakeholders. Replacement plantings would be maintained by the Operator (or as otherwise agreed with any relevant stakeholders) for a period no greater than two years.	
T.4	Construction techniques that minimise impacts to tree root zones would be employed where practicable. This would include consideration of compaction and root bridging techniques, permeable paving, tunnel boring of services, hydro-excavation and careful root pruning). The use of low impact construction techniques (on existing tree roots) for installation of new services would also be considered, where appropriate and feasible.	
T.7	Fig species (consistent with existing plantings) and *Lophostemon confertus* (Brush Box) would generally be used along Anzac Parade as replacement trees.	
T.8	Potential impacts to the large mature Figs adjacent to Anzac Parade would be reviewed by a suitably qualified arborist during detailed design, once the final tunnel construction technique has been determined. To minimise the potential impacts associated with dewatering activities on the viability of the surrounding Figs, an irrigation strategy would be developed for any Fig that is deemed to be at risk of being affected by a potential lowering of the water table.	
T.9	The health of Fig trees within Moore Park would be monitored by a suitable qualified arborist both during and post construction. Appropriate management responses would be developed by a suitably qualified arborist, in consultation with Moore and Centennial Parks Trust so as to minimise impacts to any potentially affected trees.	
T.12	Where possible, trees would be planted within the same locality from which they are removed.	

CSELR EIS ID	Environmental management measure – construction phase	Modification(s) to which the management measures would be applicable
Visual and landscape		
U.16	Reinstate planting, where removed for construction purposes, on the periphery of Centennial Park in the Randwick Precinct in accordance with the Centennial Parklands Conservation Management Plan.	▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Increase to existing levee bank in Centennial Park ▪ Revised construction methodology for the tunnel under Anzac Parade
Built and non-Indigenous heritage		
V.1	The mitigation measures for Historical Archaeological Management Units (HAMUs) listed in section 6.2.2 of Technical Paper 5 (*Heritage Impact Assessment*) of the CSELR EIS would be implemented, in accordance with the HAMU zones documented in Figures 4.4 to 4.12 of Technical Paper 5 (*Heritage Impact Assessment*) of the CSELR EIS.	▪ Grosvenor Street stop arrangement ▪ Moore Park stop arrangement ▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Wire-free infrastructure within the CBD ▪ Increase to existing levee bank in Centennial Park ▪ Revised construction methodology for the tunnel under Anzac Parade ▪ Substation locations
V.6	Works in George Street north HAMU, Ward Park HAMU, Devonshire Street Central HAMU (particularly in the location of the proposed substation), Devonshire Street East HAMU, Kensington/Kingsford HAMU and the University of NSW HAMU are likely to require some open area excavation and archival recording during site works, and post-excavation analysis and reporting. The nature and intactness of the archaeological resource may warrant interpretation. Advice from an archaeological specialist would be obtained where these areas are affected.	▪ Grosvenor Street stop arrangement ▪ Increase in the size of LRVs and stop platforms
V.9	The following mitigation measures would be implemented for the Moore Park West HAMU and Moore Park East HAMU: ▪ Works in this HAMU where air raid shelters were located are likely to require some open area excavation and archival recording during site works, as well as post excavation analysis and reporting (limited to the extent of the area affected by the CSELR proposal). The nature and intactness of the archaeological resource may warrant interpretation. ▪ Areas with nil archaeological potential would be managed in accordance with the outlined Zone 4 mitigation measures.	▪ Revised construction methodology for the tunnel under Anzac Parade ▪ Substation locations

CSELR EIS ID	Environmental management measure – construction phase	Modification(s) to which the management measures would be applicable
V.20	The following mitigation measures would be implemented for Centennial Park, Moore Park, Queens Park and the Moore Park Conservation Area: ▪ The area required for excavation would be minimised to reduce the impact of the works on Moore Park. ▪ The size and form of the tunnel portal structures would be as recessive as possible to reduce permanent visual impacts on the landscape of Moore Park. Any new structures/infrastructure would be recessive and allow the broader landscape to remain the dominant feature. ▪ The location and design of the Moore Park stop would minimise impacts on significant views of the Sydney Cricket Ground and former RAS buildings from Anzac Parade and within Moore Park. ▪ Where feasible, areas excavated for construction of the CSELR would be reinstated to the current condition on completion of construction. This includes areas to be used for construction compounds/laydown areas. ▪ A photographic archival recording of the areas of Moore Park that would be subject to impacts from construction of the CSELR, including the Anzac Parade avenue of trees, would be undertaken prior to works commencing. ▪ Works in this HAMU may require some open area excavation and archival recording during site works, as well as post excavation analysis and reporting (limited to the extent of the area affected by the CSELR proposal). The nature and intactness of the archaeological resource may warrant interpretation.	▪ Moore Park stop arrangement ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Increase to existing levee bank in Centennial Park ▪ Revised construction methodology for the tunnel under Anzac Parade
V.21	Where significant trees must be removed in the Martin Road Conservation Area suitable replacements would be made, where possible, to screen the conservation area from the CSELR.	▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection
Groundwater		
Z.1	A construction groundwater management plan would be prepared prior to construction, and would detail the control measures that aim to minimise potential impacts to groundwater resources and receiving environments during construction. The purpose of the plan is to provide practical impact mitigation principles and measures for the design and construction of the proposal consistent with relevant legislation and standard guidelines.	▪ Moore Park stop arrangement ▪ Revised construction methodology for the tunnel under Anzac Parade

CSELR EIS ID	Environmental management measure – construction phase	Modification(s) to which the management measures would be applicable
Z.2	The construction groundwater management plan would include details of a groundwater monitoring program, which would be implemented prior to construction to identify changes in groundwater quality and levels during the construction. The monitoring program would be developed in consultation with the NSW Office of Water.	▪ Moore Park stop arrangement ▪ Revised construction methodology for the tunnel under Anzac Parade
Z.3	Excavation techniques would be adopted to minimise impacts on aquifers.	
Z.4	Groundwater encountered during the construction of the proposal would be tested, managed and disposed of in accordance with the *Waste Classification Guidelines* (EPA 2014) and Transport for NSW's (Transport for NSW 2012) *Water Discharge and Re-use Guideline*. Groundwater would be disposed to ensure it does not cause the pollution of waters in accordance with Section 120 of the *Protection of the Environment Operations Act 1997*.	▪ Moore Park stop arrangement ▪ Revised construction methodology for the tunnel under Anzac Parade
Z.6	Construction techniques would aim to reduce the volume of dewatering required at the deeper sections of the tunnel.	
Aboriginal heritage		
AA.1	All contractors would receive a Heritage induction advising and informing them of the archaeological potential and actions to be implemented in the event of any unexpected remains.	▪ Grosvenor Street stop arrangement ▪ Moore Park stop arrangement ▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Wire-free infrastructure within the CBD ▪ Increase to existing levee bank in Centennial Park ▪ Revised construction methodology for the tunnel under Anzac Parade ▪ Substation locations
AA.2	A qualified archaeologist would be nominated and available to attend in the event that unidentified archaeological remains are discovered during construction.	
AA.4	Should Aboriginal objects or other archaeological evidence be identified in these areas during works, works would cease in the immediate area and the archaeologist contacted to assess the evidence. Additional investigation, such as salvage excavation, may be required.	

4.4 Operation

The environmental management measures to be implemented during the operational phase with respect to the proposed modifications are listed in Table 4.3.

Table 4.3 Revised environmental management measures for the CSELR proposal – operation

CSELR EIS ID	Environmental management measure – operational phase	Modification(s) to which the management measures would be applicable
Traffic, transport and access		
AH.6	The following intersections would be signalised as part of the CSELR to manage light rail conflicts with pedestrian and traffic movements: ▪ Devonshire Street/Marlborough Street intersection. ▪ Devonshire Street/Bourke Street intersection. ▪ South Dowling Street southbound and northbound traffic lanes at the CSELR crossing point. ▪ Wansey Road/Alison Road intersection would be signalised (on all arms) to provide pedestrian access from the residential catchments in the north and east to the Wansey Road stop. ▪ High Street/Wansey Road intersection would be signalised to accommodate pedestrians and the light rail turning movements between Wansey Road and High Street. Pedestrian crossings would be provided across Wansey Road and the eastern arm of High Street as a minimum, which would replace the existing zebra crossing on High Street. ▪ High Street/Hospital Road intersection. ▪ High Street/Clara Street intersection. ▪ The existing Nine Ways roundabout would be reconstructed and upgraded to incorporate traffic signals.	▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop)
AH.23	The off-road shared pedestrian and cyclist path between Darley Road and Wansey Road would be reinstated between the proposed CSELR route and Royal Randwick racecourse.	▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Increase to existing levee bank in Centennial Park

CSELR EIS ID	Environmental management measure – operational phase	Modification(s) to which the management measures would be applicable
Noise and vibration		
AI.1	For ~~the Surry Hills Precinct, at~~ locations where the *Rail Infrastructure Noise Guideline* (RING) (EPA 2013) operational noise trigger levels are predicted to be exceeded by more than 2 dB, a detailed investigation of feasible and reasonable noise mitigation measures would be undertaken to minimise the worst-case predicted noise levels. As detailed further in ~~Chapter 13 of the EIS and~~ Technical Paper 11 (*Noise and Vibration*) of the EIS, potential measures to be considered include: ▪ more stringent specification of LRV noise emissions in the procurement process, which would only be recommended following consultation with rolling stock providers to establish whether more stringent noise specifications could feasibly be achieved ▪ higher absorption track forms, including those described in the EIS ▪ speed restrictions to 30 kilometres per hour during the night-time between the Central Railway Station and the Surry Hills stops (with the exception of during special events) ▪ minimising wheel and rail roughness through specifications for CSELR operations, such as maintaining the rail surface (via rail grinding) and train wheel conditions (via a wheel lathe) in accordance with defined acceptance standards ▪ individual property treatments, in the event that the above alternatives are determined as not feasible or reasonable. The final form of the proposed mitigation measures would be documented in the Operational Noise and Vibration Review, as required as part of mitigation measure B.1.	▪ Increase in the size of LRVs and stop platforms

CSELR EIS ID	Environmental management measure – operational phase	Modification(s) to which the management measures would be applicable
Visual and landscape		
AJ.3	Use semi-mature to mature tree specimens, in accordance with the Transport for NSW '*Vegetation Offset Guide*' (Transport for NSW, 2013d) and the Landscape Strategy (Appendix F of the EIS) to replace the character of those lost on a 'like for like' basis, in consultation with the City of Sydney and Randwick City Council.	▪ Moore Park stop arrangement ▪ Increase in the size of LRVs and stop platforms ▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Increase to existing levee bank in Centennial Park ▪ Revised construction methodology for the tunnel under Anzac Parade
AJ.10	Provide a boulevard of street trees along Anzac Parade to improve the streetscape and extend the ceremonial avenue of street trees.	▪ Realignment of light rail alignment along Alison Road (including the relocation of Royal Randwick Racecourse stop) ▪ Realignment of light rail track at the Anzac Parade/Alison Road intersection ▪ Revised construction methodology for the tunnel under Anzac Parade
Hazards and risks		
AL.1	Targeted road safety campaigns would be used in the lead up to the opening of the CSELR and during operation to raise awareness around the operation of LRVs and to promote the safe operation of the proposal. This would focus on raising awareness and promoting safe behaviours in shared zones and at key CSELR crossings.	▪ Grosvenor Street stop arrangement ▪ Increase in the size of LRVs and stop platforms ▪ Wire-free infrastructure within the CBD

5. Design refinements and other design clarifications

This chapter provides details for a series of additional, minor design refinements that have been identified as part of the ongoing design of the approved project.

5.1 Retention of existing taxi rank on George Street

Ongoing consultation with Four Seasons Hotel as part of the ongoing refinement of the design of the project has identified that the existing taxi rank to the south of the Four Seasons Hotel *porte cochere* is required to be retained to allow taxis to wait within George Street outside of the hotel during busy periods.

While the approved project did not specifically note the removal of the existing taxi rank, the final design of the project would retain the taxi zone to the west of the proposed northbound traffic lane in this area.

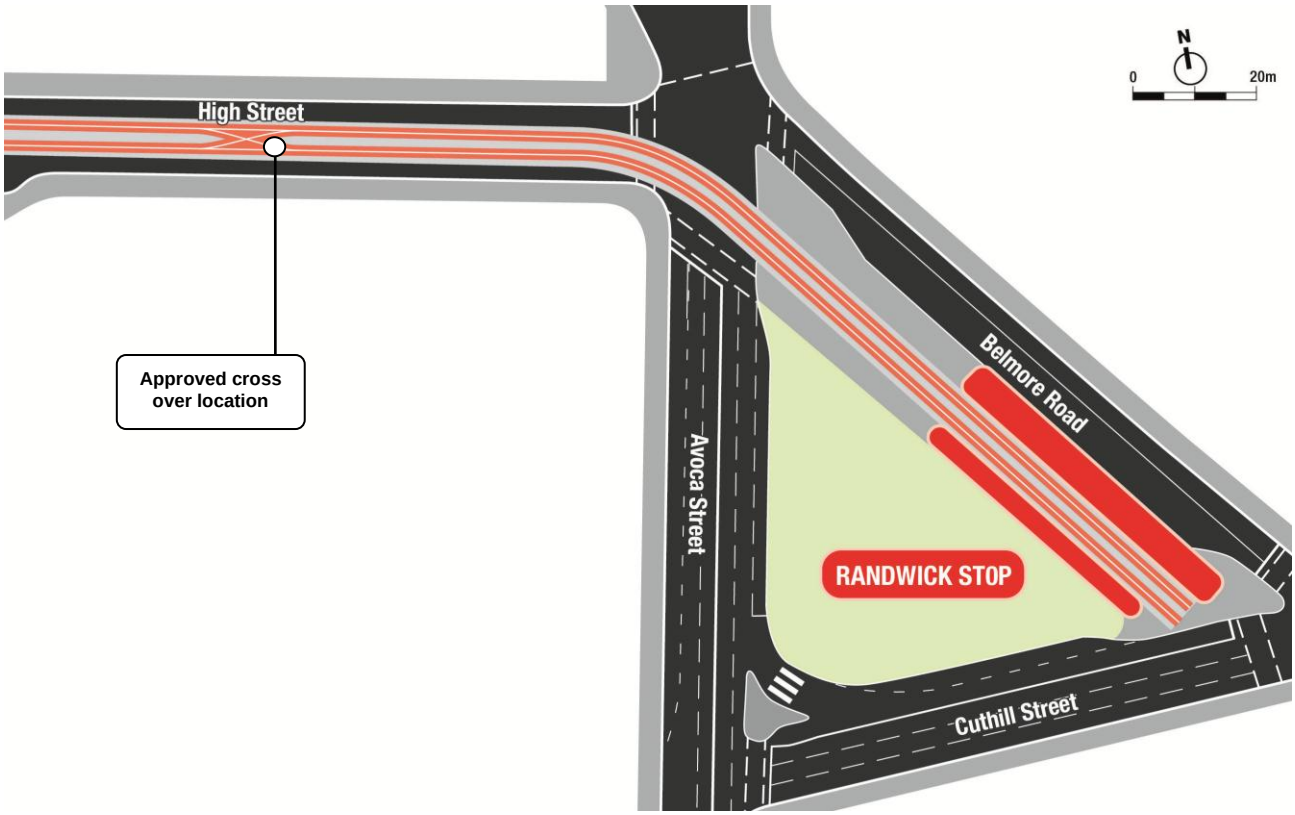
5.2 High Street LRV crossover location

As part of the approved project, the light rail vehicle crossover (a track crossing point that would enable an LRV to cross between two parallel tracks) was proposed along High Street on the western side of the intersection between High Street and Avoca Street.

As part of the refinement of the design following project approval, the proposed crossover has been relocated from High Street into the western end of the High Cross Park. As a result of the design refinement, LRVs would no longer be required to travel through the High Street/ Belmore Road intersection and across the shared bus right-turn lane in the 'wrong' direction (i.e. opposite side of the light rail tracks than what a motorist and other road users would normally expect) before changing tracks.

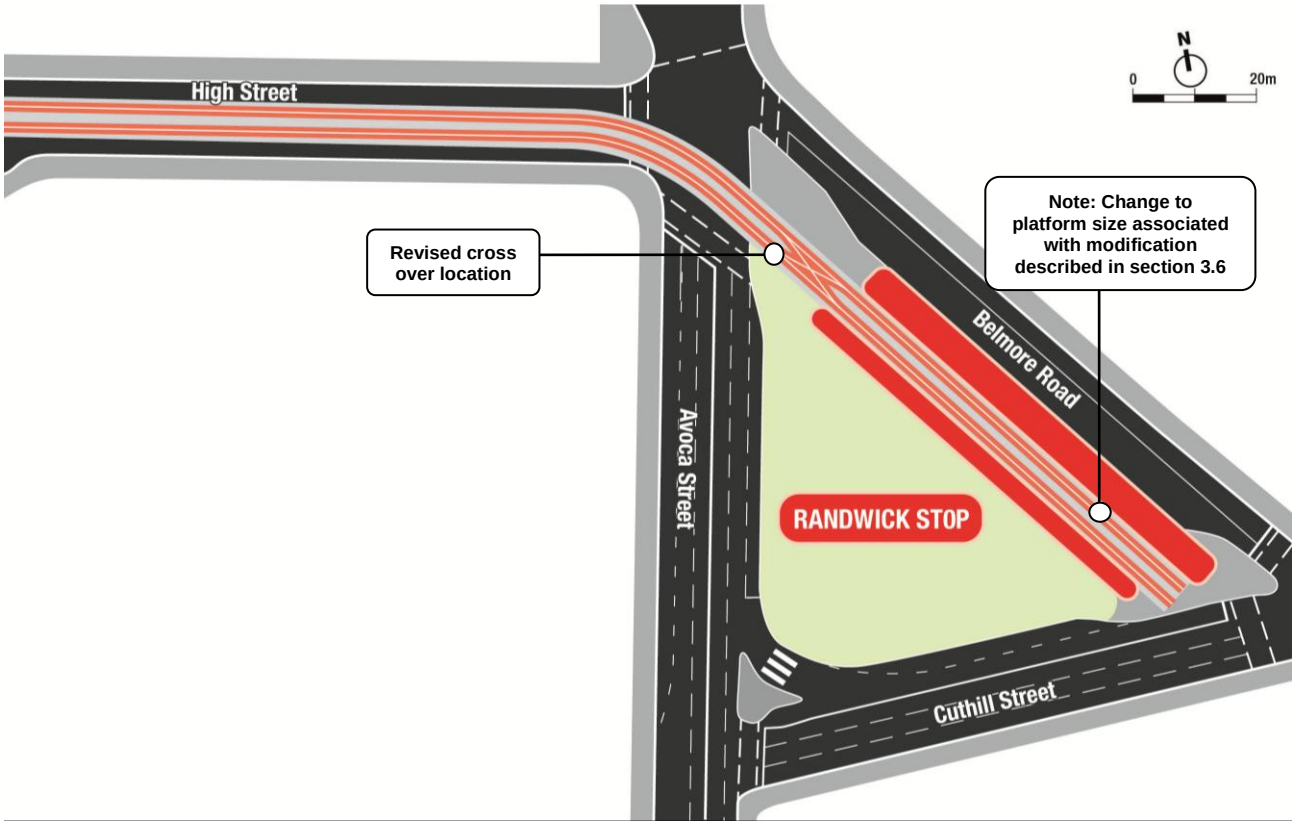
This change would represent an improved public safety outcome and would not alter the environmental impacts identified in the EIS given that the extent of works would remain the same, and would occur within the approved project footprint.

A comparison between the approved and the proposed design for the High Street LRV crossover location is provided in Figure 5.1 (approved) and Figure 5.2 (proposed).



Note: Indicative only. Subject to detailed design.

Figure 5.1 Approved location of the High Street LRV crossover location



Note: Indicative only. Subject to detailed design.

Figure 5.2 Proposed modification to the High Street LRV crossover location

5.3 Minor amendments to project boundary

As part of the ongoing refinement of the design of the project following project approval, a series of minor increases in the project footprint have been identified in order to fully capture the proposed works relating to the project. In general, the refinement of the approved project footprint has been identified to capture the extent of road works required to a number of side streets (in particular within the CBD precinct).

The location and proposed increase to the approved project footprint are provided in Table 5.1 below.

Table 5.1 Proposed changes to the approved project footprint

Location of additional land required	Proposed change to approved footprint
Loftus Street	Approximately 65 metres of additional road reserve to the south
Pitt Street	Approximately 60 metres of additional road reserve to the south
Essex Street	Approximately 20 metres of additional road reserve to the west
Bridge Street	Approximately 60 metres of additional road reserve to the east
Grosvenor Street	Approximately 45 metres of additional road reserve to the west
Margaret Street	Approximately 25 metres of additional road reserve to the west
King Street	Approximately 55 metres of additional road reserve to the west
Druitt Street	Approximately 15 metres of additional road reserve to the west
Campbell Street	Approximately 25 metres of additional road reserve to the east
Sussex Street	An additional area of Sussex Street approximately 60 metres by 20 metres
Ultimo Road	Approximately 20 metres of additional road reserve to the west
George Street	Approximately 35 metres of additional road reserve to the south
Elizabeth Street	Approximately 7 metres of additional road reserve to the north
Chalmers Street	Approximately 135 metres of additional road reserve to the south
Crown Street	Approximately 55 metres of additional road reserve to the south
Bourke Street	Approximately 35 metres of additional road reserve to the south
South Dowling Street	Approximately 40 metres of additional road reserve to the south
Anzac Parade/Cleveland Street	Two additional areas of Anzac Parade approximately 70 metres by 160 metres and 20 metres by 140 metres
Lang Road	Approximately 50 metres of additional road reserve to the east
Anzac Parade/Martin Road	Approximately 150 metres of additional road reserve along Anzac Parade to the north of the intersection with Alison Road
Alison Road	Additional land to the north of Alison Road, between Doncaster Avenue and Darley Road to accommodate the revised alignment (refer to section 3.7)
Barker Street (near Anzac Parade)	Approximately 60 metres of additional road reserve to the west

6. Stakeholder consultation

This chapter outlines the consultation that has been undertaken with agencies and stakeholders during the preparation of this Modification Application.

6.1 Consultation during preparation of application

The CBD and South East Light Rail Project Office has undertaken consultation with key agencies and stakeholders during the preparation of this report regarding the proposed modifications.

A summary of this consultation is presented in Table 6.1 below.

Table 6.1 Consultation with key agencies and stakeholders regarding the proposed modifications

Stakeholder	Date(s)	Issues raised
City of Sydney	6 November 2014 21 November 2014	▪ Wire-free technology ▪ Stop locations in CBD ▪ Length of vehicles and platforms ▪ Urban design ▪ Tree locations
Randwick City Council	30 October 2014 18 November 2014	▪ High Cross Park interchange and the potential for an alternative (once developed by Randwick City Council) to be incorporated into the detailed design (timeframes). Request for further consultation with the proponent. ▪ Impacts on High Cross park resulting from increased platform length. ▪ Frequency of services ▪ Vegetation impacts – Alison Road/Anzac Parade (significant trees) ▪ Flood mitigation modelling ▪ Impacts on cycling pedestrian/infrastructure ▪ Traffic impacts – Darley Road, access to Centennial Park ▪ Detailed design
Centennial Park And Moore Park Trust	21 October 2014 27 October 2014 (briefing to the CPMP Trust Board) 19 November 2014	▪ Integration of the light rail stop with the park ▪ Noise – impact of operational noise from LRVs; crowding at LR stop during special events ▪ Alison Road Entry ▪ Outer Perimeter Trail ▪ Loss of trees along Alison Road ▪ Fencing ▪ Jogging track and connectivity; bike and pedestrian paths ▪ Flood mitigation

Stakeholder	Date(s)	Issues raised
		▪ Ponds –access to water source, disturbance on flora and fauna ▪ Darley Road – traffic movements ▪ Integration with CPMPT Master Plan ▪ Resourcing constraints.
Australian Turf Club	10 September 2014 16 October 2014 21 November 2014	▪ Alison Road realignment ▪ Traffic management – right hand turn (Alison Road) ▪ Access – Alison Road/Wansey Road ▪ Road maintenance ▪ Crowd modelling – safety of pedestrian access for Randwick Racecourse users of the light rail stop ▪ Staff parking ▪ Operational impacts during major events ▪ Loss of trees
University of New South Wales (UNSW)	17 November 2014	▪ Safety and capacity ▪ Platform crowding ▪ Flood mitigation ▪ Anzac Parade tunnelling – length of traffic detours ▪ Upper campus stop – pedestrianisation ▪ Protection of underground utilities ▪ Progress of development agreement
The Right and Honourable Clover Moore, Lord Mayor of Sydney	21 November 2014	▪ Larger vehicles ▪ Urban design of the light rail stops
Roads and Maritime Services (RMS)	Ongoing and through the project client control group throughout preparation of the planning modifications	▪ Grosvenor Street stop arrangement ▪ Increase in the size of LRVs and stop platforms intersection operation impacts ▪ Traffic impacts at Darley Road/Alison Road and the operation of Wansey Road/Alison Road. ▪ Concern about Anzac Parade/Alison Road intersection performance. ▪ Anzac Parade Tunnel – lane options
CBD Transport Taskforce	Ongoing – throughout preparation of the planning modifications	▪ No issues raised
Health Infrastructure	19 November 2014	▪ Noise and vibration impacts on health services.

Ongoing discussions with stakeholders and project partners would continue throughout detailed design.

As part of the ongoing community consultation, the project team will communicate the proposed changes and potential impacts outlined in the modification to local residents and businesses via:

- door knocking
- letter box drops
- community newsletters
- maps and diagrams
- community and Business Forums
- the project website.

7. Conclusion

The proposed modifications have been developed as a result of ongoing consultation with stakeholders and design investigations.

The proposed modifications to the CSELR proposal described in this report would generally result in a positive overall outcome in comparison to the approved project. However, some additional environmental impacts would also occur as a result of some of the modifications.

Beneficial effects of the proposed design modifications to the approved CSELR Project would include:

- Improved traffic and pedestrian impacts resulting from further refinement to the Grosvenor Street stop; the intersection of George Street and Ultimo Road; and the intersection of Anzac Parade and Alison Road.
- Reduced visual impacts as a result of modifications to the wire free infrastructure between Circular Quay and Town Hall; the reduced bulk and scale of the approved Moore Park stop; the reduced impact on Tay Reserve; and the relocation of the Surry Hills substation to a new underground location adjacent to the Moore Park west tunnel entrance.
- Improved public transport services through the provision of longer LRVs which would accommodate increased passenger capacities. Improved operations through the removal of the World Square stop and realignment of the Alison Road/Anzac Parade intersection.
- Reduced flooding impacts on the proposed stabling yard and downstream properties, in particular for Kensington and Kingsford by raising the existing flood levee along the southern boundary of Centennial Park.

Some potential negative environmental impacts have also been identified occurring as a result of the proposed design modifications. These include:

- An increase in the number of planted trees to be removed along approved CSELR alignment (up to approximately 14 trees) resulting in increased planted tree/biodiversity impacts and adverse visual impacts at these locations. These impacts are generally associated with the relocation of the Alison Road track alignment and Royal Randwick Racecourse stop between Doncaster Avenue and Darley Road and the revised construction methodology for the tunnel under Anzac Parade. The proposed increase in tree impacts only represents the actual number of trees impacted and does not take into account the relative significance (i.e. species, quality, age and context) of the newly affected trees in comparison to the proposed tress to be retained.
- An increase in potential noise impacts at approximately 86 additional receptors across the alignment due to the increased length of the LRVs, in addition to some minor adverse impacts due to the modified alignment along Alison Road.
- Some additional impacts to Aboriginal and non-Indigenous heritage, primarily due to increased visual impacts to existing heritage items, such as the revised alignment along Alison Road and the relocated Royal Randwick Racecourse stop.

The proposed modifications are considered to be justified and would represent an overall beneficial outcome for the approved project. These improvements would result in benefits to both the local community and operation of the overall light rail system.

8. References

(NSW) Environment Protection Authority (EPA) 2014, *Waste Classification Guidelines*

(NSW) Environment Protection Authority (EPA) 2000, *Industrial Noise Policy*

NSW Government 2012, *NSW Long Term Transport Master Plan*, December 2012

NSW Government 2012, *Sydney's Light Rail Future: Expanding Public Transport, Revitalising Out City*, December 2012

NSW Government 2013, *Draft Metropolitan Strategy for Sydney 2031*

NSW Government 2013, *Sydney City Centre Access Strategy*, December 2013

Transport for NSW 2012, *Water Discharge and Re-use Guideline*

Transport for NSW 2013, *CBD and South East Light Rail Project, Environmental Impact Assessment (Volume 1A)*, November 2013

Transport for NSW 2013, *CBD and South East Light Rail Project, Environmental Impact Assessment (Volume 1B)*, November 2013

Transport for NSW 2013c, *CBD and South East Light Rail Project, Environmental Impact Assessment (Volume 6) – Technical Paper 11* (*Noise and Vibration Impact Assessment*)

Transport for NSW 2013d, *Vegetation Offset Guide*

Transport for NSW 2014, *CBD and South East Light Rail Project, Submissions Report*, March 2014

WMA Water 2013, *Centennial Park Flood Study*, April 2013.