EXHIBIT D– PLANNING APRROVAL

The Planning Approval consists of Determination Report which includes the following appendices:

a) Review of Environmental Factors

b) Conditions of Approval

c) Environmental Impact Assessment

Power Supply Upgrade
Granville Junction Substation
Determination Report

Transport Projects Delivery Office

Date	14 December 2015
Author	TfNSW
Ref	4813795
Status	Final

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1. Introduction

1.1. Background

Transport for NSW (TfNSW) is the NSW Government's lead public transport agency that ensures planning and policy is fully integrated across all modes of transport in NSW. It manages a multi-billion dollar budget allocation for rail, bus, ferry and taxi services and related infrastructure in NSW.

TfNSW is responsible for improving the customer experience of transport services, transport policy and regulation, planning and program administration, procuring transport services, and infrastructure and freight.

The Power Supply Upgrade (PSU) Program aims to improve electrical infrastructure to allow the Sydney Trains network to accommodate actual and projected increase in power demands. A power supply study undertaken as part of the program found that a new substation was required in the Granville area to provide additional capacity on the North Shore, Northern and Western Line, and on the Airport, Inner West and South Line. A new substation will also allow for the decommissioning and removal of the existing Granville Substation, which has reached the end of its recommended operational life..

Transport for NSW is the proponent for the Granville Junction Substation Project (referred to as 'the Proposed Activity' for the purposes of this document).

1.2. Granville Junction Substation Review of Environmental Factors

TfNSW prepared a Review of Environmental Factors (REF) for the Proposed Activity, which details the scope of works and environmental impacts associated with the Proposed Activity (Appendix 1).

The REF was prepared by GHD on behalf of TfNSW, in accordance with clause 228 of the *Environmental Planning and Assessment Regulation 2000*.

1.3. Purpose of this Determination Report

Prior to proceeding with the Proposed Activity, the Secretary of TfNSW must make a determination in accordance with the provisions of Part 5 of the *Environmental Planning and Assessment Act 1979* (the EP&A Act).

The objectives of this Determination Report are to:

- assess the environmental impacts with respect to the Proposed Activity which are detailed in the REF (and any proposed modifications, as detailed and assessed in this Determination Report)
- identify mitigation measures to minimise potential environmental impacts
- determine whether potential environmental impacts are likely to be significant
- address whether the provisions of the *Commonwealth Environment Protection & Biodiversity Conservation Act 1999* (the EPBC Act) applies to the Proposed Activity.

This report has been prepared having regard to, among other things, the objectives of TfNSW under the *Transport Administration Act 1988*:

(a) to plan for a transport system that meets the needs and expectations of the public,

(b) to promote economic development and investment,

(c) to provide integration at the decision-making level across all public transport modes,

(d) to promote greater efficiency in the delivery of transport infrastructure projects,

(e) to promote the safe and reliable delivery of public transport and freight services.

2. Description of the Proposed Activity

2.1. Description of the Proposed Activity in the REF

The proposed activity would upgrade the existing power supply in the Granville area to meet the requirements associated with future timetables. The Proposed Activity as outlined in the REF comprises constructing and operating a new substation. The proposed substation would supply traction power to the Sydney Trains rail network. The substation would include electrical equipment and connections (including above ground cabling in steel troughs, overhead wiring, an under track crossing and a single over track crossing structure), as well as an administration office, staff amenities and parking.

The proposed substation would be accessed directly via a new access off Railway Parade. Connections to the existing power, wastewater, potable water and stormwater drainage network would be provided.

The proposal also involves decommissioning and removing the existing Granville substation.:

The need for, and benefits of the Proposed Activity are outlined in Chapter 4 of the REF.

2.2. Design modifications

No changes have been made to the design outlined in the REF, however, some design modifications may result from the detailed design phase.

Should design modifications be required as a result of detailed design process, these modifications would be assessed to determine consistency with the approval, including significance of impact. Additional mitigation measures and/or consultation would be undertaken where necessary.

3. Consultation and assessment of submissions

3.1. Initial consultation prior to the REF public display

Initial consultation was undertaken with representatives of Parramatta City Council prior to public display of the REF. The purpose of the meeting was to provide information and obtain feedback on the proposal. Key issues raised during the meeting were traffic, transport, access, biodiversity, planning and noise impacts. Key issues raised during the meeting are summarised in Table 6.1 of the REF.

3.2. REF Public Display

The Granville Junction Substation REF was placed on public display from 16 October to 30 October 2015 (inclusive). The consultation activities undertaken with the selected stakeholders and affected community receivers for the public display included:

- Distribution of approximately 210 flyers and door knocking activities at local businesses and residents within 100m of the project notifying them about the REF public display period and feedback opportunities;
- Delivery of notification to Granville TAFE and Granville Boys' High School;
- Delivery of notification Parramatta City Council and Holroyd City Council and
- Project information, including the REF and supporting technical studies were published on the TfNSW website and hard copies of the REF were displayed at:
    - Granville Library; and
    - Transport for NSW offices (Level 5, Tower A, Zenith Centre, 821 Pacific Highway, Chatswood).

3.3. REF Submissions

Two (2) submissions from Parramatta City Council and Holroyd City Council were received by TfNSW as a result of the community consultation activities.

The submissions raised a number of issues in relation to the Proposed Activity. Key Issues raised in the submissions included:

- Landscaping and ;
- Visual amenity.

A summary of all issues raised and associated TfNSW response is provided in Table 1 below.

Table 1 Response to issues raised in submissions

No.	Issues raised	TfNSW response
1	**Landscaping**	
1.1	A plan drawing should be produced that shows the landscaping proposition such as existing trees and those that are intended to be planted.	Figure 7.1 of the REF shows the existing tree and trees that could be impacted by the construction. Section 7.2.3 of the REF discusses the flora and fauna impacts of the proposal and section 7.2.4 outlines the mitigation measures that would be implemented during construction. Due to operational and safety requirements of a substation there is limited scope for new landscaping at the substation site other than infilling gaps within the existing Council street planting. Any vegetation planted on-site or at a suitable location would consist of locally endemic native species, unless otherwise agreed with Transport for NSW, and where relevant following consultation with local Council, and/or Sydney Trains. CoA 25 further outlines the measures that would be implemented during construction for the trimming, cutting, pruning or removal of trees or vegetation where the impact has not already been identified in the REF.
3	**Visual Amenity**	
3.1	The predominant brickwork should be darker in colour and the lighter brick used for the highlights, which is effectively a reverse of the current composition. Darker colours are more recessive and their use in this instance will allow the building to blend more successfully with the existing streetscape and general context. The substation should fit in with future improvements on Railway Parade and consideration needs to be given to the streetscape and future development on the northern	Noted The detailed design of the proposal would take into account relevant urban design and visual considerations including reversal of colours scheme to make the predominant brickwork darker in colour and the lighter brick used for the highlights. Section 7.6.2 outlines the impacts associated with the landuse and social-economic issues. The proposal is consistent with the land use zoning under the LEP, and is consistent with the use of adjoining land as rail corridor. The

	side of the Western Rail Line. The substation will be visible from new development in the Granville Urban Renewal precinct (multi storey residential towers). A review of the architectural design and treatments for the substation including screening is warranted to ensure that the best outcome can be achieved in terms of the sites future context and visibility.	decommissioning of the existing Granville substation would release this land for an alternate purpose in keeping with the infrastructure zoning of the site and surrounding area. Any future uses would be considered under a separate approvals process. No significant long term community amenity impacts have been identified, other than the introduction of a new structure in the landscape. The visual amenity impacts are assessed in the Section 7.7 of the REF. The appearance of the substation would be consistent with the surrounding rail/infrastructure uses, which include existing buildings and other rail infrastructure (including overhead power lines). Furthermore the views to the site are partially obscured by vegetation. As such not all of the proposal will be visible from surrounding areas. Where possible existing vegetation will be retained to provide partial screening. Due to operational and safety requirements no further screening by landscaping can be provided north of the proposed substation, inside the rail corridor. Photomontages of the proposed substation from the nearest sensitive viewpoints are provided in Figure 7.3 to Figure 7.5 of the REF. As outlined above, the concept design for the proposal has been prepared with regard to urban design and visual considerations. Further design phases would continue to consider the potential for visual impacts. The proposal involves the provision of infrastructure required to meet the needs of the expanded Sydney Trains fleet, and is therefore consistent with the NSW Long Term Transport Master Plan. Operation of this proposal would improve service reliability by reducing the risk of disruption to rail services. This would have a socio-economic benefit to all communities with access to the North Shore, Northern and Western Line, and the Airport, Inner West and South Line.

3.4. Future consultation

Should TfNSW proceed with the Proposal, consultation activities would continue, including notifications to residents, businesses and community members in the lead up to and during construction. The consultation activities would ensure that the community and stakeholders are notified in advance of any upcoming works, including:

- changes to pedestrian or traffic access arrangements and out of hours construction activities;
- accurate and accessible information is made available; and
- a timely response is given to issues and concerns raised by the community.

The TfNSW Infoline (1800 684 490) and TfNSW email address (projects@transport.nsw.gov.au) would continue to be available during the construction phase. Targeted consultation methods, such as use of letters, notifications, signage and verbal communications, would continue to occur. The TfNSW would also include updates on the progress of construction.

4. Consideration of the environmental impacts

The REF and Determination Report have been examined and considered as follows:

***Environmental Planning and Assessment Act 1979* (EP&A Act)**

The REF addresses the requirements of section 111 of the EP&A Act. In considering the Proposed Activity, all matters affecting or likely to affect the environment are addressed in the REF and the Determination Report and associated documentation in accordance with the checklist of matters pursuant to clause 228(3) of the *Environmental Planning and Assessment Regulation 2000.*

In respect of the Proposed Activity an assessment has been carried out regarding potential impacts on critical habitat, threatened species, populations or ecological communities or their habitats, under section 112 of the EP&A Act.

The likely significance of the environmental impacts of the Proposed Activity have been assessed in accordance with the then NSW Department of Planning's 1995 best practice guideline *Is an EIS Required?* It is concluded that the Proposed Activity is not likely to significantly affect the environment (including critical habitat) or threatened species, populations of ecological communities, or their habitats. Accordingly, an environmental impact statement under Part 5.1 of the EP&A Act is not required.

***Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)**

As part of the consideration of the Proposed Activity, all matters of national environmental significance (NES) and any impacts on Commonwealth land for the purposes of the EPBC Act have been assessed. In relation to NES matters, this evaluation has been undertaken in accordance with Commonwealth Administrative Guidelines on determining whether an action has, will have, or is likely to have a significant impact. A summary of the evaluation is provided in Section 3.3.2 of the REF.

It is considered that the Proposed Activity described in the REF is not likely to have a significant impact on any Commonwealth land and is not likely to have a significant impact on any matters of NES.

5. Conditions of Approval

If approved, the Proposed Activity would proceed subject to the Conditions of Approval included in Appendix 2.

6. Conclusion

Having regard to the assessment in the REF, and the consideration of the submissions received in this report, it can be concluded that the Proposed Activity is not likely to significantly affect the environment (including critical habitat) or threatened species, populations of ecological communities, or their habitats. Consequently, an environmental impact statement is not required to be prepared under Part 5.1 of the EP&A Act.

It is also considered that the Proposed Activity does not trigger any approvals under Part 3 of the EPBC Act.

In considering the environmental impacts, proposed mitigation and broader project benefits it is recommended that the Proposed Activity be approved.

The environmental impact assessment (REF and Determination Report) is recommended to be approved subject to the proposed mitigation and environmental management measures included in the Conditions of Approval.

Appendix 1: Review of Environmental Factors

Granville Junction Substation

Review of Environmental Factors

OCTOBER 2015

NSW GOVERNMENT | Transport for NSW

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Glossary of terms

Term	Definition
Circuit breakers	Manually or automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. The basic function is to detect a fault condition and interrupt current flow.
dB(A)	Decibel expressed with the frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms more or less to the human ear response, as our hearing is less sensitive at low and high frequencies.
DCCB	Direct current circuit breaker.
Feeders	In the context of the Power Supply Upgrade Program, a feeder is either: • a 33 kilovolts AC cable coming in to the substation from the Sydney Trains supply or from Ausgrid • a cable supplying 1500 volts DC from the traction substation to the overhead wiring system.
$L_{A90(period)}$	The A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured. This is considered to represent the background noise e.g. $L_{A90(15\ min)}$.
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
Possession (rail track)	A period during which the rail line is shut down to allow for planned maintenance, construction works etc.
Proposal	Refers to the construction and operation of Granville Junction Substation, including the associated installation of high voltage feeder cabling to/from the substation, and the decommissioning and removal of the existing Granville Substation.
Proposal site	The immediate location of the proposal, which is the area that has the potential to be directly disturbed by construction.
Rectifiers	An electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification.
Study area	Consists of land in the vicinity of the proposal site, including land that has the potential to be indirectly impacted by the proposal.
Sydney Trains	Sydney Trains provides train services throughout the Sydney CBD and metropolitan area.
Traction substation	A traction substation is an electrical substation that converts electric power from the form provided by the electricity provider to an appropriate voltage, current type and frequency which can be used to supply the rail network with power.

List of abbreviations

Abbreviation	Definition
ASA	Transport for NSW Asset Standards Authority
CEMP	Construction Environmental Management Plan
CTMP	Construction Traffic Management Plan
DC	direct current
DSAPT	Disability Standards for Accessible Public Transport 2002
EME	electromagnetic energy
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	environment protection licence
GHD	GHD Pty Ltd
HV	high voltage
Infrastructure SEPP	*State Environmental Planning Policy (Infrastructure) 2007*
kilovolts	Kilovolt
LGA	local government area
m^2	square metre
m	Metre
MW	Megawatt
NSW	New South Wales
POEO Act	*Protection of the Environment Operations Act 1997*
PSU Program	Power Supply Upgrade Program
REF	Review of Environmental Factors
RMS	Roads and Maritime Services (formerly Roads and Traffic Authority (RTA))
TSC Act	*Threatened Species Conservation Act 1995*
V	volt

Executive summary

Overview

This Review of Environmental Factors (REF) considers the potential impacts of the construction and operation of a new substation at Granville. It has been prepared by GHD Pty Ltd on behalf of Transport for NSW to assess the potential impacts of the proposal, and assist Transport for NSW determine the proposal in accordance with the provisions of Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

Why is the proposal needed?

Transport for NSW is currently undertaking the Power Supply Upgrade Program (the PSU Program) to meet the actual and projected increase in power demands on the Sydney Trains electrical network. A power supply study undertaken as part of the program found that a new substation was required in the Granville area to:

- provide additional capacity on the North Shore, Northern and Western Line; and on the Airport, Inner West and South Line
- allow for the decommissioning and removal of the existing Granville Substation, which has reached the end of its recommended operational life.

Where would the proposal be located?

The site for the proposed substation is located on the northern side of Railway Parade adjacent to the rail corridor, about 420 metres north-west of Granville Station. The existing substation site is located to the north of the site for the proposed substation, in the triangle of land where the North Shore, Northern and Western Lines, and the Airport, Inner West and South Lines diverge (known as 'Granville Junction').

What would the proposal involve?

The proposal involves constructing and operating a new substation. The proposed substation would supply traction power to the Sydney Trains rail network. The substation would include electrical equipment and connections (including above ground cabling in steel troughs, overhead wiring, an under track crossing and a single over track crossing structure), as well as an administration office, staff amenities and parking.

The proposed substation would be accessed directly via a new access off Railway Parade. Connections to the existing power, wastewater, potable water and stormwater drainage network would be provided.

The proposal also involves decommissioning and removing the existing Granville substation.

How long would the proposal take to construct?

Construction is scheduled to commence in mid to late 2016 and continue for about 12 months. Civil works would be undertaken over the first nine months, with electrical and services fit-out undertaken over the following three months. Commissioning would then take about six months.

Summary of REF findings

There are not considered to be any significant long-term environmental issues associated with the presence of the substation on the proposal site, or its operation. In the short-term, there may be minor adverse impacts associated with construction. Key issues identified include:

- potential short-term noise impacts during construction
- temporary loss of about four on-street parking spaces on Railway Parade
- removal of three trees for the new site access
- management of potential hazardous materials.

Operational impacts include:

- the presence of a new structure in the landscape, which would be visible to passing traffic and pedestrians, and from some residences opposite the site on Railway Parade
- loss of two on-street parking spaces on Railway Parade.

The design of the proposal, and the proposed form and finishes, has taken the visibility of the proposal site into account.

The proposal would result in long-term positive impacts as it would increase the capacity of the rail corridor's power supply network, enabling it to meet the projected increase in power demands on the rail network. This would provide long term benefits to users of the rail network.

Adverse environmental impacts would be minimised by implementing the mitigation measures listed in this REF, including preparing and implementing a construction environmental management plan.

Justification and conclusion

The proposal is needed to meet the actual and projected increase in power demands on the Sydney Trains electrical network.

The potential environmental impacts of the proposal have been assessed in accordance with section 111 of the EP&A Act, Clause 228 of the *Environmental Planning and Assessment Regulation 2000*, the *Threatened Species Conservation Act 1995*, and the *Environment Protection and Biodiversity Conservation Act 1999*. It is considered that the adverse environmental impacts would be mainly short-term and localised in nature. With the adoption and implementation of the mitigation and management measures listed in this REF, the potential environmental impacts of the proposal would be adequately mitigated and managed, and are not considered to be significant.

1. Introduction

1.1 Overview

Transport for NSW is currently undertaking the Power Supply Upgrade Program (the PSU Program) to meet the actual and projected increase in power demands on the Sydney Trains electrical network. A power supply study undertaken as part of the program found that a new junction substation was required in the Granville area to provide additional capacity and improve reliability for the operation of trains along the North Shore, Northern and Western Lines, and the Airport, Inner West and South Lines.

As part of the PSU Program, Transport for NSW is proposing to construct a new junction substation next to the rail corridor at Granville to address the traction power needs identified by the power supply study.

The construction and operation of Granville Junction Substation, and the decommissioning and removal of the existing Granville Substation (referred to as 'the proposal' for the purposes of this document) is subject to assessment and determination under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (the EP&A Act). Transport for NSW commissioned GHD Pty Ltd (GHD) to assess the potential environmental impacts of the proposal, and prepare a Review of Environmental Factors (REF) in accordance with the EP&A Act.

1.2 The Power Supply Upgrade Program

The PSU Program was initiated in 2005 to ensure that Sydney's rail network would be capable of meeting the expected power requirements of future train timetables, and the requirements of the new generation of air conditioned trains. The PSU Program involves constructing new electrical infrastructure and upgrading substations, sectioning huts, overhead wiring and electrical feeders across the network.

The objectives of the PSU Program are to:

- support the introduction of air conditioned trains into service
- provide additional power to operate trains on the network
- improve service reliability by reducing the risk of disruption to rail services.

1.3 The proposal

The proposal involves constructing and operating a new substation on a site owned by Transport for NSW, which is located adjacent to the rail corridor (for the Airport, Inner West and South Lines) on Railway Parade in the suburb of Granville. The substation would include electrical equipment and connections (including above ground cabling in steel troughs, overhead wiring, an under track crossing and a single over track crossing structure), as well as an administration office, staff amenities and parking.

The proposal also involves the decommissioning and removal of the existing Granville Substation.

The location of the proposal is shown in Figure 1.1. A description of the proposal is provided in section 5.

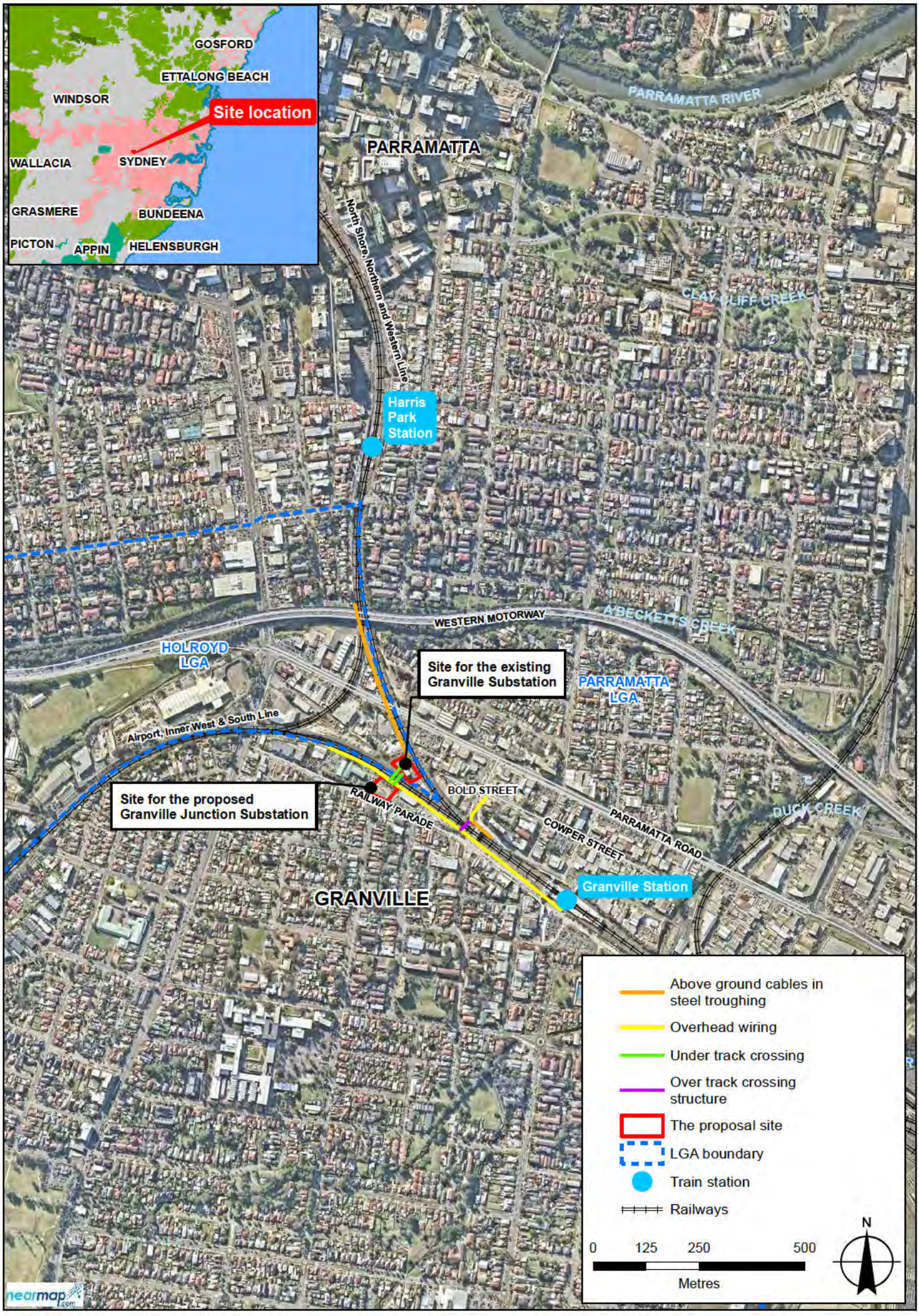

Figure 1.1 Location of the proposal

1.4 Structure of the REF

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

Table 1.1 Structure and content of the REF

Section	Description
Section 1 – Introduction	An introduction to the REF.
Section 2 – Location and setting	A description of the location, site and study area.
Section 3 – Statutory framework	An overview of the statutory requirements for the proposal, including the requirements of relevant environmental planning instruments and legislation.
Section 4 – Strategic context, need and options considered	An overview of the strategic context for the proposal, need, and the proposal development process.
Section 5 – Description of the proposal	A description of the proposal.
Section 6 – Community and stakeholder consultation	A summary of the consultation process and the key issues raised.
Section 7 – Environmental impact assessment	An assessment of the potential environmental impacts, including summaries of specialist reports prepared for the proposal.
Section 8 – Environmental management and mitigation	An outline of the requirements for the proposal's environmental management plan, and a summary of the mitigation measures identified by the REF.
Section 9 - Conclusion	A conclusion to the REF.
Section 10 – Reference list	A list of references for the REF.

1.5 Scope and methodology

1.5.1 Scope and purpose of the REF

For an activity subject to Part 5 of the EP&A Act, section 111 of the Act imposes a duty on a determining authority to 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'. Determining authorities make a determination about whether a proposal can proceed, and on what basis.

The purpose of this REF is to summarise the results of the environmental impact assessment for the proposal and provide information about the proposal as an input to the determination process. Transport for NSW (as the determining authority) will consider the findings of the REF as part of the determination process.

In summary, the REF will assist Transport for NSW to undertake the following:

- determine whether the proposal should be approved, taking into account to the fullest extent possible all matters affecting or likely to affect the environment (in accordance with section 111 of the EP&A Act)
- determine whether the proposal is likely to have a significant effect on the environment or significantly affect threatened species, populations or ecological communities or their habitats

- develop appropriate conditions (based on the mitigation measures within the REF) to be attached to any approval granted.

Clause 228 of the *Environmental Planning and Assessment Regulation 2000* (the Regulation) lists, for the purposes of Part 5 of the EP&A Act, the factors to be taken into account when considering the likely impact of an activity on the environment. Appendix A considers the potential impacts of the proposal against these factors.

1.5.2 Definitions used

For the purposes of this REF, the following definitions have been applied:

- The 'proposal' refers to the construction and operation of the Granville Junction Substation and the decommissioning and removal of the existing Granville Substation.
- The 'proposed substation' refers to the proposed Granville Junction Substation.
- The 'proposal site' includes:
  - the 'site for the proposed substation' - the site on Railway Parade where the proposed substation would be constructed and operated
  - services locations – the location of high voltage and communications cabling (both above and below ground) associated with the proposed substation
  - the 'existing substation site' – the site at Granville Junction where the existing Granville Substation is located.
- The 'study area' consists of land in the vicinity of, and including, the proposal site. The study area is the wider area surrounding the proposal site, including land that has the potential to be indirectly impacted by the proposal (for example, as a result of any noise impacts).

Other terms are defined in the glossary at the beginning of the REF.

1.5.3 Methodology

Preparing the REF has involved the following tasks:

- attending project meetings
- receiving relevant information from Transport for NSW
- site visits, including a site visit and proposal review by a GHD ecologist/arborist, and a GHD traffic engineer
- consultation and liaison with key stakeholders
- undertaking specialist noise and vibration; flora, fauna and arborist; and sustainability assessments
- reviewing specialist assessments being undertaken as part of the design process (including the contamination, geotechnical and electromagnetic fields assessments), and incorporating relevant information in the REF
- preparing photomontages of the proposed substation
- a qualitative desktop assessment of other potential environmental and social impacts, including reviews of existing information and database searches
- identifying mitigation measures to manage the impacts identified
- addressing the requirements of Part 5 of the EP&A Act and Clause 228 of the Regulation.

The REF has been prepared in consultation with relevant stakeholders, including the design team (GHD), Transport for NSW, and other relevant technical advisors and agencies. It is noted that although the REF team has consulted with members of the design team to prepare the REF, design personnel have not influenced the methodology or outcomes of the environmental impact assessment process in any way.

2. Location and setting

This section provides information on the location of the proposal, the proposal site and its surrounds (the study area).

2.1 Site location and description

The site for the proposed substation (shown in Figure 1.1) is located in the Parramatta local government area (LGA). The site occupies part of lot 2 on deposited plan (DP) 1006002. The site is located on the northern side of Railway Parade opposite the intersection with The Avenue, about 420 metres north-west of Granville Station. The site adjoins the rail corridor (for the Airport, Inner West and South Lines). The site for the proposed substation consists of the potential footprint for the substation building and surrounding facilities/hardstand areas. The site has an area of about 1,800 square metres, and approximate dimensions of 38 by 48 metres.

The site has been subject to previous disturbance and development. Buildings previously located on site have been removed, with hardstand and some building rubble remaining on site.

The existing substation site is located to the north of the site for the proposed substation, in the triangle of land where the North Shore, Northern and Western Lines, and the Airport, Inner West and South Lines diverge (known as 'Granville Junction'). The existing Granville Substation is located in the Holroyd LGA (the rail lines are the boundary between the LGAs) on land owned by Transport for NSW.

Connections to the Sydney Water potable water and wastewater networks, and Council's stormwater drainage network, would be located within Railway Parade and the rail corridor (as described in section 5.1.6).

Vehicular and pedestrian access to the proposal site during construction would be from Railway Parade via a new proposed driveway on the eastern side of the site. During operation, access would also be via this new driveway off Railway Parade.

2.2 The study area and site context

Key features of the study area are shown on Figure 2.1. The proposal site is located in an area which includes a mix of transport, residential (mostly detached dwellings) and commercial land uses.

Land uses immediately surrounding/adjoining the site for the proposed substation include:

- railway uses (rail corridor) to the north and north-east
- Sydney Trains Major Works Depot to the west
- Sydney Trains Central and Western Possessions Office to the east
- Railway Parade to the south.

There is a bus stop for the M91 Hurstville to Parramatta route located outside the site on the northern side of Railway Parade. Further information on the M91 route is provided in section 7.5.2.

Land uses in the broader area include:

- Residential land uses - includes both detached and medium density residential dwellings to the south of the proposal site. The nearest residences are located directly opposite the site on the southern side of Railway Parade.

- Commercial/light industrial land uses – various commercial and light industrial land uses are located to the north, east and west of the site. The Granville town centre is located about 200 metres to the south-east of the site. Light industrial uses are located to the north of the rail corridor, in the area roughly bounded by the rail corridor, Parramatta Road and Bold Street.
- Education uses – Granville Boys High School, Granville Public School and the Granville College of Technical and Further Education (Granville TAFE) are located within about 500 metres south of the site.

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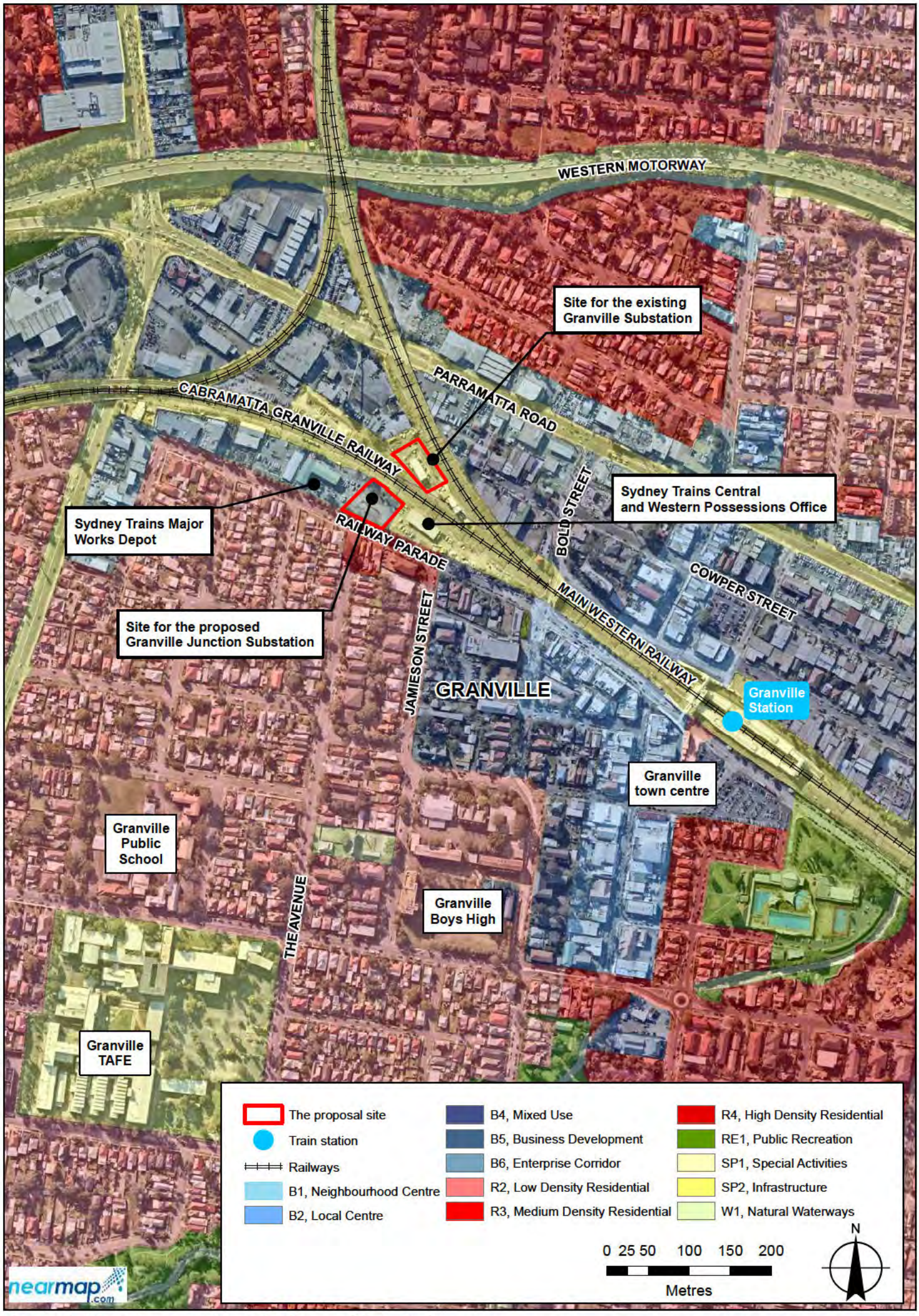

Figure 2.1 Land use and key features of the study area

3. Statutory framework

This section provides an overview of the statutory framework relevant to the proposal, including the assessment requirements, relevant environmental legislation and planning instruments.

3.1 Environmental Planning and Assessment Act 1979

The EP&A Act and the Regulation provide the statutory basis for planning and environmental assessment in NSW. The EP&A Act provides the framework for environmental planning and development approvals and includes provisions to ensure that the potential environmental impacts of a development are assessed and considered in the decision making process.

3.1.1 Application of Part 5 of the EP&A Act

As a result of the application of the *State Environmental Planning Policy (Infrastructure) 2007* (the Infrastructure SEPP), the proposal is subject to Part 5 of the EP&A Act (refer section 3.2.1). In relation to Part 5 activities, section 111 of the EP&A Act imposes a duty on a determining authority to 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'.

Section 110(1) defines a determining authority as 'a Minister or public authority and, in relation to any activity, means the Minister or public authority by or on whose behalf the activity is or is to be carried out or any Minister or public authority whose approval is required in order to enable the activity to be carried out'.

In line with Clause 79 of the Infrastructure SEPP, Transport for NSW is the proponent and determining authority for the proposal. This REF has been prepared to satisfy Transport for NSW's requirements under the EP&A Act.

3.2 Environmental planning instruments

The environmental planning instruments that are relevant to the approval and assessment of the proposal are considered below.

3.2.1 State environmental planning policies (SEPPs)

State Environmental Planning Policy (Infrastructure) 2007

The Infrastructure SEPP outlines the permissibility and development controls for infrastructure works and facilities. Clause 79 of the Infrastructure SEPP outlines which railway infrastructure facilities are permissible without the need for development consent under the EP&A Act. As the proposal meets the definitions of rail infrastructure facilities provided by clause 78, it is permissible without consent.

Clauses 13 to 16 of the Infrastructure SEPP outline the requirements for consultation with councils and other public authorities for infrastructure development carried out by or on behalf of a public authority. The proposal would not trigger any of these requirements, and therefore consultation with Parramatta and Holroyd councils and other public authorities is not required under the Infrastructure SEPP. However, relevant agencies have been, and will continue to be, consulted in relation to the proposal. Further details of the consultation process are provided in section 6.

3.2.2 Local environmental plans

The *Parramatta Local Environmental Plan 2011* (the Parramatta LEP) applies to the land in which the site for the proposed substation is located. This site is located within land zoned as B6 Enterprise Corridor. The Holroyd Local Environmental Plan 2013 (the Holroyd LEP) applies to the land in which the existing substation site is located. This site is located within land zoned as SP2 Infrastructure. The zone provisions for both zones provide that the proposal can be carried out in these zones with consent.

However, clause 5.12 of the LEPs states that '…this Plan does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out with or without development consent, or that is exempt development, under State Environmental Planning Policy (Infrastructure) 2007'. As the proposal is permitted without consent under the Infrastructure SEPP, the consent requirements of the LEPs do not apply to the proposal.

3.3 Other legislative considerations

3.3.1 NSW legislation

Other environmental legislation that is directly relevant to the approval and/or assessment of the proposal is considered in Table 3.1.

Table 3.1 Consideration of relevant legislation

Act	Potential approval requirement for rail infrastructure	Relevance to the proposal
Protection of the Environment Operations Act 1997 (POEO Act)	An environment protection licence (EPL) is required for scheduled activities or scheduled development work.	The proposal is not considered to be a scheduled activity under Schedule 1 of the POEO Act and therefore an EPL is not required for construction. Sydney Trains currently holds an EPL for the operation of the rail network (EPL no. 12208). The proposal would comply with the requirements of this licence as well as the general obligations of the POEO Act. No variation of this licence is considered to be required.
Roads Act 1993	Approval under section 138 for works to a public road	The proposal includes provision of driveway access to the site from Railway Parade (an unclassified road). Under Clause 5(1) of Schedule 2, a public authority is not required to obtain a roads authority's consent for the exercise of the authority's functions in, on or over an unclassified road. The access would be designed in accordance with the requirements of the Transport for NSW Asset Standards Authority (ASA) standard for access roads (Transport for NSW, 2014) and in consultation with Parramatta City Council.
National Parks and Wildlife Act 1974	A heritage impact permit under section 87 of the Act to harm or desecrate an Aboriginal heritage object.	There are no listed Aboriginal heritage items or places located on or in the vicinity of the site. As a result of the existing levels of site disturbance, there is minimal likelihood that unknown items of Aboriginal heritage significance would be present. Further information is provided in section 7.8.

Act	Potential approval requirement for rail infrastructure	Relevance to the proposal
Water Management Act 2000 and *Water Act 1912*	Licence for dewatering and interception of groundwater	Minor excavation work would be undertaken as part of the proposal, and it is possible that groundwater would be intercepted. Subject to confirmation with the Department of Primary Industries - Water, if Transport for NSW (as determining authority) determines that the proposal is a 'defined minimal impact aquifer interference activity', a license would not be required. Potential impacts on groundwater associated with the construction and operation of the proposal are considered in section 7.1.2.
Heritage Act 1977	Approval under section 57(1) for works to a place, building, work, relic, moveable object, precinct, or land listed on the State Heritage Register. An excavation permit under section 139 to disturb or excavate any land containing or likely to contain a relic.	There are no listed heritage items located within or in the vicinity of the proposal site. The nearest listed heritage item is located about 120 metres south-east of the proposal site. As a result of the existing levels of site disturbance, there is minimal likelihood that unknown items of historic significance or relics would be present. Further information is provided in section 7.8.
Threatened Species Conservation Act 1995 (TSC Act)	The TSC Act lists threatened species, populations or ecological communities to be considered in deciding whether there is likely to be a significant impact on threatened biota, or their habitats. If any of these could be impacted by the project, an assessment of significance that addresses the requirements of section 5A of the EP&A Act must be completed to determine the significance of the impact.	The proposal site is largely disturbed. The proposal would not result in any impacts to listed flora, fauna or communities, and a species impact statement is not required. Providing access to the site for the proposed substation would involve the removal of three trees from the road verge near the south-eastern boundary of the proposal site. Further information is provided in section 7.2.
Noxious Weeds Act 1993	Under Part 3 Division 1 of the Act, all private landowners, occupiers, public authorities and Councils are required to control noxious weeds on their land.	During site surveys, one noxious weed and two environmental weeds were observed at the site for the proposed substation. Weeds would be managed and disposed of in accordance with the requirements of the Noxious Weeds Act and/or the Weeds of National Significance: Weed Management Guides. Further information is provided in section 7.2.

3.3.2 Australian Government legislation

Environment Protection and Biodiversity and Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protected matters tool was searched on 19 June 2015 for a 1 kilometre radius around the proposal site. The results of the search are summarised in Table 3.2. As no impacts are predicted, an approval under the EPBC Act would not be required.

Table 3.2 EPBC Act protected matters search results

EPBC Act protected matter	Matter located within search radius	Comments	Potential impact
World Heritage Property	None	The proposal would not impact on any World Heritage properties.	None
National Heritage Places	None	The proposal would not impact on any National Heritage properties.	None
Wetlands of international significance (Ramsar sites)	None	The proposal would not impact on any wetlands.	None
Threatened ecological communities	Two	The proposal would not impact on any threatened ecological communities (refer section 7.2).	None
Threatened species	23 species including five birds, two frogs, five mammals, ten plant species and one reptile	The proposal is located within a highly disturbed and developed urban area with limited vegetation (native or otherwise) that would provide habitat for threatened and migratory species (refer sction 7.2).	None
Listed migratory species	13 species including one marine bird, seven terrestrial species, five wetlands species		None
Nuclear actions	None	The proposal does not involve a nuclear action.	None
Commonwealth Marine Areas	None	No Commonwealth marine areas are located within the search radius.	None
Great Barrier Reef Marine Park	None	The Great Barrier Reef Marine Park is outside the search radius.	None
Commonwealth land	One Commonwealth property	The proposal would not directly or indirectly impact on any Commonwealth land.	None
A water resource, in relation to coal seam gas development and large coal mining development	Not relevant	Not relevant.	None

3.4 Summary of approval requirements

As a result of the application of the Infrastructure SEPP the proposal does not require development consent and it is subject to assessment and determination under Part 5 of the EP&A Act. No additional approvals are required.

4. Strategic context, need and options considered

This section provides background information on the strategic and planning context for the proposal, why it is needed, and the options considered.

4.1 Strategic context and need for the proposal

4.1.1 Strategic context

The *NSW Long Term Transport Master Plan* (Transport for NSW, 2012) provides a framework for addressing transport challenges across NSW over the next 20 years. The master plan is designed to guide the prioritisation of available funds to deliver maximum benefits to NSW. The master plan includes 220 short, medium and long-term actions that are focused on transforming the NSW transport system.

One of the actions within the master plan is to 'Expand the Sydney Trains fleet to include modernised double-deck and new single-deck trains'. Within the next 10 years, around 52 per cent of the existing fleet would be replaced, and the size of the fleet would increase by around 28 per cent. This would involve the introduction of new rolling stock, which includes an air conditioned fleet.

The proposal involves the provision of infrastructure required to meet the needs of the expanded Sydney Trains fleet, and is therefore consistent with the master plan.

The *Rebuilding NSW State Infrastructure Strategy* (NSW Government, 2014) has highlighted the importance of sustaining productivity growth in major urban centres and regional communities, as well as supporting population growth toward almost six million people in Sydney and more than nine million people in NSW. The strategy provides the NSW Government's commitments to investing in new infrastructure, including rail infrastructure improvements.

4.1.2 Need for the proposal

To meet the needs of the expanded and air conditioned rail fleet and the operation of the 2018 timetable, an increase in the capacity of the power supply on the Sydney Trains electrical network is required.

A power supply study was undertaken as part of the PSU Program which identified that a new substation was required in the Granville area to:

- provide additional capacity on the North Shore, Northern and Western Line, and the Airport, Inner West and South Line
- allow for the decommissioning and removal of the existing Granville Substation, which has reached the end of its recommended operational life.

4.2 Proposal development process

The power supply study identified that the best way to address the identified needs would be to develop a new substation at a new location in Granville.

GHD was engaged by Transport for NSW to prepare pre-concept designs for the proposal. The pre-concept design process involves an options assessment, service searches, a geotechnical

survey and environmental impact assessment. The potential environmental impacts of the proposal are summarised in this REF.

4.3 Objectives of the proposal

The objectives of the proposal are to:

- establish a new substation at Granville
- provide additional power supply capacity and improved reliability for the operation of the Sydney rail network
- achieve regulatory compliance and meet all Asset Standards Authority (includes RailCorp standards) and Australian Standards.

4.4 Options considered

A summary of the main options considered as part of the development of the proposal is provided below. It is noted that the potential traffic and transport implications of the options have been based on a preliminary review by a traffic engineer. No design measurements or detailed analysis of options has been undertaken.

The 'do nothing' option

The 'do nothing' option involves not undertaking the proposal. Under this option, no new substation would be constructed at Granville. This option is not considered to be acceptable, as it would result in the Sydney Trains electrical network not being able to meet the needs described in section 4. Studies have already shown that the existing power supply network cannot meet the future needs of the Sydney Trains network.

The options considered below mainly relate to the proposed substation and the site for the proposed substation.

4.4.1 Site location options

Location option 1 – Existing substation site

Granville Substation needs to remain operational until the proposal commences operation. The existing substation site does not have sufficient available space to accommodate the proposed substation along with the existing substation. The site contains underground high voltage cables. It is also located next to a concrete batching plant. The maintenance history of the existing substation has demonstrated that airborne concrete dust particles from the batching plant have impacted the life cycle and reliability of substation equipment. These particles can lead to increased equipment maintenance costs and operational failures, reducing system assurance and reliability.

Location option 2 – Sydney Trains Major Works Depot site

The depot site is located on Railway Parade to the west of the proposal site (opposite the intersection between Railway Parade and Smith Street). This site would require excessive cable lengths to supply required power to the rail network, resulting in a requirement for larger cable sizes and additional conduiting. This would increase the amount of construction works required.

Location option 3 – West of Bold Street Bridge

This site is currently used as a construction laydown area for heavy plant and materials for track maintenance and construction works. There is no alternative access to the rail corridor for track maintenance vehicles and equipment. Additional infrastructure constructed in this area would

compromise access for heavy plant to an unacceptable level for operational and maintenance requirements.

Location option 4 – The proposal site

Option 4 is the site for the proposed substation. It was previously used as a Sydney Trains office compound and carpark.

4.4.2 Building finishes/appearance options

Three options were considered for the building finish. The building design, dimensions, louvre openings and panel width would be identical for all options.

Option 1 – vertical emphasis to the main precast concrete wall panels

Option 1 would have a vertical emphasis to the main wall panels (in terracotta colour) to frame a pair of wall louvres at first floor level. A single centre louvre at ground floor level would be set within lighter orange coloured panels to give an inverted T-pattern. The terracotta panels would have a horizontal groove pattern to contrast the narrow vertical proportion.

The louvres would be finished in a dark grey/blue colour along with other external metalwork.

The building wall facing the street would be finished in the same light coloured panels as the ground floor. The first floor level panels would have a much wider horizontal groove than the other three wall panels.

The walls between the transformers and around the perimeter of the transformer yard would be finished in similar grooved terracotta and smooth light coloured precast concrete panels, but with a wider more random spacing than the building facade.

Option 2 – smooth faced precast concrete wall panels

Option 2 would use smooth faced precast concrete panels for the ground and first floor levels so as not to create any pattern effect between the wall and louvre panels. The first floor level would be used to visually separate the two levels, with light beige colour used in the first floor wall panels, and a contrasting grey/green colour used in the ground floor panels. The walls to the ground floor area would use a wider panel and different panel set out than the first floor. This would create a visual break and contrast the narrow vertical appearance of the first floor walls. The louvres and other metal work would be finished in a dark olive green contrasting colour.

The walls between the transformers and around the perimeter of the transformer yard would be finished in a similar pattern of light and dark coloured panels, but in a wider more random spacing than the building facade.

Option 3 – precast concrete wall panels with a brick pattern facing

Option 3 would use precast concrete wall panels with a brick facing tile in the same panel set out as option 2. The precast panels would use an unglazed tile to match the colour of the bricks at the existing Signals Box, located to the north of the site for the proposed substation. A darker brown coloured unglazed tile would be used as a plinth at the ground floor level and as a soldier course string line across the heads of the ground and first floor louvres. This would reflect the recessed string lines above and below the windows at the Signals Box. The uniform brick wall colour and the strong horizontal string lines would reduce the potential visual impacts of the vertical precast wall panels.

The precast concrete walls between the transformers would be constructed using standard grey concrete colour precast panels. The walls around the perimeter of the transformer yard compound would be finished in a combination of the orange coloured tiles and smooth standard

grey concrete panels in a regular pattern. This would contrast with the darker brick used as a plinth and as a soldier course string line.

4.4.3 Permanent site access options

Option 1 – Access the site through an adjoining site owned by Transport for NSW

This option would involve establishing an access to the site via one of the adjoining sites to the east or west, and using one of the existing driveways to these sites. Provision of this access would result in:

- the need to address site security and all hours access arrangements of both the adjoining site (in accordance with the occupier's operational requirements) and the site for the proposed substation (that is, the requirements of the Office of National Rail Safety Regulator (ONRSR), the Electricity Supply (Safety and Network Management) Regulation 2002, and Sydney Trains Operational requirements)
- potential for loss of on-site parking spaces from the site through which access is gained associated with the provision of an internal driveway to the site for the proposed substation, with the resultant potential increase in the use of on-street parking spaces by employees
- potential for unsafe site arrangements and vehicle circulation within the site through which access is gained.

Option 2 – Access the site through a new access and driveway directly from Railway Parade

This option would involve establishing a new direct access to the site from Railway Parade. The new access would need to be located at the eastern end of the site, and would require a new concrete driveway and kerb crossover. Provision of this access would result in:

- permanent loss of two on-street parking spaces for the new driveway, assuming that an eight metre wide driveway would be required (based on the requirements of Roads and Maritime Services' *Guide to Traffic Generating Developments* (RTA, 2002)).
- any semi-trailer movements via this driveway would need to be under authorised traffic control as per Roads and Maritime Service's, *Traffic Control at Work Sites* manual (RTA, 2010)
- removal of three planted trees from a formed garden bed in the road verge.

4.4.4 Temporary construction site access options

Option 1 – Provide a single construction access to the site

This option would involve using the proposed new access at the eastern end of the site (option 2 above) during both construction and operation. The potential implications of this option are as noted in section 4.4.3. In addition, to control parking and allow safe entry to the site, a temporary 'no stopping zone' would need to be established on either side of the driveway, in accordance with the requirements of Parramatta City Council. The length of the no stopping zone would need to be confirmed by the construction contractor based on local sight distances and heavy vehicle moving paths. The temporary no stopping zone would result in the temporary loss of on-street parking spaces from the northern side of Railway Parade. The actual number of parking spaces lost would depend on the length of the zone, with an estimated loss of around two spaces assumed for the purpose of the REF.

Option 2 – Provide two construction accesses to the site

This option would involve using the proposed new access at the eastern end of the site for both construction and operation. It would also involve providing an additional temporary access to the western end of the site off Railway Parade, for at least some of the construction period. Provision of two accesses to the site would result in:

- temporary loss of up to an additional two on-street parking spaces (from a western temporary construction access) in addition to the two lost for the eastern access, assuming that an eight metre wide driveway would be required (based on the requirements of Roads and Maritime Services' *Guide to Traffic Generating Developments* (RTA, 2002)
- the loss of parking associated with the western driveway would be influenced by the fact that this temporary driveway would be located directly opposite to a T junction with The Avenue – the actual number of on-street parking spaces impacted would depend on the sight lines and the proposed width of the driveway, and would need to be confirmed during detailed design
- implementation of a temporary no stopping zone to control parking on either side of the driveways and associated loss of parking
- provision of an additional temporary road access in close proximity to the existing access to the adjoining site (to the west of the site)
- potential for removal of additional vegetation (one tree would need to be removed) and the need to protect the fig tree located in the road verge outside the western end of the site.

4.5 Preferred options

4.5.1 Location

Location option 4 was chosen as the preferred location for the proposal as it would:

- enable development of a substation with a rectangular footprint typical of usual traction substations
- allow direct access from the road network
- allow the existing substation to remain in service whilst construction works are undertaken
- provide sufficient cable routing and jointing options.

4.5.2 Building appearance/finishes

Option 3 was chosen as the preferred appearances/finishes option for the following reasons:

- the brick façade provides the opportunity to visually link the new substation to the brick Signals Box
- there are no other precast concrete wall buildings in the vicinity of the site
- the brick material is more consistent with the brick and weatherboard houses located along Railway Parade.
- it better reflects some of the architectural detailing of the Signals Box
- it provides different width wall panels at ground and first floor levels rather than the same narrow width panels at both levels

- the two end walls could be squared off as a parapet to reflect the parapet at the Signals Box.

4.5.3 Permanent operation access to the site

Access option 2 (a new access and driveway directly from Railway Parade) is the preferred option for the following reasons:

- The site for the proposed substation is a standalone site which requires high levels of security, including secure site access. This is better controlled by the site having its own access from the road network rather than via an adjoining site used for other purposes.
- The access to the site must always be kept free of any obstructions which could eventuate if the site was accessed from an adjoining site. Due to the importance of proposed substation (a junction substation) to the operation of the rail network, emergency and maintenance services must have unimpeded access at all times.
- Some equipment is large and very heavy, requiring delivery by a low loader articulated vehicle. The site layout has been designed to enable delivery vehicles to enter the site directly from the street. Entering the site through adjoining sites would involve difficult, if not impossible, turning movements/requirements.

4.5.4 Temporary construction access

Access option 1 (single construction access to the site) is the option that has been assessed by this REF. This option would minimise the number of site accesses required; the loss of additional vegetation; and impacts on on-street parking compared to option 2. However, this option would require semi-trailer movements to/from the site to be under authorised traffic control as per Roads and Maritime Service's, *Traffic Control at Work Sites* manual (RTA, 2010).

5. Description of the proposal

This section provides a description of the proposal, based on the design work undertaken to date. This includes an overview of the key components and design features of the substation, and a description of how it would be constructed and operated.

5.1 The proposed substation

5.1.1 Substation building and equipment

The proposal would comprise a substation building with external, bunded high voltage (HV) enclosures at ground level to house the electrical equipment and associated facilities.

The maximum external height of the building would vary between about five to eight metres above the footpath level. The total size of the substation building would be about 29 metres long by 12 metres wide. The substation building would have a ground floor area of about 380 square metres.

The cable chamber would be used to reticulate cables within the substation, with in-ground cable pits and buried conduits used to house cables connecting the substation to the existing rail network.

The building would have an internal clear height at ground floor level of 2.75 metres to the underside of the floor structure. The height of the internal switchroom would vary between 3.5 and 4.2 metres across the width of the building. Electrical equipment at switch room level would be accessed by a roller shutter door at the first floor level dock, and at ground floor level via a combined main access and service door on the southern side of the building below the dock.

An external yard on the southern side of the substation building would accommodate a power transformer, two rectifier transformers and a reactor. These transformers would be located in individual bunded enclosures separated by 4.2 metres fire walls. The overall size of the external transformer and reactor yard would be six by 25 metres.

The southernmost side of the substation site would consist of two harmonic filter compounds with size of about seven by 30 metres.

The external yards would be enclosed with precast walls that would be 4.2 metres in height.

The substation would contain the following facilities and equipment:

- one 5/6.25 MW 33/11 kV transformer
- two 5.35 MW 33 kV/600 V rectifier transformers
- two 5 MW 1500 V DC rectifiers
- one 0.5 mH 4000 amp reactor
- three 33 kV AC switchboards
- two 11 kV AC switchboards
- one 11 kV harmonic filter and one 33 kV harmonic filter
- 1500 V DC circuit breakers
- battery cabinet and charger
- distribution boards
- changeover panel
- administration office

- staff toilet
- other ancillary equipment.

The external bunded yards containing the transformers and reactor would be connected to a common oil-water separator system, via flame trap pits within each bund. The yards would be designed to ensure that any oil spills are contained on-site within the bund and/or the oil separator pit.

The bunded yards would incorporate parallel footing beam plinths extending to the southern wall, and fibreglass reinforced plastic grating installed flush with the top of the bund to provide an all-weather maintenance platform.

Figure 5.1 and Figure 5.2 show the key features of the proposal.

5.1.2 Building design and form

The ground floor cable chamber would be constructed on a concrete slab supported on bored piers. External cabling would connect to the proposed substation through underground conduits. A concrete framed structure would be constructed off the ground floor slab to support the first floor slab.

The walls of the cable chamber and switch room would consist of precast concrete panels. The panels would incorporate a profiled texture finish from first floor level and smooth finish to the ground floor panels, which would be treated with a clear anti-graffiti coating. The first floor would comprise a steel framed column and beam structure to support the wall panels and the roof. The steelwork would be exposed internally within the switch room, with the possible exception of a suspended plasterboard ceiling over the DCCB cubicles if a lower ceiling height is required. The roof would be finished with steel purlins and foil backed insulation beneath a metal deck roof.

External bunded areas would be set into the ground and include precast concrete separation walls between adjoining transformer bays as well as the perimeter of the external equipment compound. A security mesh sliding gate would be used to secure the area. The bund yards would be separated from the switch room building by two hour fire rated precast concrete wall.

The harmonic equipment bays on the street side would be set back three metres from the boundary line. Apart from the air conditioned office space, the substation will be naturally ventilated, with low level storm proof intake louvres on the eastern and western side and high level relief louvres on the southern side.

The building facade facing the street will have no wall openings. Since the street side of the substation will also house the outdoor transformer equipment, the perimeter walls of the transformer yard will also be precast concrete to 4.5 m high set behind a three metre high security fence and gates. Precast concrete wall panels with a brick pattern facing would be used.

The design of the proposed substation would continue to be refined during future design phases. The final design of the substation would integrate all relevant considerations, including:

- urban design and visual assessment
- environment and sustainability
- functional and operational needs and requirements
- access and maintenance
- security.

Figure 5.1 The proposal

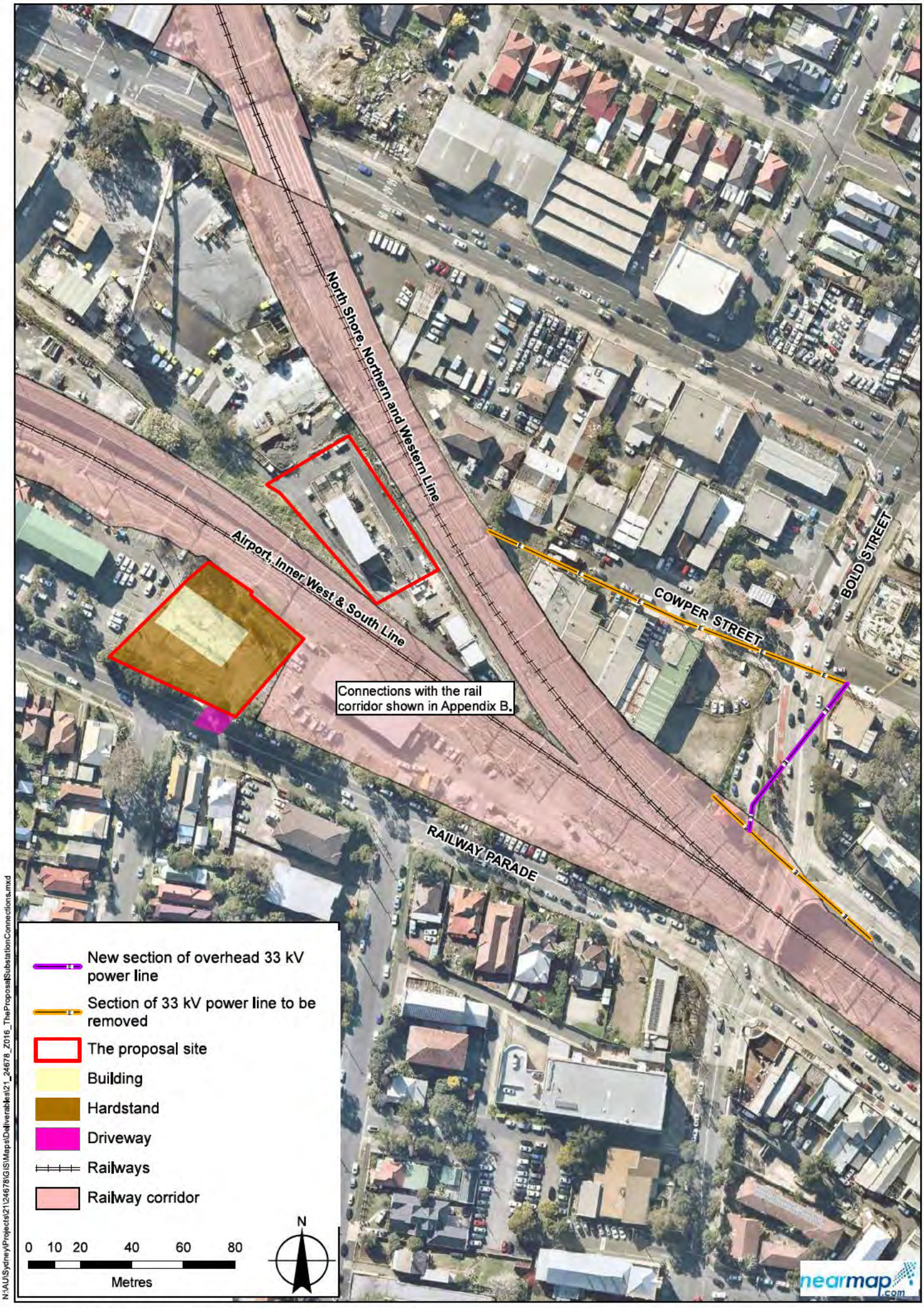

Figure 5.2 The proposal – electrical connections

5.1.3 Security fencing and lighting

A new three metre high security fence would be provided around the site boundary on all four sides of the site. The street entrance would be secured by three metre high vehicle gates to match the security fencing, and would include a separate personnel gate. The fence and gates would be finished in low gloss black powdercoat. Photo 5.1 shows similar fencing used for another substation.

The substation building would have wall mounted security lighting above each door opening for night-time illumination. The external transformer yards would have manually switched lights (integrated with staff access system) for night maintenance.

Photo 5.1 Example of fencing

5.1.4 Operational access and car parking

The security requirements for traction substations mean that a new secure vehicular access to the site for the proposed substation would be required off Railway Parade. The access would need to be of sufficient width to allow access by a semitrailer and crane. It would not be possible to access the site from adjoining sites. Vehicular access to the substation site would be via a new six metres wide concrete driveway off Railway Parade (as shown in Figure 5.1). The new driveway and kerb access would be designed in accordance with the requirements of the ASA standard for access roads (Transport for NSW, 2014), and in consultation with Parramatta City Council.

The site would also provide parking for up to three utility sized service vehicles.

5.1.5 Chemical storage

It is likely that the following approximate quantities of oil would be used within the oil-cooled transformers on-site, which would be located within appropriately secure and bunded areas attached to the substation building:

- 5,200 litres of oil in the 33/11 kV transformer
- 3,200 litres of oil in the reactor
- 5,500 litres of oil in the rectifier transformers.

The bunded areas would be designed and constructed in accordance with relevant Australian Standards. Each transformer would be positioned within its own bunded yard, which would be connected via complying sump and flame-trap arrangements to the common oil-water separator located at the eastern side of the substation. In accordance with the EPA's guidelines, *Bunding and Spill Management* (EPA, 2015) the overall collection system would, as a minimum be capable of storing/processing at least 100 per cent of the total capacity of the largest vessel within the system, with an additional allowance for rainwater (if the bund area is uncovered) allowing for sufficient capacity to cope with a one-in-twenty year 24 hour storm.

The oil-water separator would collect all run off from the outdoor yards. The oil and water separator would separate the oil from the water. The water would be discharged to the stormwater while the oil would be removed from site for disposal at an appropriately licensed facility.

5.1.6 Connection to existing overhead wiring system and services

Connection to existing feeders

Feeders originating from the existing substation would be diverted to the proposed substation by means of underground cable jointing within the rail corridor.

Connection to overhead wiring system

Connection to the existing 33 kV overhead wiring system would also be required. This would involve changes to two 33 kV overhead feeders (refer to Figure 5.2).

Feeder 718 is an overhead line which runs to the western end of Cowper Street. At the end of Cowper Street the line then goes underground at pole number 101. The proposal would involve removing the line from pole 99, located at the corner of Cowper Street and Bold Street. A new overhead line would be constructed from pole 99 across Bold Street to a new pole to be located within the rail corridor in the vicinity of the existing signals hut.

Feeder 722 is an overhead line which runs along Bridge Street and west over Bold Street to the rail corridor. At pole 145T, towards the western end of Bridge Street, the line would be relocated underground and then continue west in the rail corridor in an above-ground steel trough.

5.1.7 Service connections and relocation

Service connections

The proposal would involve new connections to Sydney Water's wastewater and potable water networks. A wastewater service runs parallel to Railway Parade along the southern side of the road, about 15 metres south of the proposal site. An existing potable water service is located to the immediate south of the proposed access gate, about 12 metres south of the proposal site.

The proposal would involve constructing underground pipeline connections to these existing services. Both pipelines would be about 100 millimetres in diameter and constructed of polyvinyl chloride (PVC). The proposed alignments of the pipelines are shown in Figure 5.1.

The proposal would also involve diversion of an existing stormwater pipeline located across the site for the proposed substation. A new stormwater pipeline would be constructed within the site, to the east of the substation footprint.

Service relocations

In the event that assessments during detailed design identify the need for any relocations, they would be undertaken by an accredited contractor in consultation with the utility provider.

Existing communication and signalling cabling connected to the existing substation would be diverted to the proposed substation. This existing cabling is within the rail corridor. The relocated service routes would be confirmed during the detailed design phase in consultation with Sydney Trains.

5.2 Decommissioning of the existing Granville Substation

Following commissioning of the new Granville Junction Substation the existing Granville Substation would be decommissioned. This would involve:

- removal of all redundant electrical equipment both within and external to the substation building
- removal of high voltage cables and cable trays
- other services (including the light and power conduits) would be capped off and retained
- remediation (if required) of any disturbed areas where hazardous materials are potentially present inside or outside the substation building
- any essential repairs and modifications to prevent deterioration and to secure the site and the building from vandalism.

Removal of the existing Granville Substation building would involve:

- removal of building and all structures to slab level
- classification and disposal of waste materials as described in section 7.10
- remediation (if required) of any disturbed areas where hazardous materials are potentially present inside or outside the substation building
- any essential repairs to prevent deterioration and to secure the site.

5.3 Construction information

5.3.1 Indicative construction activities

Construction would involve the following indicative works:

- order off-site prefabricated items as required
- site establishment
  - services protection works
  - establishing the construction compound (refer section 5.3.4)
  - installing safety fencing around the construction site
  - installing erosion control measures
  - establishing site access
  - vegetation removal and/or trimming, as required
- enabling works including installing conduits (in trenches) to rail corridor for connections from the substation to the existing feeders
- site excavation and benching
- trenching of water and wastewater mains from the site to the connection points - trenches would be about 600 mm wide, with the depths varying depending on local ground conditions or other site requirements
- piling works and site excavation for in-ground services (make use of existing for new connections as applicable):

  - use of piling rigs to construct the piles for the ground slab
  - excavate building and bund yard areas for construction of in-ground pits and conduits
  - excavate for oil/water separator tank and related services
  - excavate for toilet hydraulic services.
- construct cable ground floor cable chamber slab followed by loadbearing precast wall panels and internal columns in concrete blockwork
- substation construction – involves construction of the suspended first floor slab with openings for equipment cables, erection of wall/roof steelwork and purlins, delivery and installation of precast wall panels, installation of the metal deck roof sheeting. This would be followed by the wall ventilation louvres, doors and internal finishes and fitout.
- electrical works and fit out, including connection to the electrical network - connection to the overhead wiring structures would require some trenching activities, the size and location of trenches would be confirmed during detailed design
- paving works and driveway construction followed by installation of security fencing and gates
- equipment commissioning in new substation
- decommissioning of equipment in existing substation and removal of material from site
- removal of the existing substation and associated waste materials from site
- restoration of disturbed areas and landscaping as required
- site clean-up.

Excavation across the site would generate about 650 cubic metres of spoil, all of which would need to be removed from the site.

5.3.2 Construction workforce

Construction of the proposal would involve a maximum workforce of up to about 30 people on the site for the proposed substation at any one time.

Decommissioning/removal of the existing substation would involve a workforce of about five people for the period of works (about a week).

5.3.3 Equipment

Plant and equipment used to construct the proposal may include (but not be limited to):

- water cart
- concrete saws
- backhoes
- hand tools
- jack hammers
- light commercial and passenger vehicles
- mobile crane
- tip trucks
- concrete agitator trucks
- concrete pumps
- air compressor
- generators
- road sweepers
- large delivery trucks
- low loader
- piling rig.

5.3.4 Construction compound/s, access and vehicle movements

Construction compound

The construction compound would be located within the existing Lidcombe to Granville Corridor Upgrade Project site to the west of proposal site, shown in Figure 5.1.

Fencing

The construction site and compound would be securely fenced with temporary fencing. Signage would be erected advising the general public of access restrictions.

Construction access and parking

The proposed new site access off Railway Parade (refer to section 5.1.4) would be provided prior to construction commencing. Site access would be controlled by a locked gate.

During the daily pre-work briefs, construction workers would be encouraged to travel to the compound and proposal site via public transport, and not park in surrounding roads.

Parking for about 17 work vehicles would be provided within the construction compound.

Construction traffic and access would be managed in accordance with a traffic and access management sub-plan, to be prepared by the construction contractor as part of the construction environmental management plan (CEMP) for the proposal (refer to 7.5.4).

Vehicle movements

It is estimated that construction vehicle movements to the site for the proposed substation would involve a daily maximum of about 28 heavy vehicle movements and up to about 30 light vehicle movements. A breakdown of the traffic movements is provided in Table 5.1.

Table 5.1 Estimate of construction vehicle movements

Vehicle type	Activity	Daily vehicle numbers	Movements per day
Construction of the proposed substation			
Heavy vehicles	Concrete pours	8	16
	Delivery of precast components	4-6	8-12
Light vehicles	Construction personnel vehicles – assuming that about half of the staff would travel to site using public transport	15	30
Decommissioning/removal of the existing substation			
Heavy vehicles	Transport of waste materials from the site	2	4
Light vehicles	Construction personnel vehicles – assuming that about half of the staff would travel to site using public transport	3	6

It is anticipated that the majority of traffic movements associated with the proposal would be undertaken during standard construction hours (refer to section 5.3.5 below). However, there may be a need for limited vehicle movements outside of standard construction hours for the delivery of:

- material/equipment for railway possessions during allocated times
- oversized equipment (such as transformers) required to be transported during hours/times as specified by RMS/NSW Police.

These deliveries would be in accordance with the requirements of relevant authorities. Further information on is provided in section 7.5.

5.3.5 Construction timing, staging and work hours

Construction timing

Construction of the proposed substation is scheduled to commence in mid to late 2016 and continue for about 12 months. Civil works would be undertaken over the first nine months, with electrical and services fit-out undertaken over the following three months. Commissioning would then take about six months.

Decommissioning/removal of the existing substation would be undertaken following commissioning of the proposed substation. This would take about one to two weeks.

Work hours

Construction would occur during the standard hours set out in the *Interim Construction Noise Guideline* (DECC, 2009):

- Mondays to Fridays between 7 am and 6 pm
- Saturdays between 8 am and 1 pm

Out of hours works (including work on Sundays) would be limited mainly to scheduled rail closure times (known as 'track possessions', which are times that a rail line is shut down to allow for planned maintenance, construction works etc). However, some out of hours works would be required outside of these periods. Works that may need to be undertaken during these periods include (but are not limited to) the connection to the overhead wiring system, installation of certain electrical equipment, installation of underline crossings and delivery and/or removal of oversized equipment.

If out of hours work is required, the contractor would obtain approval from Transport for NSW as outlined in section 7.3.5. All of out of hours work would be undertaken in accordance with the *Construction Noise Strategy* (Transport for NSW, 2012).

Works during track possession periods

The proposal involves some works during track possession periods, including connection works and the decommissioning of the existing Granville Substation. A number of predetermined possession periods would be available. In the event that additional special possessions are required, these would be arranged in consultation with Sydney Trains. Controlled power outages, which may need to occur out of hours, would also be required during construction.

5.4 Operation of the proposal

The main function of the substation would be to convert the incoming 33 kV power supply to 1500 V which can be used by rolling stock on the Sydney Trains network. The substation would operate 24 hours a day to ensure that power supply is provided to the network at all times.

Generally, no permanent staff members would be located on-site. However, maintenance requirements and equipment service intervals may result in extended periods of staff being on site.

Maintenance activities would involve infrequent site visits. These visits would generally consist of one utility vehicle accessing the site. In emergency situations additional vehicles may need to access the site.

Oversized vehicles may occasionally need to access the site to maintain and/or replace the transformers. If this is required, these vehicles would enter the site from Railway Parade via the new access gate.

5.5 Sustainability

A sustainability assessment of the proposal was undertaken as part of the design process in accordance with the *Transport for NSW Sustainability Design Guidelines version 3.0* (Transport for NSW, 2013). Under the guidelines, the proposal is considered to be a 'maintenance facility'.

A number of themes were considered in the assessment including:

- energy and greenhouse
- climate resilience
- materials and waste
- biodiversity and heritage
- water
- pollution control
- community benefit.

The assessment identified discretionary and compulsory initiatives that could be incorporated into the proposal.

Compulsory initiatives may relate to a corporate target or are considered to be fundamental to the delivery of sustainable assets. If an initiative is considered applicable, then it must be completed.

A discretionary initiative may not be practical for a particular project or be the most appropriate initiative to meet a sustainability outcome. Written justification must be provided if a discretionary initiative has not been selected for implementation.

The assessment identified 16 compulsory initiatives and 69 discretionary initiatives that relate to the reference design.

The current rating of the proposal (in accordance with the guidelines and at this reference design phase) is a 'platinum' sustainability in design rating. This means that 97 per cent of applicable discretionary points have been achieved by the design. To maintain this rating, the design would continue to be refined during the detailed design phase.

An assessment of the proposal against the guidelines will also be undertaken during the detailed design phase.

6. Community and stakeholder consultation

This section summarises the community and stakeholder consultation undertaken as an input to development of the proposal and the REF.

6.1 Consultation for the Power Supply Upgrade Program

The approach to consultation for projects being undertaken as part of the PSU Program is guided by *Transport for NSW's Community Engagement Policy* (April, 2012), which notes the agency's commitment to:

- identify and, where possible, respond to the needs of the community
- provide opportunities to encourage community feedback
- keep the community regularly informed of the progress of our projects
- provide easily accessible information
- encourage a sense of community ownership of the projects we deliver
- be transparent in all that we do
- maximise community understanding of our role and the rationale for the projects we deliver.

6.2 Consultation for the proposal

6.2.1 Consultation plan

A consultation plan for the proposal (the *Granville Junction REF Community Engagement Plan*) has been developed by GHD in consultation with Transport for NSW. The purpose of this plan is to describe the management and communication processes that will be employed to provide information and seek community feedback on the design and assessment of the proposal.

6.2.2 Consultation objectives

The plan states that the overall objective of consultation is to ensure that key stakeholders and the community are aware of the proposal and are given the opportunity to express their views. The plan identifies the following objectives for consultation:

- identify the impact of the proposal on internal and external stakeholder, customers, residents and the community
- provide a proactive approach to managing issues regarding communication and information flow
- reassure internal and external stakeholders that Transport for NSW is meeting its expectations regarding professional management practice in the delivery of its capital and maintenance works programs
- enhance Transport for NSW's working relationship with its customers, residents and the community when undertaking essential capital or maintenance works.

6.2.3 Consultation and communication activities

As outlined in section 3.2.1 formal statutory consultation under the Infrastructure SEPP is not required. However, to achieve the objectives of the consultation plan, the following consultation activities will be undertaken:

- letters to stakeholders
- briefings with key stakeholders
- distribution of a community information flyer
- targeted consultation of the REF for two weeks.

The following key stakeholders have been identified:

- Parramatta and Holroyd council representatives
- residents and businesses located within the vicinity of the proposal site
- Sydney Trains
- Transport for NSW staff
- utility providers who service the site.

An initial meeting was held with representatives of Parramatta City Council on 20 July 2015. The purpose of the meeting was to provide information and obtain feedback on the proposal. Key issues raised during the meeting are summarised in Table 6.1.

Table 6.1 Issues raised by Parramatta City Council

Issue category	Issues raised	Where addressed in REF
Traffic, transport and access	Need for a new street access to the site when Sydney Trains owns the adjoining sites.	Section 5.1.4
	Nature of the proposed access to the site and traffic management associated with access	Sections 5.1.4, 5.3.4 and 7.5
	Impacts on the bus stop outside the site	Sections 4.4.3 and 7.5
	Parking for construction workers and vehicles	Section 5.3.4
	Impacts on on-street parking	Section 7.5
	Impacts on the operation of the bus stop outside the site	Section 7.5
Biodiversity	Impacts on the street trees located outside the site	Section 7.2
Planning	Impacts on land between the rail corridor and Parramatta Road proposed for redevelopment as part of the Parramatta Road urban renewal strategy	Section 7.6
Noise	Noise impacts during construction and operation	Section 7.3

6.3 Targeted consultation

Targeted consultation of the REF will be carried out for a period of two weeks, during which time written submissions will be accepted. The REF will be placed on display at Granville Library.

The REF would also be available via the Transport for NSW website at: www.transport.nsw.gov.au/projects.

Surrounding landowners and occupants would be contacted at the beginning of the consultation period. This would notify residents of the consultation period and how to access the REF.

Throughout the consultation period the following contact mechanisms would be available to the community:

- Transport for NSW's Project Infoline (1800 684 490)
- Transport for NSW's project email address (projects@transport.nsw.gov.au)
- Transport for NSW's project webpage (www.transport.nsw.gov.au/projects).

6.4 Future consultation activities

Following targeted consultation of the REF, Transport for NSW will consider the issues in the submissions and prepare a report to:

- summarise and respond to the issues raised
- provide any new information concerning the proposal
- identify any changes to the proposal and the potential impacts of those changes.

Anyone who makes a submission (and provides their contact details) would be notified when the proposal's determination report is available for viewing on the Transport for NSW website.

Should Transport for NSW proceed with the proposal, consultation with the community and key stakeholders would be ongoing in the lead up to, and during, construction of the proposal.

Transport for NSW's Project Infoline and email address would continue to be available. Targeted consultation methods, such as letters, notifications, signage and verbal communications, would occur as required. Transport for NSW's 24 hour construction information line 1800 775 465 number would also be available for any complaints or enquiries during construction.

6.4.1 Management of complaints

Complaints would be managed in accordance with Transport for NSW's Complaint Management Process (as outlined on http://www.transport.nsw.gov.au/projects/community/Complaints-handling). Specifically:

- Details of all complaints received will be recorded.
- A verbal response describing what action will be taken will be provided to the complainant within two hours (unless the complainant agrees otherwise).
- A detailed written response will be provided to the complainant within seven calendar days.

7. Environmental impact assessment

This section summarises the environmental impact assessment undertaken for the proposal and includes summaries of the specialist studies undertaken.

7.1 Soils and water quality

7.1.1 Existing environment

Topography, geology and soils

The site is relatively flat and is located at an elevation of about 10 metres Australian height datum (AHD).The *Soil Conservation Service of NSW 1:100,000 Soil Landscape Series Sheet 9130, Sydney*, indicates that the site is classified as Blacktown soil landscape. Soils are shallow to moderately deep (less than 100 centimetres) hardsetting mottled texture contrast soils, red and brown podzolic soils on crests grading to yellow podzolic soils on lower slopes, and in drainage lines. The *Geoscience Australia 1:100,000 Geological Series Sheet 9130, Sydney* classifies the site as Ashfield Shale and is described as follows: Black to dark-grey shale and laminate, Triassic age.

Parsons Brinckerhoff (PB) completed soil sampling and analysis in October 2006 (PB, 2006) at nine test pit locations across an area which included the eastern half of the site for the proposed substation. The results indicated that the area of the site that was sampled was found to be covered in ballast fill up to 0.5 metres depth. This consisted of brick fragments, small boulders and ash. The underlying geology was found to consist of clay/gravelly clay.

Contamination issues

A search of the EPA's Contaminated Land Record was undertaken on 30 June 2015 for the study area surrounding the proposal site. No contaminated sites were identified in the immediate vicinity of the proposal site. The nearest recorded contaminated site is on Parramatta Road, about 120 metres to the east of the site for the proposed substation.

No odours or staining were noted in PB's soil samples. Surface samples contained a concentration of total petroleum hydrocarbons (TPH) C_{10}-C_{36} slightly exceeding the adopted site investigation criteria. Three near surface samples contained concentrations of benzo(a)pyrene which exceeded the criteria. The ash in the fill material was noted as being the likely source of the benzo(a)pyrene exceedances.

A geotechnical and contamination site investigation was completed by GHD in July and August 2015. Borehole drilling for the site investigation was carried out between 27 and 29 July 2015.

Fill materials were encountered in all boreholes, which were typically described as gravelly clay. The fill was identified as ballast, road base or ash, mixed with clay and sand, likely to be associated with previous site uses for rail purposes. The depth of fill materials ranged from 0.5 to 1.5 metres below the ground surface.

The findings of the contamination investigation can be summarised as follows:

- Only one sample, taken from within the rail corridor, had evidence of hydrocarbon contamination. The analytical results of this sample did not indicate any exceedance of the adopted site investigation levels.
- No exceedances of heavy metals screening criteria were identified.

- Three material fragments (FRAG_01, FRAG_02 and FRAG_03) collected from building rubble on the ground surface tested positive for the presence of asbestos including chrysotile and amosite forms of asbestos.
- Surface soils collected from a depth of zero to 0.1 metres at sampling location GHD05 (including duplicate sample collected from the same location) tested positive for the presence of chrysotile asbestos in loose fibre bundle form. No respirable fibres were reported. However, given the potential for fibre release, appropriate health and safety precautions would be implemented during construction.
- Given the presence of asbestos in surface soils at sampling location GHD05, material to be excavated and disposed off-site from the vicinity of this location would be classified as 'special waste asbestos', and disposed of at an appropriate facility suitably licenced to accept such waste. Material from the vicinity of GHD05 would be excavated and stockpiled separately to avoid mixing of potentially different waste streams. The waste classification would be confirmed prior to disposal.
- For the purpose of preliminary in-situ waste classification, the laboratory analytical data collected indicates that, with the exception of soils in the vicinity of sampling location GHD05, it is likely that excavated soil materials would be classified as General Solid Waste. Waste classification of excavated material would be confirmed prior to disposal.

Further information on waste and hazardous materials (including asbestos) is provided in section 7.10.

Drainage and watercourses

The nearest waterway to the site for the proposed substation is A'Becketts Creek, which is located about 280 metres north of the site. A'Becketts Creek drains to Duck Creek about 1.2 kilometres to the east of the site, and then Duck River about two kilometres to the east.

Surface water drains to Council's stormwater network.

Groundwater

A search of the NSW Water Information Database indicated that the nearest groundwater bore is located about 115 metres to the east of the site for the proposed substation.

GHD's geotechnical and contamination investigation for the proposal included the installation of a groundwater well. On 5 August 2015 the groundwater level was observed to be 3.1 metres below ground level.

A water quality sample was taken from one borehole during the investigation. The analytical results indicated that concentrations of cadmium, nickel and zinc exceeded the adopted guidelines for protection of freshwater aquatic ecosystems. Concentrations of copper also exceeded the adopted guidelines. These elevated heavy metals are likely to be representative of background conditions in the area.

No exceedance of adopted health screening levels were noted. The majority of organic analytes were less than the laboratory practicable quantification limits (PQL), with the exception of total recoverable hydrocarbon (TRH) C_6-C_{10}. It is noted that the laboratory PQLs for naphthalene, several organochlorine pesticides (OCPs), and polychlorinated biphenyls (PCBs) were higher than the adopted guidelines for protection freshwater aquatic ecosystems. As no soil sample results exceeding the adopted guidelines were reported for these chemicals, the site for the proposed substation is not considered to be the source of this contamination.

Water quality

Surface water quality sampling from A'Becketts Creek was undertaken in March 2014 as part of the WestConnex M4 widening project. The physical parameters tested indicated aerobic water conditions (with dissolved oxygen concentrations ranging from 1.24 to 8.27 mg/L) within a freshwater environment containing varying pH levels from neutral to slightly alkaline (pH range of 6.77 to 9.1) (SMEC, 2014).

Visual observations made during the water quality sampling concluded that there were no obvious visual or olfactory evidence of potential contamination (SEMC, 2014).

Given the highly developed nature of the surrounding environment (including industrial, road, rail and residential land uses) it is likely that the quality of surface water runoff in the vicinity of the proposal site would be impacted/influenced by the existing land uses, particularly during periods of high rainfall.

7.1.2 Impact assessment

Construction

Construction of the proposal would involve disturbance to the ground surface to construct the slab, access driveway, undertrack crossings and underground services at the existing substation site. Small stockpiles of excavated soil would be created during construction.

Trenchless underboring of the undertrack services crossings would require the formation of enlarged temporary excavations positioned at the extents of the undertrack crossings to accommodate boring plant and equipment, casing and pipe lengths, excavated spoil removal and sump pumping equipment.

In accordance with the NSW Sustainable Design Guidelines (Transport for NSW, 2013), opportunities would be investigated to reuse 90 per cent of excavated, non-contaminated, spoil. The spoil would be reused on-site where possible to either backfill excavations or during site levelling works. Excess spoil (up to about 1,200 cubic metres) not suitable for backfilling would be stockpiled in a suitable location prior to being tested, classified, and disposed of at an appropriately licensed facility.

Soil disturbance

Excavation, demolition and stockpiling activities, if not adequately managed, could have the following impacts:

- erosion of exposed soil and stockpiled materials
- dust generation from excavation and vehicle movements over exposed soil
- an increase in sediment loads entering the stormwater system and/or local runoff.

These impacts are considered to be minimal, as exposure of soil and the stockpiling of spoil would be temporary and short-term in duration.

Contaminated soils

The proposal has the potential to result in soil and water contamination via any accidental fuel or chemical spills from plant and equipment. The installation and commissioning of electrical equipment (for example, the transformers) would involve injecting oils and other chemicals on-site. The potential for impacts as a result of any spills or leaks would be managed by the implementation of measures provided in section 7.1.3.

Given the preliminary waste classification data (i.e. special waste asbestos), contaminated materials may be encountered during construction. To ensure the safety of the community and construction personnel, appropriate measures would be implemented to manage, remediate

and dispose of contaminated materials. Measures to manage contaminated materials are provided in section 7.1.3. Measures to manage waste and hazardous materials are provided in section 7.10.3.

Groundwater

The proposed footings for the substation would consist of either pile footings on bedrock (to a depth of about five metres below ground level) or a stiffened raft slab (embedded within the top 1.5 metres of fill material). Either way, there is the potential for ground excavation to intercept groundwater. Contamination of groundwater may also occur through the seepage from material and waste stockpiles, or spills of fuels, oils or other chemicals.

Any impacts to groundwater during construction would be temporary and are unlikely to be significant as a result of the small scale of the works. Mitigation measures would be implemented to minimise groundwater inflow into excavations. Excavations would be backfilled progressively to limit groundwater inflow.

Provided the mitigation measures in section 7.1.3 are implemented, impacts to groundwater are not considered to be significant.

Operation

The proposal would not result in any impacts to soils or water quality. As noted in section 5.1.5, bunding designed in accordance with the applicable standards would be incorporated into the proposal to contain any chemical spills or leaks. The bunded area would contain an oil/water separator to allow the oil to be removed. Water would be discharged to the stormwater network and oil from the pit would be pumped out for offsite disposal at a suitably licensed facility.

The proposal does not increase the area of hardstand at the site for the proposed substation and therefore will not impact the volume of surface water runoff entering the stormwater drainage system.

7.1.3 Mitigation measures

Construction

The measures provided below would be implemented during construction:

General erosion and water management

- A soils and water quality sub-plan would be prepared as part of the CEMP. It would include the following measures:
  - Spoil and groundwater management and disposal requirements based on the findings of the geotechnical and contamination investigation report (GHD, 2015).
  - An erosion and sedimentation control plan (the E&S Control Plan), which would be maintained and updated as required to ensure it is representative of the actual site works at any one time.
  - Sediment and erosion control devices (as per the E&S Control Plan) would be installed to minimise transport of sediment and materials in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004). These devices would be inspected regularly and immediately after rainfall to ensure effectiveness over the duration of works. Any damage to erosion and sediment controls would be rectified immediately.
  - Control measures would be documented in the E&S Control Plan for the management and control of sediment tracking onto the local road network.

  - Maintenance and checking of the erosion and sedimentation controls would be undertaken on a regular basis and any subsequent records retained. Sediment would be cleared from behind barriers/sand bags on a regular basis as required and all controls would be managed to ensure they work effectively at all times.
  - Any soils excavated that are to be used as backfill would be appropriately stored until required.
  - Disturbed areas would be restored at the completion of works.
  - Spill kits would be maintained on-site at all times.
  - Machinery would be checked daily to ensure that no oil, fuel or other liquids are leaking as part of site pre starts.
  - A refuelling procedure for site plant and equipment in accordance with Transport for NSW's *Chemical Storage and Spill Response Guidelines* (2015).
  - All water discharges would be undertaken in accordance with Transport for NSW's *Water Discharge and Re-use Guideline* (2012).
  - The existing drainage systems would remain operational during construction.
  - Clean water would be diverted around the worksite in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).
- If dewatering is required during construction, the water would be tested (and treated if necessary) prior to re-use, discharge or disposal in accordance with Transport for NSW's *Water Discharge and Re-use Guideline* (2012).

Management of contaminated soils

- A Detailed Site Investigation would be undertaken to confirm the nature and extent of contamination within the site for the proposed substation; specific requirements for further investigation and remediation; and/or management requirements of any contamination. Recommendations from the Detailed Site Investigation would be incorporated into a Remediation Action Plan (RAP) if required, to be implemented during construction.
- The Detailed Site Investigation and RAP (if required) would be in accordance with applicable guidelines, including but not limited to:
  - National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013
  - Guidelines for Consultants Reporting on Contaminated Sites (DECCW, 2011)
  - EPA Waste Classification Guidelines (2014)
  - AS4482 Guide to investigation and sampling of site with potentially contaminated soil (2005)
  - NSW EPA Sampling Design Guidelines (1995).
- If required, the RAP would identify measures to be implemented to ensure that the contamination is appropriately managed in accordance with relevant legislation and guidelines listed above.
- Where required, any materials classified as Hazardous Waste would be treated, or an immobilisation approval obtained, in accordance with Part 10 of the Protection of the Environment Operations (Waste) Regulation 2014 prior to off-site disposal.
- An 'unexpected finds protocol' would be prepared and included in the CEMP to assist with the identification, assessment, management, health and safety implications, remediation and/or disposal (at an appropriately licenced facility) of any potentially contaminated soil and/or water.

- In the event that indicators of contamination are encountered during construction (such as odours or visually contaminated materials), work in the area would cease until an appropriately qualified person can advise on the need for further investigation, remediation or other action.
- Additional measures for the management of hazardous materials (including asbestos) are provided in section 7.10.3.

Operation

No mitigation measures are required.

7.2 Flora and fauna

This section summarises the results of the flora, fauna and arborist assessment undertaken by GHD in July 2015. A copy of the full assessment results are provided in Appendix C. The assessment relates to the site for the proposed substation.

7.2.1 Assessment approach and methodology

A desktop assessment, involving review of aerial photographs of the site, regional vegetation mapping (NSW NPWS, 2002) and threatened species databases, was undertaken to assess the likelihood of occurrence of threatened, populations or ecological communities (or their habitats) listed under the TSC or EPBC Acts at, or within, the vicinity of the proposal site.

A site inspection was undertaken on 7 July 2015. The inspection involved:

- identification and description of trees by conducting a ground based visual tree assessment
- inspection for tree-hollows, nests or scratches, scats or tracks or for other evidence of fauna activity
- searches for threatened flora species listed under the TSC and EPBC Acts previously recorded in the locality (within a 10 kilometre radius of the site)

Tree protection zones and tree structural root zones were calculated using relevant tree assessment standards, as listed in Appendix C.

7.2.2 Existing environment

Flora

Vegetation at the proposal site is shown in Photo 7.1 and 7.2 and on Figure 7.1. The vegetation consists of trees and shrubs which have (mostly) been planted within a formed garden bed along the southern fence of the proposal site (located partly on the site and partly in the road verge adjacent to Railway Parade. There are an additional two trees located near the north-western corner of the proposal site that have also been considered as part of this assessment.

The following species recorded at the proposal site are indigenous to the Parramatta LGA (see James, McDougall and Benson, 1999): Swamp Oak (*Casuarina glauca*), Blackwood (Acacia melanoxylon), Port Jackson Fig *(Ficus rubiginosa*), White Cedar (*Melia azedarach*) and Spiny-head Mat-rush *(Lomandra longifolia*). White Cedar is included in the list of exempt tree species under Parramatta Council's tree protection order (Parramatta City Council 1996), meaning that specimens of White Cedar may be removed without Council approval. Non-indigenous native species include Brush Box (*Lophostemon confertus*) and Lemon-scented Gum (*Corymbia citriodora*).

Photo 7.1 View of vegetation at the proposal site, looking north-west towards the rail corridor from Railway Parade

Photo 7.2 View of vegetation at the proposal site, looking north-east towards the rail corridor from Railway Parade

All of the trees recorded during the field inspection are planted or have self-recruited, and all are mostly in good condition. The trees range in height from six to 16 metres. Details for each tree are provided in Appendix C and the locations are shown in Figure 7.1. There are no endangered ecological communities (EECs) or native vegetation communities within or in the vicinity of the site (NSW NPWS, 2002). No threatened plant species were recorded within the proposal site during the site survey.

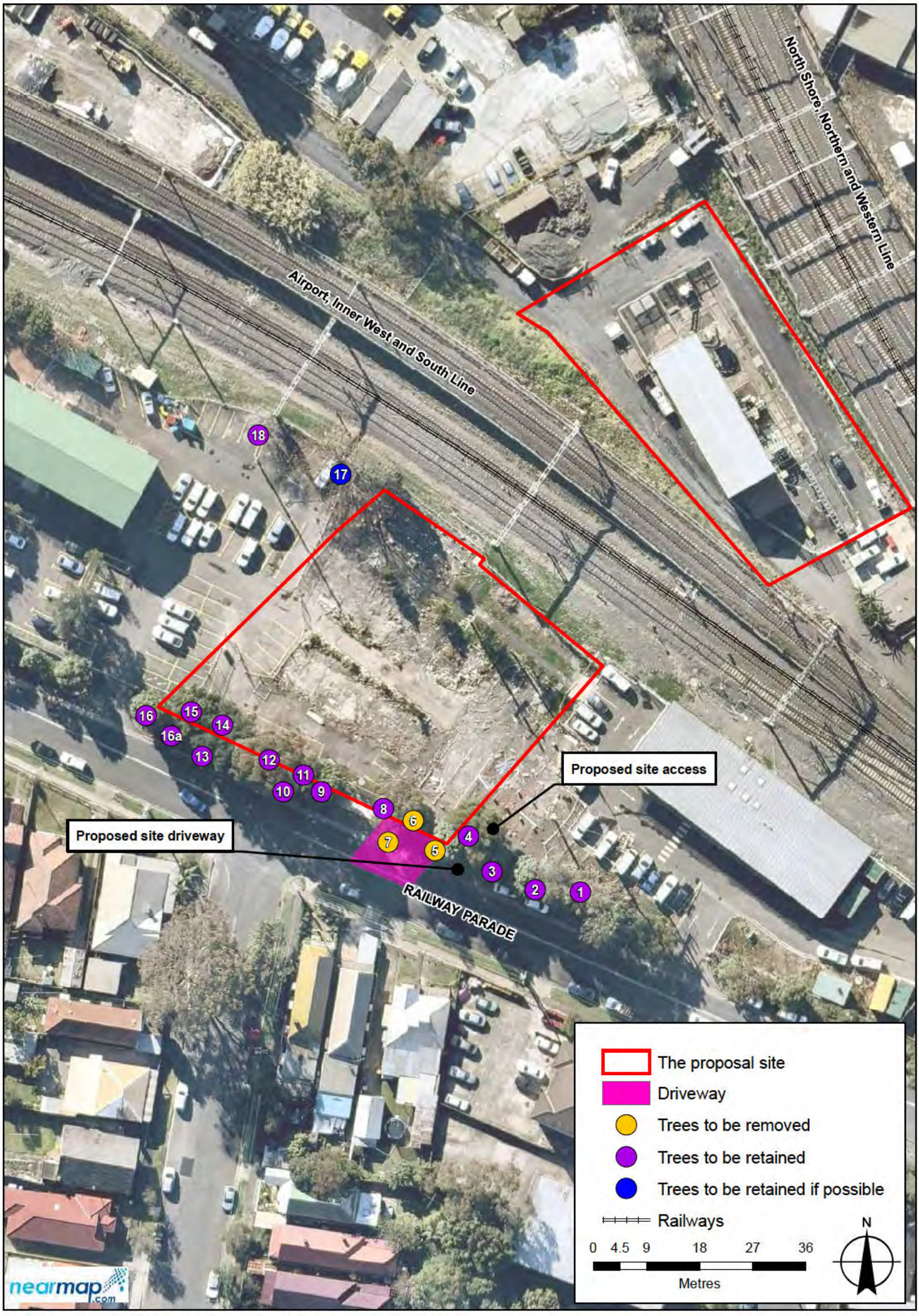

Figure 7.1 Location of surveyed trees

Weeds

Two environmental weeds, Camphor Laurel (*Cinnamomum camphora*) and Moth Vine (*Araujia sericifera*) were recorded. One noxious weed species, Green Cestrum (*Cestrum parqui*) was recorded, adjacent to the Camphor Laurel (tree 15).

Fauna and fauna habitats

The vegetation adjoining the proposal site does not provide habitat of importance for any native fauna species. The trees adjacent to the proposal site would provide only limited habitat value (foraging and roosting resources) for common, generalist bird species typical of highly modified urban landscapes. No nests or scratches (indicating the presence of arboreal mammals) were observed. No hollows were recorded at the proposal site that would provide potential roost sites for hollow-dependent fauna, such as possums or microchiropteran bats.

Tree 13, an early mature Port Jackson Fig located in the road verge at the south-western end of the site, may be occasionally visited by frugivorous birds as well as Grey-headed Flying-foxes (*Pteropus poliocephalus*) during fruiting (February to July). This single specimen is not considered an important habitat feature for this highly mobile threatened fauna species.

The proposal site and its immediate surrounds does not provide habitat for any other threatened species or migratory birds, taking into account the lack of native vegetation, habitat features or connectivity with areas of known habitat.

Trees 13 and 17 (a mature White Cedar growing in the north-western corner of the proposal site) are considered to provide the best habitat resources at the site.

7.2.3 Impact assessment

Tree removal

The proposed driveway construction would require the removal of three planted trees from the formed garden bed along the southern fence line of the proposal site (trees 5, 6 and 7). It is understood that trees 5 and 7 are located on the southern side of the site boundary fence and therefore are located within the road reserve (managed by Parramatta City Council). Tree 6 is located within the site for the proposed substation. Trees 5 and 6 are Brush Box and tree 7 is a Swamp Oak. Tree 6 is in moderate form and health. Trees 5 and 7 are in good form and health.

The proposed removal of three planted trees for the driveway would have a negligible impact on native flora and fauna within the locality. The vegetation that would be impacted by the proposal does not contain any significant fauna habitats, and equivalent vegetation areas are widespread throughout the study area surroundings. The proposed vegetation clearing/disturbance would be unlikely to affect the persistence of any local populations of native fauna.

Tree and root protection

Trees 4 (Blackwood) and 8 (Lemon-scented Gum), which occur on either side of the proposed driveway, would require protection during tree removal and driveway construction. Ground disturbance or excavation within the tree protection and structural root zones of these trees could disturb the health and stability of the trees.

Tree 17 (White Cedar), located outside the north-western corner of the proposal site, should also be protected, if practicable.

Ground disturbance may result in the disturbance of tree roots. The majority of the ground disturbance would be undertaken within the cleared area of the site or within the paved area of Railway Parade, with the exception of the connection point into the stormwater system, and the connection point into the water main. These activities may impact on the tree protection and structural root zones of trees 4, 9, 12, 13, 14 and 15 (refer to Figure 7.1).

Trees 9 to 16, which occur along the southern boundary of the proposal site, would also need to be protected during construction. In particular, trees 9 (Brush Box) and 13 (Port Jackson Fig) are likely to have structural root zones that extend into the proposal site, and may be affected by construction activities. Tree 13 has two surface roots that extend from the leader towards the proposal site that may require pruning (refer to Photo 7.3).

Photo 7.3 Surface roots extending from Tree No. 13 into the site

Mitigation measures for the protection of retained trees are provided in section 7.2.4. Any impacts associated with the connection and installation of on-site services are expected to be restricted to shallow roots only. With the implementation of appropriate mitigation measures and controls as detailed in section 7.2.4, impacts are expected to be temporary and minor.

Significance of impacts

The proposal would not have a significant impact on any threatened species, population or ecological communities listed under the TSC Act and consequently a Species Impact Statement is not required.

The proposal site does not contain any threatened ecological communities or habitat for threatened or migratory species listed under the EPBC Act. The proposal would not have a significant impact on threatened or migratory biota listed under the EPBC Act and there is no requirement for referral to the Australian Minister for the Environment based on ecological grounds.

7.2.4 Mitigation measures

Construction

The following mitigation measures would be implementation during construction:

- Access to the site and the extent of vegetation clearing would be restricted to the access driveway (as shown in Figure 5.1 and Figure 7.1).
- The CEMP and construction plans would clearly document the location and full extent of the vegetation disturbance required. These areas would be clearly marked to avoid disturbance to adjacent retained vegetation, and exclusion fencing would be installed around trees to be retained.

- The trees proposed for removal would be replaced and/or offset in accordance with Transport for NSW's *Vegetation Offset Guide* unless otherwise agreed with or directed by Transport for NSW.
- Approval would be obtained in accordance with Transport for NSW's *Application for Removal or Trimming of Vegetation* for the trimming, cutting, pruning or removal of trees or vegetation where the impact has not been identified in this REF.
- Consultation with Parramatta City Council would be undertaken and any necessary approvals obtained prior the removal of trees 5 and 7.
- A vegetation management sub-plan would be prepared as part of the CEMP. It would include the following measures:
  - The management of trees that are being retained would be consistent with the Australian Standard AS4970-2009 *Protection of trees on development sites* (incorporating Amendment No. 1 (March 2010)).
  - Tree removal, maintenance and protection work would be undertaken by a qualified arborist with appropriate competencies recognised within the Australian Qualification Framework, with a minimum of five years of continual experience within the industry of operational amenity arboriculture, and covered by appropriate and current types of insurance to undertake such works.
  - The following activities would be excluded from the tree protection zones of retained trees:
    - storage of materials, plants or equipment
    - installation of site sheds or portable toilets
    - excavations, trenching, ripping or cultivation of soils
    - modification of existing soil level or addition of fill materials
    - disposal of waste materials and chemicals (both solid or liquid)
    - mechanical removal of vegetation
    - pedestrian or vehicular movement.
  - Tree protection zones and associated controls, storage and movement restrictions would be implemented for trees 4, 8, and 17 as outlined in Appendix C.
  - A protective fence would be installed and maintained between the proposal site and trees 9 to 16.
  - Tree 13 would be retained and protected.
  - If works are required within the tree protection zones, they would be restricted to the area outside of the structural root zone to avoid disturbing the stability and health of the trees.
  - Any root pruning required within the structural root zone would be approved and conducted by the project arborist. Any digging and pruning of roots within the structural root zone would be conducted by hand for a clean cut. Only roots with a diameter of less than five centimetres would be pruned.
  - Once construction is complete, retained trees would be re-inspected by the project arborist and, where necessary, remedial work (as outlined in Appendix C) would be undertaken to reduce the risk to people and property.
- Any vegetation planted on-site would consist of locally endemic native species, unless otherwise agreed with Transport for NSW, following consultation with Parramatta City Council where relevant, and/or Sydney Trains.

- Weed control mitigation and management strategies would be documented and implemented in accordance with the *Noxious Weeds Act 1993*. This would include procedures to reduce the spread of weeds via vehicles and machinery, such as visual inspection of vehicles prior to exit from site to ensure they are clear of plant material.
- Weeds would be managed and disposed of in accordance with the requirements of the *Noxious Weeds Act 1993* and/or the *Weeds of National Significance Weed Management Guide.*

Operation

No mitigation measures are required.

7.3 Noise and vibration

A noise and vibration assessment of the proposal was undertaken by GHD. The results of this assessment are summarised below. The full assessment report is provided in Appendix D.

7.3.1 Assessment approach and methodology

The noise and vibration assessment involved the following:

- Background noise monitoring was undertaken at a single location (in the yard of the house located at 96 Railway Parade) considered to be representative of surrounding receivers. A description of the noise monitoring methodology is provided in section 2.2.1 of Appendix D.
- An assessment of the potential for construction noise and vibration impacts was undertaken in accordance with:
  - *Interim Construction Noise Guideline* (DECC, 2009)
  - *Road Noise Policy* (DECCW, 2011)
  - *Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013)
  - *Assessing Vibration: a Technical Guideline* (DEC, 2006)
  - *Construction Noise Strategy* (Transport for NSW, 2012).
- An assessment of the potential for operation noise impacts was undertaken in accordance with the *Industrial Noise Policy* (EPA, 2000).

Further information on the assessment approach and detailed results are provided in sections 4 and 5 of Appendix D.

7.3.2 Existing environment

Noise and vibration sensitive receivers were defined based on the type of occupancy and the activities undertaken. The nearest sensitive receivers and land uses to the proposal site are residences located along:

- Railway Parade
- The Avenue, about 50 metres south of the proposal site
- Jamieson Street, about 100 metres south-east of the proposal site.

A full list of the potentially sensitive receivers and land uses identified in the study area for the purpose of the assessment is provided in Table 2-1 of Appendix D. The location of the receivers and noise monitoring locations are shown on Figure 7.2.

The noise environment of the study area is dominated by road noise and the movement of trains along the rail corridor. A summary of the measured noise levels at the monitoring location is provided in Table 7.1. The results show that the rating background level for the evening period is higher than that of the daytime period. This is likely to be a result of peak hour traffic noise.

Table 7.1 Average background and ambient noise levels

Location of noise logger	Rating background level (dB(A)), 90th percentile $L_{A90(15min)}$			Ambient noise levels (dB(A)), $L_{Aeq(period)}$		
	Day	Evening	Night	Day	Evening	Night
96 Railway Parade	46	49	43	60	58	55

7.3.3 Noise and vibration criteria

Section 3 of Appendix D describes how the assessment criteria were derived for the following:

- construction noise management levels
- construction vibration – human comfort and structural damage
- operational noise – intrusive and amenity criteria
- traffic noise during construction and operation
- sleep disturbance during construction and operation.

Table 7.2 and Table 7.3 provide the construction and operation noise criteria for the proposal based on consideration of the guidelines listed in section 7.3.1. Table 7.4, Table 7.5 and Table 7.6 provide the vibration criteria for human comfort and structural damage. Safe working buffer distances to comply with the human comfort and structural damage criteria were sourced from the *Construction Noise Strategy* (Transport for NSW, 2012), and are presented in Table 7.7.

Table 7.2 Proposal specific construction noise criteria

Receiver	Construction noise management level, $L_{Aeq(15min)}$ (dB(A))					Sleep disturbance screening test L_{Amax} (external)
	During standard recommended hours[1]		Outside of standard recommended hours[2]			
	Noise affected	Highly noise affected	Day 7 am to 8 am and 1 pm to 6 pm Saturday, 8 am to 6 pm Sunday & public holidays	Evening 6 pm to 10 pm Monday to Sunday & public holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & public holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & public holidays
Residential receivers (R1 to R16)	56	75	51	51	48	58

Note 1: When evening or night time RBLs are greater than the daytime RBLs, the INP recommends that the daytime RBLs be used for assessment purposes.

Table 7.3 Proposal specific operational noise criteria

Receiver	Time period	Amenity criteria (acceptable noise level)[1,2] $L_{Aeq(period)}$	RBL, $L_{Aeq(15min)}$	Intrusive criteria[3], $L_{Aeq(15min)}$	Proposal specific noise criteria (external)	Sleep disturbance screening test (external)
Residential receivers (R1 to R16)	Day	55	46	51	**51 $L_{Aeq(day)}$**	-
	Evening	45	49 (46[3])	51	**45 $L_{Aeq(evening)}$**	-
	Night	40	43	48	**40 $L_{Aeq(night)}$**	**58 L_{Amax}**

Notes 1: With consideration to the INP, 'noise amenity area' classification, the residential receivers surrounding the proposal site have been classified as 'suburban'.

2: Attended observations during the site visit noted that here were no significant industrial noise sources in the area therefore no adjustments have been applied for the proposal.

3: When evening or night time RBLs are greater than the daytime RBLs, the INP recommends that the daytime RBLs be used for assessment purposes.

Table 7.4 Human comfort intermittent vibration limits (BS 6472-1992)

Receiver type	Period[1]	Intermittent vibration dose value ($m/s^{1.75}$)	
		Preferred value	Maximum value
Residential	Day	0.2	0.4
	Night	0.13	0.26
Educational institutes	When in use	0.4	0.8

Note 1: Day is between 7 am and 10 pm and night is between 10 pm and 7 am

Table 7.5 Guidance on effects of vibration levels for human comfort (BS 5228-2 – 2009)

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

Table 7.6 Guideline values for short term vibration on structures (DIN 4150-3:1999)

Type of structure	Guideline values for velocity, (mm/s)		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz1
Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10

Note 1: At frequencies above 100 Hz the values given in this column may be used as minimum values.

Figure 7.2 Location of receivers in the vicinity of the proposal site and noise monitoring location

Table 7.7 Vibration buffer distances

Activity	Human comfort	Structural damage	
		Heritage building/structure	Standard dwellings
Seven tonne compactor	50 m	20 m	13 m
10 tonne vibratory roller	66 m	27 m	18 m
Jackhammer[1]	Avoid contact with structure	2 m (nominal)	1 m (nominal)
Excavator	18 m	8 m	5 m
Piling (bored) [1]	N/A	4 m (nominal)	2 m (nominal)
Dozer	25 m	10 m	6 m

Note 1: These distances have been sourced from the *Construction Noise Strategy* (Transport for NSW, 2012)

7.3.4 Impact assessment

Construction noise

Table 7.8 lists the modelled construction worst case noise levels for all potential receivers, with positive values indicating exceedances of relevant criteria. The results of modelling indicate that the noise generated by construction is predicted to exceed the 'highly noise affected' noise management levels at all residential receivers.

The exceedances shown in Table 7.8 would be mitigated by implementing the standard noise mitigation measures provided by the *Construction Noise Strategy* (Transport for NSW, 2012) where feasible and reasonable (refer section 7.3.5). All potentially impacted receivers should be informed of the nature of the works, expected noise levels, duration of works and a method of contact.

The exceedances would be short-term and temporary, and limited to the duration of the construction period.

Table 7.8 Predicted worst case construction noise levels (dB(A)) for standard recommended hours

Receiver ID and address	Standard recommended hours criteria	Site clearing and demolition works		Earthworks and compaction		Substation construction works	
		Ground floor	First floor	Ground floor	First floor	Ground floor	First floor
R1 - 88 Railway Parade	56	71 (+15)	-	71 (+15)	-	73 (+17)	-
R2 - 86 Railway Parade	56	71 (+15)	-	71 (+15)	-	72 (+16)	-
R3 - 94 Railway Parade	56	71 (+15)	-	71 (+15)	-	72 (+16)	-
R4 - 84 Railway Parade	56	70 (+14)	-	70 (+14)	-	72 (+16)	-
R5 - 96 Railway Parade	56	69 (+13)	-	70 (+14)	-	70 (+14)	-

Receiver ID and address	Standard recommended hours criteria	Site clearing and demolition works		Earthworks and compaction		Substation construction works	
		Ground floor	First floor	Ground floor	First floor	Ground floor	First floor
R6 - 78-82 Railway Parade	56	67 (+11)	68 (+12)	67 (+11)	69 (+13)	68 (+12)	70 (+14)
R7 - 98 Railway Parade	56	68 (+12)	-	69 (+13)	-	69 (+13)	-
R8 - 100 Railway Parade	56	67 (+11)	-	68 (+12)	-	68 (+12)	-
R9 - 72 Railway Parade	56	57 (+1)	-	58 (+2)	-	58 (+2)	-
R10 - 108 Railway Parade	56	63 (+7)	-	64 (+8)	-	64 (+8)	-
R11 - 70 Railway Parade	56	56 (0)	-	57 (+1)	-	57 (+1)	-
R12 - 110 Railway Parade	56	62 (+6)	-	63 (+7)	-	64 (+8)	-
R13 - 112 Railway Parade	56	62 (+6)	-	63 (+7)	-	63 (+7)	-
R14 - 6 The Avenue	56	66 (+10)	-	67 (+11)	-	68 (+12)	-
R15 - 8 The Avenue	56	65 (+9)	-	66 (+10)	-	67 (+11)	-
R16 - 2 Jamieson Street	56	64 (+8)	66 (+10)	65 (+9)	67 (+11)	66 (+10)	68 (+12)

Note: **Red numerals** – exceeds criteria

Out of hours work and sleep disturbance

Some construction activities may be required to be undertaken outside of scheduled construction hours. These involve activities such as connection to the overhead wiring equipment and installation of certain electrical equipment, which would be undertaken during scheduled track possession periods.

These activities are not expected to cause adverse impacts at sensitive receivers. Noise monitoring would be conducted at the start of these works to determine compliance with out of hour works noise management levels and sleep disturbance criteria.

If out of hours work is required, the contractor would obtain approval from Transport for NSW, prior to works being undertaken. All out of hour works and activities would be undertaken with additional mitigation measures in accordance with the *Construction Noise Strategy* (Transport for NSW, 2012).

Traffic noise

In accordance with the *Road Noise Policy* (DECCW, 2011), construction traffic noise is considered to be acceptable when it is within two dB(A) of the existing noise levels. The doubling of traffic on a road is considered to generally result in an increase in noise levels of about three dB(A). Construction of the proposal would only result in a small increase in vehicles on the road network during construction (about 28 heavy vehicle and 30 light vehicle movements per day), which is a minor increase when compared with existing traffic levels (refer section 7.5.3). Therefore, the proposal would not result in any exceedance of the road traffic noise criteria.

Construction vibration

Human comfort

The assessment indicates that there would be the potential for some vibration (human comfort) impacts at sensitive receivers if compaction is undertaken within 66 metres of receivers (refer to Table 7.7). The potential for impacts would be mitigated by implementing the mitigation measures provided in section 7.3.5. Where practicable, activities with the potential to generate these impacts would be scheduled during standard construction hours. Sensitive receivers and land uses within the safe working distance buffers would be informed of the nature of the work, duration and contact details as part of the proposal communications strategy. Potential impacts would be short-term and temporary, and limited to the duration of the construction period.

Potential for building damage

The assessment indicates that the predicted magnitude of ground vibrations would not be sufficient to cause damage to any standard buildings located further than 13 metres from the proposal site (assuming use of a seven tonne compactor), or any heritage buildings located further than 20 metres from the proposal site. As there are no buildings within these distances, no vibration (building damage) impacts are anticipated during construction.

Any vibration generating activities associated with the site compound and laydown areas may have the potential to impact on nearby residential buildings and other sensitive structures. The mitigation measures provided in section 7.3.5 would be implemented to ensure that any vibration generated would be below the criteria limits.

Operation

Potential operational noise sources would include:

- two rectifier transformers (5.35 MVA)
- two rectifiers (5 MW)
- one power transformer (6.25 MVA)
- two auxiliary transformers (50 KVA)
- direct current circuit breakers (DCCB).

As rectifier and transformer noise levels fluctuate with loading, worst-case noise levels have been used for assessment purposes, even though it is unlikely that the transformers would be under maximum load during the night time period.

Operational noise levels were modelled for two separate scenarios as follows:

- Scenario 1: Rectifier and transformers operating - for assessment against the $LA_{eq(night)}$ amenity noise criteria.

- Scenario 2: Substation DCCB tripping - for assessment against the external sleep disturbance screening of L_{Amax} 58 dB(A).

It is noted that DCCB tripping is a very infrequent event, with about three to five openings within a substation per year.

Table 7.9 and Table 7.10 outline the worst case noise level results of the modelling for both scenarios at the identified receptors. Positive values indicate exceedances, and negative values indicate that the criteria have been met. The results indicate that operational noise from the proposal is predicted to comply with the noise criteria at all surrounding sensitive receivers during general operations.

For scenario 2, during DCCB tripping, the sleep disturbance criteria are predicted to be exceeded at most residential receivers. However, as noted above, DCCB tripping is a very infrequent event and is not anticipated to adversely impact surrounding residences. The risk of DCCB tripping is further reduced as additional substations are developed. The concept design has sought to minimise the potential for noise impacts as a result of DCCB tripping, by locating the switchroom housing the DCCBs to the northern side of the substation compound further away from Railway Parade.

Table 7.9 Predicted operational noise levels during normal operations (dB(A))

Receiver	Operational criteria $L_{Aeq(night)}$	Predicted noise levels ($L_{Aeq(night)}$) at each receiver height		
		Ground floor (1.5 m)	First floor (4.5 m)	Second floor (7.5 m)
R1	40	35 (-5)	-	-
R2	40	36 (-4)	-	-
R3	40	37 (-3)	-	-
R4	40	36 (-4)	-	-
R5	40	35 (-5)	-	-
R6	40	35 (-5)	36 (-4)	37 (-3)
R7	40	33 (-7)	-	-
R8	40	32 (-8)	-	-
R9	40	26 (-14)	-	-
R10	40	30 (-10)	-	-
R11	40	25 (-15)	-	-
R12	40	29 (-11)	-	-
R13	40	28 (-12)	-	-
R14	40	33 (-7)	-	-
R15	40	32 (-8)	-	-
R16	40	33 (-7)	34 (-6)	35 (-5)

Note: Green – meets criteria

Table 7.10 Predicted operational noise levels during DCCB tripping (dB(A))

Receiver	Sleep disturbance screening test, L_{Amax}	Predicted noise levels (L_{Amax}) at each receiver height		
		Ground floor (1.5 m)	First floor (4.5 m)	Second floor (7.5 m)
R1	58	69 (+11)	-	-
R2	58	69 (+11)	-	-
R3	58	55 (-3)	-	-
R4	58	68 (+10)	-	-
R5	58	66 (+8)	-	-
R6	58	65 (+7)	66 (+8)	66 (+8)
R7	58	65 (+7)	-	-
R8	58	64 (+6)	-	-
R9	58	61 (+3)	-	-
R10	58	60 (+2)	-	-
R11	58	60 (+2)	-	-
R12	58	60 (+2)	-	-
R13	58	59 (+1)	-	-
R14	58	63 (+5)	-	-
R15	58	63 (+5)	-	-
R16	58	63 (+5)	63 (+5)	63 (+5)

Note: Red– exceeds criteria, Green – meets criteria

Traffic noise

Staff will occasionally access the site out of normal business hours to perform maintenance works. Vehicle movements associated with servicing and maintenance will be infrequent and are not expected to cause noise impacts in a suburban area. Therefore no operational traffic noise impacts are anticipated at sensitive receivers

Operation vibration

There would be no vibration impacts associated with the operation of the proposal.

7.3.5 Mitigation measures

Construction

- Mitigation measures documented in *Construction Noise Strategy* (Transport for NSW 2012) would be adopted where feasible and reasonable, as specified in Tables 6-1 and 6-2 of Appendix D.
- A noise and vibration management plan would be prepared as part of the CEMP in accordance with the *Construction Noise Strategy* (Transport for NSW, 2012) and the *Interim Construction Noise Guideline* (DECC, 2009). It would include the following measures:
  - Sensitive receivers would be identified and marked on plans.
  - Works would be scheduled during recommended standard hours where practicable.
  - All equipment and construction methodologies would be selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good

working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made.

  - All site workers would be educated as to the potential for noise impacts on sensitive receivers and land uses and encouraged to take practical and reasonable measures to minimise impacts during the course of their activities. This would include:
    - toolbox talks covering avoiding the use of outdoor radios during the night period
    - avoiding shouting and slamming doors
    - where practicable, machines would be operated at low speed or power and would be switched off when not being used, rather than left idling for prolonged periods
    - avoiding dropping materials from height and metal to metal contact where practicable.
  - Truck drivers would be informed of designated vehicle routes, parking locations and the requirement to minimise engine idling.
  - Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on construction vehicles and mobile plant regularly used on-site and for any out of hours work.
  - Where noise and vibration levels during the works are predicted to exceed acceptable levels after implementation of general work practices, the additional mitigation measures included in Table 6-1 and 6-2 of Appendix D would be implemented where reasonable and feasible.
  - Nearby receivers would be notified of the works prior to commencement. Notification would include expected noise levels, duration of the works and a method of contact (Transport for NSW's 1800 775 465 number).
  - A process for complaints management as outlined in section 6.4.1.
- If out of hours works are required, the contractor would prepare and submit a Transport for NSW Out of Hours Work Assessment (3TP-PR-065) and Application Form (9TP-FT-079) for approval prior to the works being undertaken. All out of hour works and activities would be undertaken with additional mitigation measures in accordance with the *Construction Noise Strategy* (Transport for NSW, 2012).
- Where construction is required within the safe working buffer distance, alternative work methods such as smaller equipment would be considered. If no alternative work method is feasible or reasonable, then compliance vibration monitoring would be undertaken including:
  - Site tests to review the measured frequency content to determine the structural damage criteria as per Table 3-6 and Table 3-7 of the Noise and Vibration assessment (Appendix D) for standard dwelling and for heritage structures respectively.
  - Continuous vibration monitoring with a visual alarm installed to warn the equipment operator when the structural damage vibration criteria (considering frequency content) is exceeded.

Operation

- Transformers, rectifiers and other electrical equipment on site would be well maintained and operated according to specifications.
- Operational noise monitoring would be undertaken at regular periods to assess compliance against operational noise criteria.

- If the results of monitoring indicate that operational noise levels are significantly higher than those modelled for the REF, the use of mufflers or other acoustic treatment methods would be investigated.
- Maintenance operations would be scheduled during the day.
- Any noise complaints would be managed in accordance with the process for complaints management outlined in section 6.4.1.

7.4 Air quality

7.4.1 Existing environment

A search of the National Pollutant Inventory undertaken on 19 June 2015 for the 2013 to 2014 reporting period identified 36 air pollutant substances from 10 sources in Granville and the surrounding suburbs. The closest source identified is Downer EDI Works Pty Ltd located at Unwin Street, Rosehill, about 1.5 kilometres north-east of the proposal site.

Other contributors to air quality within the study area would include emissions from motor vehicles on the surrounding road network, and the diesel freight trains on the adjoining rail corridor.

The nearest sensitive receivers include residential properties along Railway Parade opposite the site.

7.4.2 Impact assessment

Construction

The proposal would have minimal impact on air quality as it would not involve substantial clearing, earthworks or other land disturbance with the potential to generate significant quantities of dust. Small amounts of dust may be produced by the excavation associated with piling, and the movement of construction vehicles.

Dust could impact on the amenity of people in nearby buildings or passing the proposal site. Due to the small amount of dust expected and the relatively short duration of works, these impacts are considered to be minimal.

Operating plant, machinery and trucks may also increase exhaust emissions in the study area; however these impacts would be minor and short-term.

Implementing standard air quality management controls (listed in section 7.4.3) would minimise the potential for air quality impacts.

Operation

Air quality

The operation of the proposal would not result in any significant air quality impacts.

Greenhouse gases

Sulphur hexafluoride gas (SF_6) would be used as an insulator within the new switchgear. SF_6 has the potential to contribute to greenhouse gas emissions as it has a high greenhouse gas equivalence of 23,900 times that of carbon dioxide. SF_6 is sealed within gas-tight compartments inside the switchgear. However, leakage could occur during maintenance activities or through poor work practices. This would be managed by the mitigation measures proposed in section 7.4.3.

7.4.3 Mitigation measures

Construction

An air quality management sub-plan would be prepared as part of the CEMP. It would include the following measures:

- All plant and machinery would be fitted with emission control devices complying with the Australian Design Standards.
- Machinery would be turned off when not in use and not left to idle for prolonged periods.
- Vehicle movements would be limited to designated entries and exits, haulage routes (to be determined during preparation of the traffic management plan, and in consultation with Roads and Maritime Services and Council) and parking areas.
- Dust generation would be monitored visually, and where required, dust control measures such as water spraying would be implemented to control the generation of dust.
- Any waste produced on-site would be stored and stockpiled for removal off-site daily, to reduce the production of dust.
- Materials transported to and from the site would be covered to reduce dust generation in transit.
- Access points would be inspected to determine whether sediment is being transferred to the surrounding road network. If required, sediment would be promptly removed from roads to minimise dust generation.
- Stabilising any excavated areas as soon as practicable.
- Stockpile management would be undertaken in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).
- Material stockpiles awaiting removal from site that are inactive for a period of greater than one week would be stabilised (seeded or covered).
- Fixed hoses would be used to dampen exposed surfaces to minimise dust generation, where required.
- Shade cloth would be fastened to the perimeter fence on the proposal site to minimise dust transported from the site during construction.

Operation

No mitigation measures are required.

7.5 Traffic and transport

This section provides an assessment of the potential traffic and transport impacts associated with construction and operation of the proposal.

7.5.1 Assessment approach and methodology

The traffic impact assessment involved the following by a GHD traffic engineer:

- a site visit and observations of the road network and transport environment surrounding the proposal site
- reviewing the traffic and pedestrian environment
- investigating the transport network in the study area

- reviewing the information available on the proposed construction method and estimates of traffic generation during construction and operation
- assessing the potential impacts of construction and operation, including an assessment of potential traffic generation, parking, access and road safety
- providing recommendations in relation to management measures.

7.5.2 Existing environment

Road network

The road network in the vicinity of the proposal site is shown in Figure 1.1 and is described below. The proposal site is accessed via Railway Parade. The signalised intersection of Railway Parade, Carlton Street and Bold Street is located about 150 metres east of the proposal site.

Traffic generators located in the vicinity of Railway Parade include the Granville TAFE, Granville Public School, Granville Boys High School and Granville Station.

Parramatta Road

Parramatta Road is an arterial road which forms part of the Great Western Highway route A44, connecting Parramatta to Haymarket. It provides a local link to the M4 Western Motorway at Church Street/Woodville Road. The carriageway is mostly undivided with between two and three lanes in each direction along the length of the route and a sign posted speed limit of 60 km/h.

Woodville Road

Woodville Road is an arterial road connecting Villawood to Granville. It provides a link between the Hume Highway and the M4 Western Motorway at Church Street. The carriageway is mostly divided with between two and three lanes in each direction along the length of the route and a sign posted speed limit of 70 km/h.

Bold Street

Bold Street, which includes a bridge over the rail corridor, connects with Parramatta Road about 200 metres to the north. The carriageway is undivided with one lane in each direction and a posted speed limit of 60 km/h.

Railway Parade

Railway Parade is a local road that terminates at a cul-de-sac to the west. The carriageway is undivided with a speed limit of 50 km/h.

Jamieson Street

Jamieson Street is a local road connecting to Railway Parade via a priority controlled intersection. The carriageway is undivided with one lane in each direction and a speed limit of 50 km/h.

The Avenue

The Avenue is a local road connecting to Railway Parade via a priority controlled intersection. The carriageway is undivided with one lane in each direction and a speed limit of 50 km/h.

Parking

In the vicinity of the proposal site, parking along Railway Parade is unrestricted on the northern side of the road with dedicated parking bays provided. On the southern side of Railway Parade, parking is restricted to two hours between 8 am and 6 pm Monday to Friday. A car park with

around 50 spaces is available at Granville Branch Library, which is located on Jamieson Street, around 300 metres from the proposal site.

Pedestrian access

A 2.5 metre wide footpath is provided on the southern side of Railway Parade. There are no formal footpath facilities on the northern side of Railway Parade

Public transport

There is a bus stop/zone located on the northern side of Railway Parade outside the proposal site (see Photo 7.4). The bus stop is for the M91 Hurstville to Parramatta route towards Hurstville, which is operated by Transdev. The M91 bus route forms part of Sydney's Metrobus network. Metrobus is a high frequency, high capacity bus network that links key employment and growth centres. Buses operate with a 10 minute frequency during peak periods, every 15 minutes during the weekday off-peak, and 20 minutes in the evening and on weekends.

Granville Station is located about 150 metres to the east of the proposal site. Granville Station is served by Sydney Trains T1 Western Line and T2 South Line services and NSW TrainLink Blue Mountains Line services.

Photo 7.4 Bus stop outside site

7.5.3 Impact assessment

Construction

Traffic generation

Information regarding the proposed arrangements in terms of construction site access, parking and vehicle movements is provided in section 5.

Construction would generate heavy vehicle movements associated with the transportation of construction machinery, equipment and materials to and from the proposal site. Light vehicle movements would be associated with employees and smaller deliveries.

Construction vehicle movements would result in a temporary increase in traffic along the road network. An estimate of the potential construction traffic generation is provided in Table 5.1 in section 5.3.4.

The worst case period in terms of construction traffic generation would occur during concrete pours, which could result in about 16 movements per day. The estimated worst case scenario for truck movements during peak periods would be about four vehicle trips per hour comprising two in and two out movements.

It is assumed that most construction vehicles would access the proposal site via the following routes:

- Parramatta Road, Bold Street and Railway Parade
- Woodville Road, Williams Street, Lumley Street, Carlton Street and Railway Parade.

During the peak construction period, it is estimated that the proposal would generate an additional 36 vehicles per day on the road network. The surrounding road network would need to accommodate an additional 14 movements during the peak morning and peak evening periods.

The construction traffic that would be generated by the proposal would be a very small proportion of the existing traffic levels on the surrounding road network. This increase is not expected to result in any impacts on the operation of the road network.

Construction access and oversized deliveries

Construction of the proposal would require delivery of oversized pieces of equipment, such as transformers, rectifiers and poles. Oversized transport may also be required during decommissioning of the existing Granville Substation to remove larger items of equipment. These deliveries would be undertaken in consultation with relevant agencies and would generally be undertaken out of hours to minimise the potential for impacts to the surrounding road network. It is noted that there is currently a sign displaying 'No through access for semi-trailers' on the corner of The Avenue and Railway Parade'.

Any semi-trailer movements entering and exiting the site would need to be under authorised traffic control in accordance with the requirements of *Traffic Control at Work Sites* (RTA, 2010).

Public transport

The bus stop outside the site can remain in its existing location, as long as the existing pad, bus zone and plinth remain in place, and buses are able to pull in parallel to the kerb in accordance with the Disability Standards for Accessible Public Transport 2002.

Parking

Parking for construction vehicles (including light vehicles) would be provided at the nominated construction compound (shown in Figure 5.1). Construction workers would be encouraged not to park in surrounding roads.

As noted in section 4.4.3, establishing a single driveway access to the site (for use during construction and operation) would result in the loss of two on-street parking spaces.

As noted in section 4.4.4, a temporary 'no stopping zone' would need to be established on Railway Parade on either side of the proposal site to control parking and allow safe entry to the site, in accordance with the requirements of Parramatta City Council. The distance occupied by the no stopping zone would be confirmed by the construction contractor. Commuter vehicles would not be able to park in the no stopping zone. This would result in the temporary loss of about two on-street parking spaces along the northern side of Railway Parade.

This loss of on-street parking is not considered to be significant, as it would be temporary and limited to the duration of the construction period. In addition, sufficient parking is available on the surrounding road network.

Pedestrian movements and access

Currently, formal pedestrian access is not available on the northern side of Railway Parade. There would be no impacts to pedestrian access on the southern side of the road.

Implementation of the construction traffic management sub-plan and the mitigation measures provided in section 7.5.4 would ensure that potential impacts to pedestrian movements and safety are minimised.

Operation

As noted in section 5.1.4 vehicular access to the proposal site would be via a new access gate off Railway Parade. This would result in the permanent removal of two on-street parking spaces.

Operation of the proposal would not result in any other impacts to traffic or access, as access for maintenance purposes would be infrequent (around two per month). Any semi-trailer movements entering and exiting the permanent driveway would need to be under authorised traffic control in accordance with the requirements of *Traffic Control at Work Sites* (RTA, 2010).

7.5.4 Mitigation measures

Construction

- A traffic management sub-plan would be prepared as part of the CEMP. It would include the following measures:
  - Traffic and access would be managed in accordance with *Traffic Control at Work Sites* (RTA, 2010) and in consultation with Roads and Maritime Services, Parramatta City Council and Holroyd City Council.
  - Residents, property owners would be notified of any access restrictions in advance of work commencing.
  - Appropriate traffic management controls would be implemented, including precautionary signs, illuminated warning devices, manual and/or electronic traffic control, and the provision of temporary barriers and markers, to control pedestrians and traffic access to and around the proposal site.
  - Safe access points to the proposal site would be established, including safety measures such as security fencing and/or barriers, maintaining sight distance requirements, signage and the provision of traffic management measures.
  - Detail of the required approvals and permits (Council and RMS) required to be obtained prior to works, including any approvals associated with temporary lane closures and / or speed reduction zones.
  - The requirements of the *Roads Act 1993* would be followed at all times prior to and during all work (including notice requirements, consultation and consent/concurrence requirements for work within public and classified roads).
  - Heavy vehicles would be restricted to the specified routes.
  - Oversized deliveries would be undertaken in accordance with the requirements of Council, Roads and Maritime Services and NSW Police.
- In consultation with Parramatta City Council, consideration would be given to implementing eight tonne load restrictions on the local roads connecting with Railway Parade, including Jamieson Street, The Avenue, Smith Street, Margaret Street and Milton Street.
- The driveway access to the site would be designed in accordance with the requirements of the ASA standard for access roads (Transport for NSW, 2014) and in consultation with Parramatta City Council.

Operation

No mitigation measures are required.

7.6 Land use and social-economic issues

7.6.1 Existing environment

The existing land uses and zoning of the proposal site and surrounds are described in sections 2.2 and 3.2.2.

The community with the potential to be impacted by the proposal would include:

- local residents
- employees on adjacent sites
- commuters accessing Granville Station and parking along Railway Parade

Future land uses

The *Parramatta Road Urban Renewal Strategy* (Urban Growth NSW, 2015) has identified the area between Parramatta Road and the railway corridor in Granville (to the north of the site) as one of eight precincts for urban renewal and redevelopment. The *Parramatta Road Urban Renewal Strategy* does not specify zoning, height or density for the areas and these will be determined as part of a precinct planning process which is planned to be undertaken later this year.

7.6.2 Impact assessment

Construction

Land use

During construction, the land use would change from the existing use (as described in sections 2.2 and 3.2.2) to a construction site.

Community amenity impacts

The proposal has the potential to result in some impacts on the amenity of the surrounding community and/or users of adjoining areas during construction. This could include those properties located in close proximity to the proposal site. These potential impacts, which include noise, air quality, traffic and access, and visual impacts, are assessed in sections 7.3.4, 7.4.2, 7.5.3, and 7.7.2 respectively. No significant impacts are identified.

Operation

Land use

The proposal would involve the use of vacant land zoned for enterprise corridor use for an infrastructure (rail) use. This use is consistent with the land use zoning under the LEP, and is consistent with the use of adjoining land as rail corridor.

The decommissioning of the existing Granville substation would release this land for an alternate purpose in keeping with the infrastructure zoning of the site and surrounding area. Any future uses would be considered under a separate approvals process

Community amenity impacts

The potential for operational impacts on amenity relate to the potential for noise, air quality, traffic and access, and visual impacts. These are assessed in sections 7.3.4, 7.4.2, 7.5.3, and

7.7.2 respectively. No significant long term impacts have been identified, other than the introduction of a new structure in the landscape.

Wider operational impacts

The proposal involves the provision of infrastructure required to meet the needs of the expanded Sydney Trains fleet, and is therefore consistent with the *NSW Long Term Transport Master Plan*. Operation of this proposal would improve service reliability by reducing the risk of disruption to rail services. This would have a socio-economic benefit to all communities with access to the North Shore, Northern and Western Line, and the Airport, Inner West and South Line.

7.6.3 Mitigation measures

Construction

The following mitigation measures would be implemented during construction:

- The CEMP would specify the approach to consultation during construction, the communication tools to be used, and response protocols. Specific consultation tasks to be undertaken include:
  - advising affected landholders of the proposal, the construction hours and duration of work, and supplying a contact number for any queries or complaints relating to the work
  - displaying accurate public information signs while work is in progress and until site restoration has been completed.

Operation

No mitigation measures are required.

7.7 Visual amenity

7.7.1 Existing environment

The visual landscape of the proposal site is dominated by rail infrastructure and services (including rail lines, overhead power lines and Sydney Trains buildings), the adjoining road network, existing trees along the site boundary, and residential uses opposite the site. Views to the site for the proposed substation are available from:

- Railway Parade – including traffic and pedestrians travelling along the road
- residences on the eastern side of Railway Parade
- train services (in particular passenger services) along the rail line.

Users of Railway Parade and residential receptors with direct views of the site are considered to be the most sensitive receptors. Views from these receivers to the site are currently dominated by vegetation, with partial views of railway infrastructure through the trees (refer Photos 7.5 and 7.6). Views to the site for the proposed substation are partially obscured by the trees located along the site boundary.

Photo 7.5 View from The Avenue towards the proposal site (looking to the north-east)

Photo 7.6 View from Railway Parade towards the proposal site (looking to the north)

7.7.2 Impact assessment

Construction

During construction, the positioning of the work site and the site compound would result in some short-term impacts on the visual amenity for nearby sensitive receivers.

Overall, the potential visual impacts of construction activities are considered to be minimal as the works would be temporary and short-term.

Operation

Potential visual impacts relate to the presence of a new structure in the landscape. An indicative description of the potential appearance of the proposal is provided in section 5.1.

Substations are common features/land uses in urban areas. The appearance of the substation would be consistent with the surrounding rail/infrastructure uses, which include existing buildings and other rail infrastructure (including overhead power lines). As noted above, views to the site are partially obscured by vegetation, so not all of the proposal will be visible from surrounding areas. The proposed removal of three trees to enable access to be provided to the site would enable views into the site from this area. At the location of the new access, the proposal would be visible from the street and residences across from the new access.

The concept design for the proposal has been prepared with regard to urban design and visual considerations. Further design phases would continue to consider the potential for visual impacts.

Photomontages of the proposed substation from the nearest sensitive viewpoints are provided in Figure 7.3 to Figure 7.5.

Figure 7.3 Photomontage of the proposed substation from Railway Parade opposite the site access looking north-west

Figure 7.4 Photomontage of the proposed substation from Railway Parade opposite the south-western corner of the site looking north-east

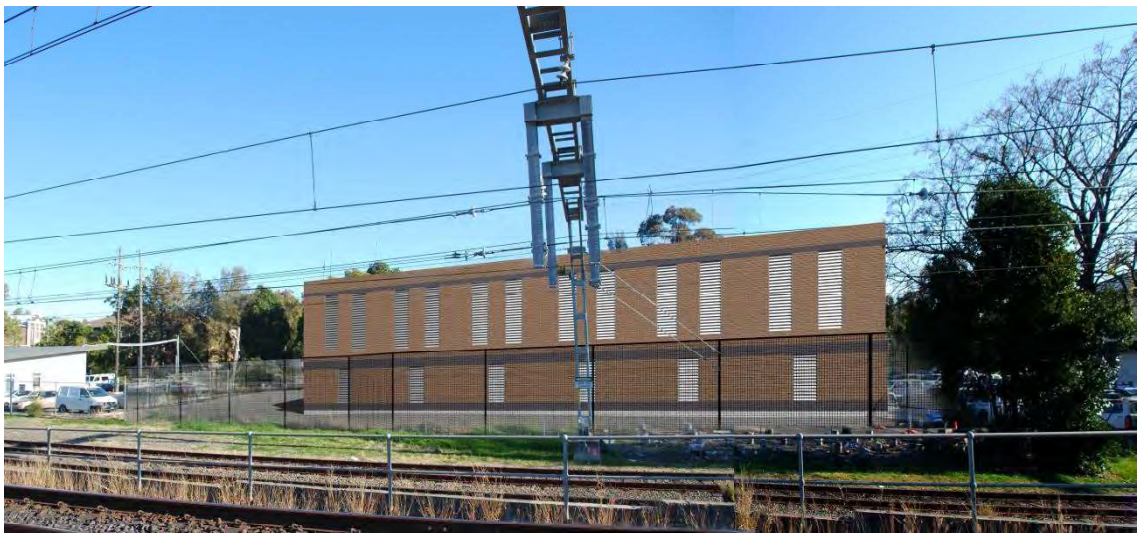

Figure 7.5 Photomontage of the proposed substation from the rail corridor looking south

7.7.3 Mitigation measures

Construction

The following mitigation measures would be implemented to minimise impacts during construction:

- Shade cloth or similar material would be attached to the site fencing to minimise views of the worksite.
- The worksite would be left in a tidy manner at the end of each work day.

Operation

The following mitigation measures would be implemented to minimise impacts during operation:

- The detailed design of the proposal would take into account relevant urban design and visual considerations.

7.8 Heritage

7.8.1 Existing environment

Aboriginal heritage

A search of the Aboriginal Heritage Information Management System was undertaken on 25 June 2015. This search identified that there are no known Aboriginal heritage items located either within the proposal site or within a 200 metre radius of the site.

Non-Aboriginal heritage

A search of the following heritage registers was undertaken for the suburb of Granville on 18 June 2015:

- State Heritage Register
- Section 170 registers for state agencies
- *Parramatta Local Environmental Plan 2011*
- Australian heritage database.

The nearest heritage listed items (within 300 metres of the site) are listed in Table 7.11. No heritage listed items are located within or in the immediate vicinity of the proposal site.

Table 7.11 Heritage items within the study area

Name	Listing	Approximate distance from the proposal site
House – 70 Railway Parade	*Parramatta Local Environmental Plan 2011*	120 metres south-east of the proposal site
Substation No. 1 - 176A Parramatta Road	*Parramatta Local Environmental Plan 2011*	150 metres north-east of the proposal site
House – 5 Margaret Street	*Parramatta Local Environmental Plan 2011*	160 metres west of the proposal site at its nearest point.
House – 28 The Avenue	*Parramatta Local Environmental Plan 2011*	180 metres south of the proposal site
29 Jamieson Street	Section 170 State agency heritage register *Parramatta Local Environmental Plan 2011* Australian Heritage database	230 metres south of the proposal site at its nearest point
Granville Town Hall	*Parramatta Local Environmental Plan 2011* Australian Heritage database Section 170 State agency heritage register	240 metres south west of the proposal site at its nearest point

7.8.2 Impact assessment

The proposal would not result in any impacts to listed/known Aboriginal or non-Aboriginal heritage items. Mitigation measures provided in section 7.8.3 would be implemented to ensure heritage listed items within proximity to the works are not impacted during construction.

As the study area has been substantially modified by urban development and subject to previous ground disturbance (associated with construction of the road and rail corridor), the risk of encountering any unknown heritage items is considered to be extremely low.

7.8.3 Mitigation measures

Construction

The following mitigation measures would be implemented to minimise impacts during construction:

- All heritage items in the immediate vicinity of the proposal site would be marked on site plans, and avoided.
- A heritage induction would be provided to all workers before construction commences informing them of the location of heritage items within the study area and guidelines to follow if unanticipated heritage items or deposits are located during construction.
- If previously unidentified indigenous or non-indigenous heritage/archaeological items are uncovered during construction works, all works in the vicinity of the find shall cease and the Transport for NSW Project Manager and Environmental Planning Manager (EPM) notified. Appropriate advice shall be sought from a suitably qualified heritage consultant/archaeologist (and in consultation with the relevant division of OEH, as required). Works in the vicinity of the find shall not re-commence until clearance has been received from the heritage consultant/archaeologist and the Transport for NSW EPM.

Operation

No mitigation measures are required.

7.9 Electromagnetic energy

An electromagnetic energy report for the proposal was undertaken by EMC Services Pty Ltd in July 2015. The results of this assessment are summarised below. The full assessment report is provided in Appendix E.

7.9.1 Impact assessment

Electromagnetic energy (EME) is invisible and found everywhere electricity is present. An electric field is a region where electric charges experience an invisible force. The strength of this force is related to the voltage, or the pressure which forces electricity along wires. Electric fields are strongest close to their source, and their strength diminishes rapidly as we move away from the source.

A magnetic field is a region where magnetic materials experience an invisible force produced by the flow of electricity, commonly known as current. Unlike electric fields, magnetic fields are only present when electric current is flowing.

The strength of a magnetic field depends on the size of the current (measured in amps), and decreases rapidly once we move away from the source. While electric fields are blocked by many common materials, this is not the case with magnetic fields.

There are two components to an electromagnetic field, the electric field strength which is very weak at the proposed voltage (1500 volts) and the magnetic field strength which decreases in an inverse square relationship close to the source and at a higher rate approximating an inverse cubic relationship at further distances.

In recent years there has been an increase in community concerns over the long-term health effects on people living and working near power lines and facilities, particularly high voltage power lines. The Australian Radiation and Nuclear Protection Safety Agency (ARPANSA) has published on its website a draft standard for exposure to magnetic fields which advocates a full-time exposure limit of 100 microtesla (a microtesla is a unit of measurement for magnetic strength), and a higher value for occupational exposure.

An assessment of the potential electromagnetic fields for the proposal was undertaken by EMC Services. This assessment found that the strongest magnetic field in a public area is predicted to be outside at the western security fence of the substation. The strengths were not found to exceed the permissible exposure limit of 100 microtesla for the general public. The electric fields within and outside the substation were also within the acceptable limit. The magnetic field drops off rapidly as the separation distance is increased.

Inside the substation building, within 0.5 and 1.1 metres of the 600 volt cabling between the transformer and the rectifier, the power frequency magnetic field is predicted to exceed the limits of 100 microtesla for the general public, and 500 microtesla for occupational personnel, respectively. However, these areas would be fenced off and would only be accessed by appropriately qualified persons.

Without accounting for shielding within the substation, when the substation is fully loaded, the radio frequency electric fields within 65 metres of the substation would not exceed the applicable limit for urban broadcast reception. Within 65 metres of the substation, radio receptions would be impacted, especially for AM reception and high frequency frequency bands. These levels would be reduced somewhat once shielding from the substation building is factored. Given the rail track is more than 30 metres from the 600 volt cabling in the substation,

there would be a low to medium risk for any train communication system which may operate over the medium to high frequency bands. The proposal is not expected to result in any interference to FM radio or television signals as the increase in EME would not significantly add to the existing ambient environment.

Considering the substation floor plan and the typical use of general electronic equipment in the areas, the risk of interference to general electronic equipment would be very low.

7.9.2 Mitigation measures

Construction

No mitigation measures are required.

Operation

The following mitigation measures would be implemented during operation to manage electromagnetic energy:

- During detailed design and commissioning of the substation, detailed analysis and monitoring would be undertaken to determine the electromagnetic energy levels within and outside the substation. Should exceedances of the criteria be found, methods to reduce these exceedances would be implemented.
- The risk of interference to MF band (500 kHz to 3 MHz) radio or communications receiver equipment within 30 metres of the 600 volt cabling would be mitigated by increasing the distance separation between the cabling and the rail track, or by installation of magnetic shielding. This would be determined during detailed design.

7.10 Waste and hazardous materials

7.10.1 Existing environment

The existing contamination status of the site for the proposed substation was described in section 7.1.1.

Based on previous surveys of substation buildings undertaken for other projects (GHD, 2014), the following potentially hazardous and/or contaminated material may be located at the existing substation site:

- equipment containing oil
- asbestos-containing materials
- synthetic mineral fibre
- lead-based paint
- lead dust
- polychlorinated biphenyl (PCBs)
- CFC and HCFC refrigerants.

7.10.2 Impact assessment

Construction of the proposed substation

The main waste generated during construction would be excess spoil (up to about 1200 cubic metres) from excavations. General waste, such as surplus pipe and cabling associated with connecting the site to services would also be produced. Careful planning of construction activities would ensure that the volume of surplus materials is minimised. The small scale of the

proposal means that only a small volume of waste is likely to be generated in comparison to other larger infrastructure construction projects.

The proposal has the potential to disturb buried asbestos during works at the site for the proposed substation.

The fit out stage would also generate small volumes of waste associated with off cuts from communications and electrical cables.

Given the preliminary waste classification data (i.e. special waste asbestos – refer to section 7.1.1), contaminated materials may be encountered during construction. To ensure the safety of the community and construction personnel, appropriate measures would be implemented to manage, remediate and dispose of contaminated materials. Measures to manage contaminated materials are provided in section 7.1.3. Measures to manage waste and hazardous materials are provided in section 7.10.3.

Decommissioning and removal of the existing Granville Substation

Potentially hazardous and/or contaminated material and spoil may be encountered during the works as noted in section 7.10.1. These materials have the potential to result in health impacts for construction workers and the general public if works within the substation are not undertaken using the correct methods. The mitigation measures outlined in section 7.1.3 and 7.10.3 would be implemented to ensure that impacts of hazardous materials is minimised.

All decommissioning and demolition wastes would be appropriately managed through the implementation of measures provided in section 7.10.3. All waste would be collected and stored on the existing substation site, prior to disposal in accordance with relevant Sydney Trains' guidelines and the *Waste Classification Guidelines* (EPA, 2014).

Operation

The only waste generated during operation would be related to periodic maintenance and general personnel waste. This would include materials such as electrical wiring that would be disposed of in accordance with Sydney Trains' existing procedures and the *Waste Classification Guidelines* (EPA, 2014).

7.10.3 Mitigation measures

Construction

The following mitigation measures would be implemented during construction:

Waste management

- Wastes generated by the proposal would be managed in accordance with the *Waste Classification Guidelines* (EPA, 2014) and in accordance with the waste minimisation hierarchy as follows:
  - avoidance, where possible
  - treated, as required and reused on-site
  - recycled, either within the process or off-site
  - where other alternatives are not possible, wastes would be disposed of at appropriately licensed waste management facilities.

Hazardous materials

A hazardous materials management plan would be prepared as part of the CEMP. It would include the following measures:

- The removal, handling and disposal of any asbestos waste would be undertaken by an appropriately licensed contractor , and in accordance with:
  - *Code of Practice for the Safe Removal of Asbestos 2005*
  - *Code of Practice for the Management and Control of Asbestos in Workplaces 2005*.
- An occupational hygienist would be responsible for conducting asbestos fibre air monitoring, visual clearance inspections and issuing clearance certificates after the completion of any removal works.
- Work would cease in the vicinity of any potential asbestos materials which have not been previously identified. The material would be analysed for the presence of asbestos. In the event the material is disturbed prior to work ceasing, the provisions of an Asbestos Removal Control Plan or similar would be followed, including seeking advice from a suitably qualified and experienced professional.
- Lead dust would be removed from the substation building by a qualified hazardous material removal contractor and should be subject to ongoing monitoring and inspections by an Occupational Hygienist to ensure compliance with the relevant legislation and Australian Standards.
- All known and presumed occurrences of polychlorinated biphenyl's would be handled and disposed of in accordance with the procedure documented within ANZECC *Identification of PCB-containing Capacitors – An information booklet for electricians and electrical contractors 1997*. Removal would be undertaken by a suitable licenced hazardous material removal contractor and would be disposed of to a suitably licenced facility.
- In the event synthetic material fibres are found on site, they would be handled and disposed of in accordance with the *National Code of Practice for the Safe Use of Synthetic Mineral Fibres*.
- Where required, any materials classified as Hazardous Waste would be treated, or an immobilisation approval obtained, in accordance with Part 10 of the *Protection of the Environment Operations (Waste) Regulation 2014* prior to off-site disposal.

Operation

No mitigation measures are required.

7.11 Cumulative impacts

7.11.1 Existing or potential projects

A search of the Department of Planning and Environment website was undertaken on 27 July for major projects located within the Parramatta and Holroyd LGAs. There were no current applications for major project developments in the vicinity of the proposal site.

A search of the development application tracking database for Parramatta and Holroyd councils was undertaken on 21 and 27 July 2015. Applications in the study area relate mainly to residential modifications located to the south of the proposal site and commercial operations along Parramatta Road.

7.11.2 Impact assessment

No major applications for development in close proximity to the proposal site have been lodged. Construction of a number of smaller scale projects may occur in the local area, however the cumulative impacts of the proposal and such small scale projects are expected to be relatively minor and manageable with the implementation of mitigation measures outlined in sections 7.5.3 and 7.11.3.

7.11.3 Mitigation measures

No mitigation measures are required.

8. Environmental management and mitigation

This section provides an outline of the environmental management requirements for the proposal, and a consolidated list of mitigation measures that form the environmental management framework.

8.1 Environmental management plans

8.1.1 Construction

Transport for NSW's ISO 14001 accredited Environmental Management System (EMS) would be used to manage 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.

A CEMP would be prepared for the proposal. The CEMP would provide a centralised mechanism through which all potential environmental impacts would be managed. The CEMP would document mechanisms for achieving compliance with the commitments made in this REF, the conditions of approval and other relevant statutory approvals. The plan would address (at a minimum) the following elements:

- water and soil management
- noise and vibration management
- air quality management
- traffic and transport management
- heritage management
- waste management
- community and stakeholder communication.

The plan would be prepared by the contractor/s for the proposal and would be reviewed and endorsed by Transport for NSW prior to the commencement of construction. Implementation and compliance with the CEMP would be monitored by Transport for NSW for the duration of construction. One of the minimum requirements in terms of the tender for the contractor/s is that they have an environmental management plan capable of meeting the requirements of ISO 14001.

8.1.2 Operation

For the operational phase, environmental issues and impacts would be managed under Sydney Trains' existing operational EMS and through the mitigation measures in section 8.2. The substation would also operate in accordance with Sydney Trains' existing EPL (EPL No. 12208).

8.2 Summary of mitigation measures

The REF has identified a range of environmental impacts with the potential to occur as a result of the proposal. Table 8.1 provides a summary of the measures proposed to mitigate and manage the potential impacts of the proposal.

The measures listed in Table 8.1 may be revised in response to submissions raised during public display of the REF. Transport for NSW would consider the final environmental

management commitments when making a determination on the proposal. Following determination, the finalised mitigation measures would guide subsequent phases of the proposal. Any contractor/s selected to undertake work would be required to undertake all works in accordance with these measures, the conditions of approval and any other relevant statutory approvals

Environmental management measures to be implemented during the proposal are listed in Table 8.1. These measures have been consolidated from those included in section 7 of the REF.

Table 8.1 Mitigation measures

Issue	ID number	Mitigation measure
Construction		
Soils and water quality – general erosion and water management	A.1	A soils and water quality sub-plan would be prepared as part of the CEMP. It would include the following measures: • Spoil and groundwater management and disposal requirements based on the findings of the geotechnical and contamination investigation report (GHD, 2015). • An erosion and sedimentation (the E&S Control Plan), which would be maintained and updated as required to ensure it is representative of the actual site works at any one time. • Sediment and erosion control devices (as per the E&S Control Plan) to minimise transport of sediment and materials in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004). These devices would be inspected regularly and immediately after rainfall to ensure effectiveness over the duration of works. Any damage to erosion and sediment controls would be rectified immediately. • Control measures are to be document in the E&S Control Plan for the management and control of sediment tracking onto the local road network. • Maintenance and checking of the erosion and sedimentation controls would be undertaken on a regular basis and any subsequent records retained. Sediment would be cleared from behind barriers/sand bags on a regular basis as required and all controls would be managed to ensure they work effectively at all times. • Any soils excavated that are to be used as backfill would be appropriately stored until required. • Disturbed areas would be restored at the completion of works. • Spill kits would be maintained on-site at all times. • Machinery would be checked daily to ensure that no oil, fuel or other liquids are leaking as part of site pre starts. • A refuelling procedure for site plant and equipment in accordance with Transport for NSW's *Chemical Storage and Spill Response Guidelines* (2015). • All water discharges would be undertaken in accordance with Transport for NSW's Water Discharge and Re-use Guideline (2012). • The existing drainage systems would remain operational during construction. • Clean water would be diverted around the worksite in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).
	A.2	If dewatering is required during construction, the water would be tested (and treated if necessary) prior to re-use, discharge or disposal in accordance with Transport for NSW's *Water Discharge and Re-use Guideline* (2012).
Soils and water quality – management of contaminated soils	A.3	A Detailed Site Investigation would be undertaken to confirm the nature and extent of contamination within the site for the proposed substation; specific requirements for further investigation and remediation; and/or management requirements of any contamination. Recommendations from the Detailed Site Investigation would be incorporated into a Remediation Action Plan (RAP) if required, to be implemented during construction.

Issue	ID number	Mitigation measure
	A.4	The Detailed Site Investigation and RAP (if required) would be prepared in consultation with Transport for NSW and would be undertaken in accordance with applicable guidelines, including but not limited to: • National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013 • Guidelines for Consultants Reporting on Contaminated Sites (DECCW, 2011) • EPA Waste Classification Guidelines (2014) • AS4482 Guide to investigation and sampling of site with potentially contaminated soil (2005) • NSW EPA Sampling Design Guidelines (1995)
	A.5	If required, the RAP would identify measures to be implemented to ensure that the contamination is appropriately managed in accordance with relevant legislation and guidelines listed above.
	A.6	Where required, any materials classified as Hazardous Waste would be treated, or an immobilisation approval obtained, in accordance with Part 10 of the Protection of the Environment Operations (Waste) Regulation 2014 prior to off-site disposal.
	A.7	An 'unexpected finds protocol' would be prepared and included in the CEMP to assist with the identification, assessment, management, health and safety implications, remediation and/or disposal (at an appropriately licenced facility) of any potentially contaminated soil and/or water.
	A.8	In the event that indicators of contamination are encountered during construction (such as odours or visually contaminated materials), work in the area would cease until an appropriately qualified person can advise on the need for further investigation, remediation or other action.
Flora and fauna	B.1	Access to the site and the extent of vegetation clearing would be restricted to the access driveway (as shown in Figure 5.1 and Figure 7.1).
	B.2	The CEMP and construction plans would clearly document the location and full extent of the vegetation disturbance required. These areas would be clearly marked to avoid disturbance to adjacent retained vegetation, and exclusion fencing would be installed around trees to be retained.
	B.3	The trees proposed for removal would be replaced and/or offset in accordance with Transport for NSW's *Vegetation Offset Guide* unless otherwise agreed with or directed by Transport for NSW.
	B.4	Approval would be obtained in accordance with Transport for NSW's *Application for Removal or Trimming of Vegetation* for the trimming, cutting, pruning or removal of trees or vegetation where the impact has not been identified in this REF.
	B.5	Consultation with Parramatta City Council would be undertaken and any necessary approvals obtained prior the removal of trees 5 and 7.
	B.6	A vegetation management sub-plan would be prepared as part of the CEMP. It would include the following measures: • The management of trees that are being retained would be consistent with the Australian Standard *AS4970-2009 Protection of trees on development sites* (incorporating Amendment No. 1 (March 2010)). • Tree removal, maintenance and protection work would be undertaken by a qualified arborist with appropriate competencies recognised within the Australian Qualification Framework, with a minimum of five years of continual experience within the industry of operational amenity arboriculture, and covered by appropriate and current types of insurance to undertake such works.

Issue	ID number	Mitigation measure
	B.6 cont.	• The following activities would be excluded from the tree protection zones of retained trees: – storage of materials, plants or equipment – installation of site sheds or portable toilets – excavations, trenching, ripping or cultivation of soils – modification of existing soil level or addition of fill materials – disposal of waste materials and chemicals (both solid or liquid) – mechanical removal of vegetation – pedestrian or vehicular movement. • Tree protection zones and associated controls, storage and movement restrictions would be implemented for trees 4, 8, and 17 as outlined in Appendix C. • A protective fence would be installed maintained between the proposal site and trees 9 to 16. • Tree 13 would be retained and protected. • If works are required within the tree protection zones, they would be restricted to the area outside of the structural root zone to avoid disturbing the stability and health of the trees. • Any root pruning required within the structural root zone would be approved and conducted by the project arborist. Any digging and pruning of roots within the structural root zone would be conducted by hand for a clean cut. Only roots with a diameter of less than five centimetres would be pruned. • Once construction is complete, retained trees would be re-inspected by the project arborist and where necessary, remedial work (as outlined in Appendix C) would be undertaken to reduce the risk to people and property.
	B.7	Any vegetation planted on-site would consist of locally endemic native species, unless otherwise agreed with Transport for NSW, following consultation with Parramatta City Council where relevant, and/or Sydney Trains.
	B.8	Weed control mitigation and management strategies would be documented and implemented in accordance with the *Noxious Weeds Act 1993*. This would include procedures to reduce the spread of weeds via vehicles and machinery, such as visual inspection of vehicles prior to exit from site to ensure they are clear of plant material.
	B.9	Weeds would be managed and disposed of in accordance with the requirements of the *Noxious Weeds Act 1993* and/or the *Weeds of National Significance Weed Management Guide*.
Noise and vibration	C.1	Mitigation measures documented in *Construction Noise Strategy* (Transport for NSW, 2012) would be adopted where feasible and reasonable, as specified in Tables 6-1 and 6 2 of Appendix D.
	C.2	A noise and vibration management plan would be prepared as part of the CEMP in accordance with the *Construction Noise Strategy* (Transport for NSW, 2012) and the *Interim Construction Noise Guideline* (DECC, 2009). It would include the following measures: • Sensitive receivers would be identified and marked on plans. • Works would be scheduled during recommended standard hours where practicable. • All equipment and construction methodologies would be selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made.

Issue	ID number	Mitigation measure
	C.2 cont	• All site workers would be educated as to the potential for noise impacts on sensitive receivers and land uses and encouraged to take practical and reasonable measures to minimise impact during the course of their activities. This would include: – toolbox talks covering avoiding the use of outdoor radios during the night period – avoiding shouting and slamming doors – where practicable, machines would be operated at low speed or power and switched off when not being used, rather than left idling for prolonged periods – avoiding dropping materials from height and metal to metal contact where practicable. • Truck drivers would be informed of designated vehicle routes, parking locations and the requirement to minimise engine idling. • Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on construction vehicles and mobile plant regularly used on-site and for any out of hours work. • Where noise and vibration levels during the works are predicted to exceed acceptable levels after implementation of general work practices, the additional mitigation measures included in Table 6-1 and 6-2 of Appendix D would be implemented where reasonable and feasible. • Nearby receivers would be notified of the works prior to commencement. Notification would include expected noise levels, duration of the works and a method of contact (Transport for NSW's 1800 775 465 number). • A process for complaints management as outlined in section 6.4.1.
	C.3	If out of hours works are required, the contractor would prepare and submit a Transport for NSW Out of Hours Work Assessment (3TP-PR-065) and Application Form (9TP-FT-079) for approval prior to the works being undertaken. All out of hour works and activities outside the recommended standard hours are to be undertaken with additional mitigation measures in accordance with the *Construction Noise Strategy* (Transport for NSW, 2012).
	C.4	Where construction is required within the safe working buffer distance, alternative work methods such as smaller equipment should be considered. If no alternative work method is feasible or reasonable then compliance vibration monitoring should be undertaken where works are required within the safe working buffer distances and include: • Site tests to review the measured frequency content to determine the structural damage criteria as per Table 3-6 and Table 3-7 of the Noise and Vibration assessment (Appendix D) for standard dwelling and for heritage structures respectively. • Continuous vibration monitoring with a visual alarm installed to warn the equipment operator when the structural damage vibration criteria (considering frequency content) is exceeded.
Air quality	D.1	An air quality management sub-plan would be prepared as part of the CEMP. It would include the following measures: • All plant and machinery would be fitted with emission control devices complying with the Australian Design Standards. • Machinery would be turned off when not in use and not left to idle for prolonged periods. • Vehicle movements would be limited to designated entries and exits, haulage routes (to be determined during preparation of the traffic management plan, and in consultation with Roads and Maritime Services and Council) and parking areas. • Dust generation would be monitored visually, and where required, dust control measures such as water spraying would be implemented to control the generation of dust. • Any waste produced on-site would be stored and stockpiled for removal off-site daily, to reduce the production of dust.

Issue	ID number	Mitigation measure
	D.1 cont.	• Materials transported to and from the site would be covered to reduce dust generation in transit. • Access points would be inspected to determine whether sediment is being transferred to the surrounding road network. If required, sediment would be promptly removed from roads to minimise dust generation. • Stabilising any excavated areas as soon as practicable. • Stockpile management would be undertaken in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004). • Material stockpiles awaiting removal from site that are inactive for a period of greater than one week would be stabilised (seeded or covered). • Fixed hoses would be used to dampen exposed surfaces to minimise dust generation, where required. • Shade cloth would be fastened to the perimeter fence on the proposal site to minimise dust transported from the site during construction.
Traffic and transport	E.1	A traffic management sub-plan would be prepared as part of the CEMP. It would include the following measures: • Traffic and access would be managed in accordance with *Traffic Control at Work Sites* (RTA, 2010) and in consultation with Roads and Maritime Services, Parramatta City Council and Holroyd City Council. • Residents, property owners would be notified of any access restrictions in advance of work commencing. • Appropriate traffic management controls would be implemented, including precautionary signs, illuminated warning devices, manual and/or electronic traffic control, and the provision of temporary barriers and markers, to control pedestrians and traffic access to and around the proposal site.
		• Safe access points to the proposal site would be established, including safety measures such as security fencing and/or barriers, maintaining sight distance requirements, signage and the provision of traffic management measures. • Detail of the required approvals and permits (Council and RMS) required to be obtained prior to works, including any approvals associated with temporary lane closures and / or speed reduction zones. • The requirements of the *Roads Act 1993* would be followed at all times prior to and during all work (including notice requirements, consultation and consent/concurrence requirements for work within public and classified roads). • Heavy vehicles would be restricted to the specified routes. • Oversized deliveries would be undertaken in accordance with the requirements of Council, Roads and Maritime Services and NSW Police.
	E.2	In consultation with Parramatta City Council, consideration would be given to implementing eight tonne load restrictions on the local roads connecting with Railway Parade, including Jamieson Street, The Avenue, Smith Street, Margaret Street and Milton Street.
	E.3	The driveway access to the site would be designed in accordance with the requirements of the ASA standard for access roads (Transport for NSW, 2014) and in consultation with Parramatta City Council.
Land use and socio-economic issues	F.1	The CEMP would specify the approach to consultation during construction, the communication tools to be used, and response protocols. Specific consultation tasks to be undertaken include: • Advising affected landholders of the proposal, the construction hours and duration of work, and supplying a contact number for any queries relating to the work. • Displaying accurate public information signs while work is in progress and until site restoration has been completed.
Visual amenity	G.1	Shade cloth or similar material would be attached to the site fencing to minimise views of the worksite.
	G.2	The worksite would be left in a tidy manner at the end of each work day.

Issue	ID number	Mitigation measure
Heritage	H.1	All heritage items in the immediate vicinity of the proposal site would be marked on site plans, and avoided.
	H.2	A heritage induction would be provided to all workers before construction commences informing them of the location of heritage items within the study area and guidelines to follow if unanticipated heritage items or deposits are located during construction.
	H.3	If previously unidentified indigenous or non-indigenous heritage/archaeological items are uncovered during construction works, all works in the vicinity of the find shall cease and the Transport for NSW Project Manager and Environmental Planning Manager (EPM) notified. Appropriate advice shall be sought from a suitably qualified heritage consultant/archaeologist (and in consultation with the relevant division of OEH, as required). Works in the vicinity of the find shall not re-commence until clearance has been received from the heritage consultant/archaeologist and the Transport for NSW EPM.
Waste and hazardous materials	I.1	Wastes generated by the proposal would be managed in accordance with the *Waste Classification Guidelines* (EPA, 2014) and in accordance with the waste minimisation hierarchy as follows: • avoidance, where possible • treated, as required and reused on-site • recycled, either within the process or off-site • where other alternatives are not possible, wastes would be disposed of at appropriately licensed waste management facilities.
	I.2	A hazardous materials management plan would be prepared as part of the CEMP. It would include the following measures: • The removal, handling and disposal of any asbestos waste would be undertaken by an appropriately licensed contractor , and in accordance with: – *Code of Practice for the Safe Removal of Asbestos 2005* – *Code of Practice for the Management and Control of Asbestos in Workplaces 2005.* • An occupational hygienist would be responsible for conducting asbestos fibre air monitoring, visual clearance inspections and issuing clearance certificates after the completion of any removal works. • Work would cease in the vicinity of any potential asbestos materials which have not been previously identified. The material would be analysed for the presence of asbestos. In the event the material is disturbed prior to work ceasing, the provisions of an Asbestos Removal Control Plan or similar would be followed, including seeking advice from a suitably qualified and experienced professional. • Lead dust would be removed from the substation building by a qualified hazardous material removal contractor and should be subject to ongoing monitoring and inspections by an Occupational Hygienist to ensure compliance with the relevant legislation and Australian Standards. • All known and presumed occurrences of polychlorinated biphenyl's would be handled and disposed of in accordance with the procedure documented within ANZECC *Identification of PCB-containing Capacitors – An information booklet for electricians and electrical contractors 1997*. Removal would be undertaken by a suitable licenced hazardous material removal contractor and would be disposed of to a suitably licenced facility. • In the event synthetic material fibres are found on site, they would be handled and disposed of in accordance with the *National Code of Practice for the Safe Use of Synthetic Mineral Fibres*. • Where required, any materials classified as Hazardous Waste would be treated, or an immobilisation approval obtained, in accordance with Part 10 of the Protection of the Environment Operations (Waste) Regulation 2014 prior to off-site disposal.

Issue	ID number	Mitigation measure
Operation		
Noise and vibration	J.1	Transformers, rectifiers and other electrical equipment on site would be well maintained and operated according to specifications.
	J.2	Operational noise monitoring would be undertaken at regular periods to assess compliance against operational noise criteria.
	J.3	If the results of monitoring indicate that operational noise levels are significantly higher than those modelled for the REF, the use of mufflers or other acoustic treatment methods would be investigated.
	J.4	Maintenance operations would be scheduled during the day.
	J.5	Any noise complaints would be managed in accordance with the process for complaints management outlined in section 6.4.1.
Air quality	K.1	Switchgear and management of SF6 would be maintained in accordance with standard management procedures.
Visual amenity	L.1	The detailed design of the proposal would take into account relevant urban design and visual considerations.
Electromagnetic energy	M.1	During detailed design and commissioning of the substation, detailed analysis and monitoring would be undertaken to determine the electromagnetic energy levels within and outside the substation. Should exceedances of the criteria be found, methods to reduce these exceedances would be implemented.
	M.2	The risk of interference to MF band (500 kHz to 3 MHz) radio or communications receiver equipment within 30 metres of the 600 volt cabling would be mitigated by increasing the distance separation between the cabling and the rail track, or by installation of magnetic shielding. This would be determined during detailed design.

9. Conclusion

This section provides a conclusion to the REF, including a summary of the proposal justification and the findings of the REF.

This REF considers the potential impacts of the proposal to construct a new substation at Granville. It has been prepared by GHD on behalf of Transport for NSW to assist with determination of the proposal under Part 5 of the EP&A Act.

9.1 Justification of the proposal

The proposal forms part of Transport for NSW's Power Supply Upgrade Program, which is being undertaken to meet the actual and projected increase in power demands on the Sydney Trains electrical network. The power supply study undertaken for the network identified that a new substation was required in the Granville area to provide additional capacity and improve reliability for the operation of trains along the North Shore, Northern and Western Line, and the Airport, Inner West and South Line. This would allow for the decommissioning of the existing Granville Substation, which has reached the end of its operational life.

The construction of Granville Junction Substation would increase the capacity of the power supply network in the area. Without this increase in power supply, the rail network would not have sufficient capacity to meet the power supply needs of the increase in the number of trains, and the increase in the number of air-conditioned trains.

9.2 Summary of REF findings

The REF has considered the potential impacts of the proposal. It has been prepared in accordance with Part 5 of the EP&A Act, and in particular, the requirements of section 111 of the Act, and clause 228 of the Regulation. The REF has documented the potential environmental impacts of the proposal, considering both potential positive and negative impacts, and recommending management and mitigation measures to protect the environment where required.

9.2.1 Clause 228 considerations

Clause 228 of the Regulation specifies the matters that must be taken into account, for the purposes of Part 5 of the Act, when consideration is being given to the likely impact of an activity on the environment. The potential impacts of the proposal have been considered in sections 7.1 to 7.11 of the REF. The Clause 228 matters and how they relate to the proposal are considered in Appendix A.

9.2.2 Ecologically sustainable development

Transport for NSW is committed to ensuring that its projects are implemented in a manner that is consistent with the principles of sustainable development. These principles would be incorporated into the management systems for the proposal.

Appendix A summarises how the principles of ecologically sustainable development adopted by the EP&A Act have been addressed by the REF process.

A sustainability assessment of the proposal against the *NSW Sustainable Design Guidelines* (Transport for NSW, 2013) was undertaken as outlined in section 5.5.

9.2.3 Significance of impacts

Whilst some potentially negative impacts may result from the proposal, these impacts would be short-term and localised and are not considered to be significant. Section 8.2 of the REF provides the mitigation measures that would be implemented to reduce the potential for impacts and manage the environmental performance of the proposal.

9.3 Conclusion

The REF identifies that the proposal would have the potential for both positive and negative impacts, and it identifies mitigation measures to reduce or manage the negative impacts.

Environmental investigations were undertaken during preparation of the REF to assess the potential environmental impacts.

There are considered to be no significant environmental issues associated with the proposal.

In the short-term, there may be minor adverse impacts associated with construction. Key issues identified include:

- potential short-term noise impacts during construction
- temporary loss of about four on-street parking spaces
- removal of three trees for the new site access
- management of potential hazardous materials.

Operational impacts include:

- the presence of a new structure in the landscape, which would be visible to passing traffic and pedestrians, and from some residences opposite the site on Railway Parade
- loss of two on-street parking spaces on Railway Parade.

Any potential adverse impacts resulting from the proposal are considered manageable through the implementation of mitigation measures in section 8.2.

In conclusion, the proposal is needed so that the power supply for the rail network has sufficient capacity for future increases in the number of services and also the type of rolling stock. It is considered that the adverse environmental impacts would be generally short-term and localised in nature. With the adoption and implementation of the proposed mitigation and management measures listed in section 8.2 the potential environmental impacts of the proposal would be adequately mitigated and managed, and are not considered to be significant.

10. References

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Appendices

Appendix A – Clause 228 factors and ecologically sustainable development considerations under the EP&A Act

Table A.1 Clause 228 considerations

Clause 228 factor	Summary of results	Potential impact
(a) Any environmental impact on a community	The proposal has the potential to result in amenity related impacts in the vicinity of the works. These impacts would be managed through the implementation of the proposal environmental management plan. No long-term environmental impacts are predicted.	Short-term – minor negative Long-term – none
(b) Any transformation of a locality	The proposal would be located adjacent to rail infrastructure zoned land which adjoins the road network. It would not result in the transformation of this locality.	None
(c) Any environmental impact on the ecosystems of the locality	The proposal would require the removal of three trees. No environmental impact on the ecosystems is anticipated.	Minor
(d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality	The proposal would require the removal of three trees.	Minor
(e) 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	The proposal would not result in any impact on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value.	None
(f) Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974*)	No impacts on protected fauna within the meaning of the *National Parks and Wildlife Act 1974* are predicted.	None
(g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air	The proposal would not endanger any species of plant, animal or other form of life.	None
(h) Any long-term effects on the environment	Other than the introduction of a new structure in the landscape, the proposal would not to have any long-term impacts on the environment.	None
(i) Any degradation of the quality of the environment	The proposal has the potential to result in minor impacts to environmental quality during the construction period. These impacts would be managed through the implementation of mitigation measures. No long-term impacts to the quality of the environment are predicted.	Short-term - minor negative Long-term - none
(j) Any risk to the safety of the environment	The construction of the proposal is not considered to result in any risk to the safety of the environment. Safety in the vicinity of the proposal would be managed by the contractor/s.	None
(k) Any reduction in the	The proposal would not result in any reduction in the range	None

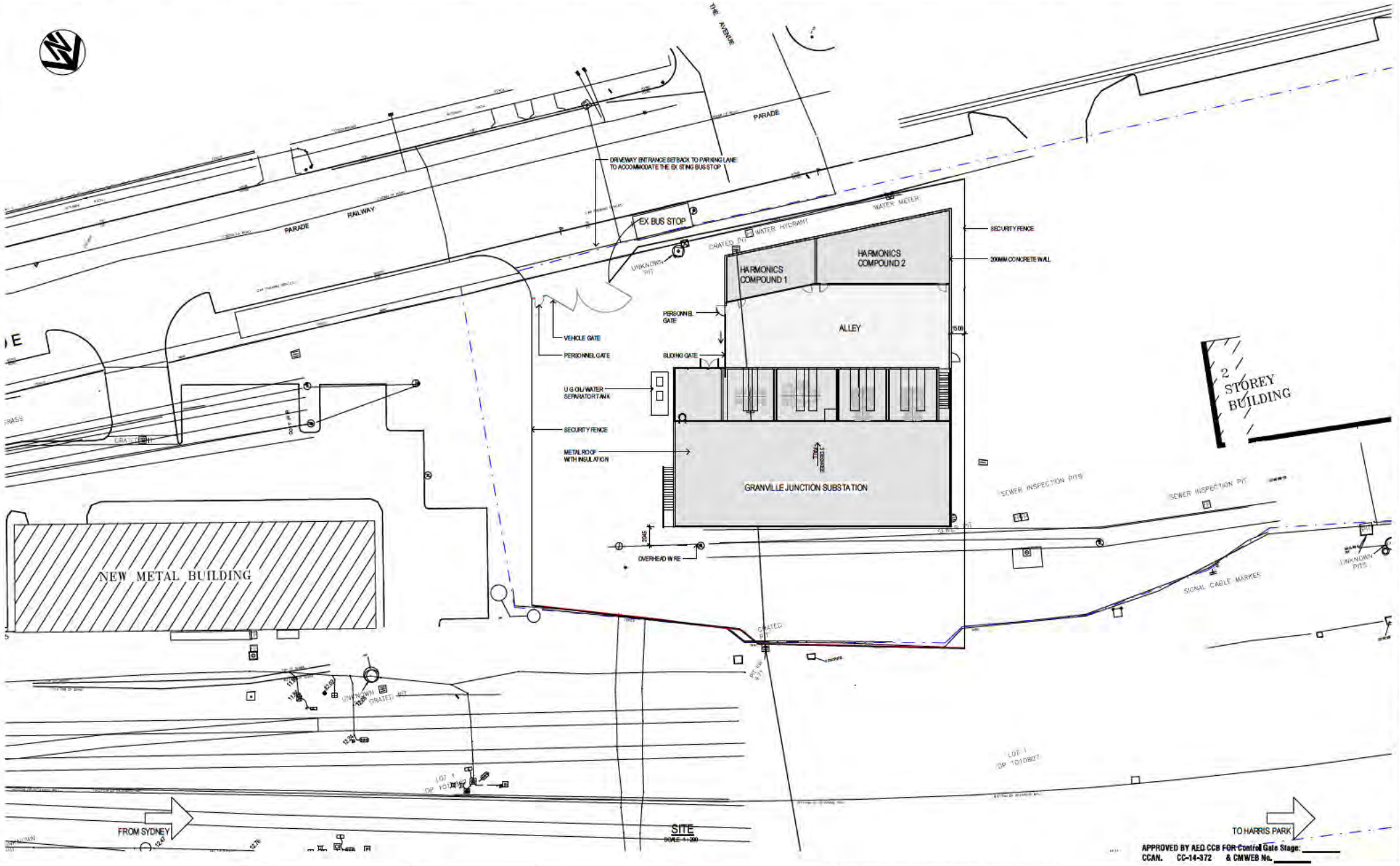
Clause 228 factor	Summary of results	Potential impact
range of beneficial uses of the environment	of beneficial uses of the environment.	
(l) Any pollution of the environment	The proposal had the potential to result in minor short-term erosion and air quality impacts during construction. These impacts would be managed through the implementation of the CEMP. Operation of the proposal would not produce any emissions and no long-term pollution impacts are predicted.	Short-term - minor negative Long-term – none
(m) Any environmental problems associated with the disposal of waste	Waste created during the works period would be removed from site and recycled where possible.	None
(n) Any increased demands on resources (natural or otherwise) that are, or are likely to become in short supply	The proposal would not increase the demand on any resources that are or are likely to become in short supply.	None
(o) Any cumulative environmental effect with other existing or likely future activities	No significant cumulative impacts were identified as a result of the interaction of the proposal with other projects.	None
(p) any impact on coastal processes and coastal hazards, including those under projected climate change conditions	The proposal would not impact on coastal processes and coastal hazards.	None

Table D.2 ESD considerations under the EP&A Act

Principle	Definition	Comment
Precautionary principle	This principle states that 'if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation'.	A range of environmental assessments have been undertaken during the preparation of this REF to ensure that the potential environmental impacts can be understood with a high degree of certainty. There are not considered to be any threats of serious or irreversible environmental damage. The proposal has evolved to avoid environmental impact where possible and mitigation measures would be implemented to minimise impacts. No mitigation measures have been deferred due to a lack of scientific certainty. The proposal is therefore considered to be consistent with the precautionary principle.
Intergenerational equity	The principle states, 'the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations'. In other words, we should ensure that future generations do not inherit a degraded environment.	The proposal site has been previously disturbed during previous uses, and development of the rail corridor. The proposal would not result in any impacts that are likely to impact on the health, diversity or productivity of the environment for future generations. The proposal would benefit future generations as the increase in power supply would allow more trains services to be introduced on to the network which would improve public transport.
Conservation of biological diversity and ecological integrity	This principle states that the 'diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and	The study area is located in a modified urban environment. No potential impacts to biological diversity and ecological integrity were identified.

Principle	Definition	Comment
	improved to ensure their survival'.	
Improved valuation, pricing and incentive mechanisms	This principle requires that 'costs to the environment should be factored into the economic costs of a project'.	The cost of environmental resources includes the costs incurred to protect the environment. The mitigation measures imposed to minimise the adverse impacts of this proposal would result in economic costs to the construction and operation of the proposal. This indicates the valuation of environmental resources has been assigned. The proposal has been designed to minimise adverse impacts on the environment by confining work to a defined area and implementing appropriate mitigation measures when impacts are expected.

Appendix B – Concept design plans



APPROVED BY AEO CCB FOR Control Gate Stage: _____
CCAN. CC-14-372 & CMWEB No. _____

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A1 Original | Coordinate System: MGA Zone 56 | Height Datum: A.H.D. | Scale: 1:200

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SCALE 1:200 AT ORIGINAL SIZE

CONSTRUCTOR

CLIENT
NSW GOVERNMENT | Transport for NSW

GHD

DRAWN	A TSANG	14.04.2015
DESIGNED	A TSANG	14.04.2015
DRG CHECK	A FRENCH	14.04.2015
DESIGN CHECK	A MILLER	14.04.2015
APPROVED	S PUSENJAK	14.04.2015

GRANVILLE JUNCTION SS
MAIN SOUTH LINE 21,735km
GRANVILLE JUNCTION SS PROJECT - PSU
SITE PLAN
PLAN

FILE No. 21-24678 | 1 OF 5
STATUS PRE-CONCEPT DESIGN
DRG No. 2759-GHD-AR-176205 | A | EDMS No. CV0176205 | A

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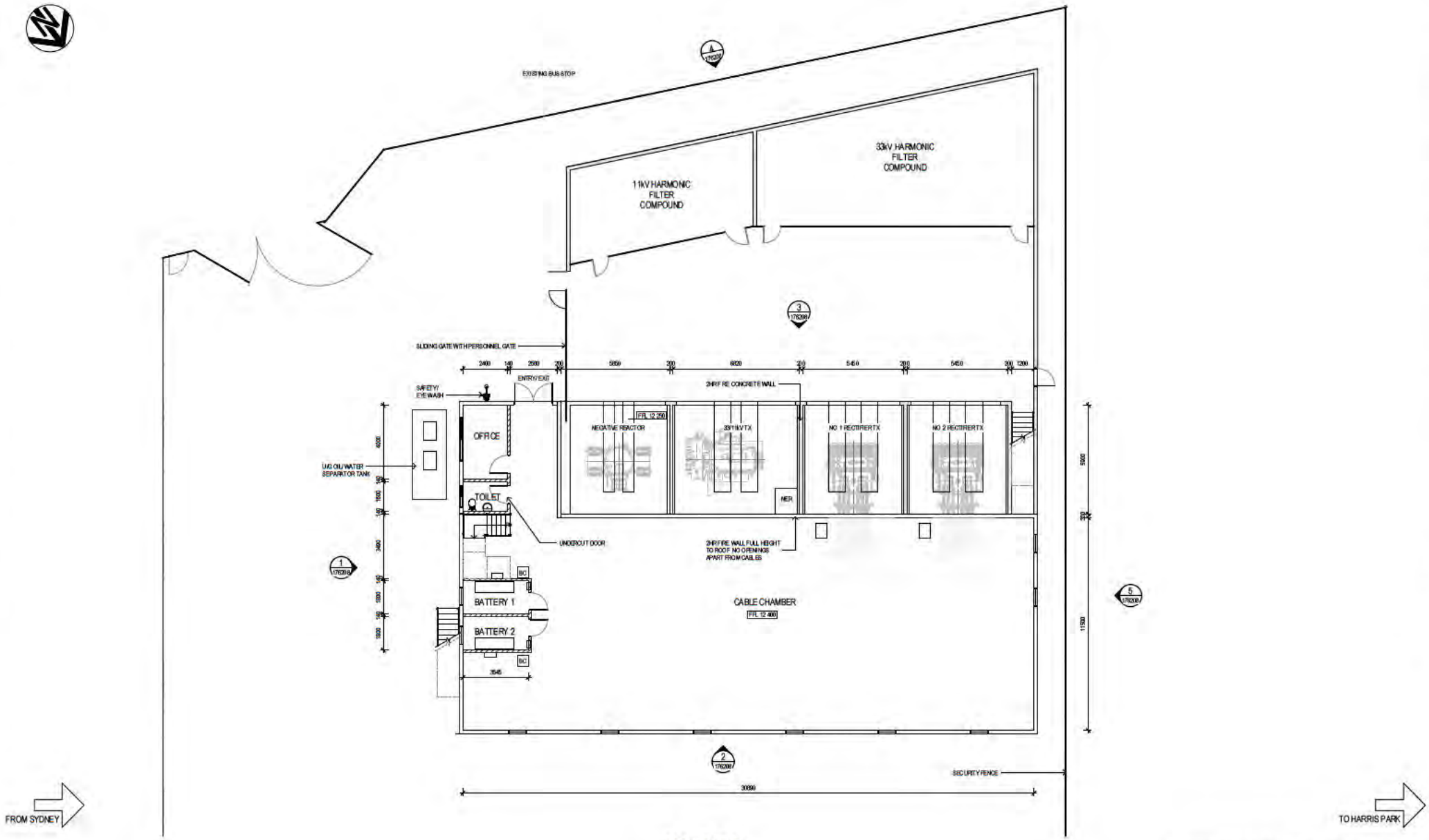

GROUND LEVEL
SCALE 1 : 100

APPROVED BY AEO CCB FOR Control Gate Stage: _____
CCAN. CC-14-372 & CNWEB No. _____

No.	BY	DATE	DESCRIPTION	APPD.
A	AT	14.04.2015	PRE-CONCEPT ISSUE	SMP

A1 Original | Coordinate System: MGA Zone 56 | Height Datum: A.H.D. | Scale: 1 : 100

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SCALE 1:100 AT ORIGINAL SIZE

CONSTRUCTOR

CLIENT
NSW GOVERNMENT | Transport for NSW

GHD

DRAWN	A TSANG	14.04.2015
DESIGNED	A TSANG	14.04.2015
DRG CHECK	A FRENCH	14.04.2015
DESIGN CHECK	A MILLER	14.04.2015
APPROVED	S PUSENJAK	14.04.2015

GRANVILLE JUNCTION SS
MAIN SOUTH LINE 21,735km
GRANVILLE JUNCTION SS PROJECT - PSU
GROUND LEVEL
PLAN

FILE No. 21-24678 | 2 OF 5
STATUS PRE-CONCEPT DESIGN
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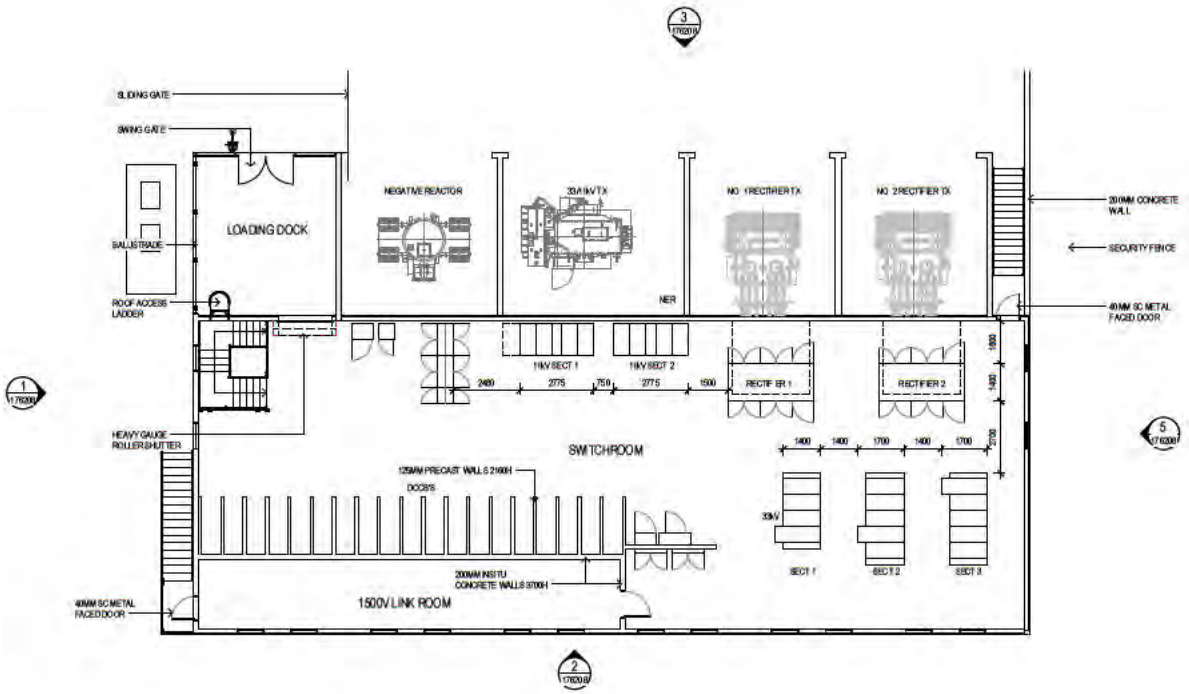

SWITCHROOM LEVEL
SCALE 1: 100

FROM SYDNEY

TO HARRIS PARK

APPROVED BY AEO CCB FOR Control Gate Stage: _____
CCAN. CC-14-372 & CNWEB No. _____

No.	BY	DATE	DESCRIPTION	APPD.
A	AT	14.04.2015	PRE-CONCEPT ISSUE	SMP

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SCALE 1:100 AT ORIGINAL SIZE

CONSTRUCTOR

CLIENT
NSW GOVERNMENT | Transport for NSW

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DESIGNED	A TSANG	14.04.2015
DRG CHECK	A FRENCH	14.04.2015
DESIGN CHECK	A MILLER	14.04.2015
APPROVED	S PUSENJAK	14.04.2015

GRANVILLE JUNCTION SS
MAIN SOUTH LINE 21,735km
GRANVILLE JUNCTION SS PROJECT - PSU
SWITCHROOM LEVEL
PLAN

FILE No. 21-24678 | 3 OF 5
STATUS PRE-CONCEPT DESIGN | ©
DRG No. 2759-GHD-AR-176207 | A | EDMS No. CV0176207 | A

File Name: C:\Users\atsang\Documents\Revit Local Files\21-24678-GRANVILLE SS_atsang.rvt
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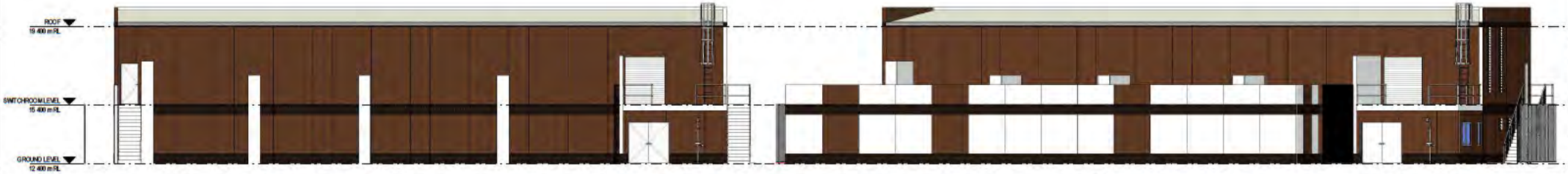
2 176206 NORTHERN ELEVATION
SCALE 1:100



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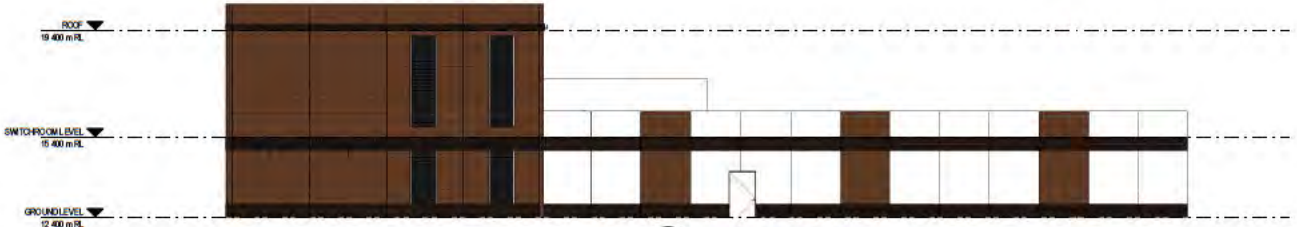

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CCAN. CC-14-372 & CMWEB No. _____

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CONSTRUCTOR

CLIENT
NSW GOVERNMENT Transport for NSW

GHD

DRAWN	A TSANG	14.08.2015
DESIGNED	A TSANG	14.08.2015
DRG CHECK	A FRENCH	14.08.2015
DESIGN CHECK	A MILLER	14.08.2015
APPROVED	S PUSENJAK	14.08.2015

GRANVILLE JUNCTION SS

MAIN SOUTH LINE 21,735km

GRANVILLE JUNCTION SS PROJECT - PSU ELEVATIONS & MATERIAL PALETTE

ELEVATIONS

FILE No. 21-24678 | 4 OF 5

STATUS PRE-CONCEPT DESIGN

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No.	BY	DATE	DESCRIPTION	APPD.
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CONSTRUCTOR

CLIENT

NSW GOVERNMENT Transport for NSW

GHD

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DESIGNED	A TSANG	14.08.2015
DRG CHECK	A FRENCH	14.08.2015
DESIGN CHECK	A MILLER	14.08.2015
APPROVED	S PUSENJAK	14.08.2015

GRANVILLE JUNCTION SS

MAIN SOUTH LINE 21.735km

GRANVILLE JUNCTION SS PROJECT - PSU

PERSPECTIVE NORTH EAST VIEW

PERSPECTIVE

FILE No. 21-24678 | 3 OF 3

STATUS PRE-CONCEPT DESIGN

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CCAN. CC-14-372 & CMWEB No._____

No.	BY	DATE	DESCRIPTION	APPD.
A	HD	14.08.2015	PRE-CONCEPT ISSUE	SMP

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CONSTRUCTOR

CLIENT

NSW GOVERNMENT Transport for NSW

GHD

DRAWN	H DE GUZMAN	14.08.2015
DESIGNED	A TSANG	14.08.2015
ORG CHECK	A FRENCH	14.08.2015
DESIGN CHECK	A MILLER	14.08.2015
APPROVED	S PUSENJAK	14.08.2015

GRANVILLE JUNCTION SS

MAIN SOUTH LINE 21,735km

GRANVILLE JUNCTION SS PROJECT - PSU

PERSPECTIVE SOUTH EAST VIEW

PERSPECTIVE

FILE No. 21-24678 | 1 OF 3

STATUS PRE-CONCEPT DESIGN

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No.	BY	DATE	DESCRIPTION	APPD.
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CONSTRUCTOR

CLIENT

NSW GOVERNMENT Transport for NSW

GHD

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DESIGNED	A TSANG	14.08.2015
ORG CHECK	A FRENCH	14.08.2015
DESIGN CHECK	A MILLER	14.08.2015
APPROVED	S PUSENJAK	14.08.2015

GRANVILLE JUNCTION SS

MAIN SOUTH LINE 21.735km

GRANVILLE JUNCTION SS PROJECT - PSU

PERSPECTIVE SOUTH WEST

PERSPECTIVE

FILE No. 21-24678 | 2 OF 3

STATUS PRE-CONCEPT DESIGN

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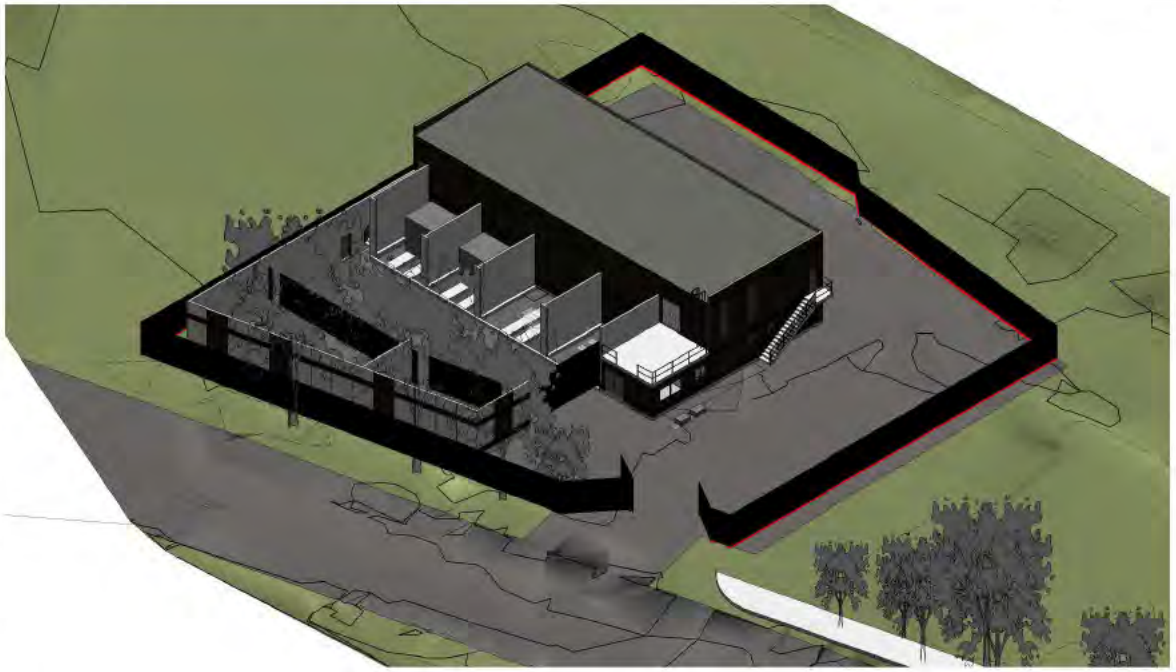

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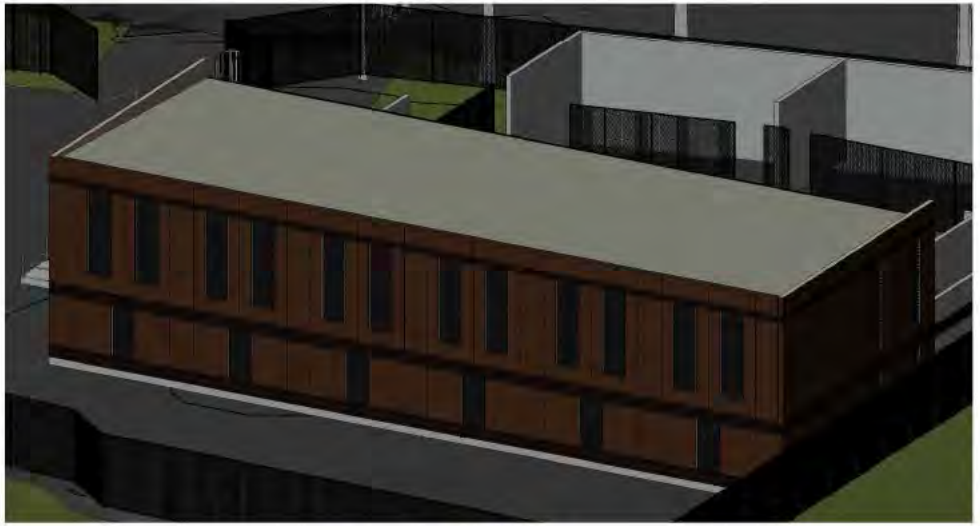
NOT TO SCALE



PERSPECTIVE - AERIAL FROM NORTH
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APPROVED BY AEO CCB FOR Control Gate Stage: _____
CCAN. CC-14-372 & CMWEB No. _____

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CONSTRUCTOR

CLIENT
NSW GOVERNMENT Transport for NSW

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DESIGNED	A TSANG	14.08.2015
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DESIGN CHECK	A MILLER	14.08.2015
APPROVED	S PUSENJAK	14.08.2015

GRANVILLE JUNCTION SS

MAIN SOUTH LINE 21,735km

GRANVILLE JUNCTION SS PROJECT - PSU
AERIAL PERSPECTIVES
PERSPECTIVE

FILE No. 21-24678 | 5 OF 5
STATUS PRE-CONCEPT DESIGN
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CCAN. CC-14-372 & CMWEB No. _____

No.	BY	DATE	DESCRIPTION	APPD.
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A1 Original | Coordinate System: MGA Zone 56 | Height Datum: A.H.D. | Scale: NTS

CONSTRUCTOR

CLIENT

NSW GOVERNMENT | Transport for NSW

GHD

DRAWN	V LEE	14.08.2015
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DESIGN CHECK	A MILLER	14.08.2015
APPROVED	S PUSENJAK	14.08.2015

GRANVILLE JUNCTION SS

MAIN SOUTH LINE 21.735km

GRANVILLE JUNCTION SS PROJECT - PSU
PHOTOMONTAGE SOUTH EAST VIEW
PERSPECTIVE

FILE No. 21-24678 | 1 OF 3

STATUS PRE-CONCEPT DESIGN

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CCAN. CC-14-372 & CMWEB No. _____

No.	BY	DATE	DESCRIPTION	APPD.
A	AT	14.08.2015	PRE-CONCEPT ISSUE	SMP

A1 Original | Coordinate System: MGA Zone 56 | Height Datum: A.H.D. | Scale: NTS

CONSTRUCTOR

CLIENT

NSW GOVERNMENT | Transport for NSW

GHD

DRAWN	V LEE	14.08.2015
DESIGNED	A TSANG	14.08.2015
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DESIGN CHECK	A MILLER	14.08.2015
APPROVED	S PUSENJAK	14.08.2015

GRANVILLE JUNCTION SS

MAIN SOUTH LINE 21.735km

GRANVILLE JUNCTION SS PROJECT - PSU PHOTOMONTAGE SOUTH WEST VIEW

PERSPECTIVE

FILE No. 21-24678 | 2 OF 3

STATUS PRE-CONCEPT DESIGN

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APPROVED BY AEO CCB FOR Control Gate Stage: _____
CCAN. CC-14-372 & CMWEB No. _____

No.	BY	DATE	DESCRIPTION	APPD.
A	AT	14.08.2015	PRE-CONCEPT ISSUE	SMP

AT Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D. | Scale: NTS

CONSTRUCTOR

CLIENT

NSW GOVERNMENT | Transport for NSW

GHD

DRAWN	V LEE	14.08.2015
DESIGNED	A TSANG	14.08.2015
DRG CHECK	A FRENCH	14.08.2015
DESIGN CHECK	A MILLER	14.08.2015
APPROVED	S PUSENJAK	14.08.2015

GRANVILLE JUNCTION SS

MAIN SOUTH LINE 21,735km

GRANVILLE JUNCTION SS PROJECT - PSU PHOTOMONTAGE NORTH VIEW

PERSPECTIVE

FILE No. 21-24678 | 3 OF 3

STATUS PRE-CONCEPT DESIGN

DRG No. 2759-GHD-AR-176215 | A | EDMS No. CV0176215 | A

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Plot Date & Time: 14/08/2015 3:05:55 PM

Appendix C – Flora, fauna and arborist assessment

Memorandum

23 July 2015

To	Steven Pusenjak		
Copy to	Amanda Raleigh		
From	Gary Leonard and Jayne Tipping	Tel	02 9239 7100
Subject	Granville Junction Substation – Flora, fauna and tree assessment	Job no.	21/24678

1 Assessment approach and methodology

A desktop assessment, involving review of aerial photographs of the site, regional vegetation mapping (NSW NPWS 2002) and threatened species databases, was undertaken to assess the likelihood of occurrence of threatened, populations or ecological communities (or their habitats) listed under the TSC or EPBC Acts at or within the vicinity of the proposal site.

A site assessment was undertaken on 7th July 2015 by Gary Leonard, GHD senior ecologist and arborist (International Society of Arboriculture membership no. 212238 and Arboriculture Australia (membership no. 2173)). The purpose of this inspection was to verify the findings of the desktop review and to determine if any native vegetation or potential habitat for threatened or migratory biota would be impacted by the project. Vegetation at the proposal site was inspected and flora species identified. Searches for threatened flora species were undertaken in garden beds. A fauna habitat assessment was undertaken, including identification of food trees and foraging resources, inspection of trees for hollows and searches of trees and gardens for evidence of fauna activity (e.g. nests, scratches on trunks etc).

A tree assessment was also undertaken. Reference was made to Parramatta City Council's Tree Preservation Order (1996). In accordance with Council's Tree Preservation Order (TPO), a tree has been defined as "…any tree, whether indigenous, endemic, exotic or introduced species, with a height equal to or exceeding 5 metres….". The trees at the proposal site were assessed individually by conducting a ground based Visual Tree Assessment (VTA) (see Lonsdale 2001). No diagnostic equipment was used. No aerial inspection (climbing) or tree root mapping was undertaken.

The height and crown spread of trees were estimated and the diameter at breast height (DBH) measured using a forestry measuring tape. For each tree, the Safe Useful Life Expectancy (SULE) was determined based on the health and structure of the subject tree (after Barrell, 2001; IACA 2010). The SULE code is presented in Table 1 in Appendix 1.

Tree Protection Zones (TPZ) were calculated based on the tree's DBH as outlined in *Australian Standard 4970 'Protection of Trees on Development Sites'* (SA, 2009).

Tree Structural root zones (SRZ), comprising the area around the base of a tree required for the tree's stability in the ground were calculated as follows:

SRZ radius = (D x 50)0.42 x 0.64, where: D = trunk diameter (in metres) measured above the root buttress.

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2 Existing environment

2.1 Flora

Vegetation at the proposal site is shown in Photo 1 and Photo 2, and on Figure 1. The vegetation consists of trees and shrubs which have (mostly) been planted within a formed garden bed that comprises a visual and aesthetic buffer along the southern fence of the proposal site adjacent to the footpath and Railway Parade. There are an additional two trees located near the north-western corner of the proposal site that have also been considered as part of this assessment.

The following species recorded at the proposal site are indigenous to Parramatta Local Government Area (LGA) (see James, McDougall and Benson 1999): Swamp Oak (*Casuarina glauca*), Blackwood (*Acacia melanoxylon*), Port Jackson Fig *(Ficus rubiginosa*), White Cedar (*Melia azedarach*) and Spiny-head Mat-rush *(Lomandra longifolia*), although White Cedar is included in the list of exempt tree species under the TPO (Parramatta City Council 1996), meaning that specimens of White Cedar may be removed without Council approval. Non-indigenous native species include Brush Box (*Lophostemon confertus*) and Lemon-scented Gum (*Corymbia citriodora*).

One tree species recorded at the proposal site, Camphor Laurel (*Cinnamomum camphora*), is an environmental weed and is included as an exempt species under Parramatta Council's TPO (1996). One noxious weed species, Green Cestrum (*Cestrum parqui*) was recorded, adjacent to the Camphor Laurel (Tree 15). Green Cestrum has a 3 classification under the *Noxious Weeds Act 1993*, which means that it is a 'Regionally Controlled Weed' which must be fully suppressed and destroyed. Moth Vine (*Araujia sericifera*) a climbing environmental weed was recorded growing on the southern boundary fence near Tree 15.

All vegetation on and adjacent to the proposal site consists of plant material which has been planted or has self-recruited within the last twenty five years. There are no patches of endangered ecological communities (EECs) or native vegetation communities within or in the vicinity of the proposal site (NSW NPWS 2002).

Searches were carried out for *Marsdenia viridiflora* subsp. *viridiflora* (an endangered population) and the following threatened plant species previously recorded in the locality (within a 10km radius of the proposal site): Downy Wattle *(Acacia pubescens)*, *Grevillea juniperina*, Nodding Geebung *(Persoonia nutans*), Spiked Rice-flower *(Pimelea spicata*) and *Pultenaea parviflora* (see James, McDougall and Benson 1999), although it is apparent that the mulched beds beneath a dense canopy would not provide appropriate habitat for these species. No threatened plant species were recorded at the proposal site during this survey.

Figure 1 Location of surveyed trees

2.2 Tree assessment

All of the trees at the proposal site are planted or have self-recruited and are mostly in good condition. Details for each tree are outlined in Table 2 in Appendix 1. Locations of surveyed trees are indicated in Figure 1. The Bottle Brush specimens at the proposal site were not included in the arboricultural assessment, because they are less than 5m tall and therefore do not constitute a “tree” as defined under the TPO (see Parramatta City Council 1996).

2.3 Fauna and fauna habitats

The vegetation at the proposal site does not provide habitat of importance for any native fauna species. The planted trees would provide only limited habitat value (foraging and roosting resources) for common, generalist bird species typical of highly modified urban landscapes. No bird calls were heard and only one bird, an Australian Magpie (*Gymnorhina tibicen*) was observed within the garden bed along Railway Parade. No nests were observed and no scratches, indicating the presence of arboreal mammals, were recorded on the leaders of smooth-barked trees. As the trees in the proposal site are no older than 25 years, there are no hollows in leaders or branches that would provide potential roost sites for hollow-dependent fauna, such as possums or microchiropteran bats. Small, common garden skinks may occur in the garden beds, but none were detected during the site inspection. There are no waterbodies to provide habitat for frogs.

It is possible that Tree 13, the Port Jackson Fig, is occasionally visited by frugivorous birds as well as Grey-headed Flying-foxes (*Pteropus poliocephalus*) during fruiting (February to July). This single specimen is early mature and is unlikely to be an important habitat feature for the local population of this highly mobile threatened fauna species.

The proposal site does not provide habitat for any other threatened species or migratory birds given the lack of native vegetation, habitat features or connectivity with areas of known habitat.

Photo 1 View of vegetation at the proposal site, looking north-west towards the rail corridor. Tree 17 (White Cedar) is visible in background

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Photo 2 View of vegetation at the proposal site, looking north-east towards the rail corridor

3 Impact assessment

The proposed driveway construction would require the removal of three planted trees (Trees 5, 6 and 7) from the formed garden bed along the southern fence line of the proposal site. Trees 5 and 6 are Brush Boxes and Tree 7 is a Swamp Oak. Tree 6 is in moderate form and health, possibly as a result of suppression from adjacent trees. Trees 5 and 7 are in good form and vigour. Trees 4 (Black Wood) and 8 (Lemon-scented Gum) which occur on either side of the proposed driveway would require protection during tree removal and driveway construction. Ground disturbance or excavation within the TPZ and SRZs of these trees could disturb the health and stability of the trees.

Trees 9-16 that occur along the southern boundary of the proposal site should also be protected during construction activities given their proximity to the proposal site. Trees 9 (Brush Box) and 13 (Port Jackson Fig) in particular are likely to have SRZs that extend into the proposal site and that may be affected by construction activities. Tree 13 also has two surface roots that extend from the leader towards the proposal site that may require pruning (see **Error! Reference source not found.**).

Photo 3 Surface roots extending from Tree 13 into site

Tree 17 (White Cedar), growing outside the north-western corner of the proposal site should be protected, if the proposed construction of the substation permits, although as previously noted, this is an exempt species in the Parramatta LGA.

Mitigation measures for the protection of retained trees are presented in Section 4 below.

The proposal site is highly modified and does not contain any intact native vegetation. The planted trees on site are early mature and therefore no hollows occur within any of these specimens. The removal of three planted trees would have a negligible impact on native flora and fauna within the locality. The proposed development would not have a significant impact on any threatened or migratory biota and there is no requirement for referral to the Commonwealth Minister for the Environment based on ecological grounds.

4 Mitigation measures

The following mitigation measures are recommended for implementation during construction:

- Access to the site and the extent of vegetation clearing should be restricted to the driveway construction area as identified in Figure 1.
- If possible, the recommended Tree Protection Zones for Trees 4 (Black Wood) and 8 (Lemon-scented Gum) (see Table 2 in Appendix 1) should be protected during tree removal and driveway construction by temporary fencing, as indicated in Appendix 2.
- Tree 17, the mature White Cedar, probably also has good habitat value for local birds, as well as providing some visual screening and the TPZ should be fenced, if possible, to avoid disturbance during construction of the substation.
- A protective fence line should be maintained between the proposal site and Trees 9-16.
- As a guide, the following activities should be excluded from the TPZs of retained trees unless otherwise stated:
  - storage of materials, plants or equipment
  - installation of site sheds or portable toilets
  - excavations, trenching, ripping or cultivation of soils
  - modification of existing soil level or addition of fill materials
  - disposal of waste materials and chemicals (both solid or liquid)
  - mechanical removal of vegetation
  - pedestrian or vehicular movement.
- If works are required within TPZs, they should be restricted to the area outside of the SRZ to avoid disturbing the stability and health of the trees. Trees with SRZs which may occur within the proposal site and/or be affected by the works are listed in Table 1 below.

Table 1 Trees with a structural root zone (SRZ) that may extend into the proposal site

Tree no.	Structural Root Zone (m radius)
4	2.76
8	2.13
9	2.65
13	2.78
17	3.88

- Any root pruning required within the SRZ should be approved and conducted by the project arborist. Any digging and pruning of roots within the SRZ should be conducted by hand for a clean cut. Only roots < 5cm may be pruned.
- Tree 13, the early-mature Port Jackson Fig, probably provides the highest habitat value of the trees at the proposal site and should be retained and protected during construction of the substation. Tree 13 has a structural root zone of 2.78 metres and it is likely that these roots extend several metres into the proposal site and may be affected by the proposed construction. The two surface roots that extend from the leader towards the proposal site may also need to be pruned. The arborist should determine, once root pruning has been completed, whether the extent of root pruning has compromised the health and/or stability of the tree, in which case remedial action may be required.
- To protect soil within the TPZ, a layer of organic mulch may be applied (no more than 75 mm thick). Any mulch used should comply with the Australian Standard – composts, soil conditioners and mulches AS4454-2012 (SA 2012).
- Once the construction works are completed, retained trees should be re-inspected by the project arborist who should carry out a more in-depth assessment that would prescribe remedial work where necessary to reduce the risk to people and property. Remedial work may include:
  - pruning of canopy where damage from construction has occurred
  - pruning of dead limbs (dead-wooding)
  - weight reduction of heavy branches
  - removal of diseased branches or poorly attached branches.
- In addition, the retained trees should be monitored after completion of the proposed development to assess their health, vigour and to identify potential hazards. This is of particular importance given the proximity of the trees to areas of public access.
- Tree removal, maintenance and protection work are specialised tasks. To ensure the works carried out are not detrimental to the survival of a tree being retained, or to assist in the safe removal of any tree, the work should be undertaken by a qualified arboriculturist with appropriate competencies recognised within the Australian Qualification Framework, with a minimum of five years of continual experience within the industry of operational amenity arboriculture, and covered by appropriate and current types of insurance to undertake such works.
- Weeds should be managed and disposed of in accordance with the requirements of the *Noxious Weeds Act 1993* and/or the *Weeds of National Significance Weed Management Guide*. Tree 15 (the

Camphor Laurel) should be removed, and the adjacent patch of Green Cestrum, as well as the Moth Vine, growing on the fence nearby should be removed.

5 Reference list

Barrell,J. (2001.), SULE: Its use and status into the new millennium, in Management of mature trees, in *Proceedings of the 4th NAAA Tree Management Seminar*, NAAA, Sydney.

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Lonsdale, D. (1999). *Principles of Tree Hazard Assessment and Management*. Forestry Commission, London.

NSW NPWS (2002) Interpretation Guidelines for the Native Vegetation of the Cumberland Plain, Western Sydney, Map 6. NSW NPWS, Hurstville.

Parramatta City Council (1996) Tree Preservation Order.

Safe Work Australia (2011) Safe Access in tree trimming and Arboriculture. Draft Code of Practice.

Standards Australia (2007). *Australian Standard: pruning of amenity trees, AS 4373 – 2007*, Standards Australia, Sydney.

Standards Australia (2009). Australian *Standard: protection of trees on development sites, AS 4970 – 2009*, Standards Australia, Sydney.

Standards Australia (2012). Australian Standard*: Composts, soil conditioners and mulches, AS 4454 (2012*). Standards Australia, Sydney.

Regards,

Jayne Tipping
Team Leader Ecology

Memorandum

Appendix 1

Table 1 **Safe Useful Life Expectancy (SULE) matrix. The SULE value generated by the below matrix gives an indication of the time a tree is expected to be usefully retained: Adapted from Barrell (2001).**

	1 - Long SULE	2 - Medium SULE	3 - Short SULE	4 - Removal	5 - Move or Replace
A	Trees that appear to be retainable at the time of assessment for >40 years with an acceptable degree of risk, assuming reasonable maintenance.	Trees that appear to be retainable at the time of assessment for 15 to 40 years with an acceptable degree of risk, assuming reasonable maintenance.	Trees that appear to be retainable at the time of assessment for 5 to 15 years with an acceptable degree of risk, assuming reasonable maintenance.	Trees which should be removed within the next 5 years.	Trees which can be readily moved or replaced.
B	Structurally sound trees located in positions that can accommodate for future growth.	Trees that may only live for 15-40 years.	Trees that may only live for another 5-15 years.	Dead, dying, suppressed or declining trees.	Small trees <5 m in height.
C	Trees that could be made suitable for retention in the long term by remedial tree care.	Trees that could live for more than 40 years but may be removed for safety or nuisance reasons.	Trees that could live for more than 15 years but may be removed for safety or nuisance reasons.	Dangerous trees because of instability or loss of adjacent trees.	Young trees less than 15 years old but over 5 m in height.
D	Trees of special significance that would warrant extraordinary efforts to secure their long term retention.	Trees that could live for more than 40 years but may be removed to prevent interference with more suitable individuals or to provide for new planting.	Trees that could live for more than 15 years but may be removed to prevent interference with more suitable individuals or to provide for a new planting.	Dangerous trees because of structural defects.	
E		Trees that could be made suitable for retention in the medium term by remedial tree care.	Trees that require substantial remedial tree care and are only suitable for retention in the short term.	Damaged trees not safe to retain.	
F				Trees that could live for more than 5 years but may be removed to prevent interference with more suitable individuals or to provide for a new planting.	

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1 - Long SULE	2 - Medium SULE	3 - Short SULE	4 - Removal	5 - Move or Replace
G			Trees that are damaging or may cause damage to existing structures within 5 years.	

Memorandum

Table 2 Trees surveyed at the proposal site

Tree no.	Botanical name	Common name	Height (m)	Canopy spread (radius - m)	Condition	DBH (m)	TPZ	SULE	Comments
1	*Casuarina glauca*	Swamp Oak	14	5	Good	0.31	4	2A	
2	**Lophostemon confertus*	Brush Box	12	4	G	0.42	5	2A	
3	**Lophostemon confertus*	Brush Box	12	5	G	0.28	4	2A	
4	*Acacia melanoxylon*	Black Wood	11	6	G	0.63	8	2A	Apparent roost tree
5	**Lophostemon confertus*	Brush Box	10	4	G	0.38	5	2A	Tree to be removed to provide site access Co-dominant leaders
6	**Lophostemon confertus*	Brush Box	11	4	Moderate	0.34	4	3A	Tree to be removed to provide site access Biased leader; suppressed growth; co-dominant leaders
7	*Casuarina glauca*	Swamp Oak	14	3	G	0.29	4	2A	Tree to be removed to provide site access Narrow canopy; suppressed growth
8	**Corymbia citriodora*	Lemon-scented Gum	12	6	G	0.33	4	4A	Environmental Weed; consider eventual removal to provide space for adjacent specimens
9	**Lophostemon confertus*	Brush Box	13	4	M	0.27; 0.28	6	2A	Co-dominant leaders; some reaction wood and included bark

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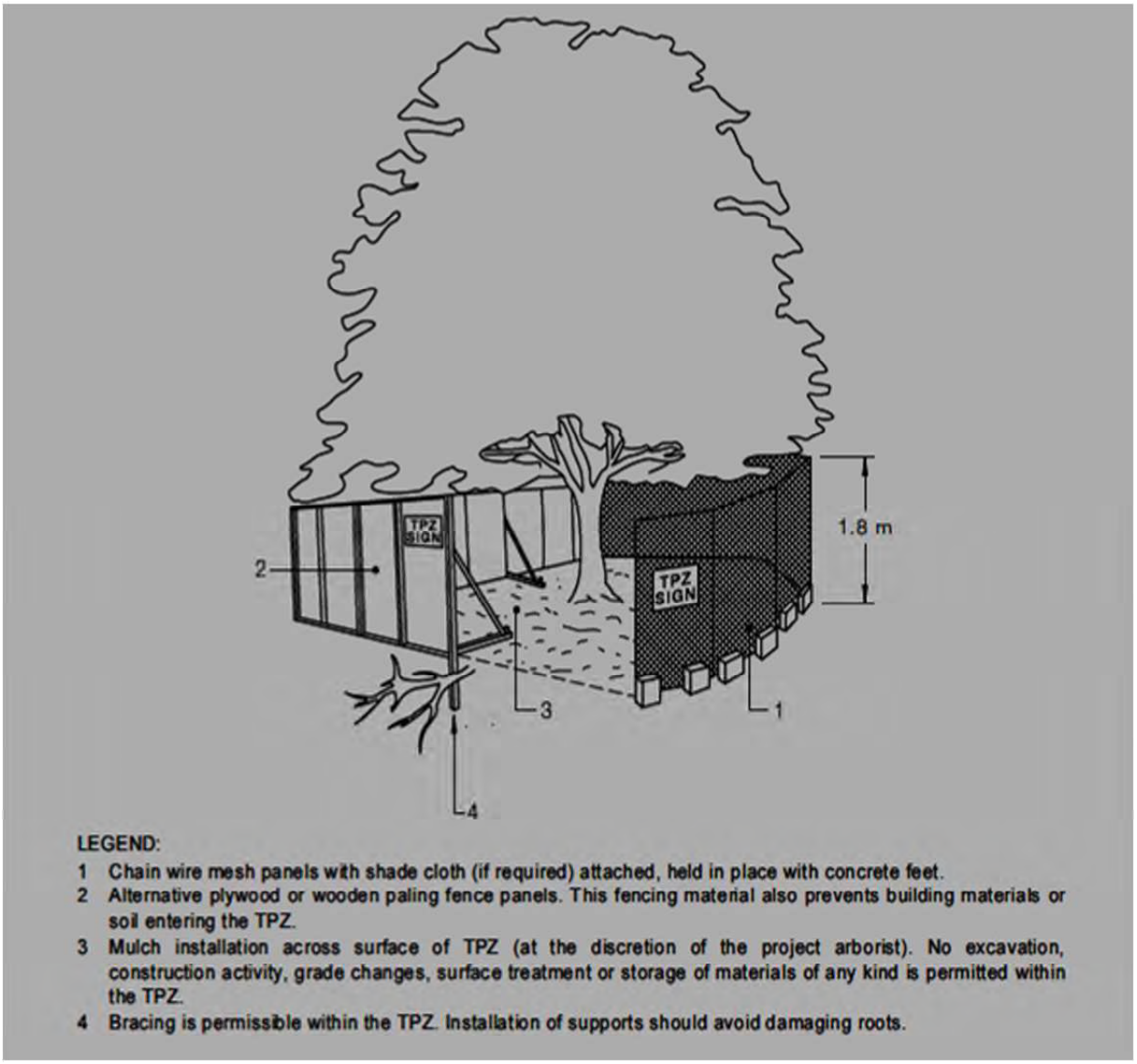
Tree no.	Botanical name	Common name	Height (m)	Canopy spread (radius - m)	Condition	DBH (m)	TPZ	SULE	Comments
10	*Lophostemon confertus*	Brush Box	9	3	M	0.24	3	2A	Suppressed growth; low, narrow branches
11	*Casuarina glauca*	Swamp Oak	14	4	G	0.27	4	2A	
12	*Corymbia citriodora*	Lemon-scented Gum	16	5	G	0.31	4	4A	Environmental Weed; consider eventual removal to provide space for adjacent specimens
13	*Ficus rubiginosa*	Port Jackson Fig	12	6	G	0.30; 0.32	8	1A	Co-dominant leaders. Surface roots extend into proposal site
14	*Lophostemon confertus*	Brush Box	10	4	M	multi	4	2A	
15	*Cinnamomum camphora*	Camphor Laurel	9	4	M	multi	NA	5A	Environmental Weed. Growing on the proposal site side of fence; Green Cestrum growing beneath canopy
16	*Lophostemon confertus*	Brush Box	10	4	M	0.31	4	2A	Biased leader; suppressed growth
16a	*Casuarina glauca*	Swamp Oak	8	3	M	0.25	4	2A	Suppressed growth
17	*Melia azedarach*	White Cedar	12	8	G	multi	8	3A	Growing near the north-western corner of the proposal site. Five leaders. Retain if construction permits.
18	*Melia azedarach*	White Cedar	6	4	M	multi	4	3A	Growing outside the north-western corner of proposal site.

* exotic or non-indigenous native species

Appendix 2

Example of a tree protection zone fence



LEGEND:

1 Chain wire mesh panels with shade cloth (if required) attached, held in place with concrete feet.
2 Alternative plywood or wooden paling fence panels. This fencing material also prevents building materials or soil entering the TPZ.
3 Mulch installation across surface of TPZ (at the discretion of the project arborist). No excavation, construction activity, grade changes, surface treatment or storage of materials of any kind is permitted within the TPZ.
4 Bracing is permissible within the TPZ. Installation of supports should avoid damaging roots.

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Appendix D – Noise and vibration assessment

Transport for NSW

Granville Junction Substation - TPD-14-4121

Noise and Vibration Assessment

September 2015

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Glossary and abbreviations

Term	Description
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L_{A90} descriptor.
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dB(A)	Decibel expressed with the frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at low and high frequencies.
CNS	*Construction Noise Strategy, (Transport for NSW, 2012)*
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
EPA	Environment Protection Authority
ICNG	*Interim Construction Noise Guideline* (DECC, 2009).
INP	*Industrial Noise Policy* (EPA, 2000).
$L_{A90(period)}$	The A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured. This is considered to represent the background noise (eg $L_{A90(15\ min)}$).
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{Amax(period)}$	The maximum sound pressure level over a specified period of time.
Mitigation	Reduction in severity.
Noise sensitive receiver	An area or place potentially affected by noise which includes: • a residential dwelling. • an educational institution, library, childcare centre or kindergarten. • a hospital, surgery or other medical institution. • an active (e.g. sports field, golf course) or passive (e.g. national park) recreational area. • commercial or industrial premises. • a place of worship.
Rating Background Level	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period. This is the level used for assessment purposes.
RNP	*Road Noise Policy* (DECCW, 2011).
Tonality	Noise containing a prominent frequency or frequencies characterised by definite pitch.
V_{rms}	The vibration velocity presented as a root mean square value.
Vibration	The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference. Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).
VDV	Vibration dose value - As defined in BS6472:1992, VDV is given by the fourth root of the integral of the fourth power of the frequency weighted acceleration.

1. Introduction

1.1 Background

Transport for NSW is currently undertaking the Power Supply Upgrade Program (the PSU Program) to meet the actual and projected increase in power demands on the Sydney Trains electrical network. A power supply study undertaken as part of the program by RailCorp in 2012 found that a new junction substation was required in the Granville area to provide additional capacity and improve reliability for the operation of trains along the North Shore, Northern and Western Line, and the Airport, Inner West and South Line.

As part of the PSU Program, Transport for NSW is proposing to construct a new junction substation next to the rail corridor at Granville to address the traction power needs identified by the power supply study.

1.2 The proposal and assessment requirements

The construction and operation of Granville Junction Substation (referred to as 'the proposal' for the purposes of this document) is subject to assessment and determination under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (the EP&A Act). The proposal would be constructed and operated on a site owned by Sydney Trains, located adjacent to the rail corridor (the Airport, Inner West and South Line) on Railway Parade in the suburb of Granville.

The location of the proposal is shown in Figure 2-1. A detailed description of the proposal is provided in the REF.

Transport for NSW commissioned GHD Pty Ltd (GHD) to assess the potential environmental impacts of the proposal, and prepare a Review of Environmental Factors (REF) in accordance with the EP&A Act. This noise and vibration assessment has been prepared as an input to the REF for the proposal.

1.3 Scope of the assessment

This report provides a summary of the results of the noise and vibration assessment of the proposal. The scope of the assessment is detailed in Table 1-1 together with the location in the report where each item has been addressed.

The noise and vibration impact assessment has been undertaken with consideration to the following documents and guidelines:

- *Industrial Noise Policy* (EPA, 2000)
- *Interim Construction Noise Guideline* (ICNG) (DECC, 2009)
- *Assessing Vibration: a Technical Guideline* (DEC, 2006)
- *Road Noise Policy* (RNP) (DECCW, 2011)
- *Construction Noise Strategy,* (Transport for NSW, 2012)
- *Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013).

Background noise monitoring was undertaken at one location selected with consideration given to the *Industrial Noise Policy*.

Table 1-1 Scope of assessment as defined by the project brief

Scope	Addressed in report section
Assessing existing background noise levels by:	
Undertaking long-term noise monitoring at one location representative of the surrounding sensitive receivers for a period of seven days.	2.2
Describing noise survey methodology including equipment details and monitoring location.	2.2.1
Presenting a summary table of monitoring results and detailed monitoring results in the appendix.	2.2.2
Assessing construction noise impacts in accordance with the ICNG and Construction Noise Strategy (TfNSW, 2012), including:	
Providing a description of construction including a review of the construction methodology with regards to staging of works and durations to determine construction scenarios.	4.1
Identifying noise goals during construction.	3.1
Construction noise modelling to predict the impacts from the Granville substation for each construction scenario at sensitive receivers.	4.2
Assessing the potential impacts of construction by comparing the predicted noise levels for each stage of work against the construction noise management levels.	4.2
Assessing construction traffic noise.	4.3
Assessing construction vibration.	4.4
Providing options for reasonable and feasible construction noise measures if required in accordance with the Construction Noise Strategy (Transport for NSW, 2012).	6.1
Assessing operational noise impacts in accordance with the INP, including:	
Modelling noise levels from the Granville substation to predict the impacts at the sensitive receivers.	5
A description of the noise modelling methodology.	5.1
A description of the operational noise criteria including screening sleep disturbance criteria.	3.4.2
Assessing the potential impacts by comparing the predicted noise levels to the operation noise criteria.	5.2
Assessing sleep disturbance impacts during the night-time period.	5.2
Assessing traffic noise from maintenance activities associated with the facility with consideration to the RNP.	5.3
Discussing recommended noise mitigation to meet the noise criteria and provide options for reasonable and feasible operation noise management measures if required.	6.3

2. Existing environment

2.1 Sensitive receivers and land uses

Noise and vibration sensitive receivers are defined based on the type of occupancy and the activities performed in the land use. Sensitive noise and vibration receivers could include both existing and proposed:

- residences
- educational institutes
- hospitals and medical facilities
- places of worship
- passive and active recreational areas such as parks, sporting fields, golf courses. Note that these areas are only considered sensitive when they are in use or occupied
- commercial or industrial premises.

The nearest sensitive receivers and land uses to the proposal site are residences located along:

- Railway Parade, about 20 metres south of the proposal site
- The Avenue, about 50 metres south of the proposal site
- Jamieson Street, about 100 metres south-east of the proposal site.

The assessed sensitive receivers and land uses in close proximity (within 100 metres) of the proposal site are identified in Table 2-1 and shown in Figure 2-1.

Table 2-1 Sensitive receivers and land uses

Receiver type	Receiver ID	Receiver address	Building type
Residential	R1	88 Railway Parade	Single storey
	R2	86 Railway Parade	Single storey
	R3	94 Railway Parade	Single storey
	R4	84 Railway Parade	Single storey
	R5	96 Railway Parade	Single storey
	R6	78-82 Railway Parade	Three storey
	R7	98 Railway Parade	Single storey
	R8	100 Railway Parade	Single storey
	R9	72 Railway Parade	Single storey
	R10	108 Railway Parade	Single storey
	R11	70 Railway Parade	Single storey
	R12	110 Railway Parade	Single storey
	R13	112 Railway Parade	Single storey
	R14	6 The Avenue	Single storey
	R15	8 The Avenue	Single storey
	R16	2 Jamieson Street	Three storey

2.2 Background noise monitoring

2.2.1 Noise monitoring methodology

Noise monitoring was undertaken from 26 June to 8 July 2015 at a single location representative of the nearest sensitive receiver adjacent to the proposal site and is considered representative of the surrounding receivers (refer to Figure 2-1).

Noise monitoring was undertaken to determine background noise levels for the noise assessment. Monitoring was undertaken at a location, which was secure from theft and vandalism and considered representative of the ambient environment in the vicinity of the proposal site.

Noise monitoring was undertaken using a Rion NL52 environmental noise loggers programmed to accumulate L_{A90}, L_{A10} and L_{Aeq} noise descriptors continuously over the entire monitoring period. Equipment details are shown in Table 2-2.

Prior to deployment, a calibration check was performed on the noise monitoring equipment using a sound level calibrator with a sound pressure level of 94 dB(A) at 1 kHz. At completion of the measurements, the meter's calibration was re-checked to ensure the sensitivity of the noise monitoring equipment had not varied. The noise loggers were found to be within the acceptable tolerance of ± 0.5 dB(A).

The data collected by the logger was downloaded and analysed, and any invalid data removed. Invalid data generally refers to periods of time where average wind speeds were greater than 5 m/s, or when rainfall occurred. Meteorological data was sourced from the Bureau of Meteorology's Sydney Olympic Park Automatic Weather Station (ID 066212).

All noise monitoring activities were undertaken and processed in accordance with the INPs long-term monitoring method.

Table 2-2 Noise monitoring location and equipment details

Location	Equipment details	Equipment settings	Site photo
96 Railway Parade	Rion NL-52 Type 1 SN: 131631	A-weighted Fast time response 15 minute intervals Pre-cal: 93.9 dB(A) Post-cal: 93.9 dB(A)	

Figure 2-1 Site location, monitoring location and sensitive receiver locations

2.2.2 Noise monitoring results

Rating background levels and ambient noise levels are summarised in Table 2-3. Daily noise level charts for the entire monitoring period are presented in Appendix A. A detailed description of the acoustic terms can be found in the glossary at the start of this report.

The ambient noise levels are typical of an area influenced by rail traffic noise, road traffic noise and residential urban noise. Intermittent noise sources such as rail movements are generally filtered out of the rating background levels as this is described by the 90th percentile $L_{A90(15min)}$.

Table 2-3 96 Railway Parade, summary of noise monitoring results, dB(A)

Date	Rating background level 90th percentile $L_{A90(15min)}$			Ambient noise levels, $L_{Aeq(period)}$		
	Day	Evening	Night	Day	Evening	Night
26/06/2015	45.6	49.8	46.4	60.5	59.5	55.1
27/06/2015	47.1	49.4	46.2	62.8	57.9	55.6
28/06/2015	44.0	47.8	42.4	59.0	57.2	54.8
29/06/2015	46.0	49.8	45.1	59.5	59.2	54.9
30/06/2015	48.0	45.2	38.3	59.3	59.0	55.7
01/07/2015	45.6	49.2	42.6	59.0	57.8	56.3
02/07/2015	50.6	46.3	41.7	60.1	56.7	54.4
03/07/2015	45.2			58.7		
RBL / average	**46**	**49**	**43**	**60**	**58**	**55**

Note 1: '-' or red text indicates data excluded due to adverse weather as per the INP Appendix B

The noise monitoring results show that the Rating background level for the evening period is higher than that of the daytime period, which is likely to be attributed to peak hour traffic.

3. Compliance criteria

The noise and vibration compliance criteria during operation and construction are presented in the following section. A summary of the noise criteria relevant to this proposal are summarised in Section 3.4.

3.1 Construction noise criteria

3.1.1 Construction noise management levels

The ICNG guideline recommends standard hours for construction activities as Monday to Friday: 7 am to 6 pm, Saturday: 8 am to 1 pm and no work on Sundays or public holidays. The ICNG acknowledges that the following activities have justification to be undertaken outside the recommended standard construction hours assuming that all reasonable and feasible mitigation measures are implemented to minimise the impacts to the surrounding sensitive land uses:

- the delivery of oversized plant or structures that police or other authorities determine to require special arrangements to transport along public roads
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- work where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours
- work which maintains noise levels at receivers to below the noise management levels outside of the recommended standard construction hours.

Table 3-1 and Table 3-2 detail the ICNG construction noise management levels at sensitive land uses and residences, respectively.

Table 3-1 Construction noise management levels at sensitive land uses

Land use	Management level, $L_{Aeq(15min)}$ (when in use)
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)
Industrial premises	External noise level 75 dB(A)
Offices and retail outlets	External noise level 70 dB(A)

Table 3-2 Construction noise management levels at residences

Time of day	Management level $L_{Aeq(15min)}$	How to apply
Recommended standard hours: • Monday to Friday 7 am to 6 pm • Saturday 8 am to 1 pm • No work on Sundays or public holidays	Noise affected Rating background level plus 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of work to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected Rating background level plus 5 dB(A)	A strong justification would typically be required for work outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

3.1.2 Sleep disturbance criteria during construction

The ICNG states that where construction work is planned to extend over more than two consecutive nights, the analysis should include maximum noise levels and the extent and number of times the maximum exceeds the rating background levels.

The INP application notes regarding sleep disturbance recommend that where the $L_{A1(1min)}$ or $L_{A(max)}$ exceeds the $L_{A90(15min)}$ by more than 15 dB(A) outside the bedroom window, a more detailed analysis is required.

The ICNG also refers to the *Environmental Criteria for Road Traffic Noise* (EPA, 1999) for more guidance on sleep disturbance from maximum noise level events. This guideline has since been superseded by the RNP. Both guidelines provide a discussion on research into the effects of maximum noise events on sleep disturbance. The results of this research is aimed at limiting the level of sleep disturbance due to environmental noise and concludes that the L_{Amax} or $L_{A1(1min)}$ level of any noise should not exceed the ambient $L_{A90(15min)}$ noise level by more than 15 dB(A). This guideline takes into account the emergence of noise events, but does not directly limit the number of such events or their highest level, which are also found to affect sleep disturbance.

The RNP provides further guidance, which indicates that:

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

For this assessment the background level plus 15 dB(A) has been used as a screening level assessment of sleep disturbance which is consistent with the INP application notes and the *Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013).

3.1.3 Construction traffic noise criteria

The RNP provides traffic noise target levels for residential receivers in the vicinity of existing roads (Table 3-3). These levels are applied to construction works to identify potential construction traffic impacts and the potential for reasonable and feasible mitigation measures.

The application notes[1] for the RNP state that *"for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion."*

If road traffic noise increases from the construction work is within 2 dB(A) of current levels then the objectives of the RNP are met and no specific mitigation measures are required.

Table 3-3 Construction traffic noise criteria, $L_{Aeq(period)}$, dB(A)

Type of development	Day 7 am to 10 pm	Night 10 pm to 7 am
Existing residence affected by additional traffic on arterial roads generated by land use developments	60 $L_{eq(15hr)}$	55 $L_{eq(9hr)}$
Existing residence affected by additional traffic on local roads generated by land use developments	55 $L_{eq(1hr)}$	50 $L_{eq(1hr)}$
School classrooms	Internal noise level 40 $L_{Aeq(1hr)}$ dB(A) (When in use)	-
Places of worship	Internal noise level 40 $L_{Aeq(1hr)}$ dB(A) (when in use)	Internal noise level 40 $L_{Aeq(1hr)}$ dB(A) (when in use)
Open space (active use)	External noise level 60 $L_{Aeq(15hr)}$ dB(A) (when in use)	-
Open space (passive use)	External noise level 55 $L_{Aeq(15hr)}$ dB(A) (when in use)	-

[1] http://www.environment.nsw.gov.au/noise/roadnoiseappnotes.htm 12 December 2012

3.2 Construction vibration criteria

3.2.1 Human comfort

Vibration has been assessed based on the criteria in *Assessing Vibration: a technical guideline* (DEC February 2006). *British Standard BS 6472:1992, Guide to evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)* is recognised by the guideline as the preferred standard for assessing the 'human comfort criteria'.

Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 3-4 for sensitive receivers.

Whilst the assessment of response to vibration in *BS 6472:1992* is based on vibration dose value and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of a peak value, since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in *BS 5228 – 2, Noise and vibration control on construction and open sites. Code of practice for basic information and procedures for noise and vibration control, Part 2: Vibration,* as shown below in Table 3-5.

Table 3-4 Human comfort intermittent vibration limits (BS 6472:1992)

Receiver type	Period[1]	Intermittent vibration dose value ($m/s^{1.75}$)	
		Preferred value	Maximum value
Residential	Day	0.2	0.4
	Night	0.13	0.26
Educational institutes	When in use	0.4	0.8

Note 1: Day is between 7 am and 10 pm and night is between 10 pm and 7 am

Table 3-5 Guidance on effects of vibration levels for human comfort (BS 5228 – 2)

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

3.2.1 Cosmetic damage

The *Construction noise strategy* refers to BS7385 Part 2 – 1993 *Evaluation and measurement for vibration in buildings Part 2* to assess the effects of transient vibration on structures. The BS 7385 values are presenting in Table 3-6.

Table 3-6 Transient vibration guide values – minimal risk of cosmetic damage (BS 7385-2)

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures. Residential or light commercial type buildings.	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above.

The conservative cosmetic damage value of 15 mm/s has been used in this assessment, where data is not provided in the CNS.

Guidance of limiting vibration values for heritage structures, or other structures particularly sensitive to vibration, is attained with reference to German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures* (refer to Table 3-7). The conservative value of 3 mm/s presented in the 1 Hz to 10 Hz range has been used to derive the safe working distances for heritage structures in this assessment. Note that safe working distances are not provided in the CNS for heritage structures.

Table 3-7 Guideline values for short term vibration on structures (DIN 4150-3) used for heritage structures

Type of structure	Guideline values for velocity, (mm/s)		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]
Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10

3.3 Operational noise criteria

The INP provides guidance on the assessment of operational noise impacts. The guidelines include both intrusive and amenity criteria that are designed to protect receivers from noise significantly louder than the background level and to limit the total noise level from all sources near a receiver. The INP also provides guidance on sleep disturbance impacts.

The INP noise criteria are planning levels and are not mandatory limits required by legislation however the noise criteria will assist the determining authority to assess operational noise impacts. Where noise criteria are predicted to be exceeded, feasible and reasonable noise mitigation strategies should be considered. Feasible and reasonable noise mitigation measures should consider the economic, social and environmental costs and benefits of the development against the noise impacts.

The intrusive noise criteria controls the relative audibility of operational noise compared to the background level at residential receivers. The amenity criteria limits the total level of extraneous noise for all receiver types. Both sets of criteria are calculated and, in the case of continuous noise sources, the lower of the two in each time period normally apply. For noise sources with intermittent characteristics both noise criteria should be assessed independently.

3.3.1 Intrusive criteria

The intrusive criteria are determined by a 5 dB(A) addition to the measured (or adopted) background level with a minimum of 35 dB(A). The INP recommends that the intrusive noise criteria for the evening period should not exceed the daytime period and the night-time period should not exceed the evening period. The intrusive noise criteria are only applicable to residential receivers.

3.3.2 Amenity criteria

The amenity criteria are determined based on the overall acoustic characteristics of the receiver area, the receiver type and the existing level of industrial noise.

Residential receiver areas are characterised into ‘urban’, ‘suburban’, ‘rural’ or other categories based on land uses, the existing level of noise from industry, commerce, and road traffic.

Amenity criteria are also provided for other sensitive land uses such as schools, hospitals, places of worship and recreational areas.

The amenity criteria aim to limit continual increases in noise levels from industrial noise sources and apply to all industrial noise sources at the receiver location, rather than just the noise source from the proposed development. To prevent cumulative noise level increases above the amenity criteria, the INP provides adjustments to the amenity criteria to set a target level for the proposed development. The applicable adjustment is scaled as per INP Table 2.2 and is based on the existing level of industrial noise at the receiver location. The INP amenity criteria are provided in Table 3-8.

Table 3-8 Industrial Noise Policy (EPA, 2000) amenity criteria

Type of receiver	Noise amenity area	Time of day	Recommended $L_{Aeq(period)}$ noise level	
			Acceptable	Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
	Urban / industrial interface	Day	65	70
		Evening	55	60
		Night	50	55
School classroom	All	When in use (highest 1 hour period)	35 (internal)	40 (internal)
Hospital ward	All	When in use (highest 1 hour period)	35 (internal) 50 (external)	40 (internal) 55 (external)
Place of worship	All	When in use	40 (internal)	45 (internal)
Passive recreation	All	When in use	50	55
Active recreation	All	When in use	55	60
Commercial	All	When in use	65	70
Industrial	All	When in use	70	75

3.3.3 Meteorological conditions

Noise propagation can be enhanced by wind conditions and temperature inversions. The INP states:

'Where inversion conditions are predicted for at least 30% (or approximately 2 nights per week) of the total night time in winter, then inversion effects are considered to be significant and should be taken into account in the noise assessment.

Wind effects need to be assessed where wind is a feature of the area. Wind is considered to be a feature where source-to-receiver wind speeds (at 10 metre height) of 3 m/s or below occur for 30 per cent of the time or more in any assessment period (day, evening, night) in any season.'

Therefore noise enhancing meteorological conditions should be included in the assessment unless it can be shown that they do not occur for 30% of the time during any seasonal period.

3.3.4 Modifying factor adjustments

The INP requires that modifying factor adjustments are added to the measured or predicted noise levels if the noise sources contain tonal, low frequency, intermittent or impulsive characteristics, which have the potential to increase annoyance. The modifying factor adjustments are summarised in Table 3-9.

Table 3-9 Industrial Noise Policy (EPA, 2000) modifying factor adjustments

Factor	Assessment/ measurement	When to apply	Correction[1,2]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz • 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive • 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz.	5 dB(A)[2]
Low frequency noise	Measurement of C-weighted and A-weighted level	Measure/assess C and A weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more.	5 dB(A)[2]
Intermittent noise	Subjectively assessed	When the night-time noise level drops to that of the background noise level with a noticeable change in noise level of at least 5 dB(A).	5 dB(A)
Impulsive noise	A-weighted fast response and impulse response	If the difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB.	Apply the difference in measured noise levels as the correction up to a maximum of 5 dB(A)

Note 1: Where two or more modifying factors are present the maximum correction is limited to 10 dB(A).
Note 2: Where a source emits a tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low frequency range.

3.3.5 Sleep disturbance during operation

The *Industrial Noise Policy's – Application Notes* and the *Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013) recommend that where the $L_{A1(1min)}$ or $L_{A(max)}$ exceeds the $L_{A90(15min)}$ by more than 15 dB(A) outside the bedroom window, a more detailed analysis is required.

The RNP provides further guidance, which indicates that:

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

3.3.6 Operational traffic noise

The traffic noise criteria presented in Section 3.1.3 for construction traffic noise would be relevant for operational traffic noise for the proposal.

3.4 Proposal specific criteria

3.4.1 Construction noise

The construction noise criteria for the proposed construction activities during recommended standard hours and outside of the recommended standard hours are provided in Table 3-11 for each sensitive receiver and are based on Table 3-1, Table 3-2 and the *Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013) guidance on sleep disturbance.

3.4.2 Operational noise

The operational noise criteria at the residential receivers surrounding the substation site are provided in Table 3-10 and are based on criteria discussed in Section 3.3.

Table 3-10 Proposal specific operational noise criteria, dBA

Receiver	Time period	Amenity criteria (acceptable noise level)[1,2], $L_{Aeq(period)}$	RBL, $L_{Aeq(15min)}$	Intrusive criteria, $L_{Aeq(15min)}$	Proposal specific noise criteria (external)	Sleep disturbance screening test (external)
Residential receivers	Day	55	46	51	**51 $L_{Aeq(15min)}$**	-
	Evening	45	49 (46[3])	51	**45 $L_{Aeq(evening)}$**	-
	Night	40	43	48	**40 $L_{Aeq(night)}$**	**58 L_{Amax}**

Note 1: With consideration to the *Industrial Noise Policy* (EPA, 2000) 'noise amenity area' classification, the residential receivers surrounding the Granville substation have been classified as 'suburban'.

Note 2: Attended observations during the site visit noted that here were no significant industrial noise sources in the area therefore no adjustments have been applied for the proposal.

Note 3: When evening or night time RBLs are greater than the daytime RBLs, the INP recommends that the daytime RBLs be used for assessment purposes.

Table 3-11 Proposal specific construction noise criteria, dBA

Receiver	Construction noise management level, $L_{Aeq(15min)}$					Sleep disturbance screening test L_{Amax} (external)
	During standard recommended hours		Outside of standard recommended hours			
	7 am to 6 pm Monday to Friday, 8 am to 1 pm Saturday, no work on Sunday or public holidays		Day 7 am to 8 am and 1 pm to 6 pm Saturday, 8 am to 6 pm Sunday & Public Holidays	Evening1 6 pm to 10 pm Monday to Sunday & Public Holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & Public Holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & Public Holidays
	Noise affected	Highly noise affected				
R1: 88 Railway Pde	56	75	51	51	48	58
R2: 86 Railway Pde	56	75	51	51	48	58
R3: 94 Railway Pde	56	75	51	51	48	58
R4: 84 Railway Pde	56	75	51	51	48	58
R5: 96 Railway Pde	56	75	51	51	48	58
R6: 78-82 Railway Pde	56	75	51	51	48	58
R7: 98 Railway Pde	56	75	51	51	48	58
R8: 100 Railway Pde	56	75	51	51	48	58
R9: 72 Railway Pde	56	75	51	51	48	58
R10: 108 Railway Pde	56	75	51	51	48	58
R11: 70 Railway Pde	56	75	51	51	48	58
R12: 110 Railway Pde	56	75	51	51	48	58
R13: 112 Railway Pde	56	75	51	51	48	58
R14: 6 The Avenue	56	75	51	51	48	58
R15: 8 The Avenue	56	75	51	51	48	58
R16: 2 Jamieson St	56	75	51	51	48	58

Note 1: When evening or night time RBLs are greater than the daytime RBLs, the INP recommends that the daytime RBLs be used for assessment purposes.

4. Assessment of construction noise and vibration impacts

4.1 Construction methodology

4.1.1 Construction timing and scheduling

It is anticipated that the majority of work for the proposal would be undertaken during the recommended standard working hours adopted as follows:

- Monday to Friday: - 7 am to 6 pm.
- Saturday: - 8 am to 1 pm.
- Sundays and Public Holidays: - no work.

However, there is potential that some work could be undertaken outside of the standard working hours. This would be limited to scheduled track possession periods and involve activities such as connection to the overhead wiring system, installation of underline crossing, and installation of certain electrical equipment.

The procedure for assessing and approving/rejecting proposals for out of hours works is set out in Figure 2 of the *Construction Noise Strategy, (*Transport for NSW, 2012). The implementation of standard mitigation measures, compliance with maximum sound power levels for plant and equipment, construction hour management and standard community consultation measures are detailed in Section 6 and are based on the objective of the CNS.

At this stage, no detailed construction scheduling information is available.

4.1.2 Construction process

The general construction process can be broken into the following three main scenarios:

- site clearing and demolition of the existing substation
- compaction and earth work
- substation construction work.

4.2 Construction noise impacts

4.2.1 Modelling methodology

For each construction scenario, the potential noise impacts on the surrounding sensitive receivers have been predicted. At present, detailed construction equipment to be used on the proposal is unknown as it would be dependent on the construction contractor and detailed construction methodology. However the noise generating equipment anticipated to be used for each construction scenario is detailed in Table 4-1 with the corresponding sound power level. Noise levels have been obtained from *Construction Noise Strategy* (TfNSW, 2012) and Australian Standard *AS 2436 – 2010 Guide to noise and vibration control on construction, demolition and maintenance sites*. Other equipment may be used, however it is anticipated that they would produce similar noise emissions.

Noise modelling was undertaken using Computer Aided Noise Abatement (CadnaA). CadnaA is a computer program for the calculation, assessment and prognosis of noise exposure. CadnaA

calculates environmental noise propagation according to *ISO 9613 – 2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation.*

The following noise modelling assumptions were made:

- surrounding land was modelled assuming a mixture of hard and soft ground with a ground absorption coefficient of 0.5
- the noise model was used to predict noise levels during typical worst case 15 minute period of operation where the noisiest items of equipment, for each construction scenario, were assumed to be running at full power
- atmospheric absorption was based on an average temperature of 10 °C and an average humidity of 70%
- atmospheric propagation conditions were modelled with favourable wind conditions for noise propagation (downwind conditions) or equivalently a well-developed moderate ground based temperature inversions.

The magnitude of off-site noise impact will be dependent upon a number of factors:

- the intensity and location of activities
- the type of equipment used
- the background noise levels
- intervening terrain and structures
- the prevailing weather conditions.

During any given period, the equipment would operate at maximum sound power levels for only brief stages. At other times, the equipment may produce lower sound levels while carrying out activities not requiring full power or when not in use. It is highly unlikely that all equipment would be operating at their maximum sound power levels at any one time and certain types of equipment would be used for only brief periods during the work.

Table 4-1 Equipment noise levels, dB(A)

Scenario	Construction category	Equipment	Sound power level
S1	Site clearing and demolition work	Bulldozer	108
		Dump truck	108
		Small Machinery (e.g. Jackhammer, Concrete saw)	118
		Chainsaw[1]	106
		Woodchipper	110
		Mobile crane	104
		Excavator	105
S2	Compaction and earth work	Compactor	113
		Vibratory Roller (10 tonne)	114
		Excavator	105
		Dump truck	108
S3	Substation construction work	Mobile crane	104
		Concrete Agitator truck	109
		Concrete Pump	108
		Piling	110
		Road truck	107
		Small Machinery (e.g. Jackhammer, Concrete saw)	118

Note: 1 Chainsaw sound power level source from *Noise Pollution in Forest Environment Due to Forest Operations,* Assoc. Prof. Igor Potocnik PhD, 2010.

4.2.2 Predicted construction noise levels

The predicted noise levels at the ground floor (1.5 metres) and first floor (4.5 metres) of sensitive receivers are detailed in Table 4-2 with receivers exceeding the relevant noise management levels being identified. Bolded results indicate exceedances to the highly noise affected management levels. Exceedances from the construction noise management levels are provided in brackets with positive values indicating potential adverse impacts. Receivers on levels above the first floor would experience noise levels less than or similar to the first floor predicted noise levels.

4.2.3 Discussion of predicted construction noise levels

Noise levels generated due to construction activities are predicted to exceed noise affected noise management levels at all residential receivers.

It is recommended that the *Construction Noise Strategy* (TfNSW, 2012) standard noise mitigation measures detailed in section 6.1.1 be implemented where feasible and reasonable and all potentially impacted residents, as well as the Granville public school and the Granville boys high school should be informed of the nature of the works, expected noise levels, duration of works and a method of contact.

During recommended standard construction hours the *Construction Noise Strategy* (TfNSW, 2012) additional mitigation measures provided in section 6.1.2 require letter box drops and compliance monitoring for the residential receivers identified above.

4.2.4 Out of hours works and sleep disturbance

Some construction activities may be required to be undertaken outside of scheduled construction hours. These would be for example – scheduled track possession periods and involve activities such as connection to the overhead wiring equipment and installation of certain electrical equipment.

These activities are not expected to cause adverse impacts at sensitive receivers. It is recommended that noise monitoring should be conducted at the start of these works to determine compliance with out of hour works noise management levels and sleep disturbance criteria.

Table 4-2 Predicted construction noise levels, dB(A)

Receiver ID	Receiver	Standard recommended hours criteria	S1 – Site clearing and demolition work		S2 – Earth works and compaction		S3 – Substation construction work	
			Ground floor (1.5 m)	First floor (4.5 m)	Ground floor (1.5 m)	First floor (4.5 m)	Ground floor (1.5 m)	First floor (4.5 m)
R1	88 Railway Pde	56	**71 (+15)**	-	**71 (+15)**	-	**73 (+17)**	-
R2	86 Railway Pde	56	**71 (+15)**	-	**71 (+15)**	-	**72 (+16)**	-
R3	94 Railway Pde	56	**71 (+15)**	-	**71 (+15)**	-	**72 (+16)**	-
R4	84 Railway Pde	56	**70 (+14)**	-	**70 (+14)**	-	**72 (+16)**	-
R5	96 Railway Pde	56	**69 (+13)**	-	**70 (+14)**	-	**70 (+14)**	-
R6	78-82 Railway Pde	56	**67 (+11)**	**68 (+12)**	**67 (+11)**	**69 (+13)**	**68 (+12)**	**70 (+14)**
R7	98 Railway Pde	56	**68 (+12)**	-	**69 (+13)**	-	**69 (+13)**	-
R8	100 Railway Pde	56	**67 (+11)**	-	**68 (+12)**	-	**68 (+12)**	-
R9	72 Railway Pde	56	**57 (+1)**	-	**58 (+2)**	-	**58 (+2)**	-
R10	108 Railway Pde	56	**63 (+7)**	-	**64 (+8)**	-	**64 (+8)**	-
R11	70 Railway Pde	56	**56 (0)**	-	**57 (+1)**	-	**57 (+1)**	-
R12	110 Railway Pde	56	**62 (+6)**	-	**63 (+7)**	-	**64 (+8)**	-
R13	112 Railway Pde	56	**62 (+6)**	-	**63 (+7)**	-	**63 (+7)**	-
R14	6 The Avenue	56	**66 (+10)**	-	**67 (+11)**	-	**68 (+12)**	-
R15	8 The Avenue	56	**65 (+9)**	-	**66 (+10)**	-	**67 (+11)**	-
R16	2 Jamieson St	56	**64 (+8)**	**66 (+10)**	**65 (+9)**	**67 (+11)**	**66 (+10)**	**68 (+12)**

Note 1: Bolded results indicate exceedances to noise affected construction noise management levels.

4.3 Construction traffic noise impacts

The application notes for the *Road Noise Policy* (DECCW, 2011) state that 'for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within two dB of, or exceeds, the relevant day or night noise assessment criterion.' This is also considered to be applicable for construction noise therefore if road traffic noise increases from construction is within two dB(A) of current levels then the objectives on the *Road Noise Policy* (DECCW, 2011) are achieved.

A significant increase in traffic volumes would be needed in order to increase road traffic noise by two dB(A) (a doubling in traffic corresponds to an approximate three dB(A) increase). It is estimated that the daily vehicle movements would not be significant when compared with the daily existing vehicle numbers in the area.

It is recommended that a traffic management plan be prepared by the contractor which detail specific routes that construction traffic and local traffic would follow throughout the construction phase and where feasible and reasonable, avoid the use of local roads.

4.4 Construction vibration

Typical vibration generating activities during the construction of the proposal will include:

- during site clearing and demolition works, bulldozers and excavators
- during concrete removal and ground compaction, compactor and concrete hand tools
- during substation construction, bored piling works.

Table 4-3 outlines typical vibration levels for these plant activities sourced from the Roads and Maritime Services *Environmental Noise Management Manual* (RTA, 2001) and GHD's internal measurements database.

Table 4-3 Typical vibration levels – construction equipment

Equipment	Peak particle velocity at 10 m (mm/s)
7 tonne compactor	7.0
10 tonne vibratory roller	10.0
Jackhammer	0.5
Excavator	2.1
Piling (bored)	0.8
Dozer	3.0

Potential vibration impacts would be limited to the construction period.

4.4.1 Assessment of impacts

Energy from equipment is transmitted into the ground and transformed into vibration, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- the efficiency of the energy transfer mechanism of the equipment (i.e impulsive, reciprocating, rolling or rotating equipment)
- the frequency content
- the impact medium stiffness
- the type of wave (surface or body)
- the ground type and topography.

Due to the above factors, there is inherent variability in ground vibration predictions without site-specific measurement data.

Safe working buffer distances to comply with the human comfort and structural damage criteria were calculated and others where sourced from the *Construction Noise Strategy* (TfNSW, 2012) and are presented in Table 4-4.

Table 4-4 Vibration buffer distances (m)

Activity	Human comfort	Structural damage	
		Heritage building / structure	Standard dwellings
7 tonne compactor	50 m	20 m	13 m
10 tonne vibratory roller	66 m	27 m	18 m
Jackhammer[1]	Avoid contact with structure	2 m (nominal)	1 m (nominal)
Excavator	18 m	8 m	5 m
Piling (bored) [1]	-	4 m (nominal)	2 m (nominal)
Dozer	25 m	10 m	6 m

Note 1: These distances have been sourced from the *Construction Noise Strategy* (TfNSW, 2012)

There is potential for some human comfort impacts at sensitive receivers when ground compaction work is undertaken within 66 metres. Any human comfort vibration impacts would be short-term in nature. Where practicable, activities with the potential to generate these impacts would be scheduled during standard construction hours. Sensitive receivers and land uses within the safe working distance buffers would be informed of the nature of the work, duration and contact details as part of the proposal communications strategy.

The building damage vibration criterion for heritage buildings is much more stringent, yet no heritage structures are identified within 100 metres of the work.

Vibration generating activities associated with the site compound and laydown areas would be considered minimal on the surrounding residential buildings and other sensitive structures. However, there is a possibility that construction activities within these areas that include vibratory activities could adversely impact on nearby residential buildings and other sensitive structures. Therefore it is recommended that the mitigation measures detailed in section 6.2 be implemented to ensure all impacts associated with vibration generating activities are below the criteria limits.

5. Assessment of operational noise impacts

5.1 Noise modelling methodology

Acoustic modelling was undertaken using Computer Aided Noise Abatement (CadnaA) v4.4 to predict the effects of industrial noise generated by the proposed substation. CadnaA v4.4 noise modelling software was used to predict the operational noise in accordance with the *ISO 9613 – 2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* algorithm. Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations. The algorithm also takes into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation.

5.1.1 Noise sources

Based on information provided at the time of the assessment, it is understood the primary sources of noise emission will include:

- two rectifier transformers (5.35 MVA)
- two rectifiers (5 MW)
- one power transformer (6.25 MVA)
- two auxiliary transformers (50 KVA)
- direct current circuit breakers (DCCB).

DCCB tripping is an extremely infrequent event with approximately three to five openings within a substation per year if the openings were uniformly spread across all DCCB. Similarly, any emergency alarms are considered one-off events and not included in this assessment.

The noise source levels of operational noise equipment are detailed in Table 5-1. These noise levels are within the range of values provided by Sydney Trains in the *Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities* (Sydney Trains, 2013)

Table 5-1 Equipment noise source information

Equipment	Noise level	Source of data
Rectifier 5 MW	L_{Aeq} 60 dB(A) Internal sound pressure level	Measurement data from GHD Erskineville traction substation site visit
Rectifier transformer 5.35 MVA	L_{Aeq} 79 dB(A) Sound power level	Based on CadnaA transformer noise equations. Confirmed by measurements undertaken on 10 February 2010 at the Erskineville traction substation.
Power transformer 6.25 MVA	L_{Aeq} 82 dB(A) Sound power level	
Auxiliary transformer	L_{Aeq} 60 dB(A) Sound power level	
DCCB	L_{Amax} 113 dB(A) Internal sound pressure level	Measurement data from the Waverton traction substation noise assessment

As rectifier and transformer noise levels fluctuate with loading, worst-case noise levels have been used for assessment purposes even though it is unlikely that the transformers will be under maximum load during the night time period.

Past measurements indicate that low frequency characteristics (in the 20 Hz to 250 Hz range) are typically present in transformers. Therefore, a plus 5 dB(A) factor adjustment has been applied to the transformer noise emission levels.

5.1.2 Substation building construction

Building components, with their modelled insertion loss (IL) or reduction index (R_W) are as follows:

- precast concrete walls, R_w 55
- metal roof R_w 45
- solid core access door, R_w 30
- roller access door, R_w 15
- louvre screen, R_w 7.

5.1.3 Noise modelling

The following noise modelling assumptions were made:

- surrounding land was modelled assuming a mixture of hard and soft ground with a ground absorption coefficient of 0.5
- the noise model was used to predict noise levels during worst case (peak loading) substation operations
- atmospheric absorption was based on an average temperature of 10 °C and an average humidity of 70%
- atmospheric propagation conditions were modelled with favourable wind conditions for noise propagation (downwind conditions) or equivalently a well-developed moderate ground based temperature inversions

The following modelling scenarios were run:

- Scenario 1: Rectifiers and transformer operating for assessment against the $L_{Aeq(night)}$ amenity noise criteria
- Scenario 2: Substation DCCB tripping for assessment against the external sleep disturbance screening level of L_{Amax} 58 dB(A).

Results were assessed at the ground floor (1.5 metres), first floor (4.5 metres) and second floor (7.5 metres) of residential receivers. Receivers on levels above the second floor would experience noise levels less than or similar to the second floor predicted noise levels.

5.2 Operational noise results

The worst case noise levels at sensitive residential receivers surrounding the site are shown in Figure 5-1 to Figure 5-6 for case 1 and case 2, respectively. The predicted noise levels with a comparison against the noise criteria are provide in Table 5-2 and Table 5-3. Exceedances from the LAeq(night) (Table 5-2) and sleep disturbance screening test (Table 5-3) are provide in brackets with positive values indicating potential adverse impacts.

Table 5-2 Predicted operational noise levels during normal operations, dB(A)

Receiver ID	Receiver	Operational criteria $L_{Aeq(night)}$	Predicted noise levels, $L_{Aeq(night)}$		
			Receiver height		
			Ground floor (1.5 m)	First floor (4.5 m)	Second floor (7.5 m)
R1	88 Railway Parade	40	35 (-5)	-	-
R2	86 Railway Parade	40	36 (-4)	-	-
R3	94 Railway Parade	40	37 (-3)	-	-
R4	84 Railway Parade	40	36 (-4)	-	-
R5	96 Railway Parade	40	35 (-5)	-	-
R6	78-82 Railway Parade	40	35 (-5)	36 (-4)	37 (-3)
R7	98 Railway Parade	40	33 (-7)	-	-
R8	100 Railway Parade	40	32 (-8)	-	-
R9	72 Railway Parade	40	26 (-14)	-	-
R10	108 Railway Parade	40	30 (-10)	-	-
R11	70 Railway Parade	40	25 (-15)	-	-
R12	110 Railway Parade	40	29 (-11)	-	-
R13	112 Railway Parade	40	28 (-12)	-	-
R14	6 The Avenue	40	33 (-7)	-	-
R15	8 The Avenue	40	32 (-8)	-	-
R16	2 Jamieson Street	40	33 (-7)	34 (-6)	35 (-5)

Table 5-3 Predicted operational noise levels during DCCB tripping, dB(A)

Receiver ID	Receiver	Sleep disturbance screening test L_{Amax}	Predicted noise levels, L_{Amax}		
			Receiver height		
			Ground floor (1.5 m)	First floor (4.5 m)	Second floor (7.5 m)
R1	88 Railway Parade	58	69 (+11)	-	-
R2	86 Railway Parade	58	69 (+11)	-	-
R3	94 Railway Parade	58	55 (-3)	-	-
R4	84 Railway Parade	58	68 (+10)	-	-
R5	96 Railway Parade	58	66 (+8)	-	-
R6	78-82 Railway Parade	58	65 (+7)	66 (+8)	66 (+8)
R7	98 Railway Parade	58	65 (+7)	-	-
R8	100 Railway Parade	58	64 (+6)	-	-
R9	72 Railway Parade	58	61 (+3)	-	-
R10	108 Railway Parade	58	60 (+2)	-	-
R11	70 Railway Parade	58	60 (+2)	-	-
R12	110 Railway Parade	58	60 (+2)	-	-
R13	112 Railway Parade	58	59 (+1)	-	-
R14	6 The Avenue	58	63 (+5)	-	-
R15	8 The Avenue	58	63 (+5)	-	-
R16	2 Jamieson Street	58	63 (+5)	63 (+5)	63 (+5)

Based on the supplied information and modelling assumptions, the predicted noise levels indicate the following:

- For scenario 1, with transformer and rectifiers operating at full load, the operational noise criteria are not predicted to be exceeded at any sensitive receiver.
- For scenario 2, with DCCB tripping, the sleep disturbance criteria are predicted to be exceeded at most residential receivers. However, DCCB tripping is an extremely infrequent event with approximately three to five openings within a substation per year. With the development of additional substations providing increased capacity the risk of DCCB tripping is further reduced. Noise levels associated with DCCB tripping are minimised by locating the switch-room housing the DCCB's to the northern side of the substation compound which further away from Railway Parade. Therefore, due to the infrequency of events and equipment positioning, DCCB tripping is not anticipated to result in adverse noise impacts to surrounding residents

5.3 Operational traffic noise

Staff would occasionally access the site out of normal business hours to perform maintenance works. Vehicle movements associated with servicing and maintenance would be infrequent and would not be expected to cause noise impacts. No operational traffic noise impacts are anticipated at sensitive receivers.

Figure 5-1 Case 1: Predicted $L_{Aeq(night)}$ noise levels, dB(A) at a receiver height of 1.5 m

Figure 5-2 Case 1: Predicted $L_{Aeq(night)}$ noise levels, dB(A) at a receiver height of 4.5 m

Figure 5-3 Scenario 1: Predicted $L_{Aeq(night)}$ noise levels, dB(A) at a receiver height of 7.5 m

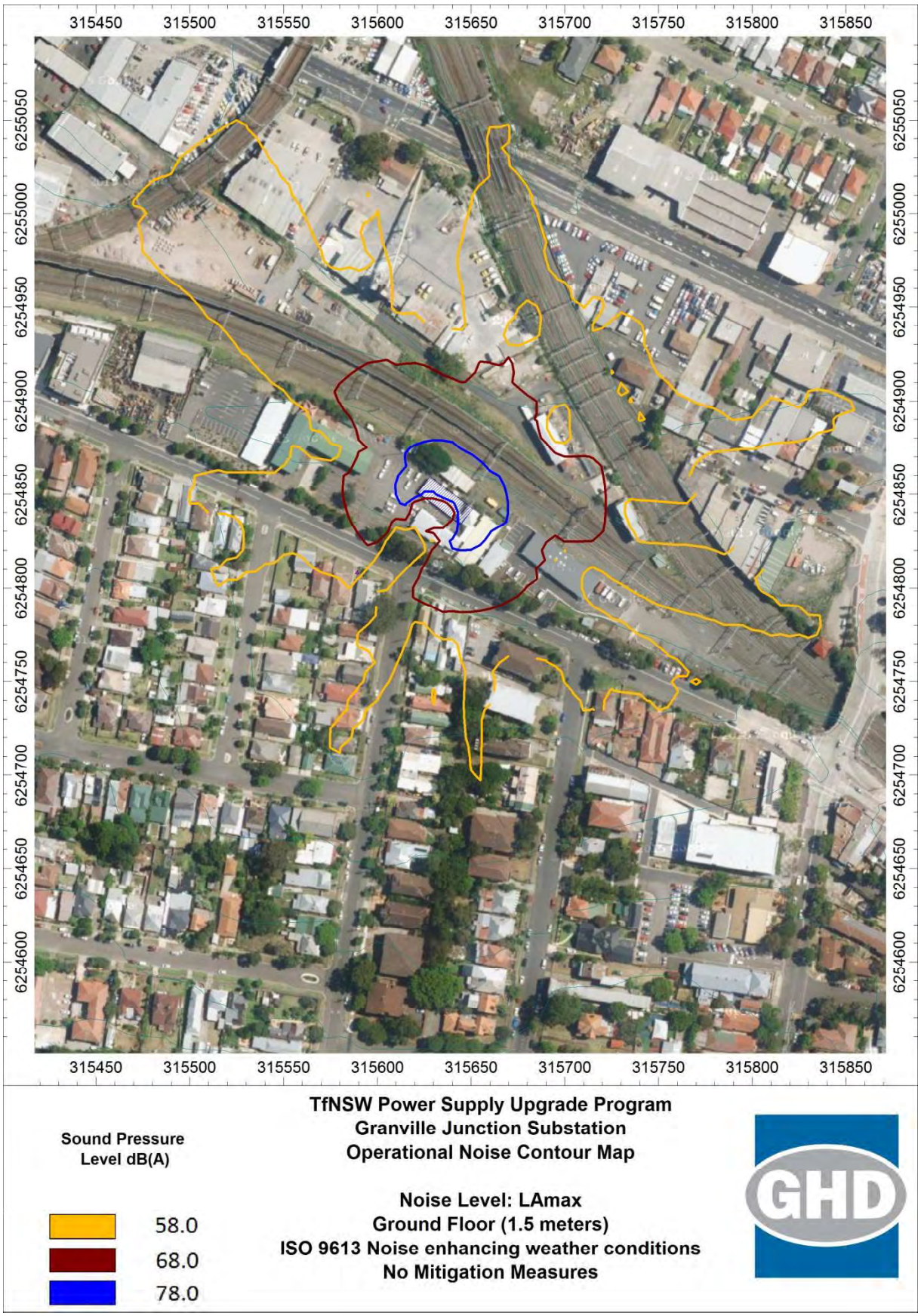


Figure 5-4 Scenario 2: Predicted L_{Amax} noise levels, dB(A) at a receiver height of 1.5 m

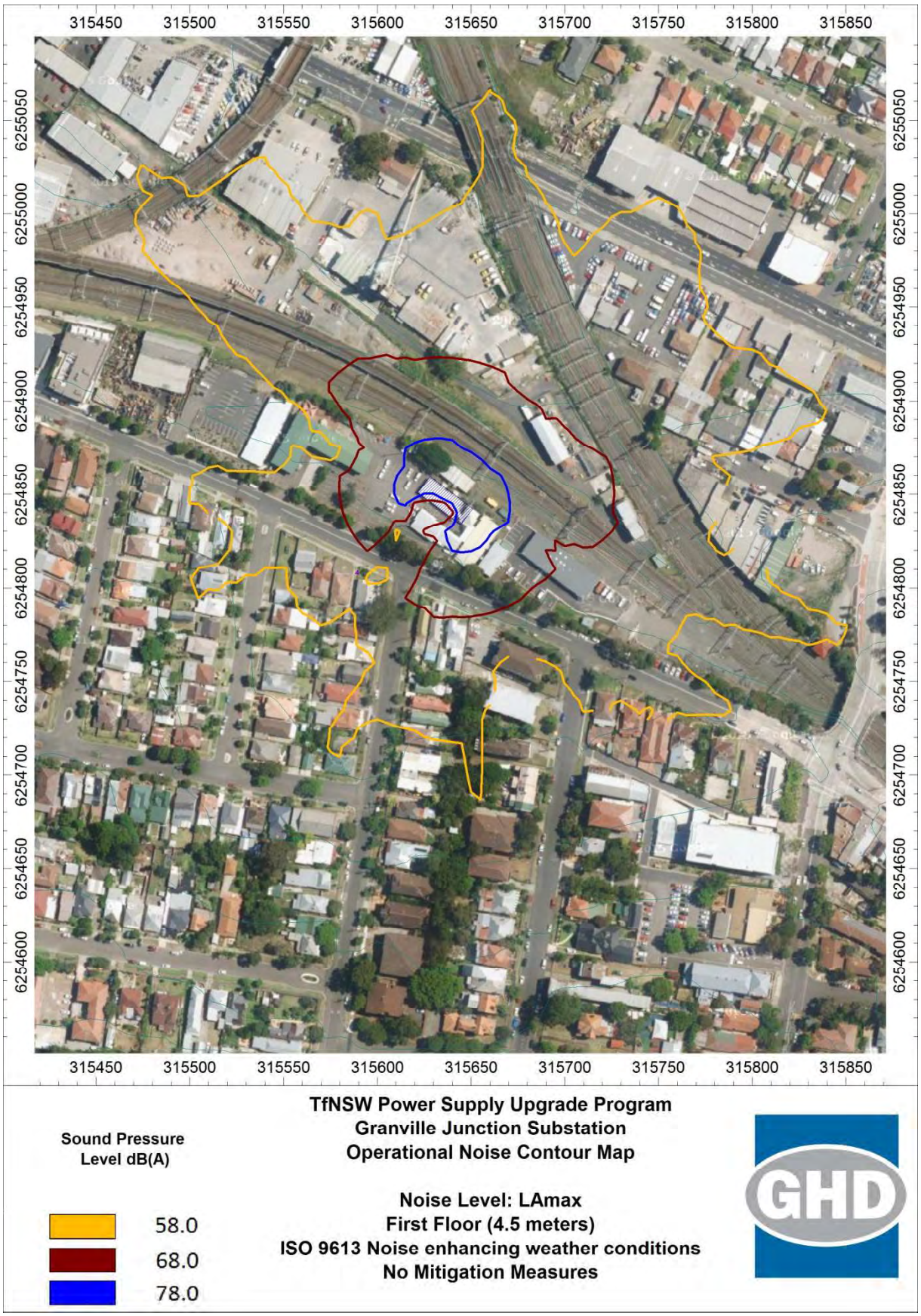


Figure 5-5 Scenario 2: Predicted L_{Amax} noise levels, dB(A) at a receiver height of 4.5 m

Figure 5-6 Scenario 2: Predicted L_{Amax} noise levels, dB(A) at a receiver height of 7.5 m

6. Mitigation measures

6.1 Construction noise

All reasonable and feasible measures would be implemented to minimise noise emissions from the construction activities. A noise management plan would be prepared and implemented as part of the construction environmental management plan for the proposal. It would include the mitigation measures listed in the following sections.

The mitigation measures provided are in accordance with the *Construction Noise Strategy* (TfNSW, 2012) and the *Interim Construction Noise Guideline* (DECC, 2009).

6.1.1 Standard mitigation measures

The noise mitigation measures detailed in Table 6-1 would be implemented to reduce the impact on the surrounding receivers and sensitive land uses.

Table 6-1 Standard mitigation measures for construction noise and vibration

Action required	Details
Management measures	
Implement community consultation measures	• periodic notification (letterbox drop or equivalent) • website • project info-line • construction response line • email distribution list • community based forums (if required by approval conditions)
Site inductions	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • all relevant project specific and standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/ unloading areas and procedures • construction traffic routes • site opening/closing times (including deliveries) • environmental incident procedures.
Behavioural practices	No unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Monitoring	Noise monitoring should be conducted at the commencement of out of hours work.
Source controls	
Construction hours and scheduling	Where reasonable and feasible, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.

Action required	Details
Construction respite period	If highly noise affected impacts are predicted high noise and vibration generating activities may only be scheduled between the following hours, unless inaudible at nearby residential properties and/or other noise sensitive receivers: (a) 8 am to 12 noon, Monday to Saturday (b) 2 pm to 5 pm Monday to Friday. An example of these activities includes jack hammering/rock breaking, concrete cutting/grinding, compacting/vibratory rolling and impact piling.
Equipment selection	Use quieter and less vibration emitting construction methods where reasonable and feasible.
Maximum noise levels	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria listed in Table 2 of the *Construction Noise Strategy*.
Use and siting of plant	Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided. The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers.
Plan worksites and activities to minimise noise and vibration	Plan traffic flow, parking and loading/ unloading areas to minimise reversing movements within the site.
Non-tonal reversing alarms	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Minimise disturbance arising from delivery of goods to construction sites	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.
Path controls	
Shield stationary noise sources such as pumps, compressors, fans etc.	Stationary noise sources should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained.
Shield sensitive receivers from noisy activities	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.

Source: *Construction Noise Strategy* (TfNSW, 2012)

6.1.2 Additional noise mitigation measures

In circumstances where the noise levels are predicted to exceed acceptable levels after implementation of the general work practices, the relevant additional mitigation measures detailed in Table 6-2 should be considered.

Table 6-2 Additional mitigation measures

Time period		$L_{Aeq(15\ min)}$ noise level above rating background level			
		0 to 10 dBA	10 to 20 dBA	20 to 30 dBA	>30 dBA
		Noticeable	Clearly audible	Moderately intrusive	Highly intrusive
Standard	Weekday (7 am – 6 pm)	-	-	LB, M	LB, M
	Saturday (8 am – 1 pm)				
OOHW Period 1	Weekday (6 pm – 10 pm)	-	LB	M, LB	M, IB, LB, PC, SN
	Saturday (1 pm – 10 pm)				
	Sunday (8 am – 6 pm)				
OOHW Period 2	Weekday (10 pm – 7 am)	LB	M, LB	M, IB, LB, PC, SN	AA, M, IB, LB, PC, SN
	Saturday (10 pm – 8 am)				
	Sunday (6 pm – 7 am)				

Monitoring (M): Compliance noise monitoring

Individual Briefings (IB): Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the proposal.

Letter box drops (LB): Letter box drops or media advertisements.

Phone Calls (PC): Phone calls detailing relevant information would be made to identified/affected stakeholders within seven days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs.

Specific Notifications (SN): Specific notifications are letterbox dropped or hand distributed to identified stakeholders no later than seven days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications.

Alternative accommodation (AA)

Source: *Construction Noise Strategy (Rail Projects),* (TfNSW, 2012)

6.2 Construction vibration

Human comfort vibration impacts may occur when compaction work is undertaken within 66 metres of sensitive receivers. Structural damage on building from vibration impacts are not expected at any sensitive receivers. Where construction is required within the safe working buffer distance, alternative work methods such as smaller equipment should be considered.

If no alternative work method is feasible or reasonable then compliance vibration monitoring should be undertaken where works are required within the safe working buffer distances and include:

- Site tests to review the measured frequency content to determine the structural damage criteria as per Table 3-6 for standard dwelling and Table 3-7 for heritage structures.
- Continuous vibration monitoring with a visual alarm installed to warn the equipment operator when the structural damage vibration criteria (considering frequency content) is exceeded.
- A dilapidation/ condition report before and after construction activities should be completed.

6.3 Operational noise

The predicted operational noise levels are expected to comply with the proposal specific criteria at all sensitive receivers. Therefore, specific operational mitigation measures are not required. However, general noise management mitigation measures should be implemented, including:

- Ensuring that transformers, rectifiers and other electrical equipment on site are well maintained and operating according to specifications. If noise levels are significantly higher than those modelled as part of this assessment, the use of mufflers or other acoustic treatment methods should be investigated.
- Scheduling maintenance operations during the day time period to minimise potential for adverse impacts at sensitive receivers.
- Investigating and addressing noise complaints.
- Conducting post construction operational noise monitoring to assess compliance against operational noise criteria and undertake remedial measures to achieve compliance if required.

7. Conclusions

This report assesses the potential noise and vibration impacts associated with the construction and operation of the proposed Granville Junction substation, as an input to the REF for the proposal.

During recommended standard construction hours, construction activities are predicted to result in noise levels that exceed the noise affected construction noise management level at sensitive receivers. Reasonable and feasible construction noise and vibration mitigation measures have been recommended, which would minimise noise impacts at potentially affected receivers.

Some construction activities may be required to be undertaken outside of scheduled construction hours. These would be limited to scheduled track possession periods and involve activities such as connection to the overhead wiring equipment and installation of certain electrical equipment. These activities are not expected to cause adverse impacts at sensitive receivers.

Construction traffic is not expected to cause adverse noise impacts as the levels of construction traffic generated by the proposal would not be significant compared with the existing daily traffic numbers on local streets. No construction traffic noise impacts are anticipated at sensitive receivers.

There is the potential for some human comfort vibration impacts at sensitive receivers when ground compaction occurs within 66 m of the nearest residence. Any human comfort vibration impacts would be short-term in nature, and where practicable, activities with the potential to generate these impacts would be scheduled to occur during standard construction hours. Sensitive receivers within the safe working distance buffers would be informed of the nature of the works, duration and contact details as part of the communications strategy for the proposal.

Structural damage on building from vibration impacts are not expected at any sensitive receiver's .Where construction is required within the safe working buffer distance it is recommended that site tests, compliance vibration monitoring and a dilapidation/ condition report before and after construction activities should be undertaken.

Operational noise is predicted to comply with the *Industrial Noise Policy* at the surrounding sensitive receivers during general operations. Operational noise from direct current circuit breaker tripping is predicted to exceed the sleep disturbance screening test. However, due to the infrequency of DCCB tripping events per year, sleep disturbance adverse impacts are not expected.

Vehicle movements associated with site operations would be infrequent and are not expected to cause noise impacts.

The proposal is considered to be acceptable from an acoustic perspective, assuming that the recommended mitigation measures are implemented.

8. References

Assessing Vibration a Technical Guideline, Department of Environment and Conservation, February 2006

Construction Noise Strategy, (Transport for NSW, 2012)

BS 5228 – 1, Noise and vibration control on construction and open sites. Code of practice for basic information and procedures for noise and vibration control, British Standards, 2009

Environmental Criteria for Road Traffic Noise, Environmental Protection Authority, 1999

BS 6472:1992, Guide to evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz), British Standards, 1992

AS 2436 – 2010, Guide to noise and vibration control on construction, demolition and maintenance sites, Australian Standards, 2010

Industrial Noise Policy, Environmental Protection Authority, January 2000

Interim Construction Noise Guideline, Department of Environment and Climate Change, July 2009

ISO 9613 – 2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, International Organization for Standardization, 1996.

Road Noise Policy, Office of Environment and Heritage, March 2011

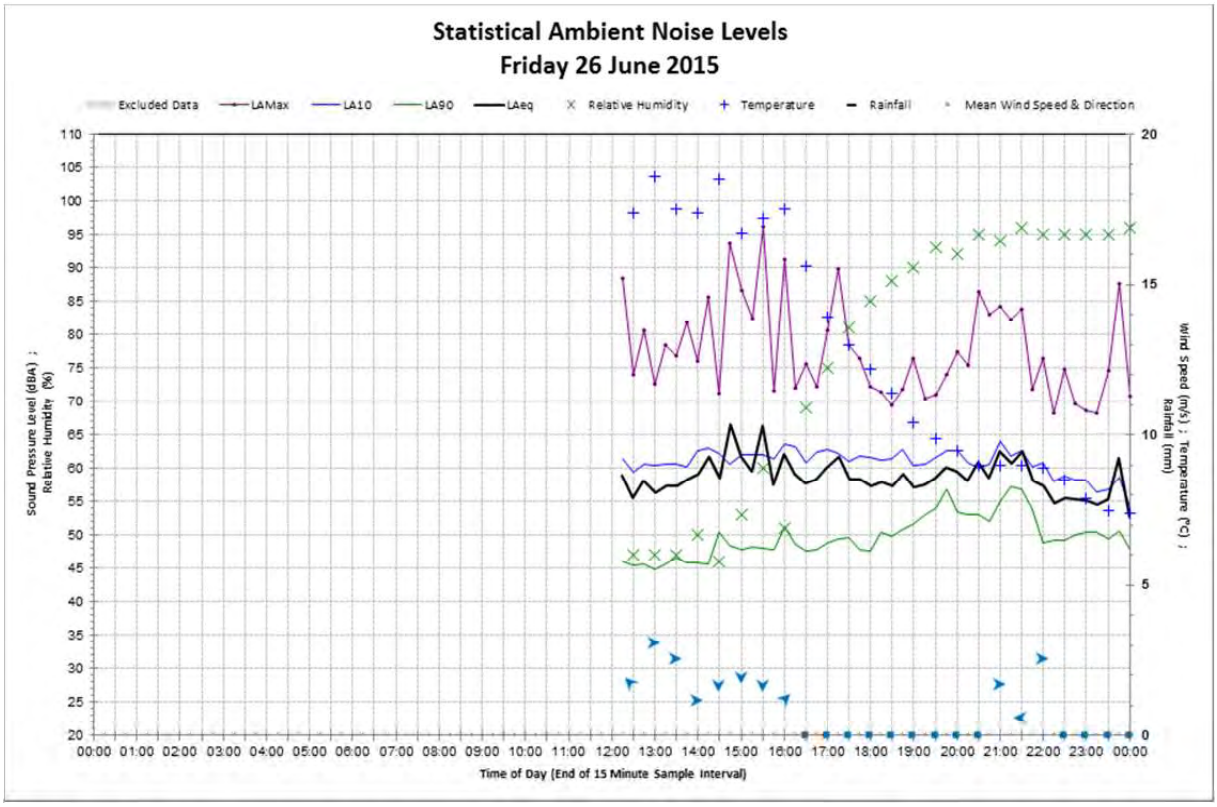
Structural Vibration Part 3: Effects of vibration on structures,

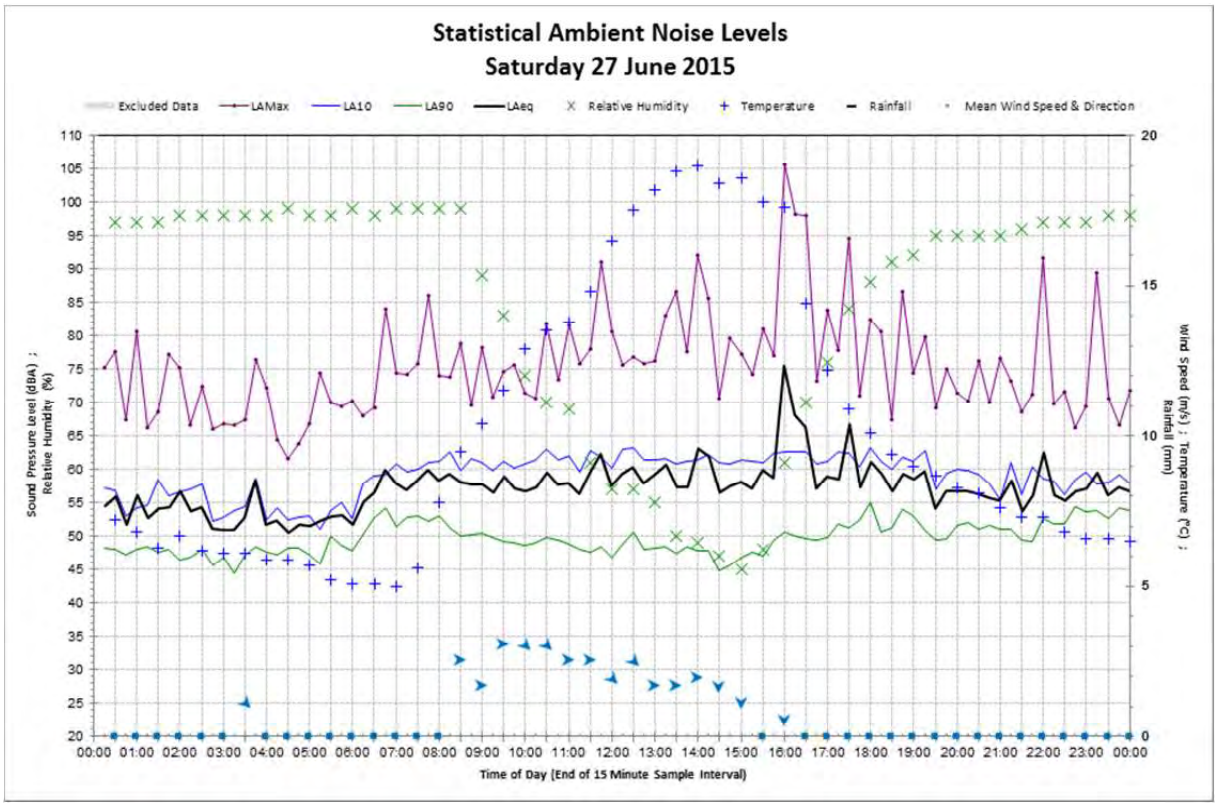
DIN 4150 – 3 (1999-02), Structural Vibration – Effects of vibration on structures, German Standards, 1999

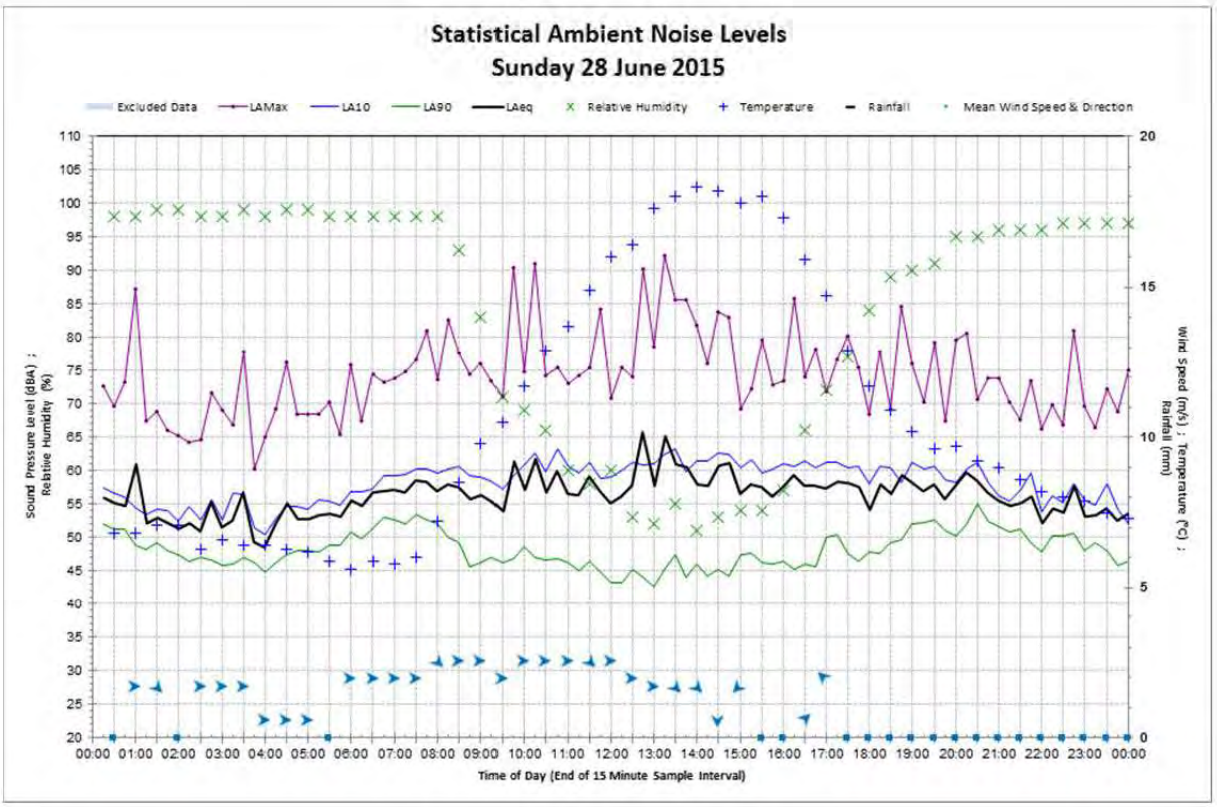
Sydney Trains Environmental Management System Guide Noise and Vibration from Rail Facilities (Sydney Trains, 2013)

Appendices

Appendix A – Noise Monitoring Charts



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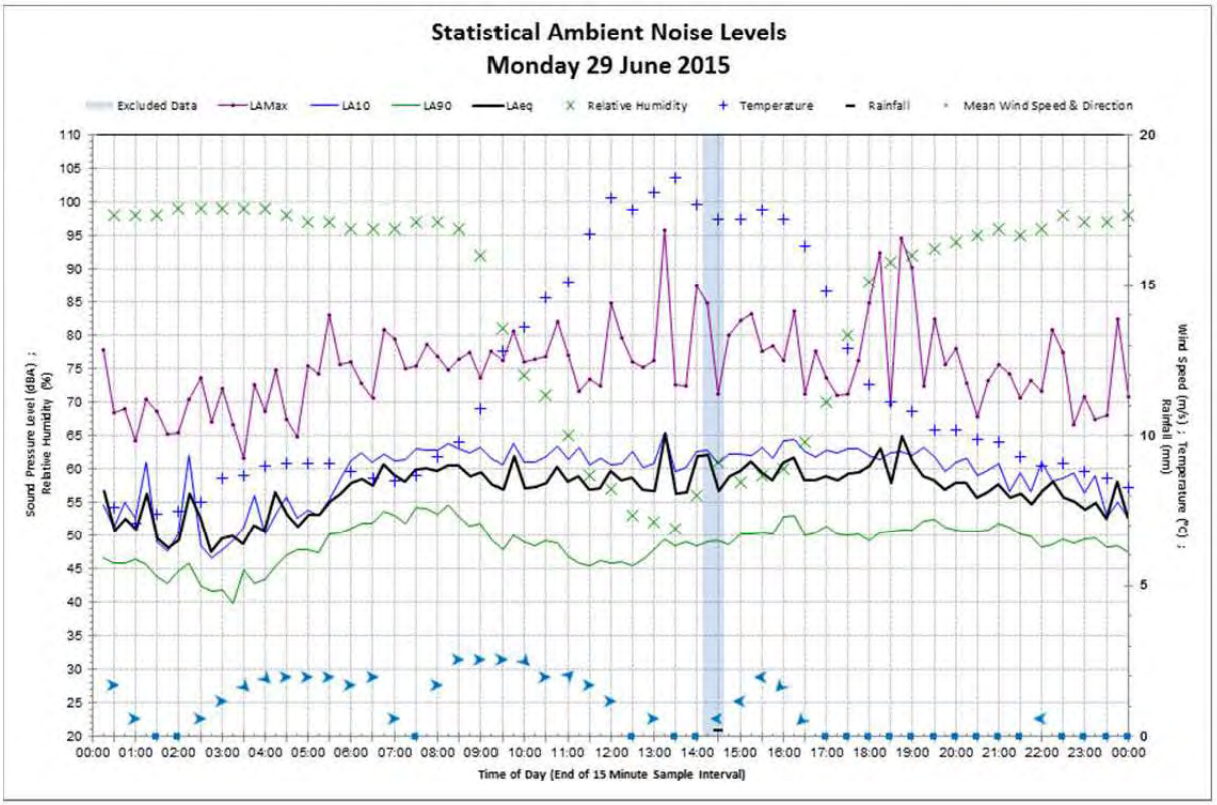
Sunday 28 June 2015
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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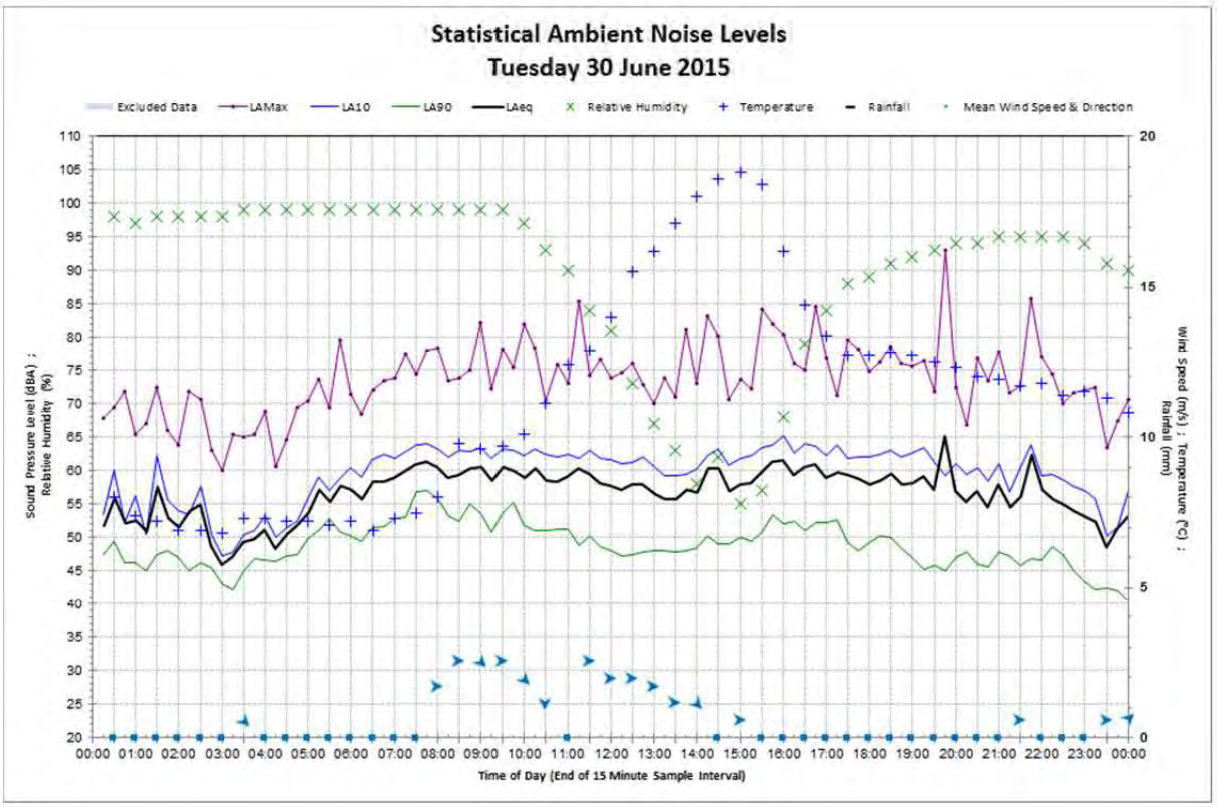
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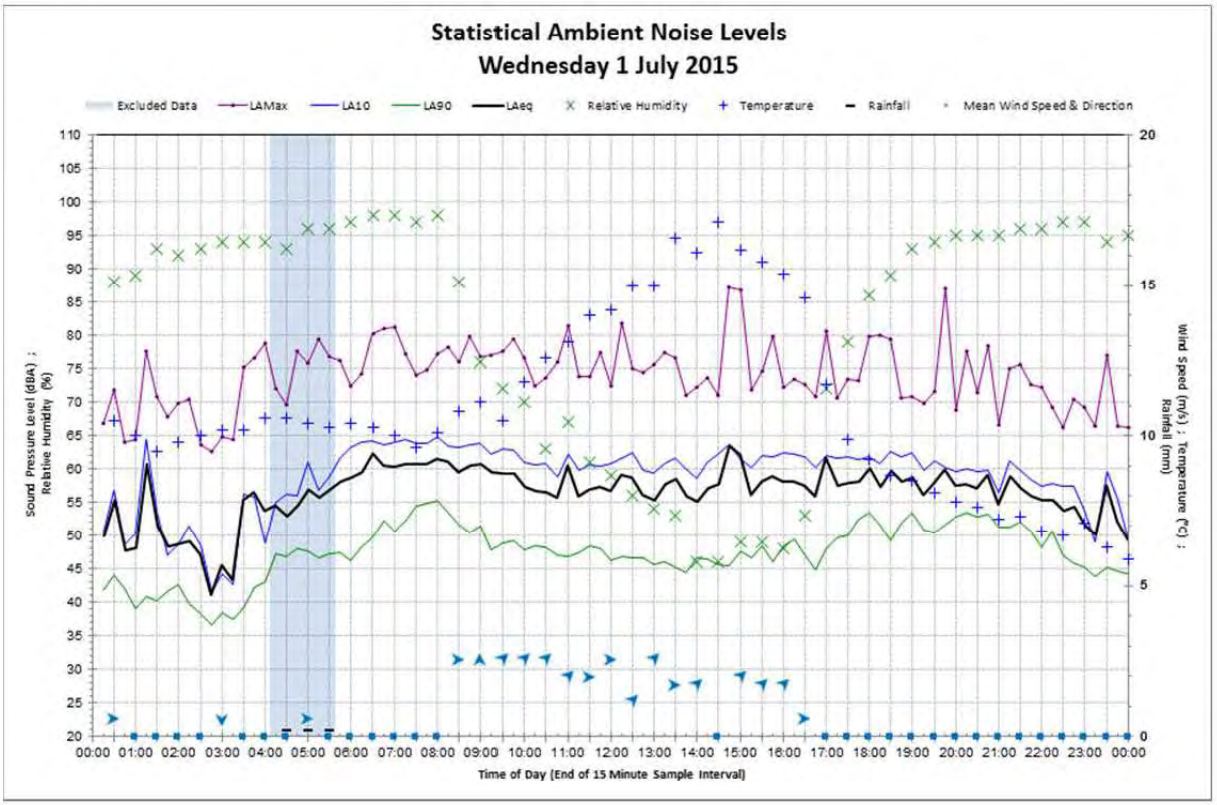
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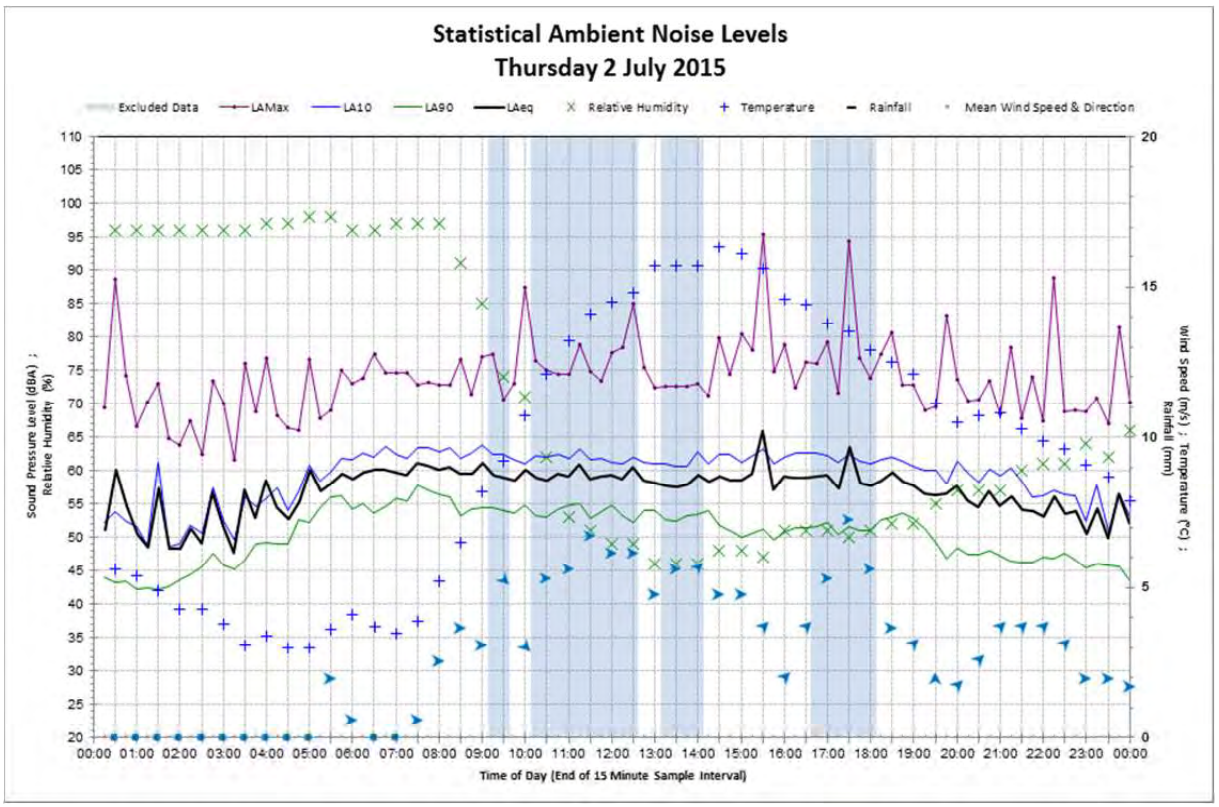
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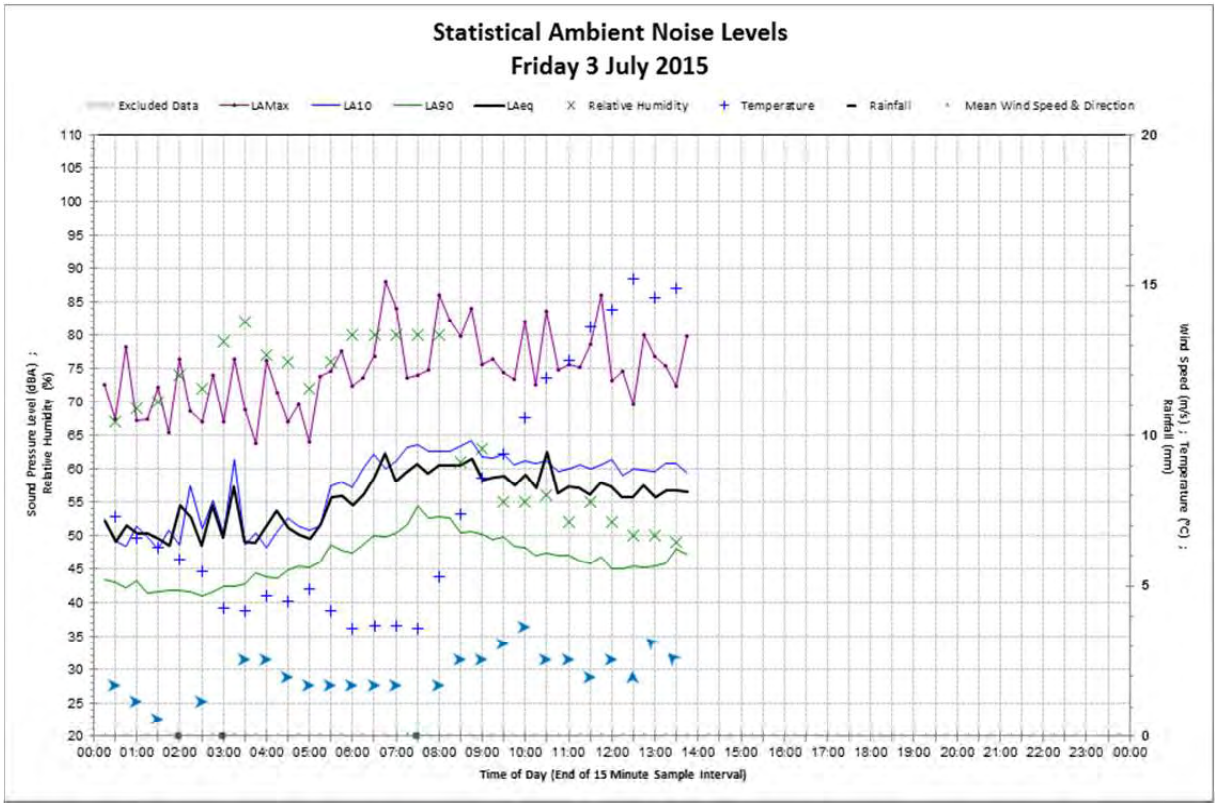
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

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Document Status

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A	P Pandey	E Milton	EM*	S Pusenjak	SP*	28/07/2015
0	P Pandey	E Milton		S Pusenjak		19/08/2015

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Appendix E – Electromagnetic assessment

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Report No. 150702b
(This replaces Report No.150702 and 150702a)

Prediction and Assessment of Electromagnetic Fields for the Proposed Granville Junction Substation

for

GHD
Level 15 133 Castlereagh Street Sydney NSW 2000

by

Yu Ji
PhD MSc (Elect) SMIEEE

Signed: 24 July 2015
Geoffrey Garrett BE (Elect) Hons.

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APPLICABLE DOCUMENTS

[1] AS/NZS 2344:2007 Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 to 1000 MHz, published by Standards Australia

[2] ARPANSA Radiation Health Series (RHS) No. 30, Interim Guidelines on Limits of Exposure to 50/60 Hz Electric and magnetic Fields (1989).

[3] RPS3 (Radiation Protection Standard 3), Maximum Exposure Levels to Radio-Frequency Fields – 3kHz to 300GHz (2002), National Health and Medical Research Council.

[4] Guidelines for the Management of 50 Hz Magnetic Fields in Office Buildings Owned and Managed by the Queensland Department of Public Works.

[5] AS/NZS CISPR 11: Industrial scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement.

1. INTRODUCTION

Transport for NSW plans to construct an electricity substation at Granville, NSW. The new Granville Junction Substation will provide additional capacity and improved reliability for the operation of trains on the North Shore, Northern & Western Line and the Airport, Inner West & South Line with the construction and commissioning of a new 2 x 5 MW traction Substation. The building for the new substation will be built between the South Line railway track and Railway Parade adjacent to Granville station. A two storey building (ground level with cable chamber and switch room level) would be constructed to house the substation equipment and access for maintenance would be gained from two entrances on the western and eastern sides of the substation. The location of the proposed substation is shown in the aerial photograph of Figure 1, and the building perspective drawing is shown in Figure 2.

Power to the substation would be supplied via 33 kV cabling to a 33/11kV power transformer and to the two transformer/rectifier sets (a main and an auxiliary supply). Each set is comprised of a 5.3 MVA rectifier transformer (33 kV and 93 A at input) which produces a low voltage (3 phase star/delta supply of 600 V AC per phase at 5100 amperes) fed to separate six phase rectifiers. The rectifier cabinet, which contains two three-phase bridge circuits with 1 diode in each bridge arm, then produces an output of 1500 V DC. A common reactor (a 0.5 mH inductor), smooths the 1500 V DC rectifier output, which is to be connected to the railway catenary and track via underground cabling. The 1500 V DC feeder cables are reticulated from underneath the 5MW rectifier (an enclosed metal cabinet) via the cable chamber and 1500 V DC circuit breaker and link switches, and connected to the relevant OHWS (overhead wiring structure). Figures 3 and 4 contain the substation floor plan showing the detail of the electrical layout cabling, switchgear, transformers and rectifiers.

The Review of Environmental Factors (REF) of Transport for NSW requires a specialist report, which assesses the potential operational impact of the electromagnetic effect on the surrounding community and to on-site staff.

The electromagnetic fields that would be produced by the substation are studied in this report. Both power frequency and radio frequency EMF can pose potential risk to human health, and interference risk to the operation of electrical equipment and appliances, if not appropriately managed. Unintentional transmission (or emission) of radio frequency fields can potentially interfere with radio and TV broadcast reception and radio communications equipment, resulting in a degradation of reception quality.

2. OBJECTIVE

This report predicts the electromagnetic fields expected to be generated by the substation, and identifies any potential constraints the electromagnetic fields may pose on the design of the substation, or impact of these fields may have on the nearby residents or the wider community. This report assesses the health risks to human occupants within the vicinity of the substation due to electromagnetic exposure and any effects on radio and TV broadcast reception and radio communications equipment that may be used in the area.

The details of this report include the following:

a) Review drawings and layouts with respect to electromagnetic issues at DC, power and RF frequencies.
b) Review locations of major equipment in the planned substation.
c) Review surrounding areas of the substation precinct in terms of potential electromagnetic impact.
d) Calculate the level of the low frequency magnetic fields and the radio frequency electromagnetic fields at the nearest residences and/or commercial areas.
e) Assess the calculated fields for conformance to the applicable OH&S requirements (ARPANSA RPS 3 and RHS 30).
f) Assess the calculated fields with the appropriate ACMA requirements for RF emissions from installations (AS/NZS CISPR 11) and AS/NZS 2344

3. APPLICABLE STANDARDS

The following Australian standards are applicable:

- RHS 30 (Radiation Health Series 30), *Interim Guidelines on Limits of Exposure to 50/60Hz Electric & Magnetic Fields* (1989), National Health and Medical Research Council
- RPS 3 (Radiation Protection Series No.3), *Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz* (2002), ARPANSA
- AS/NZS 2344: 1997 and Amdt 1: 2006 *Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 to 1000 MHz*

Tables 1a & 1b below, list the standards and limits for low frequency (50Hz) magnetic fields and radio frequency fields applicable to both human exposure and radiocommunications including broadcast radio and TV.

Table 1a Human Exposure Limits - 50/60Hz Magnetic Fields and RF fields

Exposure Type	Applicable Standard	Magnetic Field	Electric Field
Occupational 50 Hz exposure (whole working day)	RHS 30	500 μT	10 kV/m
General Public 50 Hz exposure (up to 24hrs per day)	RHS 30	100 μT	5,000 V/m
Occupational RF exposure at 1 MHz (whole working day)	RPS 3	1.63 A/m	614 V/m
General Public RF exposure at 1 MHz (up to 24hrs per day)	RPS 3	0.729 A/m	86.8 V/m

Table 1b Interference Limits – Radiocommunications

Interference Type	Applicable Standard	Magnetic Field	Electric Field
Radiocommunications (overhead power lines)	AS/NZS 2344	0.84 μA/m (1,2)	0.316 mV/m (1,2)

Notes: 1. *Limit in the frequency range of 0.15 MHz to 1.7 MHz*
2. *Limit for urban areas.*

Other than these standards, in Queensland Government owned or managed buildings, the managed limit of human exposure in "occupied areas" (4 hours or more per day on average) is 5 μT [4].

If power frequency electromagnetic fields (EMF) or static magnetic fields are significant enough, they can interfere with electronics equipment, which may result in degradation of performance or operation, and may cause malfunction.

Electronic equipment is often manufactured to withstand power frequency (50 Hz) magnetic fields that may be encountered in everyday situations, and the applicable power-frequency interference immunity limits are given in the table below:

Table 1c. – Operation of Equipment in 50 Hz Magnetic Fields

Electronic Equipment Type	Applicable Standard	Magnetic Field (50Hz)	
		(amps/metre)	(μT)
General	AS/NZS 61000.6.1	3.0	3.77

Note: 1. There are no limits applying to static and slowly varying magnetic fields.

These immunity requirements are not mandatory. Although equipment marketed in Australia is expected to comply with the above requirements.

4. ANALYSIS

4.1 Main Equipment in the Proposed Granville Junction Substation

The main electricity elements for the proposed substation at Granville, are listed below:

- Two 5.3 MW 33 kV/600 V rectifier transformers
- One 33/11kV Power Transformer
- one 0.5 millihenry 4000 amp reactor
- 33 kV AC switchboard
- 1500 V DC switchboard and circuit breakers
- Two Battery sets and battery charger
- Protection Relays
- 11kV Switchgear
- 11kV and 33kV Harmonic Filters.
- 1500V DC Harmonic Filter
- distribution boards
- changeover panel

4.2 Sources of EMF

The main sources of EMF considered within the substation include:

- High Voltage (HV) power cabling
- Low Voltage (LV) power cabling
- HV to LV power transformers
- Rectifiers

- Reactors
- Low voltage boards
- Electrical switchboards
- AC busbars and cabling
- DC busbars and cabling

4.3 Electromagnetic Field Behaviour

The power-frequency electromagnetic fields (EMF) produced by the substation predominantly comprise of magnetic fields at a frequency of 50Hz. Electric fields are also present but their influence is far less and can be negligible.

At distances close to the EMF source, such as High Voltage (HV) and Low Voltage (LV) cabling, the magnetic field generally decreases proportionally to the inverse square of the distance away from the source, that is:

$B \alpha I \times d / r^2$ where: B = magnetic field (Tesla)
I = load current (Amperes)
d = separation distance between cable conductors (metres)
r = separation distance from the EMF source to the observer (metres)

At distances that are large compared to the source, the magnetic field reduces proportionality to the inverse cube of the distance.

With radio frequencies the radiated fields comprise both electric and magnetic field components. At the higher frequencies the electric component can be considered representative of both the electric and magnetic fields. The electric field generally decreases proportionally to the inverse of the distance away from the source:

$E \alpha I \times A \times f / r$ where: E = electric field (Volts/metre)
I = excitation current (Amps)
A = area of radiator (m^2)
f = frequency (Hz)

The source of these fields is the switching or commutation of the rectifiers, which convert the alternating current supply to pulsating direct current.

The rectifier is a six phase unit with the following harmonic frequencies:

$F_n = 6 \times 50 \times n$
$= 300\ n$ where: F_n is the harmonic frequency (Hz)
n is the harmonic number

The amplitude of these harmonics decreases rapidly with increasing frequency and may be approximated as follows:

$E \alpha ((\text{Sin } x) / x)^2$ where: x is the angular frequency of the impulse π/t_d (radians)
t_d is the impulse width

4.4 Predicted EMF Field Strengths

4.4.1 Assumptions

The electromagnetic fields produced, varies depending on the amount of power that is being consumed by the substation. In determining this power consumption, the following has been assumed:

- A maximum of one transformer and rectifier is operating at any time as the second transformer and rectifier set is a backup (reserve) should one of the two fail.

- The maximum LV power supplied to the rectifiers is the rated output power of one of the transformers (5100 amps at 600 volts ac).
- The maximum output of the rectifiers is their rated DC output (3200 amps at 1500 volts)
- All the above equipment is operating at their rated (maximum) output
- All installed equipment in the substation complies with CISPR11 or equivalent.

Note - The substation would normally operate at levels much lower than the rated output. Typically, the highest power would be delivered when multiple trains are in this section supplied by the Granville Substation.

Having considered the scenarios of maximum power consumption, the predicted (calculated) electromagnetic field values are actually the maximum values expected under normal load conditions (that is the maximum achievable loading, disregarding all fault conditions).

The dominant magnetic (H) field polarization is horizontal, produced by the interconnecting cables due to high amount of current consumption from the transformer to the rectifiers.

4.4.2 Power Frequency Electromagnetic Fields

The power-frequency magnetic fields from the substation are predominantly emitted from the 600 V cabling between the transformer and the rectifier. There are 8-off cables per phase per winding and in total 48 AC low voltage cables from the rectifier transformer to the rectifier. These cables are about 6 m long, connecting the two transformers and two rectifiers, shown in Figures 3 and 4. The current in these cable conductors and the distance separating them influences the magnitude of the magnetic field produced. The maximum and average separation distances between adjacent cables are estimated as 350mm at the rectifier side and 250mm at the transformer side. The maximum magnetic field strength, for when the substation is under maximum loading, has been calculated at 16 different locations in and around the proposed substation as shown in Figures 3 and 4, and the predicted fields listed in Table 2.

Inside the substation building, within a 0.5m and 1.1m distance from the 600V cabling, when the substation is 100% loaded, the predicted maximum power frequency magnetic field exceeds the ARPANSA RHS 30 limit of 500 microtesla applicable to the Occupational and 100 microtesla, applicable to the General Public, respectively.

If a smaller separation distance between the 600V cables, of say 30 mm could have been arranged by bundling cables together, the magnetic field could have been reduced by 90% from the maximum separation of 350 mm. This reduction is possible because of the relationship that, the closer the cables are kept together, the greater the field cancellation. However, since it may be impractical to reduce the separation distance, due to a number of reasons such as stress on palm terminals, and alterations to penetrations in the blast-resistant wall between the rectifier and transformer units, there are other possible measures that can be applied for ensuring safety. Such measures could include cautioning or preventing access in close proximity to the 600V cabling, and/or reduction of the magnetic fields by installation of shielding.

Outside the new substation, the predicted field strength, at the western side of the substation security fence, is estimated to be 8.33 μT (location 7 in Figure 3). This is the strongest power frequency magnetic field outside of the substation. At the substation office (location 5 in Figure 3), which is only intended to be used on occasion, having a distance of approximately 16 metres from the main source within the substation, the maximum average magnetic field strength is estimated to be 0.29 μT.

The calculations in the above paragraph and in Table 2, are maximum field values based on the substation being loaded at maximum rated capacity. However, in practice the fields will normally be significantly lower, as during normal and peak operating hours the substation would more likely be loaded closer to approximately 30% and 60% of rated capacity respectively.

The 33kV incoming cabling will also be a source of power frequency magnetic fields, but due to its lower maximum current of 93 amps to the substation, the associated magnetic field is expected to be negligible comparing with the 600V cabling between rectifier transformers and rectifiers.

4.4.3 Radio Frequency EMF Strengths

The switching transients of the rectifiers dominate the radio frequency field radiated from the substation, and a larger transient occurs when each diode is turned 'off', the maximum rate of decay, di/dt of the forward current in each diode of the rectifier, is 50 A/μS or for two diodes in parallel 100 A/μS (two diodes are paralleled for each phase of the six phase rectifier).

The energy contained in the transient (pulse) is low and not of sufficient magnitude to constitute a hazard even directly alongside the rectifiers, however the radiated radio frequency (RF) field could potentially interfere with radiocommunications. For the purposes of this report, the interference to medium frequency broadcast is evaluated as the emissions of the transient at these frequencies, is much greater than for short wave radio and TV. Harmonics are produced at the repetition frequency (300 Hz) at an amplitude proportional to 1/n where n is the harmonic number.

The predicted electric field levels at different distances from the 600V cabling around the substation ranging from 3m to 65m are listed in Table 3. Preliminary calculations suggested that the field strength from 500 kHz to 1.7 MHz (3,333rd harmonic at 999.9 kHz) would exceed the 0.316 mV/m interference limit as shown in Table 1b, at distances of 65m, 40m and 20m, when the substation is maximum loaded, 60% loaded and 30% loaded (which is more representative during normal hours), respectively. However, if we consider a reduction for equipment or building shielding, the actual electric field level would be significantly lower than the values in Table 3.

As all 33kV switchboards are metal clad, RF emissions from busbars and bushings during a switching event, will be limited and of little concern

4.5 Analysis of EMF Predictions

4.5.1 Impact on health

The strongest magnetic field in public areas outside of the proposed substation is predicted to be at the western security fence of the substation; however the field level does not exceed the permissible exposure limit of 100 microtesla for the General Public, as set down in RHS 30 by the National Health and Medical Research Council (see Table 1a). The electric fields within and outside the substation are also well within the applicable limit.

However, as magnetic fields within areas next to transformers, rectifiers and the 600V cabling, can be very high, access should be restricted, along with precautions and procedures to prevent health risks, and warning wearers of life supporting medical devices (eg. pacemakers, Implantable Cardioverter Defibrillators, etc…), of the interference risks. The substation should only be accessed by appropriately qualified electrical maintenance and service personnel deemed to be classified Occupational Persons as defined by RHS30. It is predicted that, inside the substation building, within 1.1m and 0.5m of the 600V cabling between the transformer and the rectifier, the predicted maximum power frequency magnetic field will exceed 100 microtesla for the General Public and 500 microtesla for Occupational Personnel, respectively.

The RF fields predicted are below the human exposure requirements being less than 5 V/m at outside of the substation even when considered as a broadband signal.

4.5.2 Impact on Radiocommunications and Broadcasting

Without accounting for shielding inherent within the substation, when the substation is fully loaded, the RF electric fields at a distance of more than 65m of the substation would not exceed the applicable limit for urban broadcast reception of 0.316 mV/m applicable from 0.15 MHz to 1.7 MHz. Within a 65m distance from the substation, radio reception may be impacted, especially for AM and HF frequency bands, though the latter would generally be less of a concern, as is typically used by amateur radio operators. However, as

the rail track is more than 30m away from the 600V cabling in the substation, there would be a low to medium risk for any train communication system which may operate over the MF to HF frequency bands.

4.5.3 Power Frequency Interference

Considering the substation floor plan and the typical use of general electronic equipment in the areas, the predicted power frequency magnetic fields will not exceed the AS/NZS 61000.6.1 interference limit of 3.77μT (Table 1c), and so the risk of interference to general electronic equipment, would be very low.

5. CONCLUSION & RECOMMENDATION

5.1 Health & Safety

1. Outside the substation building, there should be no concern of risk to the health and safety of the general public or to on-site staff, due to the power-frequency or RF electromagnetic field emissions from the substation, as the predicted fields are well below the exposure limits set down by the ARPANSA RHS 30 and RPS3 guidelines.

2. Within the substation building, as the power frequency magnetic field level nearby the 600V AC cabling is expected to exceed the ARPANSA RHS 30 limit of 100μT, it is recommended that safety measures be implemented, as described in point 3 below.

3. It would be ideal that all 6 m long 600V AC cables, connecting between the transformers and rectifiers, be bundled as close as possible together in trefoil formation, so as to reduce both the power frequency and RF electromagnetic field levels. However, since it may be impractical to reduce the separation distance, due to a number of reasons such as stress on palm terminals, and alterations to penetrations in the blast-resistant wall between the rectifier and transformer units, there are other possible measures that can be applied for ensuring safety, as described in point 4.

4. An exclusion zone of 1.1m from the two rectifiers could be established around the 600V cabling, which could consist of precautionary signage warning of high magnetic fields, and also boundary markings and/or fencing. Installation of magnetic shielding is another option that can be considered, for instance if there are limitations allocating the space required for an exclusion zone, though this type of shielding should be avoided where possible as it is generally expensive.

   Access within these areas could be prevented by erection of fencing or barriers (eg. clear perspex) and accompanied with signage compliant to AS 1319, warning of the danger of high electromagnetic fields. Some examples of AS 1319 signage can be found in Appendix A. The sign shown in Figure 5 would be appropriate to place at the fence or barrier, though in this case it is recommended to substitute the text “Non-ionizing Radiation” with “Electromagnetic Fields”.

5.2 Interference

5. Except within a 65m radius, the operation of the proposed substation is not expected to produce RF fields that would significantly add to the ambient levels within the Medium Frequency (MF) band (500kHz to 3MHz) and so should not affect reception of AM radio broadcasts. Even within 65m radius, due to the equipment or building shielding of the substation, the actual impacted areas would be significantly smaller than the 65m. However, to mitigate the potential interference impact, the most efficient way is to install RF shielding around the 600V cabling. The detail of the shielding, would need to be designed, though could minimally consist in the form of a metal framed cage-like structure, which would allow access for equipment maintenance purposes and should not impact on ventilation.

6. As the RF electric field emissions within the range 30MHz to 1GHz, will largely be impacted by small dimensions and factors of the installed electrical substation (eg. conductor lengths affecting radiation efficiencies, self resonance of the circuit affecting the frequencies emitted, etc…) it is not practical to

predict these emissions from the proposed substation. However, these emissions are not likely to significantly add to the existing ambient environment, so would unlikely risk interference to the main types of communications services such as FM radio & TV broadcasts.

7. At the rail track within 30m from the 600V cabling, the predicted radio frequency electromagnetic fields exceed the RF interference limit of 0.316 mV/m (Table 1b), and the risk of interference to MF band (500kHz to 3MHz) radio or communications receiver equipment in the train, would be low to medium. The risk could be mitigated permanently, by increasing the distance separation between the 600 VAC cabling and the rail track, or by installation of magnetic shielding, of which the detail would need to be designed.

5.3 Survey

After installation of the substation, it is recommended that an electromagnetic survey be conducted, to assess the final electromagnetic environment, to ensure electromagnetic compliance and compatibility.

6. APPENDIX

Table 2. Predicted power frequency magnetic fields at the Granville Junction Substation

Position No. and description in relation to 600 V cabling in the proposed substation (refer Figures 3 and 4 for positions)	Separation distance from 600 V cabling (m)	Maximum Magnetic Field (μT, rms) (1)	Maximum Average Magnetic Field (μT, rms) (2)
Ground Level (refer Figure 3)			
0.5m away from the 600V cabling	0.5	500	300
1.1m away from the 600V cabling	1.1	103.24	61.95
1, at the western entrance	1.5	55.52	33.31
2, middle point between two rectifier/transformers	2	31.23	18.74
3, in the 33/11kV transformer room	4	7.81	4.68
4, in the negative reactor room	11	1.03	0.62
5, near batteries	16	0.49	0.29
6, in the office	18	0.39	0.23
7, next to the western security fence	3	13.88	8.33
8, in the middle of cable chamber	6	3.47	2.08
9, at the eastern entrance	12	0.87	0.52
Switch Room Level (refer Figure 4)			
0.5m away from the 600V cabling	0.5	500	300
1.1m away from the 600V cabling	1.1	103.24	61.95
10, at the western entrance	1.5	55.52	33.31
11, middle point between two rectifier/transformers	2	31.23	18.74
12, at the western corner of the switch room	6	3.47	2.08
13, at the southern corner of the switch room	20	0.31	0.19
14, at the western entrance of the switch room	8	1.95	1.17
15, at the eastern entrance of the switch room	22	0.26	0.15
16, at loading dock	15	0.56	0.33

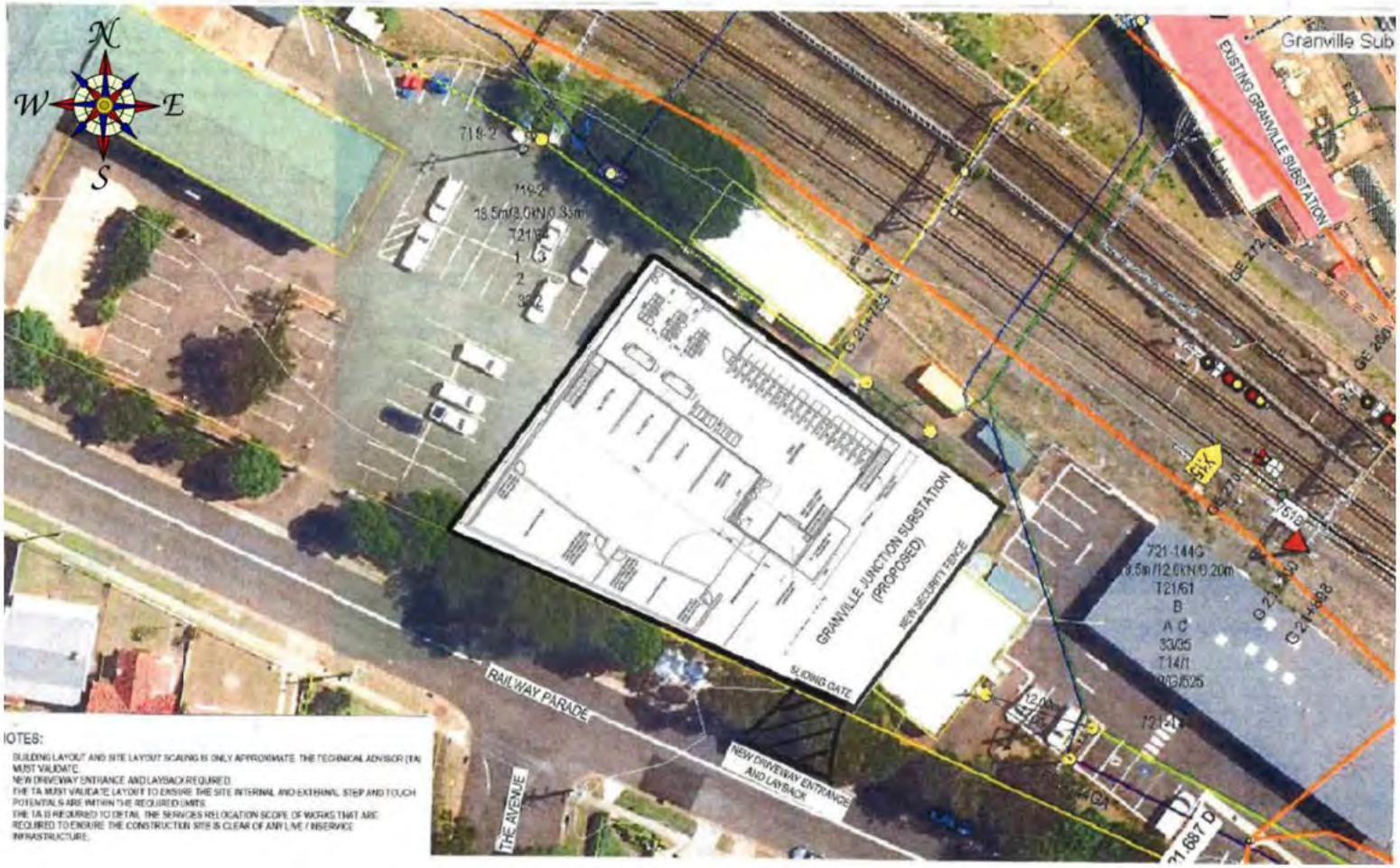
Note: 1. Maximum power frequency magnetic fields predicted are under maximum loading of the substation.
2. Maximum average power frequency magnetic fields predicted are under 60% of maximum loading of the substation..

Table 3. Predicted 500 kHz to 1.7 MHz Electric Fields at the new Granville Junction Substation

Separation distance from 600 V cabling (m)	Maximum Electric Field at 100% Load (mV/m)	Electric Field at 60% Load (1) (mV/m)	Electric Field at 30% Load (1) (mV/m)
3 (at the western security fence of the new substation	6.936	4.162	2.081
10	2.081	1.248	0.624
15 (at loading dock of the new substation)	1.387	0.832	0.416
18 (in the office)	1.156	0.694	0.347
20	1.040	0.624	0.320
25	0.832	0.499	0.250
30	0.694	0.416	0.208
35	0.595	0.357	0.178
40	0.520	0.320	0.156
45	0.462	0.277	0.139
50	0.416	0.250	0.125
55	0.378	0.227	0.113
60	0.347	0.208	0.104
65	0.320	0.192	0.096

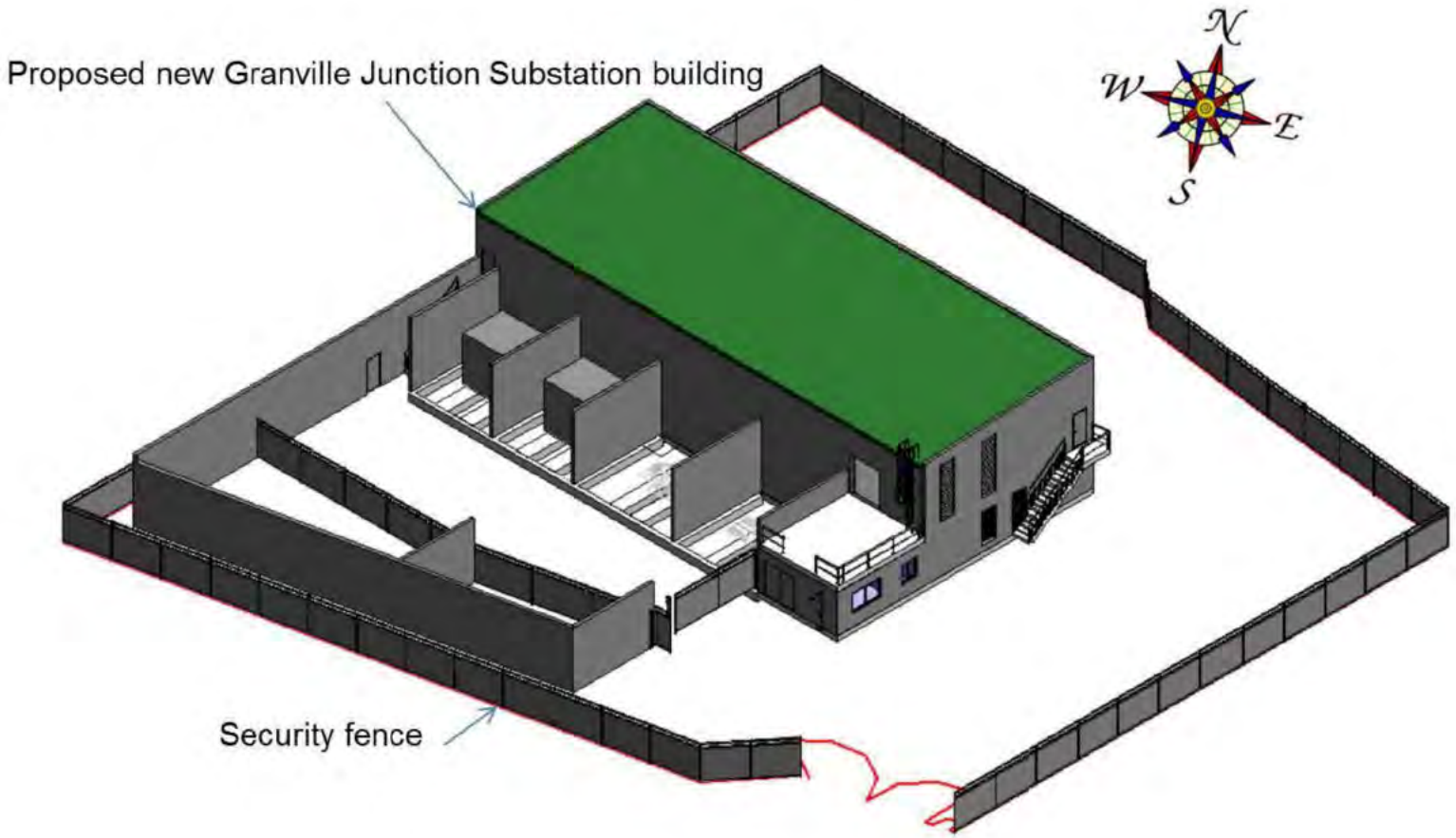
Note: 1. A 30 % or 60% loading could approximately be indicative of normal hour or peak hour loading, respectively.

Figure 1. Satellite View of the New Granville Junction Substation



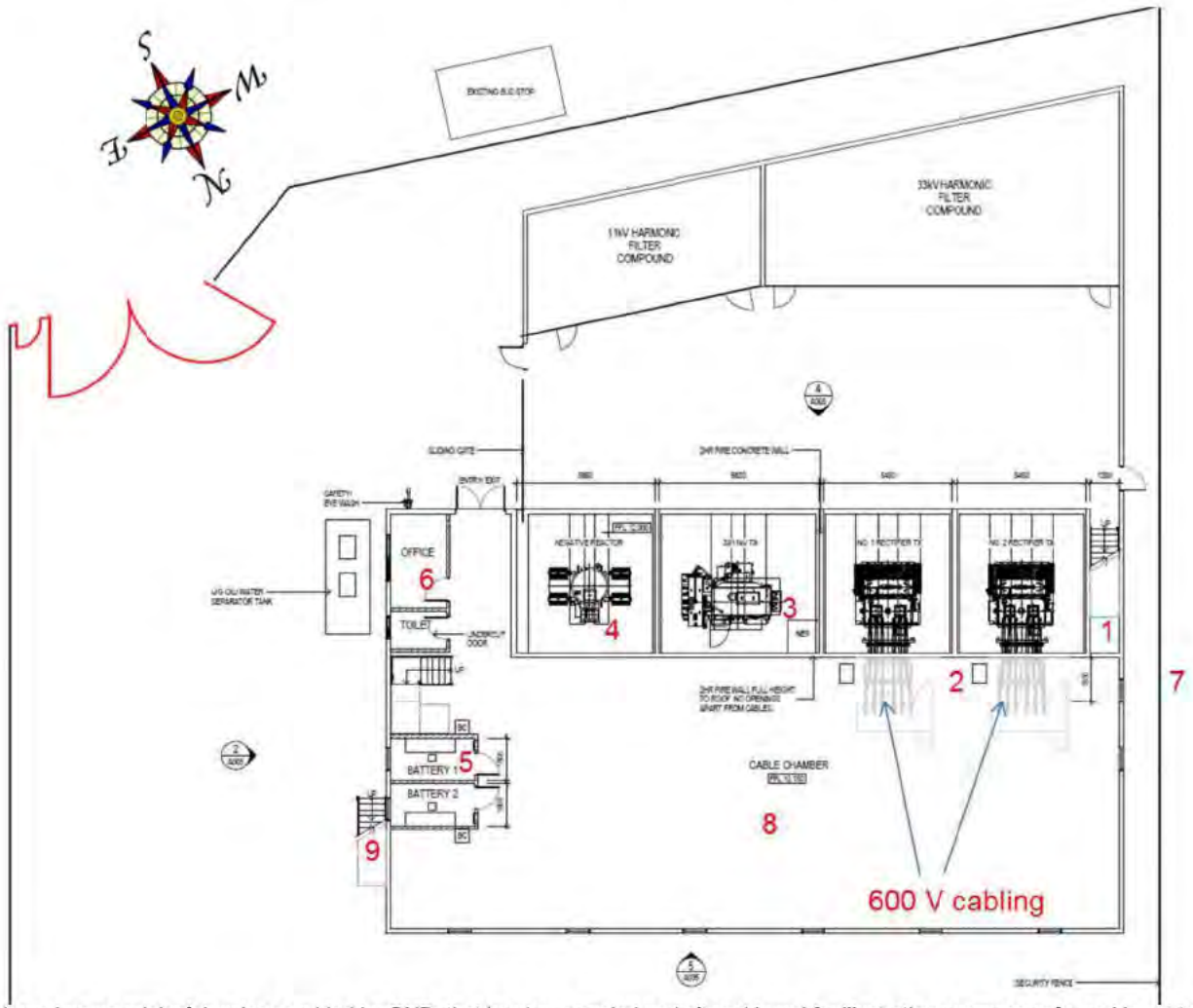
Note. This figure is for illustration purposes only, and is not to scale.

Figure 2. Perspective Drawing of the New Granville Junction Substation



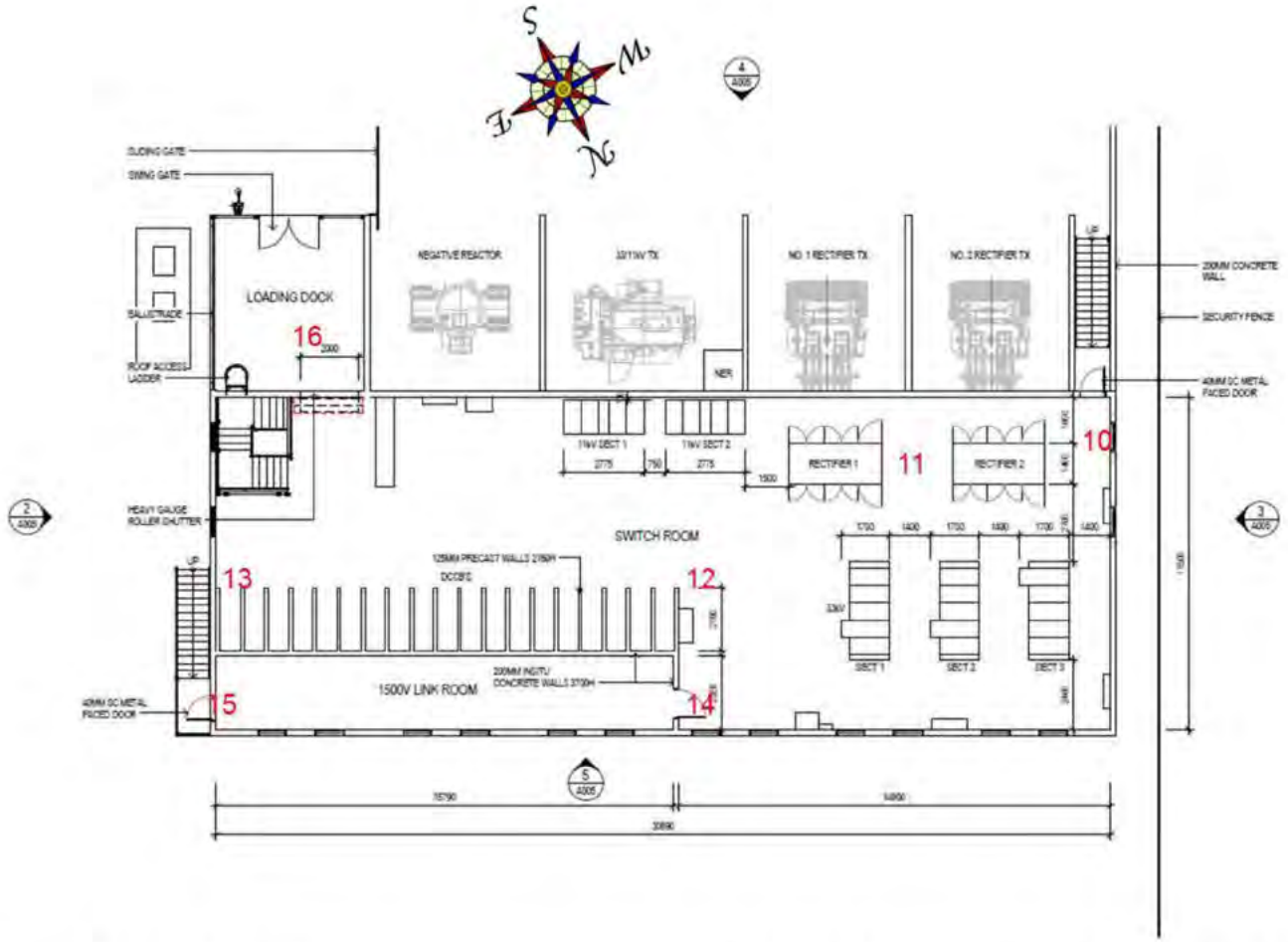
Note. This figure is based on an original drawing provided by GHD, and is not to scale.

Figure 3. Locations for EMF Predictions in the new Granville Junction Substation (Ground Level)



Note. This figure is based on an original drawing provided by GHD, that has been copied and altered in red for illustration purposes only, and is not to scale.

Figure 4. Locations for EMF Predictions in the new Granville Junction Substation (Switch Room Level)



Note. This figure is based on an original drawing provided by GHD, that has been copied and altered in red for illustration purposes only, and is not to scale.

APPENDIX A – SIGNAGE

Two examples of non-ionizing radiation signage to AS 1319, are shown in Figures 5a & 5b below:

Figure 5a –Signage (No Access in Front)

Figure 5b –Signage (Risk Above)

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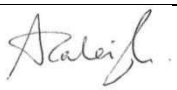
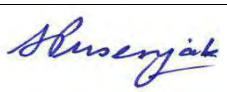
Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	GHD	A Raleigh				30/7/15
B	Ben Bracken	A Raleigh, S SPusenjak				21/8/15
C	Ben Bracken	A Raleigh, S SPusenjak				11/9/15
D	Ben Bracken	A Raleigh		S Pusenjak		07/10/15

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Appendix 2: Conditions of Approval

Conditions of Approval

Granville Junction Substation

Abbreviations

CEMP	Construction environmental management plan
CLP	Community liaison plan
EIA	Environmental impact assessment
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPL	Environment protection licence issued by the EPA under the *Protection of the Environment Operations Act 1997*
EMR	Environmental management representative
ISO	International Standards Organisation
OEH	NSW Office of Environment and Heritage
OOHWP	Out of hours work protocol
PMEM	Principal Manager Environment Management, TfNSW (or nominated delegate)
REF	Review of environmental factors
TfNSW	Transport for NSW

Definitions

construction	Includes all work in respect of the Project, other than survey, acquisitions, fencing, investigative drilling or excavation, building/road dilapidation surveys, or other activities determined by the EMR to have minimal environmental impact such as minor access roads, minor adjustments to services/utilities, establishing temporary construction compounds (in accordance with this approval), or minor clearing (except where threatened species, populations or ecological communities would be affected).
contamination	The presence in, on or under land of a substance at a concentration above the concentration at which the substance is normally present in, on or under (respectively) land in the same locality, being a presence that presents a risk of harm to human health or any other aspect of the environment.
designated works	Tunnelling, blasting, piling, excavation, bulk fill or any vibratory impact works (including jack hammering and compaction) for construction.
emergency work	Includes works to avoid loss of life, damage to external property, utilities and infrastructure, prevent immediate harm to the environment, contamination of land or damage to a heritage (indigenous or non-indigenous) item.
environmental impact assessment	The documents listed in Condition 1 of this approval.
environmental management representative	An independent environmental representative appointed to the Project or a delegate nominated by Transport for NSW.
noise sensitive receiver	In addition to residential dwellings, noise sensitive receivers include, but are not limited to, hotels, entertainment venues, pre-schools and day care facilities, educational institutions (e.g. schools, TAFE colleges), health care facilities (e.g. nursing homes, hospitals), recording studios, places of worship/religious facilities (e.g. churches), and other noise sensitive receivers identified in the environmental impact assessment.
reasonable and feasible	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account: mitigation benefits, cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
the Project	The construction and operation of the Granville Junction Substation project as described in the environmental impact assessment.
the Proponent	A person or body proposing to carry out an activity under Part 5 of the EP&A Act. In the case of the Project, TfNSW.

Conditions of approval

<table>
<tr><th>No</th><th>Condition</th></tr>
<tr><td></td><td>General</td></tr>
<tr><td>1.</td><td>Terms of approval
The Project shall be carried out generally in accordance with the environmental impact assessment (EIA) for this Project, which comprises the following documents:
<table>
<tr><th>DOCUMENT</th><th>AUTHOR</th><th>DATE</th></tr>
<tr><td>Granville Junction Substation Project – Review of Environmental Factors</td><td>GHD</td><td>October 2015</td></tr>
<tr><td>Granville Junction Substation Project – Determination Report</td><td>TfNSW</td><td>December 2015</td></tr>
</table>
In the event of an inconsistency between these conditions and the EIA, these conditions will prevail to the extent of the inconsistency.</td></tr>
<tr><td>2.</td><td>Project modifications
Any modification to the project as approved in the EIA would be subject to further assessment. This assessment would need to demonstrate that any environmental impacts resulting from the modifications have been minimised. The assessment shall be subject to approval under delegated authority by TfNSW. The Proponent shall comply with any additional requirements from the assessment of the project modification.</td></tr>
<tr><td>3.</td><td>Statutory requirements
These conditions do not relieve the Proponent of the obligation to obtain all other licences, permits, approvals and land owner consents from all relevant authorities and land owners as required under any other legislation for the Project. The Proponent shall comply with the terms and conditions of such licences, permits, approvals and permissions.</td></tr>
<tr><td></td><td>Communications</td></tr>
<tr><td>4.</td><td>Community liaison plan
The Proponent shall develop and implement a community liaison plan (CLP) to engage with government agencies, relevant councils, landowners, community members and other relevant stakeholders (such as utility and service providers, bus companies and businesses) where required. The CLP shall comply with the obligations of these conditions and should include, but not necessarily be limited to:
(a) details of the protocols and procedures for disseminating information and liaising with the community and other key stakeholders about construction activities (including timing and staging) and any associated impacts during the construction period
(b) stakeholder and issues identification and analysis
(c) procedures for dealing with complaints or disputes and response requirements, including advertising the 24 hour construction response line number
(d) details (including a program) of training for all employees, contractors and sub-contractors on the requirements of the CLP.
Sub-plans to the CLP will be developed as required. These sub-plans will detail site-specific consultation and communication requirements for construction works that impact residents, other stakeholders and businesses. They will also identify further mitigation measures and processes to reduce construction impacts.</td></tr>
</table>

No	Condition
	The CLP shall be prepared to the satisfaction of the Director Community Engagement prior to the commencement of construction and implemented, reviewed and revised as appropriate during construction of the Project.
5.	**Community notification and liaison** The local community shall be advised of any activities related to the Project with the potential to impact upon them. Prior to any site activities commencing and throughout the Project duration, the community is to be notified of works to be undertaken, the estimated hours of construction and details of how further information can be obtained (i.e. contact telephone number/email, website, newsletters etc.) including the 24 hour construction response line number. Construction-specific impacts including information on traffic changes, access changes, detours, services disruptions, public transport changes, high noise generating work activities and work required outside the nominated working hours shall be advised to the local community at least seven (7) days prior to such works being undertaken or other period as agreed to by the Director Community Engagement or as required by Environment Protection Authority (EPA) (where an environment protection licence (EPL) is in effect).
6.	**Website** The Proponent shall provide electronic information (or details of where hard copies of this information may be accessed by members of the public) related to the Project, on dedicated pages within its existing website, including: (a) a copy of the documents referred to under Condition 1 of this approval (b) a list of environmental management reports that are publicly available (c) 24 hour contact telephone number for information and complaints. All documents must be compliant with the Web Content Accessibility Guidelines 2.0.
7.	**Complaints management** The Proponent shall set up a 24 hour construction response line number. Details of all complaints received during construction are to be recorded on a complaints register. A verbal response to phone enquiries on what action is proposed to be undertaken is to be provided to the complainant within two (2) hours during all times construction is being undertaken and within 24 hours during non-construction times (unless the complainant agrees otherwise). A verbal response to written complaints (email/letter) should be provided within 48 hours of receipt of the communication. A detailed written response is to be provided to the complainant within seven (7) calendar days for verbal and/or written complaints. Information on all complaints received during the previous 24 hours shall be forwarded to the environmental management representative (EMR) each working day.
	Environmental management
8.	**Construction environmental management plan** The Proponent shall prepare a construction environmental management plan (CEMP) prior to commencement of construction which addresses the following matters, as a minimum: (a) traffic and pedestrian management (in consultation with the relevant roads authority) (b) noise and vibration management (c) water and soil management (d) air quality management (including dust suppression) (e) indigenous and non-indigenous heritage management (f) flora and fauna management

No	Condition
	(g) storage and use of hazardous materials (h) contaminated land management (including acid sulphate soils) (i) weed management (j) waste management (k) sustainability (l) environmental incident reporting and management procedures (m) non-compliance and corrective/preventative action procedures The CEMP shall: i. comply with the Conditions of Approval, conditions of any licences, permits or other approvals issued by government authorities for the Project, all relevant legislation and regulations, and accepted best practice management ii. comply with the relevant requirements of *Guideline for Preparation of Environmental Management Plans* (Department Infrastructure, Planning and Natural Resources, 2004) iii. include an Environmental Policy. The Proponent shall: 1. consult with government agencies and relevant service/utility providers as part of the preparation of the CEMP 2. submit a copy of the ECM to the EMR for review. The EMR is to be given a minimum period of 7 days to review and endorse the ECM. 3. submit a copy of the CEMP to the PMEM (or nominated delegate) for approval at least 14 days prior to commencement of construction (or such time as is otherwise agreed to by the PMEM) 4. review and update the CEMP at regular intervals, and in response to any actions identified as part of the EMR's audit of the document 5. ensure updates to the CEMP are be made within 7 days of the completion of the review or receipt of actions identified by any EMR audit of the document, and be submitted to the EMR for approval. The CEMP must be approved by the PMEM prior to the commencement of construction work associated with the Project.
9.	**Not Used**
	Hours of work
10.	**Standard construction hours** Construction activities shall be restricted to the hours of 7:00 am to 6:00 pm (Monday to Friday), 8:00 am to 1:00 pm (Saturday) and at no time on Sundays and public holidays except for the following works which are permitted outside these standard hours: (a) any works which do not cause noise emissions to be more than 5dBA higher than the rating background level at any nearby residential property and/or other noise sensitive receivers (b) out of hours work identified and assessed in the EIA or the approved out of hours work protocol (OOHWP) (c) the delivery of plant, equipment and materials which is required outside these hours as requested by police or other authorities for safety reasons and with suitable notification to the community as agreed by the PMEM (d) emergency work to avoid the loss of lives, property and/or to prevent environmental harm (e) any other work as agreed by the PMEM (or nominated delegate) and considered essential to the Project, or as approved by EPA (where an EPL is in effect).

No	Condition
11.	**High noise generating activities** Rock breaking or hammering, jack hammering, pile driving, vibratory rolling, cutting of pavement, concrete or steel and any other activities which result in impulsive or tonal noise generation shall not be undertaken for more than 3 hours, without a minimum 1 hour respite period unless otherwise agreed to by the PMEM (or nominated delegate), or as approved by EPA (where relevant to the issuing of an EPL), unless inaudible at nearby residential properties and/or other noise sensitive receivers.
	Noise and vibration
12.	**Construction noise and vibration** Construction noise and vibration mitigation measures shall be implemented through the CEMP, in accordance with TfNSW's *Construction Noise Strategy* and the EPA *Interim Construction Noise Guideline* (July 2009). The mitigation measures shall include, but not necessarily be limited to: (a) details of construction activities and an indicative schedule for construction works (b) identification of construction activities that have the potential to generate noise and/or vibration impacts on surrounding land uses, particularly sensitive noise receivers (c) detail what reasonable and feasible actions and measures shall be implemented to minimise noise impacts (including those identified in the environmental impact assessment) (d) procedures for notifying sensitive receivers of construction activities that are likely to affect their noise and vibration amenity, as well as procedures for dealing with and responding to noise complaints (e) an out of hours work protocol (OOHWP) for the assessment, management and approval of works outside the standard construction hours identified in Condition 10 of this approval, including a risk assessment process which deems the out of hours activities to be of low, medium or high environmental risk, is to be developed. All out of hours works are subject to approval by the EMR and/or PMEM (or nominated delegate) or as approved by EPA (where relevant to the issuing of an EPL). The OOHWP should be consistent with the TfNSW *Construction Noise Strategy* (f) a description of how the effectiveness of actions and measures shall be monitored during the proposed works, identification of the frequency of monitoring, the locations at which monitoring shall take place, recording and reporting of monitoring results and if any exceedance is detected, the manner in which any non-compliance shall be rectified.
13.	**Vibration criteria** Vibration (other than from blasting) resulting from construction and received at any structure outside of the Project shall be limited to: (a) for structural damage vibration - German Standard DIN 4150:Part 3 – 1999: *Structural Vibration in Buildings: Effects on Structures* (b) for human exposure to vibration – the acceptable vibration values set out in the *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DEC 2006). These limits apply unless otherwise approved by the PMEM through the CEMP.
14.	**Non-tonal reversing beepers** Non-tonal reversing beepers (or an equivalent mechanism) shall be fitted and used on all construction vehicles and mobile plant regularly used on site (i.e. greater than one day) and for any out of hours work.
15.	**Noise impact on educational facilities** Potentially affected pre-schools, schools, universities and any other affected permanent educational institutions shall be consulted in relation to noise mitigation measures to identify any noise sensitive periods (e.g. exam periods). As much as reasonably practicable noise intensive construction works in the vicinity of affected educational buildings are to be minimised.
16.	**Piling** Wherever practical, piling activities shall be completed using non-percussive piles. If percussive

No	Condition
	piles are proposed to be used, approval of the PMEM shall be obtained prior to commencement of piling activities.
	Contamination and hazardous materials
17.	**Unidentified contamination (other than asbestos)** If previously unidentified contamination (excluding asbestos) is discovered during construction, work in the affected area must cease immediately, and an investigation must be undertaken and report prepared to determine the nature, extent and degree of any contamination. The level of reporting must be appropriate for the identified contamination in accordance with relevant EPA guidelines, including the *Guidelines for Consultants Reporting on Contaminated Sites.* The Proponent shall: (a) submit a copy of any contamination report to the EMR for review. The EMR is to be given a minimum period of 7 days to review and provide any comments to the Proponent in relation to the report (b) submit a copy of the report to the PMEM for consideration upon completion of the EMR review period. The PMEM shall determine whether consultation with the relevant council and/or EPA is required prior to continuation of construction works within the affected area. ***Note:*** *In circumstances where both previously unidentified asbestos contamination and other contamination are discovered within a common area, nothing is these conditions shall prevent the preparation of a single investigation report to satisfy the requirements of both Condition 17 and Condition 18.*
18.	**Asbestos management** If previously unidentified asbestos contamination is discovered during construction, work in the affected area must cease immediately, and an investigation must be undertaken and report prepared to determine the nature, extent and degree of the asbestos contamination. The level of reporting must be appropriate for the identified contamination in accordance with relevant EPA and WorkCover guidelines and include the proposed methodology for the remediation of the asbestos contamination. Remediation activities must not take place until receipt of the investigation report. Works may only recommence upon receipt of a validation report from a suitably qualified contamination specialist that the remediation activities have been undertaken in accordance with the investigation report and remediation methodology. ***Note:*** *In circumstances where both previously unidentified asbestos contamination and other contamination are discovered within a common area, nothing in these conditions shall prevent the preparation of a single investigation report to satisfy the requirements of both Condition 17 and Condition 18.*
19.	**Storage and use of hazardous materials** Construction hazard and risk issues associated with the use and storage of hazardous materials shall be addressed through risk management measures, which shall be developed by the construction contractor prior to construction as part of the overall CEMP, in accordance with relevant EPA guidelines, TfNSW *Chemical Storage and Spill Response Guideline* and Australian and ISO standards. These measures shall include: (a) the storage of hazardous materials, and refuelling/maintenance of construction plant and equipment to be undertaken in clearly marked designated areas that are designed to contain spills and leaks (b) spill kits, appropriate for the type and volume of hazardous materials stored or in use, to be readily available and accessible to construction workers. Kits to be kept at hazardous materials storage locations, in site compounds and on specific construction vehicles. Where a spill to a watercourse is identified as a risk, spill kits to be kept in close proximity to potential discharge points in support of preventative controls (c) all hazardous materials spills and leaks to be reported to site managers and actions to be immediately taken to remedy spills and leaks (d) training in the use of spill kits to be given to all personnel involved in the storage, distribution

No	Condition
	or use of hazardous materials.
	Erosion and sediment control
20.	**Erosion and sediment control** Soil and water management measures shall be prepared as part of the CEMP for the mitigation of water quality impacts during construction of the Project. The management measures shall be prepared in accordance with *Managing Urban Stormwater; Soils and Construction 4th Edition* (Landcom, 2004).
	General
21.	**Pre-construction environmental compliance matrix** A pre-construction environmental compliance matrix (PECM) for the Project (or such stages of the Project as agreed to by the Environmental Management Representative (EMR)) shall be prepared detailing compliance with all relevant conditions and mitigation measures prior to commencement of construction. The PECM shall also include details of approvals, licences and permits required to be obtained under any other legislation for the Project. The Proponent shall: (a) submit a copy of the PECM to the EMR for review. The EMR are to be given a minimum period of 7 days to review and provide any comments to the Proponent in relation to the PECM (b) upon completion of the EMR review period, submit a copy of the PECM to the PMEM for approval, at least 14 days (or within such time as otherwise agreed to by the PMEM) prior to commencement of construction of the Project.
22.	**Construction environmental compliance report** The Proponent shall prepare a construction environmental compliance report (CECR) which addresses the following matters: (a) compliance with the construction environmental management plan (CEMP) and these conditions (b) compliance with the *Sustainable Design Guidelines Version 3.0* compliance checklist (c) compliance with any approvals or licences issued by relevant authorities for construction of the Project (d) implementation and effectiveness of environmental controls (the assessment of effectiveness should be based on a comparison of actual impacts against performance criteria identified in the CEMP) (e) environmental monitoring results, presented as a results summary and analysis (f) details of the percentage of waste diverted from landfill and the percentage of spoil beneficially reused (g) number and details of any complaints, including summary of main areas of complaint, actions taken, responses given and intended strategies to reduce recurring complaints (subject to privacy protection) (h) details of any review and amendments to the CEMP resulting from construction during the reporting period (i) any other matter as requested by the PMEM. The Proponent shall: 1. submit a copy of the CECR to the EMR for review. The EMR is to be given a minimum period of 7 days to review and provide any comments to the Proponent in relation to the CECR 2. submit a copy of the CECR to the PMEM (or nominated delegate) for approval upon completion of the EMR review period. The first CECR shall report on the first six months of construction and be submitted within six

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	weeks of expiry of that period (or at any other time interval agreed to by the PMEM). CECRs shall be submitted no later than six months after the date of submission of the preceding CECR (or at other such periods as requested by the PMEM) for the duration of construction.
23.	**Pre-operation compliance report** A pre-operation compliance report (POCR) for the Project shall be prepared, prior to commencement of operation of the Project. The POCR shall detail compliance with all conditions of approval, licences and permits required to be obtained under any other legislation for the project. The Proponent shall: (a) submit a copy of the POCR to the EMR for review. The EMR is to be given a minimum period of 7 days to review and provide any comments to the Proponent in relation to the POCR. (b) upon completion of the EMR review period submit a copy of the POCR to the PMEM (or nominated delegate) for approval. The POCR is to be provided to the PMEM at least one month prior to the scheduled operation of the Project (or such time as otherwise agreed to by the PMEM).
	Environmental management
24.	**Environmental controls map** The Proponent shall prepare an environmental controls map (ECM) in accordance with TfNSW's *Guide to Preparing ECMs* prior to the commencement of construction for implementation for the duration of construction. The ECM is to be endorsed by the EMR and may be prepared in stages as set out in the CEMP. The Proponent shall submit a copy of the ECM to the EMR for review and endorsement. The EMR is to be given a minimum period of 7 days to review and endorse the ECM. Following receipt of the EMR's endorsement, the ECM shall be submitted to the PMEM (or nominated delegate) for approval, at least 14 days prior to commencement of construction (or such time as is otherwise agreed to by the PMEM). The ECM shall be prepared as a map – suitably enlarged (e.g. A3 size or larger) for mounting on the wall of a site office and included in site inductions, supported by relevant written information. Updates to the ECM shall be made within 7 days of the completion of the review or receipt of actions identified by any EMR audit of the document, and be submitted to the EMR for approval.
	Flora and fauna
25.	**Replanting program** All cleared vegetation shall be offset in accordance with TfNSW's *Vegetation Offset Guide*. All vegetation planted on-site is to consist of locally endemic native species, unless otherwise agreed by the PMEM, following consultation with the relevant council, where relevant, and/or the owner of the land upon which the vegetation is to be planted. All vegetation planted on-site shall be maintained for a minimum period of 12 months, unless otherwise agreed by the PMEM.
26.	**Removal of trees or vegetation** Separate approval, in accordance with TfNSW's *Application for Removal or Trimming of Vegetation*, is required for the trimming, cutting, pruning or removal of trees or vegetation where the impact has not already been identified in the EIA for the Project. The trimming, cutting, pruning or removal of trees or vegetation shall be undertaken in accordance with the conditions of that approval.
	Heritage management
27.	**Indigenous and non-Indigenous heritage** If previously unidentified Indigenous or non-Indigenous heritage/archaeological items are uncovered during construction works, all works in the vicinity of the find shall cease and appropriate advice shall be sought from a suitably qualified heritage consultant (and in consultation with the OEH Heritage Branch where appropriate), and in accordance with the Unexpected Heritage Finds Guideline - 3TP-SD-115. Works in the vicinity of the find shall not re-

No	Condition
	commence until clearance has been received from a suitably qualified and experienced heritage consultant.
	Property
28.	**Property condition surveys** Subject to landowner agreement, property condition surveys shall be completed prior to piling, excavation or bulk fill or any vibratory impact works including jack hammering and compaction (Designated Works) in the vicinity of the following buildings/structures: (a) all buildings/structures/roads within a plan distance of 50 metres from the edge of the Designated Works (b) all heritage listed buildings and other sensitive structures within 20 metres of construction involving vibration intensive compaction equipment. Property condition surveys need not be undertaken if a risk assessment indicates that selected buildings/structures/roads identified in (a) and (b) will not be affected as determined by a qualified geotechnical and construction engineering expert with appropriate registration on the National Professional Engineers Register prior to commencement of Designated Works. Selected potentially sensitive buildings and/or structures shall first be surveyed prior to the commencement of the Designated Works and again immediately upon completion of the Designated Works. All owners of assets to be surveyed, as defined above, are to be advised (at least 14 days prior to the first survey) of the scope and methodology of the survey, and the process for making a claim regarding property damage. A copy of the survey(s) shall be given to each affected owner. A register of all properties surveyed shall be maintained. Any damage to buildings, structures, lawns, trees, sheds, gardens, etc. as a result of construction activity direct and indirect (i.e. including vibration and groundwater changes) shall be rectified at no cost to the owner(s).
29.	**Pre-construction sustainability report** Prior to commencement of construction, a pre-construction sustainability report (PCSR) shall be prepared to the satisfaction of the PMS. The Report shall include the following minimum components: (a) a completed electronic checklist demonstrating compliance with the *Sustainable Design Guidelines Version 3.0* (b) a statement outlining the Proponent's own corporate sustainability obligations, goals, targets, in house tools, etc (c) a section specifying any areas of innovation that will be explored and/or implemented on the Project during the course of the construction period. The Proponent shall submit a copy of the PCSR to the PMS for approval, at least 14 days prior to the commencement of construction (or within such time as otherwise agreed to by the PMS).
	Traffic and Access
30.	**Traffic management plan** The Proponent shall prepare a construction traffic management plan (TMP) as part of the CEMP which addresses, as a minimum, the following: (a) ensuring adequate road signage at construction work sites to inform motorists and pedestrians of the work site ahead to ensure that the risk of road accidents and disruption to surrounding land uses is minimised (b) maximising safety and accessibility for pedestrians and cyclists (c) ensuring adequate sight lines to allow for safe entry and exit from the site (d) ensuring access to railway stations, businesses, entertainment premises and residential properties (unless affected property owners have been consulted and appropriate alternative arrangements made)

No	Condition
	(e) managing impacts and changes to on and off street parking and requirements for any temporary replacement provision (f) parking locations for construction workers away from stations and busy residential areas and details of how this will be monitored for compliance (g) routes to be used by heavy construction-related vehicles to minimise impacts on sensitive land uses and businesses (h) details for relocating kiss-and-ride, taxi ranks and rail replacement bus stops if required, including appropriate signage to direct patrons, in consultation with the relevant bus operator. Particular provisions should also be considered for the accessibility impaired. (i) measures to manage traffic flows around the area affected by the Project, including as required regulatory and direction signposting, line marking and variable message signs and all other traffic control devices necessary for the implementation of the TMP. The Proponent shall consult with the relevant roads authority during preparation of the TMP, as required. The performance of all Project traffic arrangements must be monitored during construction.
31.	**Road condition reports** Prior to construction commencement (or as otherwise agreed with the PMEM), the Proponent shall prepare road condition surveys and reports on the condition of roads and footpaths potentially affected by construction. The roads and footpaths to be surveyed are to be agreed with TfNSW prior to commencement of the surveys. Any damage resulting from the construction of the Project, aside from that resulting from normal wear and tear, shall be repaired at the Proponent's expense.
32.	**Road safety audit** Prior to commencement of any construction works, a Road Safety Audit is to be undertaken for the construction and operation of the substation. . The Road Safety Audit is to be prepared by a suitably qualified and experienced traffic engineer, and is to include specific assessment of: (a) sight distances for vehicles exiting or entering the driveway entrance at the Granville Junction and Railway Parade intersection and mitigation measures proposed (b) assessment of the Granville Junction and Railway Parade intersection and mitigation measures proposed The Road Safety Audit is to be submitted for comment to TfNSW.
	Urban design and landscaping
33.	**Urban design and landscaping plan** The Proponent shall prepare an urban design and landscaping plan (UDLP) which demonstrates design excellence in the essential urban design requirements of the Project, as evident in the following matters: (a) the appropriateness of to the proposed design with respect to the existing surrounding landscape, built form, behaviours and use-patterns (b) materials, finishes, colour schemes and maintenance procedures including graffiti control for new walls, barriers and fences (c) landscape treatments and street tree planting to integrate with surrounding streetscape (d) design detail that is sympathetic to the amenity and character of heritage items located within or adjacent to the Project site (e) total water management principles to be integrated into the design where considered appropriate (f) design measures included to meet the *Sustainable Design Guidelines Version 3.0* (g) take into account relevant urban design and visual considerations including reversal of colours scheme to make the predominant brickwork darker in colour and the lighter brick used for the highlights during the detailed design of the proposal

No	Condition
	The UDLP shall be: (a) prepared prior to the finalisation of the concept design for the Project (b) prepared in consultation with Council and relevant stakeholders (c) prepared by a registered architect and/or landscape architect (d) submitted for acceptance to TfNSW - Urban Design Team.
	Miscellaneous
34.	**Graffiti and advertising** Hoardings, site sheds, fencing, acoustic walls around the perimeter of the site, and any structures built as part of the Project are to be maintained free of graffiti and advertising not authorised by the Proponent during the construction period. Graffiti and unauthorised advertising will be removed or covered within the following timeframes: (a) offensive graffiti will be removed or concealed within 24 hours (b) highly visible (yet inoffensive) graffiti will be removed or concealed within a week (c) graffiti that is neither offensive or highly visible will be removed or concealed within a month (d) any unauthorised advertising material will be removed or concealed within 24 hours.
35.	**Electromagnetic energy** An electromagnetic study is to be conducted for the detailed design, to assess the final electromagnetic environment. If required, modifications are to be made to the substation design to ensure electromagnetic compliance and compatibility. During commissioning of the substation, an electromagnetic survey is to be conducted, to assess the final operational electromagnetic environment, to ensure compliance with the following Australian Standards: (a) RHS 30 (Radiation Health Series 30), *Interim Guidelines on Limits of Exposure to 50/60 Hz Electric & Magnetic Fields* (1989), National Health and Medical Research Council (b) RPS 3 (Radiation Protection Series No.3), *Maximum Exposure Levels to Radiofrequency Fields* – 3 kHz to 300 GHz (2002), ARPANSA (c) AS/NZS 2344: 1997 and Amdt 1: 2006 *Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 to 1000 MHz* A survey report is to be submitted to TfNSW for comment prior to the completion of commissioning.
36.	**Hazardous materials** A hazardous materials management plan is to be prepared as part of the CEMP. The plan is to include the following measures. (a) The Hazardous Materials Survey should be updated prior to works commencing to confirm presence and conditions of hazardous items. (b) The removal, handling and disposal of any asbestos waste is to be undertaken by an appropriately licensed contractor (an occupational hygienist who is also a licensed asbestos assessor), and in accordance with: 1. *Code of Practice for the Safe Removal of Asbestos 2005* 2. *Code of Practice for the Management and Control of Asbestos in Workplaces 2005.* (c) The occupational hygienist shall be responsible for conducting asbestos fibre air monitoring, visual clearance inspections and issuing clearance certificates after the completion of any removal works. (d) Work is to cease in the vicinity of any potential asbestos materials which have not been previously identified, and the material be analysed for the presence of asbestos. In the event the material is disturbed prior to work ceasing, the provisions of an Asbestos Removal Control Plan or similar is to be followed, including seeking advice from a suitably qualified and

No	Condition
	experienced professional. (e) Where the Hazardous Materials Survey identifies the presence of Lead paint and/or Lead dust within the Project site, Lead paint stabilisation and/or Lead dust removal is to be carried out by a qualified hazardous material removal contractor for all relevant areas within the substation areas affected by construction/demolition or utilised for construction access. The stabilisation/removal works are to be completed prior to the commencement of construction unless otherwise agreed by the PMEM. (f) All known and presumed occurrences of polychlorinated biphenyl's would be handled and disposed of in accordance with the procedure documented within *ANZECC Identification of PCB-containing Capacitors – An information booklet for electricians and electrical contractors 1997*. Removal would be undertaken by a suitable licenced hazardous material removal contractor and would be disposed of at an appropriately licenced facility. (g) In the event synthetic material fibres are found on site, they would be handled and disposed of in accordance with the *National Code of Practice for the Safe Use of Synthetic Mineral Fibres*. (h) Where required, any materials classified as Hazardous Waste would be treated, or an immobilisation approval obtained, in accordance with Part 10 of the *Protection of the Environment Operations (Waste) Regulation 2014* prior to off-site disposal.
37.	**Contamination investigation** A Phase 2 detailed site investigation shall be undertaken prior to construction commencing. The assessment shall be undertaken in accordance with: (a) *The National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013* (b) NSW EPA (1995) *Sampling Design Guidelines* (c) *AS4482 Guide to investigation and sampling of site with potentially contaminated soil* (2005). (d) *Guidelines for Consultants Reporting on Contaminated Sites* (DECCW, 2011) The report shall include a preliminary waste classification in accordance with the NSW EPA *Waste Classification Guidelines* (2014). Specific requirements for further investigation, remediation or management of any contamination within the identified areas recommended in the Phase 2 Detailed Site Investigation shall be included in the CEMP as appropriate. If contamination is identified within the Site, the Proponent is to determine whether there is a Duty to Report under section 60 of the *Contaminated Land Management Act 1997* and relevant EPA Guidelines.
38.	**Contamination management plan** Specific requirements for further investigation, remediation and management of any potential contamination within the identified areas recommended in the Phase 2 contamination assessment shall be included in a Contamination Management Plan (CMP) or a Remediation Action Plan (RAP) as appropriate. Recommendations from the Detailed Site Investigation would be incorporated into a CMP/RAP if required, to be implemented during construction. The Detailed Site Investigation and CMP/RAP (if required) would be in accordance with applicable guidelines, including but not limited to: (a) *The National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013* (b) NSW EPA (1995) *Sampling Design Guidelines* (c) *AS4482 Guide to investigation and sampling of site with potentially contaminated soil* (2005). (d) *Guidelines for Consultants Reporting on Contaminated Sites* (DECCW, 2011) (e) EPA *Waste Classification Guidelines* (2014) (f) *AS4482 Guide to investigation and sampling of site with potentially contaminated soil* (2005)

END OF CONDITIONS

Appendix 3: Environmental Impact Assessment

GRANVILLE JUNCTION SUBSTATION PROJECT

APPROVAL

I, BEN GROTH, as delegate of the Secretary, Transport for NSW:

1. Have examined and considered the Proposed Activity in the Granville Junction Substation Project Review of Environmental Factors and Granville Junction Substation Project Determination Report in accordance with the provisions of section 111 of the *Environmental Planning and Assessment Act 1979*.
2. Determine on behalf of Transport for NSW (the Proponent) that the Proposed Activity may be carried out in accordance with the Conditions of Approval in this Determination Report, consistent with the proposal described in the Granville Junction Substation Project Review of Environmental Factors as amended by this Determination Report.

Ben Groth
Principal Manager, Environmental Impact Assessment, Planning and Environment Services
Transport for NSW

Date: 15/12/15