



Transport for New South Wales

# Lindfield Substation Review of Environmental Factors

22 July 2014



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# Glossary

AC	alternating current
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
BoM	Bureau of Meteorology
CBD	central business district
CEMF	Construction Environmental Management Framework
CEMP	Construction Environmental Management Plan
CO	carbon monoxide
CSR	A combined services route (CSR) is a technical railway term used to describe the buried pipe or enclosed box (typically a steel box fixed to a pole approximately one metre high) that holds the signalling, communication and electrical cables running along the railway corridor
CPTED	crime prevention through environmental design
CNVS	construction noise vibration strategy
dB	decibel
DC	direct current
DCP	Development Control Plan
DECC	Department of Environment Climate Change
DECCW	Department of Environment Climate Change and Water
DMP	dust management plan
Down-track	Refers to the line on which trains travel away from Sydney away from Chatswood Station and the Sydney CBD towards Lindfield Station
DP&E	(NSW) Department of Planning and Environment
Draft Strategy	<i>Draft Metropolitan Strategy for Sydney 2031</i>
ECRL	Epping to Chatswood Rail Link
EIS	Environmental Impact Statement
EP&A Act	(NSW) <i>Environmental Planning and Assessment Act 1979</i>

EP&A Regulation	(NSW) <i>Environmental Planning and Assessment Regulation 2000</i>
EPA	(NSW) Environment Protection Authority
EPBC Act	(Commonwealth) <i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPL	environment protection licence
ESCP	erosion and sediment control plan
ESD	ecologically sustainable development
EMP	Environmental Management Plan
fugitive dust	dust derived from a mixture of sources (non-point source) or not easily defined sources. Examples of fugitive dust include dust from vehicular traffic on unpaved roads, materials transport and handling, and un-vegetated soils and surfaces
GST	galvanised steel troughing
GLT	ground level troughing
HCA	heritage conservation area
Heritage Act	(NSW) <i>Heritage Act 1977</i>
ICNG	<i>Interim Construction Noise Guideline</i>
ICNIRP	International Commission on Non-Ionizing Radiation protection
Infrastructure SEPP	<i>State Environmental Planning Policy (Infrastructure) 2007</i>
INP	<i>Industrial Noise Policy</i>
IRCSs	isolating and rail connecting switches
km	Kilometres
Ku-Ring-Gai LEP	<i>Ku-Ring-Gai Local Environmental Plan (Local Centres) 2012</i>
Ku-Ring-Gai PSO	<i>Ku-Ring-Gai Planning Scheme Ordinance 2013</i>
LEP	Local Environmental Plan
LPG	liquid petroleum gas
LGA	local government area
kV	kilovolt
MNES	Matters of National Environmental Significance
Metropolitan Plan	<i>Metropolitan Plan for Sydney 2036</i>
MLALC	Metropolitan Local Aboriginal Land Council

Native Vegetation Act	(NSW) <i>Native Vegetation Act 2003</i>
NEPM	National Environment Protection Measure
NO <sub>x</sub>	oxides of nitrogen
Noxious Weeds Act	(NSW) <i>Noxious Weeds Act 1993</i>
NPI	National Pollution Inventory
NSW	New South Wales
NSW 2021	<i>NSW 2021: A plan to make NSW number one</i>
NWRL	North West Rail Link
O <sub>3</sub>	ozone
OEH	(NSW) Office of Environment and Heritage
OHW	overhead wiring
PAD	Potential Archaeological Deposit
PEA Act	(NSW) <i>Protection of the Environment Administration Act 1991</i>
PM <sub>2.5</sub>	Particulate matter less than or equal to 2.5 µm in aerodynamic diameter
PM <sub>10</sub>	Particulate matter less than or equal to 10 µm in aerodynamic diameter
PoEO Act	(NSW) <i>Protection of the Environment Operations Act 1997</i>
PSO	Planning Scheme Ordinance
RBL	rating background level
REF	Review of Environmental Factors
REP	Regional Environmental Plan (now deemed SEPP)
RNP	<i>Road Noise Policy</i> (DECCW, 2011)
Roads Act	(NSW) <i>Roads Act 1993</i>
Roads and Maritime	(NSW) Roads and Maritime Services
SEPP	State Environmental Planning Policy
RTU	remote terminal unit
SCADA	supervisory control and data acquisition
SEPP 19 – Urban Bushland	<i>State Environmental Planning Policy No. 19 – Bushland in Urban Areas</i>
SEPP 55 – Remediation of Land	<i>State Environmental Planning Policy No 55 – Remediation of Land</i>

SHR	State Heritage Register
SO <sub>2</sub>	sulphur dioxide
SoHI	Statement of Heritage Impact
SREP	Sydney Harbour Catchment Regional Environmental Plan
State Infrastructure Strategy	<i>State Infrastructure Strategy 2012–2032</i>
Sydney Harbour Catchment REP	<i>Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005</i>
Sydney's Rail Future	<i>Sydney's Rail Future Modernising Sydney's Trains</i>
TMP	traffic management plan
Transport for NSW	Transport for New South Wales
Transport Master Plan	<i>NSW Long Term Transport Master Plan</i>
TSC Act	(NSW) <i>Threatened Species Conservation Act 1995</i>
TSP	total suspended particles
µg	micrograms
Up-track	Refers to the line on which a train travels toward the city away from Lindfield Station towards Chatswood Station and the Sydney CBD

# Executive summary

## Lindfield substation works

In future, Sydney Trains intends to operate increasing train services on the North Shore Line. A new traction power substation is required to allow for this increase in capacity and will support the delivery of the North West Rail Link. Therefore, a new substation is proposed to be constructed at Lindfield to supply the North Shore Line. The proposal also includes ancillary electrical works generally between Killara Station and the Clanville Road overbridge in Lindfield.

The substation site (where the substation would be constructed) is located on Lindfield Avenue at the intersection with Strickland Avenue in Lindfield, approximately 300 metres to the south of Lindfield Station. The site is within the existing rail corridor between the North Shore Line up-track (i.e. travelling towards Sydney central business district (CBD)) and Lindfield Avenue. In addition, the works comprise ancillary electrical works, including the installation of aerial earth wires to existing power poles generally between Killara Station and Russell Avenue, Lindfield and the realignment of existing overhead wiring generally between Russell Avenue and the Clanville Road overbridge.

The key features of the proposal are:

- construction and operation of a new traction power substation at Lindfield in order to continue to power the Sydney Trains network (in particular the North Shore Line). Components of the substation would generally include:
  - ▶ construction of two new rectifier transformers
  - ▶ installation of switchgear room containing switchgear and switchboards, batteries and changers, voice and data communications equipment
  - ▶ installation of the rectifier and reactor unit(s)
  - ▶ office and associated facilities
  - ▶ earthworks and construction of a retaining wall on the western side of the substation site, adjacent to the rail line
- realignment of the existing 33 kilovolt (kV) and 11 kV overhead wiring (OHW), to a new combined services route (CSR), generally between power pole P57 (to the south of Lindfield Station near the intersection with Russell Avenue, Lindfield and power pole P49 (to the north of the Clanville Road overbridge)
- relocation and installation of signalling cable and communication cable to the substation to connect with existing cables along the North Shore Line
- construction of a new driveway access to the substation site from Lindfield Avenue and a paved surface area to provide car parking for approximately four vehicles within the proposed substation compound
- security and permanent maintenance lighting within and external to the building
- landscaping and vegetation surrounding the proposed substation building, generally to the east and south of the site
- installation of feeder and return cabling to the OHW system on the North Shore Line
- installation of an aerial earth wire to the top of the existing (Sydney Trains) power poles, generally between Killara Station and Russell Avenue, Lindfield
- relocation of street lighting and power routes to provide access to the substation for construction and maintenance (including future replacement of substation equipment).

Minor enabling works are expected to be undertaken in late 2014. Service relocation will commence in mid-2015 with construction of the substation expected to commence in early 2016 (subject to Transport for NSW's determination of this Review of Environmental Factors (REF)) with testing and commissioning anticipated in August 2017. The substation site is expected to be handed over to Sydney Trains in late 2017.

## Key environmental impacts of the proposal

This REF assesses the construction and operational environmental impacts of a proposed traction substation at Lindfield. The key potential impacts associated with the proposal would likely comprise:

- *Vegetation removal* — construction of the proposed substation and associated cabling at Lindfield would require the removal of up to approximately 0.94 hectares of native vegetation being a combination of Blue Gum High Forest and Sydney Turpentine Ironbark Forest scrubby regrowth. Up to approximately 2.31 hectares of habitat would be removed which is of low to moderate condition and may provide some marginal foraging habitat for several threatened species of birds and bats. Significance assessments have been undertaken for threatened biodiversity which have concluded that due to the small area and highly modified condition of the vegetation and habitat recorded within the study area, the proposed substation construction is not likely to have a significant impact on any threatened biodiversity, nor would it interfere with their recovery, assuming appropriate mitigation measures are implemented. Based on the assumption that the 'additional aerial earth (overhead) wires only' section of the proposed will require the removal of vegetation to the north of Lindfield Station construction of the proposed substation at Lindfield will require the removal of 2.31 hectares of potential foraging habitat for these species. In the likelihood that power poles are not replaced as part of the proposed this area of vegetation removed will be reduced. However, if required, offsetting would be undertaken in alignment with Transport for NSW offsetting guidelines (Transport for NSW, 2014) during detailed design.
- *Construction noise* — the proposal would result in construction noise and vibration impacts within the local area at a range of residential receivers during specific activities. There may be some short-term exceedances of the construction noise criteria (including the use of rock breaking equipment and the placement of plant and equipment) in addition to during out-of-hours works. These exceedances are expected to be short-term in duration and all feasible and reasonable practices would be applied to minimise noise impacts to the local community during these periods. In the event of the need for out-of-hours works, the contractor would be required to discuss the proposed works with the (NSW) Environment Protection Authority (EPA) and notify local residents and businesses prior to the proposed works occurring. Mitigation measures put in place during construction would reduce the predicted noise levels to within an acceptable range.
- *Operational noise* – some noise impacts may occur to sensitive receivers adjacent to the proposal site. The predicted base case steady state noise levels have been identified as resulting in a worst-case 11 dB exceedance of the night-time intrusive goal at the nearest sensitive receivers (without mitigation). The predicted  $L_{A1(60\text{second})}$  noise levels also exceed the sleep disturbance goals at the nearest residential receiver locations by up to 16 dB. It should be noted, however, that the predicted noise level from circuit breaker operation will not occur on a continuous basis and will likely be a very infrequent occurrence during the night-time period – potentially once or twice a month.

Whilst this exceedance has been predicted to be moderate, it is expected that the substation can be readily designed (during the detailed design stage of the proposal) to meet the noise goals through provision of shielding or consideration of the acoustic performance of the enclosure during detailed design of the structure. Mitigation measures would be put in place to reduce the predicted noise levels to within an acceptable range during operation of the substation.

- *Visual* – the landscape and visual impacts would generally be restricted to a small number of localised viewing locations to the site as a result of the introduction of a new structure and the removal of some existing screening. This potentially increases the visibility of the substation and existing train movements along the rail corridor. Some improvement to the existing visual landscape would occur as a result of the removal of overhead wiring generally between power pole P57 (south of Lindfield Station near Russell Avenue) and power pole P49 (north of the Clanville Road overbridge). Landscape and visual impacts would occur during both the construction and operational phases. However, the proposed landscape planting would partially screen the outer sides of the building from views from the surrounding areas.
- *Construction traffic* — some limited traffic impacts may occur during the construction of the proposed substation and associated cabling, including some increase in heavy vehicle movements and the potential for limited road closures during the delivery of primary equipment such as transformer and reactor units.

An assessment of each of the above, and other environmental issues associated with the proposal, is provided in the body of this REF.

It is considered that the potential adverse environmental impacts are generally localised in nature. With the adoption and implementation of the proposed mitigation measures and commitments specified in Chapter 8, the potential environmental impacts of the proposal could be adequately mitigated and managed, and are not considered to be significant.

## Next steps

Transport for NSW will exhibit the REF for a period of 10 business days to enable the community to provide written comments on the proposal.

A range of stakeholder and community consultation activities would be undertaken as part of the public exhibition. Additional stakeholder and community consultation would continue to be implemented to inform the community and stakeholders about the proposal throughout the detailed design and construction of the project (should it be approved during the determination phase).

At the close of the exhibition period, Transport for NSW will consider the submissions received in response to the REF. A submissions report would be prepared to address and respond to the issues raised in the submissions. This report, along with the REF and any other relevant information, would be used by Transport for NSW to assess and determine the proposal.

Should the proposal be approved, Transport for NSW would make the submissions report and any conditions of approval publicly available. The local community would be notified by way of advertisements in local newspapers, community newsletters and the Transport for NSW website [www.transport.nsw.gov.au/projects](http://www.transport.nsw.gov.au/projects). Correspondence would also be sent to people who make a submission which would include contact details for further information and an indication of the anticipated timing of construction work.





# 1. Introduction

## 1.1 Overview of the proposal

This section provides an overview of the proposal that is the subject of this Review of Environmental Factors (REF). A more detailed description of the proposal is provided in Chapter 5.

### 1.1.1 Background and need for the proposal

The NSW Government has developed a plan to transform and modernise Sydney's rail network so that it can grow with the city's population and meet the needs of customers into the future. The NSW Government has identified that Sydney's rail system is reaching the limits of its capacity. For example, at present there are parts of the network where 20 trains are scheduled to run in the busiest peak hour but often only 17 trains actually arrive during that period (NSW Government 2012b).

In future, Sydney Trains intends to operate increasing train services on the North Shore Line. A new traction power substation is required to allow for this increase in capacity and will support the delivery of the North West Rail Link (NWRL). Therefore, a new substation is proposed to be constructed at Lindfield to supply the North Shore Line.

### 1.1.2 Proposal site and location of the proposal

For the purposes of this assessment, the following definitions are used:

- The 'proposal site' refers to the area that would be directly impacted by the proposal. The location of the proposal site is shown on Figure 1.2 and would encompass two main components consisting of the following:
  - ▶ the 'substation site' (where the substation would be constructed)
  - ▶ the 'electrical works site' (comprising an area of associated electrical works, generally between Killara Station, in Lindfield, in the north and the Clanville Road, Lindfield overpass in the south)
- The 'study area' encompasses the proposal site and the area that may be indirectly impacted by the proposal. This area can vary in size depending on the environmental issue being discussed (e.g. biodiversity, heritage etc.) and the specific area for each issue is described in the relevant section of Chapter 6.

The proposal site lies wholly within the Ku-Ring-Gai local government area (LGA) and is surrounded by developed urban areas and the Sydney Trains' North Shore Line to the west. The site is predominantly surrounded by residential development to the east, west and south of the proposal site. The main town centre of Lindfield, including light industrial and commercial uses, is located to the north of the site (refer to Figure 1.1).

The substation site is located on Lindfield Avenue, at its intersection with Strickland Avenue in Lindfield, approximately 300 metres to the south of Lindfield Station. The substation site is within the existing rail corridor between the North Shore Line up-track (i.e. travelling towards Sydney central business district (CBD)) and Lindfield Avenue. Figure 1.2 shows the location of the overall proposal site, including the substation site and the electrical works site.



Figure 1.1 Location of the proposed Lindfield substation

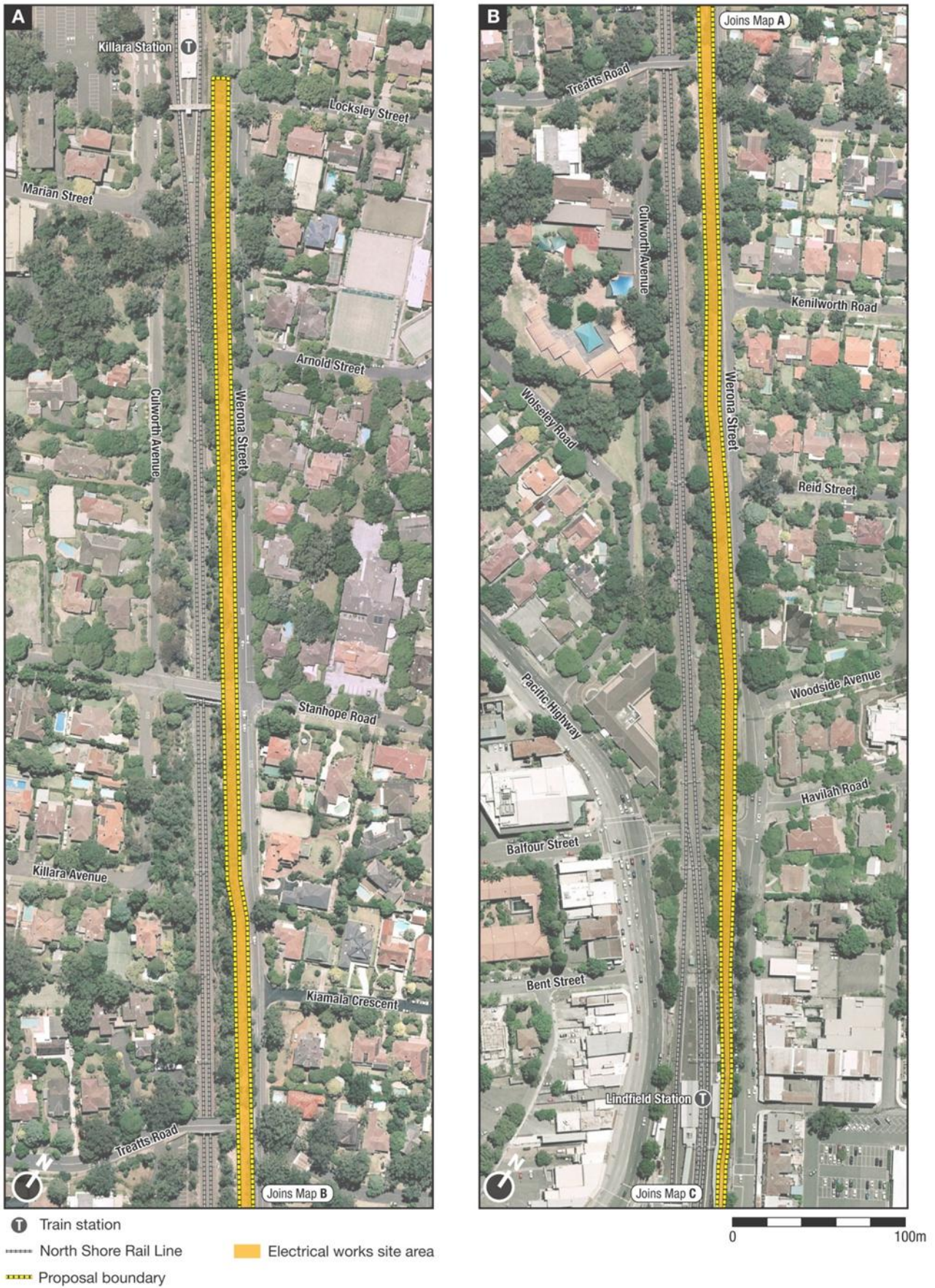


Figure 1.2a Proposal boundary



Figure 1.2b Proposal boundary

### 1.1.3 Existing environment

The overall proposal site forms part of the operational rail corridor generally between Killara Station and the Clanville Road overbridge. It is adjacent to a residential area which consists of a mix of low and medium density residential dwellings. Lindfield town centre is also located to the north of the main substation site. Further details of surrounding land uses are provided in section 6.5. The substation site is currently accessed via an existing gate located off Lindfield Avenue (further details of the surrounding road network are located in section 6.1). Other parts of the proposal site are accessed by a series of existing Sydney Train access gates along the rail corridor (described in greater detail in section 6.1).

The proposal site contains vegetation that generally consists of weeds or introduced species. This railway corridor has been greatly disturbed as a result of the existing infrastructure (railway line), however some portions of Sydney Turpentine Ironbark Forest and Blue Gum High Forest derived from scrubby regrowth vegetation communities have been identified within the wider proposal site (further details of flora and fauna are located in section 6.4). To the north and south of the substation site, the corridor is predominately cleared and consists of a mixture of grassed and gravel surfaces which provide access along the corridor towards the north.

There are no surface waterways that have been located within close proximity to the proposal site.

The existing site is shown in Figures 1.3 to 1.9 below.



**Figure 1.3 View of the proposed substation site looking north from Strickland Avenue**

Source: Envisage consulting, 2014



**Figure 1.4 View of the northern end of the proposed substation site looking north from within the site**  
Source: Parsons Brinckerhoff, 2014



**Figure 1.5 View of the proposed substation site looking west towards the existing site entrance from Lindfield Avenue**

Source: Envisage consulting, 2014



**Figure 1.6 View of the proposed substation site looking west towards the proposed new entrance from Lindfield Avenue**

Source: Envisage consulting, 2014



**Figure 1.7 View of the proposed substation site looking east from Strickland Avenue**

Source: Envisage consulting, 2014



**Figure 1.8** Typical example of the proposal site to the south of the substation site for the installation of the new combined services route, south of the Strickland Road Bridge

Source: Transport for NSW, 2014



**Figure 1.9** Typical example of the southern end of the proposal site for the installation of the new combined services route, to the north of Clanville Road

Source: Transport for NSW, 2014



### 1.1.4 Key features of the proposal

The proposal comprises the construction of a new substation building, and installation of associated wiring, cabling and substation equipment. The key features of the proposal would comprise:

- construction and operation of a new traction power substation at Lindfield in order to continue to power the Sydney trains network (in particular the North Shore Line). Components of the substation would generally include:
  - ▶ construction of two new rectifier transformers
  - ▶ installation of switchgear room containing switchgear and switchboards, batteries and changers, voice and data communications equipment
  - ▶ installation of the rectifier and reactor unit(s)
  - ▶ office and associated facilities
- realignment of the existing 33 kilovolt (kV) and 11 kV overhead wiring (OHW), to a new combined services route (CSR) generally between power pole P57 (to the south of Lindfield Station near the intersection with Russell Avenue) and power pole P49 (to the north of the Clanville Road overbridge)
- relocation and installation of signalling cable and communication cable to the substation to connect with existing cables along the North Shore Line
- construction of a new driveway access to the substation site from Lindfield Avenue and a paved surface area to provide for car parking for approximately four vehicles within the proposed substation compound
- lighting within and external to the building would consist of security and permanent maintenance lighting
- landscaping and vegetation surrounding the proposed substation building, generally to the east and south of the substation
- installation of feeder and return cabling to the OHW system on the North Shore Line
- installation of an aerial earth wire to the top of the existing (Sydney Trains) poles, generally between Russell Avenue, Lindfield and Killara Station
- relocation of street lighting and power routes to provide access to the substation for construction and maintenance (including future replacement of substation equipment).

Minor enabling works are expected to be undertaken in late 2014. Service relocation will commence in mid-2015 with construction of the substation expected to commence in early 2016 (subject to Transport for NSW's determination of this REF) with testing and commissioning anticipated in August 2017.

The substation site is expected to be handed over to Sydney Trains in late 2017.

### 1.1.5 Proponent and delivery

The construction of the Lindfield traction substation and associated electrical works would be undertaken by a contractor engaged by Transport for NSW. At the award of the works package, the proposal site would be occupied by the contractor, who will carry out all activities required for its work including site clearing and excavation, relocation of affected utility services, construction and fit-out of the substation, including associated works such as high voltage cable relocations, signalling equipment relocations, testing and commissioning and all remaining works such as landscaping and site restoration.

At the completion of the works package, the substation and proposal site would be handed over to Sydney Trains for operation of the substation.

## 1.2 Structure and content of the REF

The structure and content of the REF is outlined in Table 1.1.

**Table 1.1 Structure and content of the REF**

Chapter	Description
Chapter 1 – <i>Introduction</i>	Outlines the background of the proposal and need for the proposal.
Chapter 2 – <i>Statutory and planning considerations</i>	Outlines the relevant environmental planning instruments and policies and provides an assessment of their relevance to the proposal.
Chapter 3 – <i>Community and stakeholder engagement</i>	Outlines how the community and stakeholders have been, and will continue to be, involved in the proposal's development, assessment and construction phases. This chapter also summaries the issues raised by stakeholders during the preparation of the REF.
Chapter 4 – <i>Options development and selection</i>	Provides an overview of the options that were considered during the selection of the site for the Lindfield traction substation and the methodology that was used to select the preferred option.
Chapter 5 – <i>Proposal description</i>	Provides a detailed description of the proposal, including the elements of the proposal, and construction, operation and maintenance of the proposed substation.
Chapter 6 – <i>Environmental impact assessment</i>	Provides an assessment of the potential impacts of the proposal on traffic and transport, noise and vibration, Aboriginal heritage, non-Indigenous heritage, air quality, biodiversity, soils, hydrology and water quality, sustainability, visual, resource use, utilities and waste management and cumulative impacts.
Chapter 7 – <i>Environmental management and mitigation</i>	Outlines the proposed environmental management systems to be implemented and provides the management and mitigation measures during the construction, operation and maintenance of the proposed substation, to manage the impacts identified in the REF.
Chapter 8 – <i>Justification and conclusion</i>	Provides the justification for the proposal and an outline of the key conclusions of this report.

The REF is supported by six technical papers, which provide detailed assessment of specific environmental issues associated with the proposal. These technical papers form appendices to the REF and have been used to inform the REF, as follows:

- Technical Paper 1 – Traffic and transport impact assessment (Parsons Brinckerhoff)
- Technical Paper 2 – Noise and vibration impact assessment (SLR Consulting)
- Technical Paper 3 – Visual impact assessment (Envisage)
- Technical Paper 4 – Ecological impact assessment (Parsons Brinckerhoff)
- Technical Paper 5 – Non-Indigenous cultural heritage impact assessment (Artefact Heritage)
- Technical Paper 6 – Aboriginal archaeological impact assessment (Artefact Heritage).

## 2. Statutory and planning considerations

This chapter outlines the statutory requirements and explains the environmental planning process and approvals process for the construction and operation of the proposed traction substation and associated electrical works at Lindfield ('the proposal'). The environmental planning instruments relevant to the construction and operation of the proposed substation are also outlined.

### 2.1 NSW legislation and regulations

#### 2.1.1 Environmental Planning and Assessment Act 1979

The proposal comprises an 'activity' for the purposes of Part 5 of the (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) by reason of clause 79 of *State Environmental Planning Policy (Infrastructure) 2007* (the Infrastructure SEPP). Specifically, Clause 79 of the Infrastructure SEPP outlines that development for the purpose of railways and railway infrastructure facilities, which include 'power supply (including overhead power supply) systems', are permissible without the need for development consent under Part 4 of the EP&A Act when undertaken by a public authority. Further details regarding the Infrastructure SEPP are provided in section 2.4.1 of this REF.

As the determining authority for the purposes of Part 5 of the Act, Transport for NSW must:

- examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity, in accordance with Section 111 of the EP&A Act
- determine whether or not the activity is likely to significantly affect the environment or is likely to significantly affect threatened species, populations and ecological communities.

Chapter 6 of this REF assesses the likely effect of the proposal on the environment and threatened species, populations and ecological communities. Having regard to the provisions of Sections 111 and 112 of the EP&A Act, no significant impact on the environment or threatened species is predicted and therefore neither an Environmental Impact Statement (EIS), nor a species impact statement is required.

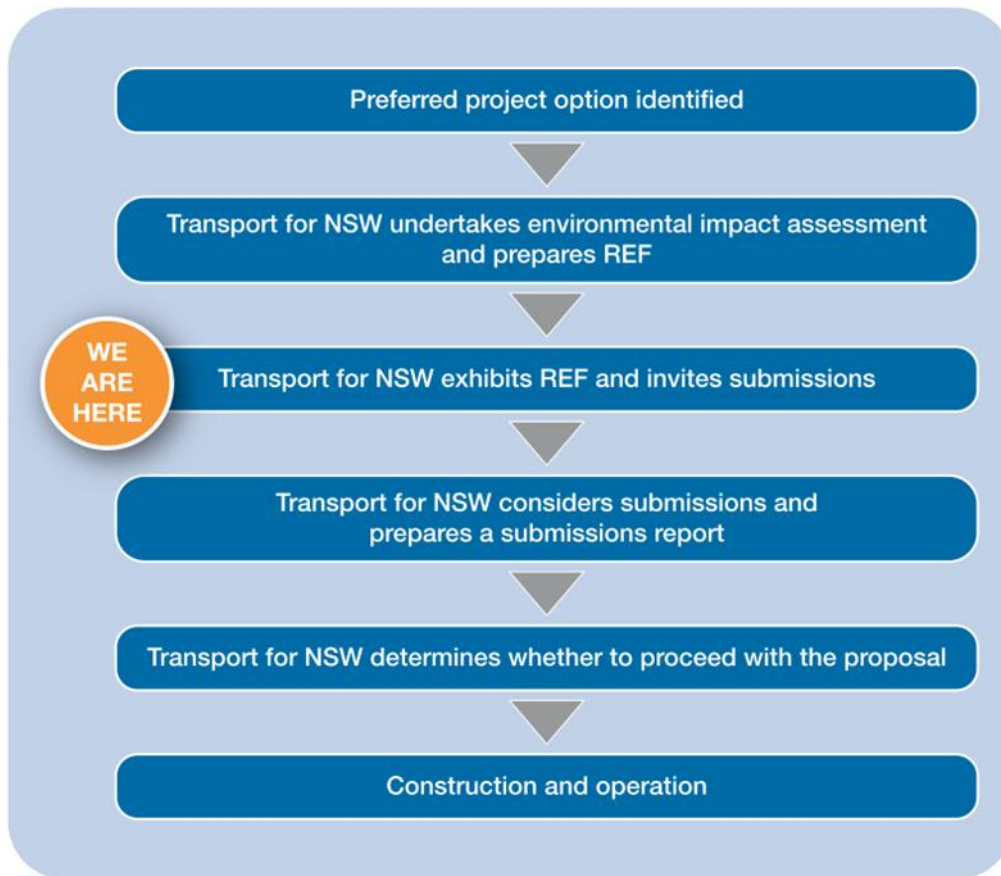
#### Assessment and approval process under Part 5

Transport for NSW has prepared this REF, which includes appropriate mitigation measures to manage and minimise impacts on the environment. The REF document will be exhibited and made publicly available from 28 July 2014 to 11 August 2014. During the exhibition period, the community would be encouraged to make submissions to Transport for NSW on the proposal and information contained in the REF.

Following the exhibition period, Transport for NSW will consider issues raised in submissions and respond to community feedback in a submissions report. If required, Transport for NSW may also propose changes to the proposal and detail these in the submissions report. These documents will be available to the public via the Transport for NSW website ([www.transport.nsw.gov.au/projects](http://www.transport.nsw.gov.au/projects)).

Following the preparation of the submissions report, Transport for NSW will determine whether to proceed with the proposal. If the proposal proceeds, it would be designed, constructed and operated in accordance with the mitigation measures outlined in this REF, the submissions report and any additional conditions of approval.

The planning approvals process for the proposal under Part 5 of the EP&A Act is outlined in Figure 2.1.



**Figure 2.1 Planning approvals process for the proposal**

#### Sustainability requirements under the EP&A Act

Schedule 2 of the (NSW) *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), and Section 6(2) of the (NSW) *Protection of the Environment Administration Act 1991* (PEA Act) outline the four principles of ecologically sustainable development (ESD).

Transport for NSW is committed to ensuring that its projects are implemented in a manner that is consistent with the principles of ESD, which are:

- *The precautionary principle*: If there are threats of serious or irreversible damage, a lack of full scientific uncertainty should not be used as a reason for postponing measures to prevent environmental degradation.
- *Intergenerational equity*: The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.
- *Conservation of biological diversity and ecological integrity*: The diversity of genes, species, populations and their communities, as well as the ecosystems and habitats they belong to, should be maintained or improved to ensure their survival.
- *Improved valuation, pricing and incentive mechanisms*: Environmental factors should be included in the valuation of assets and services.

Transport for NSW has considered these principles and broader sustainability themes in the development of the proposal. A discussion of how the proposal has considered the principles of ESD, including sustainability initiatives incorporated into the proposal, is provided in section 6.14 and Chapter 8 of this REF.

## 2.2 NSW Government policies and strategies

### 2.2.1 NSW 2021 – State Plan

*NSW 2021: A plan to make NSW number one* (NSW Government 2011; 'NSW 2021') is a 10-year plan to rebuild the economy, return quality services, renovate infrastructure, restore accountability to government, and strengthen the local environment and communities. The plan sets immediate priorities for action and guides NSW Government resource allocation in conjunction with the NSW Budget. It replaces the former *NSW State Plan – Investing in a Better Future* (NSW Government 2010a) as the NSW Government's strategic business plan. NSW 2021 includes 32 goals and 180 targets to frame the achievements of its commitments.

A number of goals in NSW 2021 are specifically aimed at improving access and transport across the State. Common aims and themes across these goals include maximising the efficiency and effectiveness of public transport, and for active transport systems – including reducing travel times, increasing patronage, enhancing customer experience, integration across modes and desired origin/destination points and improving the frequency and reliability of services. The investment in critical infrastructure is also a key goal of the plan (Goal 19).

The proposed new substation at Lindfield would assist in meeting a number of these goals by providing ongoing and future traction power supply requirements to the existing Sydney Trains network to enable the ongoing supply of power, in particular to the North Shore Line. This would support the broader goals of the Plan by allowing expansion of Sydney's rail network including the ability to run additional services during peak periods, thereby improving the frequency and reliability of services.

### 2.2.2 NSW Long Term Transport Master Plan and Sydney's Rail Future

The *NSW Long Term Transport Master Plan* (NSW Government 2012a; 'Transport Master Plan') is a 20-year plan to improve the NSW transport system. It provides the basis upon which further detailed transport planning, including the proposal, can be undertaken. This includes the development of *Sydney's Rail Future* (NSW Government 2012b) which aims to reform, improve and grow services on the existing Sydney Trains network, leading to an overall capacity increase of 60 per cent.

The Transport Master Plan considers the future population growth and employment precincts within the State (including Sydney) and outlines the capabilities and limitations of the transport network for all transport modes (including buses, heavy rail, light rail, ferry and private vehicles) to provide clear direction for future transport investigations.

A key element of the Transport Master Plan is the need to address congestion coming into and within the Sydney CBD. As part of *Sydney's Rail Future*, five key stages have been identified. As part of Stage 3 of the plan, the provision of *a train from Chatswood to the CBD every three minutes in peak periods* is noted. In order to support this commitment, additional trains would be required to operate along the North Shore Line. The proposed Lindfield substation is an important component in achieving this, by providing ongoing and future traction power supply requirements to the existing Sydney Trains network to meet the increased service requirements.

## 2.2.3 State Infrastructure Strategy

The NSW Government's *State Infrastructure Strategy 2012–2032* (Infrastructure NSW 2012; 'State Infrastructure Strategy') sets out and commits to the State's infrastructure delivery and reform priorities over the next five years. The strategy is designed to complement the Transport Master Plan.

A core element of the State Infrastructure Strategy is the development of a pipeline of projects that prioritises investment, and provides opportunities for private sector involvement in delivery and operations. The strategy seeks to prioritise projects that maximise economic benefits for the State, while also considering the capacity of the Government to provide funds for new projects.

The State Infrastructure Strategy supports the ongoing aim to provide reliable, frequent and fast passenger trains as an essential part of the economic success of NSW and of the amenity of life, particularly in Global Sydney. The construction of the proposed Lindfield substation as a means of maintaining and providing sufficient traction power for meeting the current and future Sydney Trains requirements is considered to be consistent with this aim.

## 2.3 Other relevant environmental planning instruments

The following environmental planning instruments are considered relevant to the proposal:

- *State Environmental Planning Policy (Infrastructure) 2007* ('Infrastructure SEPP')
- *State Environmental Planning Policy No. 19 – Bushland in Urban Areas* ('SEPP 19 – Urban Bushland')
- *State Environmental Planning Policy No 55 – Remediation of Land* ('SEPP 55 – Remediation of Land')
- *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* ('Sydney Harbour Catchment SREP')
- *Ku-Ring-Gai Local Environmental Plan (Local Centres) 2012*
- *Draft Ku-Ring-Gai Local Environmental Plan 2013*.

Given that the Infrastructure SEPP controls the proposal, the LEPs listed above would not apply to the extent that they are inconsistent with the Infrastructure SEPP. In light of this, the proposal's compliance with these instruments is considered below.

### 2.3.1 State environmental planning policies (SEPPs)

#### Infrastructure SEPP

*State Environmental Planning Policy (Infrastructure) 2007* (the Infrastructure SEPP) outlines the permissibility and development controls for infrastructure works and facilities. Specifically, clause 79 of the Infrastructure SEPP outlines what railway facilities are permissible without the need for development consent under the EP&A Act under Part 4 of the EP&A Act. Rail infrastructure facilities are defined in Clause 78 of the SEPP, which includes 'power supply (including overhead power supply) systems' (part (c) of the definition of 'rail infrastructure facilities').

The proposed Lindfield substation is therefore considered to be permissible without consent as the proposal can be defined as a 'rail infrastructure facility' under the Infrastructure SEPP.

## SEPP 19 – Urban Bushland

*State Environmental Planning Policy 19 – Urban Bushland* (SEPP 19 – Urban Bushland) applies to bushland within the urban areas identified in Schedule 1 of the SEPP, which includes the Ku-Ring-Gai LGA in which the proposal is located. The aim of SEPP 19 – Urban Bushland is to protect and preserve bushland for its natural heritage aesthetic, recreational, educational and scientific resource values.

Clause 7 of SEPP 19 requires public authorities (i.e. the proponent) to have regard for the aims of the policy before deciding to disturb any remnant bushland. Notwithstanding, SEPP 19 is not applicable to the proposal as no consent is required for the proposal under the provisions of the Infrastructure SEPP.

Additionally, under Clause 9(2) of SEPP 19 – Urban Bushland, a public authority must not grant approval to or carry out development on land which adjoins bushland zoned or reserved for public open space unless it has taken into account:

- (c) the need to retain any bushland on the land,
- (d) the effect of the proposed development on bushland zoned or reserved for public open space purposes and, in particular, on the erosion of soils, the siltation of streams and waterways and the spread of weeds and exotic plants within the bushland, and
- (e) any other matters which, in the opinion of the approving or consent authority, are relevant to the protection and preservation of bushland zoned or reserved for public open space purposes’.

The substation site at Lindfield is not located within or adjacent to land zoned or reserved for public open space. Notwithstanding, a small amount of vegetation at the substation site would be required to be cleared to accommodate the proposed substation. Some additional clearing would be required towards within the southern part of the electrical works site to allow for the relocation of the existing electricity feeder cables, generally between the substation site and Clanville Road. These impacts are discussed further in section 6.4 of this REF.

## SEPP 44 – Koala Habitat Protection

*State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44) aims to encourage the proper conservation and management of natural vegetation areas that provide habitat for koalas to ensure that permanent, free living areas are maintained over their present range. The policy applies to a number of LGAs across NSW, including the Ku-Ring-Gai Council.

The requirements of SEPP 44 do not apply to this proposal, as it is not subject to council consent. However, the proposal has considered the potential impacts with respect to SEPP 44 criteria in its environmental impact assessment process. The assessment criteria consider whether the percentage cover of known feed trees, listed under Schedule 2 of SEPP 44 is greater or less than 15 per cent of the total tree canopy.

As outlined in section 6.4, the proposal site contains limited native vegetation, of which the identified vegetation is not considered to be an identified feed tree species as identified in Schedule 2 of SEPP 44. The proposal site is therefore is not considered to represent an activity which would impact on koala habitat.

## SEPP 55 – Remediation of Land

SEPP 55 provides a State-wide approach to the remediation of contaminated land for the purpose of minimising the risk of harm to the health of humans and the environment. In accordance with Clause 7(1) of SEPP 55, a consent authority must not consent to the carrying out of development on any land unless:

- (a) it has considered whether the land is contaminated.
- (b) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or would be suitable, after remediation) for the purpose for which the development is proposed to be carried out.

- (c) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land would be remediated before the land is used for that purpose.'

As the proposal is permissible without consent, the provisions of SEPP 55 do not apply. However, section 6.7 of this REF contains an assessment of the potential contamination impacts of the proposal. It is unlikely that any large-scale remediation (Category 1) work would be required as part of the proposal. The proposed land use does not differ to the existing use and is, therefore, unlikely to be affected by any potential contaminants that exist within the rail corridor. Any remediation works required for the proposal would be undertaken in accordance with this SEPP.

### Sydney Harbour Catchment Regional Environmental Plan (REP)

The *Sydney Harbour Catchment Regional Environmental Plan* (SREP) (now referred to as a deemed SEPP) applies to all the waterways of Sydney Harbour, the foreshores and its wider catchment. The SREP aims to protect, enhance and maintain the catchment, foreshores, waterways and islands of Sydney Harbour. The SREP also aims to establish a balance between promoting a prosperous working harbour, maintaining a healthy and sustainable waterway environment and promoting recreational access to the foreshore and waterways.

Within the Sydney Harbour Catchment, particular provisions of the SREP apply to:

- the Foreshores and Waterways Area (as shown on the Foreshores and Waterways Area Boundary of the SREP)
- various strategic foreshore sites (as shown on the Strategic Foreshore Sites Map of the SREP)
- various heritage items (as shown on the Heritage Map of the SREP)
- various wetland protection areas (as shown on the Wetlands Protection Area Map of the SREP).

Although the proposal is within the broader catchment of the Sydney Harbour Catchment SREP, the proposal is not located within the foreshore areas of the Sydney Harbour Catchment and would not impact upon any heritage items or wetlands; therefore none of the provisions apply to the proposal. The proposal is not expected to result in any detrimental impacts on the existing environmental quality of Sydney Harbour, largely due to its distance from the harbour.

### Local environmental plans (LEPs)

The proposal is located within the Ku-Ring-Gai LGA. The operation of the Infrastructure SEPP means that LEPs would not apply to the extent that they impose controls which are inconsistent with the Infrastructure SEPP. However, during the preparation of the REF, the provisions of the following LEPs were considered:

- *Ku-Ring-Gai Local Environmental Plan (Local Centres) 2012* ('Ku-Ring-Gai LEP')
- *Draft Ku-Ring-Gai Local Environmental Plan 2013*.

The proposed Lindfield substation would be located within the existing rail corridor on land zone SP2 Railway Infrastructure under the Ku-Ring-Gai LEP. Irrespective of the provisions of the applicable LEPs, permissibility for the proposal is provided for under the provisions of the Infrastructure SEPP.

A draft LEP is currently being prepared by Ku-Ring-Gai Shire Council. Should this plan apply to the proposal site, it is not expected that the proposal would be inconsistent with this draft LEP.



## 2.3.2 Approvals under other NSW legislation

### (NSW) Protection of the Environment Operations Act 1997

The (NSW) *Protection of the Environment Operations Act 1997* ('the PoEO Act') administers environment protection licences (EPLs) for specific activities relating to air, water and noise pollution, and waste management. The EPA and local government, where relevant, administer the PoEO Act.

Development activities require an environment protection licence under the POEO Act if those activities meet the assessment criteria outlined in Schedule 1 of the Act. The construction works for the new Lindfield substation proposal is not considered to fall within the definition of 'railway system activities', pursuant to clause 33(1) of Schedule 1 of the POEO Act. Consequently, an environment protection licence would not be required to be obtained under the POEO Act.

### (NSW) Native Vegetation Act 2003

Some clearing of native vegetation would be required for the construction of the Lindfield substation as part of the proposal (refer to section 6.4 of this REF).

The (NSW) *Native Vegetation Act 2003* ('the Native Vegetation Act') is administered by the (NSW) Office of Environment and Heritage (OEH) and manages the clearing of native vegetation in NSW. Section 25(g) of the Native Vegetation Act provides that it does not apply to any clearing that is part of an activity that is permissible without consent.

Furthermore, the Ku-Ring-Gai LGA is identified in Schedule 1 as land excluded from operation of the Native Vegetation Act. Therefore, the Act therefore does not apply to the proposal. Notwithstanding the above, a comprehensive assessment of the extent and potential impact of vegetation clearing as a result of the proposed Lindfield substation has been completed as part of this REF (refer to section 6.4 and Technical Paper 4).

### (NSW) Threatened Species Conservation Act 1995

The (NSW) *Threatened Species Conservation Act 1995* ('the TSC Act') provides protection for threatened species, populations and ecological communities and their habitat in NSW. Significance assessments must be completed for all endangered ecological communities, and threatened populations and species listed under the TSC Act that are found to be within the footprint of a proposal, or that are likely to occur and which would be directly or indirectly affected by a proposal.

An ecological assessment, *Ecological Assessment for proposed substation at Lindfield* (Technical Paper 4) has been prepared to assess the impacts of the construction of the proposed substation at Lindfield.

Significance assessments were carried out for threatened species, populations or communities listed under the TSC Act that were known or predicted to occur in the proposal locality (within a 10 kilometre radius of the study area) that had a moderate to high likelihood of occurring within the study area, based on suitable habitat and that were likely to be impacted upon by construction of the proposed substation.

A summary of the significance assessments undertaken for threatened biodiversity are provided in Appendix E of Technical Paper 4 and summarised in section 6.4 of this report. Due to the small area and highly modified condition of the vegetation and habitat recorded within the study area, the impact assessments concluded that the proposal is not likely to have a significant impact on any threatened biodiversity, nor would it interfere with their recovery, assuming the mitigation measures outlined in section 6.4.5 and Chapter 7 are implemented.

### (NSW) National Parks and Wildlife Act (1974)

The (NSW) *National Parks & Wildlife Act 1974*, administered by the OEH provides statutory protection for all Aboriginal 'objects' (consisting of any material evidence of the Aboriginal occupation of NSW) under Section 90 of the Act, and for 'Aboriginal Places' (areas of cultural significance to the Aboriginal community) under Section 84.

The protection provided to Aboriginal objects applies irrespective of the level of their significance or issues of land tenure. However, areas are only gazetted as Aboriginal Places if the Minister is satisfied that sufficient evidence exists to demonstrate that the location was and/or is, of special significance to Aboriginal culture.

The Act was recently amended (2010) and as a result the legislative structure for seeking permission to impact on heritage items has changed. Under the amendments to the Act the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales was introduced in October 2010 by the OEH (formerly the Department of Environment, Climate Change and Water). The aim of the guidelines is to assist individuals and organisations to exercise due diligence when carrying out activities that may harm Aboriginal objects and to determine whether they should apply for consent in the form of an Aboriginal Heritage Impact Permit (AHIP).

A due diligence assessment should take reasonable and practicable steps to ascertain whether there is a likelihood that Aboriginal sites will be disturbed or impacted during the proposed development. If it is assessed that sites exist or have a likelihood of existing within the development area and may be impacted by the proposed development, further archaeological investigations may be required along with an AHIP. If it is found to be unlikely that Aboriginal sites exist within the study area and the due diligence assessment has been conducted according to the Code of Practice, work may proceed without an AHIP.

An Aboriginal due diligence assessment has been undertaken as part of the assessment of the proposal and is provided as Technical Paper 6. A summary of the due diligence assessment is included as section 6.9 of this REF.

### (NSW) Noxious Weeds Act 1993

The (NSW) *Noxious Weeds Act 1993* ('the Noxious Weeds Act') provides for the declaration of noxious weeds by the Minister for Primary Industries. Noxious weeds may be considered noxious on a national, state, regional or local scale. All private landowners, occupiers, public authorities and Councils are required to control noxious weeds on their land under Part 3 Division 1 of the Noxious Weeds Act.

Of the 36 exotic species that were recorded within the proposal study area, eight species of plant are listed under the Noxious Weeds Act for the Ku-Ring-Gai Council noxious weed control area. Of these species, four species are listed as a Weed of National Significance. This is discussed further in section 6.4 of this report and Technical Paper 4.

As a result of the mitigation measures proposed for the proposal (refer to section 6.4.5 and Chapter 7), it is unlikely that the proposed works would result in an increase in propagation of the existing weed species. Clearance of some existing weeds may occur as a result of clearing works at the substation site. The waste from these works would be disposed of appropriately so as not to introduce or further spread any weeds to other locations.

### (NSW) Heritage Act 1977

The (NSW) *Heritage Act 1977* ('the Heritage Act') provides for the conservation of environmental heritage in NSW. Environmental heritage is defined as items that are of State and local importance. Heritage items usually have historical, scientific, cultural, social, archaeological, architectural, natural or visual value to the State or a particular local area.

Sections 57 to 69 of the Heritage Act address the requirements for items and places listed on the State Heritage Register (SHR), or which are affected by an interim heritage order. Unless an exemption is granted, the demolition, damage or alteration of a heritage item or place requires the approval of OEH under Section 60 of the Heritage Act. An example of where an exemption may be granted is if the impact to a heritage item is considered to be minor in nature. As outlined in section 6.8 of this REF, there are no items within the substation site listed on the SHR.

Under Section 139 of the Heritage Act, approval from OEH is required prior to the disturbance or excavation of land if a project will, or is likely to result in, a relic being discovered, exposed, moved, damaged or destroyed.

Section 170 of the Heritage Act requires government agencies to maintain a heritage and conservation register (Section 170 register). These registers provide a list of government assets which may have State or local heritage significance.

No heritage listed items or items listed on the Sydney Trains Section 170 register have been identified within the vicinity of the substation site (refer to *Lindfield Substation – Statement of Heritage Impact – Technical Paper 5*).

### (NSW) Roads Act 1993

Section 138 of the (NSW) *Roads Act 1993* ('the Roads Act') requires Transport for NSW to obtain consent from the relevant roads authority for the erection of a structure, or the carrying out of work in, on or over a public road, or the digging up or disturbance of the surface of a road. However, under Clause 5(1) in Schedule 2 of the Roads Act, public authorities do not require consent for works on unclassified roads. Whilst it is not anticipated that the proposal would impact on any classified roads, consent from the appropriate roads authority, being the (NSW) Roads and Maritime Services (Roads and Maritime) or the local council as relevant, may be required in accordance with section 138 of the Roads Act in respect of work carried out by a 'public authority' if the works were to impact on a classified road.

Consultation would be undertaken with the relevant council(s) and/or Roads and Maritime (as the applicable roads authority) if impacts may occur to roads in and surrounding the proposal area.

### (NSW) Contaminated Land Management Act 1997

Part 3 of the (NSW) *Contaminated Land Management Act 1997* empowers the EPA to regulate contaminated sites that pose a significant risk of harm to human health and/or the environment. There is no registered contamination on this site however, given the likely history of the site and proximity to an active rail corridor, there is some potential for contaminated soils to exist within this site.

A contamination management plan would be incorporated into the Construction Environmental Management Plan (CEMP) to minimise any impacts of contamination and its removal.

## 2.4 Commonwealth legislation

### 2.4.1 (Commonwealth) Environment Protection and Biodiversity Conservation Act 1999

The (Commonwealth) *Environment Protection and Biodiversity Conservation Act 1999* ('the EPBC Act') provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as 'matters of national environmental significance'.

Under the EPBC Act, any action that has, would have, or is likely to have a significant impact on a Matter of National Environmental Significance or on Commonwealth land, triggers the EPBC Act and may require approval from the Commonwealth Minister for Environment. An action may include a project, development, undertaking, activity, or series of activities. If the Commonwealth Minister for the Environment determines that an approval is required under the EPBC Act, the proposed action is deemed to be a 'controlled action'. It must then undergo assessment and approval under the EPBC Act before the action is carried out. The EPBC Act provides that a proponent of an action that may be, or is, a controlled action must refer the proposal to the Minister for the Minister's decision as to whether or not the action is a controlled action.

As described in section 2.2.3, an ecological assessment has been prepared to assess the impacts of the construction of the proposed substation at Lindfield (refer Technical Paper 4). The scrubby regrowth vegetation recorded within the study area during the preparation of the ecological assessment) contained a number of plant species characteristic to the Sydney Turpentine-Ironbark Forest, which is listed as critically endangered under the EPBC Act. Although the vegetation within the study area does contain some characteristic shrub and groundcover plant species, it does not contain a tree canopy, is less than one hectare in size and does not occur in areas of vegetation in excess of five hectares. Therefore, the vegetation within the study area is not consistent with the Commonwealth listing criteria for Sydney Turpentine-Ironbark Forest. It is therefore considered that the proposal is not likely to result in a significant impact on the identified threatened species.

Based on the presence of suitable habitat within the study area, the Grey-headed Flying-fox is considered to have a moderate or greater likelihood of occurrence. The Grey-headed Flying-fox is listed as Vulnerable under the EPBC Act and therefore a significance assessment under the EPBC Act was undertaken (refer Appendix E in Technical Paper 4). Construction of the proposed substation and associated electrical works at Lindfield will require the removal of 0.05 hectares of potential foraging habitat for the Grey-headed Flying-fox. Based on the small area of degraded habitat to be impacted, this species is unlikely to be significantly affected by the proposal. Overall, the potential impact from the proposal on the species is not considered significant with regard to its context and intensity.

No other Matters of National Environmental Significance are likely to be impacted by the proposal. An EPBC Act referral is not, therefore, considered to be required for the proposal.

# 3. Community and stakeholder consultation

This chapter summarises the planned community and stakeholder engagement activities to be undertaken to support the REF exhibition and construction phase. The REF exhibition phase will include targeted consultation activities including the provision of a community information session to provide an opportunity for stakeholders and the community to provide feedback on the proposal.

## 3.1 Consultation objectives

Transport for NSW has developed a communications and consultation strategy for the Lindfield substation REF which includes details on key activities that will be undertaken as part of informing and engaging with the local community and key stakeholders.

In summary, Transport for NSW's consultation approach for the project is to:

- provide a detailed communication and engagement plan that supports the REF program
- inform the community and other stakeholders by providing clear, factual and timely information about timing and impacts associated with the construction and operation of the new substation
- provide a mechanism for prompt issues resolution
- provide adequate opportunities for community members and other stakeholders to provide feedback
- ensure coordinated communications with other relevant agencies and stakeholders including Sydney Trains, Roads and Maritime, Ausgrid, Telstra, Optus and Jemena.

Transport for NSW will ensure that community and stakeholders are engaged throughout the life of the project including:

- public exhibition of the REF
- post determination of the project and throughout construction.

## 3.2 Consultation during REF exhibition

### 3.2.1 Engagement activities and tools

Table 3.1 lists the key engagement activities and tools and how they will be used to engage with the community and stakeholders during the public exhibition of the REF.

**Table 3.1 Key community and stakeholder engagement tools and activities**

Engagement tool	Activity
Project website	<a href="http://www.transport.nsw.gov.au/projects">www.transport.nsw.gov.au/projects</a>
Community newsletter	A newsletter will be distributed to surrounding residential, community and commercial properties.
Stakeholder meetings/briefings	Transport for NSW will undertake a briefing session to Ku-Ring-Gai Council, Ausgrid, Roads and Maritime, Telstra, Optus and Jemena on the proposed works the subject of this REF.

Engagement tool	Activity
Aboriginal consultation	There were no identified indigenous heritage items within the site. As such, no consultation has been undertaken with the local Aboriginal community groups and Land Councils at this time.
Community information sessions	One community information session is proposed to be held during the public exhibition of the REF.
Advertisements	Advertisements were placed in the North Shore Times prior to the community information sessions. The advertisements notified the community about the proposal and invited people to attend the community information sessions.
Doorknocking	Directly impacted residential, community and commercial properties will be doorknocked to notify stakeholders of the REF exhibition.
Place Manager	A Place Manager will manage all community and stakeholder inquiries throughout the REF exhibition period.

### 3.2.2 Consultation with government agencies

During public exhibition of the REF, Transport for NSW is intending to undertake a briefing session with Ku-Ring-Gai Council, Ausgrid, Roads and Maritime, Telstra, Optus and Jemena on the proposed works the subject of this REF.

## 3.3 Consultation activities proposed during public exhibition

The REF will be placed on public exhibition from Monday 28 July 2014 to Monday 11 August 2014 (2 weeks). During this period, written submissions will be accepted for consideration.

The REF will be displayed at the following locations:

- the Transport for NSW website: [www.transport.nsw.gov.au/projects](http://www.transport.nsw.gov.au/projects)
- Ku-Ring-Gai Council Offices, 18 Pacific Hwy, Gordon (Monday to Friday 9.00 am to 5.00 pm)
- Ku-Ring-Gai Library, 818 Pacific Highway, Gordon (Monday to Friday 8.30 am to 5.00 pm)
- Transport for NSW Information Centre, Ground Floor, 388 George Street (corner of King and George Streets) Sydney (Monday to Friday 9.00 am to 5.00 pm).

Community members and stakeholders are invited to submit their feedback on the proposal to Transport for NSW by emailing [lindfieldsubstation@transport.nsw.gov.au](mailto:lindfieldsubstation@transport.nsw.gov.au) or writing to:

Lindfield Substation  
Manager Precinct and Place  
PO Box K659  
Haymarket, NSW 1240

Comments must be received by 5.00pm on 11 August 2014.

During the exhibition period, community members and stakeholders can direct any enquiries to Transport for NSW:

- enquiries phone line: 1800 659 770
- email: [lindfieldsubstation@transport.nsw.gov.au](mailto:lindfieldsubstation@transport.nsw.gov.au)

## 3.4 Submissions report

Following public exhibition of the Lindfield substation REF, a submissions report will be prepared by Transport for NSW. This report will:

- list any issues raised in submissions
- consider and respond to the issues raised, including detailing appropriate mitigations measures
- provide any new information concerning the proposal
- identify any changes to the proposal as a consequence of feedback received during public exhibition and the potential impact of the changes.

Transport for NSW will write to individuals and organisations that have made submissions advising them that their submission will be addressed in the submissions report. The submissions report will be published on the Transport for NSW website ([www.transport.nsw.gov.au/projects](http://www.transport.nsw.gov.au/projects)).

## 3.5 Post-determination consultation activities

Subject to determination of the project, Transport for NSW would continue to engage with community and stakeholders in the lead up to, and during construction of the Lindfield substation.

Methods used for engaging and providing project information to the community and stakeholders include:

- project updates on the Transport for NSW website: [www.transport.nsw.gov.au/projects](http://www.transport.nsw.gov.au/projects)
- a 24 hour construction complaints line
- enquiries phone line: 1800 659 770
- an enquiry email address: [lindfieldsubstation@transport.nsw.gov.au](mailto:lindfieldsubstation@transport.nsw.gov.au)
- delivering works notifications to nearby residents, businesses and stakeholders
- doorknocking directly impacted residents and businesses
- providing a Place Manager as a key point of contact for stakeholders, businesses and residents
- meetings and briefing for stakeholders, businesses and residents as required
- site signage.





# 4. Options development and selection

This chapter outlines the alternatives considered for the development of the proposed Lindfield traction power substation.

## 4.1 Substation options

### 4.1.1 Options considered

During the development phase of the proposal, a number of sites were considered for the construction of the substation, which is required for use by Sydney Trains to continue to run the North Shore Line during increased operations under future transport requirements.

The following sites were considered by Transport for NSW for the location of the proposed substation (note that the 'up-track' refers to the line on which a train travels toward the city away from Lindfield Station towards Chatswood Station and the Sydney CBD and the 'down-track' refers to the line on which trains travel away from Sydney away from Chatswood Station and the Sydney CBD towards Lindfield Station):

- *Option 1* — the existing Epping to Chatswood Rail Link (ECRL) maintenance depot facility located adjacent to the rail corridor and Boundary Street at Chatswood
- *Option 2* — Roseville, between the up-track side of the rail corridor and Hill Street
- *Option 3* — North Roseville, in the rail corridor between the up-track and Strickland Avenue
- *Option 4* — Lindfield, located in the rail corridor between the up-track and Lindfield Avenue (the preferred option)
- *Option 5* — Lindfield, within the rail corridor between the down-track and Llewellyn Lane.

The indicative locations of each of these options are shown in Figure 4.1.

It is important to note that the focus of the options assessment process was on the siting of the main substation itself. The associated electrical works were not specifically assessed as part of the specific options assessment.

#### Do Nothing Option

A 'do nothing' option was also considered by Transport for NSW. As the proposal is required to maintain the existing traction power requirements for the existing Sydney Trains and is required to support additional future services (in particular increased services along the North Shore Line during peak periods), failure to construct a new substation in the area would result in an adverse impact on the reliability of the rail network and the public who rely on its services.

The 'do nothing' approach was therefore not considered to be a viable alternative for the proposal and this option was not pursued further.

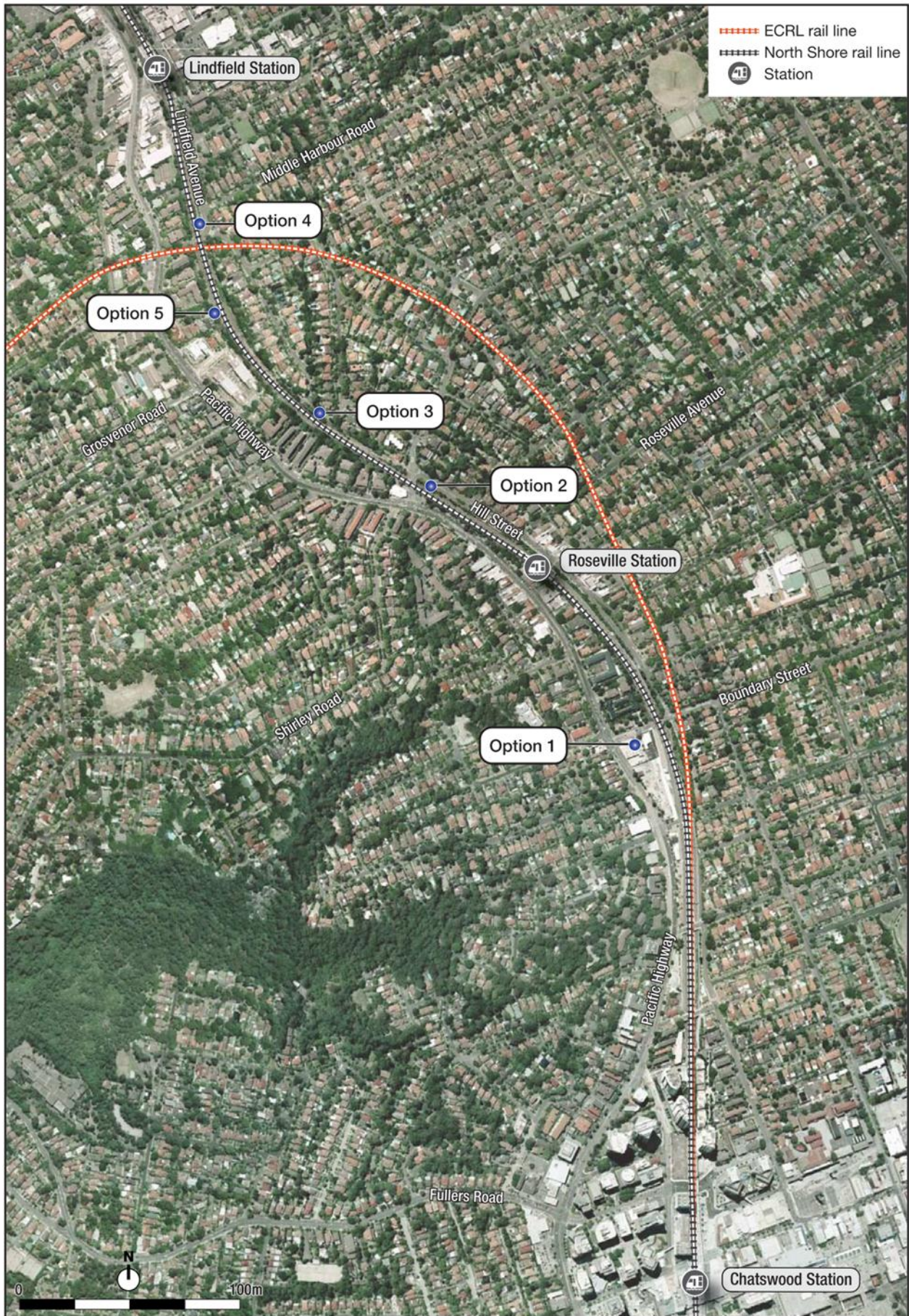


Figure 4.1 Location of proposed traction substation site options

## 4.1.2 Options assessment

The options outlined in section 4.1.1 were considered as part of the development phase of the proposal and assessed against the following criteria:

- available area — approximately 500 square metres in area is required for the construction of a substation
- location of the high voltage feeders (electrical lines) in relation to the proposed substation location
- land profile – grade difference between the track level and street level, which determines the quantity of earthworks, embankments and/or retaining walls
- potential impact on adjoining residences – i.e. visual impact, access constraints
- need to minimise the amount of vegetation clearance required
- need to minimise the land acquisition required
- availability of vehicle accessibility into the site.

Having regard to the requirements of the proposal, the sites outlined above were assessed for their suitability, as follows:

- Option 1 — the existing ECRL maintenance depot facility located adjacent to the rail corridor and Boundary Street at Chatswood:
  - ▶ Whilst this site would meet a number of the identified site criteria (such as land area, profile, minimising vegetation clearance and land acquisition etc.) this site was not considered to be a feasible option as it is located a greater distance outside the preferred location range identified by the traction modelling and is more likely to be retained for existing, ongoing rail operations.
- Option 2 — Roseville, between the up-track side of the rail corridor and Hill Street:
  - ▶ This site has an area of approximately 400 square metres, which is significantly less than the minimum area of 500 square metres required for the substation.
  - ▶ Construction of a substation on the site would require considerable earthworks as there is a significant grade difference of approximately four to six metres between the track and street levels.
  - ▶ The option would also require construction of embankments and/or retaining walls, acquisition of car parking spaces and the transfer of the site to government ownership.
- Option 3 — North Roseville, in the rail corridor between the up-track and Strickland Avenue:
  - ▶ This site has an area of approximately 520 square metres, which complies with the minimum area required for the substation.
  - ▶ The construction of a substation would require significant earthworks due to a grade difference of approximately eight to ten metres between the track and street levels.
  - ▶ The option would also require construction of embankments and/or retaining walls and considerable removal of trees for site clearing.
- Option 4 — Lindfield, located in the rail corridor between the up-track and Lindfield Avenue:
  - ▶ This site has an area of approximately 710 square metres, which exceeds the minimum area required for the substation.
  - ▶ Minimal earthworks would be required as the site is level with the adjacent road.
  - ▶ There is an existing access to the rail corridor for maintenance which would need to be relocated.

- Option 5 — Lindfield, within the rail corridor between the down-track and Llewellyn Lane:
  - ▶ This site is 650 square metres which exceeds the minimum area required for the substation.
  - ▶ However, the construction of a substation here would require considerable earthworks due to a significant grade difference of approximately four to six metres between the track and street levels and the need for construction of embankments and/or retaining walls.
  - ▶ Additionally, private residences with driveways onto the street are located directly across from the site on Llewellyn Lane.

### 4.1.3 Preferred option (option 4)

Having regard to the above factors, the site at Lindfield (option 4) was selected as the preferred option for the traction substation. Overall, the proposed substation site is considered the most favourable in relation to the assessment criteria described above. Furthermore, this site is considered to be feasible and suitable for the construction of the proposed traction substation for the following reasons:

- all construction activities that would impact on the operation of the North Shore Line can be undertaken within normal rail line possessions (i.e. scheduled rail line possessions nominated within the year)
- the Strickland Avenue road bridge adjoining the site is suitable for heavy vehicles travelling to and from the site
- Sydney Trains has no objection to the realignment and undergrounding of the 33 kilovolt and 11 kilovolt aerial feeders required for the construction of the substation.

A more detailed description of the preferred option (as part of the overall proposal) is provided in Chapter 5.

# 5. Description of the proposal

This chapter describes the built form, construction, operation and maintenance of the proposed substation and associated electrical works (i.e. signalling and feeder cabling) at Lindfield. It includes a description of the physical components to be undertaken, an outline of the construction methods and proposed management approach.

## 5.1 Overview of the proposed works

The proposal, the subject of this REF, involves the construction and operation of a traction power substation at Lindfield and associated electrical works. The key components of the proposal include:

- construction and operation of a new traction power substation at Lindfield in order to continue to power the Sydney Trains network (in particular the North Shore Line). Components of the substation would generally include:
  - ▶ construction of two new rectifier transformers
  - ▶ installation of switchgear room containing switchgear and switchboards, batteries and changers, voice and data communications equipment
  - ▶ installation of the rectifier and reactor unit(s)
  - ▶ office and associated facilities
  - ▶ earthworks and construction of a retaining wall on the western side of the substation site, adjacent to the rail line
- construction of a new driveway access to the substation site from Lindfield Avenue and a paved surface area to provide for car parking for approximately four vehicles within the proposed substation compound
- security and permanent maintenance lighting within and external to the building
- landscaping and vegetation surrounding the proposed substation building, generally to the east and south of the substation
- realignment of the existing 33 kilovolt (kV) and 11 kV overhead wiring (OHW), to a new combined services route (CSR) generally between power pole P57 (to the south of Lindfield Station near the intersection with Russell Avenue) and power pole P49 (to the north of the Clanville Road overbridge)
- relocation and installation of signalling and communication cable to the substation to connect with existing cables along the North Shore Line
- installation of feeder and return cabling to the OHW system on the North Shore Line
- relocation of street lighting and power routes to provide access to the substation for construction and maintenance (including future replacement of substation equipment)
- installation of an aerial earth wire to the top of the existing (Sydney Trains) poles, generally between Russell Avenue, Lindfield and Killara Station.

More detail regarding the components of the proposal is provided in section 5.2. Greater detail regarding the proposed approach to construction is provided in section 5.3.

## 5.2 Components of the proposal

### 5.2.1 Substation built form and layout

#### Substation building

The architectural design of the substation building is intended to limit the impact of the building in the residential neighbourhood, to reduce its perceived scale and to provide a landscaped edge treatment between the building and the adjoining street. The landform/contours of the substation site have been used to reduce the overall height of the building by locating the tallest elements to the south, where they sit below natural ground level.

The proposed substation building would consist of an aboveground structure, located within the rail corridor between the North Shore Line up-track and Lindfield Avenue at the intersection with Strickland Avenue, as shown in Figure 1.2. The substation building would occupy most of the substation site and would be approximately 40 metres by 10 metres in size. Additional hardstand and driveway areas would be located towards the northern end of this site to allow for vehicle access and car parking spaces for approximately four vehicles. The building would be single storey (with a cable subfloor) with a height of approximately 6 metres.

The building would be architecturally designed and generally be constructed from precast concrete panels, with a metal clad roof and would be rectangular in shape. The exterior of the building would be designed to minimise visual intrusion to the surrounding area. A range of metal louvers and roller shutters would also be required within the building façade to provide both access to, and ventilation for, the building. The final building materials and finishes for the proposed substation building would be determined during the detailed design phase of the proposal.

As part of the construction of the substation site, a retaining wall approximately three metres in height would be constructed along the western boundary of the substation site between the substation and the up-track of the North Shore Line. This wall would run for the entire length of the substation site.

Access to the substation site (refer to Figure 1.2b) would be via a relocated driveway along Lindfield Avenue, approximately 20 metres to the north of its intersection with Middle Harbour Road.

The proposed layout and access to the substation is shown on Figure 5.1. Indicative elevations of the proposal are provided in Figure 5.2 and Figure 5.3. Indicative visual perspectives of the proposal are also provided in Figure 5.4 and Figure 5.5.

#### Security

Security fencing would be installed around the substation and would be compliant with current Sydney Trains standards for substation fencing. This would include generally three metre high palisade/security fencing on all sides of the substation site. Additional security mesh would be installed on top of the retaining wall on the western perimeter of the substation where it faces the rail line.

To comply with Sydney Train safety requirements, a second level of security is to be provided at the entry to the plant room. Other security measures which would be incorporated into the substation site include:

- entry doors to the plant rooms would be located behind the two-tier entry security
- limited perimeter doors to the street would be provided to ensure security levels are maintained
- the substation office would have direct surveillance over the site entry and car parking area

- structured planting to building perimeter. Crime prevention through environmental design (CPTED) principles (such as natural surveillance, access control, territorial reinforcement and maintenance) would be incorporated to ensure the planting does not conceal the building to provide increased visibility whilst providing a natural 'green' edge
- installation of security lighting (refer below for further details).

### Lighting

Lighting within and external to the building would consist of security and permanent maintenance lighting. The security lighting would automatically switch on in low light conditions to provide minimal light for safe access and security. Maintenance lighting would only be used while works are being undertaken at the substation. External security lighting would be installed in a manner which minimises light spill to areas beyond the substation site boundary.

### Plant Room ventilation

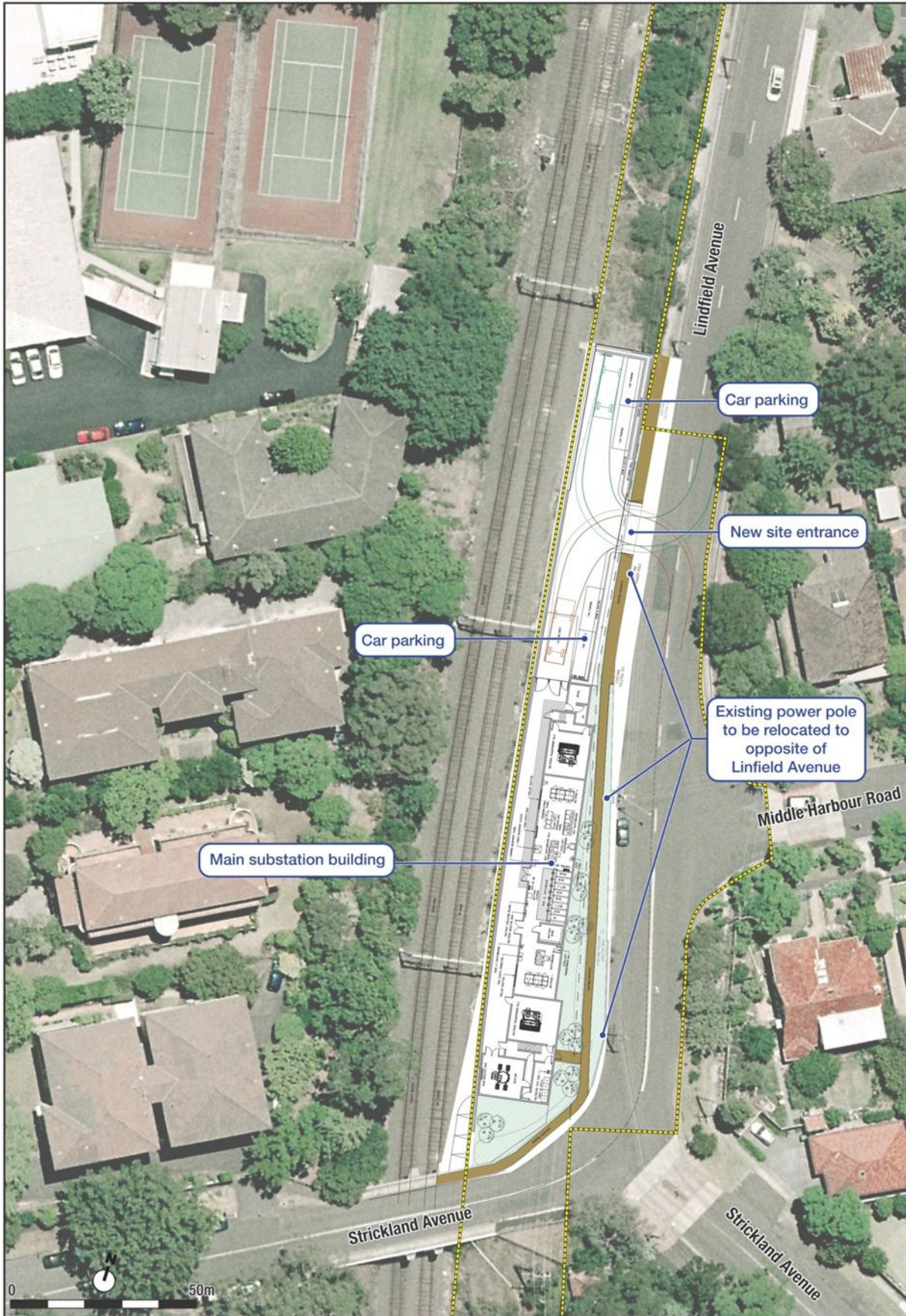
The building form would provide all plant rooms with passive/natural ventilation. The plant room's façade would include louvered panels. Cross ventilation would be provided by means of roof top ventilators for the two transformer rooms omitting the need for louvers in the eastern side of the building.

### Earth grid

An earth grid is a connection to the greater mass of the earth, usually made by burying metallic conductors in the soil to minimise the potential for step voltage (the voltage between the feet of a person standing near an energised grounded object) and provide a safe work environment within the substation site. The earth grid would be installed prior to any preparation or form work carried out for the substation foundations. Trenches would be cut into the subsoil and copper earthing electrodes would be driven into the trenches and connected to the switchroom main earth bar via the outside earth grid. Provision would be made for connection of other metal clad equipment, such as fences, slab reinforcement and transformers to the earth grid.

### Traction power feeders and returns

The power supply to run the trains (traction power) at 1500V DC would require connections from the proposed new substation to the existing OHW system. This would involve installation of a series of cables to a suitable location for traction power feeder lines and return cables. The proposed location would be approximately 80 metres south of the Strickland Road overbridge. From this location, the traction power feeder lines would be connected to the existing OHW of the North Shore Line.

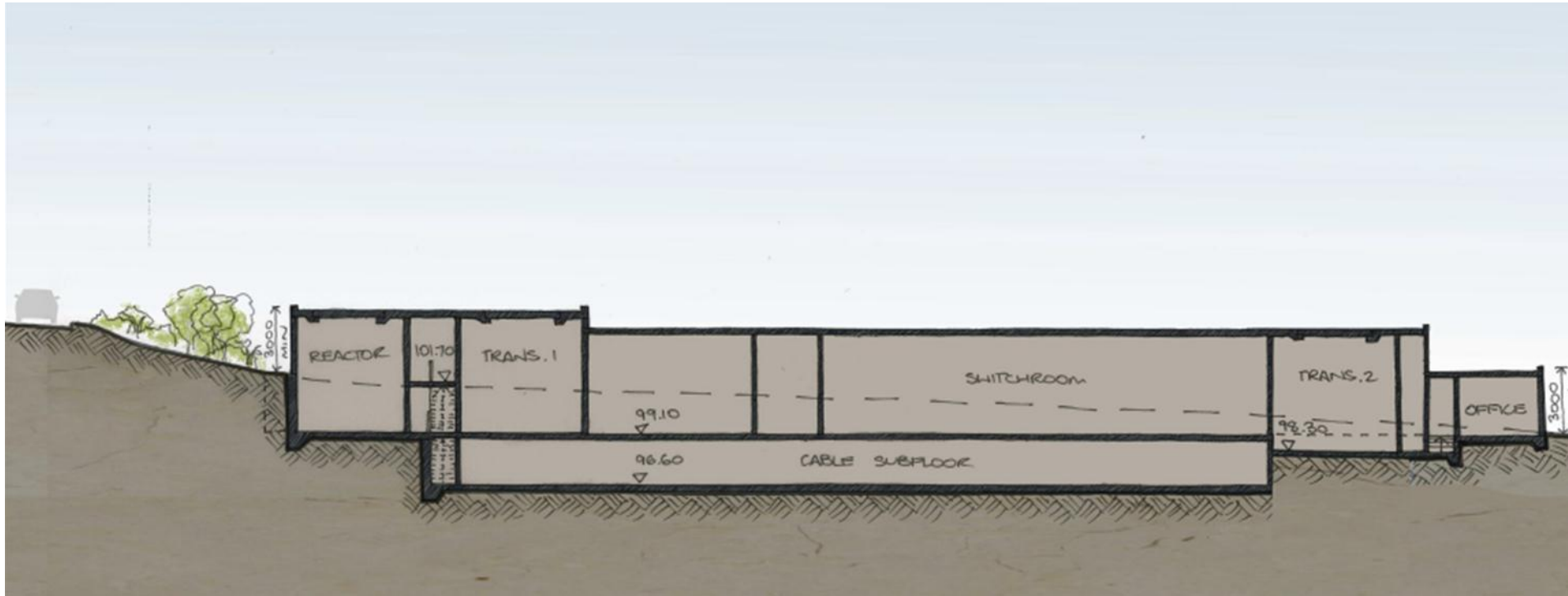


--- Proposal boundary

Note: Indicative only. Subject to detailed design

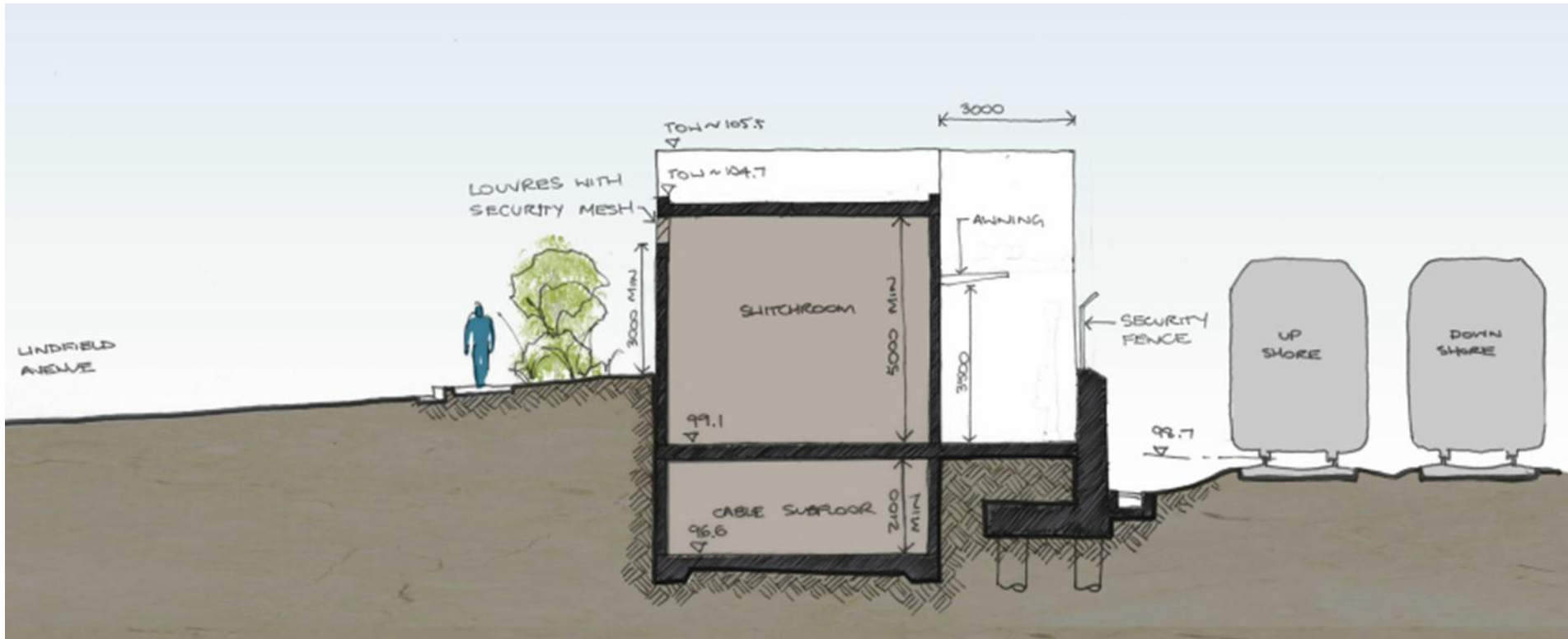
**Figure 5.1** Indicative layout of the proposed Lindfield substation





Note: Indicative only. Subject to detailed design

Figure 5.2 Indicative elevation of the proposed Lindfield substation looking west (south to left of page)



Note: Indicative only. Subject to detailed design

Figure 5.3 Indicative elevation of the proposed Lindfield substation looking south (east to left of page)



Note: Indicative only. Subject to detailed design

**Figure 5.4** Indicative visual perspective of the proposed Lindfield substation looking north from the intersection of Strickland Road and Lindfield Avenue



Note: Indicative only. Subject to detailed design

Figure 5.5 Indicative visual perspective of the proposed Lindfield substation looking south along Lindfield Avenue

## Drainage works

Following excavation of the substation site, new stormwater drainage would be installed around the perimeter of the substation site, generally prior to the construction of the main civil and buildings works on the substation site. The proposed stormwater drainage works would include:

- a new concrete lined cess drain along the western side of the substation site (to the west of the proposed retaining wall)
- longitudinal pipes along the length of the substation site, connected by a series of stormwater inlet and junction pits
- an underground rainwater tank (for the collection of roof water) adjacent to the northern end of the main building structure
- an on-site detention (OSD) tank towards the northern end of the substation site to collect surface flows from within the site
- a stormwater quality improvement device connected to the OSD tank to allow for stormwater quality improvement of collected water prior to discharging off-site
- general kerb and guttering surrounding the hardstand areas of the substation site, including a grated drain at the substation site driveway entrance point.

### 5.2.2 High voltage line realignment

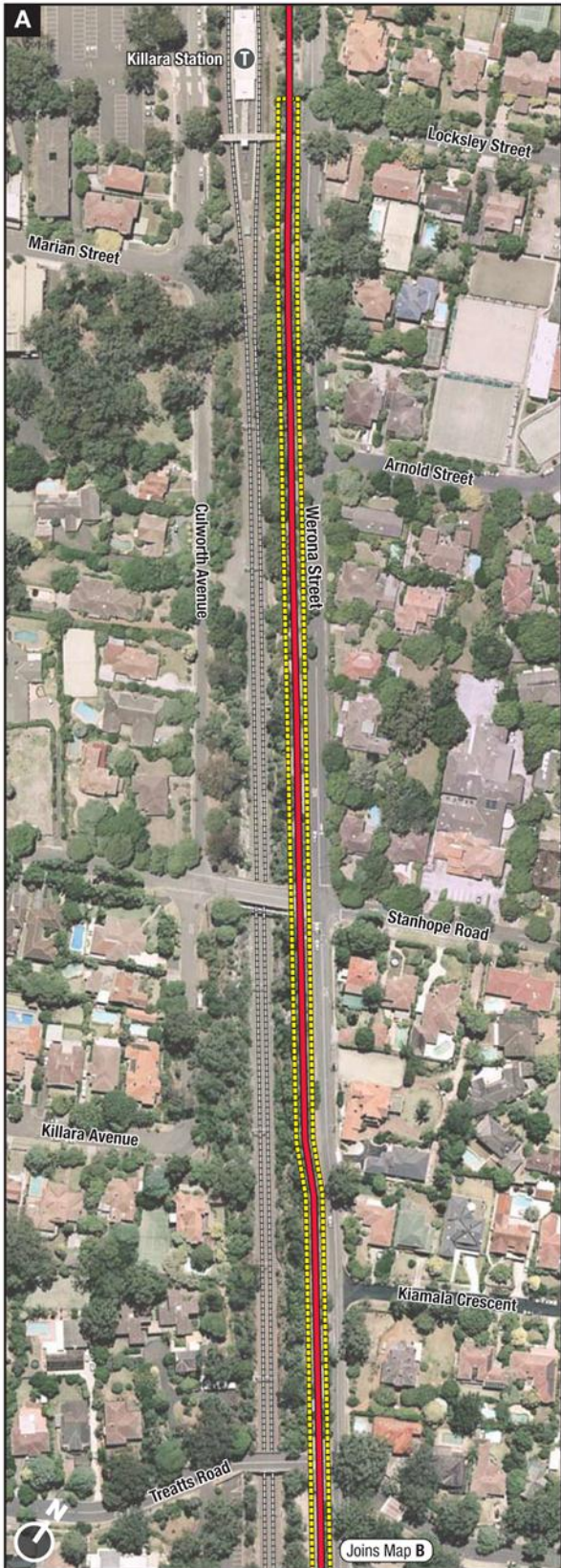
Aboveground electricity lines (aerial feeders) including high voltage 33 kilovolt (kV) and 11 kV lines currently connect the Gordon and Chatswood North substations and are located within the rail corridor throughout the wider proposal site. As part of the construction of the new substation, a section of these cables, where they cross the proposed site between power pole P57 and power pole P49 (refer to Figure 5.6), would require relocation to a CSR within the eastern side of the existing rail corridor. The CSR would utilise a combination of galvanised steel troughing (GST), ground level troughing (GLT) and buried conduits to underground the existing electrical cables. New cable turning/pulling pits would also be installed as part of the realignment.

The realignment of the aboveground feeder lines would consist of approximately 950 metres of lines between pole power poles P57 and P49. The redundant aerial 33kV and 11 kV feeder lines would be removed as part of the proposal.

Figure 5.6 shows an indicative arrangement for the reconfigured high voltage aerial feeder lines. The detailed route of the proposed CSR would be determined during detailed design.

### 5.2.3 Signalling services route realignment

The substation site at Lindfield has an existing signalling services route across it which includes a number of pits and signalling cables that would require relocation. A concept design has been prepared for the relocation of the route from the up track side to the down track side to ensure the security of the cables during the construction stage of the work.

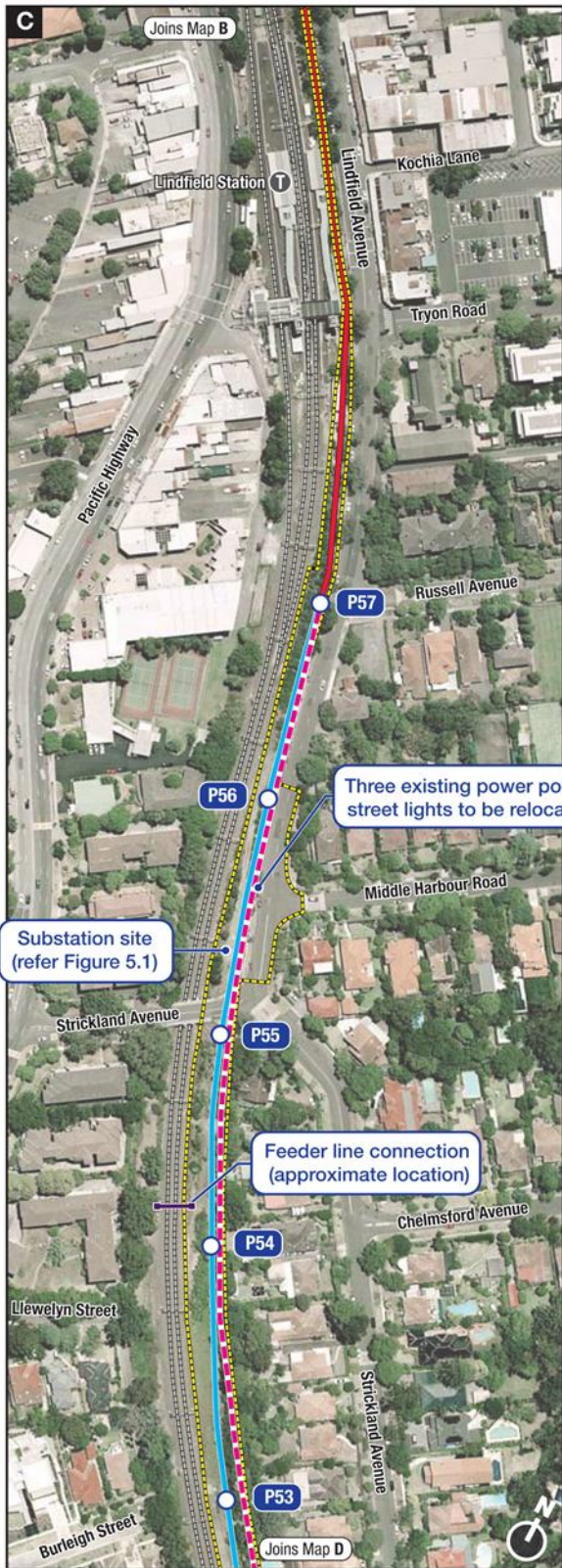


- ① Train station
- North Shore Rail Line
- Proposal boundary
- Aerial earth wire (indicative alignment)

0 100m

Note: Indicative only, subject to detailed design.

Figure 5.6a Proposed aerial earth wire and realignment of high voltage aerial feeder lines



- ⓘ Train station
- North Shore Rail Line
- Proposal boundary
- Aerial earth wire (indicative alignment)
- Existing high voltage aerial
- Proposed combined services routes (indicative alignment)

0 100m  
 Note: Indicative only, subject to detailed design.

Figure 5.6b Proposed aerial earth wire and realignment of high voltage aerial feeder lines

## 5.2.4 Aerial earth wire

In addition to the relocation of the existing aerial 33kV and 11 kV feeder lines, a new aerial earth wire would be required to be installed between Killara Station in the north and existing power pole P57 (near the intersection with Russell Avenue) to the south. The installation of the aerial earth wire would be undertaken through the placement of a new metal shaft to the top of the existing 33kV and 11kV power poles. The aerial earth wire would then be attached to the new structure.

Where it is deemed that an existing power pole is in a poor condition, a new pole would be installed in a similar location (within approximately one to two metres of the existing pole) and all existing wires relocated to the new pole.

An example of a typical aerial earth wire arrangement to an existing power pole is shown in Figure 5.7.



**Figure 5.7** Example of a typical aerial earth wire arrangement on the top of an existing power pole



## 5.2.5 Utilities realignment

Notwithstanding the 33 kV and 11 kV aerial feeders that cross the substation site (refer to section 5.2.2), the proposal would require some additional utility diversions. The utilities that may be impacted and may therefore require augmentation as part of the proposed are discussed below.

Potential impacts to existing services and utilities would be confirmed during the detailed design phase of the proposal, with any proposed relocation and/or protection works determined in consultation with the relevant asset owners.

### Ausgrid

Ausgrid high voltage underground cables are located in the footpath on the western side of Lindfield Avenue adjacent to the substation site. Protection or adjustment of the cables at the vehicle access location may be required if the depth of the Ausgrid services under the vehicle crossing does not meet Ausgrid requirements. The Ausgrid low voltage overhead power lines in Lindfield Avenue adjacent to the substation site would also require relocation to avoid clashes with cranes during construction and future maintenance operations. Three poles would be removed and replaced with underground conduits located in the roadway.

The Ausgrid street lighting supply aerial cable in Lindfield Avenue would be relocated to the eastern side of Lindfield Avenue. The location of the new street lighting would be revised during detailed design to maintain appropriate lighting levels.

### Telstra

There is a major Telstra route with 20 conduits in the footpath on the western side of Lindfield Avenue adjacent to the substation site. Several Telstra access chambers are also located in the footway adjacent to the substation site, and vehicular crossing locations have been located to avoid these access chambers. Protection or adjustment of the conduits at the vehicle access location may be required if the depth of the Telstra services under the vehicle crossing does not meet Telstra requirements.

Foxtel/Telstra cables have also been identified as aerial cables on the Ausgrid poles which are to be removed. These cables would be relocated as part of the overall relocation of cabling from these poles.

### Optus

Optus aerial cables are mounted on the Ausgrid poles which are required to be removed. These cables would be relocated as part of the overall relocation of cabling from these poles.

### Jemena (Gas)

A Jemena 110 millimetre diameter nylon gas main crosses the rail alignment on the southern side of the Strickland Avenue overbridge and then crosses to the eastern side of Lindfield Avenue. It is not expected that the proposed works would impact this gas main.

## 5.2.6 Substation equipment

The substation would contain primary (rectifier transformers, rectifiers, reactors) and secondary (switchgear and switchboards, batteries and changers, voice and data communications) equipment which would be installed within the new building structure.

Equipment and facilities within the proposed substation building would include:

- two x Rectifier Transformers and associated rectifier/switchgear
- two x auxiliary transformers
- one x 11kV and 2 x 33kV switchboards
- one x reactor and main negative bar
- one x 1,500V DC isolating and rail connecting switches (IRCSs) bank
- supervisory control and data acquisition (SCADA), remote terminal unit (RTU) and marshalling panel
- telecommunication equipment
- battery bank and charger(s)
- small office area with washroom amenities.

The final design and specifications of the proposed equipment to be installed within the substation would be refined during the detailed design phase of the proposal to meet the specific ongoing requirements of the Sydney Trains network at the time of construction.

### Cabling

All cables would be installed to allow adequate space for fixing and for heat dissipation. Control and induction cables and light and power cables would be run separately from the high voltage cables in accordance with installation standards. High voltage cables would be insulation tested to ensure their integrity prior to connection to equipment. The final testing and connection to the Sydney Trains network would be carried out during track possessions and high voltage electrical isolations of the North Shore Line.

Traction supply feeders and return cables also would be installed as part of the construction of the substation.

## 5.3 General construction approach

Minor enabling works are expected to be undertaken in late 2014. Service relocation will commence in mid-2015 with construction of the substation expected to commence in early 2016 (subject to Transport for NSW's determination of this REF) with testing and commissioning anticipated in August 2017. The substation site is expected to be handed over to Sydney Trains in late 2017.

The methodology presented below is based on the current concept design and will be subject to confirmation by the construction contractor (not yet appointed). Any material changes to the construction methodology which could result in additional environmental impacts to those assessed in this REF would be the subject of additional environmental assessment or consistency review.

It is anticipated that the main construction activities would generally be carried out in the following sequence:

- establishment works and vegetation clearance
- excavation
- civil and building works including:
  - ▶ access improvements
  - ▶ piling works and deflection/retaining wall
  - ▶ drainage works
  - ▶ cable sub-floor chamber
  - ▶ ground beams
  - ▶ floor slab
  - ▶ super structure
  - ▶ electrical fit out
- pre-commissioning and commissioning.

#### Site establishment and vegetation clearance

On possession of the proposal site, the contractor will initially install any additional temporary fencing to adequately secure the site (in particular the substation site), and install all necessary construction environmental management measures such as sedimentation controls (refer section 7.2.1). Following this, the proposal site would be rechecked for all utility services and any affected services will be relocated or made safe to allow construction to proceed.

Minor earthworks will be undertaken to establish the site amenities. These earthworks would include:

- cut and fill to establish a level area for the site facilities and temporary storage areas
- trenching to install services (power, water, sewer)
- refurbishment of existing proposal site access and access roads.

The site for the substation and southern half of the electrical works site would then be cleared of existing vegetation and grubbed, and access roads would be constructed to the area for the substation site facilities and temporary storage areas (where required).

As part of the initial preparation works for the new traction power feeder lines and improvement to the rail corridor access from Strickland Lane, clearance of some vegetation would also be undertaken generally to the south of the Strickland Road overbridge. Further discussion regarding the proposed vegetation clearance is provided in section 6.4 of this REF.

Site office(s) and any other temporary buildings would also be brought onto site at this time, with power connected to these buildings. Construction power supplies for the site facilities and construction activities would be sourced from local Ausgrid street supplies. Construction water supply would be sourced from the existing Sydney Water street supplies in Lindfield Avenue. Provision would be made to utilise this connection for the permanent water supply to the completed substation.

Construction hoardings and/or temporary acoustic fencing/barriers would be erected around the substation site perimeter and southern half of the electrical works site where this is considered to be feasible and reasonable to mitigate off-site noise levels. Noise barriers would be effective for receptors at or near ground level and not effective for receptors overlooking the sites. If required, large hoardings may require significant footings.

As part of site establishment, the existing cess area (a track drainage area adjacent to the railway tracks) between the OHW stanchions and the existing rock face on the up-track side of the North Shore Line would be cleared and safety barriers (New Jersey barriers with an extended three metre grid fence above) would be installed to protect the track and site during the piling, retaining wall and excavation works.

### Combined services routes

The North Shore Line CSR would run through the substation site and would be relocated to allow construction of the substation. The CSR currently contains a mix of signalling and communications cables. A new trunk CSR would be constructed using a mix of buried pit and conduit and above ground GST and would service relocated signals, communications and 11kV and 33kV feeder lines. The new route would run from power pole P57 along the embankment in GST then underground in pit and conduit adjacent to the new vehicle access and back to a temporary mounting along the length of the substation. South of the Strickland Road bridge the cabling would re-join the existing CSR.

The new CSR south of the Strickland Road bridge would be constructed using a mix of buried conduit and GST between the Strickland Avenue and power pole P49 for sole use of the 11kV and 33kV feeders (refer below). Following completion of the substation works, a permanent CSR will be constructed on the trackside face of the substation basement wall.

### Signalling and communications

The relocation would be carried out in two phases. Phase 1 would include construction of a new pit and pipe CSR from a pit adjacent to power pole P56 (part of the northern section of the electrical works site) under the maintenance access road to trackside. A temporary CSR would be attached to the New Jersey barriers as far as the up-track side of the Strickland Avenue road bridge and then by a new pit and pipe CSR re-joining the existing CSR at a pit adjacent to power pole P55 (about 10 metres to the south of the Strickland Avenue road bridge).

Signalling and communications cables would be cut at suitable locations either side of the new route and new cabling pulled through the new CSR, spliced to existing cables and tested. Any cable that cannot be spliced for operational or technical reasons would be replaced and terminated at its original point. Relocation of these cables would be carried out during a North Shore railway line track possession period.

Phase 2 would take place following completion of substation piling and construction of the retaining wall. A permanent CSR consisting of GST would be mounted on the trackside face of the retaining wall and the signalling and communications cable lifted from the temporary CSR and placed in the GST.

### High voltage aerial realignment

Realignment of the aerial feeders would commence during completion of the substation basement and the trackside retaining wall and concurrent with completion of the substation civil and building works. All realignment works would be carried out during North Shore Line track possession period(s) and high voltage electrical possession(s).

Construction of the underground and GST routes would be completed between existing power poles P57 and P49 (refer to section 5.2.2). The 33 kV and 11 kV cable would be installed ready for connection to the underground overheads (UGOH's). Sufficient additional length of cables would be provided between the UGOH's poles to allow cutting and pulling of the 33 kV and 11 kV cables into the proposed substation when equipment installation has been completed and the proposed substation is available for connection to the respective power supplies.

## Piling and retaining wall works

Retaining walls for the substation site would be constructed within the embankment. This may involve the use of piling rigs to construct the retaining walls required to hold back the existing rail embankment. This would be required to be undertaken during a track possession period (refer to section 5.3.3 for further details).

## Excavation

Excavation would be undertaken to remove excess material from the substation site and level the site. Some spoil from the excavation may be reused on site for filling and compaction of the facilities/storage areas and access improvements for the existing access which is currently gained off Strickland Lane. Excavation works will be carried out using diesel powered excavators and rockbreakers and excess spoil would be removed from site by dump truck for off-site disposal, in accordance with a Construction Traffic Management Plan for the proposed works (refer to section 6.1).

Based on the current substation layout, the estimated earthworks volume for the Lindfield substation is approximately 4,500 cubic metres. This is the in-situ volume of the material to be excavated with no allowance for bulking. Where possible, spoil generated would be used within the wider proposal site to provide the required levels. However, spoil that cannot be used would be sent for recycling or disposal to a licensed facility.

There would also be a requirement to maintain safe working clearances under the 33 kV and 11 kV aerial feeders within the substation site. Accordingly, excavation of the substation site would commence at the northern end, where clearances from natural ground level to the aerials exceed the safe working requirements. Benching and spoil removal would progress to the south of the substation site using rock breakers, excavators and trucks. This methodology would ensure that safe clearances are maintained and excavation works can proceed without the requirements for electrical possessions of the North Shore Line.

## Civil and building works

### *Civil works*

The civil works would commence with construction of the foundation works following excavation and drainage works for the foundation, installation of the earthgrid and then formation and casting of reinforced concrete sections from the basement level to the final substation equipment floor level. Works adjacent to the North Shore Line would be undertaken in accordance with rail safe working requirements due to the close proximity of the up-track.

Some works may need to be carried out during the weekend track possessions (rail close-downs) of this line.

### *Building works*

Building works, including interior and exterior walls and roofing, would be progressed to lock-up stage ready for building services installation including general lighting, power, ventilation and hydraulic services. Installation of electrical equipment for the substation would be undertaken using cranes to lift in the required equipment.

Large and/or heavy equipment would be craned into position which may require a temporary closure of Lindfield Avenue during lifting operations.

### Pre-commissioning activities

Pre-commissioning activities would form part of the construction and installation works and would incorporate all tests and checks to confirm that construction quality assurance documentation, inspection and test plans, checklists and associated activities have been completed for each individual component of plant. This is to ensure that it has been supplied and installed in accordance with the design and statutory standards and is safe to proceed to commissioning.

### Site clean-up and landscaping

This phase would occur following the completion of construction and involve the removal of all materials not required during the operation of the substation. This would primarily be the removal of the construction compound.

New landscaping would also be provided around the perimeter of the substation site following the completion of the main building works to assist with screening of the new substation structure (refer to Figure 5.4 and Figure 5.5 for an indicative illustration of the proposed landscaping).

## 5.3.1 Construction plant and equipment

An indicative list of construction plant and equipment likely to be required for the key construction elements is provided below. Not all of the equipment identified below would be required for all phases of the proposed construction of the Lindfield substation and electrical works.

- Bobcat
- Bulldozers
- Cable trucks
- Cable winch
- Chainsaws
- Compressors
- Concrete trucks
- Coring equipment
- Cranes
- Delivery vehicles
- Elevated work platforms
- Excavators with rock breaker
- Flat top trucks
- Front end loaders
- Generators
- Hi-rail trucks with Hiab cranes
- Jack hammers
- Jointing and welding equipment
- Lighting
- Miscellaneous small tools
- Mobile concrete pump
- Personnel vehicles
- Piling rig
- Rollers/compactor
- Scrapers
- Small vehicles
- Traffic control vehicles
- Trucks
- Truck mounted augers
- Water truck

### 5.3.2 Workforce and working hours

A total of approximately 20 to 30 construction staff would be required on-site for the duration of the construction period however the number of personnel may increase and vary depending on the type of work being undertaken in accordance with the work methodology.

Works would be generally undertaken within the standard EPA construction hours, which are as follows:

- 7.00 am to 6.00 pm Monday to Friday
- 8.00 am to 1.00 pm Saturdays
- no work on Sundays or public holidays.

#### Out-of-hours works

Some work will be required outside of standard construction hours and would be mainly during rail possessions. In addition, there may be occasions when oversized deliveries of materials or substation electrical equipment may need to occur outside of peak traffic hours, standard construction hours or during rail possessions.

Exemptions and approval for works outside the above standard construction hours may also be required in the following circumstances:

- works required by utility service providers or where impacts to services cannot be reasonably managed
- works requiring track possessions (as outlined below)
- unloading of machinery that can only be transported between hours specified by the police or Roads and Maritime
- where works can be undertaken so as to be inaudible at the nearest residential receivers
- as otherwise agreed with the EPA in the issuing of an environmental protection licence for licensable works.

If required, out-of-hours works would be applied for by the construction contractor and appropriate assessments, mitigation strategies undertaken prior to these works being undertaken. Nearby residents, businesses and stakeholders would be notified in advance.

#### Rail possession works

Rail possessions are times when rail services are not running, allowing maintenance and/or construction works to be safely undertaken. Sydney Trains is permitted a certain number of weekend rail possessions per year to allow for railway maintenance, construction and other activities that are only able to be undertaken whilst normal services are not operating.

### 5.3.3 Traffic management and construction access

A majority of construction traffic would enter the proposal site from the Pacific Highway into Strickland Avenue and turn left into Lindfield Avenue. This route avoids the Balfour Street underpass and the shopping precinct in Lindfield Avenue. The proposal site would typically be exited via Lindfield and Strickland Avenues back to the Pacific Highway. This route is suitable for all construction materials including concrete and manufactured items, such as transformers, switchboards and other electrical equipment.

Construction access will be provided from the following locations:

- Lindfield Avenue — Access to and egress from the substation site would be via Lindfield Avenue which is subject to a local area three-tonne load limit. A temporary closure of Lindfield Avenue would be required for the delivery and installation of major heavy equipment such as substation transformers and rectifiers.
- Strickland Avenue — Construction traffic would exit the Pacific Highway via Strickland Avenue, which also has a local area three-tonne load limit, and turn left into Lindfield Avenue. Construction traffic leaving the substation site would travel via Lindfield Avenue and turn right into Strickland Avenue and then to the Pacific Highway.
- Strickland Lane — Construction traffic would exit the Pacific Highway via Strickland Avenue, which also has a local area three-tonne load limit, and turn right into Strickland Avenue and progress through local streets to Strickland Lane. Strickland Lane provides a vehicle route between Strickland Avenue and the rail access gate.
- Clanville Road — Construction traffic would exit the Pacific Highway via Clanville Road. Construction traffic leaving the southern portion of the electrical works site would travel via Clanville Road and then to the Pacific Highway. A Traffic Management Plan would be prepared in consultation with Ku-ring-gai Council. Any disturbed surface will be reinstated to match pre-existing conditions.

Further details regarding access and haulage routes for the proposal are provided in section 6.1.2.

### 5.3.4 Potential site compounds and storage

There is minimal space available within the existing rail corridor for site compounds and materials storage. Worksites would be established within suitable barriers and protected by traffic management establishment in accordance with the approved Traffic Management Plan.

If required small site compound(s) could be positioned within the rail corridor to the north of the substation site (subject to discussion with Sydney Trains). It is expected that contractors would operate from their local depots with materials and equipment loaded on trucks and brought to site for immediate installation, where possible. Temporary fencing would be provided to the site during construction for public safety and site security.

## 5.4 Operation and maintenance

### 5.4.1 Commissioning

This phase of works would link the substation construction activities to the operational activities. Once all high voltage and low voltage testing is completed, electrical protection systems have been set and all Quality Assurance documentation has been completed and the systems energised, commissioning would proceed.

The new substation would be commissioned and integrated with any necessary Sydney Trains external facilities.



## 5.4.2 Operational access

Once commissioned, access to the site would be via Lindfield Avenue at the new driveway entry, as shown on Figure 5.6. The existing maintenance access into the rail corridor would be relocated to the northern side of the new substation, subject to consultation with Sydney Trains.

## 5.4.3 Ongoing maintenance of the substation and feeder lines

Once construction is completed, the Lindfield substation would undergo testing and would be commissioned for service. Once operational, the maintenance requirements of the substation and traction power feeder lines are anticipated to be small. For the substation building, it is anticipated that there would be up to one site visit per month by one person for maintenance and attendance for switching operations during power isolations.

Overhead traction power feeder lines would be inspected in accordance with Sydney Trains operational requirements.



# 6. Environmental impact assessment

This chapter provides an environmental impact assessment for the proposed construction and operation of the proposed traction power substation and associated electrical works in Lindfield ('the proposal').

## 6.1 Traffic and transport

A traffic and transport assessment has been prepared by Parsons Brinckerhoff and is included as Technical Paper 1. A summary of the assessment is provided in the following sections.

### 6.1.1 Existing traffic and transport environment

#### Road network and hierarchy

Roads within a network are classified according to a road hierarchy relating closely to their functional role and the volume of traffic they carry. Roads and Maritime has defined four classes for the classification of roads:

- arterial roads
- sub-arterial roads
- collector roads
- local roads.

The key roads on the surrounding road network include:

- *Pacific Highway (A1)* — a six-lane undivided road configuration which carries approximately 58,000 vehicles per day (refer Technical Paper 1) through the Chatswood area. As a major arterial road, this road is designated as a B-double route and allows vehicles with a maximum vertical height clearance of 4.6 metres.
- *Lindfield Avenue* — a two-lane, two-way collector road that provides an important link on the eastern side of the Pacific Highway and railway line connecting the Lindfield town centre to local residents. Lindfield Avenue has a posted speed limit of 50 kilometres per hour.
- *Strickland Avenue* — a two-lane, two-way local road that provides an important link on the eastern side of the Pacific Highway and railway line connecting the Lindfield town centre to local residents, and providing a key local railway crossing (bridge). Strickland Avenue has a posted speed limit of 50 kilometres per hour.
- *Clanville Road* — a is a two-lane, two-way local road that provides an important link on the northern side of the Pacific Highway connecting to local residents to the Pacific Highway via a key local railway crossing (bridge). Clanville Road has a posted speed limit of 50 kilometres per hour.

Unrestricted on-street parallel parking is currently provided on both sides of Lindfield Avenue adjacent to the substation site. Pedestrian footpaths are located on both sides of Lindfield Avenue adjacent to the substation site.

### Vehicle load, length, height and turning restrictions

A review of the Roads and Maritime Restricted Access Vehicle information and details obtained during a site inspection indicate the following restrictions apply to certain vehicles in the study area:

- three tonne load limit on Strickland Avenue, Lindfield Avenue and Rawhiti Street, Lindfield near the wider proposal site
- four metre height clearance on Balfour Street, Lindfield (road under railway bridge).

### Rail services

Existing access to the North Shore Line rail corridor is currently provided through the future substation site via a gated access off Lindfield Avenue. This existing access will be relocated further north along Lindfield Avenue (north of Middle Harbour Road – refer to section 6.1.4 below), subject to discussion with Sydney Trains.

Additional access gates would be utilised from Clanville Road, Strickland Lane and Llewellyn Street. These access locations would not require relocation as part of the proposal.

### Bus services

Bus services that currently operate in the Lindfield area are provided by Transdev and include a service along Lindfield Avenue and Middle Harbour Road.

### Parking

Within the vicinity of the main substation site, unrestricted on-street parallel parking is currently provided on Lindfield Avenue, Strickland Avenue and Middle Harbour Road in close proximity of the substation site.

No on-street parallel parking is provided at the cable and service relocation accesses on Llewellyn Lane, Strickland Lane and off Clanville Road. On-street parallel parking is however provided on both sides of Llewellyn Street and Burleigh Street which adjoin Llewellyn Lane.

## 6.1.2 Traffic and transport impacts during construction

The potential impacts of construction traffic on the existing traffic and transport environment are described below.

### Construction traffic generation and distribution

Traffic generation during construction of the project is assumed to comprise traffic generated by construction personnel and construction vehicles travelling to and from the proposal site. During construction, traffic movements would vary depending on the stage of works being completed. However, most movements would occur during the earthworks and civil construction phases. The anticipated typical construction traffic generated by this project is presented in Table 6.1. Construction staff are assumed to arrive at the proposal site by personal vehicle.

**Table 6.1 Construction traffic generation**

Location/Construction elements	Number of workforce (daytime shift)	Trips during the PM peak hour	Total daily trips during weekend day (in and out)
Construction of substation	Up to 20	10	40
Cable and services relocation works	Up to 10	5	20

Construction staff would generally arrive at the proposal site before the shift start at 7.00 am and would generally depart the site after the shift between 3.00 pm and 6.00 pm. The construction light vehicle trips were not considered for the morning peak hour traffic assessment as they do not coincide with the background morning traffic peak. However they were considered for the afternoon peak hour traffic assessment as they would coincide with the background afternoon traffic peak. It is assumed approximately 50 per cent of construction light vehicle outbound trips would occur during the afternoon peak hour. Construction vehicle trips (heavy vehicles) were considered for the assessment during both the morning and afternoon peaks as they would occur throughout the working day (shift).

The proposed construction traffic would generate a minor impact to existing local traffic conditions due to an increase in construction traffic comprising typically vehicles transporting equipment, materials and spoil; mobile cranes for use in work sites; and worker vehicles.

Transport for NSW and/or the contractor would notify the community of any proposed traffic and pedestrian changes prior to construction and during the construction process. Access to surrounding properties would be maintained throughout construction and operation of the proposal.

Two-way traffic would generally be maintained on local roads at all times during construction of the project. Temporary closure of Lindfield Avenue would however be required for the delivery and installation of substation transformers. Ku-Ring-Gai Council and Roads and Maritime (as appropriate) would also be notified of any proposed road impacts and would be provided with an appropriate construction traffic management plan (CTMP) for these impacts. Transport for NSW would obtain all appropriate 'road opening' and 'control of traffic at work sites' licences, and approvals that may be required for the proposal (subject to detailed design and final construction methodology).

#### Access and haulage routes

Construction traffic would primarily access the site via the Pacific Highway, Strickland Avenue and then into Lindfield Avenue. Construction vehicles would access the site via the proposed new entrance gate along Lindfield Avenue (refer to Figure 6.1a and Figure 6.1b). Additional access for the cable and service relocation would occur from existing Sydney Train access gates in Llewellyn Lane, Strickland Lane and Clanville Road (refer to Figure 6.1a and Figure 6.1b). Lindfield Avenue is subject to a local area three tonne load limit (refer to section 6.1.1).

Construction traffic would enter the substation site from the Pacific Highway into Strickland Avenue and turn left into Lindfield Avenue, refer to Figure 6.1a and Figure 6.1b. This route avoids the Balfour Street underpass and the shopping precinct in Lindfield Avenue. This route is suitable for all construction materials including concrete and manufactured items, such as transformers, switchboards and other electrical equipment. Access to the proposal site would also require the temporary removal of approximately six on-street parking spaces during construction to allow vehicle site access. Additional access gates would be utilised from Clanville Road, Strickland Lane and Llewellyn Street (refer to Figure 6.1b). These access gates would generally be used to access the rail corridor south of the Strickland Road bridge for the construction of the proposed CSR works (for the existing 11kV and 33kV feeder cable relocations).

A permit to exceed the local load limit would be obtained from Ku-Ring-Gai Council on an as required basis for delivery of construction equipment, removal of excess spoil from substation site excavation activities, concrete deliveries and delivery of construction materials and equipment. Temporary closure of Lindfield Avenue would also be required for the delivery and installation of substation transformers. A CTMP would be prepared in consultation with Ku-Ring-Gai Council. Any disturbed surface would be reinstated to match pre-existing conditions. The substation worksite would be established within suitable barriers and protected by traffic management establishment in accordance with the approved CTMP.

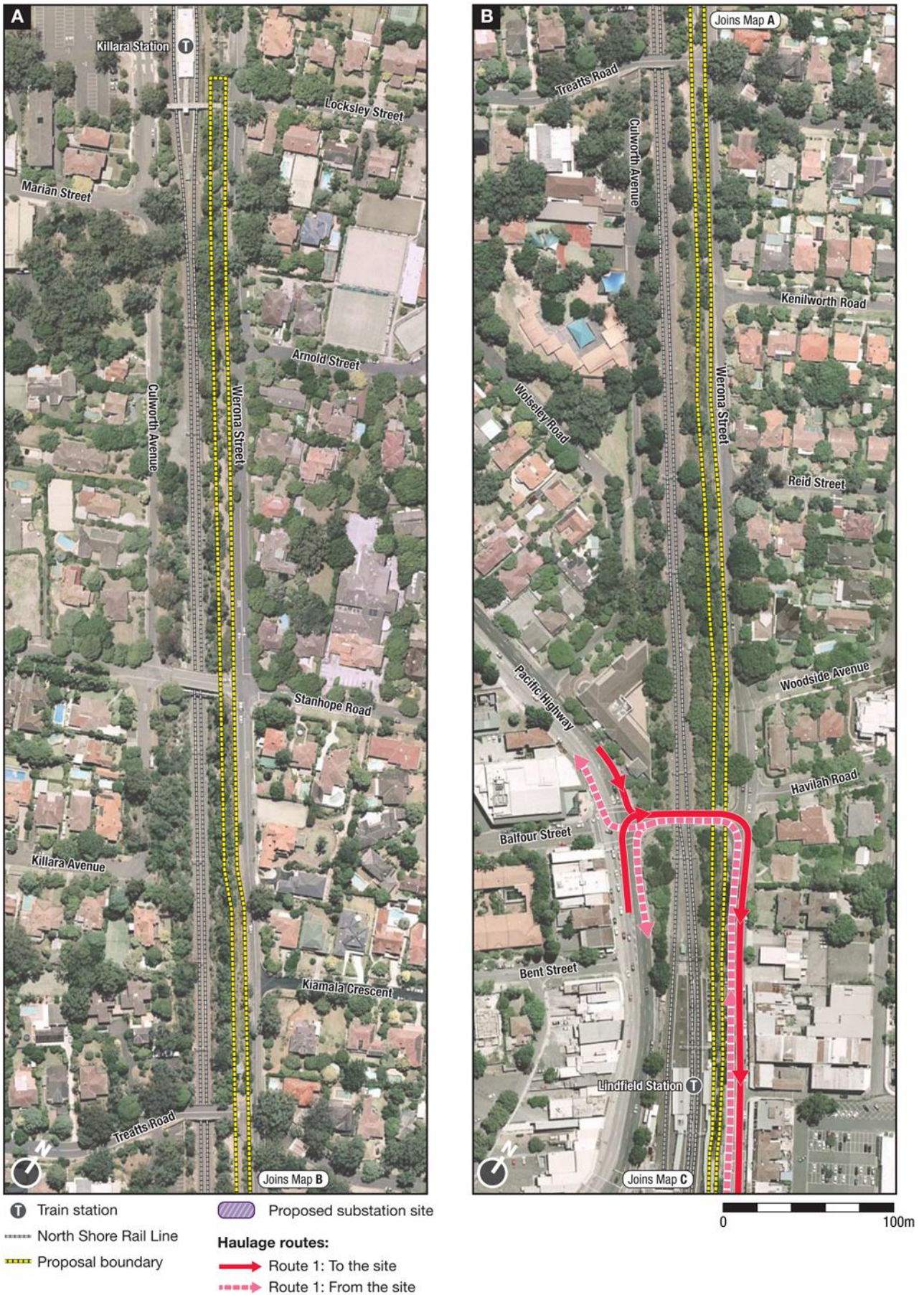


Figure 6.1a Proposed access and heavy vehicle haulage route to the proposal site



Figure 6.1b Proposed access and heavy vehicle haulage route to the proposal site

### Intersection performance

At the proposal site, up to 10 vehicles (refer to Table 6.1 above) could be leaving in the afternoon peak hour. These vehicles are likely to travel to the Pacific Highway via either Balfour Street or the adjacent intersection at Strickland Avenue. The Strickland Avenue intersection is unsignalised and, therefore, the impacts would be minimal. The low vehicle volumes would also result in minimal impacts at the Balfour Street intersection.

### Construction vehicle and staff parking

Construction vehicles would be parked off-street within the rail corridor. Where possible, personal construction staff vehicles would be parked off-street as well, however there would be limited or no space for construction staff vehicle parking at the substation site. It is considered that the surrounding streets within the local area have sufficient capacity to allow for the temporary use of some parking spaces for this use during construction.

### Pedestrians and cyclists

Given the location of the proposal site and location of all works within the existing rail corridor, there are not expected to be any impacts to pedestrians or cyclists at any of the proposed worksites or stations.

However, temporary pedestrian footpath diversions within the vicinity of the proposal site are likely to be required during construction. Pedestrians would generally be diverted to the existing pedestrian footpaths on the adjacent side of Strickland Avenue and Lindfield Avenue during the construction period. Appropriate directional signage would be erected.

### Property access

There are not expected to be any impacts to existing property accesses along Lindfield Avenue.

## 6.1.3 Traffic and transport operational impacts

Once construction is completed, the Lindfield substation would undergo testing and would be commissioned for service. Traffic and transport operational impacts of the proposed Lindfield substation are expected to be minimal. Only one vehicle per month is anticipated to be required at the substation site to undertake maintenance at the site.

The relocation of the existing rail corridor access gate to the northern end of the proposed substation site may result in the loss of approximately two existing on-street, parallel parking spaces along Lindfield Avenue.

Once construction is completed, maintenance requirements of the relocated HV cables and other services are anticipated to be small and have only negligible traffic impacts on the surrounding road network and local intersections.

## 6.1.4 Management and mitigation measures

As part of the Construction Environmental Management Plan (CEMP), a Construction Traffic Management Plan (CTMP) would be developed to address construction traffic and transport management. The following management and mitigation measures would be implemented as part of the CTMP to minimise the traffic and transport impacts of the proposal:

- traffic controllers positioned at access gates adjacent to residential areas and access driveways
- road occupancy licences for temporary closure of roads would be obtained, where required
- heavy vehicles would be restricted to the routes specified and route markers installed for heavy vehicles along designated routes



- signs would be provided at the site access point to assist in deliveries to the worksite
- signs would be provided at the access point for pedestrian and cyclist guidance
- traffic controllers would be located at the access point to direct vehicle movements, vehicle deliveries, pedestrians and cyclists, where required
- an emergency response plan would be developed for construction traffic incidents
- a pre and post-construction assessment of road pavement assets would be conducted in areas likely to be used by construction traffic
- public communications would be conducted to notify the community and local residents of vehicle movements and anticipated effects on the local road network relating to the site works
- access to all private properties adjacent to the works would be maintained during construction
- during project inductions, all heavy vehicle drivers would be provided with the emergency response plan for construction traffic incidents
- road safety audits would be undertaken where required or deemed necessary
- project staging, vehicle movement and scheduling, equipment and resourcing would be coordinated.

Given the minimal traffic impacts during operation, no specific mitigation measures are proposed for operation.

## 6.2 Noise and vibration

A Noise and Vibration Assessment addressing both construction and operational noise and vibration for the proposed substation was undertaken by SLR Consulting Australia Pty Ltd in March 2014 (refer to Technical Paper 2). The results of this assessment are summarised below.

### 6.2.1 Methodology

To quantify and characterise the existing ambient noise environment adjacent to the proposed works, baseline noise surveys were undertaken. At the proposed substation site, an unattended survey was undertaken from 11 to 18 December 2013. The measured noise levels were then applied to establish appropriate noise assessment goals for fixed facilities and as a basis for assessing potential noise impacts during construction.

#### Methodology for unattended noise monitoring

Unattended noise monitoring of the substation site was undertaken using a noise logger which continuously measured noise levels in 15 minute sampling periods to determine the existing  $L_{Aeq}$ ,  $L_{A90}$  and other relevant statistical noise levels during the daytime, evening and night-time periods.

The noise measurements were carried out with a typical Acoustic Research Laboratories Environmental Noise Logger. The equipment was set up with a microphone at approximately 1.5 metres above the ground level and, where possible, at least one metre from the facade of the subject building.

The noise measurements were carried out with typical Acoustic Research Laboratories Environmental Noise Loggers. The calibration of the noise logger was checked both before and after each measurement survey and the variation in calibration at the site location was found to be within acceptable limits at all times.

The analysis of the measured noise levels was been carried out in accordance with the procedures contained in the NSW *Industrial Noise Policy* (INP) (EPA, 2000) to establish representative noise levels. Consistent with the INP, periods of unsatisfactory monitoring conditions of rain and wind speeds greater than five metres per second were filtered from the results.

### Attended airborne noise measurements

Attended measurement of ambient noise was also used to determine the various noise sources that influence the existing noise environment at the substation site. During the measurement, the observer noted the various noise sources and the contributing noise level.

The attended measurements were performed using a Brüel and Kjaer Type 2260 sound level meter for a minimum period 15 minutes. The wind speed was less than five metres per second at all times, and the measurements were performed at a height of 1.5 metres above ground level. Calibration of the sound level meter was checked before and after the measurement and the variation in calibration was found to be within acceptable limits at all times.

## 6.2.2 Existing noise environment

### Receiver locations

As described in section 6.5 of this REF, the predominant surrounding land uses are a combination of low density and medium density residential uses. The sensitive noise receptors are generally located surrounding the substation site on both the eastern side of Lindfield Avenue and the western side of the North Shore Line. During a site inspection, the nearest affected residential receivers were identified.

The identified sensitive residential receiver properties within the vicinity of the substation site are shown on Figure 6.2 whilst the approximate distance to each of the receivers is shown in Table 6.2.

**Table 6.2 Sensitive Receivers near the substation site**

Receiver	Address	Approximate distance to site (metres)
R1	239 Pacific Highway, Lindfield	25
R2	251 Pacific Highway, Lindfield	25
R3	4 Middle Harbour Road, Lindfield	25
R4	1 Middle Harbour Road, Lindfield	25
R5	36 Strickland Avenue, Lindfield	30

### Existing background and ambient noise levels

#### Unattended noise monitoring results

The results of the unattended ambient noise survey are presented in Table 6.3. The rating background level (RBL) refers to the single overall background noise level measured in each relevant assessment period (day, evening or night), while  $L_{Aeq}$  refers to the average noise level evaluated over the daytime, evening and night-time periods and is used to assess the potential construction noise impacts.

**Table 6.3 Summary of unattended noise logging**

Location	Address	Noise level (dBA) <sup>1</sup>					
		Daytime 7.00 am to 6.00 pm		Evening 6.00 pm to 10.00 pm		Night-time 10.00 pm to 7.00 am	
		RBL	$L_{Aeq}$	RBL	$L_{Aeq}$	RBL	$L_{Aeq}$
BG1 – Lindfield	In rail corridor near access gate	48	59	44	58	33	53

Note 1: The RBL and  $L_{Aeq}$  noise levels have been obtained using the calculation procedures documented in the INP.

*Attended airborne noise measurements*

The noise environment at the attended monitoring location is described in Table 6.4.

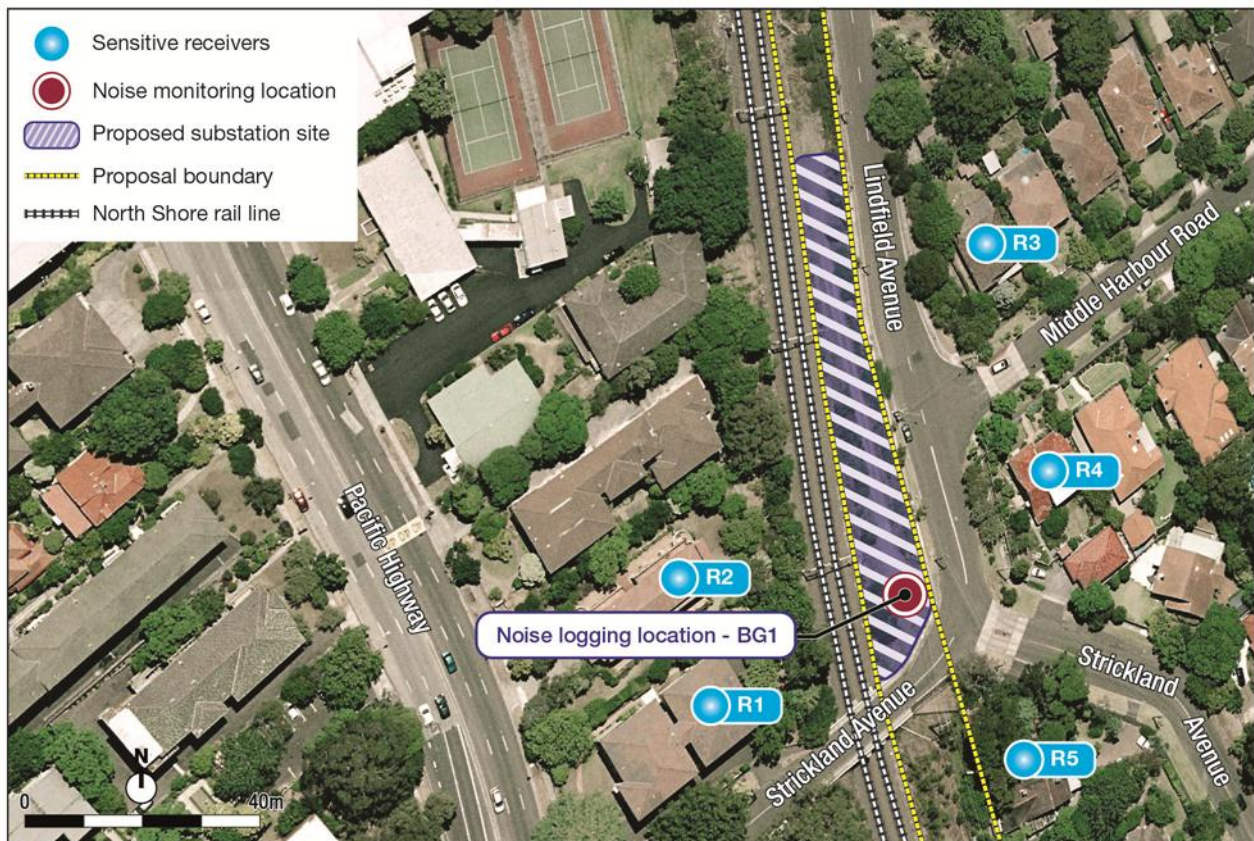
**Table 6.4 Summary of attended noise monitoring results**

Location	Noise level (dBA)					Description and typical $L_{Amax}$ Levels (dBA)
	$L_{Amax}$	$L_{A1}$	$L_{A10}$	$L_{Aeq}$	$L_{A90}$	
BG1 – Lindfield 18/12/13	75	70	66	58	51	60–64 cars 55 birds 70 motorbike 66 train

$L_{Amax}$ : The 'typical maximum noise level' for an event, used in the assessment of potential sleep disturbance during night-time periods.

$L_{Aeq(15minute)}$ : The 'energy average noise level' evaluated over a 15 minute period

$L_{A90}$ : The 'background noise level' or Rating Background Level (RBL) in the absence of construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods respectively and is used to set the  $L_{Aeq(15minute)}$  noise management levels for residential receivers.



**Figure 6.2 Noise monitoring location and sensitive receivers adjacent to the proposed substation site**

## 6.2.3 Noise and vibration guidelines

### Construction noise and vibration strategy

A *Construction Noise and Vibration Strategy* (CNVS) would be required to be adopted by contractors to manage construction noise and vibration as part of the construction of the Lindfield substation (refer to Appendix C of Technical Paper 2). In preparing this strategy, consideration was given to several guideline documents including the *Interim Construction Noise Guideline* (DECC 2009), Transport for NSW's *Construction Noise Strategy*, Australian Standard AS 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* and the *Road Noise Policy* (DECCW 2011).

The CNVS documents the best-practice techniques for managing construction noise and vibration, and implementing feasible and reasonable mitigation measures. The CNVS includes a standard suite of mitigation measures to be implemented across construction sites (such as periodic notification of proposed works, adherence to construction respite periods, use of non-tonal reversing alarms, etc.). It also includes additional mitigation and management measures when construction noise is predicted to exceed the noise management levels (such as noise monitoring, individual briefings, respite offers and in some instances at night, alternative accommodation). These measures are primarily aimed at proactive engagement with affected sensitive receivers.

In addition to the mitigation measures described in the CNVS, contractors may introduce further measures or mitigation strategies to reduce noise and vibration impacts at sensitive receivers. The CNVS is provided in Appendix C of the Noise and Vibration Technical Paper (Technical Paper 2 of this REF).

### Construction noise criteria

#### *Noise management levels*

The *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) sets out ways to deal with the impacts of construction noise on residences and other sensitive land uses. It does this by presenting assessment approaches that are tailored to the scale of construction projects. The ICNG contains a quantitative assessment method which is applicable to new infrastructure projects. Guidance levels are given for airborne noise at residences and other sensitive land uses, including commercial and industrial premises. For residences, guidance in relation to ground-borne noise and sleep disturbance is also provided.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the guidance, or management levels. The 'management levels' are referred to as noise management levels (NMLs). They have been reproduced from the ICNG and are presented in Table 4 of Technical Paper 2. These NMLs apply to all the construction activities and sites associated with the proposal. For residences, the NMLs are set with reference to the Rating Background Level or RBL.

#### *Sleep disturbance and maximum noise level events*

There are no specific criteria for sleep disturbance nominated in the ICNG, the INP and associated Application Notes, or in the *Road Noise Policy* (RNP) (DECCW, 2011). Some guidance on possible impacts is contained in the RNP which contains a section on sleep disturbance that includes a summary of current literature.

The RNP concludes that:

- maximum internal noise levels below 50 dBA to 55 dBA are unlikely to cause awakening reactions
- one or two events per night, with maximum internal noise levels of 65 dBA to 70 dBA, are not likely to affect health and wellbeing significantly.

On the basis of the above guidance, i.e. an external sleep disturbance screening level of RBL + 15 dB, an internal sleep disturbance NML of  $L_{Amax}$  55 dBA has been adopted, which equates to an external noise level of 65 dBA (assuming open windows).

### Construction vibration criteria

The effects of vibration in buildings can be divided into three main categories – those in which the occupants or users of the building are concerned or possibly disturbed, those where the building contents may be affected and those in which the integrity of the building or the structure itself may be prejudiced.

In relation to human comfort, the vibration management levels are based on guidance contained in the *Assessing Vibration – a technical guideline* (DEC, 2006). Mitigation and management measures including consideration of alternative construction methods, attended monitoring and observance of respite periods are required in situations where vibration levels are predicted to exceed the management levels.

Structural damage vibration limits are based on Australian Standard AS 2187: Part 2-2006 *Explosives – Storage and Use – Part 2: Use of Explosives* and British Standard BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2*. These standards provide frequency-dependent vibration limits related to cosmetic damage, noting that cosmetic damage is very minor and superficial in nature, is readily repairable and does not affect the structural integrity of the building.

In order to simplify the assessment process and provide a conservative assessment of the potential impacts associated with the proposed construction activities, a conservative vibration damage screening level of 7.5 millimetres per second has been adopted for the proposal.

### Operational Noise Criteria – Fixed facilities

Operational noise impacts have also been considered for the proposed substation. This type of plant is considered to be fixed facilities and as such, operational noise levels are required to be assessed in accordance with the INP.

The INP sets two separate noise criteria to meet environmental noise objectives – one to account for intrusive noise and the other to protect the amenity of particular land uses. When determining project specific noise criteria, both the amenity and intrusive criteria are considered. The more stringent of these two criteria usually defines the project specific noise levels. For both amenity and intrusiveness, night-time criteria are more stringent than daytime or evening criteria. As the substation has the potential to operate during any period, the night-time period is likely to be the controlling time period.

To provide for protection against intrusive noise, the INP states that the  $L_{Aeq}$  noise level of the source, measured over a period of 15 minutes, should not be more than 5 dB above the ambient (background)  $L_{A90}$  noise level (or RBL), during the daytime, evening and night-time periods at the nearest sensitive receivers. In this case, the RBLs listed in Table 6.4 describe the noise environment as measured near the proposed fixed facilities.

To protect against impacts on amenity, the INP identifies recommended acceptable and maximum  $L_{Aeq(period)}$  noise levels for particular land uses and activities during the daytime, evening and night-time periods. The residences in the vicinity of the proposed facilities are considered to be 'Suburban'. According to the INP, a 'Suburban' area would be characterised by local traffic with intermittent traffic flows, decreasing noise levels in the evening period; and/or evening ambient noise levels defined by the natural environment and infrequent human activity.

The amenity criteria for suburban residential receivers are shown in Table 6.5.

**Table 6.5 INP amenity noise levels for suburban residential receivers**

Land use	Time of day	Recommended $L_{Aeq}$ noise level (dBA)	
		Acceptable	Recommended maximum
Suburban	Day	55	60
	Evening	45	50
	Night	40	45

## 6.2.4 Noise and vibration impacts during construction

### Quantitative noise and vibration assessment

Where works are likely to require significant durations to complete and have the potential to impact on nearby receivers, a quantitative assessment in accordance with the ICNG has been undertaken. A quantitative assessment has been completed for the construction works associated with the proposed substation.

The construction noise and vibration assessment is therefore based on preliminary, indicative information and previous project experience. It also assumes no mitigation measures are put in place to reduce noise and vibration as part of the base impact levels. The assessed quantitative construction scenarios for the works are detailed in Table 6.6.

**Table 6.6 Quantitative construction scenarios**

Scenario	Assumed timing	Equipment required
Excavation	Standard daytime	Road profiler, excavator with breaker attachment, tipper truck
Foundation preparation		Bobcat, hand tools, concrete pump, concrete truck
Delivery and placement of equipment		Flatbed truck, mobile crane, hand tools

With reference to the ambient noise survey results in section 6.2.2, the site specific construction NMLs for the proposed works are presented in Table 6.7.




















**Table 6.7 Construction NMLs – residential receivers**

$L_{Aeq}$ (15 minutes) Construction NMLs (dBA)		
Daytime (RBL + 10 dB)	Evening (RBL + 5 dB)	Night (RBL + 5 dB)
58	49	38

Note: noise management levels are based on representative monitoring location BG1 (refer to Figure 6.2)

The predicted typical  $L_{Aeq(15\text{minute})}$  daytime noise levels exceedances are summarised in Table 6.8.

**Table 6.8 Predicted daytime exceedences with no mitigation**

Receiver area	Noise modelling scenario		
	Excavation	Foundation preparation	Delivery and placement of equipment
R1 - 239 Pacific Highway, Lindfield			
R2 - 251 Pacific Highway, Lindfield			
R3 - 4 Middle Harbour Road, Lindfield			
R4 - 1 Middle Harbour Road, Lindfield			
R5 - 36 Strickland Avenue, Lindfield			
<b>Legend</b>			
Compliance 	≤ 10 dB exceedance 	10 dB to ≤ 20 dB exceedance 	> 20 dB exceedance or $L_{Aeq(15minute)} > 75$ dBA 

The findings of the construction noise impact assessment indicate:

- the predicted daytime noise levels indicate high exceedances of the NMLs during excavation works at nearest residences adjacent to substation site (properties R1 to R4 which have all been identified within approximately 25 metres of the substation site). The predicted noise levels during this scenario are anticipated to be greater than 75 dBA
- during foundation preparation and delivery and placement of equipment, minor to medium exceedances of the NMLs are anticipated.

It should be noted with respect to the proposed excavation, excavation within the rail corridor is expected to take place over two weekend possessions during 2015. Further bulk excavation work for the substation building would commence in early 2016 and is only anticipated to occur for approximately three months.

#### Construction vibration safe working distances

During site preparation and construction of the substation, the major potential sources of vibration emission include rock breakers, jackhammers and other large construction plant and equipment.

As discussed in section 6.2.3, a conservative cosmetic vibration damage screening level of 7.5 millimetres per second has been adopted for the proposal. Table 6.9 provides a summary of the indicative 'safe working distances for the plant items likely to be used for the construction works. The safe working distances are less than those identified in section 3.3 of the CNVS (refer to section 6.2.3) on the basis of the conservative nature of the 7.5 millimetres per second screening level (refer to Table 6.9).

**Table 6.9 Safe working distances – cosmetic damage (based on 7.5 mm/s screening level)**

Plant items	Indicative safe working distance
Hydraulic Impact Hammer – Small	1 metre
Hydraulic Impact Hammer – Medium	4 metres
Hydraulic Impact Hammer – Large	15 metres

As shown above, the offset distance from the substation site to the nearest receivers is sufficient to mitigate any potential impacts from vibration. Should the above construction activities be required within the indicative safe working distances to nearby structures, attended vibration measurements may be required to ensure that the vibration levels remain below the safe levels corresponding to cosmetic damage.

## 6.2.5 Noise and vibration impacts during operation

### Steady state noise

Noise levels have been predicted to the nearest sensitive receivers surrounding the substation site. As shown in Figure 6.2, a number of receivers surrounding the substation site are around 25 metres away. Whilst excavation is proposed at the substation site to lower the existing ground elevation so the substation is at rail level, a direct line-of-sight has been assumed between the substation and all surrounding receivers to ensure a conservative assessment.

The predicted base case night-time noise levels during operation of the proposal in relation to the criteria are provided in Table 6.10.

**Table 6.10 Base case assessment of the Lindfield substation, night-time**

Period	Noise level (dBA)			
	Predicted		INP criteria	
	$L_{Aeq(15minute)}$	$L_{Aeq(Period)}$	$L_{Aeq(15minute)}$ Intrusive	$L_{Aeq(Period)}$ Amenity
Night-time	49	49	38	40

### Circuit breaker noise

The circuit breakers in the proposed substation can emit an impulsive ‘bang’ when a fault causes a breaker to trip. The frequency of such events is however typically very low and would be assumed to occur approximately once or twice a month on average. Noise levels are typically 100 dBA to 120 dBA (fast response) at a distance of approximately six metres from an unenclosed circuit breaker.

The circuit breakers at the proposed substation would be located within the main enclosure of the substation, which would provide some noise attenuation. Non-mechanical ventilation in the form of louvers would also likely be used to provide the required ventilation and reduce noise emissions. As the noise emissions from this source are intermittent in nature and can occur at any time of the day, it is appropriate to assess the potential noise emissions in relation to the night-time sleep disturbance goals.

The predicted night-time  $L_{A1(60second)}$  noise levels during operation of the circuit breakers are provided in Table 6.11.



**Table 6.11 Assessment of circuit breakers**

Period	Noise level (dBA)	
	Predicted 1	INP criteria
	L <sub>A1(60second)</sub>	L <sub>A1(1minute)</sub> Sleep disturbance
Night-time	64	48

The predicted base case steady state noise levels (without any mitigation measures) would result in a worst-case 11 dB exceedance of the night-time intrusive goal at the nearest sensitive receivers. The predicted L<sub>A1(60second)</sub> noise levels also exceed the sleep disturbance goals at the nearest residential receiver locations by up to 16 dB. It should be noted, however, that the predicted noise level from circuit breaker operation would not occur on a continuous basis and will likely be a very infrequent (and momentary) occurrence during the night-time period – potentially once or twice a month. The substation would also be designed, during the detailed design phase, to meet the requirements of the operational requirements of the INP.

Whilst exceedances have been predicted, this represents a ‘worst case’ scenario, of an unmitigated assessment. The substation would be designed to meet the noise goals through provision of shielding or upgrading the acoustic performance of the enclosure. Past experience of measurements of similar substations indicates that the major noise source which requires specific attention is the rectifier transformer. Therefore, further detailed design of the substation would be progressed to ensure that the INP criteria in Table 6.10 are met.

Other than a noise wall, noise mitigation measures could include the optimisation of the substation layout to orient the main noise sources away from of the nearest receivers, or the use of acoustically absorptive material inside the rectifier transformer enclosure in combination with acoustic louvers.

## 6.2.6 Management and mitigation measures

The ICNG and the NWRL Construction Noise Strategy describe strategies for construction noise mitigation and control that are applicable to this proposal. The strategies are designed to minimise, to the fullest extent practicable, noise during construction through the application of all feasible and reasonable mitigation measures.

All construction works associated with the proposal would be managed in accordance with the CNVS (provided as Appendix B of Technical Paper 2). The CNVS documents the best-practice techniques specific to the proposal for managing construction noise and vibration, and implementing feasible and reasonable mitigation measures.

### During detailed design

As noted above, during detailed design, the substation would be designed to meet the noise goals through provision of shielding or upgrading the acoustic performance of the enclosure.

### During construction

Example mitigation measures which are considered appropriate for these works and could be implemented during construction include:

- implementation of proactive community consultation measures
- site inductions for all contractors
- shielding of works using site hoardings
- for construction concentrated in a single area, temporary acoustic fencing/barriers around the site perimeter would be considered where feasible and reasonable to mitigate off-site noise levels

- restriction of noise intensive works to daytime and evening periods, where possible
- where night works are required, these would be programmed to minimise the number of consecutive nights impacting the same receptors, where possible
- avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receptors would result in reduced noise emissions
- equipment which is used intermittently is to be shutdown 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
- use of less noisy equipment
- regular compliance checks on the noise emissions of all plant and machinery used for the proposal would indicate whether noise emissions from plant items were higher than predicted
- reversing of equipment should be minimised so as to prevent nuisance caused by reversing alarms
- respite periods.

## 6.3 Landscape and visual character

A visual impact assessment has been prepared by Envisage Consulting Pty Ltd (July 2014) to assess the visual impacts and changes associated with the proposal. This report is included as Technical Paper 3. A summary of the assessment is provided in the following sections.

### 6.3.1 Methodology

The methodology used for the visual impact assessment is based on the Roads and Maritime (2013) *Environmental Impact Assessment Practice Note - Guideline for Landscape Character and Visual Impact Assessment* and the United Kingdom's *Landscape Institute and the Institute of Environmental Management and Assessment* (2002 and 2013). This assessment focuses on two main types of visual impact:

- effects on visual amenity
- effects on surrounding viewpoints.

An assessment of those two effects (or impacts) on visual amenity and on surrounding viewpoints depends on the combination of two main factors:

- *visual sensitivity* — visual sensitivity is related to the overall context of any landscape, taking into account landscape character (the combination of land use, landform and vegetation cover), visual (or scenic) amenity and visibility. Visual sensitivity is related to the type of viewpoint (whether it is public, private, permanent or transient) and the number of viewers.
- *the magnitude of the visual change* — magnitude of visual change relates to aspects such as how extensive the alteration is to the natural or existing landform, any vegetation loss, the difference in scale of new structures to the surrounding area and the contrast in colour and materials.

The consideration of both of these factors is necessary to arrive at an overall level of effect or impact. The assessment therefore determines the potential level of impact to both visual amenity of the substation site and its surrounds, as well as more specific impact to key surrounding viewpoints such as from public roads and residential locations, as provided in the subsequent sections of this report.

Table 6.12 illustrates the general relationship of the two factors of visual sensitivity and the magnitude of visual change, that together are used to determine the likely impact on the existing visual amenity and surrounding viewpoints.

**Table 6.12 Summary of potential social and economic impacts during construction**

Potential impact impact level		Magnitude of visual change				
		Devastating	Severe	Moderate	Minor	None or negligible
Visual sensitivity	Very high	Devastating impact	Devastating impact	Severe impact	Moderate impact	Minor or negligible impact
	High	Devastating impact	Severe impact	Moderate impact	Moderate impact	Negligible impact
	Moderate	Severe impact	Moderate impact	Moderate impact	Minor impact	Negligible impact
	Low	Moderate impact	Moderate impact	Minor impact	Negligible impact	Negligible impact

### 6.3.2 Existing landscape and visual environment

The proposal site is within the main urban area of the northern suburbs of Sydney. The dominant surrounding land use is residential closest to the main works occurring on the substation site, fringed further to the north by the Lindfield Railway Station and associated Lindfield shopping area. Traversing this part of Lindfield from north to south are two transport corridors including the North Shore Railway and the Pacific Highway.

The substation site typically comprises of a generally rectangular, vacant portion of the railway corridor that is elevated several metres above the level of the railway lines. It is currently covered predominantly with grass and weeds, with some native plant species. There is a wire-mesh security fence along the eastern side of the corridor.

The broader landform slopes gently from the Pacific Highway, west of the railway corridor down, towards Lindfield Avenue alongside the substation site, and continues falling towards Middle Harbour approximately three kilometres to the east.

#### Immediate surrounding land uses

The immediate boundaries of the proposal site include the local two-lane roadway of Lindfield Avenue to the east; the railway corridor to the west and north; and the railway bridge along Strickland Avenue to the south.

On the opposite side of Lindfield Avenue, and extending down both sides of Strickland Avenue to the south-east, is low density, detached housing, dominated by Federation-style, brick houses on quite large blocks. The Clanville heritage conservation area covers part of this area.

Across the railway corridor to the west of the substation site are a number of older-style three storey residential flat buildings that front the Pacific Highway which have the rear of the buildings orientated east towards the railway corridor and substation site. On the opposite, southern, side of Strickland Avenue is another older-style three storey residential flat building which fronts Strickland Avenue.

### Visual amenity

The overall proposal site's visual amenity reflects its location as part of an urban railway corridor. The vacant and generally untended nature of the proposal site means that the site itself and railway corridor have a low visual amenity, however, the surrounding residential area of Lindfield exhibits an attractive and moderate visual amenity, which is comparable with other nearby suburbs in the northern parts of Sydney.

### Visibility

The current visibility of the proposal site is relatively limited when considered that it is within an urban setting, with views towards the site quite limited due to intervening buildings, vegetation and the configuration of the landform.

The main residential views to the substation site and wider proposal site are typically from those houses on the opposite side of Lindfield Avenue, the residential flat buildings on the western side of the railway corridor and the residential flat building on the opposite side of Strickland Avenue. Some views are also possible from the houses on the upper parts of Strickland Avenue near where it meets Lindfield Avenue, with views reducing further south-east along Strickland Avenue where it falls away.

Public views are possible from Lindfield Avenue, Strickland Avenue, the railway overbridge and from within the railway corridor.

### Surrounding key viewpoints

The locations of the key viewpoints and the two photomontages illustrating the indicative appearance of the proposed substation, are indicated in Figure 6.3. Due to the limited area from where the substation would be visible, and its relatively small scale the visual impact assessment of key viewpoints has focussed on those affected viewpoints within 300 metres, as beyond that distance any visual changes would represent a negligible change.

Seven key viewpoints have been identified:

1. View from Lindfield Avenue (roadway and footpath users)
2. View from Lindfield Avenue (residential properties)
3. View from Strickland Avenue and Clanville heritage conservation area
4. View from railway overbridge
5. View from residential flat buildings to west
6. View from rail corridor
7. View from Middle Harbour Road.

The impact of the proposal on these key viewpoints is discussed further in the following sections.

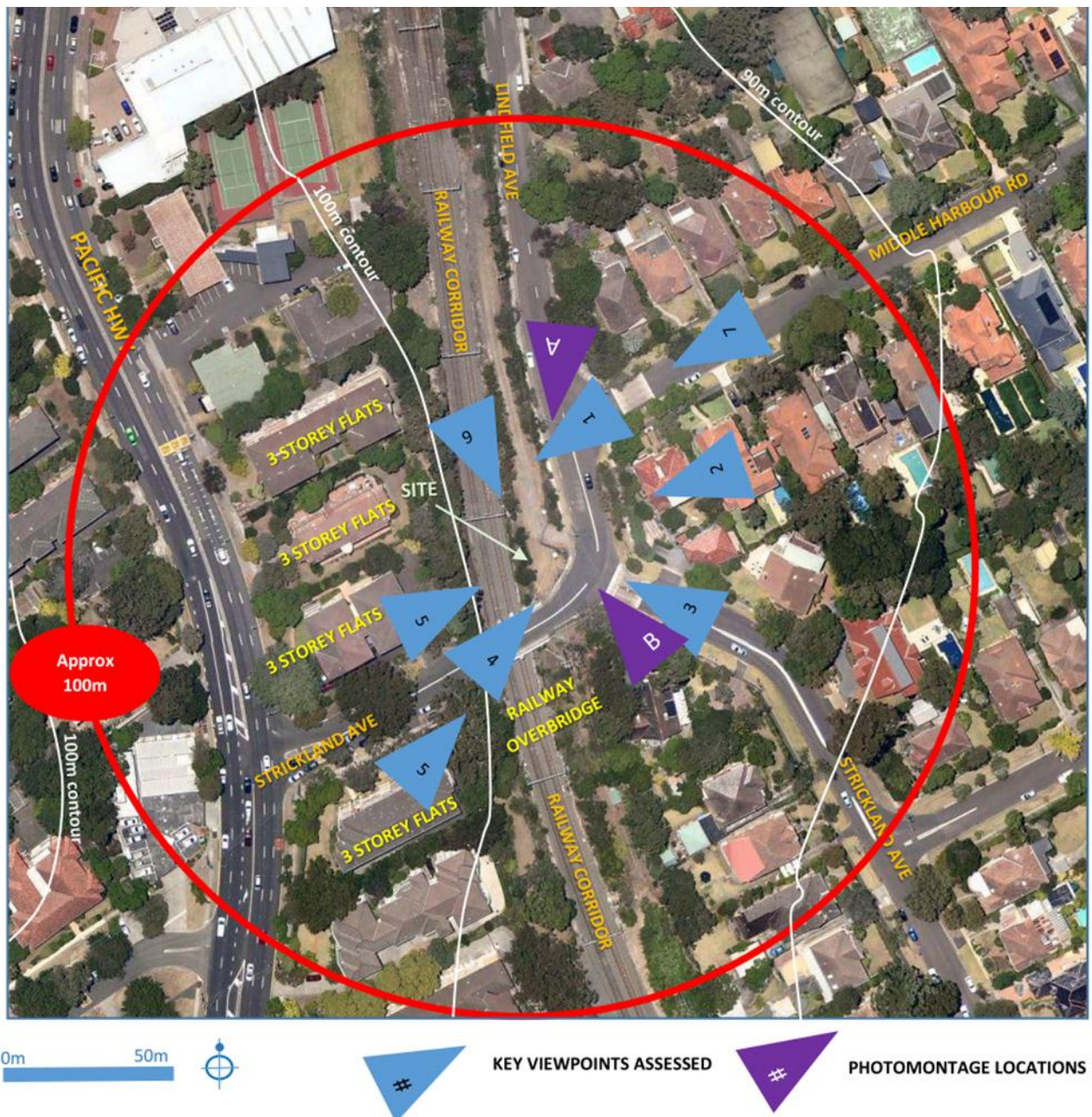


Figure 6.3 Key viewpoints and photomontage locations

### 6.3.3 Landscape and visual impacts during construction

There would be some, short term impacts during the construction phase. The construction of the proposal may temporarily reduce visual amenity for surrounding residents, adjacent businesses and road users nearby due to:

- erection of fencing, barricades, gates and lighting to provide safe and secure worksites
- the presence of construction machinery and materials storage
- general construction activities within the construction footprint, such as vegetation clearing, earthworks, stockpiling materials and the parking/use of construction plant and vehicles
- construction vehicle movements and minor traffic disruption associated with construction traffic.

The proposal's impact on individual sensitive receivers would depend on their location and the severity of the impact. In general, these visual changes would be of a short term, temporary nature and limited to a relatively small area, and therefore would be considered to have a minor impact.

### 6.3.4 Landscape and visual impacts during operation

#### Visual sensitivity of viewpoint

The potential visual sensitivity of each of the key viewpoints is discussed below in Table 6.13. The visual impact assessment of the key viewpoints focussed on those affected viewpoints within 300 metres, as changes beyond that distance would be negligible.

**Table 6.13 Visual sensitivity of viewpoint**

View location	Visual sensitivity of viewpoint
1. View from Lindfield Avenue (roadway and footpath users)	Lindfield Avenue is along the immediate eastern boundary of the substation site, with a concrete public footpath on the closest road verge. The relatively high use of Lindfield Avenue, and its proximity to the site, means that the visual sensitivity of the viewpoint is high.
2. View from Lindfield Avenue (residential properties)	The closest residential properties are on the opposite side of Lindfield Avenue, some 20 metres away. The private nature of these viewpoints, and their proximity, means that the visual sensitivity of the viewpoint is moderate.
3. View from Strickland Avenue and Clanville HCA	The closest residential properties on Strickland Avenue are approximately 25 metres away. There are also public viewpoints along Strickland Avenue and the associated part of the Clanville heritage conservation area. Taking into account the heritage conservation area and the relatively high traffic on Strickland Avenue, overall the visual sensitivity of these areas is considered high.
4. View from View from railway overbridge	The railway overbridge is along the immediate southern boundary of the substation site, where views of the substation would be seen. The public nature of this viewpoint, and its close proximity, lead to a visual sensitivity of this viewpoint of high.
5. View from residential flat buildings to west	There are two residential flat buildings on the western side close to the substation site, one on either side of Strickland Avenue. The private nature of these viewpoints, and their proximity, means that the visual sensitivity of these viewpoints is moderate.
6. View from rail corridor	This is a public viewpoint in very close proximity, however, its location within the rail corridor itself, and the very transient nature of any views to rail users mean that it is considered to have a visual sensitivity of minor.
7. View from Middle Harbour Road	Middle Harbour Road is a local road that connects down to Middle Harbour and has relatively low traffic volumes. The visual sensitivity of the viewpoint is moderate.

#### Magnitude of visual change

The potential magnitude of visual change for each of the key viewpoints is discussed below in Table 6.14.

**Table 6.14 Magnitude of visual change**

View location	Magnitude of visual change
1. View from Lindfield Avenue (roadway and footpath users)	<p>Current views are of the rail corridor where the substation site is located are of the boundary security fence with existing vegetation seen through the fence along the rail corridor.</p> <p>The substation building would occupy the majority of the outer boundary of the substation site along Lindfield Avenue. The building would extend approximately three metres above the level of the road verge, and between the building and the footpath there would be some landscape planting which would partially screen the building. At each end of the building there would be a black palisade security fence through which views across the outer compound areas would be possible. The magnitude of visual change of the proposal is assessed as being minor.</p>

View location	Magnitude of visual change
2. View from Lindfield Avenue (residential properties)	Views would be of the side of the substation, and in some cases part of the roof, of the building extending approximately three metres above the level of the road verge. The side view of the building would be visually broken-up by landscape planting which would partially screen the building. At each end of the building there would be a black palisade security fence through which views across the outer compound areas would be possible. The magnitude of visual change of the proposal is assessed as being minor.
3. View from Strickland Avenue and Clanville HCA	<p>The landform along Strickland Avenue falls away from the site of the substation, meaning that many views from Strickland Avenue and the Clanville heritage conservation area would be from a lower point looking slightly upslope. The effect of the landform means that as a viewer moves further down Strickland Avenue the more that the lower part of substation building would be blocked from view.</p> <p>From the nearest viewpoint on Strickland Avenue (at the corner of Lindfield Avenue), the majority of the substation would be seen. From this viewpoint the side view of the building would be visually broken-up by landscape planting which would partially screen the building. The magnitude of visual change of the proposal is assessed as being minor on this viewpoint.</p>
4. View from View from railway overbridge	Views would be of the southern end and the side facing the railway corridor when on the bridge. Footpath users would have the longest views, with roadway users experiencing more of a glimpse when travelling over the bridge. As the railway bridge is somewhat higher than the substation site, views would be mostly of the upper part of the building and roof. The magnitude of visual change of the proposal is assessed as being minor to this viewpoint.
5. View from residential flat buildings to west	<p>Views would be available from the eastern side of number 239 Pacific Highway (north side of Strickland Avenue), and the eastern end and northern side of number 235-237 Pacific Highway (south side of Strickland Avenue), with the extent of views depending on where the unit of the viewer is located. Both buildings have balconies which would allow views towards the substation site, with more elevated views as passers-by move higher. Current views are of the partially vacant site and the mostly shrubby vegetation along the edges.</p> <p>From the eastern side units of number 239 Pacific Highway, the railway side of the new substation would be seen with the security fence in the foreground where there are gaps in the existing vegetation. However, the substantial vegetation within this property alongside the rail corridor means that most views would be prevented or filtered. Any such views would be of the substation building approximately three metres above the ground, with views of the roof from the higher units.</p> <p>Views from 235-237 Pacific Highway would be more obscure due to the increased distance and some intervening vegetation between the residential flat building and the substation site, both within the property itself and along the railway corridor. There would be no views from ground floor units, however some of the upper units on the eastern end and northern side would have the potential for some views of the railway side of the building and southern end of the substation site, with landscape planting providing partial screening. The magnitude of visual change of the proposal on both of these viewpoints is assessed as being minor.</p>
6. View from rail corridor	Frequent users of this part of the railway would likely notice some level of visual change associated with the substation, most notably during the construction phase when the activity may draw attention to viewers. However, the lower level of the railway line means that any such views would be generally hidden from viewers on the lower carriage levels, with those on the top level having a quick glimpse of the substation site as the train passes. The magnitude of visual change of the proposal is assessed as being minor to this viewpoint.
7. View from Middle Harbour Road	<p>Views would be of side of the substation building when approaching along Middle Harbour Road. The quite steep slope on the road means that the building would be seen against the skyline. The initial removal of vegetation would be visually obvious as the vegetation forms the terminating view currently along this part of the road. The proposed landscape planting would partially screen the building over time.</p> <p>The magnitude of visual change of the proposal is assessed as being moderate as the substation building would be quite obvious in the viewpoint, particularly before the proposed landscape works mature.</p>

## Overall effect on key viewpoints

The overall effect of the proposal on the key viewpoints is identified below in Table 6.15.

**Table 6.15 Magnitude of visual change**

View locations	Magnitude of visual change
1. View from Lindfield Avenue (roadway and footpath users)	Based on a visual sensitivity of high, and a magnitude of visual change of minor, the overall level of effect is assessed as being a moderate impact to this viewpoint.
2. View from Lindfield Avenue (residential properties)	Based on a visual sensitivity of moderate, and a magnitude of visual change of minor, the overall level of effect is assessed as being a minor impact to this viewpoint.
3. View from Strickland Avenue and Clanville HCA	Based on a visual sensitivity of high, and a magnitude of visual change of minor, the overall level of effect is assessed as being moderate impact to this viewpoint.
4. View from View from railway overbridge	Based on a visual sensitivity of high, and a magnitude of visual change of minor, the overall level of effect is assessed as being moderate impact to this viewpoint.
5. View from residential flat buildings to west	Based on a visual sensitivity of moderate, and a magnitude of visual change of minor, the overall level of effect is assessed as being a minor impact to these viewpoints.
6. View from rail corridor	Based on a visual sensitivity of low, and a magnitude of visual change of minor, the overall level of effect is assessed as being negligible impact to this viewpoint.
7. View from Middle Harbour Road	Based on a visual sensitivity of moderate, and a magnitude of visual change of moderate, the overall level of effect is assessed as being a moderate impact to this viewpoint.

Other visual changes with potential impact are related to the:

- realignment of the existing 33 kilovolt (kV) and 11 kV OHW, to a new CSR, generally between power pole P57 and power pole P49
- installation of an aerial earth wire to the top of the existing power poles generally between Russell Avenue, Lindfield and Killara Station.

In general, the visual impact of the second element would be that the current OHW which are aboveground would be moved to ground level, (which would be seen only from passing trains) or be underground. Therefore there would overall be a beneficial visual impact. For the installation of the aerial earth wires there would be a negligible visual impact.

## 6.3.5 Management and mitigation measures

### Construction

Recommended mitigation during construction to mitigate any construction impacts in terms of visual impact include:

- ensure any security fencing includes screening of the site from views from the outer boundary and if possible is not of a garish or light colour (if permitted)
- minimise the storage of materials and construction machinery as far as possible
- maintain the proposal site in an orderly and tidy fashion
- cut-off and directed lighting would be used to ensure glare and light spill are minimised lit during night work periods (where this is required).



## Operation

The following committed mitigation measures would be implemented as part of the detailed design of the proposed substation to minimise potential visual impacts:

- the site of the building would be excavated so that the building sits as low as possible when viewed from outside the rail corridor
- the building would be of high quality materials and coloured in recessive, dark colours to minimise visual contrast with the surrounding area and blend with the new vegetation
- landscape planting would be established along the Lindfield Avenue and Strickland Avenue boundaries to partially screen the substation
- the security fence would have a high quality design and finish, being a black, palisade fence.

The site attributes and committed mitigation measures would substantially contribute to reducing the potential visual impact of the proposal on both the general visual amenity of the immediate area and the impact to key viewpoints.

## Materials and finishes

To ensure high quality materials and finishes are achieved on the substation building and fence, the proposed materials and finishes to be used would be clarified as part of the detailed design. Any outside attachments to the buildings, such as services, air conditioning units or vents should also be of a similar high quality and positioned to be as unobtrusive as possible, and screened as necessary.

## Landscape design

Landscape planting would be undertaken that would partially screen the outer sides of the building from views from surrounding areas. At this stage, landscape planting has not been finalised. It is therefore recommended that this planting have the following attributes:

- ensure partial screening occurs whilst still considering aspects such as personal safety for users of the adjacent footpaths and not creating concealment opportunities or the potential for planting to encroach onto the footpath
- use of trees and shrubs ranging up to two metres when near the footpath
- local native plants should be selected as far as practical
- planting densities of lower storey plants should be a minimal of one per square metre to assist in the management of weeds
- all landscape planting should be in fully prepared, mulched planting beds, and at least half of the pot sizes planted should be of 200 millimetre or greater, and trees planted at 10 litre pot sizes (minimum).

## Lighting

Lighting within and external to the building would consist of security and permanent maintenance lighting. The security lighting would automatically switch on in low light conditions to provide minimal light for safe access and security. Maintenance lighting would only be used while works are being undertaken at the substation. External security lighting would be installed in a manner which minimises light spill to areas beyond the substation site boundary.

## 6.4 Biodiversity

An ecological impact assessment of the proposal has been prepared by Parsons Brinckerhoff and is included as Technical Paper 4. A summary of the assessment is provided in the following sections.

### 6.4.1 Methodology

#### Database searches

The aim of this background research was to identify threatened flora and fauna species, populations and ecological communities; Commonwealth listed Migratory species and critical habitat recorded previously or predicted to occur in the vicinity of the study area. This allowed the known habitat requirements to be compared with those of the study area to determine the likelihood of occurrence of threatened biodiversity. The assessment included a review of:

- research papers, books and other published data
- aerial photographs
- southeast NSW Native Vegetation Classification Mapping (SCIVI) (Tozer 2003)(Tozer 2003)
- Transport for NSW 'Vegetation Offset Guide' (Transport for NSW 2014)
- database searches including:
  - ▶ Bionet Atlas of NSW Wildlife
  - ▶ PlantNet Database
  - ▶ EPBC Protected Matters Search Tool
  - ▶ Noxious Weeds Database.

#### Field survey

The study area was inspected during daylight hours by an ecologist on 28 November 2013 (for the substation site) and 24 June 2014 (to access inside the rail corridor for the substation site and the electrical works site). These surveys were structured primarily to assess the extent and condition of vegetation and fauna habitat, especially for the threatened species and ecological communities.

For the substation site, random meander transects were completed in accordance with the technique described by Cropper (1993) whereby the recorder walks in a meandering pattern throughout the site. Attributes recorded during random meander transects included variation in species composition and vegetation structure, the presence or absence of threatened or noxious species of plant and boundaries between vegetation communities. The random meander surveys were used as a method of searching for threatened species of plant throughout the main works area covering all major native vegetation occurrences. The time spent in each vegetation community was generally proportional to the size of the community and its species richness.

For the electrical works site, a visual inspection of the vegetation was made from the roadside adjacent to the rail corridor. This visual inspection sought to primarily assess the extent and condition of vegetation. Where vegetation was obscured from view, the vegetation was inferred from vegetation which could be seen within other parts of the rail corridor. Fauna habitat assessments were undertaken to assess the likelihood of threatened species of animal (those species known or predicted to occur within the locality from the literature and database review) occurring within the study area. Significance assessments were carried out for threatened species, populations or communities listed under the TSC Act or EPBC Act that were known or predicted to occur in the proposal locality (within a 10 km radius from the study area), that had a moderate to high likelihood of occurring within the study area, based on suitable habitat and that were likely to be impacted upon by the construction.

## 6.4.2 Existing environment

The ecological assessment considered the substation site which is within the rail corridor immediately north of Strickland Avenue overpass and runs adjacent to Lindfield Avenue in Lindfield, NSW. The study area is bordered by railway line (part of the North Shore Line), Lindfield Station to the north, arterial roads and residential development. This railway corridor has been greatly disturbed as a result of previous land uses including residential development and associated infrastructure (railway lines and roads) and weed invasion.

Figure 6.4a and Figure 6.4b below shows the vegetation communities found within the substation location. These are:

- *Blue Gum High Forest* – this vegetation type occurred only in the section between Russell Avenue, Lindfield and Killara Station (refer to Figure 6.4a). The vegetation recorded within the study area contains plant canopy, shrub layer and groundcover species characteristic of Blue Gum High Forest.  
This disturbed vegetation type was in low ecological condition. This vegetation community has been extensively modified by past land use and as a consequence has lost most of its native species and is significantly structurally modified with low density of native vegetation cover. Exotic species are dominant and have replaced the vast majority of the indigenous shrub layer and groundcover.
- *Sydney Turpentine Ironbark Forest derived scrubby regrowth* – this vegetation type occurred throughout the majority of the study area. The scrubby regrowth vegetation recorded within the study area contains plant shrub layer and groundcover species characteristic of Sydney Turpentine Ironbark Forest.  
This disturbed vegetation type was in low ecological condition. This vegetation community has been extensively modified by past land use and as a consequence has lost most of its native species and is significantly structurally modified with low density of native vegetation cover. Exotic species are dominant and have replaced the vast majority of the indigenous shrub layer and groundcover.
- *Cleared and disturbed land* – this vegetation type occupied areas predominantly along the access tracks within the study area. These areas have been subjected to substantial human disturbance including full clearing for the construction of the railway line, adjacent roads, residential properties and access tracks into the rail corridor. Other disturbances include rubbish dumping and weed invasion.  
This cleared and disturbed land vegetation community was in low ecological condition. This vegetation community has been extensively modified by past land use and as a consequence has lost most of its native species and is significantly structurally modified with minimal native vegetation cover.

### Flora

One-hundred and four plant species were recorded within the study area. Of these, 50 were native (48 per cent) and 54 (52 per cent) were introduced species. Of the 54 exotic species that were recorded in the study area, 15 species of plant are listed under the Noxious Weeds Act for the Ku-Ring-Gai Council noxious weed control area. Of these species six species, *Asparagus aethiopicus\**, *Asparagus asparagoides\**, *Asparagus officinalis\**, *Lantana camara\**, *Nassella neesiana\** and *Rubus fruticosus\** are listed as a Weeds of National Significance (Australian Weeds Committee 2013).

### Fauna

A total of 16 species of animal were recorded in the study area of which 14 were native. Birds accounted for 12 species (75 per cent), while mammals were represented by three individuals and reptiles by one species. Most of the species recorded are typical of disturbed environments within a highly modified urban landscape in addition to more intact habitats. No threatened species were recorded within the study area during the field survey within the study area however one Grey-headed Flying-fox individual (listed under the TSC Act and EPBC Act) was recorded within close proximity and is likely to utilise habitat within the study area. The field surveys for fauna were limited to opportunistic recording of birds, reptiles and habitat assessment.



Figure 6.4a Vegetation types



- T** Train station
  - North Shore Rail Line
  - Proposal boundary
- Vegetation communities**
- Cleared and disturbed land
  - Sydney Turpentine Ironbark Forest derived scrubby regrowth (EEC TSC Act)
  - Sydney Turpentine Ironbark Forest (EEC TSC Act)
  - Blue Gum High Forest (EEC TSC Act)

Figure 6.4b Vegetation types

### 6.4.3 Potential impacts on biodiversity from on the substation site

#### Loss of vegetation

Clearing of native vegetation is listed as a key threatening process under both the TSC Act and the EPBC Act. Based on the assumption that the 'additional aerial earth (overhead) wires only' section of the proposed will impact the vegetation to the north of Lindfield Station the construction of the proposal would require the removal of approximately 0.94 hectares (50 square metres) of native vegetation from the proposal site, refer to Table 6.16. In the likelihood that power poles are not replaced as part of the proposed this area of vegetation removed will be reduced.

**Table 6.16 Potential impacts and loss of native vegetation within the proposal site**

Vegetation community/Fauna habitat	Vegetation clearing (ha)
<b>Vegetation community</b>	
Blue Gum High Forest	0.36
Sydney Turpentine Ironbark Forest scrubby regrowth	0.58
Cleared and disturbed land (including scrubby regrowth)	1.37
<b>Total area of vegetation communities</b>	<b>2.31</b>
<b>Total area of endangered ecological community*</b>	<b>0.94</b>
<b>Fauna habitat</b>	
Cleared land with scrubby regrowth	1.69
Forest	0.62
<b>Total Fauna habitats</b>	<b>2.31</b>

\*Forms part of the endangered ecological community, Turpentine-Ironbark Forest and critically endangered Blue Gum High Forest as listed under the TSC Act

As a result of clearing and the loss of vegetation and habitats, a range of direct and indirect ecological impacts may occur. These include:

- reduction in the extent of vegetation communities and associated habitats
- loss of local populations of species
- fragmentation or isolation of remnants of vegetation communities or local populations of individual species
- increased edge effects and habitat for invasive species
- reduction in the viability of ecological communities resulting from loss or disruption of ecological functions (e.g. increased desiccation, light penetration, herbivore, weed invasion, predation, parasitism)
- destruction of flora and fauna habitat and associated loss of biological diversity (habitat removal may include removal of hollow bearing trees, loss of leaf litter layer, and resultant changes to soil biota)
- soil exposure and altered water flow patterns resulting in increased erosion and sedimentation.

The proposal would have an impact on fauna habitats with the removal or modification of approximately 2.31 hectares of habitat which is in low to moderate condition and may provide some marginal foraging habitat for several threatened species of birds and bats.

### Direct loss of fauna

During the construction of the substation, direct injury or death to fauna could occur as a result of the proposed activities particularly during the excavation and site clearing activities. Some mobile species, such as birds, have the potential to move away from the path of clearing, while other species that are less mobile may have difficulty moving over relatively large distances. Species of animal that may be at particularly high risk of injury or death during vegetation clearing include microchiropteran bats, reptiles, nestling birds and frogs. Appropriate mitigation measures would be implemented to reduce the potential for fauna mortality during construction of the substation.

### Habitat fragmentation impacts

Habitat fragmentation is the division of a single area of habitat into two or more smaller areas, with the occurrence of a new habitat type in the area between the fragments. Due to the existing highly fragmented nature of the study area it is considered unlikely that the proposed construction would increase fragmentation, isolation or barrier effects further.

### Environmental noise impacts

Various species of animals rely on sound to communicate, navigate, evade danger and find food. Although ambient noises are part of the natural environment, some human-made noise can alter the behaviour of animals or interfere with their normal functioning. During construction, noise levels will increase in the study area and surrounds due to ground disturbance, machinery operation and vehicle movements and vegetation clearing. This may cause disturbance for some fauna.

The study area is already affected by noise levels associated with vehicle movements along the railway corridor and adjacent arterial roads. Specific impacts to fauna occupying the local area as a result of construction noise is difficult to predict, however given the current minimal habitat on site and the existing noise environment, any impacts are likely to be minor.

### Weed and pest invasion

The construction of the substation has the potential to disperse weeds into new areas. The most likely causes of weed dispersal associated with the proposed construction activities would include earthworks, movement of soil and attachment of seed (and other propagules) to vehicles and machinery.

The process of weed dispersal may also reduce the habitat quality of threatened species, such as woodland species of bird. The invasion of exotic perennial grasses, such as *Nassella neesiana*\*, *Bromus catharticus*\*, *Paspalum dilatatum*\* and *Pennisetum clandestinum*\* which were recorded within the existing road corridor, is recognised as a Key Threatening Process under the TSC Act.

The invasion and establishment of escaped garden plants, exotic vines and scramblers and other exotic species (i.e. *Lantana camara* and *Olea europaea* subsp. *cuspidata*) which were recorded within the existing rail corridor are recognised as Key Threatening Processes under the TSC Act.

Given the moderate level of weed invasion, and the presence of fifteen noxious weeds, within the majority of the rail corridor, construction, has the potential to spread weeds from the study area to other sites. Therefore mitigation measures relating to weed control have been outlined in section 6.4.5 of this report.

## Key threatening processes

A process is defined as a key threatening process under the TSC Act and EPBC Act if it threatens or may threaten the survival, abundance, or evolutionary development of a native species or ecological community. The proposal has the potential to contribute to the following threatening processes:

- Key Threatening Processes (TSC Act):
  - ▶ invasion of native plant communities by exotic perennial grasses
  - ▶ clearing of native vegetation
  - ▶ loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
  - ▶ Invasion, establishment and spread of *Lantana camara*
  - ▶ Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*
  - ▶ Invasion and establishment of exotic vines and scramblers
- Key Threatening Processes (EPBC Act):
  - ▶ land clearance
  - ▶ loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.

The proposal would result in the loss of native vegetation and thus contribute to the Key Threatening Process of clearing of native vegetation and land clearance. The proposal is not likely to significantly increase the introduction or spread of exotic weed species, if undertaken in accordance with mitigation measures provided below.

Impact assessments were completed for all of the threatened biodiversity considered to have a moderate or higher likelihood to occur. Completed significance assessments are provided in Appendix E in Technical Paper 4. Due to the small area and highly modified condition of the vegetation and habitat recorded within the study area the impact assessments concluded that the proposal is not likely to have a significant impact on any threatened biodiversity, nor would it interfere with their recovery, assuming the mitigation measures outlined in section 6.4.4 are put in place.

### 6.4.4 Management and mitigation measures

As part of CEMP, a vegetation management plan would be developed to address potential biodiversity impacts. The following measures would be implemented during construction activities to ensure ecological impacts are minimised:

- biodiversity offset requirements:
  - ▶ although the impacts to threatened biodiversity are not considered to be significant, the proposed project would result in residual impacts that cannot be avoided or mitigated. Based on the worst case scenario (i.e. vegetation within the entire 'additional aerial earth (overhead) wires only' section of the project area will require removal in addition to the main works area), these impacts are associated with the clearing of 0.94 hectares of native vegetation. To mitigate these residual impacts it would be necessary to develop an offset strategy in accordance with the requirements of Transport for NSW 'Vegetation Offset Guide' (Transport for NSW 2014), in particular the offset strategy should aim to:
    - replace/offset 100 per cent of any native vegetation cleared
    - achieve a neutral or beneficial long-term ecological outcome when native vegetation is cleared
  - ▶ the final offset strategy and quantum of offset requirement will be developed in consultation with Transport for NSW on completion of construction



- implement pre-clearing protocols, including:
  - ▶ check for the presence of flora and fauna species and habitat on site before clearing begins such as the presence of bird nests
  - ▶ prior to construction, site personnel should be adequately informed of environmental management procedures including, but not limited to, issues related to flora and fauna management, weed control, erosion and sediment control
  - ▶ establish exclusion zones to protect vegetation and fauna habitat outside of the assessed and approved clearing limits, including the threatened ecological communities recorded within the study area (including Blue Gum High Forest and Sydney Turpentine Ironbark Forest scrubby regrowth). Vegetation to be retained are to be clearly defined on ground and 'no go zones' clearly signposted and fenced to prevent unauthorised clearing and vehicular and/foot traffic
- implement clearing and construction protocols, including:
  - ▶ carefully clear vegetation so as not to mix topsoil with debris and to avoid impacts to surrounding native vegetation
  - ▶ avoid excessive soil disturbance
  - ▶ when accessing construction sites, contractors should only use designated access tracks
- implement flora and fauna control measures including:
  - ▶ clearing of vegetation would be minimised, to only vegetation that is absolutely required to be removed in order to undertake work
  - ▶ replace power poles only where necessary and appropriate to do so as to reduce impacts to biodiversity
  - ▶ noxious weeds within the study area such as *Ligustrum lucidum*\* (Broad-leaved Privet), *Cinnamomum camphora*\* (Camphor Laurel), *Asparagus aethiopicus*\* (Asparagus Fern), *Lantana camara*\* (Lantana), *Ligustrum* spp. (Privet), *Nassella neesiana*\* (Chilean Needle Grass), *Tradescantia albiflora*\* (Wandering Dew) and *Rubus fruticosus*\* (Blackberry) would be managed in accordance with the *Noxious Weeds Act 1993*.
- weed species within the study area would be managed in order to control them from further spread. Management techniques may include immediate weed removal and disposal without stockpiling, disposal of weed-contaminated soils at appropriate weed disposal facilities and to ensure that all equipment is cleaned prior to and on completion of works to ensure weeds are not introduced or spread to other locations.

## 6.5 Land use, property and socio-economic

### 6.5.1 Existing environment

As described in section 2.3.2, land use and development within the vicinity of the proposal is controlled through the zoning provisions of the *Ku-Ring-Gai Local Environmental Plan (Local Centres) 2012*. Under this LEP, the proposed Lindfield substation and associated cable relocation works would be located within the existing rail corridor on land zone SP2 Railway Infrastructure. As the whole of the proposal site is within the existing rail corridor, the property is owned and operated by Sydney Trains.

The land use adjacent to the substation site and associated cable relocation works typically consists of low to medium-density residential housing to the east, west and south of the proposal site. The main town centre of Lindfield, including light industrial and commercial uses are located to the north of the substation site. The broader study area includes a mix of land uses which are characteristic of both suburban and business park settings, including residential, commercial, industrial, recreation, education, infrastructure and parks and reserves.

Photos of the key land uses within the vicinity of the proposal site are provided in Figure 6.5 to Figure 6.8. The key land uses within the vicinity of the proposal site are shown in Figure 6.9a and Figure 6.9b.



**Figure 6.5** Example of low density residential housing to the south of the proposal site

Source: Envisage consulting, 2014



**Figure 6.6** Example of medium density residential housing to the west of the proposal site

Source: Envisage consulting, 2014



**Figure 6.7** Example of the medium density residential housing which overlooks the proposal site to the west

Source: Envisage consulting, 2014



**Figure 6.8** Example of the medium density residential housing which overlooks the proposal site to the west

Source: Envisage consulting, 2014

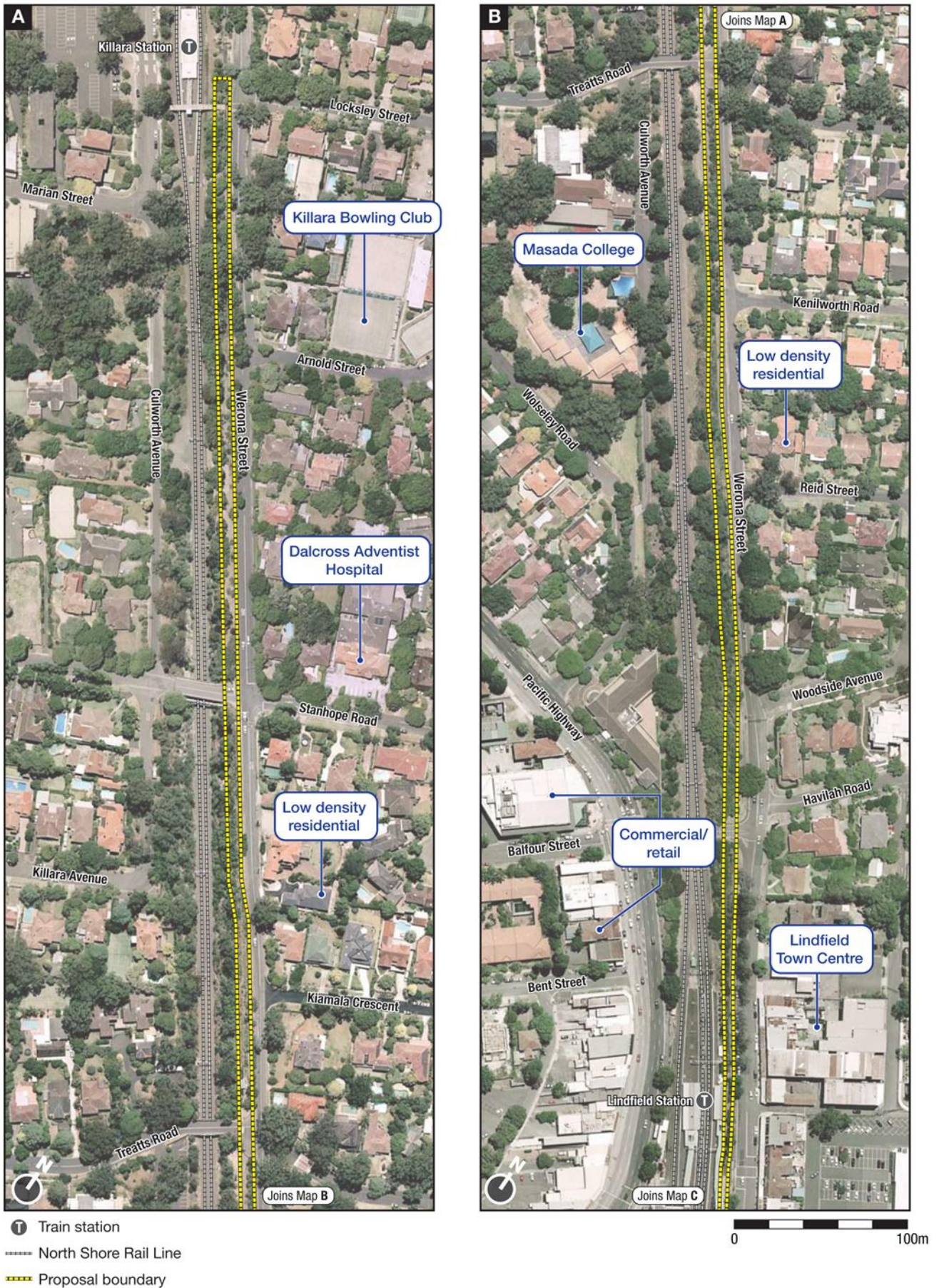


Figure 6.9a Key land use within the vicinity of the proposal site



Figure 6.9b Key land use within the vicinity of the proposal site

## Socio-economic

It is unlikely that there would be any significant social impacts as a result of the proposal. Notwithstanding, the construction of the new substation would ensure that the reliability of the Sydney Trains network to cater for the increased capacity during peak hour on the North Shore Line is maintained.

An assessment of the potential social and economic impacts of the proposal was undertaken as part of this REF. Table 6.17 summarises the conclusions of the assessment in relation to the potential construction impacts, including consideration of management and mitigation measures to reduce the identified impacts.

**Table 6.17 Summary of potential social and economic impacts during construction**

Potential impact	Potential impact without mitigation	Potential impact with mitigation
<p><b>Impacts to businesses</b></p> <p>Relating to the potential loss or relocation of businesses due to the proposal.</p>	<p><b>No impact</b></p> <p>Given the location of the proposal, no businesses are located within the immediate vicinity of the proposal that would be affected by the proposal.</p>	<p>None required.</p>
<p><b>Noise and vibration</b></p> <p>Relating to the potential loss amenity for residential properties and businesses due to the construction of the proposal.</p>	<p><b>Slight negative</b></p> <p>Some potentially sensitive residential noise receivers have been identified adjacent to the substation site that would be impacted slightly during construction and operation.</p> <p>No business or commercial properties have been identified within the immediate vicinity that may be impacted by construction related noise and vibration.</p>	<p><b>Slight negative</b></p> <p>Standard mitigation measures would be implemented during construction to minimise noise and vibration amenity impacts (refer to section 6.2 of this REF).</p> <p>Mitigation measures such as shielding and design of the substation would also be investigated during detailed design to minimise noise and vibration impacts during operation of the substation.</p>
<p><b>Traffic, access and parking</b></p> <p>Relating to the availability of car parking for customers and employee and increases in construction related traffic.</p>	<p><b>Slight negative</b></p> <p>Construction workers could potentially park on nearby streets reducing the amount of parking available for existing customers and workers.</p> <p>Additionally, approximately two to four existing parking spaces along Lindfield Avenue may be lost due to the relocation of the existing rail corridor access point associated with the proposed Lindfield substation.</p>	<p><b>Slight negative</b></p> <p>To limit construction workers parking in surrounding streets, where feasible and safe to do so, parking for some vehicles would be provided within the proposal site/within the rail corridor adjacent to the proposal site.</p> <p>Short term impacts would be further minimised through the implementation of a CEMP and CTMPs.</p>
<p><b>Increased demand for goods and services</b></p> <p>Demand for local goods and services from the construction industry.</p>	<p><b>Slight positive</b></p> <p>Some businesses within the Lindfield town centre may experience a slight positive benefit from additional customers resulting from the construction activities and additional workers in the locality.</p>	<p>None required</p>
<p><b>Employment generation</b></p> <p>Relating to the generation of construction employment as a direct and indirect consequence of the project.</p>	<p><b>Slight positive</b></p> <p>Employment generation benefits would occur on commencement of the project's planning, design and construction work.</p>	<p>None required</p>
<p><b>Economic multipliers</b></p> <p>Relating to economic activity in one industry and the flow on benefits to others across the national economy.</p>	<p><b>Slight positive</b></p> <p>Benefits of construction and job generation would flow through to the wider economy on commencement of the project's planning, design and construction work.</p>	<p>None required</p>

## 6.5.2 Operational impacts

There would be no changes to land use as a result of the operation of the proposal. All of the proposed works would occur within the existing rail corridor and would not impact on other existing land uses during operation.

The proposal is not expected to stimulate any change to land uses adjacent to the railway corridor or have any socio-economic impacts.

## 6.5.3 Management and mitigation measures

Given the minor impact of the proposal on existing land uses, no specific management and mitigation measures are proposed to be implemented during construction or operation of the proposal.

Mitigation measures which would reduce the amenity impacts of construction are outlined throughout the remainder of this REF.

# 6.6 Water quality, hydrology, drainage

## 6.6.1 Existing environment

The proposal site for the Lindfield substation and associated electrical works falls within the Sydney Harbour and Parramatta River Catchment area. This area extends from Blacktown in the west, Sydney Harbour National Park in the east, Marrickville to the south and Warringah to the north. The proposal site is situated approximately two kilometres to the north east of the Lane Cove River, which is a tributary of the Parramatta River.

No other surface waterways have been identified within the vicinity of the proposal.

## 6.6.2 Construction impacts

The potential impacts from the proposed construction works on water quality would mainly comprise the pollution of stormwater run-off with sediments, fuels and other hazardous materials from the proposal site. The following potential water quality impacts could result from activities associated with the construction of the proposal:

- *Earthworks and excavation activities* – the construction of the substation earthworks, excavation activities and installation of the new CSR would create opportunities for stockpiled material and excavated soils to erode causing sedimentation of water runoff entering drainage systems and potentially increasing sediment loads into urban drainage systems. In addition, fuels from vehicles, plant and machinery operated around the substation site could potentially spill and leak. Any potential fuel spills could leach into exposed ground surfaces causing soil contamination or enter drainage systems polluting receiving waterways.
- *Accidental chemical spills and leaks* – accidental chemical spills and leaks associated with the transportation, use and storage of hazardous materials could contaminate stormwater run-off from the substation site. Spillage of diesel, lubricating oils or other chemicals could occur during refuelling and/or maintenance of construction vehicles, while leakage of fuels or oils could occur from poorly maintained construction vehicles. However with the appropriate mitigation measure in place these impacts are unlikely.

### 6.6.3 Operational impacts

As a result of the construction of the Lindfield substation and new CSR in existing vegetated areas, stormwater runoff would potentially be increased as a result of the increase in hardstand area. During the operation stage of the substation the quality of water should not be impacted. All rainfall runoff would be from sealed or stabilised areas and would enter the council stormwater system via a new drainage system as described in section 5.3.1 of this REF. The stormwater run-off expected from the substation is unlikely to exceed the capacity of the existing system as only a small amount of vegetation would be removed from the proposal site and replaced with sealed surfaces, however the proposal would discharge volumes of water into the existing infrastructure at a rate that complies with the Ku-Ring-Gai Council limits.

In addition to the increase in potential runoff, accidental spills and leaks associated with the use and storage of hazardous substances within the substation site could contaminate stormwater run-off. Spillage of diesel, lubricating oils or other chemicals could occur during substation maintenance activities potentially impacting the water quality of receiving waterways.

### 6.6.4 Management and mitigation measures

As part of the CEMP, a water quality management plan would be developed to address potential soil and water quality management on the substation site. The following management and mitigation measures would be implemented as part of the water quality management plan to minimise the potential impacts of the proposal:

#### Construction

The following management and mitigation measures would be implemented to minimise water quality impacts during the construction of the proposal:

- no stockpiles of materials or storage of fuels or chemicals would be located adjacent to existing culverts
- vehicles and machinery would be properly maintained to minimise the risk of fuel/oil leaks
- routine inspections of all construction vehicles and equipment would be undertaken for evidence of fuel/oil leaks
- all water discharges would be undertaken in accordance with Transport for NSW's *Water Discharge and Re-use Guideline*
- construction plant, vehicles and equipment would be refuelled off-site, or in designated re-fuelling areas located at a minimum distance of 50 metres from drainage lines or waterways
- the existing Sydney Trains and Council drainage systems would remain operational throughout the construction of the project
- stabilised surfaces would be reinstated as quickly as practicable after construction
- material transport from site to surrounding pavement surfaces would be minimised
- drainage will be installed to carry stormwater collected on site and connected into existing council stormwater infrastructure.

Further mitigation measures regarding particular impacts relating to water and soil management are provided in section 6.7.4 below.

#### Operation

Operational water quality impacts from the substation site would be managed in accordance with Sydney Trains' existing environmental management system.



## 6.7 Soils and contamination

### 6.7.1 Existing environment

#### Soils

The study area is located within the broad sandstone plateau of the Sydney Basin. The sandstone geology is generally overlaid on the broader portions of the ridge crest landforms by Ashfield Shale. Soils across the gently sloping crest landforms would largely be residual in nature, with some colluvial movement on slopes and fluvial deposition associated with watercourses.

#### Contamination

The substation would be constructed on a section of vacant land within the North Shore Line rail corridor at Lindfield. It is likely that in recent history, this land would have been used by Sydney Trains as a storage area for equipment, machinery construction materials and other miscellaneous items as necessary. The remainder of the proposed works, including realignment of the existing high voltage aerial feeder lines, is also within the existing rail corridor.

There is no registered contamination within the substation site. However, given the likely history of the site and proximity within an active rail corridor, there may be some potential for contaminated soils within the proposal site. The most likely source of potential soil contamination would be a result of any storage or use of hydrocarbons and fuels within the proposal site. Management measures would be undertaken during the excavation and construction works to assess the area for contamination so that any contaminated material can be safely removed from site.

### 6.7.2 Construction impacts

The impacts on soils within the substation site would be due to excavation works carried out as part of the substation foundation works as well as for the creation of pits and footing. Where possible, spoil generated would be used on site to provide the required levels. However, spoil that cannot be used would be sent for recycling or disposal to a licensed facility. During the construction of the Lindfield substation, a substantial amount of excavation would be required (approximately 4,500 cubic metres). Some of this excavation may be suitable for reuse within other part of the substation site for elements such as access tracks.

The proposal also has the potential to impact negatively on the surrounding environment due to excavations that may lead to erosion and sediment transfer offsite and contamination issues associated with hydrocarbon spills as a result of plant operating within the proposal. If any contaminated material is found, it would be removed as part of the works in accordance with the waste classification guidelines. A contamination management plan would be incorporated into the CEMP to minimise any impacts of contamination and its removal.

Given the site characteristics and the scope and size of the proposal, it is anticipated that erosion and sediment risks are minimal and can be effectively managed through the implementation of standard measures as outlined in the Landcom *Managing Urban Stormwater, Soils and Construction Guidelines* (Landcom 2004).

### 6.7.3 Operational impacts

Some potential contamination risks could arise from potential spillages/leakages of fuels and oils used within the substation site. These impacts would be managed through the implementation of Sydney Trains standard operational procedures.

## 6.7.4 Management and mitigation measures

The following management and mitigation measures would be implemented to minimise contamination impact pre-construction and during the construction of the proposal:

### Soils

- an Erosion and Sedimentation Control Plan (ESCP) will be developed and maintained for the site in accordance with *Managing Urban Stormwater, Soils and Construction Guidelines* (Landcom, 2004) (the Blue Book). The plan will include site access controls preventing tracking of sediment from site, limiting the removal of groundcover and ensuring that the excavation works do not block natural drains or create undrained areas
- all material required for off-site disposal is to be appropriately tested and classified against the Waste Classification Guidelines prior to being disposed of off-site (DECC, 2008)
- excavated material will be reassessed for reuse onsite
- site rehabilitation of disturbed areas to be undertaken progressively as activities are completed during the proposal.

### Contamination

- the CEMP would include a contamination management plan and an asbestos management plan
- all fuels, chemicals and hazardous liquids would be stored within an impervious bunded area in accordance with Australian standards and EPA Guidelines
- spill kits and a temporary refuelling bund will be installed and used onsite
- if fill material is discovered during excavation works, the material should remain on-site where possible (where contaminant concentrations meet the National Environment Protection Council's National *Environment Protection (Assessment of Site Contamination) Measure 1999*)
- should any signs of contamination be identified during work within the site, the material would be tested against the National Environment Protection Council's National Environment Protection (Assessment of Site Contamination) Measure 1999, and managed accordingly
- a hazardous materials inspection is to be undertaken of any areas where historical infrastructure is to be demolished to assess the materials for the presence of asbestos and/or lead paint. If present, appropriate management measures would be implemented for safe removal
- soil excavated in areas with identified surrounding industrial land uses (including former uses) is to be assessed for either its potential re-use on-site or classified for waste disposal purposes. If groundwater is encountered during the works, groundwater quality is to be investigated and appropriate management measures implemented to avoid further impacts
- procedures for handling asbestos contaminated materials (if found on site), including record keeping, site personnel awareness and waste disposal would be undertaken in accordance with WorkCover requirements.

## 6.8 Non-Indigenous heritage

A non-Indigenous statement of heritage impact (SoHI) has been prepared by Artefact Heritage (June 2014) and is included as Technical Paper 5 (Artefact 2014a). A summary of the assessment is provided in this section.

### 6.8.1 Methodology

The study area for the assessment of non-Indigenous heritage was identified as including the area of proposed impact (the proposal site) and a 100 metre buffer surrounding this site. Heritage items within 100 metres of the proposed impact area were also included in this assessment to ensure that all potential impacts to the context and setting of the heritage items were taken into consideration.

A search of existing heritage items within the study area was undertaken through a search of the following heritage lists and registers:

- World Heritage List
- National Heritage List
- State Heritage Register
- Section 170 Registers, under the NSW *Heritage Act 1977* ('the Heritage Act')
- local environmental plans (LEPs):
  - ▶ Ku-Ring-Gai Planning Scheme Ordinance 2013 ('Ku-Ring-Gai PSO'),
  - ▶ Draft Ku-Ring-Gai Local Environmental Plan 2013 ('Draft Ku-Ring-Gai LEP')
- Register of the National Trust.

Documentary research was conducted to investigate the general history of the locality, as well as the history of the heritage-listed items within the study area. The following libraries and archives were consulted:

- State Library of NSW
- National Library of Australia, including maps and newspaper archives
- Land and Property Information Division, including the Parish Map Preservation Project and aerial photographs.

Following this research, an initial site inspection was conducted on 4 December 2013 to verify the desktop assessment and identify and inspect any visible heritage items, with additional confirmation site visits undertaken on 20 March 2014 and 24 June 2014. Based on this information obtained, assessments of significance for each of the identified heritage items within the study area were prepared in accordance with the NSW Heritage Assessment Guidelines (included in the *NSW Heritage Manual*, Heritage Office and Department of Urban Affairs & Planning 1996).

### 6.8.2 Existing non-Indigenous heritage

Lindfield was originally the traditional land of the Ku-Ring-Gai, or Guringai people. The name of the suburb and Railway Station was taken from the name of a cottage constructed by an early settler in the region, Francis John List. The focus of the suburb of Lindfield was originally on the Lane Cove River where a government convict timber-getting camp was established around 1810, known as the Lane Cover Sawing Establishment. The railway line was established in 1890, increasing and diversifying the population as Lindfield began to be increasingly suburbanised. Further discussion of the historical context of the proposal site is provided in Chapter 4 of the SoHI (Technical Paper 5).

## Heritage listings

### *World Heritage List*

No items listed on the World Heritage List were identified within the study area.

### *National Heritage List*

No items listed on the National Heritage List were identified within the study area.

### *State Heritage Register*

A single item within the study area is listed on the SHR being a residential property known as 'Woodlands' (SHR No 01762)

### *Section 170 Registers*

No items listed on Sydney Train's Section 170 were identified within the study area.

### *Register of the National Trust*

No items listed on the Register of the National Trust were identified within the study area.

### *LEP listings*

Four heritage-listed items which are located within or adjacent to the proposal site:

- Ku-ring-gai Local Environmental Plan (Local Centres) 2012
  - ▶ Item No. I41 Commercial Block
  - ▶ Item No. I42: 'Laurabada', dwelling house
  - ▶ Item No. I55: St Alban's Anglican Church
  - ▶ Item No. C27 Blenheim Road Conservation Area
- Draft Ku-ring-gai Local Environmental Plan 2013 (LEP)
  - ▶ Item No. I1106 Killara Railway Station Group
  - ▶ Item No. I407 Killara Post Office
  - ▶ Item No. I391 Dwelling House at 23 Stanhope Road
  - ▶ Item No. I393 'Mooralbeck' Dwelling House at 29 Stanhope Road
  - ▶ Item No. I405 'Woodlands' Dwelling House at 1 Werona Avenue
  - ▶ Item No. I483 Dwelling House at 6 Waimea Road
  - ▶ Item No. I482 Dwelling House at 4 Waimea Road
  - ▶ Item No. C92: Clanville Conservation Area
  - ▶ Item No. C26 Oliver Grant Conservation Area
  - ▶ Item No. C21 Springdale Conservation Area

These items are summarised in Table 6.18. A map of the identified heritage sites within the vicinity of the proposal site are shown in Figure 6.10a and Figure 6.10b.

**Table 6.18 Summary of non-Indigenous heritage listed items within the study area**

Listing	Item name	Significance/comment
Ku-Ring-Gai (Local Centres) LEP 2012	Commercial Block	The inventory sheet for the building, held by the Ku-ring-gai Council, is incomplete, as is often the case with older heritage listings. The building was constructed between 1921 and 1940 and was listed as being locally significant on social and architectural grounds.
Ku-Ring-Gai (Local Centres) LEP 2012	Laurabada' dwelling house	'Laurabada' is located at 9 Middle Harbour Road, Linfield, approximately 90 metres to the east of the study area. The statement of significance for 'Laurabada' as outlined in the Ku-Ring-Gai (Local Centres) LEP 2012 is as follows:  <i>No. 9 Middle Harbour Road, Lindfield, has significance as part of the early residential development of the suburb of Lindfield during the second decade of the 20<sup>th</sup> Century when the subdivision of the larger holdings was at its peak. Although having undergone some modifications to the original building, the house remains largely intact externally with its original Federation Bungalow stylistic detailing. The largely intact and mature gardens at the front of the house contribute to the streetscape character as a significant curtilage to this early 20<sup>th</sup> Century residence.</i>
Ku-Ring-Gai (Local Centres) LEP 2012	St Albans Anglican Church	The heritage item includes the St Albans church complex, including the church, hall, offices and residence, at 1–5 Tryon Avenue. The statement of significance for St Albans Anglican Church as outlined in the Ku-Ring-Gai (Local Centres) LEP 2012 is as follows:  <i>The church building is a good representative example of a large Inter War Gothic Style brick church which has simplified medieval design details such as castellations to the bell tower and unusual triangular parapet detail. The building is of high quality workmanship particularly the brickwork and leadlight windows. The church is of landmark social and historical value to the local community in providing spiritual and religious services for 100 years. The site includes a good representative example an Inter War bungalow residence and a c1960 hall and office facilities. The complex of buildings makes a strong contribution to the Lindfield Town Centre and is located on a landmark site, opposite the Lindfield Railway Station and next to the retail and commercial precinct.</i>
Ku-Ring-Gai (Local Centres) LEP 2012	Blenheim Road Conservation Area	The Blenheim Road Conservation Area encompasses all properties in Blenheim Road, with boundaries along Treatts Road, Kenilworth Road, Woodside Avenue and Nelson Road. The statement of significance for the Blenheim Road Conservation Area contained within Ku-ring-gai DCP 2012 is as follows:  <i>The Blenheim Road Conservation Area has historical and aesthetic significance. The Blenheim Road HCA is of historical significance as an intact portion of the Heart of Lindfield subdivision auctioned in December 1911.</i>  <i>The Blenheim Road HCA is of aesthetic significance as a predominantly intact area of overwhelmingly single storey Federation and Inter-War housing.</i>

Listing	Item name	Significance/comment
Draft Ku-Ring-Gai LEP 2013	Killara Railway Station Group	<p>The Killara Railway Station is located in a suburban setting away from the Pacific Highway between Werona Avenue and Culworth Avenue. It is enclosed by mature trees that line both sides of these roads. The station consists of an early twentieth century station building, modern steel awnings, an island platform, footbridge, and a well maintained ornamental garden on the eastern side. The statement of significance for the Killara Railway Station Group obtained from the SHI listing for the item is as follows:</p> <p><i>Killara Railway Station has heritage significance at a local level. It is a typical suburban station with associated ornamental gardens, and one of the few stations in the region where there has been relatively little change to the appearance of the overall setting. It is one of a number of stations that demonstrate the significant impact of the railway in facilitating settlement in the northern suburbs of Sydney and is an important station on the first purely suburban line in NSW. The station has local significance in terms of its association with the formerly prestigious Railway Stations Gardens Competition. It is one of the most important and intact railway gardens in the region. The grouping of the station building, platform and footbridge in their landscape setting, contribute to the characteristic nature of the North Shore line, with its homogenous early twentieth century station designs and garden settings. The replacement of the original roof form of the station building with a poorly designed substitute structure detracts from the overall setting and significance.</i></p>
Draft Ku-Ring-Gai LEP 2013	Killara Post Office	<p>The former Killara Post Office, along with the ornamental garden of the Killara Railway Station, forms part of small but significant suburban heritage precinct.</p> <p>The inventory sheet for the building, held by the Ku-ring-gai Council, is incomplete, as is often the case with older heritage listings.</p>
Draft Ku-Ring-Gai LEP 2013	Dwelling House at 23 Stanhope Road	<p>The heritage listing for this item is incomplete. It was constructed between 1901 and 1920. The statement of significance for this item, taken from its inventory listing on the SHI states that that item has architectural, group value and municipal significance.</p>
Draft Ku-Ring-Gai LEP 2013	'Mooralbeck' Dwelling House at 29 Stanhope Road	<p>The building occupying Lot 1, 29 Stanhope Road is a two storey, early twentieth century building, constructed in the Federation Arts and Crafts style and is referred to in the Heritage study area of the Municipality of Ku-ring-gai as Item No. 28:064. It represents a fine example of Federation Arts and Crafts architecture and it remains in largely original condition both externally and internally. It may date from 1907.</p> <p>The building features an upright styling with a steeply pitched, terra cotta tiles roof set behind prominent decorative gables. Large box windows feature on most elevations. Walls are of red face brickwork at the lower level and stuccoed in the Federation fashion above a stringer course. A number of small out buildings exist on the site but these are not significant structures and most probably date from the period 1921-1938.</p> <p>The statement of significance for Mooralbeck, obtained from a Statement of Heritage Impact for the property, is as follows:</p> <p><i>The building is of historical significance for its links to the residential development of Killara after 1890. The building is of aesthetic significance as it is a fine example of a Federation Arts and Crafts period building which remains largely intact.</i></p>

Listing	Item name	Significance/comment
Draft Ku-Ring-Gai LEP 2013	'Woodlands' Dwelling House at 1 Werona Avenue	<p>'Woodlands' (formerly known as 'Inglewood') is situated on approximately 2113 metre square corner block bound by Kiamala Crescent to the north and Werona Avenue to the west. The original entrance is marked by two palm trees. Subdivision of the property has altered the original front boundary. In its original form (circa 1800) the house was a two storey square brick building reminiscent of the Victorian Georgian style. The statement of significance for 'Woodlands' obtained from the SHR listing for the item is as follows:</p> <p><i>The c.1884 'Woodlands' (originally known as 'Inglewood') is of State heritage significance for its historical association with the acclaimed Australian children's author Ethel Turner (1870-1958) whose most famous literary work 'Seven Little Australians' was written during Turner's occupancy of the property. Ethel Turner lived at 'Woodlands' with her family from September 1891 to December 1894. During this period she wrote three books: her first and most famous children's novel 'Seven Little Australians', its sequel 'The Family at Misrule', and 'The Story of a Baby'. 'Seven Little Australians' and its sequel were strongly influenced by the social and domestic environment of 'Woodlands' and its natural surroundings creating a provocative portrayal of children and Australian identity in the late 19th century.</i></p> <p><i>'Seven Little Australians' has been in print for well over 100 years. It has sold over several million copies in the English language. It has been translated into at least 13 languages, performed as stage play and been made into a film, a BBC television series in 1953, a 10 episode television series for the ABC in 1973 and a musical in 1988. 'Woodlands' is one of the earlier substantial Ku-ring-gai residences pre-dating the Hornsby to St Leonards railway line which opened in 1890. The two storey late Victorian Georgian style house demonstrates many aspects of the Federation Filigree style having been remodelled during the Federation period. It provides a rare example of the layering of the Victorian and Federation era styles in domestic architecture.</i></p>
Draft Ku-Ring-Gai LEP 2013	Dwelling House at 6 Waimea Road	The heritage listing for this item is incomplete. It was constructed between 1901 and 1920. The statement of significance for this item, taken from its inventory listing on the SHI states that that item has architectural, group value and municipal significance.
Draft Ku-Ring-Gai LEP 2013	Dwelling House at 4 Waimea Road	The heritage listing for this item is incomplete. It was constructed between 1901 and 1920. The statement of significance for this item, taken from its inventory listing on the SHI states that that item has architectural, group value and municipal significance.
Draft Ku-Ring-Gai LEP 2013	Clanville Conservation Area	<p>Located to the south of Chelmsford Avenue, only a small portion of the Clanville Conservation Area is in the study area. Views from the conservation area into the proposed Lindfield substation site are largely obscured by vegetation. The statement of significance for the Clanville Conservation Area contained within Ku-Ring-Gai Draft LEP 2013 is as follows:</p> <p><i>The Clanville HCA has high historic significance as the David Dering Mathew grant of 400 acres called 'Clanville', whose boundaries are evident through the following streets; Archbold Road, Boundary Street, Pacific Highway and Tryon Road. Successive subdivisions in the late 19<sup>th</sup> century were spurred by the development of the North Shore Railway Line in 1890–1893. This subdivision reflects improved transport connections due to the construction of the North Shore Railway Line. Further subdivisions took place in the early twentieth century.</i></p> <p><i>The HCA has high aesthetic significance as a cohesive early twentieth century and Interwar development and for the high proportion of quality houses.</i></p>

Listing	Item name	Significance/comment
Draft Ku-Ring-Gai LEP 2013	Oliver Grant Conservation Area	<p>The topography of the Oliver Grant Heritage Conservation Area is generally elevated. The streets are perpendicular to the railway line. Lorne Avenue reflects the alignment of a creek to the North. The street grid is distorted by the alignment of Lorne Avenue. The lots are inconsistent due to this alignment and due to layers of re-subdivision. The statement of significance for the Oliver Grant Conservation Area contained within Ku-Ring-Gai Draft LEP 2013 is as follows:</p> <p><i>The Oliver Grant HCA forms part of the 45-acre Henry Oliver grant later divided into three farms. The grant boundaries are evident through the following streets: Stanhope Road, Pacific Highway and Treatts Road. The HCA has high historic significance for its early twentieth century subdivisions of Killara Park estate (1904) and Restholm Estate (1902). These subdivisions reflect improved transport connections due to the construction of the North Shire railway Line. The HCA has medium historic significance for the overlay of Interwar subdivision evidence in the lots on the southern side of Stanhope Road and some houses. This later subdivision reflects improved transport connections due to the construction of the Sydney Harbour Bridge and the electrification of the railway in 1927.</i></p> <p><i>The HCA has high aesthetic significance as a reasonably intact late nineteenth century and early twentieth century development, and high aesthetic significance for the high proportion of quality houses.</i></p>
Draft Ku-Ring-Gai LEP 2013	Springdale Conservation Area	<p>The Springdale Heritage Conservation Area consists of one and two-storey Interwar development with remnant of c1920 Federation houses. The statement of significance for the Oliver Grant Conservation Area contained within Ku-Ring-Gai Draft LEP 2013 is as follows:</p> <p><i>The Springdale Heritage Conservation Area has high historic significance as the 1839 160 acres of Jane Bradley's Springdale grant whose boundaries are evident through the following streets: Karanga Avenue, Locksley Street, Roseberry Road, Stanhope Road and the Pacific Highway. Jane Bradley married James McGillvray in 1830. The HCA has high historic significance as a late nineteenth century subdivision of the Springdale Estate evident in the lots and fine houses. The HCA reflects improved transport connections due to the construction of the North Shire Rail line and the opening of Killara Station in 1899. The consolidation of development reflects improved transport connections due to the electrification of the railway in 1927 and the construction of the Sydney Harbour Bridge. The HCA has high aesthetic significance as a cohesive late nineteenth and early twentieth century development for its high proportion of quality of houses.</i></p>



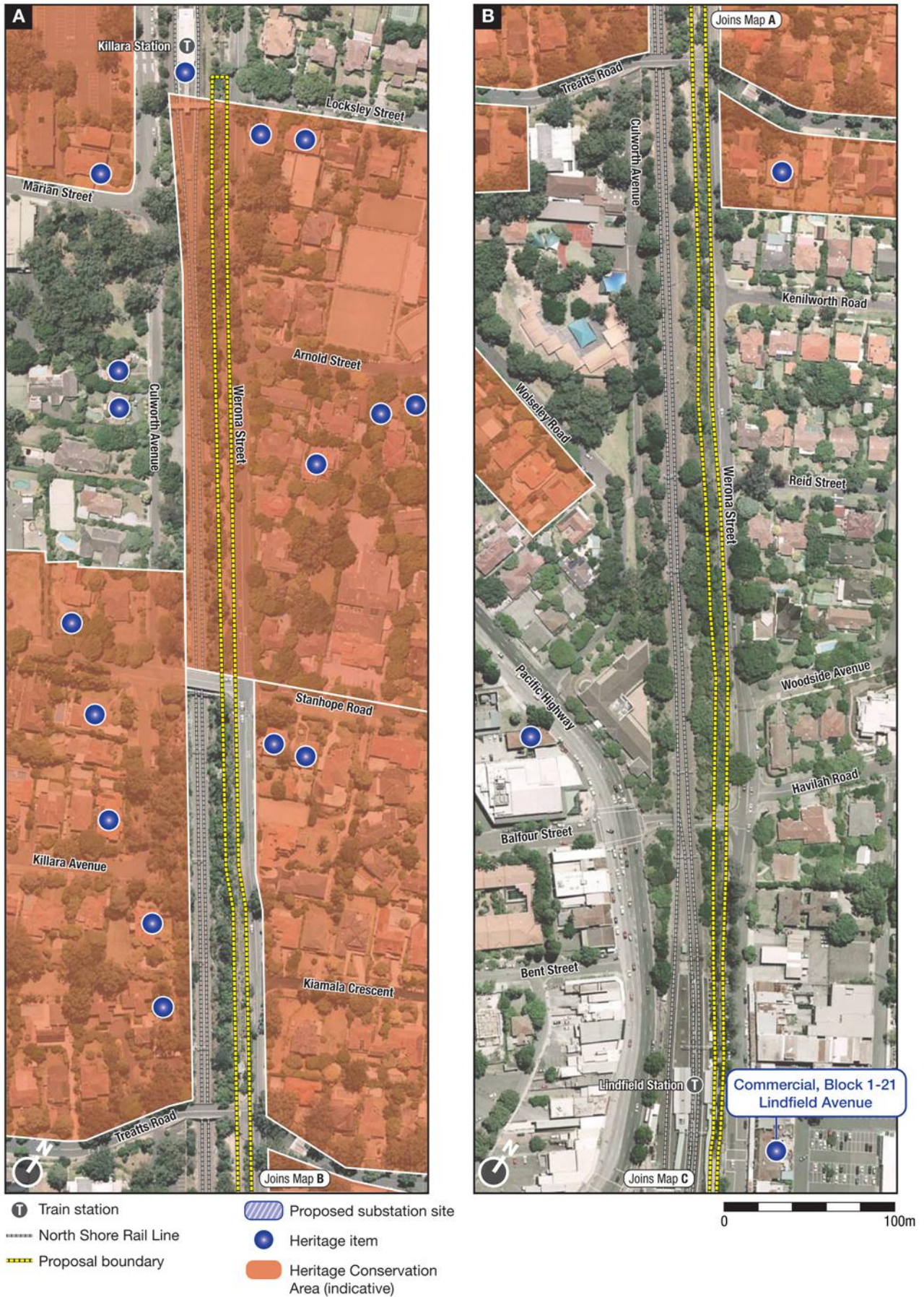


Figure 6.10a Identified heritage sites within the vicinity of the proposal site



Figure 6.10b Identified heritage sites within the vicinity of the proposal site

### 6.8.3 Assessment of archaeological and research potential

#### Known impacts in the study area

The study area has been occupied by the railway line and surrounding residential properties from the late 19<sup>th</sup> century. The study area is likely to have been subject to impacts that may have affected the potential archaeological resource. The impacts may have included, but are not limited to, the following:

- increasing residential density in the Lindfield area achieved through subdivision
- the widening and formalisation of the Pacific Highway
- early 20<sup>th</sup> century construction impacts from the residences to the east and the south of the study area. This may have involved the excavation of footing trenches and ground levelling
- the establishment of Lindfield Avenue in the early 20<sup>th</sup> century
- the establishment of the North Shore railway line in the late 19<sup>th</sup> century. The construction of the line in the study area would have involved substantial excavation and ground modification that would have resulted in the displacement of any potential archaeological remains
- the relocation of the existing power lines and in-ground electrical services relating to the railway.

#### Assessment of archaeological potential

Archaeological potential is defined as the potential of a site to contain archaeological relics, as classified under the Heritage Act. Archaeological potential is assessed by identifying former land uses and associated features through historical research, and evaluating whether subsequent actions may have impacted on evidence for these former land uses.

The Clanville estate, granted in 1819, was originally utilised for its timber resources. It is likely that this period of intensive timber felling lasted into the mid-19<sup>th</sup> century. After this resource had been exhausted, the property was planted with citrus. Therefore archaeological remains from this period of the estate are likely to include evidence of the types of plants established within the property, structural remains such as fencing, water managements systems (dams and channels) and evidence of landscape modification (vegetation clearance, earth movement). Archaeological remains associated with these types of activities tend to be extremely ephemeral.

Analysis of historic plans of Lindfield indicates that the Clanville estate remained relatively intact into the early 20<sup>th</sup> century. The Clanville estate contained a single structure in the early to mid-19<sup>th</sup> century, constructed during Richard Archbold's ownership of the property. This structure was located outside and to the south of the current study area. Later maps do not indicate that additional structures were located within the Clanville estate (although this is not uncommon in Parish maps, which do not tend to show structures), and it is likely that the study area did not contain any substantial structures until it was subdivided in the early 20<sup>th</sup> century. Therefore, the study area is unlikely to contain substantial archaeological remains associated with residential occupation.

Due to the substantial impact caused by the construction of Lindfield Avenue and the railway line, and the unlikelihood of encountering ephemeral remains associated with earliest agricultural use of the Clanville estate, it is highly unlikely that archaeological remains would have survived within the study area.

Overall, the study area has little to no archaeological potential.

## 6.8.4 Impacts on non-Indigenous heritage

With the exception of vistas and views to and from heritage items, the current proposal would have no impact on potential archaeological resources or heritage buildings within the study area. The potential impacts of the proposal on heritage items within the study area are discussed below.

### Commercial block

The commercial block is located on the eastern side of Lindfield Avenue from the railway corridor and is located in an area where the only impact would be the installation of an additional overhead wire to the existing power poles. As the poles are existing, there would be no additional visual impact on this heritage item.

The proposal would therefore have no impact on the heritage significance of the item.

### 'Laurabada' dwelling house

'Laurabada' is located over 100 metres to the east of the proposed substation building. Visual connections between the proposal and the heritage item are therefore limited. This view corridor is further obscured by the mature street plantings alongside the road corridor on Middle Harbour Road.

The proposal adheres to the recommendations for management of 'Laurabada' outlined in the inventory sheet for the heritage item, included in the Ku-ring-gai (Local Centres) LEP 2012 and would therefore have no impact on the heritage significance of 'Laurabada.'

### St Albans Anglican Church

The site comprising a complex of church, residence and hall has a high level of social, aesthetic and historical significance to the local community. The visual connections between the church complex and the proposed substation site, however, are extremely limited. Lindfield Avenue rises slightly to the south a rise that mostly obscures the study area. Mature street plantings further obscure this view corridor. The significant view corridor towards the church is to the south from the Lindfield Railway Station and town centre, located further north. The rear view of the church complex is heavily vegetated. The proposed substation would not visually dominate the church, or reduce views to or from the church, or from the public realm.

The proposal adheres to the to the recommendations for management outlined in the inventory sheet for the heritage item, included in the Ku-ring-gai (Local Centres) LEP 2012 and would therefore have no impact on the heritage significance of 'St Albans Anglican Church'.

### Blenheim Road Heritage Conservation Area

The Blenheim Road is located on the eastern side of Lindfield Avenue, which separates the item from the study area and the railway corridor. It is located in an area where the only impact would be the installation of an additional overhead wire to the existing power poles. As the poles are existing, there would be no additional visual impact on this heritage item. The proposal would therefore have no impact on the heritage significance of the item.

### The Killara Railway Station Group

The Killara Railway Station Group is located immediately north of the proposal study area. The only impact in this location would be the installation of an additional overhead wire to the existing power poles. As the poles are existing, there would be no additional visual impact on this heritage item. The proposal would therefore have no impact on the heritage significance of the item.

### The Killara Post Office

The Killara Post Office is located on the eastern side of Werona Avenue, which separates the item from the study area and the railway corridor. It is located in an area where the only impact would be the installation of an additional overhead wire to the existing power poles. As the poles are existing, there would be no additional visual impact on this heritage item. The proposal would therefore have no impact on the heritage significance of the item.

### Dwelling houses at 23 and 29 Stanhope Road and 'Woodlands'

The heritage items are located on the eastern side of Lindfield Avenue, which separates the item from the study area and the railway corridor. It is located in an area where the only impact would be the installation of an additional overhead wire to the existing power poles. As the poles are existing, there would be no additional visual impact on this heritage item. The proposal would therefore have no impact on the heritage significance of the items.

### Dwelling houses at 4 and 6 Waimea Road

The houses at 4 and 6 Waimea Road are oriented to the south-west and towards the railway corridor; however, direct views towards are obscured by the high bank of the rail line in this location. The heritage items are located in an area where the only impact would be the removal of existing overhead power lines and their replacement with in-ground services. The proposal would therefore have no impact on the heritage significance of the items.

### Clanville Heritage Conservation Area

The proposed location of the substation site is to the immediate north of the Clanville Heritage Conservation Area. The proposed substation would be clearly visible from Strickland Avenue, where it crosses the railway line, and immediately north of the heritage conservation area (HCA). There is a clear visual connection between the northernmost portion of the HCA and the southernmost portion of the proposed substation. The installation of security fencing and retaining wall, and the construction of the substation building itself, would be the most visually intrusive elements of the proposal. However, this view of the substation site would only affect the residence at the intersection of Lindfield and Strickland Avenues, which is screened from Strickland Avenue, and therefore the substation site, by a substantial garden. The visual impact of the HCA is therefore considered to be acceptable if measures are taken to minimise visual impacts by establishing screening vegetation and using sympathetic finished where possible.

### Oliver Grant Heritage Conservation Area

The heritage items are located on the eastern side of Lindfield Avenue, which separates the item from the study area and the railway corridor. It is located in an area where the only impact would be the installation of an additional overhead wire to the existing power poles. As the poles are existing, there would be no additional visual impact on this heritage item. The proposal would therefore have no impact on the heritage significance of the item.

### Springdale Heritage Conservation Area

The heritage items are located on the eastern side of Lindfield Avenue, which separates the item from the study area and the railway corridor. It is located in an area where the only impact would be the installation of an additional overhead wire to the existing power poles. As the poles are existing, there would be no additional visual impact on this heritage item. The proposal would therefore have no impact on the heritage significance of the item.

Table 6.19 provides a summary of potential heritage constraints on the proposal. This includes impacts to heritage buildings and fabric, impacts to the potential archaeological resource within the study area and potential impacts on views and vistas.

**Table 6.19 Potential heritage constraints of the proposal**

Item name	Potential heritage constraints		
	On heritage buildings/fabric	On potential archaeology	On views and vistas
Commercial Block	None	None	None
'Laurabada' dwelling house	None	None	None
St Albans Anglican Church	None	None	None
Blenheim Road HCA	None	None	None
Killara Railway Station Group	None	None	None
Killara Post Office	None	None	None
Dwelling House at 23 Stanhope Road	None	None	None
'Mooralbeck'	None	None	None
'Woodlands'	None	None	None
Dwelling House at 6 Waimea Road	None	None	None
Dwelling House at 4 Waimea Road	None	None	None
Clanville Conservation Area	None	None	The proposed substation, security fencing and retaining wall would all be clearly visible from the northern most portion of the HCA, although this is screened by existing plantings.
Oliver Grant HCA	None	None	None
Springdale HCA	None	None	None

### Overall statement of heritage impact

Table 6.20 provides an overall statement of heritage impact for the proposed works.

**Table 6.20 Potential heritage constraints of the proposal**

Development	Discussion
What aspects of the proposal respect or enhance the heritage significance of the study area?	<p>The proposal, as a whole, would not have a negative impact on the heritage items contained within the study area, on any potential archaeological remains, or on the heritage significance of the study area as a whole. There is extremely limited visual connection between 'Laurabada' and St Albans Church. The works would not impact on the heritage significance of these items.</p> <p>There is a visual connection between the northernmost portion of the Clanville HCA and the substation site. However this view would only affect the residence at the intersection of Lindfield and Strickland Avenues, which is screened from Strickland Avenue, and the substation site, by a substantial garden. The visual impact of the HCA is therefore considered to be acceptable if measures are taken to minimise visual impacts by establishing screening vegetation and using sympathetic finished where possible.</p>

Development	Discussion
What aspects of the proposal could have a detrimental impact on the heritage significance of the study area?	The proposal is unlikely to have a detrimental impact on the heritage items included within the study area. There are no impacts to heritage fabric, and the study area does not have archaeological potential.  Visual impacts of the proposal on the Clanville HCA are considered acceptable.
Have more sympathetic options been considered and discounted?	The proposal is considered to have minimal potential impacts to existing heritage and conservation items. No additional sympathetic options have been considered to be required.

## 6.8.5 Management and mitigation measures

The heritage significance of the majority of listed items adjacent to or within the study area would not be affected by the proposal, and would therefore not require specific mitigation measures.

The Clanville HCA is located to the south of the substation site. There are some visual constraints in this location although the negative impact of the proposal on the HCA is considered to be minor. These minor impacts could be mitigated by introducing screening vegetation at the completion of works and taking care in the choice of sympathetic finishes and elevations.

The following recommendations have been made regarding potential impact of the proposal on the Clanville HCA:

- Care should be taken to make the substation building as unobtrusive as possible. This can be achieved by completing the roofing and walls in dark colours, sympathetic to the surrounding area.
- The lower the substation is in the landscape, the less visual impact it would have on the HCA, and the surrounding Lindfield area.
- Consideration should be given toward introducing screening vegetation along the southern boundary of the substation site at the completion of works.

## 6.9 Aboriginal heritage

An Aboriginal heritage Due Diligence Assessment June 2014 has been prepared by Artefact Heritage and is included as Technical Paper 6 (Artefact 2014b). A summary of the assessment is provided in the following sections.

### 6.9.1 Methodology

The Aboriginal heritage assessment was prepared using the OEH *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (2010) (the 'code of practice') as best practice. However, the report does not conform to the code of practice as it does not include systematic survey coverage of each buffer area (due to access limitations), an impact assessment, a significance assessment, or consultation with the Metropolitan Local Aboriginal Land Council (MLALC).

A search of the OEH Aboriginal Heritage Information Management System (AHIMS) database was conducted on 2 December 2013, based on a 50 metre buffer area of the proposal. Site surveys of the study area were undertaken on 20 March 2014 and 24 June 2014.

## 6.9.2 Existing Aboriginal heritage

### Aboriginal historical background

Prior to the appropriation of their land by Europeans, Aboriginal people lived in small family or clan groups that were associated with particular territories or places. Territorial boundaries were likely to be fairly fluid, although details are not known. The language group spoken on the Cumberland Plain is known as Darug (Dharruk – alternative spelling). The Darug language group is thought to have extended from Appin in the south to the Hawkesbury River, west of the Georges River, Parramatta, Lane Cove River and to Berowra Creek. The area was home to a number of different clan groups throughout the Cumberland Plain.

The study area is within the territory of the Wallumedegal (or Wallumattagal) clan. The exact boundaries of the territory are not known, and may have been fluid, but the Wallumedegal area is thought to have extended around Sydney Harbour from Lane Cove along the northern bank of the Parramatta River.

European appropriation of Wallumedegal territory occurred very early in the colonisation period. Boats were sent along the harbour up the Lane Cove and Parramatta Rivers within days of the arrival of the First Fleet. Numerous overland parties quickly arrived to explore the potential of land surrounding the harbour. Information about the way that Aboriginal people lived before European settlement can be gained from observations of these early parties of explorers. From 1790, any Aboriginal people remaining in the Ryde area would have been further disenfranchised, as convicts were moved in to harvest the timber and lime resources of the area.

### Registered Aboriginal heritage sites in the study area

A search of the AHIMS database (2 December 2013) identified a total of 70 Aboriginal sites within a 50 metre buffer (the AHIMS search area), refer. No recorded Aboriginal sites were identified to be located within the study area.

The most frequently recorded Aboriginal site types within the AHIMS search area include art sites (pigment or engraved) (n=19), artefact sites (n=17), and midden sites (n=15). Other site types identified in the area include potential archaeological deposit (PAD), grinding grooves, and habitation structures.

Seventy sites were located within the AHIMS search area, with none located within the study areas. Of the 70 sites recorded within the AHIMS search area, 36 are listed as closed sites and 34 as open sites. A closed site context indicates the site is located within a shelter or overhang, formations which occur amongst suitable outcropping sandstone in the local area. Site types within shelter formations include midden and/or stone artefacts within the floor deposit, pigment or charcoal art on shelter walls, and engravings and/or grinding grooves. Open site contexts indicate site types that have not been identified in a shelter formation, and can include artefact and midden sites.

The variety of site types in the local context, and their association with both open and closed site contexts, demonstrates the variability of Aboriginal settlement history of the area, and the use of subsistence resources from the local watercourses and use of sandstone shelter formations.

### Archaeological context of the study area

Archaeological data gathered in the locality has demonstrated the widespread and varying use of the area by Aboriginal people. This predictive model comprises a series of statements about the nature and distribution of evidence of Aboriginal land use that is expected in the study area. The substation site is located across broad crest and gently sloping landform contexts and not in close proximity to the major watercourses of the area. No recorded Aboriginal sites have been identified within the study area. The most likely site type to occur within the study areas would be isolated artefacts or concentrations of artefacts in those areas, such as public reserves, where there is the possibility of surface exposure and a lesser degree of surface disturbance.



### 6.9.3 Potential Aboriginal heritage impacts

The site of the proposed substation was found to be highly disturbed with extensive ground level modification evident. The cut and fill across the site of the proposed substation has occurred as a result of the construction of the adjacent railway line and Middle Harbour Road.

The study area to the north of the substation site was primarily adjacent to Werona Avenue, or within the rail corridor. This section of the study area was found to be highly disturbed and no areas of archaeological potential were identified.

The study area to the south of the substation site is located along the eastern side of the rail corridor. The majority of this section of the study area was found to be highly disturbed. A small section of the study area between power pole P50 and power pole P51 appeared to be less disturbed and may contain remnant landform. This area did not exhibit any evidence for Aboriginal archaeological potential as it is not within the vicinity of permanent water and did not include a sensitive landform unit.

The aim of the due diligence assessment undertaken was to assess whether any Aboriginal objects or areas of archaeological potential are located within the study area, to assess whether any Aboriginal objects or areas of archaeological potential are likely to be impacted by the proposal, and if so to recommend whether further investigation is required.

The archaeological sensitivity of the study area was found to be low due to high levels of ground disturbance and modification. As the proposal site has been found to be of low archaeological sensitivity there are unlikely to be impacts to Aboriginal heritage values as a result of the proposal.

### 6.9.4 Management and mitigation measures

The following management and mitigation measures would be implemented to minimise impacts on Aboriginal heritage:

- If suspected Aboriginal objects are located during construction, an archaeologist would be notified to assess the nature and significance of the find. If the find is an Aboriginal object, further investigation and permits may be required before works commence. If the find is an Aboriginal object OEH and the MLALC would be notified.
- If suspected human skeletal remains were uncovered at any time within the study area, the following actions would need to be followed:
  - ▶ immediately cease all excavation activity in the vicinity of the remains
  - ▶ notify NSW Police
  - ▶ notify OEH via the Environment Line on 131 555 to provide details of the remains and their location
  - ▶ no recommencement of activity in the vicinity of the remains unless authorised in writing by
  - ▶ OEH.

## 6.10 Waste and resource management

This section provides an overview of typical waste streams that would be generated during construction and operation of the proposed substation and associated cabling works at Lindfield and appropriate waste management or mitigation measures.

## 6.10.1 Construction impacts

### Waste sources

As a result of the construction of the proposal, the following key waste sources would be generated:

- green waste from vegetation clearance within the substation site
- excess spoil from excavations works (the estimated earthworks volume for the Lindfield substation based on the current draft substation layout is 4500 cubic metres)
- solid waste, including any construction and demolition waste such as removed signalling, communications and electrical cabling and systems, station infrastructure and signage as well as any solid wastes generated from internal changes to station buildings and office fit-outs
- liquid waste such as oils and used chemicals from equipment maintenance
- domestic waste from site personnel including food scraps, glass and plastic bottles, paper and plastic containers
- site sewage and other wastewater run-off including water utilised for dust suppression.

### Resource use

#### *Materials selection and use*

The proposal would require a wide range of materials during construction including spoil, steel, plastics, paints, concrete, ballast, aggregate, cabling and timber. Plants and mulch would also be required for landscaping around the substation site. All opportunities to utilise recycled building materials in the overall structure of the proposal would be explored.

All materials used in the construction of this project are common construction materials. The highest value materials used in the proposal will be large amounts of copper used in the cabling and transformers housed in the substation building although this metal is still abundant.

#### *Energy and fuel use*

Construction of the proposal would require the use of energy and fuels to power plant, equipment and transport vehicles. Fuels would include non-renewable sources such as petroleum, diesel, natural gas and liquefied natural gas.

#### *Water*

Water would be required during construction for dust suppression, compaction and pavement stabilisation during earthworks, concrete batching, washing of plant and equipment, watering of landscaped areas, fire-fighting (if required) and for staff facilities. Water would be reused on-site where practicable.

## 6.10.2 Operational impacts

Minimal operational waste or resource impacts are anticipated during the operation of the new substation.

The only waste generated during operation of the proposal would be related to periodic maintenance activities. This would include materials such as electrical wiring that would be disposed of in accordance with Sydney Trains existing procedures and DECC Waste Classification Guidelines (2008).

### 6.10.3 Management and mitigation measures

A waste management plan would be prepared as part of the CEMP. Construction waste would be managed through the waste hierarchy established under the *Waste Avoidance and Recovery Act 2001*, which comprises the following principles:

1. *Avoidance of waste* — Minimise the amount of waste generated during construction by avoiding unnecessary resource consumption (i.e. avoid the use of inefficient plant and construction equipment and avoid materials with excess embodied energy, waste and excessive packaging).
2. *Resource recovery* — Reuse, reprocess and recycle waste products generated during construction to minimise the amount of waste requiring disposal.
3. *Disposal* — Where resources cannot be recovered, dispose of them appropriately to minimise the potential adverse environmental impacts.

All waste requiring off-site disposal would be classified in accordance with the OEH's *Waste Classification Guidelines* (DECCW 2009) prior to disposal. Further details of waste management measures are discussed below. With implementation of these management measures, construction wastes would be largely reduced such that no significant waste impacts are expected during the construction of the proposal.

The following key waste mitigation and management strategies would be implemented throughout the construction of the proposal and would be governed by the CEMP:

- where possible, construction wastes would be diverted from landfill and reused or recycled within the proposal areas or through an appropriate recycling contractor
- construction materials that contain minimal embodied energy would be utilised
- construction materials would be purchased in accordance with an established procurement strategy that prioritises the selection of materials that utilise best practice recycled material content and sustainability ratings
- site disturbance and unnecessary excavation would be minimised
- materials from any demolition works would be reused or recycled where practicable
- formwork would be reused where possible
- sewage waste would be disposed of by a licensed waste contractor in accordance with Sydney Water and OEH requirements.

## 6.11 Air quality

A qualitative assessment of potential air quality impacts resulting from the proposal has been undertaken. A summary of the potential air quality impacts is provided below.

### 6.11.1 Existing air quality

#### Existing background air quality

Background air quality data from the OEH-operated Rozelle monitoring location has been adopted in identifying background air quality. This monitoring station location is considered representative of the proposal area, which includes residential and commercial land uses. Air quality data recorded from 2011 to 2012 was used to establish background air quality. The background air quality data adopted from the OEH Rozelle location for the proposal is generally good and below criteria levels.

### Existing air emission sources

The substation site is located predominantly within a residential precinct. The ambient air quality of the surrounding environment is dominated by proximity to the surrounding local streets and is fairly typical an urban area. The predominant cause of local air pollution is vehicle exhaust.

Construction of the substation may result in dust impacts to nearby residents and the general public, however will be limited in duration. A number of sources within the proposed project area have the potential to influence the local air shed to varying degrees. These include, but are not limited to:

- traffic emissions from the existing road networks (the greatest source of air pollution)
- light commercial and general residential sources (including domestic wood heaters).

A search of the National Pollution Inventory database (NPI) at substation site was conducted to investigate cumulative pollutants within the proposed project's airshed. For the 2011/2012 reporting period there were no individual facilities reporting within the vicinity of the proposed substation. The primary contributors to air pollutant levels in the project are expected to be emissions from motor vehicles along arterial and local roads. Air quality can also be influenced by naturally occurring events such as bushfires and dust storms.

Ambient concentrations of pollutants along the proposal corridor are expected to be primarily dependent on local and regional weather conditions and overall regional air quality.

### 6.11.2 Potential air quality impacts during construction

During construction, the following key activities have the potential to generate air emissions. These activities will have the following impacts for each set of works for the proposal:

- During site establishment there is potential for high volumes of dust to be generated from bulk earthworks. The substation site and a portion of the electrical works site would be cleared and grubbed, excess material excavated and removed, then cut and filled. This will create dust emissions at the areas being excavated or cleared.
- Dust emissions may occur during the piling process for foundation works.
- Gaseous vehicle emissions resulting from the use of vehicles and other machinery on site including:
  - ▶ trucks
  - ▶ cranes
  - ▶ front end loaders
  - ▶ bobcats
  - ▶ generators.
- There could be potential for dust impacts during installation of cabling and traction supply feeders for the proposed substation. The substation also requires also number of pits in be installed, creating limited localised dust emissions.

The excavation works associated with the construction of the Lindfield substation have the greatest dust generating potential of the proposed construction activities, however the impacts would be short-term and readily controlled to minimise emissions. Although the qualitative assessment cannot confirm compliance with relevant air quality criteria, anticipated levels of particulate matter are considered to be minor, temporary and easily managed.

The dispersion of particulate matter would depend on the meteorological conditions present during the works, but it is expected that these particulate levels would drop significantly with distance. During unfavourable meteorological conditions such as dry and windy conditions, particulate emissions may be higher and would require specific corrective measures. The CEMP would identify triggers and procedures for dealing with these conditions.

### Particulate matter

During construction, the generation of particulate matter could affect the local ambient air environment. Dust emission sources with potential to generate emissions during proposal construction include:

- excavation and earthwork operations
- wind erosion of freshly exposed areas
- light vehicle movements in track work areas and on paved roads.

Dust generation would be primarily be limited to construction activities within the substation site and would be expected to increase where higher dust generating activities are undertaken (such as excavation works). The activity specific nature of construction and the high level of control available enable particulate matter emissions to be effectively managed.

### 6.11.3 Potential air quality impacts during operation

The proposed substation at Lindfield would have almost no operating impacts as it is an electrical generation and transmission system resulting in zero fuel combustion emissions, other than ongoing maintenance. A very small amount of gaseous emissions would be expected during maintenance works once the substation is operational. This is due to the substation undergoing monthly testing once it is commissioned for service. Emission rates and impacts depend on the power output of any ancillary combustion engines, the quality of the fuel, and condition of the combustion engine. Provided these factors are effectively managed under the POEO Act, maintenance works of substation is not anticipated to cause adverse impacts given the scant scheduling of these works.

### 6.11.4 Management and mitigation measures

The following management and mitigation measures would be implemented to minimise impacts on air quality during construction of the proposal. The implementation of suitable mitigation and management measures would control and reduce the extent of impacts experienced at nearby sensitive receivers. The CEMP would include a range of mitigation measures, as well as trigger levels and required monitoring.

The following mitigation measures are recommended during the construction phase of works and should be considered for inclusion within the CEMP:

- dust minimisation measures would be developed and implemented prior to commencement of construction
- methods for management of emissions would be incorporated into proposal inductions, training and pre-start talks
- activities with the potential to cause significant emissions such as earthworks or track removal would be identified in the CEMP. Work practices which minimise emissions during these activities should be investigated and applied where reasonable and feasible

- during bulk earthworks, visual inspection for dust in periods of unfavourable meteorological conditions (such as high wind events and dry weather) would be undertaken and where necessary the following measures would be implemented:
  - ▶ apply water (or alternative measures) to exposed surfaces that are causing dust generation. Surfaces may include any exposed surfaces (for example recently scraped/graded areas)
  - ▶ apply water to works related to removal of redundant equipment. Application rates should be related to atmospheric conditions (e.g. prolonged dry periods)
  - ▶ dust-generating activities (particularly clearing and excavating) should be avoided or minimised during dry and windy conditions
- a mechanism for responding to complaints from the community would be put in place for the duration of the construction phase
- construction plant and equipment would be well maintained and regularly serviced so that vehicular emissions remain within relevant air quality guidelines and standards
- emissions from trucks and other heavy vehicles would be regulated in accordance with the requirements prescribed in the National Environment Protection Measure (NEPM) (Diesel Vehicle Emissions)
- all construction vehicles would be ensured to be tuned to not release excessive level of smoke from the exhaust and are compliant with OEH's Smokey Vehicles Program under the POEO Act and (NSW) *Protection of the Environment and Operations Regulations 2010*
- strategies would be put in place to reduce usage of chemical and fuels in addition to using alternative fuel technologies as recommended in the NSW Action for Air (NSW EPA 2009). Particular focus would be on those products with the potential to release high levels of air toxics
- during operation of the substation site, ancillary service vehicles and maintenance equipment would be maintained and operated in accordance with the manufacturer's requirements and the POEO Act.

## 6.12 Greenhouse gases

### 6.12.1 Existing environment

The sources of greenhouse gas emissions related to the proposal can be categorised as part of emissions of three scope types, depending on the sources of these emissions. Table 6.21 describes these categories and the probable sources of emissions.

**Table 6.21 Emission scopes and sources**

Emission scope	Type of emission	Probable proposal source
Scope 1	Direct emissions within the boundary of the proposal operations, such as fuel combustion and manufacturing processes, or provision of supplementary energy such as generating electricity for onsite usage.	Construction phase: <ul style="list-style-type: none"> <li>■ fuel combustion emissions from construction plant and equipment</li> <li>■ clearing site vegetation.</li> </ul> Operations phase: <ul style="list-style-type: none"> <li>■ substation maintenance activities.</li> </ul>
Scope 2	Indirect emissions from consumption of purchased electricity, steam or heat purchased for the proposal but produced by another organisation.	Construction phase: <ul style="list-style-type: none"> <li>■ electricity used to operate site office(s).</li> </ul> Operations phase: <ul style="list-style-type: none"> <li>■ operations of substation and systems, such as lighting and signalling.</li> </ul>

Emission scope	Type of emission	Probable proposal source
Scope 3	Indirect emissions from all other emissions that are a consequence of activities of the project but are not from sources owned/controlled by the proposal.	<p>Construction phase:</p> <ul style="list-style-type: none"> <li>■ embodied energy of construction materials</li> <li>■ emissions from transporting such materials to and from site.</li> <li>■ emissions from the extraction, production, transmission and distribution of fuel and electricity used onsite.</li> </ul> <p>Operations phase:</p> <ul style="list-style-type: none"> <li>■ embodied energy in maintenance materials.</li> </ul>

## 6.12.2 Construction impacts

Greenhouse gas emissions may be emitted directly or indirectly. The direct greenhouse gas-generating activities associated with construction include mobile vehicular emissions (particularly from using heavy vehicles to move materials like spoil and concrete) and, depending on the extent required, removing vegetation (Scope 1 emissions). Indirect greenhouse gas emissions as a result of the project would include emissions associated with the consumption of electricity within site compounds and construction equipment, extraction of diesel and the emissions embodied in the products used on-site, particularly steel and concrete (Scope 2 emissions).

Typically, the operation of on-site machinery during construction works and general site operations account for the majority of construction-related greenhouse gas emissions.

Expected greenhouse gas sources of construction emissions for the project would include:

- combustion of fuel in construction plant, equipment and vehicles (direct emissions occurring on-site)
- vegetation clearing (direct emissions from the decomposition of vegetative material and soil carbon releases)
- electricity used at the construction compound/worksite (electricity indirect emissions, occurring off-site at the power station)
- disposal of waste from construction staff and site compound (indirect emissions from the decomposition of waste material, occurring off-site and waste disposal facilities)
- indirect emissions embodied in key construction materials, including cement and steel (i.e. the energy and resources that were consumed to produce a particular construction material).

The volume of greenhouse gas emissions that would be generated during construction would depend on the quantity of construction materials consumed and the types of construction plant and equipment used.

## 6.12.3 Operational impacts

Operational greenhouse gas emissions would primarily be associated with the operation and maintenance of the substation and associated infrastructure. Greenhouse gas emissions would predominantly be generated by the following activities:

- electricity consumption to power the substation, signalling, lighting, and communications systems
- combustion of fuel in maintenance plant, equipment and vehicles where required (direct emissions occurring on-site)

- disposal of waste from the substation
- embodied energy (and associated greenhouse gas emissions) in materials used in the maintenance of the substation infrastructure (the energy and resources that were consumed to produce a particular construction material).

The operational life of the proposal is estimated to be approximately 60 years prior to being replaced with new transformer units. It is conceivable that emissions would occur during any future demolition or possible modification of the proposal. The timeframes and types of technologies/materials that will be used during such processes are not yet known.

Overall, construction related greenhouse gas emissions and energy usage are considered to be manageable through design and the application of standard mitigation measures, as outlined in section 6.12.4.

#### 6.12.4 Management and mitigation measures

While it would not be possible to completely mitigate the generation of greenhouse gas emissions during construction (due to the need to consume energy and resources), the amount of emissions could be reduced by implementing the following mitigation measures:

- purchasing electrical energy derived from a renewable energy source (where available)
- using low greenhouse gas-intensive construction materials (where a suitable substitute for a high greenhouse gas-intensive material is available)
- adopting energy efficient work practices
- identifying measures for mitigation as part of site inductions, training and pre-start talks
- procuring construction services and materials locally to minimise the distance travelled and therefore emissions of vehicles accessing the site
- ensuring that deliveries are managed in an efficient manner to minimise the number of trips required and therefore reduce the amount of emissions
- implementing energy-efficient work practices, such as switching off construction plant, vehicles and equipment when not in use to minimise idling
- regularly monitoring, auditing and reporting on energy, resource use and associated greenhouse gas emissions as part of the environmental reporting requirements specified within the CEMP
- selecting materials during construction planning to ensure products that reduce embodied carbon are considered and used
- ensuring clearance of vegetation be limited to the minimum that is required for the project
- ensuring all vegetation cleared be disposed of at a registered compost facility in the Sydney area and that it is not to be sent to landfill or burnt.

Opportunities to reduce operational greenhouse gas emissions would be investigated during detailed design. These opportunities could include purchasing electricity derived from a renewable energy source (where available) or the use of photovoltaic powered lighting for security.



## 6.13 Electric and magnetic fields

Electric and Magnetic Fields (EMFs) are invisible and found at acceptable levels everywhere electricity is present.

The possibility of adverse health effects due to the EMF associated with electrical equipment has been the subject of extensive research throughout the world. To date, while adverse health effects have not been established, the possibility that they may exist cannot be ruled out. Given the inconclusive nature of the science, it is considered that a prudent/precautionary approach continues to be the most appropriate response in the circumstances. Under this approach, the operators of electricity infrastructure design and construct their facilities to limit the intensity of the associated EMFs to be as low as reasonably practicable. This is typically achieved by locating the equipment as far as is practicable from public areas.

At present the Australian electrical power industries adopt the draft Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) standard, which is closely aligned to the International Commission on Non-Ionizing Radiation protection (ICNIRP) recommendations referenced in most international EMF standards.

In recent years the profile of EMF exposure raised by the research has resulted in an increase in community concerns over the long term health effects on people living and working nearby power lines and facilities (particularly high voltage power lines).

There are two components to an electromagnetic field, the electric field and the magnetic field.

An electric field is a region where electric charges experience an invisible force due to the voltage on a nearby conductor. The strength of this force, i.e. the electric field, is related to the source voltage and is strongest close to the source. The electric field strength diminishes rapidly at locations away from the electrical equipment.

A magnetic field is a region where electric charges experience an invisible force due to the flow of electricity, commonly known as current, in nearby conductors. Unlike electric fields, magnetic fields are only present when electric current is flowing. The strength of a magnetic field depends on the magnitude of the current (measured in amps), and decreases rapidly at locations away from the electrical equipment.

The electrical equipment associated with the proposed substation would be contained in metal safety enclosures, which would also serve to shield the public and operators from both AC and DC electric fields associated with the electrical equipment. Accordingly, both the alternating and static electric field contribution from the proposed substation would be negligible inside and outside the substations.

While electric fields are effectively shielded by conductive and semi-conductive (e.g. concrete) materials, this is not the case with magnetic fields. Even highly conductive copper enclosures provide negligible shielding to power frequency magnetic fields.

The ARPANSA has published a Draft Standard for exposure to magnetic fields which advocates a full-time exposure limit of 1,000 mG (mG is a unit of measurement for magnetic strength), and a higher value for occupational exposure.

The alternating field levels to which people may be exposed are greatest in the localised areas within the substation near the 600 V transformer tails, the High Voltage AC switchgear and at cable risers where cables run vertically up from below grounds level. These localised field levels decrease very quickly at small distances from the cables and equipment.

EMF studies on similarly configured substations have concluded that the static magnetic field levels are well below the general public guidelines.

Overall the areas of higher field levels are highly localised to the immediate vicinity of the electrical equipment and would be contained within the Transport for NSW property, and the likelihood of public encountering any significant EMFs is low.

The ARPANSA, as part of the Health and Ageing Portfolio, is a Federal Government agency charged with responsibility for protecting the health and safety of people, and the environment, from EMF. ARPANSA advises that:

*The scientific evidence does not firmly establish that exposure to 50 Hz electric and magnetic fields found around the home, the office or near powerlines is a hazard to human health.*

The construction of the substation has the potential to alter the electromagnetic field strength currently experienced in the surrounding area, although not significantly. This is achieved by maximising the separation distance between the substation and public areas. The EMF levels are not expected to increase over and above the occupational or incidental exposure limits set by ARPANSA in their Draft Standard.

## 6.14 Sustainability

The *National Strategy for Ecologically Sustainable Development* (Department of Environment and Heritage 1992) defines ESD as 'using, conserving and enhancing the community's resources so that the ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased'. The concept of ESD gives formal recognition to environmental and social considerations in decision-making to ensure that current and future generations enjoy an environment that functions as well as, or better than, the environment they inherit.

With respect to the proposed Lindfield substation, the detailed design of the proposal would ensure that it complies with Transport for NSW's *NSW Sustainable Design Guidelines for Rail* (Transport for NSW 2012). The aim of this guideline is to deliver sustainable development practice by embedding sustainability initiatives into the design process. Within the guideline, substations are defined as a 'maintenance facility' and as such the proposal must meet a series of compulsory and discretionary targets and requirements for maintenance facilities.

The proposal would strive to meet all compulsory targets and any required discretionary targets in the guidelines. Measures to meet the sustainability requirements of the guidelines would continue to be investigated during the detailed design of the proposal, including consideration of design elements such as:

- insulation
- use of five-star appliances
- ensuring climate change impacts are considered
- reduction of waste
- biodiversity offsetting in accordance with relevant Transport for NSW guidelines
- water efficiency measures including the proposed use of on-site detention storage (as outlined in Chapter 3).

The role of greenhouse gas emissions related to this proposal is also discussed in further detail in section 6.12 of this REF.

## 6.15 Cumulative impacts

### 6.15.1 Overview

Cumulative impacts could occur if the construction of the new Lindfield substation coincided with the construction or operation of other local development, such as residential or commercial development, road upgrades or other public utility works.

The significance of the potential cumulative impacts has been assessed in the following sections, with consideration given to the location and timing of the potential developments. Where the timing of a development was not known at the time of writing this REF, the assessment assumed a worst-case scenario in that the proposal would coincide with that development.

### 6.15.2 Potential developments

To identify any potential developments, a review of the major projects listed on the NSW Planning and Environment and the Ku-Ring-Gai Council websites was undertaken (as of 28 March 2014). Minor developments (such as minor alterations to existing dwellings) have not been included in the assessment due to the limited extent and nature those of works and, therefore, minimal interaction with the proposed works.

One approved major development has been identified within the vicinity of the proposed substation proposal. The proposed project application is for demolition of existing buildings, excavation, and construction of a six and seven storey mixed use development comprising of retail uses and 102 residential apartments with two-level basement car parking for up to 150 vehicles. The site is located at 23–37 Lindfield Avenue, approximately 300 metres to the north of the proposal site for the new substation.

However, given the construction period for the proposal is between mid-2015 and mid-to late 2017, it is considered that most of the approved developments identified in the current search would be completed by this time and therefore would not affect the cumulative impacts of the proposal (or are geographically separated to the extent that there is unlikely to be any immediate overlap of impacts). Therefore it is not considered that this search would be representative of the potential cumulative construction impacts and have not been further assessed. In addition, it is expected that other major developments would be proposed and approved between now and the construction of the proposed works, the details of which are not yet publicly available.

### 6.15.3 Construction cumulative impacts

Cumulative construction impacts may include:

- increased construction vehicle traffic on public roads causing access issues, traffic congestion or travel delays, increased air pollution around the construction work sites, particularly along Lindfield Avenue (the substation site) and surrounding streets which provide access to the substation site and the proposed major development
- noise impacts from multiple construction works or construction vehicle traffic
- increased loss of parking which would be used for construction vehicles
- reduced local biodiversity as a result of vegetation clearing
- reduced visual amenity to the local area due to multiple construction worksites.

Sensitive receivers most likely to be affected by potential cumulative construction impacts are those located in close proximity to the construction sites or along the proposed construction vehicle haulage route. The severity of potential cumulative impacts on surrounding receivers would vary at any given time during the construction period and would generally be dependent on factors such as:

- the types of works being undertaken at each site at any one time
- the duration of the works for each development
- the sensitivity of the receiver.

Notwithstanding, it is noted that the construction of the proposal is anticipated to occur between 2016 and 2017 and therefore construction of many of the above developments may have been completed by this time. The cumulative impacts of the proposal and the proposed residential development (or any other similar developments which may be identified prior to commencement of construction) are unlikely to be significant. During preparation of the CEMP for the proposal, Transport for NSW would liaise with the proponents for this proposal to ensure that no potential significant impacts would result from cumulative construction activities.

#### 6.15.4 Operational cumulative impacts

No cumulative operational impacts are likely to occur as a result of the operation of the proposed substation at Lindfield.

#### 6.15.5 Management and mitigation measures

The following management and mitigation measures would be implemented to minimise any cumulative impacts:

- The potential cumulative impacts associated with the proposal would be further considered as the design develops and as further information regarding the location and timing of potential developments is released. Environmental management measures would need to be developed and implemented as required.
- Transport for NSW would consult with the proponents of other major projects in the area at the time of construction of the proposed substation to avoid any potential cumulative impacts.

# 7. Environmental management

Transport for NSW's ISO 14001 accredited environmental management system elements would be used to manage the construction of a new traction substation and associated cable relocation at Lindfield ('the proposal'). The management system would provide the framework for implementing the environmental management measures documented in this REF, and any conditions of other approvals, licences or permits.

## 7.1 Environmental management plans

### 7.1.1 Construction environmental management framework

The Construction Environmental Management Framework (CEMF – see Appendix A) sets out minimum environmental, stakeholder and community management requirements for construction. It acts as a linking document between the initiatives described in this REF documentation and further development and implementation by contractors through individual Construction Environmental Management Plan(s) (CEMP) (refer to section 7.1.2 below).

Contractors would be required to implement and adhere to the requirements of the Construction Environmental Management Framework.

### 7.1.2 Construction environmental management plan

A CEMP would be prepared for the construction phase of the proposal. The CEMP would provide a centralised mechanism through which all potential environmental impacts would be managed. The CEMP would document mechanisms for demonstrating compliance with the commitments made in this REF, the submissions report (to be prepared following the public exhibition of the REF), and other relevant statutory approvals. The CEMP would outline a framework for the management of environmental impacts during construction of the proposal. The plan would address (at a minimum) the following elements:

- traffic management
- noise and vibration management
- air quality management (including dust suppression)
- landscape and rehabilitation plan (for the substation site at Lindfield)
- community and stakeholder involvement
- Aboriginal and non-Indigenous heritage management
- water and soil management (particularly for the substation site)
- flora and fauna and weed management (for the substation site)
- soil and erosion management
- contamination and waste management.

It is anticipated that the contractor appointed to undertake the construction of the substation and associated works would prepare a CEMP for the works which would be reviewed and endorsed by Transport for NSW prior to the commencement of construction. It is also anticipated that Sydney Trains would be required to be consulted during the preparation of all CEMP, due to the proposed work occurring within the rail corridor.

### 7.1.3 Operational environmental management

During operation of the traction substation at Lindfield, environmental issues and impacts would be managed by Sydney Trains under its existing environmental management system.

## 7.2 Management and mitigation measures

The REF has identified a range of environmental impacts that are likely to occur as a result of the proposal. Tables 7.1 to 7.2 provide a summary of the environmental management measures that Transport for NSW proposed to manage the potential environmental impacts associated with the construction and operation of the proposed traction substation at Lindfield.

The safeguards and management commitments documented in Tables 7.1 to 7.2 may be revised in response to submissions raised in response to the public display of this REF and/or design changes made subsequent to the public exhibition of the REF. Transport for NSW would consider the final environmental management commitments when making a determination on the proposal. Following project approval, the finalised safeguards and management measures would guide subsequent phases of the proposal. The contractors appointed for the construction of the traction substation at Lindfield would be required to undertake all works in accordance with these environmental management measures.

### 7.2.1 Construction management

Environmental management measures to be implemented during the construction phase of the proposal are listed in Table 7.1.

**Table 7.1 Construction environmental management measures**

ID number	Environmental management measures
<b>Traffic and transport</b>	
	<p>As part of CEMP, a CTMP would be developed to address construction traffic and transport management. The following management and mitigation measures would be implemented as part of the CTMP to minimise the traffic and transport impacts of the proposal:</p> <ul style="list-style-type: none"> <li>■ traffic controllers positioned at access gates adjacent to residential areas and access driveways</li> <li>■ road occupancy licences for temporary closure of roads would be obtained, where required</li> <li>■ heavy vehicles would be restricted to the routes specified and route markers installed for heavy vehicles along designated routes</li> <li>■ signs would be provided at the access point to the site assist in deliveries to the worksite</li> <li>■ signs would be provided at the access point for pedestrian and cyclist guidance</li> <li>■ traffic controllers would be located at the access point to direct vehicle movements, vehicle deliveries, pedestrians and cyclists, where required</li> <li>■ an emergency response plan would be developed for construction traffic incidents</li> <li>■ a pre- and post-construction assessment of road pavement assets would be conducted in areas likely to be used by construction traffic</li> <li>■ public communications would be conducted to warn the community and local residents of vehicle movements and anticipated effects on the local road network relating to the site works</li> <li>■ access to all private properties adjacent to the works would be maintained during construction</li> <li>■ during project inductions, all heavy vehicle drivers would be provided with the emergency response plan for construction traffic incidents</li> </ul>

ID number	Environmental management measures
	<ul style="list-style-type: none"> <li>■ road safety audits would be undertaken where required or deemed necessary</li> <li>■ project staging, vehicle movement and scheduling, equipment and resourcing would be coordinated.</li> </ul>
<b>Noise and vibration</b>	
B.1	<p>All construction works associated with the proposal would be managed in accordance with the <i>Construction Noise and Vibration Strategy</i> (CNVS) which has previously been developed for the NWRL (provided as Appendix B of Technical Paper 2). The CNVS documents the best-practice techniques specific to the proposal for managing construction noise and vibration, and implementing feasible and reasonable mitigation measures.</p>
B.2	<p>Mitigation measures which are considered appropriate for these works which could be implemented during construction include:</p> <ul style="list-style-type: none"> <li>■ implementation of proactive community consultation measures</li> <li>■ site inductions for all contractors</li> <li>■ shielding of works using site hoardings</li> <li>■ for construction concentrated in a single area, temporary acoustic fencing/barriers around the site perimeter would be considered where feasible and reasonable to mitigate off-site noise levels</li> <li>■ restriction of noise intensive works to daytime and evening periods, where possible</li> <li>■ where night works are required, these would be programmed to minimise the number of consecutive nights impacting the same receptors, where possible</li> <li>■ avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receptors would result in reduced noise emissions</li> <li>■ equipment which is used intermittently is to be shutdown when not in use</li> <li>■ where possible, the offset distance between noisy plant items and nearby noise sensitive receptors should be as great as possible</li> <li>■ where possible, equipment with directional noise emissions should be oriented away from sensitive receptors</li> <li>■ use of less noisy equipment</li> <li>■ regular compliance checks on the noise emissions of all plant and machinery used for the proposal would indicate whether noise emissions from plant items were higher than predicted</li> <li>■ reversing of equipment should be minimised so as to prevent nuisance caused by reversing alarms</li> <li>■ respite periods.</li> </ul>
<b>Landscape and visual character</b>	
C.1	<p>Mitigation measures which are considered appropriate for these works which could be implemented during construction include:</p> <ul style="list-style-type: none"> <li>■ ensure any security fencing includes screening of the site from views from the outer boundary and if possible is not of a garish or light colour (if permitted)</li> <li>■ minimise the storage of materials and construction machinery as far as possible</li> <li>■ maintain site in an orderly and tidy fashion.</li> </ul>

ID number	Environmental management measures
<b>Biodiversity</b>	
D.1	<p>Biodiversity offset requirements:</p> <ul style="list-style-type: none"> <li>■ Although the impacts to threatened biodiversity are not considered to be significant, the proposed project would result in residual impacts that cannot be avoided or mitigated. Based on the worst case scenario (i.e. vegetation within the entire 'Additional aerial earth (overhead) wires only' section of the project area will require removal in addition to the main works area), these impacts are associated with the clearing of 0.94 hectares of native vegetation. To mitigate these residual impacts it would be necessary to develop an offset strategy in accordance with the requirements of Transport for NSW 'Vegetation Offset Guide' (Transport for NSW 2014), in particular the offset strategy should aim to: <ul style="list-style-type: none"> <li>▶ Replace/offset 100 per cent of any native vegetation cleared</li> <li>▶ Achieve a neutral or beneficial long-term ecological outcome when native vegetation is cleared</li> </ul> </li> <li>■ The final offset strategy and quantum of offset requirement will be developed in consultation with Transport for NSW on completion of construction.</li> </ul> <p>If required, offsetting would be undertaken in alignment with Transport for NSW offsetting guidelines (Transport for NSW, 2014) during detailed design.</p>
D.2	<p>The following measures would be implemented during construction activities to ensure ecological impacts are minimised:</p> <ul style="list-style-type: none"> <li>■ implement pre-clearing protocols, including: <ul style="list-style-type: none"> <li>▶ check for the presence of flora and fauna species and habitat on site before clearing begins such as the presence of bird nests</li> <li>▶ prior to construction, site personnel should be adequately informed of environmental management procedures including, but not limited to, issues related to flora and fauna management, weed control, erosion and sediment control</li> <li>▶ establish exclusion zones to protect vegetation and fauna habitat outside of the assessed and approved clearing limits, including the threatened ecological communities recorded within the study area. Vegetation to be retained are to be clearly defined on ground and 'no go zones' clearly signposted and fenced to prevent unauthorised clearing and vehicular and/foot traffic</li> </ul> </li> </ul>
D.3	<ul style="list-style-type: none"> <li>■ implement clearing and construction protocols, including: <ul style="list-style-type: none"> <li>▶ carefully clear vegetation so as not to mix topsoil with debris and to avoid impacts to surrounding native vegetation</li> <li>▶ avoid excessive soil disturbance</li> <li>▶ when accessing construction sites, contractors should only use designated access tracks</li> </ul> </li> </ul>
D.4	<ul style="list-style-type: none"> <li>■ implement flora and fauna control measures including: <ul style="list-style-type: none"> <li>▶ clearing of vegetation would be minimised, to only vegetation that is absolutely required to be removed in order to undertake work</li> <li>▶ noxious weeds within the study area such as <i>Ligustrum lucidum</i>* (Broad-leaved Privet), <i>Cinnamomum camphora</i>* (Camphor Laurel), <i>Asparagus aethiopicus</i>* (Asparagus Fern), <i>Lantana camara</i>* (Lantana), <i>Ligustrum</i> spp. (Privet), <i>Nassella neesiana</i>* (Chilean Needle Grass), <i>Tradescantia albiflora</i>* (Wandering Dew) and <i>Rubus fruticosus</i>* (Blackberry) would be managed in accordance with the <i>Noxious Weeds Act 1993</i>.</li> </ul> </li> </ul>
D.5	<p>Weed species within the study area would be managed in order to control them from further spread. Management techniques may include immediate weed removal and disposal without stockpiling, disposal of weed-contaminated soils at appropriate weed disposal facilities and to ensure that all equipment is cleaned prior to and on completion of works to ensure weeds are not introduced or spread to other locations.</p>



ID number	Environmental management measures
<b>Water quality, hydrology, drainage</b>	
E.1	<p>The following management and mitigation measures would be implemented to minimise water quality impacts during the construction of the proposal:</p> <ul style="list-style-type: none"> <li>■ no stockpiles of materials or storage of fuels or chemicals would be located adjacent to existing culverts</li> <li>■ vehicles and machinery would be properly maintained to minimise the risk of fuel/oil leaks</li> <li>■ routine inspections of all construction vehicles and equipment would be undertaken for evidence of fuel/oil leaks</li> <li>■ all water discharges would be undertaken in accordance with Transport for NSW's <i>Water Discharge and Re-use Guideline</i></li> <li>■ construction plant, vehicles and equipment would be refuelled off-site, or in designated re-fuelling areas located at a minimum distance of 50 metres from drainage lines or waterways</li> <li>■ the existing Sydney Trains and Council drainage systems would remain operational throughout the construction of the project</li> <li>■ stabilised surfaces would be reinstated as quickly as practicable after construction</li> <li>■ material transport from site to surrounding pavement surfaces would be minimised</li> <li>■ drainage will be installed to carry stormwater collected on site and connected into existing council stormwater infrastructure.</li> </ul>
<b>Soils and contamination</b>	
F.1	<p>Soils</p> <ul style="list-style-type: none"> <li>■ an Erosion and Sedimentation Control Plan (ESCP) will be developed and maintained for the site in accordance with <i>Managing Urban Stormwater, Soils and Construction Guidelines</i> (Landcom, 2004) (the Blue Book). The plan will include site access controls preventing tracking of sediment from site, limiting the removal of groundcover and ensuring that the excavation works do not block natural drains or create undrained areas</li> <li>■ all material required for off-site disposal is to be appropriately tested and classified against the Waste Classification Guidelines prior to being disposed of off-site (DECC, 2008)</li> <li>■ excavated material will be reassessed for reuse onsite</li> <li>■ site rehabilitation of disturbed areas to be undertaken progressively as activities are completed during the proposal.</li> </ul>
F.2	<p>Contamination</p> <ul style="list-style-type: none"> <li>■ the CEMP would include a contamination management plan and an asbestos management plan</li> <li>■ all fuels, chemicals and hazardous liquids would be stored within an impervious bunded area in accordance with Australian standards and EPA Guidelines</li> <li>■ spill kits and a temporary refuelling bund will be installed and used onsite</li> <li>■ if fill material is discovered during excavation works, the material should remain on-site where possible (where contaminant concentrations meet the National Environment Protection Council's <i>National Environment Protection (Assessment of Site Contamination) Measure 1999</i>)</li> <li>■ should any signs of contamination be identified during work within the site, the material would be tested against the National Environment Protection Council's <i>National Environment Protection (Assessment of Site Contamination) Measure 1999</i>, and managed accordingly</li> <li>■ a hazardous materials inspection is to be undertaken of any areas where historical infrastructure is to be demolished to assess the materials for the presence of asbestos and/or lead paint. If present, appropriate management measures would be implemented for safe removal</li> </ul>

ID number	Environmental management measures
	<ul style="list-style-type: none"> <li>■ soil excavated in areas with identified surrounding industrial land uses (including former uses) is to be assessed for either its potential re-use on-site or classified for waste disposal purposes. If groundwater is encountered during the works, groundwater quality is to be investigated and appropriate management measures implemented to avoid further impacts</li> <li>■ procedures for handling asbestos contaminated materials (if found on site), including record keeping, site personnel awareness and waste disposal would be undertaken in accordance with WorkCover requirements.</li> </ul>
<b>Non-Indigenous heritage</b>	
G.1	<ul style="list-style-type: none"> <li>■ Care should be taken to make the substation building as unobtrusive as possible. This can be achieved by completing the roofing and walls in dark colours, sympathetic to the surrounding area.</li> <li>■ The lower the substation is in the landscape, the less visual impact it would have on the heritage conservation area, and the surrounding Lindfield area.</li> <li>■ Consideration should be given toward introducing screening vegetation along the southern boundary of the proposed substation site at the completion of works.</li> </ul>
<b>Aboriginal heritage</b>	
H.1	<ul style="list-style-type: none"> <li>■ If suspected Aboriginal objects are located during construction, an archaeologist would be notified to assess the nature and significance of the find. If the find is an Aboriginal object, further investigation and permits may be required before works commence. If the find is an Aboriginal object OEH and the MLALC would be notified.</li> </ul>
H.2	<ul style="list-style-type: none"> <li>■ If suspected human skeletal remains were uncovered at any time within the study area, the following actions would need to be followed: <ul style="list-style-type: none"> <li>▶ immediately cease all excavation activity in the vicinity of the remains</li> <li>▶ notify NSW Police</li> <li>▶ notify OEH via the Environment Line on 131 555 to provide details of the remains and their location</li> <li>▶ no recommencement of activity in the vicinity of the remains unless authorised in writing by OEH.</li> </ul> </li> </ul>
<b>Waste and resource management</b>	
I.1	<p>The following key waste mitigation and management strategies would be implemented throughout the construction of the proposal and would be governed by the CEMP:</p> <ul style="list-style-type: none"> <li>■ where possible, construction wastes would be diverted from landfill and reused or recycled within the proposal areas or through an appropriate recycling contractor</li> <li>■ construction materials that contain minimal embodied energy would be utilised</li> <li>■ construction materials would be purchased in accordance with an established procurement strategy that prioritises the selection of materials that utilise best practice recycled material content and sustainability ratings</li> <li>■ site disturbance and unnecessary excavation would be minimised</li> <li>■ materials from any demolition works would be reused or recycled where practicable</li> <li>■ formwork would be reused where possible</li> <li>■ sewage waste would be disposed of by a licensed waste contractor in accordance with Sydney Water and OEH requirements.</li> </ul>

ID number	Environmental management measures
<b>Air quality</b>	
J.1	<p>The following mitigation measures are recommended during the construction phase of works and should be considered for inclusion within the CEMP:</p> <ul style="list-style-type: none"> <li>■ dust minimisation measures would be developed and implemented prior to commencement of construction</li> <li>■ methods for management of emissions would be incorporated into proposal inductions, training and pre-start talks</li> <li>■ activities with the potential to cause significant emissions such as earthworks or track removal would be identified in the CEMP. Work practices which minimise emissions during these activities should be investigated and applied where reasonable and feasible</li> <li>■ during bulk earthworks, visual inspection for dust in periods of unfavourable meteorological conditions (such as high wind events and dry weather) would be undertaken and where necessary the following measures would be implemented: <ul style="list-style-type: none"> <li>▶ apply water (or alternative measures) to exposed surfaces that are causing dust generation. Surfaces may include any exposed surfaces (for example recently scraped/graded areas)</li> <li>▶ apply water to works related to removal of redundant equipment. Application rates should be related to atmospheric conditions (e.g. prolonged dry periods)</li> <li>▶ dust-generating activities (particularly clearing and excavating) should be avoided or minimised during dry and windy conditions</li> </ul> </li> <li>■ a mechanism for responding to complaints from the community would be put in place for the duration of the construction phase</li> <li>■ construction plant and equipment would be well maintained and regularly serviced so that vehicular emissions remain within relevant air quality guidelines and standards</li> <li>■ emissions from trucks and other heavy vehicles would be regulated in accordance with the requirements prescribed in the National Environment Protection Measure (NEPM) (Diesel Vehicle Emissions)</li> <li>■ all construction vehicles would be ensured to be tuned to not release excessive level of smoke from the exhaust and are compliant with OE's Smokey Vehicles Program under the POEO Act and (NSW) <i>Protection of the Environment and Operations Regulations 2010</i></li> <li>■ strategies would be put in place to reduce usage of chemical and fuels in addition to using alternative fuel technologies as recommended in the NSW Action for Air (NSW EPA 2009). Particular focus would be on those products with the potential to release high levels of air toxics</li> <li>■ during operation of the substation site, ancillary service vehicles and maintenance equipment would be maintained and operated in accordance with the manufacturer's requirements and the POEO Act.</li> </ul>
<b>Greenhouse gasses</b>	
K.1	<p>While it would not be possible to completely mitigate the generation of greenhouse gas emissions during construction (due to the need to consume energy and resources), the amount of emissions could be reduced by implementing the following mitigation measures:</p> <ul style="list-style-type: none"> <li>■ purchasing electrical energy derived from a renewable energy source (where available)</li> <li>■ using low greenhouse gas-intensive construction materials (where a suitable substitute for a high greenhouse gas-intensive material is available)</li> <li>■ adopting energy efficient work practices</li> <li>■ identifying measures for mitigation as part of site inductions, training and pre-start talks</li> <li>■ procuring construction services and materials locally to minimise the distance travelled and therefore emissions of vehicles accessing the site</li> <li>■ ensuring that deliveries are managed in an efficient manner to minimise the number of trips required and therefore reduce the amount of emissions</li> </ul>

ID number	Environmental management measures
	<ul style="list-style-type: none"> <li>■ implementing energy-efficient work practices, such as switching off construction plant, vehicles and equipment when not in use to minimise idling</li> <li>■ regularly monitoring, auditing and reporting on energy, resource use and associated greenhouse gas emissions as part of the environmental reporting requirements specified within the CEMP</li> <li>■ selecting materials during construction planning to ensure products that reduce embodied carbon are considered and used</li> <li>■ ensuring clearance of vegetation be limited to the minimum that is required for the project</li> <li>■ ensuring all vegetation cleared be disposed of at a registered compost facility in the Sydney area and that it is not to be sent to landfill or burnt.</li> </ul>

## 7.2.2 Operational management

Environmental management measures to be implemented during the operation of the traction substation at Lindfield are listed in Table 7.2.

**Table 7.2 Operational environmental management measures**

ID number	Safeguard/management measure
<b>Landscape and visual character</b>	
L.1	<p><b>Materials and finishes</b></p> <p>To ensure high quality materials and finishes are achieved on the building and fence, the proposed materials and finishes to be used would be clarified as part of the detailed design. Any outside attachments to the buildings, such as services, air conditioning units or vents would also be of a similar high quality and positioned to be as obtrusive as possible, and screened as necessary.</p>
L.2	<p><b>Landscape design</b></p> <p>One of the most positive visual mitigation measures would be the proposed landscape planting that would partially screen the outer sides of the building from views from surrounding areas. At this stage, the final design of such landscape planting has not been finalised. . However, the planting must have the following attributes:</p> <ul style="list-style-type: none"> <li>■ ensure partial screening occurs whilst still considering aspects such as personal safety for users of the adjacent footpaths and not creating concealment opportunities or the potential for planting to encroach onto the footpath</li> <li>■ use of trees and shrubs ranging up to two metres when near the footpath</li> <li>■ local native plants should be selected as far as practical</li> <li>■ planting densities of lower storey plants should be a minimal of one per square metre to assist in the management of weeds</li> <li>■ all landscape planting should be in fully prepared, mulched planting beds, and at least half of the pot sizes planted should be of 200 millimetre size or greater, and trees planted at 10 litre pot sizes as a minimum.</li> </ul>
<b>Noise and vibration</b>	
M.1	The substation would be designed and operated to comply with the Industrial Noise Policy.

# 8. Justification and conclusion

## 8.1 Justification for the proposal

This REF seeks to assess the environmental impacts of the construction and operation of a traction substation and associated cabling relocation works at Lindfield ('the proposal').

In future, Sydney Trains intends to operate increasing train services on the North Shore Line. A new traction power substation is required to allow for an increase in the capacity along the North Shore Line for additional train services to be run and will support the delivery of the NWRL. Therefore, a new substation is proposed to be constructed at Lindfield to supply the North Shore Line.

## 8.2 Ecologically sustainable development considerations

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration for the proposal. This includes the effective integration of economic and environmental considerations in all decision-making processes.

In accordance with the (NSW) *Environmental Planning and Assessment Regulation 2000*, the four principles of ESD, as set out in Schedule 2, are:

- *precautionary principle* — Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for not implementing mitigation measures or strategies to avoid potential impacts
- *inter-generational equity* — The present generation should ensure that the health, diversity and productivity of the environment are equal to or better for the future generations
- *conservation of biological diversity and ecological integrity* — Preserving biological diversity and ecological integrity requires that ecosystems, species and genetic diversity within species are maintained
- *improved valuation and pricing of environmental resources* — This principle establishes the need to determine economic values for services provided by the natural environment, such as the atmosphere's ability to receive gaseous emissions, cultural values and visual amenity.

Transport for NSW is committed to ensuring that its activities are undertaken in a manner that is consistent with the four principles of ESD. These principles would be incorporated into Transport for NSW's management systems for the proposal (discussed previously in Chapter 7).

Table 8.1 summarises how the four principles of ESD have been addressed through the proposal design and assessment processes.

**Table 8.1 Adherence with the principles of ESD**

ESD principle	Adherence
Precautionary principle	A precautionary approach has been applied throughout the proposal's development. The options development and assessment, the design development and the REF process have sought to minimise the environmental impact of the proposal. There are no threats of serious or irreversible damage posed by this development. All of the environmental risks have been carefully and thoughtfully considered through the preparation of the REF and would be mitigated through the implementation of the Construction Environmental Management Plan (CEMP) for the proposal.
Intergenerational equity	This proposal would help to ensure that future generations have a safer, more comfortable and more reliable rail transport option, through increased reliability, and more frequent services. Additionally, the proposal would help to meet the needs of an increasing population size and potentially reduce the use of private vehicles.
Conservation of biological diversity and ecological integrity	A specialist biodiversity assessment was completed as part of this REF, as described in section 6.4. Due to the generally disturbed nature of the proposal site, no biodiversity of ecological significance is anticipated to be encountered. However, the adherence to the mitigation measures outlined in this REF would help to ensure that biological diversity and ecological integrity of receiving environments would be retained.
Improved valuation and pricing of environmental resources	Environmental and social issues were considered in the strategic planning and establishment of the need for the proposal, and in consideration of various proposal options. The value placed on environmental resources is evident in the extent of the planning, environmental investigations and design of proposal safeguards. Implementation of these mitigation measures would result in an economic cost to Transport for NSW. Mitigation measures for the avoidance, reuse, recycling and management of waste during construction and operation are to be implemented.

## 8.3 Clause 228 considerations

Clause 228 of the NSW *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) states factors that must be taken into account when assessing the impact of an activity on the environment.

Table 8.2 provides a summary checklist of matters that must be considered under Clause 228 of the EP&A Regulation.

**Table 8.2 Clause 228 considerations**

Clause 228 considerations	Impact
<p>a <b>Any environmental impact on a community</b></p> <p>Some impacts on the local community are anticipated during the construction of the proposal, including minor traffic and parking impacts.</p> <p>Some operational visual impacts are expected from the proposed substation at Lindfield including the visual impact of the new substation structure and removal of some of the existing vegetation on the proposal site.</p> <p>In terms of noise, whilst exceedances have been predicted, it is expected that the substation can be readily designed to meet the noise goals through provision of shielding or upgrading the acoustic performance of the enclosure. Past experience of measurements of similar substations indicates that the major noise source which requires specific attention is the rectifier transformer.</p>	<p>Short-term negative impacts during the construction period</p> <p>Minor negative impact</p>

Clause 228 considerations	Impact
<p>Mitigation and management measures would be implemented to manage and minimise any adverse impacts (refer Chapter 7). The long-term benefits of maintaining the required traction power supply to the North Shore Line are considered to outweigh the potential negative impacts associated with the proposal.</p>	
<p><b>b Any transformation of a locality</b></p> <p>The proposed substation at Lindfield is expected to have some visual amenity impacts on the surrounding locality due to the removal of some existing vegetation and construction of the new substation building. The proposal is not however anticipated to result in a substantial transformation of the locality.</p>	<p>Long-term (permanent vegetation removal) minor negative impacts</p>
<p><b>c Any environmental impact on the ecosystems of the locality</b></p> <p>A biodiversity assessment was undertaken for the proposal, as described in Section 6.4 and Technical Paper 4. Vegetation of ecological significance recorded in the study area included the Sydney Turpentine Ironbark Forest threatened ecological community (0.05 hectares) listed as endangered under the NSW <i>Threatened Species Conservation Act 1995</i>. This community within the study area was highly modified as a result of previous land clearing and invasion of weed species. As a result of its low condition this community did not meet the Commonwealth condition criteria for the critically endangered Sydney Turpentine Ironbark Forest of the Sydney Basin as listed under the Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> listed. Based on the small area of degraded habitat to be impacted, this species is unlikely to be significantly affected by the proposal. Overall, the potential impact from the proposal on the species is not considered significant with regard to its context and intensity.</p> <p>The study area contained some native plant species however was dominated by a variety of introduced species, the most dominant of which included Privet species (<i>Ligustrum</i> spp*), Camphor Laurel (<i>Cinnamomum camphora</i>*), Asparagus Fern (<i>Asparagus aethiopicus</i>*), Wandering Jew (<i>Tradescantia albiflora</i>*) and Chilean Needle Grass (<i>Nassella neesiana</i>*).</p> <p>No threatened species or populations of plant were recorded during vegetation surveys of the study area. No threatened species of animals were recorded. However, fauna survey was limited to day-active species and habitat assessment which was undertaken from the roadside. Vegetation within the study area was of low conservation importance as it provided potential habitat only for species that are adapted to disturbed urban landscapes such as bats and birds. This habitat does provide marginal habitat for a number of threatened animal species such as Powerful Owl and a variety of bats.</p> <p>The vegetation within the study area adjoins the rail corridor and local arterial roads which heavily fragment the vegetation within the study area. As a result, the vegetation within the study area is isolated and only connects to planted street trees. Although there are only small patches of vegetation within the study area it plays a minor role in maintaining local connectivity between larger remaining patches of habitat in the broader locality. These linkages may be used by highly mobile species (such as bats and birds).</p> <p>The proposal is likely to have minor impacts on biodiversity. Assessments of significance were conducted on threatened species considered likely to occur within the study area. If mitigation measures, as outlined in this report, are implemented it is unlikely that the proposal will have significant impacts on threatened species or ecological communities.</p>	<p>Long-term (permanent vegetation removal) minor negative impact</p>

Clause 228 considerations		Impact
d	<p><b>Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality</b></p> <p>The proposal is expected to have some ecological and visual impacts on the proposal area, as outlined in Sections (a) to (c) above.</p> <p>The design of the proposed substation building is not anticipated to result in the reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality.</p>	Long-term (permanent vegetation removal) minor negative impact
e	<p><b>Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations</b></p> <p>The proposal would not have an effect on a locality, place or building of significance or other special value for present or future generations. There would be no impact to any listed heritage items.</p>	No impacts
f	<p><b>Any impact on the habitat of protected fauna (within the meaning of the <i>National Parks and Wildlife Act 1974</i>)</b></p> <p>No protected fauna habitat (within the meaning of the <i>National Parks and Wildlife Act 1974</i>) was identified within the proposal site.</p>	No impacts
g	<p><b>Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air</b></p> <p>Impacts on biodiversity are discussed in Section 6.4, Technical Paper 4 and summarised above in Section (c) of this table.</p> <p>The proposal is likely to have some impacts on biodiversity within the proposal site. Assessments of significance were conducted on threatened species considered likely to occur within the study area. If mitigation measures, as outlined in this report, are implemented it is unlikely that the proposal will have significant impacts on threatened species or ecological communities.</p>	Long-term (permanent vegetation removal) negative impact
h	<p><b>Any long-term effects on the environment</b></p> <p>Environmental impact assessments are discussed in Chapter 6 and the attached Technical Papers. Most environmental impacts resulting from the proposal would occur during the construction phase and therefore cause short-term effects on the environment.</p> <p>As discussed in Section 6.4, Technical Paper 4 and summarised above in Section (c) of this table, some permanent, long-term effects on the environment will result from the proposed vegetation clearing at the site. The biodiversity assessment however confirmed that the proposal is likely to have some impacts on biodiversity within the proposal site.</p> <p>The design of the proposed substation building is also not anticipated to result in any substantial negative visual impacts on the existing, urban environment.</p>	<p>Short-term negative impacts</p> <p>Long-term negative impacts (typically associated with vegetation clearance)</p>
i	<p><b>Any degradation of the quality of the environment</b></p> <p>There is potential for contaminated land to be encountered and exposed during the construction of the substation at (refer Section 6.7 of this REF). Management measures have been proposed to minimise risks associated with these potential impacts during excavation and construction on the site.</p> <p>It is considered that should these impacts occur during construction of the substation, any potential adverse environmental impacts would be generally localised in nature.</p>	Short-term negative impacts
j	<p><b>Any risk to the safety of the environment</b></p> <p>A CEMP would be prepared to cover all construction activities. Management measures have been proposed in Chapter 7 to minimise the risks associated with encountering contaminated land and other potential safety considerations.</p>	No impacts



Clause 228 considerations		Impact
k	<p><b>Any reduction in the range of beneficial uses of the environment</b></p> <p>The proposed substation and associated cabling relocation is required to maintain and provide additional traction power supply to the Sydney Trains network, in particular the North Shore Line for current and future operations. This land is within the rail corridor and owned by Sydney Trains.</p> <p>The proposal does not require the acquisition of any land and therefore is not considered to result in any reduction in the range of beneficial uses of the environment.</p>	No impacts
l	<p><b>Any pollution of the environment</b></p> <p>There is the potential for some short-term air, water and soil pollution as well as potential of exposure of contaminated soil during the construction of the proposal.</p> <p>Management and mitigation measures have been proposed (refer Chapter 7) to manage and mitigate any potential pollution of the environment caused during the construction of the proposal.</p>	Short-term negative impacts
m	<p><b>Any environmental problems associated with the disposal of waste</b></p> <p>Waste generated by the proposal would be managed in accordance with a waste management plan to be prepared in accordance with all relevant legislation.</p>	No impacts
n	<p><b>Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply</b></p> <p>There would be no increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply as a result of the proposal.</p>	No impacts
o	<p><b>Any cumulative environmental effect with other existing or likely future activities</b></p> <p>Cumulative impacts with other known developments surrounding the proposal are discussed in Section 6.15. Notwithstanding the development identified, it is noted that the construction of the proposal is anticipated to occur between 2016 and 2017 and therefore construction of other identified developments may have been completed by this time.</p> <p>The cumulative impacts of the proposal and the currently proposed known developments are unlikely to be significant.</p>	Short-term negative
p	<p><b>Any impact on coastal processes and coastal hazards, including those under projected climate change conditions</b></p> <p>Not relevant.</p>	No impacts

## 8.4 Consideration of matters of national environmental significance

Table 8.3 provides a summary checklist of matters of national environmental significance that were considered for the proposal under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

**Table 8.3 Checklist of EPBC Act matters**

Matters of national environmental significance	Impact
<p><b>World heritage properties</b></p> <p>There are no items within the proposal area listed on the World Heritage List.</p>	No impacts
<p><b>National heritage places</b></p> <p>There are no items within the proposal area listed on the National Heritage List.</p>	No impacts
<p><b>Wetlands of international importance</b></p> <p>There are no wetlands of international importance in the proposal site or likely to be affected by the proposal.</p>	No impacts
<p><b>Nationally threatened species and ecological communities</b></p> <p>A biodiversity assessment was undertaken for the proposal site, as described in section 6.4 and Technical Paper 4.</p> <p>Vegetation of ecological significance recorded in the study area included the Sydney Turpentine Ironbark Forest threatened ecological community (0.05 hectares) listed as endangered under the NSW <i>Threatened Species Conservation Act 1995</i>.</p> <p>This community within the study area was highly modified as a result of previous land clearing and invasion of weed species. As a result of its low condition, this community did not meet the Commonwealth condition criteria for the critically endangered Sydney Turpentine Ironbark Forest of the Sydney Basin as listed under the Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> listed.</p>	No impacts
<p><b>Migratory species</b></p> <p>Migratory species are protected under international agreements to which Australia are a signatory, including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA), the Republic of Korea Australia Migratory Bird Agreement (RoKAMBA) and the Bonn Convention on the Conservation of Migratory Species of Wild Animals.</p> <p>A biodiversity assessment was undertaken for the proposal site, as described in section 6.4 and Technical Paper 4. Based on the findings of the desk-top assessment, a total of 33 Migratory species have been recorded or have the potential to occur in the study area locality. Although no Migratory species were recorded during field surveys, the site does contain potential habitat however for the White-throated Needletail.</p> <p>While terrestrial Migratory species of bird may potentially use the area, the site would not be classed as 'important habitat' as defined <i>EPBC Act Policy Statement 1.1 Significant Impact Guidelines</i> as the site does not contain:</p> <ul style="list-style-type: none"> <li>■ habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species</li> <li>■ habitat utilised by a migratory species which is at the limit of the species range</li> <li>■ habitat within an area where the species is declining.</li> </ul> <p>As such, it is not likely that the proposed activity would significantly affect Migratory species.</p>	No impacts

Matters of national environmental significance	Impact
<b>Commonwealth marine areas</b> Not relevant to the proposal.	No impacts
<b>The Great Barrier Reef Marine Park</b> Not relevant to the proposal.	No impacts
<b>Nuclear actions (including uranium mining)</b> Not relevant to the proposal.	No impacts
<b>A water resource, in relation to coal seam gas development and large coal mining development</b> Not relevant to the proposal.	No impacts

## 8.5 Significance of the environmental impacts

The potential impacts of the proposal have been considered in accordance with the requirements of Section 111 of the EP&A Act, Clause 228 of the EP&A Regulation and the EPBC Act. Whilst some potentially negative impacts may result from the proposal, these impacts are not considered to be significant, as discussed in Chapter 6 of this REF. Chapter 7 of this REF provides mitigation measures and management strategies that would be implemented to reduce potentially negative impacts and manage environmental impacts.

## 8.6 Conclusion

The NSW Government has developed a plan to transform and modernise Sydney's rail network so that it can grow with the city's population and meet the needs of customers into the future. The NSW Government has identified that Sydney's rail system is reaching the limits of its capacity. For example, at present there are parts of the network where 20 trains are scheduled to run in the busiest peak hour but often only 17 trains actually arrive during that period (NSW Government 2012b).

In future, Sydney Trains intends to operate increasing train services on the North Shore Line. A new traction power substation is required to allow for an increase in the capacity along the North Shore Line for additional train services to be run and will support the delivery of the NWRL. Therefore, a new substation is proposed to be constructed at Lindfield to supply the North Shore Line.

Notwithstanding the above benefits, the proposal would result in some adverse environmental impacts during construction and operation of the proposed substation. The key potential impacts associated with the proposal would likely comprise:

- Vegetation removal** — construction of the proposed substation and associated cabling at Lindfield would require the removal of up to approximately 0.94 hectares of native vegetation being a combination of Blue Gum High Forest and Sydney Turpentine Ironbark Forest scrubby regrowth. Up to approximately 2.31 hectares of habitat would be removed which is of low to moderate condition and may provide some marginal foraging habitat for several threatened species of birds and bats. Significance assessments have been undertaken for threatened biodiversity which have concluded that due to the small area and highly modified condition of the vegetation and habitat recorded within the study area, the proposed substation construction is not likely to have a significant impact on any threatened biodiversity, nor would it interfere with their recovery, assuming appropriate mitigation measures are implemented.

Based on the assumption that the 'additional aerial earth (overhead) wires only' section of the proposed will require the removal of vegetation to the north of Lindfield Station construction of the proposed substation at Lindfield will require the removal of 2.31 hectares of potential foraging habitat for these species. In the likelihood that power poles are not replaced as part of the proposed this area of vegetation removed will be reduced. However, if required, offsetting would be undertaken in alignment with Transport for NSW offsetting guidelines (Transport for NSW, 2014) during detailed design.

- *Construction noise* — the proposal would result in construction noise and vibration impacts within the local area at a range of residential receivers during specific activities. There may be some short-term exceedances of the construction noise criteria (including the use of rock breaking equipment and the placement of plant and equipment) in addition to during out-of-hours works. These exceedances are expected to be short-term in duration and all feasible and reasonable practices would be applied to minimise noise impacts to the local community during these periods. In the event of the need for out-of-hours works, the contractor would be required to discuss the proposed works with the EPA and notify local residents and businesses prior to the proposed works occurring. Mitigation measures put in place during construction would reduce the predicted noise levels to within an acceptable range.
- *Operational noise* – some noise impacts may occur to sensitive receivers adjacent to the proposal site. The predicted base case steady state noise levels have been identified as resulting in a worst-case 11 dB exceedance of the night-time intrusive goal at the nearest sensitive receivers (without mitigation). The predicted  $L_{A1(60\text{second})}$  noise levels also exceed the sleep disturbance goals at the nearest residential receiver locations by up to 16 dB. It should be noted, however, that the predicted noise level from circuit breaker operation will not occur on a continuous basis and will likely be a very infrequent occurrence during the night-time period – potentially once or twice a month.
- Whilst this exceedance has been predicted to be moderate, it is expected that the substation can be readily designed (during the detailed design stage of the proposal) to meet the noise goals through provision of shielding or consideration of the acoustic performance of the enclosure during detailed design of the structure. Mitigation measures would be put in place to reduce the predicted noise levels to within an acceptable range during operation of the substation.
- *Visual* – the landscape and visual impacts would generally be restricted to a small number of localised viewing locations to the site as a result of the introduction of a new structure and the removal of some existing screening. This potentially increases the visibility of the substation and existing train movements along the rail corridor. Some improvement to the existing visual landscape would occur as a result of the removal of overhead wiring generally between power pole P57 (south of Lindfield Station near Russell Avenue) and power pole P49 (north of the Clanville Road overbridge). Landscape and visual impacts would occur during both the construction and operational phases. However, the proposed landscape planting would partially screen the outer sides of the building from views from the surrounding areas.
- *Construction traffic* — some limited traffic impacts may occur during the construction of the proposed substation and associated cabling, including some increase in heavy vehicle movements and the potential for limited road closures during the delivery of primary equipment such as transformer and reactor units.

Notwithstanding the above impacts, it is considered that the adverse environmental impacts are generally localised in nature. With the implementation of the proposed mitigation and management measures specified in Chapter 7, the potential environmental impacts of the proposal could be adequately mitigated and managed, and are not considered to be significant.

## 9. References

Australian Weeds Committee 2013, *Weeds of National Significance*, viewed 2/12/2013 2013, <<http://www.weeds.org.au/WoNS/>>

Department of Environment and Conservation, (DEC) 2006, *Assessing Vibration – a technical guideline*

Department of Environment Climate Change (DECC) 2008, *Waste Classification Guidelines prior to being disposed of off-site*

Department of Environment Climate Change (DECC) 2009, *Interim Construction Noise Guideline*

Department of Environment Climate Change and Water (DECCW) 2011, *Road Noise Policy*

Department of Environment and Heritage 1992, *National Strategy for Ecologically Sustainable Development*

Department of Urban Affairs & Planning 1996, *NSW Heritage Manual*

Environment Protection Agency 1999, *NSW Action for Air*

Environment Protection Agency 2000, *NSW Industrial Noise Policy*

Infrastructure NSW 2012, *State Infrastructure Strategy*

Landcom 2004, *Managing Urban Stormwater, Soils and Construction Guidelines*

NSW Government 2010a, *NSW State Plan – Investing in a Better Future*, March 2010

NSW Government 2010b, *Metropolitan Plan for Sydney 2036*

NSW Government 2011, *NSW 2021: A Plan to Make NSW Number One*, September 2011

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

NSW Government 2012b, *Sydney's Rail Future Modernising Sydney's Trains*, June 2012

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

NSW Government 2013b, *North Ryde Station Precinct Development Control Plan*

NSW Office of Environment and Heritage (OEH) 2010, *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*

Parsons Brinckerhoff 2014, *Epping to Chatswood Rail Link – Alternative Transport Assessment: Volume 1 and Volume 2*

Roads and Maritime Services 2013, *Environmental Impact Assessment Practice Note - Guideline for Landscape Character and Visual Impact Assessment* and the

Tozer, M 2003, 'The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities', *Cunninghamia*, vol. 8, no. 1, pp. 1-75

Transport for NSW 2012, *NSW Sustainable Design Guidelines for Rail*

Transport for NSW 2014, *Vegetation Offset Guide*

United Kingdom's 2013, *Landscape Institute and the Institute of Environmental Management and Assessment*