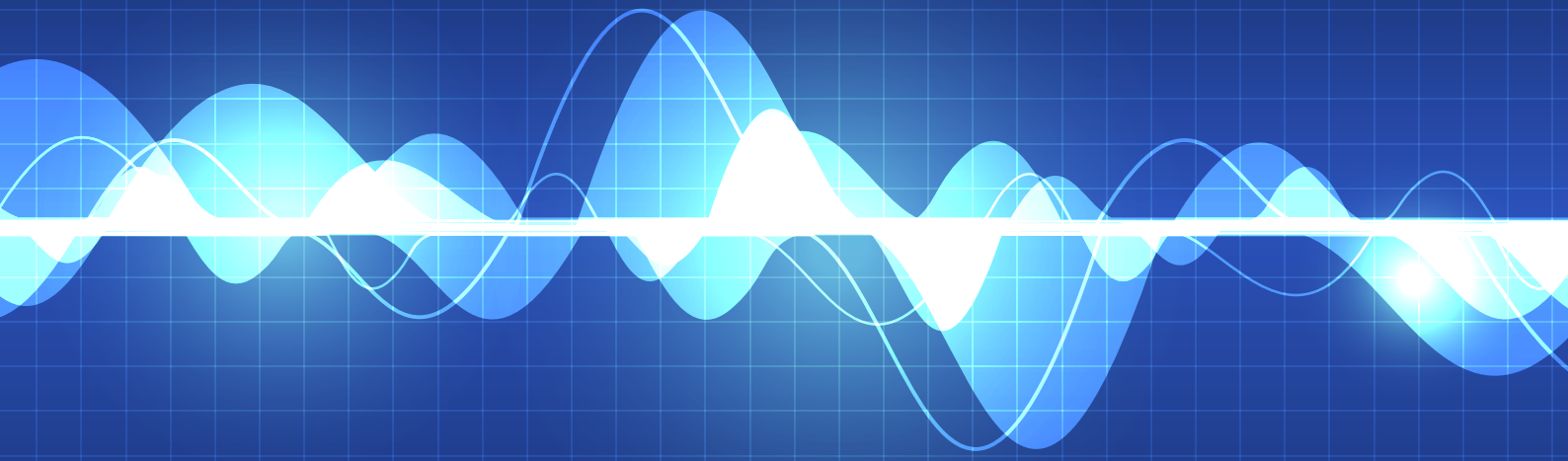
M4-M5 Link Mainline Tunnels

Construction Noise and Vibration Impact Statement - Parramatta Road East and West civil site

Prepared for Lendlease Samsung Bouygues Joint Venture
April 2020



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Report Number

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Client

Lendlease Samsung Bouygues Joint Venture

Date

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9 Final

Prepared by

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27 April 2020

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Director
27 April 2020

Executive Summary

EMM has prepared a Construction Noise and Vibration Impact Statement (CNVIS) for works proposed at the Parramatta Road East and West civil site (PREW) for the M4-M5 Link Mainline Tunnels project. PREW functions as support for the civil and tunnelling sites at Haberfield. Activities at PREW are principally associated with use of the carpark areas, laydown area and office warehouse.

The potential noise levels from the PREW were assessed in accordance with relevant policies, standards, guidelines and the instrument of approval conditions.

The existing environment in the vicinity of PREW comprises residential and non-residential uses as identified in the M4-M5 Link EIS. The study area was divided up into Noise Catchment Areas (NCA's) and background noise monitoring conducted at representative receiver locations. The NMLs for the project are based on measured background noise levels as described in the EIS in the absence of construction noise from each stage of the WestConnex project. Therefore, adhering to NMLs as far as practicable would also assist in minimising cumulative noise impacts from the project.

The primary document in NSW for assessing construction noise is the Environmental Protection Authority (EPA) Interim Construction Noise Guideline (ICNG). Noise from construction sites is inevitable, but the aim if the ICNG "is to protect the majority of residences and other sensitive land uses from noise pollution most of the time". It is inherent for some construction projects to exceed noise management levels provided in the ICNG. However, where this is the case, all feasible and reasonable noise mitigation and management measures must be implemented.

The CNVIS has considered the $L_{Aeq,15min}$ (average noise as per the ICNG) and $L_{A1,1min}$ or L_{Amax} (eg maxima events) potential noise impacts from activities at PREW. Noise levels have been predicted to satisfy the NMLs for all residential and non-residential receivers for standard and Out of Hours (OOH) periods. The assessment has indicated potential for exceedance of sleep disturbance 'screening criterion' at night, however the predicted levels are less than the existing L_{Amax} and L_{A1} noise levels that the residential receivers were or are currently exposed to, likely from traffic on Parramatta Road.

The construction scenarios presented in this report are considered representative of typical or worst case. The CNVIS provides methods on how noise can be managed and mitigated in Section 10.

The potential for cumulative noise impacts from the project with other components of the WestConnex project (New M5 and M4 East) have been considered. A review of PREW and M4 East project timeframes and the distances between the work sites indicates that the scheduled overlap would be minor, and based on the noise predictions from PREW, would unlikely cause cumulative noise impacts. The M4-M5 Wattle Street civil and tunnelling site is located more than 250m from PREW and would not result in cumulative noise impacts.

Project traffic on public roads has been assessed against the Roads and Maritime Construction Noise and Vibration Guideline (CNVG). Traffic volumes associated with the works are low relative to existing movements on the roads potentially affected (ie Parramatta Road). The relative increase in average road traffic noise levels on Parramatta Road is less than 0.2dB, which satisfies the CNVG guidelines.

Activities proposed for PREW would not result in emission of significant ground vibration that would result in vibration levels approaching the human comfort or cosmetic damage criteria.

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1 Introduction

1.1 Context

This Construction Noise and Vibration Impact Statement (CNVIS) has been prepared to identify the noise and vibration impacts from a portion of Stage 1 of the WestConnex 3A – M4-M5 Link Mainline Tunnels project (The Project). In addition, this CNVIS also responds to (as required) the various noise and vibration requirements detailed within the Minister's Conditions of Approval (CoA), the WestConnex M4-M5 Link Environmental Impact Statement (EIS), the revised environmental management measures (REMM) listed in the Submissions and Preferred Infrastructure Report (SPIR) and all applicable legislation.

1.2 Project background and description

An EIS (AECOM 2017) assessed the potential impacts of construction and operation of the project on noise and vibration, within Chapter 10.

The EIS identified the potential noise and vibration impacts during construction typically associated with noise intensive construction works. It concluded any potential impacts could be managed by standard mitigation and management measures.

The WestConnex M4-M5 Link project is being constructed in two stages

- Stage 1 (the Project and subject of this document): M4-M5 Link Mainline Tunnels; and
- Stage 2: Rozelle interchange.

Sydney Motorway Corporation (SMC) has engaged Lendlease Samsung Bouygues Joint Venture (LSBJV) to design and construct Stage 1 of the project (refer Figure 1.1). The key features of the Mainline tunnels project include:

- Twin mainline motorway tunnels between the M4 East at Haberfield and the New M5 at St Peters. Each tunnel would be around 7.5 kilometres long and would generally accommodate up to four lanes of traffic in each direction;
- Connections of the mainline tunnels to the M4 East project, comprising:
  - A subterranean connection to the M4 East mainline stub tunnels east of Parramatta Road near Alt Street at Haberfield;
  - Entry and exit ramp connections between the mainline tunnels and the Wattle Street interchange at Haberfield (which is currently being constructed as part of the M4 East project);
  - Minor physical integration works with the surface road network at the Wattle Street interchange including road pavement and line marking;
- Connections of the mainline tunnels to the New M5 project, comprising:
  - A subterranean connection to the New M5 mainline stub tunnels north of the Princes Highway near the intersection of Mary Street and Bakers Lane at St Peters;
  - Entry and exit ramp connections between the mainline tunnels and the St Peters interchange at St Peters (which is currently being constructed as part of the New M5 project);

  - Minor physical integration works with the surface road network at the St Peters interchange including road pavement and line marking;

- Construction of tunnel stubs to provide for future underground connection of the mainline tunnels to the Rozelle interchange and Iron Cove Link;
- A motorway operations complex at St Peters (Campbell Road) (MOC5). The types of facilities that would be contained within the motorway operations complexes would include substations, water treatment plants, ventilation facilities and outlets (the Campbell Road ventilation facility), offices, on-site storage and parking for employees;
- Tunnel ventilation systems, including ventilation supply and exhaust facilities, ventilation fans, ventilation outlets and ventilation tunnels;
- Fit out (mechanical and electrical) of part of the Parramatta Road ventilation facility at Haberfield (which is currently being constructed as part of M4 East project) for use by the M4-M5 Link project;
- Drainage infrastructure to collect surface and groundwater for treatment at dedicated facilities;
- Water treatment would occur at the operational water treatment facility at the Campbell Road motorway operations complex (subject to future Modification);
- Ancillary infrastructure and operational facilities for electronic tolling and traffic control and signage (including electronic signage);
- Emergency access and evacuation facilities, including pedestrian and vehicular cross and long passages and fire and life safety systems;
- Utility works, including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities;
- Temporary construction ancillary facilities to facilitate construction of the project at the following locations:
  - Northcote Street civil and tunnel site (C3a), Haberfield (subject to future Modification);
  - Haberfield civil site (C2b), Haberfield;
  - Parramatta Road East civil site (C3b), Haberfield;
  - Parramatta Road West civil site (C1b), Ashfield;
  - Wattle Street civil and tunnel site (C1a), Haberfield;
  - Pyrmont Bridge Road tunnel site (C9), Camperdown/Annandale;
  - Campbell Road civil and tunnel site (C10), St Peters; and
  - White Bay civil site (C11), Rozelle.

An overview of the project footprint and ancillary facilities is presented in the Construction Environmental Management Plan (CEMP) and Site Environmental Management Plan (SEMP). Further detail of the project description is presented in Section 1.3 of the CEMP.

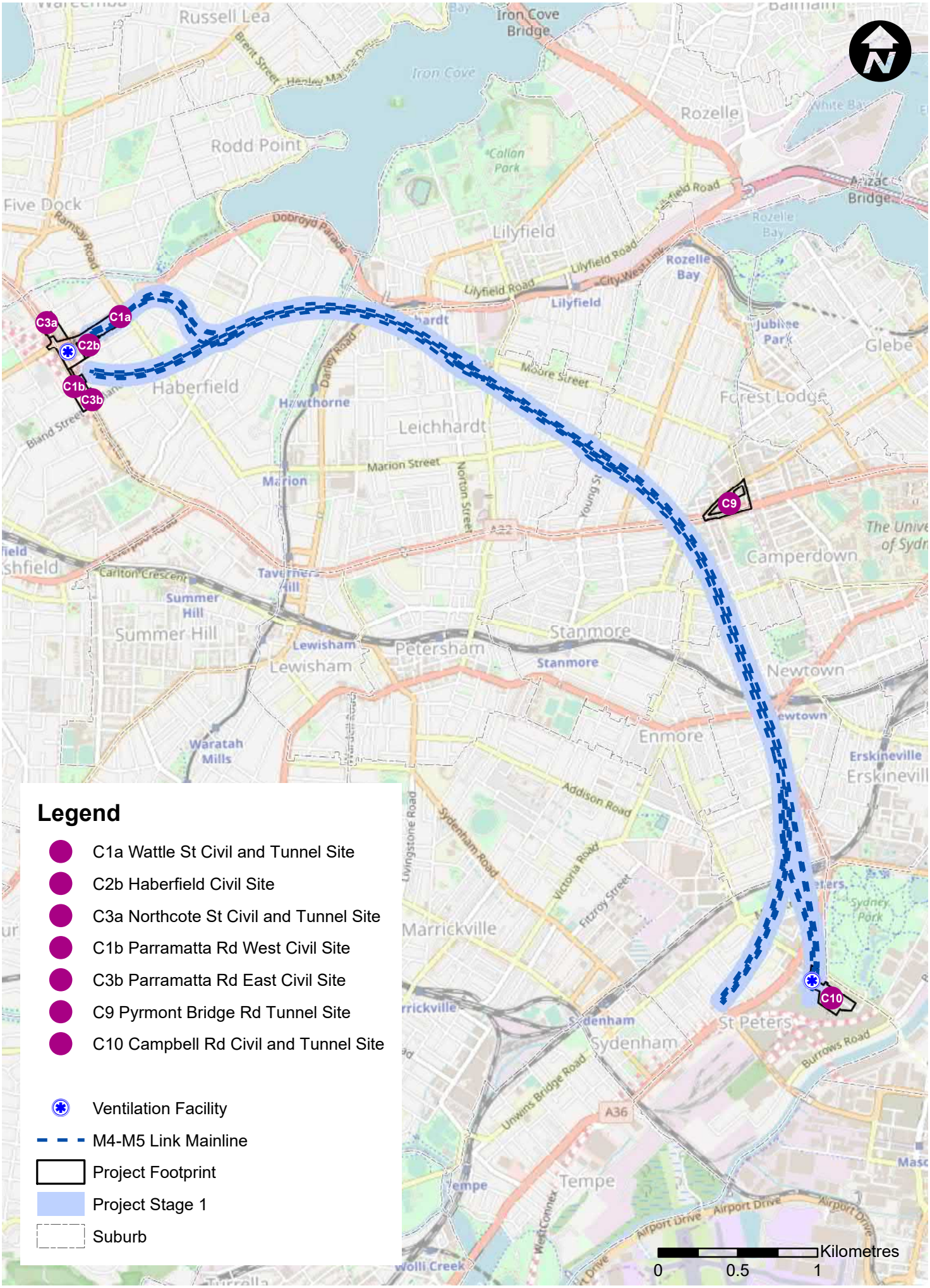


Figure 1-1 Overview of Stage 1 - M4-M5 Link Mainline Tunnels (the Project)

1.3 Scope of this CNVIS

The scope of this CNVIS is to assess potential noise and vibration impacts from the post site establishment construction activities at PREW and to develop feasible and reasonable noise management and mitigation measures where impacts are identified.

PREW comprises four areas on the eastern and western sides of Parramatta Road at the junction of Alt Street as shown in Figure 1.2. The construction of the ancillary facility would use land above ground that is currently vacant but was previously operated as commercial premises. The Site Establishment CNVIS assessed preliminary construction at PREW including environmental controls, demolition, erection of hoardings and noise walls, bridge construction and provision of site facilities and services.

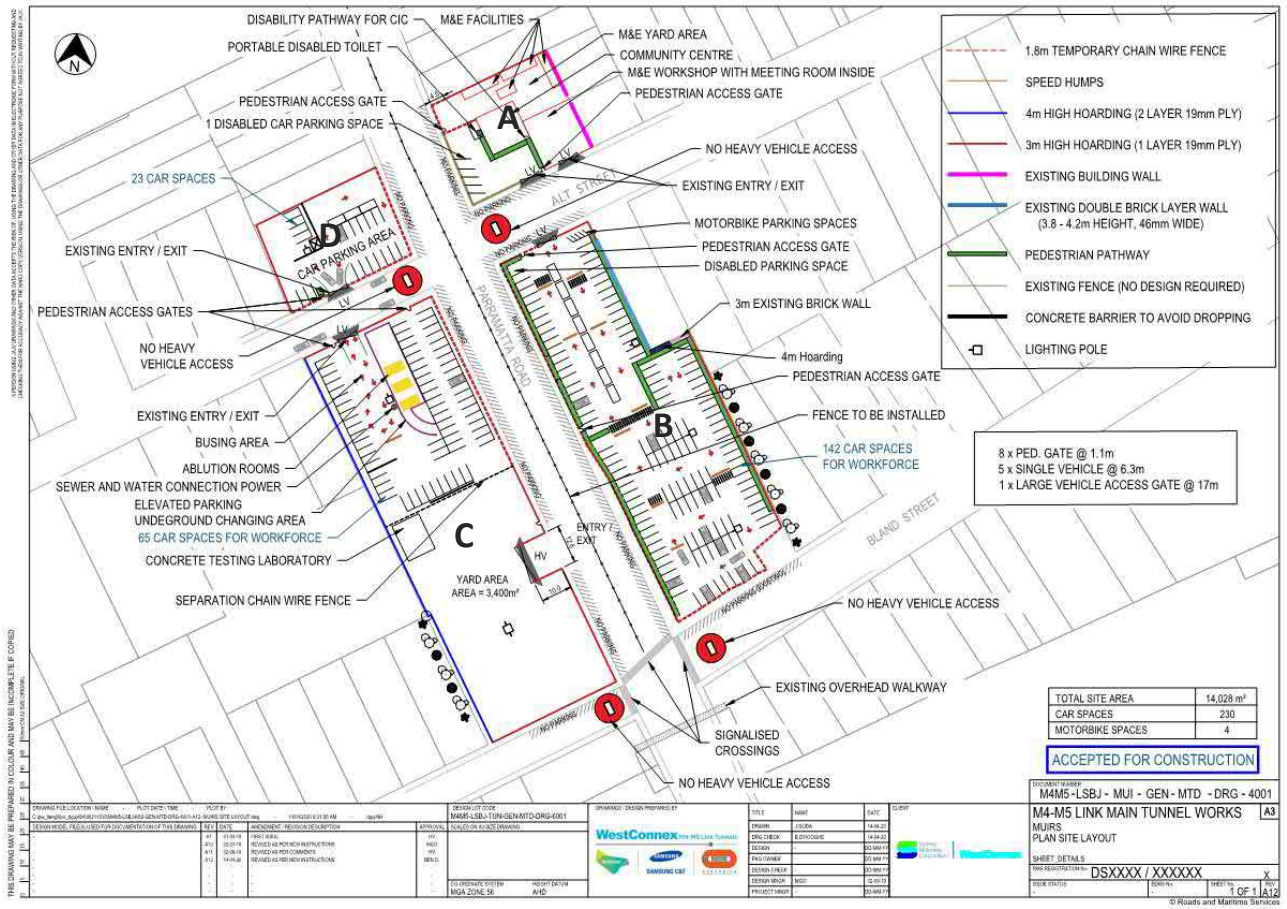


Figure 1.2 Parramatta Road East and West (C1b and C3b) layout

The key activities to be carried out at PREW would include:

- carparking, ablutions, mechanical and electrical (M&E) workshop, office and Community Information Centre (CIC) utilising existing building on Area A;
- carparking on Area B;
- carparking, bus transfer, laydown, concrete testing and maintenance area (day and evening use only) on Area C, night laydown for unforeseen and emergency use only; and
- carparking on Area D.

Activities at PREW are principally associated with carparking and laydown use. Limited M&E workshop activities would be conducted within the existing building on Area A whilst the laydown area would be utilised during day and evening hours for temporary laydown and maintenance assembly activities (night use is proposed infrequently but has been assessed for completeness). Acoustic barriers and hoardings for each of the areas (A, B, C and D) have been incorporated into the design. Testing of concrete samples could be conducted at any time, however stripping of panels and disposal to skip bin is proposed during standard construction hours only.

Operational noise and vibration measures for the M4-M5 Link do not fall within the scope of this CNVIS.

1.4 Environmental management systems overview

The environmental management system overview is described in Section 1.5 of the CEMP. Noise and vibration impacts are managed through the implementation of the Construction Noise and Vibration Management Plan (CNVMP) as required by CoA C4 (b).

2 Purpose and objectives

The key objective of the CNVIS is to ensure all CoA, revised environmental management measures and licence/permit requirements relevant to noise and vibration are described, scheduled and assigned responsibility as outlined in:

- The EIS prepared for WestConnex M4-M5 Link;
- The SPIR prepared for WestConnex M4-M5 Link;
- CoA granted to the project on 17 April 2018;
- Roads and Maritime specifications G36;
- The Project's Environmental Protection Licence (EPL); and
- All relevant legislation and other requirements described in Section 3 of this Plan.

3 Environmental requirements

3.1 Legislation

This CNVIS has been prepared in accordance with:

- Environmental Planning and Assessment Act 1979; and
- Protection of the Environment Operations Act 1997 (POEO Act).

3.2 Guidelines

The following guidelines apply to Project related construction noise and vibration:

- NSW Industrial Noise Policy (INP) 2000, Environmental Protection Authority [1];
- NSW Interim Construction Noise Guideline (ICNG) 2009, Department of Environment and Climate Change;
- NSW Road Noise Policy, Department of Environment 2011, Climate Change and Water;
- NSW Assessing Vibration – a technical guideline (AVTG) 2006, Department of Environment and Conservation;
- NSW Noise Criteria Guideline (NCG) 2015, Roads and Maritime;
- NSW Noise Mitigation Guideline (NMG) 2015, Roads and Maritime;
- Construction noise and vibration guideline (CNVG) 2016, Roads and Maritime Services;
- Australian Standard AS/NZS 2107:2000 'Acoustics - Recommended design sound levels and reverberation times for building interiors';
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration;
- Australian Standard AS 2187.2 'Explosives - Storage and use - Part 2 Use of explosives';
- Australian Standard AS2436-1981 'Guide to Noise Control on Construction, Maintenance and Demolition Sites';
- British Standard BS 6472-2008, 'Evaluation of human exposure to vibration in buildings (1-80Hz)';
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings';
- German Standard DIN4150-1999 'Structural vibration Part 3: Effects of vibration on Structures';
- Construction Noise Strategy 7TP-ST-157/2.0 (CNS) 2012, Transport for NSW; and
- Environmental Noise Management Manual (ENMM) 2001, Roads and Traffic Authority.

[1] This document has since been superseded by the NSW Noise Policy for Industry (NPfI) 2017. However, the INP remains the relevant policy in accordance with the project's Instrument of Approval and NPfI transitional requirements.

3.3 Conditions of approval

The CoA relevant to ancillary facility construction noise and vibration are listed in Table 3.1.

Table 3.1 Conditions of Approval for construction noise and vibration

Condition	Key requirement
CONSTRUCTION ANCILLARY FACILITIES	
C19	Only one of the two ancillary facility options (A or B) presented in Chapter 6 of the EIS can be implemented at Haberfield, except if one site is used for parking and other works that do not exceed the 'Noise affected' Noise Management Levels as identified in the ICNG.
C20	Should Option B, as presented in Chapter 6 of the EIS, be progressed, a comparative analysis of environmental impacts of the use of the sites during construction of the project (excluding Site Establishment Works and erection of acoustic enclosures), must be undertaken. The comparative analysis must be undertaken for the following key environmental impacts: noise and vibration, traffic and transport, visual amenity and socio-economic.
C21	In the event that Option B is progressed, for purposes other than for parking and works that do not exceed the 'Noise affected' Noise Management Levels as identified in the ICNG, the Proponent must submit a report outlining the findings of the comparative analysis required by Condition C20 to the Secretary for approval at least one (1) month prior to the establishment of the Option B construction ancillary facilities. The report must demonstrate how management and mitigation measures, consistent with those included in the documents referred to in Condition A1 and as required by the terms of approval, would be implemented to achieve, on balance, comparable environmental outcomes when compared to Option A.
Noise Assessments	
E67	All noise and vibration assessment, management and mitigation required by this approval must consider the cumulative noise impacts of approved CSSI and SSI projects. This includes using ambient and background levels which do not include other WestConnex M4 East and New M5 (SSI 6307 and SSI 6788) projects. This condition applies to all works and operation.
Works Hours	
E68	Works must be undertaken during the following hours: 7:00 am to 6:00 pm Mondays to Fridays, inclusive; 8:00 am to 1:00 pm Saturdays; and at no time on Sundays or public holidays.
E69	Notwithstanding Condition E68, works may be undertaken between 1:00 pm to 6:00 pm on Saturday.
Highly Noise Intensive Works	
E72	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver must only be undertaken: between the hours of 8:00 am to 6:00 pm Monday to Friday; between the hours of 8:00 am to 1:00 pm Saturday; and in continuous blocks not exceeding three (3) hours each with a minimum respite from those activities and works of not less than one (1) hour between each block. For the purposes of this condition, 'continuous' includes any period during which there is less than a one (1) hour respite between ceasing and recommencing any of the work that are the subject of this condition.

Table 3.1 Conditions of Approval for construction noise and vibration

Condition	Key requirement
Construction Noise and Vibration – General	
E79	Construction Noise and Vibration Impact Statements must be prepared for construction ancillary facility(s) before any works that result in noise and vibration impacts commence, and include specific mitigation measures identified through consultation with affected sensitive receivers. The Statements must supplement the Construction Noise and Vibration Management Sub-plan or Site Establishment Management Plan(s) and are to be implemented for the duration of the works. The Construction Noise and Vibration Impact Statement for the White Bay Civil Site (C11) must be prepared in consultation with the Port Authority of NSW and NSW Heritage Council.
E80	Noise generating works in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institutions are made at no cost to the affected institution.
E81	Mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria: construction 'Noise affected' noise management levels established using the Interim Construction Noise Guideline (DECC, 2009); vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure); Australian Standard AS 2187.2 - 2006 "Explosives - Storage and Use - Use of Explosives"; BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they are "applicable to Australian conditions"; and the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage). Any works identified as exceeding the noise management levels and/or vibration criteria must be managed in accordance with the Construction Noise and Vibration Management Sub-plan. Note: The Interim Construction Noise Guideline identifies 'particularly annoying' activities that require the addition of 5 dB(A) to the predicted level before comparing to the construction Noise Management Level.
E83	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before works that generate vibration commences in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owner and occupiers are to be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier. These properties must be identified and considered in the Construction Noise and Vibration Management Sub-plan.
E85	The Proponent must seek the advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring at heritage-listed structures.

4 Existing environment

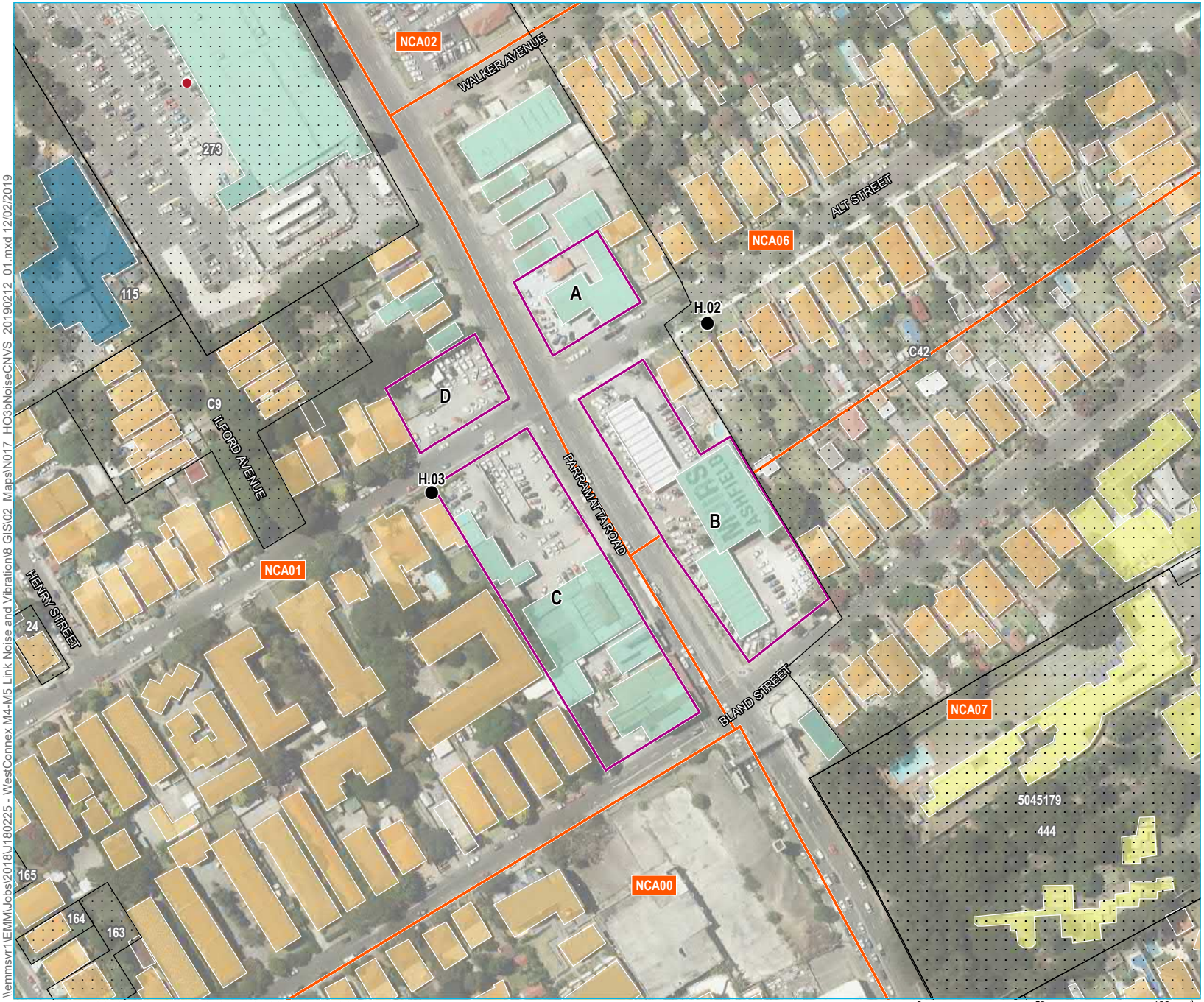
4.1 Noise and vibration sensitive receivers

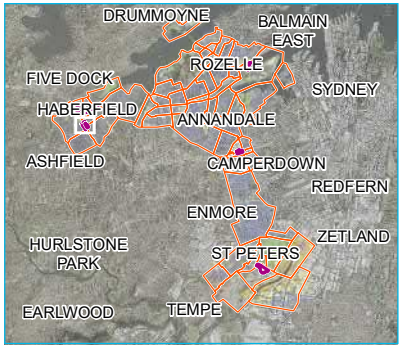
A detailed land use survey has been undertaken to address E66 of the CoA. The outcomes of the land use survey have been incorporated into this CNVIS. A visual representation of the survey is provided in the CNVMP. For the purpose of this assessment, receivers potentially sensitive to noise have been categorised as:

- Residential dwellings;
- Commercial, retail and industrial properties; and
- Other, including:
    - Education institutions;
    - Childcare centres;
    - Medical (hospital wards or other uses including medical centres);
    - Places of worship;
    - Outdoor open areas (passive and active recreation);
    - Aged care;
    - Hotel;
    - Theatre/auditorium;
    - Public building; and
    - Recording studio.

The sensitive receivers for PREW are shown in Figure 4.1.

Heritage items of importance where vibration emission needs to be considered are also shown in Figure 4.1.





KEY

- Noise logger location
- Heritage item identified in EIS
- Noise catchment boundary
- Site boundary
- Heritage item (local environmental plan)

Noise receiver

- Commercial
- Residential
- Other (childcare)
- Other (educational)

Source: EMM (2018); LendLease (2018); DFSI (2017); DPE (2017)

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Parramatta Road east and west–noise catchment areas, receivers and noise monitoring locations

M4-M5 Link Mainline Tunnels
Construction noise and vibration impact statement
Figure 4.1

EMM

4.2 Noise catchment areas

The study area has been divided into NCAs. NCAs group individual sensitive receivers by common traits such as existing noise environment and location in relation to the works.

The noise catchment areas of relevance to this CNVIS are shown in Figure 4.1 and are explained in Table 4.1

Table 4.1 Noise catchment areas

NCA	Description
NCA00	West of Parramatta Road between Bland Street and Orpington Street. Land use consists of residential receivers
NCA01	West of Parramatta Road between Iron Cove Creek and Bland Street. Land use comprises of a mix of residential receivers, special use facilities, active and passive recreation areas and commercial receivers fronting Parramatta Road
NCA06	East of Parramatta Road between Walker Avenue and Alt Street residences. Land use consists of residential and commercial receivers and an educational facility on Ramsay Street
NCA07	East of Parramatta Road between Dalhousie Street and Bland Street residences. Land use comprises of a mix of residential and commercial facilities, other sensitive and active and passive recreation areas

Source: M4-M5 Link EIS

1. Approximate minimum horizontal offset distance from the nearest receiver building facade (receiver of any type) to the nearest point that construction works could occur.

4.3 Background noise levels

This CNVIS has adopted background noise levels documented in the EIS which are presented in Table 4.2 for each relevant NCA. Representative monitoring locations are shown in Figure 4.1.

The majority of the NCAs surrounding the project are influenced by road traffic noise levels from major roads. In accordance with prescribed methods in the NSW INP (Section 3.3) and the NSW Road Noise Policy (Section 2.5.5), the background noise logging data for the Project was reviewed in greater detail to identify potential shoulder periods.

This review identified background noise levels in the night period between 10pm and 12am and 5am to 7am that were elevated in comparison to the total night-time RBL. This is most likely caused by the presence of higher road traffic volumes during these times. The shoulder period analysis is provided outlined in more detail in the CNVMP Appendix B2

It is proposed to adopt the INP mid-point approach for RBLs and NMLs during the shoulder periods of 5am to 7am and 10pm to midnight in order to manage noise according to the noise characteristics of the catchments. For the morning shoulder 5am to 7am, this involves taking the mid-point of the night and day RBL. For the evening shoulder, this involves taking the mid-point of the evening and night RBL.

It is noted that the Interim Construction Noise Guideline (ICNG) relies on methodologies contained within the NSW INP for the establishment of RBLs. Hence, this approach is deemed consistent with the guidance provided by the ICNG.

Table 4.2 Rating background levels

Site	NCA	Representative. monitoring location	Receiver type	Address	Rating background level (RBL)[1]				
					5am-7am	Daytime	Evening	10pm-12am	Night
Parramatta Road East and West	NCA00	H.03[2]	Residential	119 Alt St, Ashfield	42	46	46	42	38
	NCA01	H.03[2]	Residential	119 Alt St, Ashfield	42	46	46	42	38
	NCA06	H.02[2]	Residential	141 Alt St, Haberfield	45	46	46	45	43
	NCA07	H.02[2]	Residential	141 Alt St, Haberfield	45	46	46	45	43

1. ICNG defines daytime period as 7:00am to 6:00pm Monday to Saturday, 8:00am to 6:00 pm Sunday; Evening as 6:00pm to 10:00pm; Night as 10:00pm to 7:00am Monday to Saturday, 10:00pm to 8:00am Sunday.
2. Taken from M4 East EIS assessment.

5 Construction noise criteria

5.1 Interim Construction Noise Guideline (ICNG)

The ICNG provides guidelines for the assessment and management of noise from construction works.

Table 5.1 is an extract from the ICNG and provides construction NMLs for residential receivers for both recommended standard construction hours and outside of these periods.

It is noted that the CoA allows extended standard hours of construction during 1pm to 6pm on Saturdays which deviates slightly from ICNG recommended standard hours.

Table 5.1 ICNG residential noise management levels

Time of day	Management level $L_{Aeq,15\ minute}$	How to apply
Recommended standard hours: Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 6:00 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq,15 minute 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 works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB	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; and – 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 RBL + 5 dB	• A strong justification would typically be required for works 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.

1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Table 5.2 summarises noise management levels for non-residential land uses as defined in the ICNG.

Table 5.2 ICNG noise management levels at other land uses

Land use	Management level, $L_{Aeq,15\ minute}$
Industrial premises	External noise level 75 dB (when in use)
Offices, retail outlets	External noise level 70 dB (when in use)
Classrooms at schools and other educational institutions	Internal noise level 45 dB (when in use)
Hospital wards and operating theatres	Internal noise level 45 dB (when in use)
Places of worship	Internal noise level 45 dB (when in use)
Active recreation areas	External noise level 65 dB (when in use)
Passive recreation areas	External noise level 60 dB (when in use)

Source: ICNG (DECC, 2009).

The ICNG provides further guidance for construction noise levels at commercial and industrial premises as follows:

> Due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories. The external noise levels should be assessed at the most-affected occupied point of the premises:
>
> - Industrial premises: external $L_{Aeq\ (15\ min)}$ 75 dB(A)
> - offices, retail outlets: external $L_{Aeq\ (15\ min)}$ 70 dB(A)
> - other businesses that may be very sensitive to noise, where the noise level is project specific as discussed below.
>
> Examples of other noise-sensitive businesses are theatres and child-care centres. The proponent should undertake a special investigation to determine suitable noise levels on a project-by-project basis; the recommended 'maximum' internal noise levels in AS 2107 Acoustics – Recommended design sound levels and reverberation times for building interiors may assist in determining relevant noise levels (Standards Australia 2000).
>
> The proponent should assess construction noise levels for the project and consult with occupants of commercial and industrial premises prior to lodging an application where required.
>
> During construction, the proponent should regularly update the occupants of the commercial and industrial premises regarding noise levels and hours of work.

5.2 Sleep disturbance at residences

PREW will operate during the night-time period (10pm to 7am). Therefore, the assessment of potential sleep disturbance at residences is required in accordance with the INP application notes. Sleep disturbance is defined as both awakenings and disturbance to sleep stages.

The INP application notes suggests that an $L_{A1(1min)}$ or L_{Amax} level of RBL plus 15 dB is a suitable screening criteria for sleep disturbance for the night-time period.

A detailed maximum noise level event assessment is required if the screening criteria is exceeded. Further guidance in regard to potential impact on sleep is provided in the NSW RNP. The RNP calls upon a number of studies that

have been conducted into the effect of maximum noise levels on sleep, and provides the following factors that are key in assessing the extent of impacts on sleep:

- how often high noise events would occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the project;
- whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods); and
- current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

5.3 Project specific NMLs - residential

In accordance with the ICNG and based on the RBLs presented in Table 4.2, Table 5.3 presents the project specific construction noise affected NMLs applicable to residential premises during the proposed work hours. The highly noise affected NML also applies to all residential receivers during standard hours.

Table 5.3 Project specific NMLs at residential locations

NCA	Representative monitoring location	Standard construction NMLs (RBL + 10dB)	Out of hours NMLs (RBL + 5dB) [1]					Sleep disturbance screening criteria (RBL + 15 dB)[3,4]
		Day[1]	5-7pm	Day[2]	Evening	10-12am	Night	
NCA00	H.03	56	47	51	51	49	43	53
NCA01	H.03	56	47	51	51	49	43	53
NCA06	H.02	56	50	51	51	50	48	58
NCA07	H.02	56	50	51	51	50	48	58

1. L_{Aeq}, 15minute noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.
2. This applies to daytime and outside of standard ICNG hours.
3. Level applies at the nearest and/or most exposed facade to construction noise levels.
4. Sleep disturbance NML's for 'shoulder' 5am to 7am and 10pm to 12am can be determined by adding 10dB to the NML of the respective period presented above.

5.4 NMLs - non-residential

Table 5.4 presents the construction NMLs applicable to non-residential land uses as defined in the NSW ICNG and AS2107 when in use.

Table 5.4 NMLs at non-residential land uses

Land use	Noise management level, $L_{Aeq,15\ minute}$ (apply when premise is in use)
Industrial premises	External noise level 75 dB
Offices, retail outlets	External noise level 70 dB
Classrooms at schools and other educational institutions	Internal noise level 45 dB
Hospital wards and operating theatres	Internal noise level 45 dB
Places of worship	Internal noise level 45 dB
Active recreation areas	External noise level 65 dB
Passive recreation areas	External noise level 60 dB
Child care centres1	External noise level 65 dB
Aged care1	External noise level 65 dB (7am to 10pm) External noise level 60 dB (10pm to 7am)
Hotels1	External noise level 65 dB (7am to 10pm) External noise level 60 dB (10pm to 7am)
Theatre/auditorium1	External noise level 45 dB
Recording studio1	External noise level 45 dB

5. NML based on AS2017 recommend maximum internal noise level and the premise that windows and doors for such development could be open for ventilation purposes, hence providing 10 dB of outdoor to indoor construction noise level reduction.
6. Notwithstanding NMLs in this table, Condition E80 states "Noise generating works in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institutions are made at no cost to the affected institution."

5.5 Off-site road traffic noise criteria

When construction related traffic moves onto the public road network a different noise assessment method applies, as vehicle movements are regarded as 'additional road traffic' rather than as part of the construction works and as such would be assessed under the Roads and Maritime Construction Noise and Vibration Guideline (CNVG) and Noise Criteria Guideline (NCG) (2015). The NCG documents Roads and Maritime's approach to implementing the EPA's Road Noise Policy (RNP).

The CNVG requires that an initial screening test should be applied by evaluating whether noise levels would increase by more than 2 dB due to construction traffic or a temporary reroute due to a road closure. Where increases are 2 dB or less then no further assessment is required as noise level changes would most likely not be perceptible to most people.

Where noise levels increase by more than 2 dB further assessment is required using criteria presented in the RNP provided in Table 5.5. The additional assessment is to consider all feasible and reasonable measures to meet the respective noise level. Noise abatement measures are considered feasible if it can be engineered and is practical to build given project constraints such as safety and maintenance. Reasonable measures are selected from feasible

measures and consider whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including cost. To assist in this judgement, consideration may be given to:

- noise impacts;
- noise mitigation benefits;
- cost effectiveness of noise mitigation; and
- community views.

Table 5.5 RNP criteria for assessing construction vehicles on public roads

Road category	Type of project/land use	Assessment criteria (external) (dB)	
		Day	Night
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	60 $L_{Aeq(15\ hour)}$	55 $L_{Aeq(9\ hour)}$
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	55 $L_{Aeq(1\ hour)}$	50 $L_{Aeq(1\ hour)}$

Parramatta Road is classified as an arterial road under the definitions of the RNP. Arterial and sub-arterial roads refer to roads handling through-traffic, with characteristically heavy and continuous traffic flows during peak periods. Alt Street and Bland Street were conservatively considered as local roads even though they directly connect to an arterial road. Under the definitions of the RNP, a local road typically handles local traffic only having characteristically low or intermittent traffic flows.

6 Construction vibration criteria

6.1 Overview

Vibration criteria adopted for the works are consistent with those established in the EIS and in accordance with the Instrument of Approval (SSI 7485). CoA E81 states that mitigation measures must be implemented with the aim of achieving the following vibration criteria:

- vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure);
- Australian Standard AS 2187.2 - 2006 “Explosives - Storage and Use - Use of Explosives”;
- BS 7385 Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2” as they are “applicable to Australian conditions”; and
- the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage).

It is noted that blasting is not part of the scope for works relevant to this CNVIS.

6.2 Human comfort – Assessing vibration: a technical guideline (DEC)

Environmental Noise Management – Assessing Vibration: a technical guideline (DEC, 2006) is based on guidelines contained in BS 6472 – 2008, Evaluation of human exposure to vibration in buildings (1-80Hz).

The Guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The Guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in Table 6.1.

Table 6.1 Examples of types of vibration (from Table 2.1 of the guideline)

Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990).	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

Intermittent vibration is representative of activities such as impact hammering, vibratory rolling or general excavation work (such as an excavator tracking) and, as such, is most relevant to this assessment.

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Section 2.4 of the Guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted RMS (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz. To calculate VDV the following formula (refer section 2.4.1 of the guideline) was used:

$$VDV = \left[\int_0^T a^4(t)dt\right]^{0.25}$$

Where VDV is the vibration dose value in m/s1.75, a (t) is the frequency-weighted rms of acceleration in m/s2 and T is the total period of the day (in seconds) during which vibration may occur.

The Acceptable Vibration Dose Values (VDV) for intermittent vibration are reproduced in Table 6.2.

Table 6.2 Acceptable vibration dose values (VDV) for intermittent vibration (m/s $^{1.75}$)

Location	Daytime		Night-time	
	Preferred value, m/s$^{1.75}$	Maximum value, m/s$^{1.75}$	Preferred value, m/s$^{1.75}$	Maximum value, m/s$^{1.75}$
Critical Areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

1. Daytime is 7 am to 10 pm and night-time is 10 pm to 7 am.
2. These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The Guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

6.3 Structural vibration criteria

Most commonly specified “safe” structural vibration limits are designed to minimise the risk of threshold or cosmetic surface cracks and are set well below the levels that have potential to cause damage to the main structure.

6.3.1 Australian Standard AS 2187.2 - 2006

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2 - 2006 'Explosives - Storage and Use - Use of Explosives' recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 'Evaluation and measurement for vibration in buildings Part 2' be used as they are "applicable to Australian conditions".

The Standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the Standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 6.3 and graphically in Figure 6.1.

Table 6.3 Transient vibration guide values - minimal risk of cosmetic damage

Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	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

Source: BS 7385 Part 2-1993.

The Standard states that the guide values in Table 6.3 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 6.3 may need to be reduced by up to 50%.

Sheet piling activities (for example) are considered to have the potential to cause dynamic loading in some structures (eg residences) and it may therefore be appropriate to reduce the transient values by 50%.

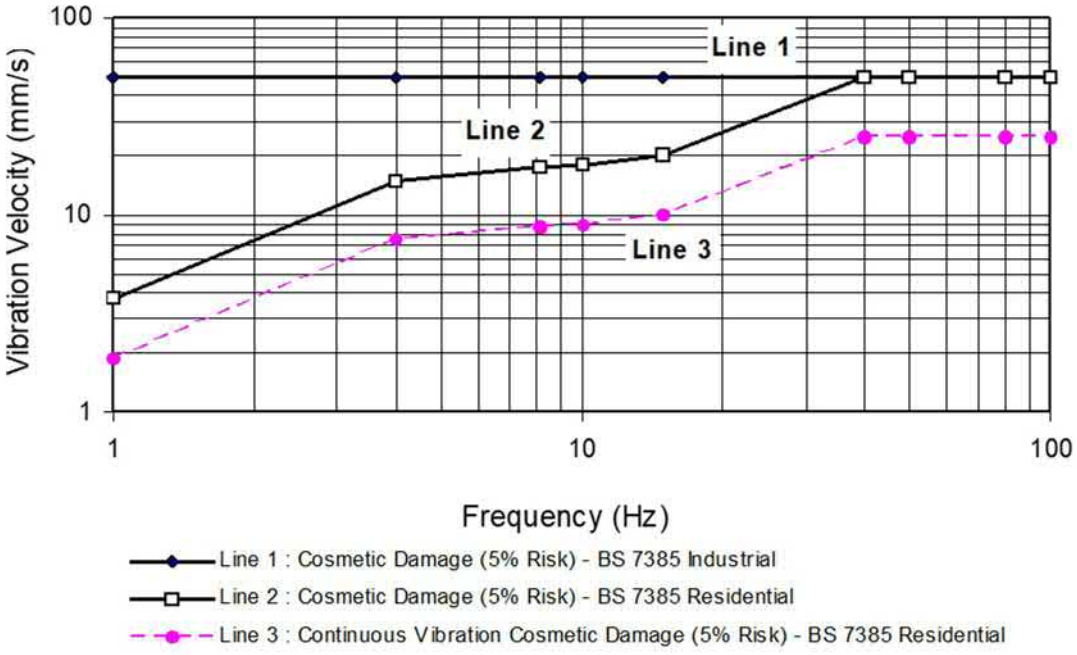

Figure 6.1 Graph of transient vibration guide values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz. The standard goes on to state that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 6.3, and major damage to a building structure may occur at values greater than four (4) times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 6.3 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measurements should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Figure 6.1.

It is noteworthy that extra to the guide values nominated in Table 6.3, the standard states that:

> "Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK."

Also, that:

> "A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive."

A vibration screening criterion of 15 mm/s is recommended for structures surrounding the site for vibration inducing construction. This should be reduced to 7.5mm/s (by 50%) if the vibration activity is continuous and has the potential to cause resonance effects in surrounding structures (eg sheet piling).

6.3.2 German Standard DIN 4150-3:1999

The German Standard DIN 4150 - Part 3: 1999, provides the strictest guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, or maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in

Table 6.4 and shown graphically in Figure 6.2.

For residential and commercial type structures, the standard recommends safe limits as low as 5mm/s and 20mm/s respectively. These limits increase with frequency values above 10Hz. The operational frequency of construction plant typically ranges between 10Hz to 30Hz, and hence according to DIN4150, the safe vibration guide limit range for dwellings is 5 to 15 mm/s. For reinforced commercial type buildings, the limit is as low as 20mm/s, while for heritage or sensitive structures the lower limit is 3mm/s.

Table 6.4 Structural damage guideline values of vibration velocity – DIN4150

Line*	Type of Structure	Vibration Velocity in mm/s			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		1Hz to 10Hz	10Hz to 50 Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	5 to 20	15
3	Structures that because of their particular sensitivity to vibration do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

Notes: 1. "Line* " refers to curves in Figure 1 of DIN4150.
2. For frequencies above 100Hz the higher values in the 50Hz to 100Hz column should be used.

These levels are "safe limits", for which damage due to vibration effects is unlikely to occur. "Damage" is defined in DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls.

Should such damage be observed without vibration levels exceeding the "safe limits" then it is likely to be attributable to other causes. DIN 4150 also states that when vibration levels higher than the "safe limits" are present, it does not necessarily follow that damage will occur.

As indicated by the guide levels from DIN 4150 in Table 6.2, high frequency vibration has less potential to cause damage than lower frequencies. Furthermore, the "point source" nature of vibration from plant causes the vibratory disturbances to arrive at different parts of nearby large structures in an out-of-phase manner, thereby reducing its potential to excite in-phase motion of the low order modes of vibration in such structures.

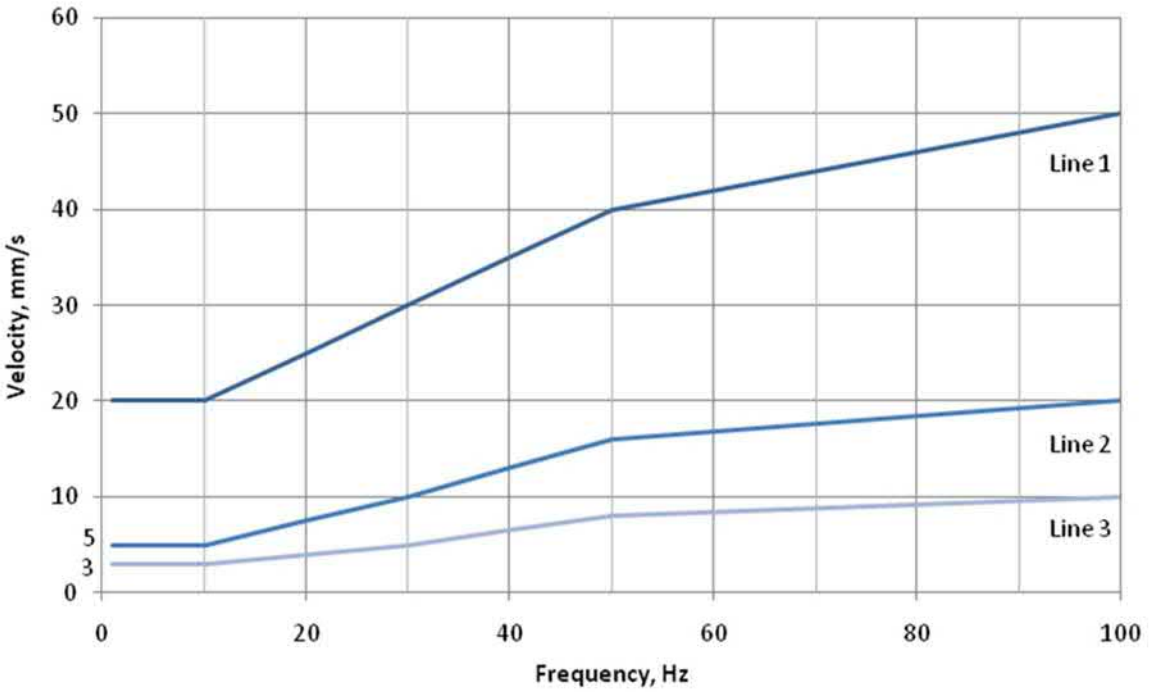

Figure 6.2 DIN4150 structural damage guideline values of vibration velocity

6.3.3 Project specific structural vibration criteria

Condition E81 requires that BS7385-2 and DIN4150-3 are both satisfied. DIN4150-3 is more conservative and provides more information for the assessment of heritage structures. If DIN4150-3 limits are satisfied, the limits in BS7385-2 will also be satisfied.

DIN4150-3 has therefore been adopted as the structural vibration criteria for the project.

7 Construction noise assessment

7.1 Assessment method

Methods and base parameters used to model construction noise emissions from PREW are presented in this section.

Potential noise levels from the project were predicted using a computer-generated model using Brüel & Kjær Predictor software (the model). The model calculates total noise levels at assessment locations from concurrent operation of multiple noise sources. It considers factors that influence noise propagation such as the lateral and vertical location of plant, source-to-receptor distances, ground effects, atmospheric absorption, topography of the site and surrounding area, other noise attenuating features such as buildings and barriers and applicable meteorological conditions.

The model was populated with 3-D topography of the project and surrounding area, extending out to nearest assessment locations and buildings. Plant and equipment representing the range of envisaged operational scenarios was placed at locations which would represent typical to worst case noise levels throughout the construction program.

7.2 Construction sound power levels

Acoustically significant fixed and mobile equipment items considered in the model for PREW are provided in Table 7.2. A detailed list of equipment items and activities per scenario is provided in Appendix A.

Equipment sound power levels have been sourced from the following in order of precedence:

- Transport for NSW 2016, Construction Noise Strategy;
- AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance;
- Department of Environment, Food and Rural Affairs (DEFRA) 2005, Update of Noise Database for Prediction of Noise on Construction and Open Sites;
- Recommendations for the calculation of sound emissions of parking areas, motorcar centres and bus stations as well as of multi-storey car parks and underground car parks 6th Edition (Bavarian Landesamt für Umwelt 2007); and
- EMM in-house measurement databases.

A 5 dB penalty has been added to plant that is considered to be impulsive, intermittent or contain other characteristics relative to overall construction activity noise that may cause greater annoyance as required by the ICNG and the CoA.

- as far as practicable employees and contractors shall utilise Parramatta Road followed by the initial portion of Alt Street to access PREW LV parking areas;
- the laydown area will typically be used during day and evening periods only. Notwithstanding, due to unforeseen or emergency purposes, the laydown in Area C may be used during the night period in accordance with the site's out-of-hours works protocol;
- the use of roller door (existing building) fronting Alt Street on Area A shall be utilised as follows:
  - Standard Day hours 7.00am to 6.00pm Monday to Friday and Saturday 8.00am to 6.00pm - Open
  - Saturday 7.00am to 8.00am, Sunday, Public holidays and Evening (6.00pm to 10.00pm) door open 50% of time (7.5min in 15 min)
  - Night (10.00pm to 7.00am) door open 33% of time (5min in 15 min)
- the mechanical and electrical (M & E) workshop on Area A will utilise an existing building. For assessment purposes the composite transmission loss (TL) shown in Table 7.1 was adopted for modelling of the northern building façade, constructed of a combination of double brick, cavity wall (metal skin, stud, cavity, internal plasterboard lining) and transparent gable end. The TL of the northern façade would be verified following commissioning of the building. Where verification or compliance audits identify the northern elevation of the building requires acoustic upgrading., measures implemented would typically comprise acoustic blankets or weighted vinyl (8kg/m^2) hung to cover the full gable end and overlapping lower wall by not less than 300mm.

Table 7.1 Composite (1/1) octave band transmission loss

Element	1/1 Octave band transmission loss (Hz)							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
M&E workshop – north facade	10	13	17	22	27	32	35	35

- the concrete testing facility shall be wholly contained within a 20-foot shipping container or equivalent with doors facing Parramatta Road. Doors may be open when shed is in use;
- stripping of test panels and disposal of concrete to skip during standard construction hours only;
- provision of small office with AC unit adjacent concrete testing shed;
- use of air brakes to be avoided where practical; and
- the community will be consulted throughout the construction project in accordance with the projects' Community Communication Strategy.

7.3 Scenarios

Works at PREW have been separated into three scenarios comprising:

1. Typical - activities:
    a) use of workshop and light commercial vehicle (<4.5t and <7.5m) (Area A);
    b) laydown area including heavy vehicle, fork lift and concrete testing (Area C); and
    c) light vehicle movements (Area A, B, C and D).
2. OOH Peak – during shift change:
    a) use of workshop and light commercial vehicle (<4.5t and <7.5m) (Area A);
    b) laydown area including heavy vehicle, fork lift and concrete testing (Area C);
    c) light vehicle movements (Area A (7), B (222), C (112) and D (59)); and
    d) mini bus movements Area B and C.
3. Day Peak – during shift change:
    a) use of workshop and light commercial vehicle (<4.5t and <7.5m) (Area A);
    b) laydown area including heavy vehicle, fork lift, concrete testing, stripping of panels and disposal of concrete (Area C);
    c) light vehicle movements (Area A (7), B (222), C (112) and D (59)); and
    d) mini bus movements Area B and C.

These scenarios represent the typical and peak noise level snapshots in time and are detailed in Table 7.2 and Appendix A. In order to allow flexibility for shift changeover at PREW, noise modelling has considered peak LV changeover for both day and OOH (day, evening and night) assessment periods. Initial road works, traffic management and provision of utilities including site office and amenities, guard station, vehicle parking and construction of hoarding and acoustic walls is proposed at PREW and addressed in the Site Establishment CNVIS. Any remaining activities will be undertaken in accordance with that CNVIS.

Noise mitigating features incorporated in the noise model for each scenario are as follows:

- noise barriers and site hoardings as presented in Figure 4.1 will be implemented at PREW;
- operation of PREW in accordance with the assumptions presented in Appendix A;
- site signage to instruct drivers / workers to be mindful of residential neighbours, limit extended idling, no use of horns, etc.;
- traffic calming devices, drainage grates, covers plates etc. in trafficable areas shall be acoustically isolated and or fixed to avoid impact noise;

Table 7.2 PREW construction scenarios (approximate duration 2019 – 2023)

ID	Description	Hours of work (ICNG hours)			Activity sound power level, dBA				Physical noise mitigation (refer Figure 4.1)
		Day (Standard)	Day OOH, Evening OOH	Night OOH	Day L_{Aeq}	Day OOH / Evening OOH L_{Aeq}	Night OOH L_{Aeq}	OOH L_{Amax}	
1	Typical operations – Area A - workshop activities, light commercial (<4.5t), light vehicle movements (4/15min) Area B - light vehicle movements (4/15min) Area C - heavy vehicle* (1/15min), concrete testing, fork lift, light vehicle movements (4/15min) Area D - light vehicle movements (4/15min)	Yes	Yes	Yes	107	106	99	95/112	Plywood hoarding generally 3m high, existing masonry wall 3.5m high to Area A, existing masonry wall 3.8-4.2m high Area B and return wall 4m high, 4m high to rear of Area C (Figure 4.1). Restriction in opening of roller door to Alt Street (Area A), 7.5min in 15min (Day OOH and Evening OOH), 5min in 15min (Night) to allow vehicle access.
2	Peak operations – OOH and Night Area A - workshop activities, light commercial (<4.5t), light vehicle movements (7/15min) Area B - light vehicle movements (222/15min), mini bus (2/15min)# Area C - heavy vehicle* (1/15min), concrete testing, fork lift, light vehicle movements (112/15min) Area D - light vehicle movements (59/15min)	No	Yes	Yes	n/a	104	101	95/112	Plywood hoarding generally 3m high, existing masonry wall 3.5m high to Area A, existing masonry wall 3.8-4.2m high Area B and return wall 4m high, 4m high to rear of Area C (Figure 4.1). Restriction in opening of roller door to Alt Street (Area A), 7.5min in 15min (Day OOH and Evening OOH), 5min in 15min (Night) to allow vehicle access.
3	Peak operations – Day Area A - workshop activities, light commercial (<4.5t), light vehicle movements (7/15min) Area B - light vehicle movements (222/15min), mini bus (2/15min)# Area C - heavy vehicle* (1/15min), concrete testing, concrete stripping and disposal, fork lift, light vehicle movements (112/15min) Area D - light vehicle movements (59/15min)	Yes	No	No	107	n/a	n/a	n/a	Plywood hoarding generally 3m high, existing masonry wall 3.5m high to Area A, existing masonry wall 3.8-4.2m high Area B and return wall 4m high, 4m high to rear of Area C (Figure 4.1). Restriction in opening of roller door to Alt Street (Area A), 7.5min in 15min (Day OOH and Evening OOH), 5min in 15min (Night) to allow vehicle access.

OOH - Out-of-hours
Day - 7:00 am to 6:00 pm Monday to Friday, 8:00 am to 6:00 pm Saturday
Day OOH - Day out of hours Saturday 1pm to 6pm, Sunday and Public holidays 8:00 am to 6:00 pm
Eve - Evening 6:00 pm to 10:00 pm Monday to Sunday
Night - Night 10:00 pm to 7:00 am Monday to Friday and 10:00 pm to 8:00 am Saturday, Sunday and Public holidays
L_{Aeq} - Leq,15minutes
* heavy vehicle located at Area C servicing laydown area
# mini buses distributed 2 x Area B
L_{Amax} noise levels: 95dB(A) for LV, 112dB(A) for HV

7.4 Results

Noise predictions from proposed construction activities at PREW is based on the scenarios presented in Table 7.2 and plant and equipment noise data presented in Appendix A. A review of general operations, sleep disturbance and cumulative noise is presented in the following sections.

7.4.1 General activities

Construction (L_{Aeq}) noise has been assessed for the closest and potentially most exposed residential and commercial receivers. The results of the noise modelling confirm predicted noise levels satisfy the NML's at all locations. A summary of the predicted noise levels and NML's is presented in Appendix B.

7.4.2 Sleep disturbance

Predicted noise levels from intermittent noise sources possible at night confirm compliance with the sleep disturbance screening criterion at most of the residential locations. A review of the predicted L_{Amax} levels has identified potential exceedance of the sleep disturbance screening criterion at five assessment locations (refer to Appendix C). These assessment locations are located directly adjacent to Area C and Area D and represent the upper floor.

The predicted levels relate to the potential for truck airbrake release on the laydown in Area C. It has also been confirmed by LSBJV that use of the laydown area during night hours is only anticipated in unforeseen or emergency circumstances and accordingly these activities are not considered typical and unlikely to occur.

Peak traffic movements during shift changeover could occur during morning, evening and night hours. The predicted levels are less than the RNP L_{Amax} of 65dB(A) and within the range or lower than the existing L_{Amax} noise levels that these receivers are exposed to from traffic on Parramatta Road. Management measures provided herein will be used to minimise such impacts.

A review of the noise monitoring results for NCA 1, 6 and 7 representative of the potentially affected locations, confirm existing night time L_{Amax} noise levels range from 60-91dB(A) with an average of 69dB(A). A review of the existing baseline noise monitoring data for H.02 (NCA 06 and NCA 07) and H.03 (NCA 00 and NCA 01) confirm that 100% of existing night-time L_{Amax} noise levels exceed the sleep disturbance screening criteria. The predicted levels range from 47-68dB(A) and are well within the range of existing measured noise levels and would not be expected to give rise to sleep disturbance.

7.4.3 Cumulative noise

A review of WestConnex M4 East Construction Noise and Vibration Management Plan confirms finishing works for the M4 East are forecast to be completed by Quarter 1 2019 (Section 5.1 of the M4 East CNVMP). It is expected that this phase of construction at the Site will ramp up over a period of three to six months and will only commence in the assessed form in Q2 2019 and extend to 2023. Accordingly, the overlap and cumulative noise from the two projects is expected to be minor hence cumulative noise impacts is not considered a risk.

The M4-M5 Wattle Street civil and tunnelling site is located more than 250m from PREW and would not result in cumulative noise impacts.

8 Construction vibration assessment

8.1 Safe working distances and assessment methodology

Table 8.1 provides an indication of potential offset distances required from sensitive receivers in order to comply with relevant vibration criteria. This information should be used by relevant personnel when planning their work to identify when other forms of construction methodology or vibration mitigation and/or management measures may need to be investigated or implemented. This data is based on information provided in the noise and vibration assessment prepared for the EIS as well as publicly available data for other large infrastructure projects in Sydney.

The safe working distances provided are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

Table 8.1 Vibration levels and safe working distance guidance – transient vibration

Source	Estimated safe working distance			
	Human comfort	Commercial, Industrial or similar structures^	Dwellings and similar structures^	Heritage and other sensitive structures^
Large Vibratory Roller (20t)	100m	5m	33m	50m
Medium Vibratory Roller (10t)	100m	5m	20m	31m
Compactor (7t)	50m	5m	20m	20m
Hand operated whacka packer on backfill	10m	5m	5m	5m
Hand operated whacka packer on asphalt	10m	5m	5m	5m
Heavy Hydraulic Hammer (1500kg hammer on 30t excavator)	73m	5m	22m	44m
Medium Hydraulic Hammer (900kg hammer on 18t excavator)	23m	5m	10m	15m
Light Hydraulic Hammer (300kg on 5t excavator)	10m	5m	5m	5m
Jack Hammer	Avoid contact with structure	5m	5m	5m
Air Track Drill	20m	5m	5m	10m
Small rock drill (estimate)	10m	5m	5m	5m
Down the Hole Hammer	10m	5m	5m	5m
Ripping (measured in Sydney sandstone)	10m	5m	5m	5m
Impact Piling	30m	5m	10m	20m
Vibratory Piling	30m	5m	26m	100m
Rock Sawing	10m	5m	5m	5m
Bored Piling	N/A	5m	10m	10m

1. Based on information provided in the NorthConnex Construction Noise and Vibration Management Sub Plan prepared by Lend Lease Bouygues Joint Venture dated 1 May 2017.
2. ^ based on DIN4150 for cosmetic damage

Scenarios for PREW are principally associated with carparking and laydown use. Limited M&E workshop activities would be conducted within the existing building on Area A whilst the laydown area would be utilised during day and evening hours for temporary laydown and maintenance assembly activities. No activities are proposed that generate significant ground vibration that would result in vibration levels approaching the human comfort or cosmetic damage criteria. Accordingly ground vibration has not been considered further in this CNVIS.

9 Offsite traffic noise

The road traffic noise potentially generated by activities related to PREW has been assessed in accordance with the Roads and Maritime Construction Noise and Vibration Guideline (CNVG) and Noise Criteria Guideline (NCG) that documents their approach to implementing the EPA's NSW RNP. This document provides the principle guidance to assess the impact of road traffic noise on noise sensitive receivers, such as residences which are in close proximity to the site or related transport route.

Spoil Haulage vehicle noise has been assessed in detail in the WestConnex M4-M5 Mainline Tunnels, Spoil Haulage CNVIS.

PREW will operate 24/7 for support infrastructure, offices, ablutions and parking for the Haberfield civil and tunnelling sites.

Existing traffic movements in this assessment are based on weekday 2018 data as found in the Roads and Maritime Services (RMS) traffic volume viewer on RMS's website. LSBJV confirmed that on average there would be up to 39 heavy vehicles and 1,184 light vehicle movements daily related to PREW.

Over the course of defined RNP periods, the anticipated distribution is:

- 30 additional heavy vehicle and 641 additional light vehicle movements during the day; and
- 9 additional heavy vehicle and 545 additional light vehicle movements during the night.

It is noted that peak light vehicle movements will occur at shift change that would occur during day and night assessment periods.

Most project traffic would utilise Parramatta Road, however light vehicles would use the early portion of Alt Street to access the sites. Parramatta Road is classified as arterial in accordance with the RNP (EPA 2009). For arterial roads the noise assessment descriptor is an $L_{Aeq,15hr}$ and $L_{Aeq,9hr}$.

The relative increase in noise levels which incorporate the additional traffic movements were calculated using the UK's Calculation of Road Traffic Noise (CoRTN) algorithm, adjusted for Australian conditions, and are presented in Table 9.1.

Table 9.1 Assessment of increased traffic noise levels – Parramatta Road

Road	Period	Existing traffic movements		Additional traffic movements	
		Light	Heavy	Light	Heavy
Parramatta Road	Day	53700	4670	641	30
	Night	14645	1274	545	9

Notes: 1.Daytime is defined as 7am to 10pm and night-time is defined as 10pm to 7am as per the RNP

The results indicate that increased traffic movements from PREW are negligible and will result in less than 0.2dB change to the existing average traffic noise levels on Parramatta Road. This increase to average noise is not discernible and satisfies the RMS, CNVG 2 dB allowance threshold.

10 Noise and vibration mitigation and management

10.1 Site specific

The EPA's NSW ICNG requires that construction noise levels are assessed against NMLs. It is not uncommon for construction projects to exceed NMLs. For this reason, they are not considered as noise criteria, but as a trigger for all feasible and reasonable noise mitigation and management to be considered, once exceeded.

Site specific noise mitigation and management were incorporated into the noise modelling and outlined in detail (Section 7.3) to reduce operational noise levels to satisfy NMLs at assessment locations.

Notwithstanding, LSBJV will actively consult with the residents at upper floors of neighbouring properties to confirm the level of impact is acceptable and where appropriate apply additional reasonable and feasible mitigation.

10.2 General

In addition, general measures will be adopted by the project. Examples of these measures are listed in the following sections.

10.2.1 Work practices

Work practice methods include:

- regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration;
- regular identification of noisy activities and adoption of improvement techniques;
- avoiding the use of public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;
- develop routes for the delivery of materials and parking of vehicles to minimise noise;
- where possible, avoid the use of equipment that generates impulsive noise;
- minimise the movement of materials and plant and unnecessary metal-on-metal contact;
- Switch engines off when not required for more than five minutes;
- Avoid metal on metal contact such as dropping materials, tail gate banging;
- Avoid shouting at night;
- Any stationary plant such as generators or lighting towers shall be enclosed or otherwise shielded from the direction of nearby receivers;
- Only non-tonal reversing alarms permitted;
- Set site up to avoid the need for trucks to reverse;

- Noise monitoring to verify assumptions made within the CNVIS and validate predictions; and
- minimise truck movements.

10.2.2 Plant and equipment

Additional measures for plant and equipment include:

- where possible, choose quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks;
- operate plant and equipment in the quietest and most efficient manner;
- activities within warehouse and workshop areas consistent with the modelling assumptions presented in this report and Appendix A;
- activities associated with concrete testing, stripping and disposal consistent with the modelling assumptions presented in this report and Appendix A; and
- regularly inspect and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.

10.2.3 Work scheduling

Work scheduling measures include:

- where possible, schedule activities to minimise impacts by undertaking all possible work during hours that will least adversely affect sensitive receivers and by avoiding conflicts with other scheduled events;
- where possible, scheduling work to coincide with non-sensitive periods;
- where possible, scheduling noisy activities to coincide with high levels of neighbourhood noise so that noise from the activities is partially masked and not as intrusive;
- where possible, planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers;
- optimise the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours; and
- where possible, designating, designing and maintaining access routes to the site to minimise impacts.

10.3 Community consultation and complaints handling

Community consultation and complaints handling will be undertaken in accordance with the projects Community Communication Strategy (CCS).

11 Conclusion

EMM has prepared a CNVIS for works proposed at the Parramatta Road East and West (PREW) civil site for the M4-M5 Link Mainline Tunnels project. PREW functions as support for the civil and tunnelling sites at Haberfield.

The potential noise levels from the project components have been assessed in accordance with relevant policies, standards, guidelines and the instrument of approval conditions.

The primary document in NSW for assessing construction noise is the EPA's ICNG. It is common for construction projects to exceed noise management levels provided in the ICNG. However, where this is the case, all feasible and reasonable noise mitigation and management measures must be implemented.

Noise levels have been predicted to satisfy the NMLs for all residential and non-residential receivers for standard and OOH periods. The assessment has indicated potential for exceedance of sleep disturbance 'screening criterion' at night, however the predicted levels are less than the existing L_{Amax} noise levels that the residential receivers are currently exposed to, likely from traffic on Parramatta Road.

The scenarios presented in this report are considered representative of typical and peak activities, although proposed activities at PREW may evolve from the CNVIS stage. Any changes to the proposed activities at the PREW would require further detailed noise assessment to ensure that NML's are achieved. Methods on how noise can be managed and mitigated are provided in Section 10.

The potential for cumulative noise impacts from the project with other components of the WestConnex project (New M5 and M4 East) have been considered. A review of PREW and M4 East project timeframes indicates that the scheduled overlap would be minor in duration and activity, and based on the noise predictions from PREW, would unlikely to result in cumulative noise impacts. The M4-M5 Wattle Street civil and tunnelling site is located more than 250m from PREW and would not result in cumulative noise impacts.

Project traffic on public roads has been assessed against the Roads and Maritime CNVG. Traffic volumes during the works are low relative to existing movements. The relative increase in average road traffic noise levels on Parramatta Road is less than 0.2dB, which satisfies the CNVG guidelines.

The potential for vibration impacts have been assessed. The activities proposed for this phase of construction would not result in emission of significant ground vibration that would result in vibration levels approaching the human comfort or cosmetic damage criteria.

Appendix A

Plant and equipment modelling assumptions - Parramatta Road East and West

ID	Description	Equipment	Quantity	Periods				Equipment Sound Power Levels, dB											
				Day	OOH day	OOH evening	OOH night	Item LAeq, 15min	Typical runtime per 15min			Modifying factor	Item LAeq, 15min - adjusted			Overall LAeq,15min			Group Lmax - night
									Day	Day OOH, Evening OOH	Night OOH		Day	Day OOH, Evening OOH	Night OOH	Day	Day OOH, Evening OOH	Night OOH	
1 Typical	NE area (Area A) *Activties internal to building*	Light vehicles	4	Yes	Yes	Yes	Yes	74	33%	33%	33%		75	75	75	98	96	95	112
		Hand tools	1	Yes	Yes	Yes	Yes	100	50%	30%	17%		97	95	92				
		Fork lift (Manitou)	1	Yes	Yes	Yes	Yes	92	100%	50%	50%		92	89	89				
		Light commercial (<4.5t)	1	Yes	Yes	Yes	Yes	96	10%	10%	10%		86	86	86				
	SE area (Area B)	Light vehicles	4	Yes	Yes	Yes	Yes	74	33%	33%	33%		75	75	75	75	75	75	95
	SW area (Area C)	Light vehicles	5	Yes	Yes	Yes	Yes	74	33%	33%	33%		76	76	76	106	105	97	112
		Heavy vehicles	1	Yes	Yes	Yes	Yes	103	100%	100%	20%		103	103	96				
		Hand tools	1	Yes	Yes	Yes		100	100%	100%			100	100					
		Mini bus	1	Yes	Yes	Yes	Yes	94	17%	17%	17%		86	86	86				
		Fork lift (Manitou)	1	Yes	Yes	Yes	Yes	92	100%	100%	50%		92	92	89				
		AC Unit	1	Yes	Yes	Yes	Yes	63	100%	100%	100%		63	63	63				
		Concrete testing	1	Yes	Yes	Yes	Yes	70	100%	100%	100%		70	70	70				
		Concrete stripping	1	Yes	Yes			98	100%				98						
		Concrete disposal	1	Yes	Yes			109	3%				94						
		Exhaust fan	4	Yes	Yes	Yes	Yes	75	100%	100%	100%		81	81	81				
	NW area (Area D)	Light vehicles	4	Yes	Yes	Yes	Yes	74	33%	33%	33%		75	75	75	75	75	75	95
2 OOH peak	NE area (Area A) *Activties internal to building*	Light vehicles	7		Yes	Yes	Yes	74	33%	33%	33%		78	78	78	N/A	96	95	112
		Hand tools	1		Yes	Yes	Yes	100	50%	30%	17%		97	95	92				
		Fork lift (Manitou)	1		Yes	Yes	Yes	92	100%	50%	50%		92	89	89				
		Light commercial (<4.5t)	1		Yes	Yes	Yes	96	10%	10%	10%		86	86	86				
	SE area (Area B)	Light vehicles	222		Yes	Yes	Yes	74	33%	33%	33%		93	93	93	N/A	94	94	95
		Mini bus	2		Yes	Yes	Yes	94	17%	17%	17%		89	89	89				
	SW area (Area C)	Light vehicles	113		Yes	Yes	Yes	74	33%	33%	33%		90	90	90	N/A	102	98	112
		Heavy vehicles	1		Yes	Yes	Yes	103	20%	20%	20%		96	96	96				
		Fork lift (Manitou)	1		Yes	Yes	Yes	92	50%	50%	50%		89	89	89				
		Hand tools	1		Yes	Yes		100	100%	100%			100	100					
		Mini bus	3		Yes	Yes	Yes	94	17%	17%	17%		91	91	91				
		AC Unit	1		Yes	Yes	Yes	63	100%	100%	100%		63	63	63				
		Concrete testing	1		Yes	Yes	Yes	70	100%	100%	100%		70	70	70				
		Concrete stripping	1		Yes			98	100%				98						
		Concrete disposal	1		Yes			109	3%				94						
	NW area (Area D)	Light vehicles	59		Yes	Yes	Yes	74	33%	33%	33%		87	87	87	N/A	87	87	95
3 Peak	NE area (Area A) *Activties internal to building*	Light vehicles	7	Yes	Yes			74	33%	33%	33%		78	78	78	98	N/A	N/A	N/A
		Hand tools	1	Yes	Yes			100	50%	30%	17%		97	95	92				
		Fork lift (Manitou)	1	Yes	Yes			92	100%	50%	50%		92	89	89				
		Light commercial (<4.5t)	1	Yes	Yes			96	10%	10%	10%		86	86	86				
	SE area (Area B)	Light vehicles	222	Yes	Yes			74	33%	33%	33%		93	93	93	94	N/A	N/A	N/A
		Mini bus	2	Yes	Yes			94	17%	17%	17%		89	89	89				
	SW area (Area C)	Light vehicles	113	Yes	Yes			74	33%	33%	33%		90	90	90	106	N/A	N/A	N/A
		Heavy vehicles	1	Yes	Yes			103	100%	100%	20%		103	103	96				
		Hand tools	1	Yes	Yes			100	100%	100%			100	100					
		Fork lift (Manitou)	1	Yes	Yes			92	100%	100%	50%		92	92	89				
		Mini bus	3	Yes	Yes			94	17%	17%	17%		91	91	91				
		AC Unit	1	Yes	Yes			63	100%	100%	100%		63	63	63				
		Concrete testing	1	Yes	Yes			70	100%	100%	100%		70	70	70				
		Concrete stripping	1	Yes	Yes			98	100%				98						
		Concrete disposal	1	Yes	Yes			109	3%				94						
	NW area (Area D)	Light vehicles	59	Yes	Yes			74	33%	33%	33%		87	87	87	87	N/A	N/A	N/A

Notes:

Day Day 7:00 am to 6:00 pm Monday to Friday, 8:00 am to 6:00 pm Saturday

Day OOH Day out of hours Sunday and Public holidays 8:00 am to 6:00 pm

Evening Evening 6:00 pm to 10:00 pm Monday to Sunday

Night Night 10:00 pm to 7:00 am Monday to Friday and 10:00 pm to 8:00 am Saturday, Sunday and Public holidays

Area A Roller door is assumed to be open for Day standard hours, open for 7.5 minute in any 15 minute period during Day OOH, Evening OOH and 7.5 minute in any 15 minute period Night OOH

Appendix B

Predicted noise levels - $L_{Aeq,15min}$

Table B.1 Predicted noise levels $L_{Aeq,15min}$

Receiver	Classification	NCA	NML's		Predicted Noise Levels per Scenario			
			Time Period	NML	Typical L_{Aeq} Scenario 1	Peak L_{Aeq} Scenario 2^	Peak L_{Aeq} Scenario 3^	Compliance
142 Alt Street	Residential	6	5am-7am	50	44	45	n/a	yes
			Day*	56	50	n/a	50	yes
			Day OOH	51	47	47	n/a	yes
			Eve OOH	51	47	47	n/a	yes
			10pm-12am	50	44	n/a	n/a	yes
			Night OOH	48	44	n/a	n/a	yes
128 Alt Street	Residential	1	5am-7am	47	41	46	n/a	yes
			Day*	56	47	n/a	49	yes
			Day OOH	51	47	47	n/a	yes
			Eve OOH	51	47	47	n/a	yes
			10pm-12am	49	41	n/a	n/a	yes
			Night OOH	43	41	n/a	n/a	yes
139 Alt Street	Residential	6	5am-7am	50	47	48	n/a	yes
			Day*	56	54	n/a	54	yes
			Day OOH	51	49	49	n/a	yes
			Eve OOH	51	49	49	n/a	yes
			10pm-12am	50	47	n/a	n/a	yes
			Night OOH	48	47	n/a	n/a	yes
1 Walker Street	Residential	6	5am-7am	50	36	39	n/a	yes
			Day*	56	42	n/a	43	yes
			Day OOH	51	41	41	n/a	yes
			Eve OOH	51	41	41	n/a	yes
			10pm-12am	50	36	n/a	n/a	yes
			Night OOH	48	36	n/a	n/a	yes
126 Alt Street	Residential	1	5am-7am	47	38	44	n/a	yes
			Day*	56	44	n/a	46	yes
			Day OOH	51	43	43	n/a	yes
			Eve OOH	51	43	43	n/a	yes
			10pm-12am	49	38	n/a	n/a	yes
			Night OOH	43	38	n/a	n/a	yes
119 Alt Street	Residential	1	5am-7am	47	37	44	n/a	yes
			Day*	56	43	n/a	46	yes
			Day OOH	51	42	42	n/a	yes
			Eve OOH	51	42	42	n/a	yes
			10pm-12am	49	37	n/a	n/a	yes
			Night OOH	43	37	n/a	n/a	yes
209 Parramatta Road	Commercial	6	When in use	70	44	42	45	yes

Receiver	Classification	NCA	NML's		Predicted Noise Levels per Scenario			
			Time Period	NML	Typical L_{Aeq} Scenario 1	Peak L_{Aeq} Scenario 2	Peak L_{Aeq} Scenario 3^	Compliance
144 Alt Street	Residential	6	5am-7am	50	42	44	n/a	yes
			Day*	56	49	n/a	49	yes
			Day OOH	51	46	46	n/a	yes
			Eve OOH	51	46	46	n/a	yes
			10pm-12am	50	42	n/a	n/a	yes
			Night OOH	48	42	n/a	n/a	yes
136 Bland Street	Residential	7	5am-7am	50	37	43	n/a	yes
			Day*	56	43	n/a	45	yes
			Day OOH	51	43	43	n/a	yes
			Eve OOH	51	43	43	n/a	yes
			10pm-12am	50	37	n/a	n/a	yes
			Night OOH	48	37	n/a	n/a	yes
207 Parramatta Road	Commercial	6	When in use	70	42	42	44	yes
138 Bland Street	Residential	7	5am-7am	50	39	44	n/a	yes
			Day*	56	45	n/a	47	yes
			Day OOH	51	45	44	n/a	yes
			Eve OOH	51	45	44	n/a	yes
			10pm-12am	50	39	n/a	n/a	yes
			Night OOH	48	39	n/a	n/a	yes
137 Bland Street	Residential	7	5am-7am	50	48	49	n/a	yes
			Day*	56	49	n/a	50	yes
			Day OOH	51	49	48	n/a	yes
			Eve OOH	51	49	48	n/a	yes
			10pm-12am	50	48	n/a	n/a	yes
			Night OOH	48	48	n/a	n/a	yes
135 Bland Street	Residential	7	5am-7am	50	43	47	n/a	yes
			Day*	56	50	n/a	51	yes
			Day OOH	51	50	49	n/a	yes
			Eve OOH	51	50	49	n/a	yes
			10pm-12am	50	43	n/a	n/a	yes
			Night OOH	48	43	n/a	n/a	yes
137 Alt Street	Residential	6	5am-7am	50	42	49	n/a	yes
			Day*	56	56	n/a	56	yes
			Day OOH	51	51	51	n/a	yes
			Eve OOH	51	51	51	n/a	yes
			10pm-12am	50	48	n/a	n/a	yes
			Night OOH	48	48	n/a	n/a	yes
302 Parramatta Road	Commercial	1	When in use	70	44	43	45	yes

Receiver	Classification	NCA	NML's		Predicted Noise Levels per Scenario			
			Time Period	NML	Typical L_{Aeq} Scenario 1	Peak L_{Aeq} Scenario 2^	Peak L_{Aeq} Scenario 3^	Compliance
298 Parramatta Road	Commercial	1	When in use	70	43	43	45	yes
122 Bland Street	Residential	1	5am-7am	47	39	41	n/a	yes
			Day*	56	46	n/a	46	yes
			Day OOH	51	46	46	n/a	yes
			Eve OOH	51	46	46	n/a	yes
			10pm-12am	49	39	n/a	n/a	yes
			Night OOH	43	39	n/a	n/a	yes
115 Alt Street[1]	Residential	1	5am-7am	47	35	40	n/a	yes
			Day*	56	42	n/a	43	yes
			Day OOH	51	41	40	n/a	yes
			Eve OOH	51	41	40	n/a	yes
			10pm-12am	49	35	n/a	n/a	yes
			Night OOH	43	35	n/a	n/a	yes
124 Bland Street[1]	Residential	1	5am-7am	47	41	42	n/a	yes
			Day*	56	48	n/a	48	yes
			Day OOH	51	48	48	n/a	yes
			Eve OOH	51	48	48	n/a	yes
			10pm-12am	49	41	n/a	n/a	yes
			Night OOH	43	41	n/a	n/a	yes
119a Bland Street	Residential	0	5am-7am	47	40	41	n/a	yes
			Day*	56	46	n/a	47	yes
			Day OOH	51	46	49	n/a	yes
			Eve OOH	51	46	49	n/a	yes
			10pm-12am	49	40	n/a	n/a	yes
			Night OOH	43	40	n/a	n/a	yes

Notes: Day/Evening/Night
1. Construction noise assessed in accordance with ICNG
2. L_{Amax} assessed to top floor of apartment buildings
Levels in 'Italics' exceedances of screening criterion
* Day – Standard Hours

^ noting utilisation factors outlined in Appendix A

Appendix C

Predicted noise levels - L_{Amax} (Night)

Table C.1 Predicted noise levels L_{Amax}

Receiver	Classification	NCA	Screening Criterion	Predicted Noise Levels	Compliance
			L_{Amax}	L_{Amax}	
142 Alt Street	Residential	6	58	53	yes
128 Alt Street	Residential	1	53	55	no
139 Alt Street	Residential	6	58	53	yes
1 Walker Street	Residential	6	58	51	yes
126 Alt Street	Residential	1	53	54	no
119 Alt Street	Residential	1	53	52	yes
209 Parramatta Road	Commercial	6	n/a	n/a	n/a
144 Alt Street	Residential	6	58	51	yes
136 Bland Street	Residential	7	58	47	yes
207 Parramatta Road	Commercial	6	n/a	n/a	n/a
138 Bland Street	Residential	7	58	53	yes
137 Bland Street	Residential	7	58	57	yes
135 Bland Street	Residential	7	58	58	yes
137 Alt Street	Residential	6	58	54	yes
302 Parramatta Road	Commercial	1	n/a	n/a	n/a
298 Parramatta Road	Commercial	1	n/a	n/a	n/a
122 Bland Street	Residential	1	53	56	no
115 Alt Street[1]	Residential	1	53	45	yes
124 Bland Street[1]	Residential	1	53	59	no
119a Bland Street	Residential	0	53	52	yes
115 Alt Street[2^]	Residential	1	53	60	no
124 Bland Street[2^]	Residential	0	53	68	no

Notes: 1. Construction noise assessed in accordance with ICNG
2. L_{Amax} assessed to top floor of apartment buildings
^ allowance for 3dB acoustic shielding from truck body for airbrake to upper levels
* Day – Standard Hours