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MARTIN PLACE METRO CSSI

Construction Noise and Vibration Management Plan

7 December 2020

Lendlease Group

TK422-F03 (r16) Martin Place CSSI CNVMP

35 1982-2017 ACOUSTIC ENGINEERING EXCELLENCE

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We have prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

The information contained herein is for the purpose of acoustics only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the specialist field of acoustics engineering including and not limited to structural integrity, fire rating, architectural buildability and fit-for-purpose, waterproofing and the like. Supplementary professional advice should be sought in respect of these issues.

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1 Introduction

1.1 Overview

The Sydney Metro works at Martin Place to be undertaken by Lendlease as part of the Critical State Significant Infrastructure (CSSI) project (reference SSI 7400) will be completed over a number of stages which can be summarised as:

1. Demolition of 9-19 Elizabeth St
2. Bulk shaft excavation works
3. Station construction and fit-out

This Construction Noise and Vibration Management Plan (CNVMP) was initially developed to account for the demolition works at 9-19 Elizabeth St and subsequently updated to include, the bulk shaft excavation, and station construction stages.

1.2 Purpose

Renzo Tonin & Associates was engaged by Lendlease (LL) to prepare a site specific Construction Noise and Vibration Management Plan (CNVMP) for works associated with the Sydney Metro Martin Place Station, including:

- Demolition of 9-19 Elizabeth Street, Sydney
- Cut and cover excavation works in Martin Place between Elizabeth and Castlereagh Streets, including additional land at 9-19 Elizabeth Street not covered under the existing approval
- Shaft excavation followed by mined excavation of the station cavern, including mined excavation of an unpaid concourse line beneath Martin Place and 50 Martin Place
- Works to connect the existing MLC pedestrian link to the station concourse
- Construction and fit-out of the station's northern and southern entries
- Operation of the construction compound located at 33 Bligh Street, previously constructed and operated by the Tunnelling and Excavations (TSE) Contractor. MPISD will operate this compound from mid-December 2020.

The above works are referred to as 'the Project' within this CNVMP.

This CNVMP forms part of the Construction Environmental Management Plan (CEMP) that has been developed for the construction site.

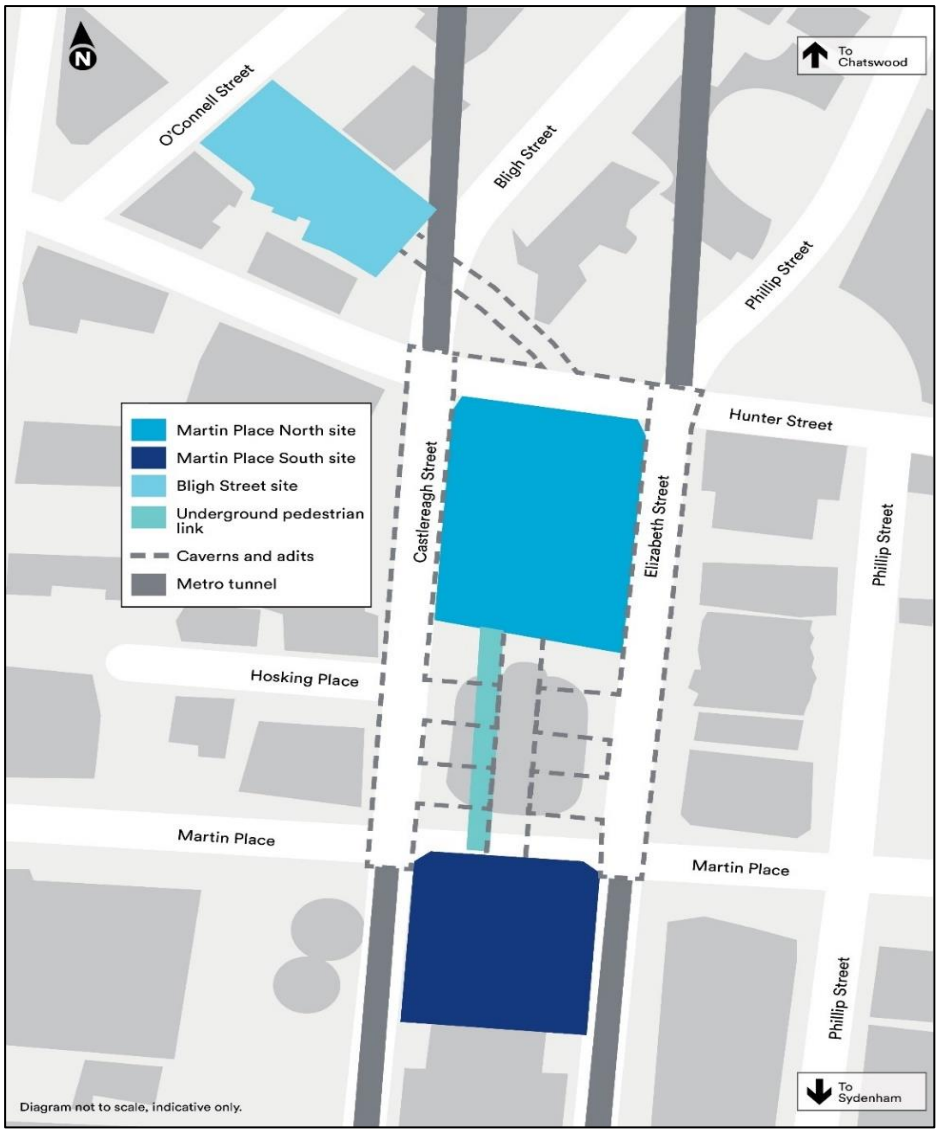
The Minister approved the Stage 2 (Chatswood to Sydenham) Metro application lodged by Transport for NSW (TfNSW) as a Critical State Significant Infrastructure (CSSI) project (reference SSI 7400) (the CSSI

Consent) on 9 January 2017. The demolition and construction works form part of the Sydney City Metro & Southwest (Chatswood to Sydenham) (SMCSWCS) project.

The Sydney Metro approval has been modified a number of times, including a modification (Mod 3), approved on 22 March 2018. SSI 7400 MOD 3 incorporates Macquarie's proposed scheme for Martin Place.

This CNVMP describes how noise and vibration will be managed and mitigated during construction of the Project. This Plan has been prepared to address the relevant requirements of Sydney Metro's Construction Environmental Management Framework (Appendix B of the *Submissions and Preferred Infrastructure Report*), the Revised Environmental Mitigation Measures (REMMs), the Revised Environmental Performance Outcomes, applicable legislation, the SMCSWCS Environmental Impact Statement (EIS) (Sydney Metro, 2016) and contractual requirements and the Project Planning Approval. The relevant requirements addressed by this CNVMP are listed in Part B – Systems and tools, along with the relevant section that it is addressed in this CNVMP.

Figure 0: Project location



1.3 Project background and scope

The Critical State Significant Infrastructure (CSSI) for the Martin Place Metro station, a part of the Sydney Metro City & Southwest project, has been approved by NSW Government Department of Planning and Environment. The Metro Martin Place precinct development consists of the Martin Place Metro Station, Over Station Development (OSD) and the associated integrated civic, retail and commercial areas. The proposed redevelopment is to create a transportation metro precinct that offers mixed use space including commercial office space, modern retail outlets and civic space. The North Tower OSD consists of 39 storeys of office space. The precinct is located between Hunter Street to the north, 50 Martin Place to the south, Elizabeth Street to the east and Castlereagh Street to the west.

This CNVMP addressed the management strategy for noise and vibration impacts from construction works related to the Project.

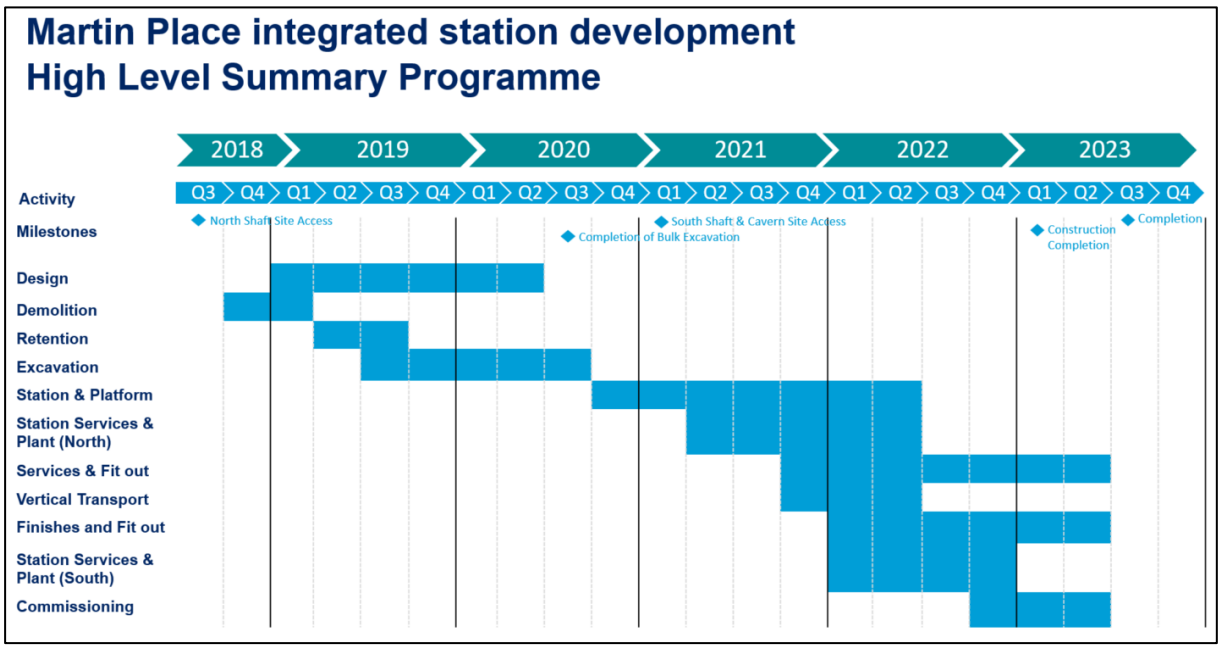
The scope of works is shown in Table 1.1.

Table 1.1: The Project scope of work

Stage	Phase
Demolition	Demolish an area including the following: • 11 Storeys plus 1.5 Basement Levels (9-19 Elizabeth Street) to slab on ground.
Retention works	Bored piling will be undertaken along the southern boundary of the site shared with 50 Martin Place, and along the western, northern and eastern perimeter boundaries
Bulk Shaft Excavation	Bulk shaft excavation from ground level to RL-5m (approximately platform level)
Mined excavation	Excavation of the Concourse Link Tunnel between the Southern and Northern Station Boxes
Station Construction	Construction of the metro station including the following activities: • Construction of basement and core structures at Northern and Southern Shafts • Fit-out works • Surface works (i.e. landscaping) • Operation of the Bligh Street compound Construction of the north and south towers do not form part of this CNVMP.

The key stages of the Project are outlined in the below diagram extracted from the Lendlease Construction and Site Management Plan.

Figure 1 Martin Place integrated station development High Level Summary Programme



Further details for the project phases, timeframes and construction activities is presented in Section 2.

1.4 Objectives

The objectives for this noise and vibration management plan are to ensure:

- Compliance with the Minister for Planning's Project Planning Approval;
- Compliance with Minister of Planning's Modification of Infrastructure Approval (SSI 7400 MOD 3);
- Noise levels would be minimised with the aim of achieving the noise management levels where feasible and reasonable;
- The project would avoid any damage to buildings from vibration;
- Construction noise and vibration impacts are mitigated and managed in accordance with the Sydney Metro Construction Noise and Vibration Strategy (CNVS);
- Affected sensitive receivers are notified of upcoming works and any out-of-hours works;
- Reasonable and feasible mitigation measures are implemented to minimise and manage noise and vibration impacts on surrounding residents, commercial and other sensitive receivers;
- Any complaints are addressed in a timely and efficient manner.

1.5 Plan Structure

1.5.1 Interactions with other management documents

This plan is a sub-plan of the Construction Environmental Management Plan for the Project. It has the following interrelationships with other management plans and documents:

- Construction Noise and Vibration Impact Statements (CNVIS's) will detail predicted noise impacts and activity-specific mitigation measures for the various stages of works (i.e. demolition, bulk excavation and construction).
- Environment Control Maps which identify adjacent residential and other receivers and environmental controls. This will be progressively updated to incorporate physical management measures identified in relevant CNVIS's.
- The Community Communication Strategy developed for the Project, which details the procedures and processes for community notification, consultation and complaints management.
- The Construction Heritage Management Plan developed for the Project to provide details of heritage structures and items in the areas surrounding the Project.

1.5.2 Structure of this CNVMP

Structure of this construction noise and vibration management plan is as follows:

- Section 1: Introduction – Introduction to the project and description of this CNVMP and interaction with other documents
- Section 2: Summary of project works
- Section 3 : Environmental requirements
- Section 4: Existing noise environment and noise/vibration sensitive receivers
- Section 5: Hours of work, construction activities and program
- Section 6: Construction noise and vibration objectives
- Section 7: Evaluation, assessment, documentation and consultation
- Section 8: Reasonable and feasible noise and vibration mitigation
- Section 9: Construction noise and vibration monitoring program
- Part B – Systems and tools
- Appendices

As this management plan is technical in nature, Appendix A contains a glossary of acoustic terms used in this report.

1.5.3 Construction Noise and Vibration Impact Statements (CNVIS)

Under the CNVMP sit individual CNVISs that provide detailed predictions, assessment and management of impacts for individual construction activities (e.g. demolition of 9-19 Elizabeth Street). Section 7.1.2 provides more detail on the CNVIS process.

Activity-specific CNVISs, as detailed in Section 7.1.2, will be prepared by Renzo Tonin and Associates to address the following works associated with demolition, excavation and construction of the Project:

- Demolition works at 9-19 Elizabeth Street
- Bulk excavation and retention works
- Station construction works
- Bligh Street compound operation

Adjacent residential and other sensitive receivers, Noise Catchment Areas (NCAs) and site-specific management measures identified in the CNVIS will be progressively incorporated into the CEMP.

1.6 Training

All personnel working on the site will undertake a site induction, which will provide initial training on various environmental aspects including noise and vibration.

Further to this, noise and vibration management requirements are to be regularly tool boxed. Further details regarding training are outlined below:

- Induction training will include noise and vibration information on:
  - Standard construction hours
  - Out of hours works (OOHW)
  - Sensitive receivers
  - Noise and vibration mitigation and management measures
- Tool-boxing will be undertaken on the CNVIS's and will also reinforce and reiterate information from inductions. The tool box talks will be presented when changes in work practices (e.g. OOHW) or seasonal weather increases the risk of adverse impact from noise and/ or vibration.

1.7 Consultation

Consultation with the following will form part of the development of each CNVIS and further development of this CNVMP:

- Potentially-affected community, religious and educational institutions;
- Potentially impacted residential and other sensitive receivers;

- Proponents of other construction works in the vicinity of the Martin Place Station;
- Environmental Protection Authority (where required) and other relevant agencies.

Stakeholder feedback relevant to construction noise and vibration will be incorporated into CNVISs, and this CNVMP where appropriate. The agency and stakeholder consultation register are provided in the CEMP.

A record of consultation with relevant agencies in relation to this CNVMP, including responses to agencies comments and how they have been incorporated in this plan are attached in APPENDIX F.

For the demolition of 9-19 Elizabeth Street, in addition to meeting with City of Sydney Council on 17/8/2018 to outline the contents of the CNVMP and CNVIS , stakeholder consultation with the EPA had also been undertaken. Further stakeholder consultation has been undergoing for bulk shaft excavation and stations construction.

2 Summary of project works

2.1 Construction/demolition works

A preliminary demolition, excavation and construction program for the project has been developed by LL, and is presented in Table 2.1. Three major stages are proposed for the Project which are:

1. Demolition
2. Bulk Excavation
3. Station precinct construction

Preliminary construction site layouts, with key entry and exit points for demolition at 9-19 Elizabeth Street, northern shaft excavation and station construction, and southern station constructions are presented in Appendix C.

Table 2.1: Construction program for demolition, excavation and construction works

Stage	Phase	Activities	Commencement	Completion
Demolition	Site Establishment	Establish Site as per Site Establishment Plan – including perimeter/overhead protection, signage, access, amenities, emergency equipment, storage areas, environmental controls. All site personnel to complete Site Induction All plant to be assessed as per Plant and Equipment checklist	September 2018	October 2018
	Services Disconnection	Disconnection, isolation of Services	September 2018	October 2018
	HAZMAT Removal	Remove HAZMAT Obtain Clearance Certificates	November 2018	April 2019
	Demolition	Implement Management Plans & Demolition Work Plans Complete Change Management As Required Change Management Process		
	Monitor/ Review	Site Inspections Safe Works Observations Audit		
	Demolition Close	Post Conditional Surveys Survey of Service locations Complete Demolition Handover Checklist		
Bulk Excavation	Retention work	Micro-piling, grouted dowels, rockbolting and shotcreting	April 2019	September 2019
	Bulk Shaft Excavation Stages 1 & 2	Rock saws for wall profiling, dozers for ripping and pushing, and excavators for hammering and loading bogie trucks	July 2019	September 2020

Stage	Phase	Activities	Commencement	Completion
	Bulk Shaft Excavation Stage 3	Rock saws for wall profiling, dozers for ripping and pushing, and excavators for hammering and loading bogie trucks		
	Detailed Excavation	Large excavators with rock saw and rock hammer attachments		
Concourse Tunnel Excavation	Concourse Tunnel Excavation	Installation of canopy tubes, excavation of split heading, and shotcreting;	October 2020	June 2023
Station precinct construction	Basements Structure/ Core Structure/Fitout (North)	Cranework, concrete work and power tools	October 2020	June 2023
	Basements Structure/ Core Structure/Fitout (South)	Cranework, concrete work and power tools		
	Surface Works	Cranework, concrete work and power tools		

The above phases rely on all directions, required approvals, permits, licenses, adjoining owners agreements and approvals being in place to commence in accordance with the above time line.

2.2 Construction traffic

The worksite will generate additional traffic movements in the form of:

- Light vehicle movements generated by construction personnel travelling to and from work
- Heavy vehicle movements generated by:
  - Delivery vehicles bringing raw materials, plant, and equipment to the site
  - Trucks removing demolition / excavation material from the site

The access/exit point for the northern site is to be located on Castlereagh Street. Once the TSE contractor has completed the excavation works on the southern site, Lendlease will utilise this site for the pedestrian link tunnel (tunnelling from south) and station construction, and have an access/exit point on Castlereagh Street.

Construction traffic on the site is included as part of the construction noise assessment of the work activities, while when construction-related traffic moves on the public road network, a different noise assessment methodology is appropriate as vehicle movements would be regarded as additional road traffic on public roads rather than as part of the construction site's activities.

As part of the planning works for the project, LL has developed a Construction Traffic Management Plan . Noise impacts from construction related traffic on public roads will be reviewed and addressed in each CNVIS, to mitigate the potential impacts throughout the construction of the Project.

3 Environmental requirements

3.1 Legislation

This CNVMP is prepared in accordance with the:

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

Refer to the CEMP for further details.

3.2 Project compliance requirements

Key planning requirements from the Project Planning Approval (PPA) are summarised in Construction Environmental Management Framework included in Section 1.1 of this Plan.

Additional noise and vibration management requirements are included in Part B of this Plan.

Relevant noise and vibration requirements are also included in the Project contractual requirements. These require that the Demolition and Construction Management Plan include:

> *Section 3.2 (p) (vii) - local barriers to shield high noise impacts;*
>
> *Section 3.2 (p) xi) - measures to mitigate noise and vibration impacts to adjacent and surrounding properties in compliance with the Contract;*

3.3 Environmental performance outcomes

PPA Condition C4(a) requires that the environmental performance outcomes identified in the EIS as amended by the documents listed in PPA Condition A1 will be achieved.

As a CEMP sub-plan, this CNVMP describes how noise and vibration will be managed and mitigated during construction of the Project. To achieve environmental performance outcomes, this Plan has been prepared to address the relevant requirements of Sydney Metro's Construction Environmental Management Framework (Appendix B of the *Submissions and Preferred Infrastructure Report*), the Revised Environmental Mitigation Measures (REMMs), the Revised Environmental Performance Outcomes, applicable legislation, the SMCSWCS Environmental Impact Statement (EIS) (Sydney Metro, 2016),contractual requirements and the Project Planning Approval. The relevant requirements addressed by this CNVMP are listed in Part B – Systems and tools, along with the relevant section where specific requirements are addressed in this CNVMP.

Additionally, records of consultation with relevant agencies are attached in APPENDIX F.

3.4 Guidelines

Additional guidelines and standards relating to the management of construction noise and vibration from this project include:

- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009
- NSW Road Noise Policy (RNP), Department of Environment, Climate Change and Water 2011
- NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006
- Australian Standard AS/NZS 2107:2016 *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), Transport for NSW 2012
- Environmental Noise Management Manual (ENMM), Roads and Traffic Authority 2001.

3.5 TfNSW and Sydney Metro Construction Noise and Vibration Strategies

TfNSW's Construction Noise Strategy (Report No. 7TP-ST-157/2.0, 2012) and the Sydney Metro City & Southwest Construction Noise and Vibration Strategy (Report No. 610.14213-R3, 2016) provide practical guidance on how to minimise, to the fullest extent possible, the impacts of noise and vibration on the community. They outline all feasible and reasonable mitigation measures that should be considered by the Project to reduce airborne noise, ground-borne noise and vibration during the construction of infrastructure projects. The above reference strategies will be adopted to guide management of construction noise and vibration impacts.

The Sydney Metro City & Southwest Construction Noise and Vibration Strategy (Addendum A v2) has been updated by Sydney Metro to satisfy Condition of Approval E32. The Addendum provides internal noise criteria for sensitive receivers, consistent with the requirements of Conditions of Approval E38, E41, E42 and E43. Where internal noise criteria are applicable, additional steps are required when preparing CNVISs to predict internal noise levels based on the facade transmission loss of affected receivers and applying appropriate levels of mitigation, consultation and respite (refer Sections 6.2.1 and 8.2).

3.6 Environmental Representative and Acoustic Advisor

The Project Planning Approval requires Sydney Metro to appoint an independent Environmental Representative (ER) for the duration of the Project and an independent Acoustic Advisor (AA) to oversee construction noise and vibration planning, modelling, management and reporting. The ER and AA have been appointed by Sydney Metro. The role of the ER and the AA is set out in the Construction Environmental Management Plan (CEMP) and in:

- Project Planning Approval Conditions A22 to A24, in relation to the ER
- Project Planning Approval Conditions A25 to A27, in relation to the AA.

The principal role of the ER and the AA with regard to noise and vibration from the SMCSWCS works is as follows:

- Receive and respond to communication from the Secretary of NSW Government Department of Planning and Environment (DP&E) in relation to the performance of SMCSWCS Works in relation to noise and vibration;
- Consider and inform the Secretary on matters specified in the terms of this approval relating to noise and vibration;
- Consider and recommend, to the Proponent, improvements that may be made to work practices to avoid or minimise adverse noise and vibration impacts;
- Review all noise and vibration documents required to be prepared under the terms of this approval and, should they be consistent with the terms of this approval, endorse them before submission to the Secretary (if required to be submitted to the Secretary) or before implementation (if not required to be submitted to the Secretary);
- Regularly monitor the implementation of all noise and vibration documents required to be prepared under the terms of this approval to ensure implementation is in accordance with what is stated in the document and the terms of this approval;
- Notify the Secretary of noise and vibration incidents in accordance with Condition A41 of this approval;
- In conjunction with the ER, the AA must:
    - Consider requests for out of hours construction activities and determine whether to endorse the proposed activities in accordance with Condition E47
    - As may be requested by the Secretary or Complaints Commissioner, help plan, attend or undertake audits of noise and vibration management of the SMCSWCS Works including briefings, and site visits;
    - If conflict arises between the Proponent and the community in relation to the noise and vibration performance during construction of the Project, follow the procedure in the

Community Communication Strategy approved under Condition B3 of the CSSI Consent to attempt to resolve the conflict, and if it cannot be resolved, notify the Secretary;

- Consider relevant minor amendments made to this CEMP, relevant sub-plans and noise and vibration monitoring programs that require updating or are of an administrative nature, and are consistent with the terms of this approval and the management plans and monitoring programs approved by the Secretary and, if satisfied such amendment is necessary, endorse the amendment. This does not include any modifications to the terms of this approval;
- Prepare and submit to the Secretary and other relevant regulatory agencies, for information, a monthly Noise and Vibration Report detailing the AAs actions and decisions on matters for which the AA was responsible in the preceding month (or other timeframe agreed with the Secretary). The Noise and Vibration Report must be submitted within seven (7) days following the end of each month for the duration of construction of the Project, or as otherwise agreed with the Secretary of DP&E.

3.7 Collaboration with Sydney Metro, ER, IC and AA

The Environment Representative (ER) and the Acoustic Advisor (AA) have roles that include overseeing noise and vibration management. These roles are set out in the Construction Environmental Management Plan (CEMP).

LL will provide Sydney Metro, the ER, IC and the AA with:

- Noise and vibration documents for review
- Access to monitoring activities and data

LL will work collaboratively with Sydney Metro, the ER, IC and the AA to ensure all reasonable and feasible noise mitigation is implemented in accordance with the Conditions of Approval (CoA), the Revised Mitigation Measures and Performance Environmental Outcomes and this CNVMP.

AA and ER endorsement of the CNVMP is required prior to submission to DP&E for approval and or prior to implementation of the document.

4 Existing noise environment and noise/vibration sensitive receivers

4.1 Surrounding receivers and land use

The location of the project site, and the nearby surrounding land use is presented in Appendix B.

A detailed land-use survey has been completed and will be further refined (if required) as part of each CNVIS. The survey brought the NSW cadastral database, a building basement survey conducted by Sydney Metro and identified land use details into a Geographic Information System (GIS). The GIS allows potentially critical areas that are sensitive to construction noise, vibration and ground-borne noise impacts to be easily identified and updated as land uses change during the project timeline. The data can be readily included into the noise and vibration modelling, to allow effective management of noise and vibration impacts on identified sensitive receivers.

4.2 Existing acoustic environment and residential receivers

The primary contributor to the ambient noise environment in the study area is traffic noise from the existing road network and urban hum (eg. commercial building mechanical plant and equipment). SLR conducted long-term noise monitoring on behalf of TfNSW to quantify ambient noise levels for the EIS of the SMCSWCS project. Section 3.5 of the EIS Noise and Vibration Technical Paper provides noise data results.

Table 4.1 below summarises the NCAs for the Project and the representative Rating Background Levels (RBLs). These are used to establish construction noise management levels (NMLs) at residential receivers in accordance with the NSW ICNG.

Table 4.1: Nearest Noise and Vibration Sensitive Residential Receivers and Rating Background Noise Levels (RBLs)

NCA	Monitoring location[1]	Relationship to EIS NCAs[1]	RBL Day	RBL Evening	RBL Night
MP_01	Location EIS B.11	Combined EIS NCAs A,G & F	61	56	52
MP_02	1 Hoskings Place, Sydney	EIS Martin Place Station_B	61	56	52
MP_03		EIS Martin Place Station_C	61	56	52
MP_04		EIS Martin Place Station_D & E	61	56	52

Notes: 1. Based upon EIS and Submissions and Preferred Infrastructure Reports for the Sydney City Metro & Southwest (Chatswood to Sydenham) (SMCSWCS) project

2. Location EIS B.11 was long term measurements undertaken at 1 Hoskings Place, Sydney.

4.2.1 Noise and vibration sensitive receivers

The sensitivity of occupants to noise and vibration varies according to the nature of the occupancy and the activities performed within the affected premises. For example, recording studios are more sensitive to vibration and ground-borne noise than residential premises, which in turn are more sensitive than typical commercial premises.

To assess and manage construction noise impacts, the areas around the worksite (up to approximately 250 m from the worksite) have been divided into Noise Catchment Areas (NCAs). These are based on each area's similar acoustic environment before construction works start. The NCAs, based upon the SMCSWCS EIS, have been reviewed and modified, based on more detailed design information and site-specific characteristics.

The land use information was collated from a combination of site inspections; review of street-level imagery and aerial photography; and review of publicly available land and property information. All cadastral lots within the identified NCAs were classified into one of the following receiver categories:

Figure 2: Land use categories identified in Land Use Survey GIS and Appendix B

The comprehensive updated land-use survey in each project NCA are included in Appendix B.

4.2.2 Heritage receivers

Renzo Tonin and Associates, in consultation with LL, have identified potentially vibration sensitive heritage properties in each NCA near the construction site. Heritage properties (see list provided in Table 4.2) have been included in the land use GIS database, and subsequently incorporated into the vibration models to ensure vibration impacts are managed to minimise the risk of property damage.

Table 4.2: Identified heritage receivers in proximity to the project

Item name	Location	Listing	Approximate horizontal distance from Project
Commonwealth Bank of Australia	48–50 Martin Place	Item 1895 City of Sydney LEP ; SHR Item 01427	Adjacent building (< 5m)
Former "MLC Building"	38–46 Martin Place	Item 1894 City of Sydney LEP ; SHR Item 00597	65 m
Bennelong Stormwater Channel No 29	Along Elizabeth & Castlereagh Streets includes Martin Place	Sydney Water S170 Item 4570854	5 m
Martin Place Railway Station	3 Martin Place	Item 1891 City of Sydney LEP ; SHR Item 01187 ; RailCorp S170 Item 4801162	60m
Richard Johnson Square including monument and plinth	Bligh Street	Item 1673 City of Sydney LEP	40m
Former "Qantas House" including interiors	68–96 Hunter Street	Item 1811 City of Sydney LEP ; SHR Item 01512	20m

Item name	Location	Listing	Approximate horizontal distance from Project
Former "City Mutual Life Assurance" building including interiors	10 Bligh Street	Item 1675 City of Sydney LEP & archaeological site	20m
Chifley Square	Chifley Square	Item 1708 City of Sydney LEP	35m

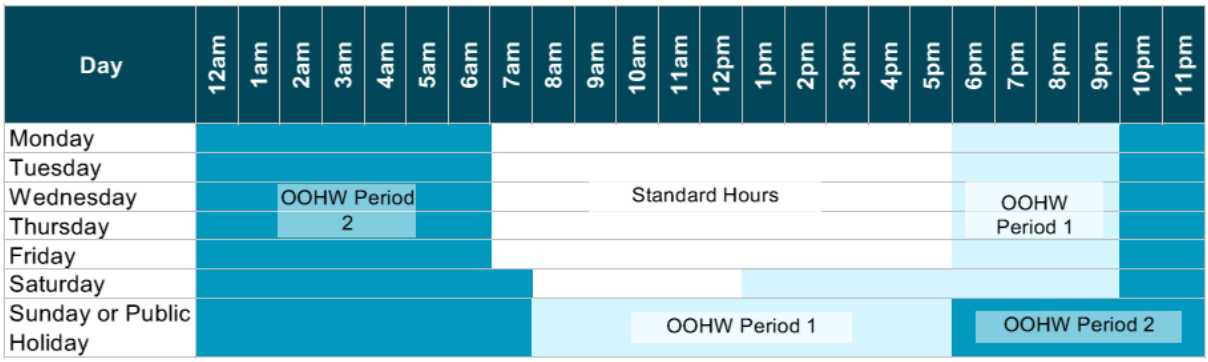
5 Hours of work, construction activities and program

5.1 Construction hours

The construction hours for the Project are defined by the CSSI Project Planning Approval. The standard construction hours of work are defined in Project Planning Approval Condition E36 and summarised in Table 5.1 below. Works may be carried out outside standard hours under Project Planning Approval Conditions E37, E38, E41, E42, E44 and E46.

The standard hours and out-of-hours work (OOHW) periods are depicted in Table 5.1 below. The OOHW periods are further defined as OOHW Period 1 and 2, based on the TfNSW's Construction Noise Strategy (TfNSW CNS).

Table 5.1: Construction hours



Note – see background noise-based exceptions in Section 5.2.1

The Sydney Metro CNVS defines the construction hours in Section 5.2, then further categorises the OOHW into two time periods, for the purpose of managing impacts and identifying additional mitigation measures. These two OOHW periods are both named 'OOHW' in the Sydney Metro CNVS. Guidance has been taken from the TfNSW Construction Noise Strategy, which defines the OOHW periods as OOHW Period 1 and OOHW Period 2. The naming of the OOHW periods assists when reviewing, assessing and managing impacts from OOHW.

5.1.1 Impulsive or tonal noise emissions

High noise and vibration generating activities (e.g. jack and rock hammering, sheet and pile driving, rock breaking and vibratory rolling) may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block, unless otherwise agreed under Project Planning Approval Condition E38.

At Martin Place, Project Planning Approval Condition E38 requires consultation to be undertaken with affected receivers to determine appropriate hours of respite. This is required if internal noise levels are greater than $L_{Aeq(15minute)}$ 60 dB(A), inclusive of a 5 dB(A) penalty for activities similar to those mentioned

above. Under Project Planning Approval Condition E38, respite periods may differ from the standard 3 hour continuous blocks with minimum 1 hour respite.

5.2 Out of hours works

The following Project Planning Approval conditions allow for construction work to be undertaken outside standard construction hours, under defined circumstances:

- OOHW under conditions E37, E38, E41, E42
- Variation to standard construction hours under condition E44
- Emergency construction works (CoA E45)
- OOHW rock breaking and other particularly annoying activities under condition E46

Standard construction hours of work are defined in CoA E36 and the Sydney Metro CNVS, as noted in Section 5.1.

5.2.1 Out of Hours Work Protocol

All out of hours works (except in emergency situations) will be managed under the Sydney Metro Out of Hours Works Protocol (Reference Document: SM ES-PW-317) or PPA Condition E47 OOHW Protocol, which applies to out of hours work not subject to an EPL.

The requirements of PPA Condition E47 are provided below:

> *E47 An Out of Hours Work Protocol for the assessment, management and approval of work outside of standard construction hours, as defined in Condition E36 of this approval, must be prepared in consultation with the EPA and submitted to the Secretary for approval before construction commences for works not subject to an EPL. The protocol must include:*
>
> *(a) the identification of low and high risk construction activities;*
>
> *(b) a risk assessment process in which the AA reviews all proposed out of hours activities and identifies their risk levels;*
>
> *(c) a process for the endorsement of out of hours activities by the AA and approval by the ER for construction activities deemed to be of:*
>
> *i. low environmental risk; or*
>
> *ii. high risk where all construction works cease by 9pm.*
>
> *All other high risk out of hours construction must be submitted to the Secretary for approval unless otherwise approved through an EPL.*

The protocol must detail standard assessment, mitigation and notification requirements for high and low risk out of hours works, and detail a standard protocol for referring applications to the Secretary.

5.2.2 Out of hours work under Road Occupancy Licence

Utility and Local Area works will often be required to be completed under Road Occupancy Licence (ROL). Where the ROL, due to the importance of the road to the functionality of the road network, precludes or restricts access to the work area before 10 pm, construction works will have to be carried out during the 'night' period, or OOHW Period 2 as indicated in Table 5.1.

The existing background noise levels around the project site are generally controlled by ambient urban noise, since the Project site is an inner-city site. The noise logging results indicate that background noise levels remain steady or marginally decrease in the early night between 10 pm to 12 am, and decrease to minimum levels around 2 am to 4 am.

As such, it would be unduly stringent to apply stricter 'night' criteria during these periods. Accordingly, a shoulder period has been derived in line with guidance provided in the NSW Industrial Noise Policy (INP) (Section 3.3) so that the assessment NMLs are consistent with the existing background noise levels during this assessment period. As such, an additional OOHW Period, OOHW Shoulder has been identified for assessing and managing OOHW at residential receivers under the ROL.

5.2.3 Out of hours deliveries

Delivery of most plant and equipment to the worksite will be undertaken during standard construction hours. However, during the various stages of construction works, there will be instances where oversized deliveries are necessary. Oversized movements can cause disruptions to the existing traffic and can be a potential hazard for road users. Therefore, there is a requirement for these vehicles to move during off-peak hours when traffic volumes are typically at a minimum, thereby ensuring road user and public safety and minimising disruption to the road network.

The transportation of oversized equipment and machinery may require the occupation of more than one traffic lane. Where this occurs, all movements are to be strictly in accordance with RMS guidelines for oversized movements and where required the issuing of a Road Occupancy Licence (ROL).

5.3 Construction activities and indicative demolition and excavation activities and methodologies

5.3.1 Construction noise sources

Appendix D summarises the typical construction activities and an indicative schedule of potential operating construction noise generating plant and equipment that will be used during the demolition, bulk excavation and construction stages of the project. The likely stage and phases lengths are presented in Table 2.1.

The sound power levels for the activities presented in Appendix D are based on maximum levels given in Table A1 of Australian Standard 2436 - 2010 '*Guide to Noise Control on Construction, Demolition and Maintenance Sites*', the ICNG and information from past projects and information held in the Renzo Tonin & Associates library files.

5.3.2 Structure-borne and ground-borne noise

Structure-borne or ground-borne noise results from vibration excitation on a building element or surface causing the element to vibrate, generating noise within the receiving buildings.

Vibration resulting from the use of high impact plant equipment/process such as rock breakers and the dropping of demolished material down the shafts may generate structure-borne or ground-borne noise within the nearby buildings in addition to airborne noise. Consideration will be given to the potential impacts of structure borne and ground-borne noise, and alternative methods to rock hammering, as outlined in Section 5.3.3.

The receivers within 50 Martin Place, Sydney have been identified as having the potential to be impacted by structure-borne noise during the demolition / excavation works, as the buildings share a common wall/boundary. Other nearby buildings may be impacted by ground-borne noise during the bulk excavation works.

5.3.3 Alternative methods to rock hammering and blasting

In accordance with CoA E35, the Proponent must review alternative methods to rock hammering and blasting (not currently proposed) for excavation as part of the detailed construction planning with a view to adopting methods that minimise impacts on sensitive receivers. The construction methodology is to adopt the least impact alternative in any given location unless it can be demonstrated, to the satisfaction of the AA, why it should not be adopted.

The demolition and excavation works at the Project site may use rippers, pulverisers, excavators, roadheaders and rock hammers. Further clarification on the excavation methods will be undertaken and updated in the relevant CNVIS.

A consideration of alternative construction methodologies to rock hammering and blasting is presented in Table 5.2 for the demolition works. Option 2 is the preferred method and will be adopted for the demolition works at 9-19 Elizabeth Street. Each CNVIS will review the proposed required use of rockhammers and any available alternatives.

Table 5.2: Review of demolition methodologies - Demolition of slabs and walls

Method	Demolition method	Comments
Conventional Method	Hammer in situ all of the reinforced concrete walls slabs stairs and the like using excavators with hydraulic hammer attachments.	This method does not allow sufficient respite from hydraulic hammering to be provided to affected receivers.

Method	Demolition method	Comments
Alternative method - Option 1	Section sawing, slab sawing and wall sawing the slabs and walls into smaller sections, and then lifting them off the building.	Saw cutting is considered a high noise activity. Considering the duration of saw cutting required in this method, it is not considered to be more effective than the conventional method from an acoustic standpoint.
Alternative method - Option 2	Using a combination of mainly pulverising, however sometimes hydraulic hammering to demolish the reinforced concrete walls, slabs, stairs and the like.	The reduction in time spent using hydraulic hammers will provide opportunity to offer sufficient respite periods to affected receivers. The use of the pulveriser can be limited due to access limitations, during which the use of a hydraulic hammering will be required.

For the northern shaft and pedestrian tunnel excavation, Lendlease have reviewed various excavation methodologies (i.e. bulldozer with ripper, Xcentric Ripper, roadheading, rock sawing, etc.) to choose methods with low-impacts suited to the soil and rock conditions at Martin Place. Blasting is not being considered due to unfavourable ground conditions. Lendlease proposed that the main excavation method for the site will be a combination of rock hammers, headers and bulldozer with ripper.

At the large shaft at Martin Place North, depending on fault zones there will likely be a large volume of rock with potential for ripping by a bulldozer in place of rock hammering. Noise generated by a bulldozer with a ripper attachment is approximately half the intensity of noise generated by rock hammering. In addition, the noise is not impulsive or tonal in nature, making it less annoying to receivers. Using a bulldozer with ripper attachment greatly reduces vibration (less than half) compared to rock hammering and similarly reduces ground-borne noise levels.

For pedestrian tunnel excavation between the station shafts, the use of roadheaders will substantially reduce the noise and vibration impacts compared to open box excavation.

6 Construction noise and vibration objectives

6.1 Summary of construction noise and vibration objectives

The policies and standards outlined in Table 6.1 have been used to establish construction noise and vibration management levels for the Project.

Table 6.1: Construction noise and vibration levels

Environment impact	Relevant policy/ standard used to establish noise and vibration management level
Airborne noise	NSW Interim Construction Noise Guideline (ICNG) Conditions of Approval
Sleep disturbance and maximum noise events	Road traffic noise - NSW Road Noise Policy (RNP) and the RMS Environmental Noise Management Manual (ENMM) Practice Note 3. Construction noise – NSW Environmental Criteria for Road Traffic Noise
Ground-borne noise	NSW Interim Construction Noise Guideline (ICNG) Conditions of Approval Australian Standard AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors
Construction-related road traffic noise	No specific guidelines, but guidance taken from the NSW Interim Construction Noise Guideline (ICNG) and the NSW Road Noise Policy (RNP).
Vibration (disturbance to building occupants)	NSW DECC's Assessing vibration; a technical guideline, published in February 2006, in line with CoA D16(b), which incorporates: British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)
Vibration (structural damage to buildings)	British Standard 7385:1993 Evaluation and measurement of vibration in buildings – Part 2 Guide to damage from ground-borne vibration
Vibration (structural damage to buried services)	German Standard DIN 4150:1999 – Part 3 Structural vibration in buildings – Effects on structures
Vibration (sensitive scientific and medical equipment)	ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control Gordon GC 28 September 1999 Generic Vibration Criteria for Vibration Sensitive Equipment Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
Blast noise and vibration	Australian Standard AS 2187.2-2006 Explosives – Storage and use – Part 2 Use of explosives British Standard 7385: Part 2 Evaluation and measurement of vibration in buildings

6.2 Airborne construction noise management levels

Construction noise management levels have been determined using the NSW Interim Construction Noise Guideline (ICNG) and the Conditions of Approval, in accordance with the Sydney Metro City & Southwest Construction Noise and Vibration Strategy. They are as follows:

- At Martin Place, internal noise management levels are applicable at sensitive receiver locations during the 7am to 8pm period per Conditions of Approval E37 and E38. This worksite is referred to as 'identified precincts' in Addendum A of the Sydney Metro CNVS;

- If approved OOHW are undertaken at the worksite, internal noise management levels are applicable at residential receiver locations during the 8pm to 7am period per Conditions of Approval E41 and E42.

6.2.1 Internal noise criteria from Conditions of Approval

Table 6.2 below (reproduced from Addendum A of Sydney Metro CNVS) sets out the internal noise criteria levels for residential and other sensitive receivers. The Project site falls within and an Identified Precinct in accordance with Condition E37.

Table 6.2: Internal construction noise criteria levels (Conditions of Approval)

Area	Receiver Type	Approval Condition	Time Period	Criteria (internal)4
Identified Precincts[1]	All	E38	7am to 8pm	Noise levels are required to be less than LAeq(15 minute) 60 dB(A) for at least 6.5 hours between 7am and 8pm, of which at least 3.25 hours must be below LAeq(15 minute) 55 dB(A). Noise equal to or above LAeq(15 minute) 60 dB(A) is allowed for the remaining 6.5 hours between 7am and 8pm.3
Non-residential zones	Residential	E41	8pm to 9pm	LAeq(15minute) 60 dB(A)
			9pm to 7am	LAeq(15minute) 45 dB(A)
Residential zones	Residential	E42	8pm to 7am	LAeq(15minute) 45 dB(A)
All	All	E43	All	LAeq(8hour) 85 dB(A) (external) near the CSSI

Notes: 1. Identified precincts are provided in Condition E37 and include Crows Nest, Victoria Cross, Barangaroo, Martin Place and Pitt Street.

2. These are identified by the applicable Local Environmental Plan land zoning of the receiver.

3. Criteria as described in Condition E38

4. A 5 dB penalty shall be applied if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration is planned.

6.2.2 Noise Management Levels from ICNG (Residential receivers)

Table 6.3 below (reproduced from Table 2 of the ICNG) sets out the noise management levels and how they are to be applied to residential receivers.

Table 6.3: ICNG Construction noise management levels (residential receivers)

Time of Day	Noise Management Level LAeq(15min)	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) 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.

Time of Day	Noise Management Level LAeq(15min)	How to apply
Standard hours	Highly noise affected 75dB(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, considering: 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 RBL + 5dB(A)	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 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

6.2.3 Noise Management Levels at other noise sensitive receivers

Table 6.4 sets out the noise management levels for various noise-sensitive land use developments, including commercial premises adopted from the ICNG. Internal (or indoor) noise management levels for land uses not identified in the ICNG are referenced to the 'maximum' internal noise levels presented in Australian Standard AS2107. The noise management levels presented in Table 6.4 are applicable where the premises are in use.

Table 6.4 presents a detailed, but not exhaustive list of typical 'other' land uses. Where a land use has not been identified in Table 6.4, a suitable noise management level can be determined by taking guidance from Australian Standard AS2107.

As identified for residential receivers, where the predicted or measured $L_{Aeq(15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. All of the potentially impacted receivers shall be informed of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Table 6.4: ICNG Airborne Construction Noise Management Levels at Other Noise Sensitive Land Uses

Land Use	Noise Management Level LAeq(15min)	Where NML Applies	Referenced from:
Studio building (music recording studio)	25 dB(A)	Internal noise level	AS2107 'maximum'
Studio building (film or television studio)	30 dB(A)	Internal noise level	AS2107 'maximum'
Cinema space, theatre, auditorium	35 dB(A)	Internal noise level	AS2107 'maximum'
Hotel (Sleeping areas: Hotels near major roads)	40 dB(A)	Internal noise level	AS2107 'maximum'
Classrooms at schools and other educational institutions	45 dB(A)	Internal noise level	ICNG

Land Use	Noise Management Level LAeq(15min)	Where NML Applies	Referenced from:
Hospital wards and operating theatres	45 dB(A)	Internal noise level	ICNG
Places of worship	45 dB(A)	Internal noise level	ICNG
Library (reading areas)	45 dB(A)	Internal noise level	AS2107 'maximum'
Office building (general office areas)	45 dB(A)	Internal noise level	AS2107 'maximum'
Hotel (bars and lounges)	50 dB(A)	Internal noise level	AS2107 'maximum'
Café/ Restaurant/ Bar (indoors)	50 dB(A)	Internal noise level	AS2107 'maximum'
Community centres – Municipal Buildings	50 dB(A)	Internal noise level	AS2107 'maximum'
Restaurant, bar (Bars and lounges/ Restaurant)	50 dB(A)	Internal noise level	AS2107 'maximum'
Medical facilities	55 dB(A)	Internal noise level	AS2107 'maximum'
Railway platform and concourse areas	55 dB(A)	Internal noise level	AS2107 'maximum'
Café/ Restaurant/ Bar (outdoors)	60 dB(A)	External noise level	AS2107 'maximum*'
Passive recreation areas (e.g. area used for reading, meditation)	60 dB(A)	External noise level	ICNG
Active recreation areas (e.g. sports fields)	65 dB(A)	External noise level	ICNG
Commercial premises (including offices and retail outlets)	70 dB(A)	External noise level	ICNG
Industrial premises	75 dB(A)	External noise level	ICNG

Note: * Outdoor noise level based on recommended maximum internal noise level in AS 2107(2000) and assumes 10 dB loss through an open window.

Channel 7 studios is situated at 52-56 Martin Place Sydney near the Martin Place worksite. An independent assessment of this location was carried out by Pulse Acoustics (Pulse Acoustic Consultancy Pty Ltd, 30 June 2017) on behalf of Sydney Metro to establish the noise sensitivity of the studio from construction noise. The transmission loss testing of the studio façade shows that the noise reduction from outside to inside for impulsive noise sources is 42 dB(A).

The following construction noise objectives are recommended in the Pulse Acoustics report:

- External construction noise level of 85 dB(A) at 2 m from the façade
- Internal construction noise level of 45 dB(A)
- For construction activity that doesn't have any significant impulsive content, the threshold level for impact is increased by 5 dB(A)

6.2.4 Sleep Disturbance

The ICNG recommends that where construction works are planned to extend over more than two consecutive nights, maximum noise levels and the extent and frequency of maximum noise level events exceeding the RBL should be considered. In line with the ICNG, further guidance is taken from the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (Environment Protection Authority 1999).

To assess the likelihood of sleep disturbance, an initial screening level of L_{Amax} 45 dB(A) (internal) has been established for residential receivers. In the CBD, where windows of residential receivers (or hotels) are likely

to be closed, this results in an equivalent external screening level of L_{Amax} 65 dB(A), based on an outside to inside noise reduction of 20 dB(A).

Where there are noise events found to exceed the initial screening level, further analysis is made to identify:

- The likely number of events that might occur during the night assessment period
- Whether events exceed an 'awakening reaction' level of 55dBA L_{Amax} (internal) that equates to an external NML of L_{Amax} 75 dB(A) (assuming closed windows).

The ICNG recommends that where construction works are planned to extend over more than two consecutive nights, maximum noise levels and the extent and frequency that maximum noise levels exceed the RBL should be analysed.

6.3 Ground-borne construction noise management levels

Ground-borne noise management levels (GNMLs) are based on the ICNG and Conditions of Approval, in accordance with the Sydney Metro City & Southwest Construction Noise and Vibration Strategy.

6.3.1 Noise criteria from Conditions of Approval (CoA)

The internal noise criteria outlined in Section 6.2.1 represent the total noise levels from airborne and ground-borne noise sources.

6.3.2 Noise management levels from ICNG (Residential receivers)

The following GNMLs for residences are nominated in the ICNG and indicate when management actions would be implemented. These levels recognise the temporary nature of construction and are only applicable when ground-borne noise levels are higher than airborne noise levels. This is typically where noise sensitive receivers are located vibration intensive construction activities (e.g. rock breaking).

Table 6.5 below (taken from the ICNG) sets out the GNMLs and how they are to be applied to residential receivers. The proponent should also inform all potentially impacted receivers of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Table 6.5: ICNG Ground-borne Construction Noise Management Levels at Residential Receivers

Assessment Period	Time of Day	Ground-borne Noise Management Level, LAeq(15minute)
Daytime	7:00am to 6:00pm	45 dB(A) internal
Evening	6:00pm to 10:00pm	40 dB(A) internal
Night	10:00pm to 7:00am	35 dB(A) internal

6.3.3 Noise management levels from ICNG (Other noise sensitive receivers)

For other sensitive receivers, including commercial receivers such as offices and retail areas, the ICNG does not provide guidance in relation to acceptable ground-borne noise levels. This CNVMP however has adopted an internal GNML derived from the airborne NML presented in the ICNG for commercial premises and assuming a minimum 20 dB(A) noise reduction from outside to inside with closed windows, consistent with the EIS. The GNMLs are applicable during periods when the sensitive receiver is in use.

For other noise sensitive receivers, such as cinema spaces and recording studios, guidance is taken from the recommended 'maximum' internal noise levels in AS/NZS 2107:2016 'Acoustics - Recommended design sound levels and reverberation times for building interiors' to determine suitable noise management levels. Refer to Table 6.4 for details.

The GNMLs for 'other' noise sensitive land uses are identified below in Table 6.6.

Table 6.6: Ground-borne Construction Noise Management levels at Other Sensitive Land Uses

Land Use	GNML LAeq(15min)	Where NML Applies	Referenced from:
Classrooms at schools and other educational institutions	45 dB(A)	Internal noise level	ICNG
Places of worship	45 dB(A)	Internal noise level	ICNG
Commercial premises (including offices)	50 dB(A)	Internal noise level	ICNG
Commercial premises (including retail outlets)	55 dB(A)	Internal noise level	AS/NZS 2107:2016
Industrial premises	55-60 dB(A)	Internal noise level	ICNG and AS/NZS 2107:2016

6.4 Noise intensive activities

Construction activities (including works associated with utility adjustments) between 7am and 8pm that result in high noise impact, such as rock breaking or other annoying activities, shall be managed in accordance with PPA Conditions E37 and E38 (refer Table 6.2).

Condition E37 requires consultation with all receivers with predicted internal noise levels greater than $L_{Aeq(15minute)}$ 60 dB(A) to determine appropriate hours of respite.

6.5 Construction-related road traffic noise

When trucks and other vehicles are operating within the boundary of a construction site, road vehicle noise contributions are included in the overall predicted $L_{Aeq(15minute)}$ construction site noise emissions. When construction-related traffic moves onto the public road network a different noise assessment methodology is appropriate, as vehicle movements would be regarded as 'additional road traffic' rather than as part of the construction site.

On roads located immediately adjacent to construction sites, the community may associate heavy vehicle movements with the project works. However, once the heavy vehicles move further from construction sites onto major collector or arterial roads, the noise may be perceived as being part of the general road traffic.

Noise from construction traffic on public roads is not assessed under the ICNG, although the guideline does reference the Environmental Criteria for Road Traffic Noise (Environment Protection Authority, 1999), which has been superseded by the RNP. The RNP states that in assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person. For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments (in this case the construction area), any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'without construction' scenario.

Where the road traffic noise levels are predicted to increase by more than 2 dB as a result of construction traffic, consideration would be given to applying feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity.

In considering feasible and reasonable mitigation measures where the relevant noise increase is greater than 2 dB, consideration would also be given to the actual noise levels associated with construction traffic and whether or not these levels comply with the following road traffic noise criteria in the RNP:

- 60 dB $L_{Aeq(15hour)}$ day and 55 dB $L_{Aeq(9hour)}$ night for existing freeway/ arterial/ sub-arterial roads.
- 55 dB $L_{Aeq(1hour)}$ day and 50 dB $L_{Aeq(1hour)}$ night for existing local roads.

This approach is consistent with the Sydney Metro City & Southwest Construction Noise and Vibration Strategy.

6.6 Construction Vibration - disturbance to buildings occupants

Assessment of potential disturbance from construction vibration on human occupants of buildings is made in accordance with the guideline 'Assessing Vibration; a technical guideline' (DECC, 2006). The guideline provides criteria which are based on the British Standard BS 6472-1992 'Guide to evaluation of human exposure to vibration in buildings (1-80Hz)'.

BS6472-1992 nominates guideline values for various categories of disturbance, the most stringent of which are the levels of building vibration associated with a "low probability of adverse comment" from occupants.

BS 6472-1992 was amended in 2008 to extend the use of the Vibration Dose Values (VDV) to all types of vibration (i.e. continuous, impulsive and intermittent). The vibration dose value is dependent upon the level and duration of the short-term vibration event, as well as the number of events occurring during the daytime or night-time period.

The vibration dose values recommended in BS 6472-1992 for which various levels of adverse comment from occupants may be expected are presented in Table 6.7.

Table 6.7: Vibration Dose Value ranges which might result in various probabilities of adverse comment within buildings

Place and Time	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Critical areas (day or night)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
Residential buildings 16 hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hr night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
Offices, schools, educational institutions and places of worship (day or night)	0.4 to 0.8	0.8 to 1.6	1.6 to 2.4
Workshops (day or night)	0.8 to 1.6	1.6 to 3.2	3.2 to 6.4

Note: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above.

To assess the potential for vibration impact on human comfort, an initial screening test will be done based on peak velocity units, as this metric is also used for the cosmetic damage vibration assessment. This screening test is a conservative approach since it is based on the continuous vibration velocity criteria (i.e. vibration that continues uninterrupted for a defined assessment period) whilst construction works are mostly intermittent. The screening test will be based on the preferred peak values, as shown in Table 6.8, for pseudo-continuous work activities such as roadheader excavation and on maximum peak values for surface construction works, which are intermittent in nature. This approach has been adopted so that the screening test is not unduly stringent.

If the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (i.e. eVDV) will be determined based on the level and duration of the vibration event causing exceedance.

Table 6.8: Construction vibration disturbance – initial screening test.

Place and Time	Preferred peak velocity, mm/s (>8Hz)	Maximum peak velocity, mm/s (>8Hz)
Critical areas (day or night)	0.14	0.28
Residential buildings 16 hr day	0.28	0.56
Residential buildings 8 hr night	0.20	0.40
Offices, schools, educational institutions and places of worship (day or night)	0.56	1.10
Workshops (day or night)	1.10	2.20

6.7 Construction Vibration – structural damage to buildings

Potential structural damage of buildings caused by vibration is typically managed by ensuring vibration induced into the structure does not exceed certain limits and standards, such as British Standard 7385 Part 2 (1993) as required by Project Planning Approval Condition E28. BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur.

The cosmetic damage levels set by BS 7385 are considered 'safe limits' up to which no damage due to vibration effects has been observed for certain particular building types. Damage comprises minor non-

structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks and separation of partitions or intermediate walls from load bearing walls. 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

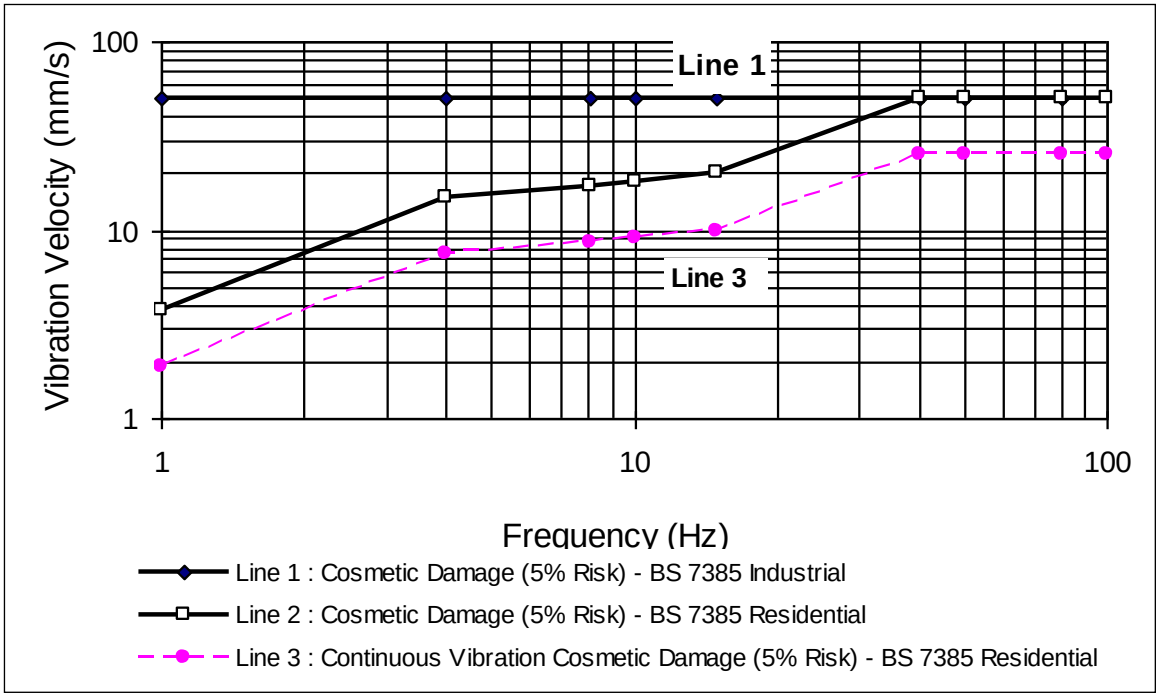
Table 6.9 sets out the recommended limits from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential, commercial and industrial buildings. This is shown graphically in Figure 3.

Table 6.9: Transient vibration guide values - minimal risk of cosmetic damage (BS 7385) - peak component particle velocity

Line	Type of structure	Frequency range 4 to 15 Hz	Frequency range 15 to 40 Hz	Frequency range 40 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s	50 mm/s
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4Hz, increasing to 20 mm/s at 15Hz	20 mm/s at 15Hz, increasing to 50 mm/s at 40Hz	50 mm/s

BS7385 states that the guide values in Table 6.9 relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to 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 6.9 may need to be reduced by up to 50%, as shown by Line 3 of Figure 3 for residential buildings.

Figure 3: Graph of Transient Peak Component Particle Velocity Vibration Guide Values for Cosmetic Damage



6.7.1 General Vibration Screening Criterion

The British Standard states that the guide values in Table 6.8 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 may give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 6.8 may need to be reduced by up to 50%.

Rock breaking/hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures (e.g. residences) and it may be appropriate to reduce the transient values by 50%. In addition, for most construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers, excavators and the like, the predominant vibration energy occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). On this basis, a conservative vibration damage screening level per receiver type is given below:

- Reinforced or framed structures (Line 1, see Figure 3): **25.0 mm/s**
- Unreinforced or light framed structures (Line 2, see Figure 3): **7.5 mm/s**

At locations where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity), a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable safe vibration level.

6.8 Construction Vibration – Vibration Sensitive and Special Structures

6.8.1 Heritage

The British Standard states that,

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

In accordance with Project Planning Approval Condition E31, the advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage-listed structures will be sought.

Unless otherwise advised, heritage buildings and structures would be assessed as per the screening criteria in Section 6.7.1 as they should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. If a heritage building or structure is found to be structurally unsound (following inspection) a more conservative cosmetic damage objective of 2.5 mm/s peak component particle velocity (from DIN 4150) would be considered, consistent with the EIS.

However, for the historic building at 50 Martin Place, the proposed work will adapt the cosmetic damage objective of 7.5 mm/s peak component particle velocity as per PPA Condition E28.1, which stated *'the vibration screening criterion for 50 Martin Place must remain at 7.5 mm/s, unless a detailed investigation of*

the construction of the building determines that increasing the screening criterion to 25 mm/s is acceptable. The investigation must be undertaken by a suitably qualified structural engineer with experience assessing heritage structures and approved by the Secretary and must be supported by evidence to demonstrate the higher criterion is appropriate.'

Generally speaking, proposed works at Martin Place will be managed to not exceed the 7.5 mm/s criterion. The CNVISs will assess whether any specific construction activities would trigger this level thus determine if further structural assessment is required,

The approach to manage potential vibration impacts at other heritage buildings (not including 50 Martin place) and structures shall be to:

1. Identify heritage items where the 2.5 mm/s peak component particle velocity objective (derived from DIN4150) may be exceeded during specific construction activities
2. Structural engineering report to be undertaken on identified heritage items, to confirm structural integrity of the building and confirm if item is 'structurally sound'
3. If item confirmed as 'structurally sound', the screening criteria in Section 6.7.1 shall be adopted, or
4. If item confirmed as 'structurally unsound', *the more* conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity would be adopted.

6.8.2 Sensitive Scientific and Medical Equipment

Some scientific equipment (e.g. electron microscopes and microelectronics manufacturing equipment) can require more stringent objectives than those applicable to human comfort.

No such equipment has been identified in proximity to the Project area. If required, objectives for the satisfactory operation of sensitive instruments will be identified in the relevant CNVIS. Where manufacturer's data is not available, generic vibration criterion (VC) curves as published by the Society of Photo-Optical Instrumentation Engineers (Colin G. Gordon - 28 September 1999) may be adopted as vibration goals.

6.8.3 Utilities and Other Vibration Sensitive Structures

Some structures and utilities located near the Project may be particularly sensitive to vibration. A vibration goal which differs from the cosmetic damage goals presented in Section 6.7 may need to be adopted. Examples of such structures and utilities include:

- Tunnels
- Gas pipelines
- Fibre optic cables

The British Standard BS 7385-2:1993 'Evaluation and measurement for vibration in buildings - Part 2: Guide to damage levels from ground-borne vibration' notes that structures below ground are known to sustain higher levels of vibration and are very resistant to damage unless in very poor condition (British Standard BS 7385-2:1993, p5). Further guidance is taken from the German Standard DIN 4150: Part 3-1999.02 'Structural vibration in buildings - Effects on Structures'. Section 5.3 of DIN 4150: Part 3 sets out guideline values for vibration velocity to be used when evaluating the effects of vibration on buried pipework.

Table 6.10 presents the initial reference guideline for utilities and other buried pipework to evaluate the effects of short-term vibration impact. Specific vibration goals should be determined on a case-by-case basis as part of the CNVIS for each work site.

Table 6.10: DIN 4150-3 Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on buried pipework

Line	Pipe Material	Guideline values for vibration velocity measured on the pipe
1	Steel (including welded pipes)	100 mm/s
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80 mm/s
3	Masonry, plastic	50 mm/s

Note 1. Rock breaking/hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures and it may therefore be appropriate to reduce the transient values by 50%.

6.9 National Standard for exposure to noise

In accordance with PPA Condition E43, project worksites will be managed to ensure that noise generated by construction will not exceed the National Standard for exposure to noise in the occupational environment of an eight-hour equivalent continuous A-weighted sound pressure level of $L_{Aeq,8h}$, of 85dB(A) for any employee working at a location near a Project worksite.

7 Evaluation, assessment, documentation and consultation

7.1 Construction noise and vibration management system

7.1.1 Overview

This Plan has been prepared to provide a framework for assessment of noise and vibration impacts and the identification of reasonable and feasible noise mitigation measures. Site specific Construction Noise and Vibration Impact Statements (CNVIS) will be progressively prepared to address:

- Demolition works at 9-19 Elizabeth Street
- Bulk excavation works
- Station construction works
- Operation of the Bligh Street compound to support station construction.

Each CNVIS will provide detailed construction noise and vibration predictions, assessment, mitigation design outcomes and discussion of management measures to limit impacts to sensitive receivers.

The outcomes of the CNVIS feed into the Community Communication Strategy to inform the affected community of the likely noise and vibration that will be experienced during construction.

OOHW will follow the OOHW Procedure, which is further described in Section 7.4.

7.1.2 Construction noise and vibration impact statements

The CNVISs will be a key site management tool that will give LL clear instructions for managing the worksite. Each CNVIS will be prepared before construction noise and vibration impacts commence and will set out the mitigation and management measures required for the construction stage, through consultation with affected receivers (in accordance with Condition of Approval E33) and the specific measures that must be in place before any construction works may start.

Each CNVIS will address:

- Scope of work covered by the CNVIS;
- Justification for OOHW (where required);
- Nearest noise and vibration sensitive receivers, based on land use survey;
- Construction noise and vibration objectives;
- Construction noise and vibration assessment;
- Mitigation options and preferred management measures;

- Noise and vibration monitoring requirements for each construction worksite/activity.

Physical noise mitigation measures such as noise barriers, acoustic enclosures around fixed plant and acoustic sheds will be outlined in the CNVIS. Furthermore, management measures such as staging of works; respite periods and community notification will also be summarised. The CNVIS will identify how the proponent is required to notify the community of works pending to ensure the community is informed of the likely noise and vibration impacts during the assessed works, the duration of impact and any additional mitigation (e.g. respite periods) that may be required to manage noise and vibration impacts. The CNVIS will aid in reducing noise and vibration impact from construction.

7.1.3 Management procedures and hold points for OOHW

As noted in Section 5.2.1, the PPA provides two approval pathways for works outside of the standard construction hours specified in PPA Conditions E36 and E45 and set out in Section 5.1:

- PPA Condition E47 OOHW Protocol, which applies to out of hours work not subject to an EPL.
- Sydney Metro Out of Hours Works Protocol.
- For emergency construction works, additional requirements are applicable per PPA Condition E45 (see Section 5.2), including notifying the AA, the ER and the EPA (if an EPL applies) of the need for those activities or work and using best endeavours to notify all affected sensitive receivers of the likely impact and duration of those works.

Both the Protocol and the Procedure address internal approval and hold points relating to:

- The justification of OOHW
- Noise and vibration assessment
- External approvals, including high noise/vibration risk works, either
  - No EPL:
    - ER approval following endorsement by AA
    - DPE approval following endorsement by AA and ER for high risk works after 9 pm
  - EPA Approval under the EPL
- Community notification
- Tool boxing of the workforce on sensitive receivers and management requirements prior to the commencement of works
- Noise and vibration verification monitoring.

All OOHW (except in emergency situations) will be documented on the relevant OOHW Form.

7.2 Overview of evaluation and assessment process

Renzo Tonin & Associates recognises construction noise and vibration management is a key community issue. Detailed models are developed to accurately model and predict airborne noise, ground-borne noise and vibration impacts related to the Project. In close consultation with the construction team, all potential options and optimum solutions for reasonable and feasible noise and vibration mitigation are identified for the construction works. This process includes:

- Use of CadnaA noise modelling software to develop detailed models of the construction worksites. The models allow different stages of construction to be modelled and noise emissions predicted, giving greater ability to find noise mitigation solutions that suit each construction stage of the worksite. Verification monitoring on previous infrastructure projects has found that measured noise levels are within the predicted noise levels, giving greater confidence in the modelled outcomes. The noise models consider:
  - Location of noise sources at each worksite, sources located within acoustic sheds and enclosures
  - Sensitive receiver locations, including land use details obtained from the GIS database, to ensure appropriate NMLs are applied
  - Height of sources and receivers referenced to digital ground contours within the construction site area and 1 to 2 metre digital ground contours outside the construction site area
  - Noise source levels of individual construction plant, based Renzo Tonin & Associate's extensive database of construction plant and equipment noise data
  - Outcomes from CadnaR modelling of acoustic enclosures (if required) to ensure noise inputs from these sources are representative in the CadnaA model
  - Ground type between sources and receivers (mixed soft/ hard)
  - Attenuation from barriers (natural and purpose built) and other structures such as buildings surrounding the construction site
  - Identifying facade transmission loss of airborne noise affected receivers to predict internal airborne noise levels.
- Training engineers on noise modelling and required inputs to ensure accurate information for the modelling process. Key details regarding the construction site layout, the likely plant and equipment (including truck movements), and hours of operation will be provided by the Design and Construction Teams
- Sensitivity analysis to determine the best combination of management measures including scheduling (avoiding impacts at night where possible), using quieter plant and equipment where practicable, using barriers and enclosures, and training staff in quiet noise practices
- Under the PPA, an independent Acoustic Advisor (A) has been engaged by Sydney Metro to review noise and vibration assessments.

- Comprehensive community notification and complaints management. LL will engage with residents, utility owners, businesses and stakeholders to help them understand what to expect during the Project works.

The assessment process for construction noise and vibration impacts is detailed in the flow diagram in Figure 4.

Figure 4: Construction noise and vibration impact assessment process

1. Determine noise and vibration objectives	
For each key construction area:	• Identify noise and vibration sensitive receivers • Determine relevant noise and vibration objectives, with reference to Section 5. Note: Assessment usually undertaken at locations considered to be representative of a group of receivers with a similar level of exposure to construction works.
2. Identify Construction Stages	
For each key construction area:	• Identify construction aspects or stages and key activities for each stage • Include: - the site location; - times of operation; - processes involved; - plant & equipment (including size / type). • Identify construction works in the vicinity of the project. Liaise with Proponent to ensure cumulative noise & vibration impacts are managed, in particular in relation to OOHW. • Identify construction works in the vicinity of the project. Liaise with Proponent to ensure cumulative noise & vibration impacts are managed, in particular in relation to OOHW.
3. Predict Noise and Vibration Impacts	
Airborne Construction Noise:	• Determine $L_{Aeq(15\ minute)}$ sound power levels for plant and equipment based on operating scenarios for input to noise model (see below). • Establish noise model for construction activity/ component. The noise model should include: - Height and location of sources and receivers - Distance attenuation (incorporating noise reflections, ground absorption); - Effects of noise shielding (topography, buildings, fences, barriers etc) - Effects of standard noise mitigation measures. • Calculate the $L_{Aeq(15minute)}$ noise levels from the proposed construction activities at each receiver and compare these with the construction noise objectives. • For night-time activities, calculate the maximum (L_{Amax}) noise levels and compare with $L_{A1(1min)}$ 65 dB(A) sleep disturbance criterion, applied at the external facade.
Ground-borne Construction Noise:	• Determine the location of plant or equipment item in relation to each receiver. • On the basis of ground-borne noise levels versus distance prediction curves for each plant item, determine the level of ground-borne noise at each building location. For highly sensitive building occupancies, the assessment may need to incorporate the acoustic properties of the building space and the structural response of the building.
Construction Vibration	• Determine the location of each plant or equipment item in relation to each receiver. • Where vibration intensive equipment could potentially be operating in close proximity to receivers, determine whether this is within the minimum working distances (**Section 8.3.5**). Note that minimum working distances may differ for heritage items; • Where plant & equipment may operate within minimum working distances, or for heritage items: • Use vibration levels vs distance prediction curves for each plant item • Determine the vibration likely to occur at each building location For highly sensitive equipment, assessment may need to incorporate structural response of building & particular sensitivities of equipment.
4. Assess Noise and Vibration Impacts	
Where predicted noise and vibration exceeds the objectives identified in Step 1:	• Identifying key hours of impact from affected sensitive receivers (see **Section 7.3**). • Implement appropriate reasonable/ feasible standard mitigation measures (see **Section 8**). • Predicted noise / vibration at receivers, incorporating nominated mitigation measures, based on the expected noise reduction from mitigation measures. • Additional mitigation measures may need to be considered. Note: Assessment usually undertaken at locations considered to be representative of a group of receivers with a similar level of exposure to construction works.

7.3 Communication and consultation

7.3.1 Overview of approach

The aim during construction is to minimise disruption, delay and inconvenience to nearby residents and businesses. The Community Communication Strategy (CCS) and its sub-plans outline how essential commitment to collaboration, mutual respect and genuine consideration of community and business concerns is in achieving this. It also details how the proponent will meet the community relations obligations of the Project Approval. It acknowledges that robust community and stakeholder engagement depends on effective communications and on strong collaboration and coordination between Sydney Metro and Lend Lease (LL), other Project contractors and other significant projects under construction near the Project construction site. The overarching objectives of the CCS are to:

- Comply with the community consultation obligations and Project Planning Approval;
- Work cooperatively with Sydney Metro to provide a coordinated and consistent approach;
- Identify and appropriately address stakeholder, business and community issues;
- Maximise stakeholders and the community understanding of the Project activities, the objectives and benefits and the timing, potential impacts, mitigation measures and expected outcomes;
- Provide timely, accurate and relevant information to the community;
- Minimise, where possible, the Project impacts on stakeholders, businesses and the community;
- Enhance and protect the reputation of the Project, the NSW Government and Sydney Metro.

There will be a diverse range of residential, commercial and government stakeholders, with potentially changing communication needs across the life of the project. A range of communication and consultation tools will be implemented for the Project. Recognising the relative strengths of different communication tools, they can be matched to stakeholders and their need for accurate information and interaction. Capitalising on opportunities created by technology allows the proponent to better inform, receive and respond to feedback with interactive communication.

7.3.2 Proactive consultation and notification

Residents, property owners, businesses and community facilities near the construction site will have a wide range of unique needs and concerns about construction impact. LL will engage through multiple channels to notify and build understanding of the likely impacts of airborne noise, ground-borne noise and vibration, and the reasonable and feasible options available to mitigate these impacts, including respite. Every effort will be made by the project team to mitigate these impacts. LL will ensure proactive stakeholder and community liaison and communication at all times, is embraced across the project, delivering timely, quality information and consultation to local stakeholders and community as outlined in the Community Communication Strategy and Business Management Plan for the project. Using multiple communication channels, clear points of contact will be provided and face-to-face communication for those most affected. With the scale of construction currently underway in Sydney, the stakeholders and the community will be

affected by multiple sources of impacts and information. When they are affected, they may not understand which of the projects or contractors should be contacted to address their issues. They are also likely to have interests in different stages of the Project (e.g. demolition works vs over-station development construction) for various reasons.

A key feature of the strategy is extensive collaboration with Sydney Metro, agencies and interface contractors to find opportunities to minimise cumulative impacts. Coordinated communications in 'plain English' will serve to guide the community to the right points of contact for information and complaints and minimise frustration.

When informing sensitive receivers on the level of noise and vibration to be expected from construction activities, potential impacts will be described using qualitative terminology consistent with the TfNSW Construction Noise Strategy (e.g. noticeable, clearly audible, moderately intrusive, highly intrusive).

7.3.3 Specific Project Planning Approval requirements

PPA Condition C3 requires relevant council(s) to be consulted for each CEMP sub-plan. The records of consultation with relevant agencies in this plan, responses to agency comments and how these were implemented in this plan are attached in APPENDIX F.

To satisfy the PPA Condition E33, consultation will be carried out to develop specific mitigation measures for the works with the affected sensitive receivers. The outcomes of this consultation will be fed back into the construction noise and vibration management system and will assist with the final detailed design of mitigation measures for the site, where reasonable and feasible.

As presented in Table 7.1 and APPENDIX B, there are 'other' noise and vibration sensitive receivers (e.g. educational institutions, medical facilities, places of worship and recreational areas) around the construction sites that have been identified. In accordance with PPA Condition E34, relevant CNVIS's will assess the noise and vibration impacts at these receivers to determine if consultation is required as part of the management of the works to determine if respite periods or other suitable arrangements are required to avoid or minimise impacts during sensitive periods.

Table 7.1: E34 affected receiver locations

Other sensitive receivers (Condition E34)		
Address	**Business name**	**Other Sensitive Receiver Category**
9 Castlereagh Street Sydney	Castlereagh Street Early Learning Centre	Childcare
15 Castlereagh Street Sydney	Explore and Develop	Childcare
27-39 Castlereagh Street Sydney	CTA Business Club	Hotel (bars and lounges)
165 Phillip Street Sydney	Travelodge Hotel	Hotel (bars and lounges)
52-56 Martin Place Sydney	Channel 7	Recording Studio
183 Macquarie Street Sydney	Macquarie Street Medical Centre	Medical

Other sensitive receivers (Condition E34)		
Address	**Business name**	**Other Sensitive Receiver Category**
28-34 O'Connell Street Sydney	O'Connell Street Little Academics early Learning Centre – CBD	Childcare
64-66 Pitt Street Sydney	Radisson Blu Sydney	Hotel
61-101 Phillip Street Sydney	Sofitel Sydney Wentworth	Hotel

PPA Condition E38 requires consultation with all identified receivers at Martin Place to determine appropriate hours of respite so that construction noise does not exceed the internal noise management levels. Any out of hours rock hammering will need to be undertaken in accordance with Condition E44.

In addition, currently other worksites such as Site Establishment works of TSE at Martin Place North shaft, demolition activities at 39 Martin Place and Shopping Circle and construction works at 60 Martin Place are active in the area. Proponents of these construction sites near the worksite will be consulted and reasonable steps will be taken to coordinate works in order to minimise cumulative noise and vibration impact and coordinate respite for affected sensitive receivers, to satisfy PPA Condition E39. Furthermore, cumulative impacts will be assessed in the CNVISs.

Consultation with affected receivers identified in the CNVIS will take place prior to the works commencing and will include discussion on mitigation measures including agreed respite periods and community contact details.

Outcomes from engagement with affected receivers will be included in the CNVIS and recorded in the Sydney Metro Consultation Manager database. PPA Condition E33 requires this CNVIS consultation to occur prior to noise and vibration impacts commence, however PPA Condition C3 does not require this for approval of the CNVMP. APPENDIX G outlines the dates of completed meetings with affected sensitive receivers.

7.3.4 Complaints management

A complaint is defined as any communication received from a stakeholder expressing dissatisfaction. This is a purposely broad definition and is used to ensure that matters of concern to stakeholders are addressed promptly.

Stakeholders will be able to register enquiries and complaints through several channels including:

- 24-hour, 1800 community information line (1800 171 386 which is run by Sydney Metro for the Project as a whole)
- Dedicated project email mailbox Tunnels@transport.nsw.gov.au
- Dedicated website www.sydneymetro.info
- Post

Specific details on the above communication channels are made available within the project Community Communication Strategy. Complaints may be received directly or referred by Sydney Metro or other contractors.

All calls to the 1800-number will be answered and responded to 24 hours a day, seven days a week. A call centre reception service managed by Sydney Metro records contact details and basic information about the nature and location of the complaint. The complainant is made aware that an on-call officer will contact them shortly to address the issue. With this approach, the caller is not placed on hold or referred to a recorded message. If the rostered officer cannot receive a call (e.g. they are on the phone responding to another caller), calls can be directed to an alternate rostered on-call officer. Translators will be arranged if a stakeholder or community member is unable to communicate their concerns in English. Email and other contact options will assist those with disabilities.

Specific protocols and procedures have been arranged to ensure a consistent approach to managing enquires and complaints, including systems for recording and monitoring stakeholder contact. All staff and work crews will be informed that all contact from the community must be referred to the community relations team for action. To facilitate this everyone will be provided with community contact cards to direct enquiries to the community information line or email address.

Each stakeholder contact is an opportunity to build understanding about the Project and allay concerns. Complaints provide important feedback to improve project processes and mitigation measures to avoid or minimise further complaints. All reasonable measures will be taken to prevent the reoccurrence of stakeholder and community complaints. The strategic approach to managing complaints consists of:

- Courtesy
- Accessibility
- Responsiveness
- Delegation of authority to resolve the issue
- Access to accurate information.

All employees and subcontractors are required to respond to stakeholders with courtesy and professionalism. This will be reinforced during Project inductions. Specific toolbox talks will further consolidate the approach.

LL Community and Stakeholder Liaison Manager will manage the ongoing communication with the complainant until they are satisfied with the actions taken. The LL Community and Stakeholder Liaison Manager will immediately report all environmental complaints to the Project Environment Manager and relevant Environment Co-ordinator to confirm any required action, including but not limited to:

- Noise, and/or vibration monitoring (see Section 9.5)
- Subject to monitoring results consideration of options to reduce impacts including:

  - Scheduling activities to minimise impacts
  - Targeted inspection to determine if it is reasonable and to install additional controls (i.e. noise barriers)
  - Respite offers (for example, coffee vouchers, movie tickets, meal vouchers or alternative accommodation)
- Site visit with complainant to assist in understanding our operations and mitigation strategies.

The complaint is escalated to the Lendlease Project Director and Sydney Metro representative if the complainant remains unsatisfied. Further escalation will be in line with the Sydney Metro Overarching Community Communications Strategy (Sydney Metro Document Reference: A5732897) and the Sydney Metro Construction Complaints Management System and may include the:

- Environmental Representative required under Project Planning Approval Condition A22,
- Acoustic Advisor required under Project Planning Approval Condition A25,
- Community Complaints Commissioner required under Project Planning Approval Conditions B11 to B14 or
- Independent Property Impact Assessment Panel (IPIAP) required under Project Planning Approval Condition E62 as appropriate.

7.4 OOHW operation strategy

A separate application will be submitted to Sydney Metro or EPA (where relevant) when out of hours works (OOHW) are planned, which will be in accordance with PPA E44, E45, and E46 in Section 5.2, and PPA Condition 47 which defines the Sydney Metro OOHW Protocol in Section 5.2.1.

The Community Communication Strategy will also support LL's application for commencing out of hours work. It will detail how the community will be notified in advance of planned activities, kept informed of works progress and how potential regenerated noise impacts will be managed.

8 Reasonable and feasible noise and vibration mitigation measures

As outlined in Section 7.1.2, each CNVIS will review in detail the noise and vibration mitigation and management measures for each construction stage, including all physical noise mitigation measures such as noise barriers, acoustic enclosures around fixed plant and acoustic sheds, along with all management measures such as staging of works; respite periods and community notification that are appropriate to the construction stage.

This section outlined the standard noise and vibration mitigation and management measures (including the Revised Environmental Management Measures NV1 to NV7 in Part B of this plan) that are to be reviewed and adopted where reasonable and feasible across the project, and will be considered in each CNVIS.

8.1 Standard noise and vibration management measures

An indicative list of standard noise and vibration mitigation measures to be implemented for the Project construction works to reduce construction noise and vibration is provided in the tables that follow. This information is based on information available at the time of preparation of this CNVMP and includes:

- Table 8.1 which identifies standard noise and vibration management measures
- Table 8.2 which lists standard noise and vibration source mitigation measures
- Table 8.3 which lists standard noise and vibration path mitigation measures
- Table 8.4 which sets out standard noise and vibration receptor mitigation measures.

Table 8.1: Standard noise and vibration management measures

Action required	Applies to[1]	Details	Estimated noise benefit[2]	Comments on feasibility/ reasonableness	Recommend to adopt for project where reasonable & feasible?
Construction Noise and Vibration Management Plan update	Prior to construction	The CNVMP and associated CNVIS, must be prepared prior to the commencement of Construction and regularly updated to account for changes in noise management issues and strategies.	N/A	N/A	Yes
Implementation of any project specific mitigation measures required	ABN, GBN, V	Project specific measures will be determined on a site by site basis and outlined in the CNVISs	0-30dB reduction	Yes	Yes
Implement community consultation or notification measures	ABN, GBN, V	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night period, any operational noise benefits from the works (where applicable) and contact telephone number. Notification should be a minimum of seven calendar days prior to the start of works. For this project, more advanced consultation or notification should be adopted, including: • Website • Contact telephone number for community • Email distribution list (if required) More detail regarding community consultation and notifications is provided in Section 7.3 and Section 8.2	Ensures stakeholders know what to expect and keeps stakeholders informed of the likely impact. Community may identify solution to assist in managing impacts.	N/A	Yes
Register of Noise Sensitive Receivers	ABN, GBN, V	A register of all noise and vibration sensitive receivers (NSRs) would be kept. The register would include the following details for each NSR: • Address of receiver • Category of receiver (e.g. Residential/Commercial etc.) • Contact name and phone number	N/A Ensures worksites can contact NSRs.	N/A	Yes

Notes
1. ABN = Airborne noise, GBN = Ground-borne noise, V = Vibration
2. Estimated noise benefits are not necessarily cumulative

Action required	Applies to[1]	Details	Estimated noise benefit[2]	Comments on feasibility/ reasonableness	Recommend to adopt for project where reasonable & feasible?
Site inductions and briefings	ABN, GBN, V	All employees, contractors and subcontractors are to receive environment and community inductions and site briefings that will detail: • all project specific and relevant standard noise and vibration mitigation measures • relevant licence and approval conditions • community consultation and notification requirements • 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 • site opening/closing times (including deliveries) • community contact protocols • complaints management requirements.	Keeps construction workforce informed of actions required to minimise noise and vibration impact.	N/A	Yes
Behavioural practices	ABN, GBN, V	• No swearing or unnecessary shouting or loud stereos/radios on site. • No dropping of materials from height where practicable, throwing of metal items or solid objects onto metal items, and slamming of doors. • No excessive revving of plant and vehicle engines • Controlled release of compressed air.	0-20dB reduction Reduce annoyance + sleep disturbance.	Reasonable cost, limited noise reduction, reduced overall impact.	Yes
Verification	ABN, GBN, V	A noise verification program is to be carried out for the duration of the works in accordance with the CNVMP and any approval and licence conditions. More detail on the program is provided in Section 9. Ongoing noise monitoring during construction at sensitive receivers during critical periods (i.e. times when noise emissions are expected to be at their highest - e.g. piling and hammering) to identify and assist in managing high risk noise events.	Identifies and minimises noise and vibration impacts.	Reasonable cost, limited noise/vibration reduction, reduced overall impact.	Yes
Attended vibration measurements	V	Attended vibration measurements are required at the commencement of vibration generating activities to confirm that vibration levels satisfy the criteria for that vibration generating activity. Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the applicable safe-working distances. More detail is provided in Section 9.2.	Reduces vibration impact + risk of building damage. Identifies and minimises noise and vibration impacts.	Reasonable cost, and consideration of refinement of operations to reduce overall impact.	Yes

Action required	Applies to[1]	Details	Estimated noise benefit[2]	Comments on feasibility/ reasonableness	Recommend to adopt for project where reasonable & feasible?

Notes 1. ABN = Airborne noise, GBN = Ground-borne noise, V = Vibration

2. Estimated noise benefits are not necessarily cumulative

Table 8.2: Standard noise and vibration source mitigation measures

Action required	Applies to[1]	Details	Estimated noise benefit[2]	Comments on feasibility/ reasonableness	Recommend to adopt for project where reasonable & feasible?
Construction hours and scheduling	ABN, GBN, V	Where feasible and reasonable, construction would be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels would be scheduled during less sensitive time periods. When working adjacent to recording studios, particularly noisy activities should be scheduled outside recording periods, where feasible and reasonable.	Minimise high noise impact and reduce risk of annoyance.	The diverse mix of land uses around worksites will make reaching any agreement on scheduling a significant challenge	Yes
Construction respite period - standard hours	ABN, GBN, V	Appropriate construction respites for each stage of the works will be finalised after consultation with receivers identified in accordance with Condition E37. As a guide, high noise generating activities near receivers should be carried out in blocks that do not exceed three hours each, with a minimum respite period of one hour between each block. The duration of each block of work and respite should be flexible to accommodate the usage and amenity at nearby receivers.	Minimise noise and vibration impact and reduce risk of annoyance.	Reasonable cost, limited noise/vibration reduction, reduced overall impact.	Yes
Consider vibration in selecting plant and equipment	ABN, GBN, V	Use quieter and less vibration emitting construction methods where feasible and reasonable.	0-20dB reduction depending on selected equipment	Reasonable cost, limited noise reduction, reduced overall impact.	Yes
Construction methodology/ Equipment selection	ABN, GBN, V, notably high noise impact works	Use quieter and less noise emitting construction methods where feasible and reasonable, especially where they can replace high noise or vibration impact works.	0-20dB reduction/ less vibration impact + risk of annoyance.	Variable noise/vibration reduction, reduced overall impact, cost varies. Reasonableness and feasibility needs to be determined on a case by case basis.	Yes

Maximum noise levels	ABN	The noise levels of plant and equipment must have operating Sound Power Levels compliant with the maximum noise levels stated in the CNVIS. Regular compliance checks on the noise emissions of all plant and machinery used for the project would indicate whether noise emissions from plant items were higher than predicted. This also identifies defective silencing equipment on the items of plant.	Varies depending on plant sound power level	Reasonable cost, variable noise reduction, minimum requirement.	Yes
Rental plant and equipment	ABN	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the maximum noise levels stated in the CNVIS.	Varies depending on plant sound power level	Reasonable cost, variable noise reduction, minimum requirement.	Yes
Plan worksites and activities to minimise noise and vibration	ABN, V	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. Use site sheds and other structures within the worksite to provide additional noise barriers to receivers. The offset distance between noisy plant items and nearby NSRs should be as great as possible	Reduce noise/ vibration impact + risk of annoyance.	Reasonable cost, variable noise/vibration reduction, reduced overall impact.	Yes
Switch off plant not in use	ABN, V	Avoid the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers to reduce noise to NSRs.	3-6dB reduction	Reasonable cost, medium reduction, where practicable	Yes
Non-tonal reversing alarms	ABN	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. Whilst the use of non-tonal reversing alarms is suggested to ensure noise impacts are minimised, it is noted that WHS requirements must also be fully satisfied.	5-10dB reduction + reduce vibration	Reasonable cost, medium noise reduction	Yes
Minimise disturbance arising from delivery of goods to construction sites	ABN	Loading and unloading of materials/deliveries is to occur as far as possible from NSRs Select site access points and roads as far as possible away from NSRs Dedicated loading/unloading areas to be shielded if close to NSRs Delivery vehicles to be fitted with straps rather than chains for unloading, wherever feasible and reasonable	Reduce noise/ vibration impact + risk of annoyance.	Reasonable cost, variable noise/vibration reduction, reduced overall impact.	Yes
Engine silencing	ABN	The minimising of noise emissions from mobile plant by fitting residential grade mufflers on all mobile plant regularly used at worksites. Ensure plant including the silencer is well maintained. Heavy vehicle vehicles using the sites should have RMS compliant mufflers to control engine breaking noise.	0-20dB reduction Reduce annoyance + sleep disturbance.	Medium cost of install, moderate to high noise reduction.	Yes
Air brake silencing	OOHW truck movements ABN	Air brake silencers should be installed and fully operational for any heavy regularly used at worksite. This will reduce potential sleep disturbance impacts, especially at OOHW site exits	5-10dB LAmax reduction	Reasonable cost, medium noise reduction	Yes
Engine compression braking	ABN	Limit the use of engine compression brakes at night and in residential areas.	5-20dB reduction	Reasonable cost, medium noise reduction	Yes

		Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.			

Notes
1. ABN = Airborne noise, GBN = Ground-borne noise, V = Vibration
2. Estimated noise benefits are not necessarily cumulative
3.

Table 8.3: Standard noise and vibration path mitigation measures

Action required	Applies to[1]	Details	Estimated noise benefit[2]	Comments on feasibility/ reasonableness	Preferred action where reasonable & feasible?
Shield stationary noise sources such as pumps, compressors, fans, etc.	ABN	Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of AS 2436:2010 lists materials suitable for shielding.	5-10dB reduction	Reasonable cost, medium noise reduction, reduced overall impact.	Yes
Shield sensitive receivers from noisy activities	ABN	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.	5-10dB reduction	Reasonable cost, medium noise reduction, reduced overall impact.	Yes
Use temporary noise barriers around worksites	ABN	Where construction compounds share a common boundary with residential or other noise sensitive receivers, a temporary noise barrier of nominal height 2 to 3 metres should be installed to reduce noise impact to receivers.	5-10dB reduction	Medium cost, medium noise reduction, reduced overall impact.	Yes

Notes
1. ABN = Airborne noise, GBN = Ground-borne noise, V = Vibration
2. Estimated noise benefits are not necessarily cumulative

Table 8.4: Standard noise and vibration receptor mitigation measures

Action required	Applies to	Details	Estimated noise benefit[2]	Comments on feasibility/ reasonableness	Preferred action where reasonable & feasible?
Building condition surveys	Prior to commencement of construction using vibration significant plant	Undertake building dilapidation surveys on all buildings assessed as being at risk of property damage prior to commencement of activities with the potential to cause property damage.	Limits building damage.	Reasonable cost, limited vibration reduction, reduced overall impact.	Yes
Condition surveys and vibration monitoring	Prior to using vibration significant plant near highly sensitive buildings	Pre-construction condition surveys of vibration sensitive buildings may be warranted. At locations where there are high-risk receptors, such as the heritage buildings listed in Appendix B vibration monitoring should be conducted during the activities causing vibration.	Limits building damage and risk of annoyance to receivers.	Reasonable cost, limited vibration reduction, reduced overall impact.	Yes

Notes
1. ABN = Airborne noise, GBN = Ground-borne noise, V = Vibration
2. Estimated noise benefits are not necessarily cumulative

8.2 Additional noise and vibration management measures

During the Project construction works there will be circumstances where after application of the all reasonable and feasible mitigation measures identified in Table 8.1 to Table 8.4, the construction noise and vibration objectives (refer Section 6) will be exceeded. In these instances, and consistent with the Sydney Metro CNVS, additional noise and vibration management may be applicable, taking into consideration when works are being undertaken (standard hours or OOHW) and the level of exceedance.

The Sydney Metro CNVS provides two pathways for identifying additional noise and vibration management measures.

For noise and vibration assessments undertaken in accordance with the ICNG and Assessing vibration – a technical guideline, additional management measures are outlined in Sections 8.2.1 to 8.2.3.

In order to address the internal noise criteria are applicable (refer Section 6.2.1), the process described in Addendum A of the Sydney Metro CNVS will be applied.

Additional management measures to be applied when mitigating and managing impacts from the Project construction works in the CNVISs are described in Table 8.5.

Table 8.5: Additional management measures

Measure	Description	Abbreviation
Letter box drops	LL will prepare newsletters to be distributed to the local community via letterbox drop and the project email list. The newsletters will provide an overview of current and upcoming Project works and other topics of interest and/or provide advanced warning of high noise impact activities during the day or potentially audible OOHW. The objective is to engage and inform and provide project-specific messages. The newsletter will disseminate Project construction works information to interested stakeholders. The newsletter will be distributed monthly.	LB
Verification monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be considered implemented.	V
Specific notification	Specific notifications are given to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advise of unscheduled works. Specific notification may be in the form of personalised letter delivered or hand distributed; phone call; and/or email.	SN
Individual briefing	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 Project works.	IB

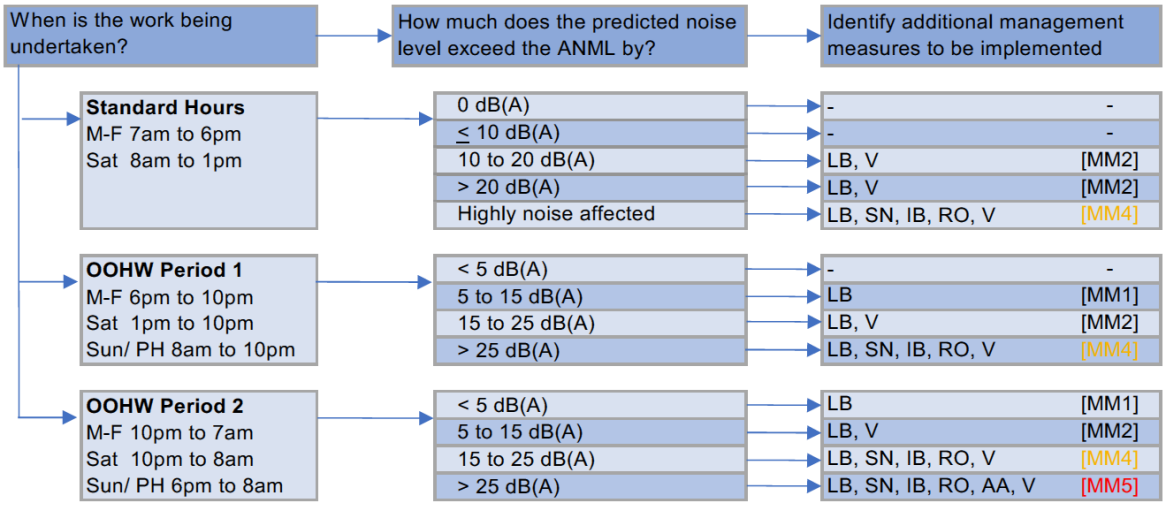
Measure	Description	Abbreviation
Project specific respite offer	The purpose of the Project Works specific respite offer is to provide respite to residents subjected to lengthy periods of noise or vibration from an ongoing impact. This may be in the form of rescheduling works to better suit sensitive receivers (where reasonable/ feasible). Alternatively, the Project Works specific respite offer may include pre-purchased movie tickets, coffee or meal vouchers. Respite offers will be determined on a case-by-case basis.	RO
Alternative accommodation	Alternative accommodation options may be offered to residents living near construction works that are likely to incur unreasonably high impacts over an extended period. Alternative accommodation will be determined on a case-by-case basis.	AA

8.2.1 Applying additional management measures - airborne construction noise

In circumstances where, after application of all reasonable and feasible mitigation measures, the $L_{Aeq(15minute)}$ airborne construction noise levels are still predicted to exceed the NMLs, additional airborne noise management measures can be applied to further limit the risk of annoyance from construction noise. This requirement is supplemental to the basic requirements in the ICNG.

The steps to be carried out to determine the additional management measures to be implemented are identified in Figure 5.

Figure 5: Additional airborne noise mitigation measures



Notes: Use the abbreviation codes in the table above to confirm management measures required
Code in square brackets [] refers to noise management code for affected receivers identified in each CNVIS

LB = Letter box drops
V = Verification monitoring
SN = Specific notifications
IB = individual briefing
RO = Project specific respite offer
AA = Alternative accommodation

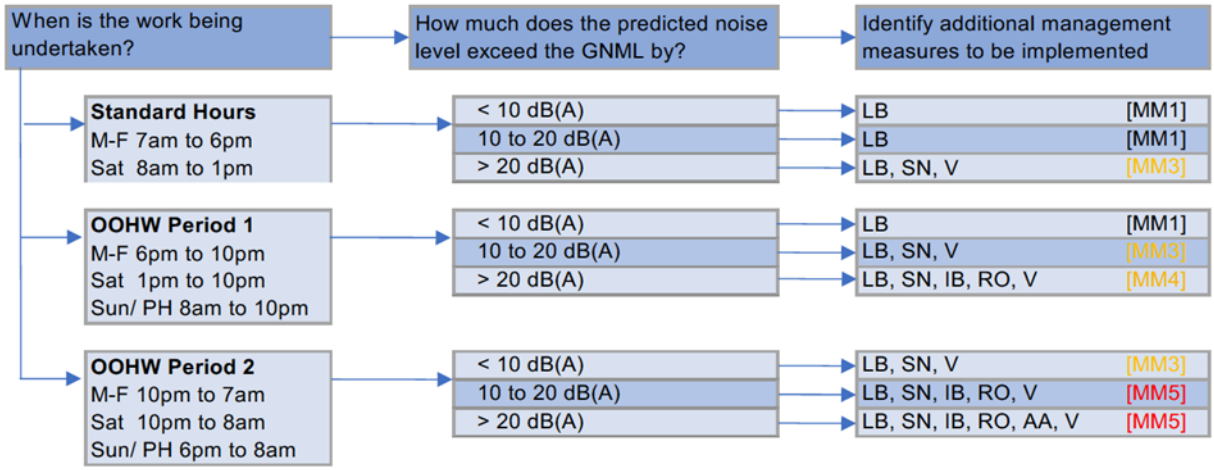
8.2.2 Applying additional management measures – ground-borne construction noise

In circumstances where, after application of all reasonable and feasible mitigation measures, the $L_{Aeq(15minute)}$ ground-borne construction noise levels are still predicted to exceed the NMLs, additional

ground-borne noise management measures can be applied to further limit the risk of annoyance from construction noise. This requirement is supplemental to the basic requirements in the ICNG.

The steps to be carried out to determine the additional management measures to be implemented are identified in Figure 6.

Figure 6: Additional ground borne noise management measures



Notes: Use the abbreviation codes in the table above to confirm management measures required
Code in square brackets [] refers to noise management code for affected receivers identified in each CNVIS

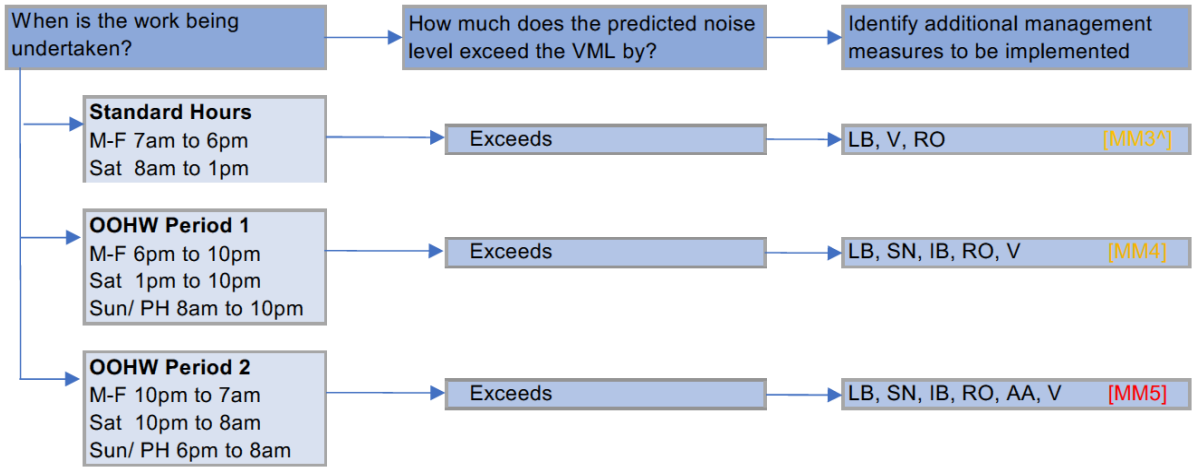
LB = Letter box drops
SN = Specific notifications
RO = Project specific respite offer
V = Verification monitoring
IB = individual briefing
AA = Alternative accommodation

8.2.3 Applying additional management measures – construction vibration

In circumstances where, after application of all reasonable and feasible mitigation measures, construction vibration is still found to exceed the VMLs in Section 6.6, additional vibration management measures can be applied to further limit the risk of annoyance from construction noise.

The steps to be carried out to determine the additional management measures to be implemented are identified in Figure 7.

Figure 7: Additional vibration management measures



Notes: Use the abbreviation codes in the table above to confirm management measures required
Code in square brackets [] refers to noise management code for affected receivers identified in each CNVIS

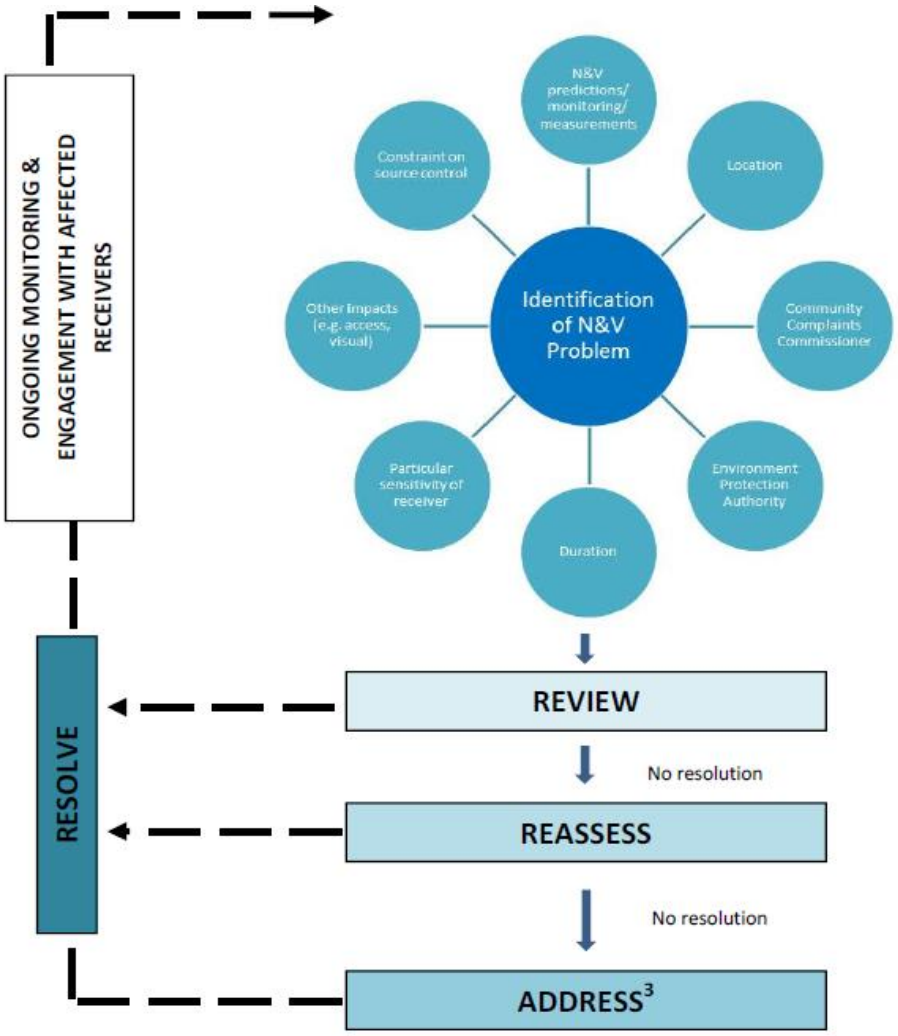
LB = Letter box drops
V = Verification monitoring
SN = Specific notifications
IB = individual briefing
RO = Project specific respite offer
AA = Alternative accommodation

If the predicted ground-borne vibration levels exceed the structural damage objectives in Section 6, a different construction method with lower source vibration levels should be considered. Attended measurements should be undertaken at the commencement of all high vibration generating activities. If there is any risk of exceedance of the structural damage objective, a permanent vibration monitoring system should be installed, to warn plant operators (via flashing light, audible alarm, SMS, etc.) when vibration levels are approaching the structural damage objective.

8.2.4 Applying additional management measures – Exceedances of internal noise levels

Should detailed modelling as part of CNVIS predictions indicate exceedances of the noise and vibration objectives, the process described in Addendum A2 of the Sydney Metro CNVS (Figure 8) will be followed to identify additional mitigation and management measures.

Figure 8: Mitigation process for locations where impacts are predicted to be long term and significant



Note 3 – Additional mitigation measures are to be considered (e.g. at property treatment, temporary relocation, other forms of mitigation where impacts are predicted to be long term and significant)

8.3 Residual impacts

At some receiver locations, noise and/ or vibration may exceed the management levels even after all reasonable and feasible noise and vibration management measures have been considered and adopted, resulting in residual impacts. Residual impact management, including respite offers, alternative accommodation and at-property treatment, will be addressed on a site by site basis in each CNVIS prepared under this CNVMP. A negotiated agreement can be sought with the affected receivers in accordance with PPA Condition E44(e) which requires agreement with a substantial majority of affected receivers.

Some of the considerations for residual impact management are outlined in the following sub-sections.

8.3.1 Short-term OOHW residual impacts

Construction of the Martin Place Station is anticipated to be largely carried out during standard construction hours. Exceptions to this would be out of hours work that is required under PPA Condition

E44 and addressed in PPA Condition E48. Works that meet PPA Condition E44(a), (b), (c) or (d) would not incur residual impacts. Works that fall under PPA Condition E44(c) or (f) may potentially cause residual impacts, where all reasonable and feasible noise mitigation has been exhausted. These works would require a CNVIS to identify impacts and recommend suitable mitigation and management measures to satisfy PPA E44, including how residual impacts are managed.

All reasonable and feasible mitigation must be explored for a work activity prior to addressing residual impacts. Residual impacts resulting from short term OOHW will be managed in accordance with the additional noise and vibration mitigation measures outlined in Section 8.2. Short term residual impacts are managed based on the level of exceedance of the management level, namely:

- Exceeds management level, but below the alternative accommodation trigger: consideration will be given to offering respite in the form of movie tickets, coffee vouchers or similar.
- Exceeds management level AND the alternative accommodation trigger: consideration will be given to offering alternative accommodation for the duration of the noise or vibration impact where this occurs over 2 or more consecutive nights.

9 Construction noise and vibration monitoring program

The Construction Noise and Vibration Monitoring Guideline in the Sydney Metro CNVS sets out the requirements for:

- Operator attended monitoring (short term)
- Continuous, unattended monitoring (including real-time monitoring)

This construction noise and vibration monitoring program will apply for the duration of works that pose a risk of exceeding set criteria. Monitoring is not required where activities to be undertaken do not pose risk of exceeding set criteria from the project planning approval..

The Construction Noise and Vibration Monitoring Program results will be submitted to the EPA and relevant Councils, as required by PPA Condition C9.

Noise and vibration monitoring will be undertaken to verify compliance with the noise and vibration objectives and/or the predicted levels in the relevant CNVIS's. Real-time noise and vibration monitoring for the duration of the works is currently being undertaken at the nearest affected receivers as detailed in the following sections.

9.1 Noise Monitoring

9.1.1 Baseline noise monitoring data

Baseline noise monitoring data was reported in the SMCSWCS EIS. Near the Martin Place worksite, ambient noise measurements were undertaken at a single noise monitoring location (B.11 - 1 Hoskings Place). A summary of the noise monitoring results at this location is provided below:

Table 9.1 Summary of unattended noise monitoring results

Location	Noise Level, dB(A)					
	Daytime 7am to 6pm		Evening 6pm to 10pm		Night-time 10pm to 7am	
	RBL	LAeq	RBL	LAeq	RBL	LAeq
B.11	61	66	56	62	52	63

No further baseline data is required to be obtained.

9.1.2 Parameters to be monitored

The following noise parameters are required to be measured when assessing construction noise levels:

- $L_{Aeq(15minute)}$ (internal or external) to assess compliance with the relevant internal or external NMLs

- L_{Amax} (fast response) to assess potential sleep disturbance at residential receivers.

Additional details are provided in the noise monitoring specifications in Appendix E.

9.1.3 Plant and Equipment Noise

Regular inspection of each item of plant will include listening for excessive noise from sources such as poorly performing mufflers, loose engine cowling and moving parts needing lubrication. Plant maintenance records to be checked where excessive noise production is identified.

Where attended noise monitoring demonstrates exceedance of predicted noise levels, noise performance of the plant would be investigated. Corrective actions identified to be necessary to eliminate excessive noise would be taken as soon as practicable, in accordance with plant being operated in a proper and efficient manner.

9.1.4 Attended Airborne Noise Monitoring in the Community

Attended monitoring of construction noise levels will be undertaken as follows:

- As described in this CNVMP to ensure that noise and vibration levels in the adjacent community remain consistent with the requirements of the project planning approval conditions..
- Where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis).
- As otherwise required by the CNVIS.

Attended monitoring will be undertaken at a location representative of the most affected noise sensitive receiver/s in proximity to construction activities. Noise monitoring locations will be identified in the CNVIS and will consider factors including:

- The location of previous monitoring sites;
- The proximity of the receiver to a Project works area;
- The sensitivity of the receiver to noise;
- Background noise levels;
- The expected duration of the impact.

Attended noise monitoring will be undertaken at one of the representative residential receivers identified in the table below in the NCAs most impacted by the works (i.e. a minimum of one location for each NCA). Nominated attended measurement locations have been selected with the best opportunity to validate predicted noise levels in the CNVIS.

Table 9.2: Nominated verification monitoring locations

NCA	Nominated receiver address	Monitoring locations
MP_02	50 Martin Place Sydney	Footpath on Elizabeth Street
	15 Castlereagh Street Sydney	Footpath on Castlereagh Street
MP_04	52-56 Martin Place Sydney	Footpath on Elizabeth Street

Notes: Monitoring on private property is subject to owner consent and where relevant, occupier consent

Monitoring may also be undertaken in response to a complaint. Where any investigation identifies works or activities being undertaken on the subject worksite as the likely source of the complaint, the proponent must offer to undertake attended noise or vibration monitoring at the complainant's premises. The attended measurements will need to be carried out by an appropriately trained person in the measurement and assessment of construction noise, who is familiar with the requirements of the relevant standards and procedures (refer to Appendix E – Monitoring Procedure).

Where noise monitoring indicates that the activity, work or combination of simultaneous activities or works has caused or is causing noise or vibration levels higher than the predicted levels at any noise sensitive receiver, LL must review and where possible, modify the work or activity to prevent any recurrence.

9.1.5 Attended Ground-borne Noise Monitoring in the Community

Attended monitoring of ground-borne construction noise levels will be undertaken, where appropriate, in response to a noise related complaint(s) (determined on a case-by-case basis).

Monitoring will be undertaken in the most affected room of the residence or other sensitive building and will be conducted in conjunction with vibration measurements whenever practicable (see Section 9.2). Note that the room selected for noise monitoring should be well shielded from airborne noise intrusions, such as road traffic noise, to allow the ground-borne noise to dominate over non-construction generated airborne noise.

The attended measurements will need to be carried out by an appropriately trained person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures (refer to Appendix E – Monitoring Procedure).

9.1.6 Real-time (unattended) noise monitoring

Real time (unattended) noise monitoring will be undertaken to satisfy PPA Condition C11. A real time noise monitor will be deployed to manage noise impacts from 'high risk' activities (demolition and bulk excavation works), where there is likely to be a high risk of annoyance from construction noise.

A review of potential impacts has found that real-time monitoring is required at 50 Martin Place due to its close proximity to the works.

The real-time noise monitor will be installed at a suitable location within 50 Martin Place prior to commencement of demolition and bulk excavation works. The position of the noise monitor will be

moved (as required) to various locations inside 50 Martin Place, based on the current stage of the works so that the measurement locations accurately represents areas of the building with the highest potential noise impacts. During the demolition works (for example), the preferred monitoring location will be at an internal location within 50 Martin Place opposite the floor where demolition works are occurring (i.e. noise monitoring location will move down the building alongside the top-down demolition works).

Real-time noise monitoring will continue during works that pose a risk of exceeding set criteria. Where activities being undertaken do not pose risk of exceeding set criteria from the project planning approval, real-time monitoring may be ceased. A secure website is required for data storage for the duration of monitored construction activities.

The monitor will be installed by an appropriately trained person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures (refer to Appendix E – Monitoring Procedure).

The real-time monitoring data will be available to LL, Sydney Metro, ER, AA and DP&E via a web based portal.

9.2 Vibration Monitoring

9.2.1 Attended vibration monitoring

Attended vibration monitoring is to be undertaken as follows:

- At the commencement of operation for each plant or activity on site, which has the potential to generate significant vibration levels, where the vibration screening criteria is likely to be exceeded (see Section 6.7.1 and Section 9.2), as determined by the CNVIS
- At the first opportunity following the commencement of each phase of works (refer to Table 2.1 for indicative phases) to verify and, if necessary, update the GBN&V models
- Where it is not feasible to modify construction methodology to reduce vibration intensive construction activities
- Where deemed to be relevant to construction works in response to a vibration related complaint
- To measure vibration from excavation works for the purpose of determining ground-borne noise levels inside the premises, and
- As otherwise required by the CNVIS.

Where attended vibration monitoring is not feasible, due to extended periods of vibration intensive works, a permanent vibration monitoring system is to be installed to warn plant operators (via flashing light, audible alarm, SMS, email etc.) that there is potential cosmetic damage to buildings and structures.

Plant and equipment vibration measurement procedures, including real-time monitoring, are further detailed in Appendix E.

9.2.2 Real-time (unattended) vibration monitoring

Real time (unattended) vibration monitoring will be undertaken to satisfy PPA Condition C11. A real time vibration monitor- will be deployed to manage vibration impacts from 'high risk' activities (demolition and bulk excavation works), where there is an increased risk of annoyance (or potential building damage) from construction vibration. Real-time vibration monitoring may also be used to measure vibration from excavation activities for the purpose of determining ground-borne noise levels or to validate real-time noise measurement results.

A review of potential impacts has found that real-time vibration monitoring is required at 50 Martin Place due to its close proximity to the works and the heritage status of the building.

The real-time vibration monitor will be installed prior to commencement of demolition and bulk excavation works. The position of the monitor will be moved (as required) to various locations inside 50 Martin Place, based on the current stage of the works and whether the key risk is associated with cosmetic building damage (normally measured at a position near the building foundations) or human comfort (at positions where staff are impacted).

For the real-time monitoring, attended measurements may be required to determine relevant transfer functions between monitoring locations (unaffected by extraneous vibration) and other positions in the building where staff are impacted). Real-time vibration monitoring will continue during works that pose a risk of exceeding set criteria. Where activities being undertaken do not pose risk of exceeding set criteria from the project planning approval, real-time monitoring may be ceased.

A secure website is required for data storage for the duration of monitored construction activities.

The monitor will be installed by an appropriately trained person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures (refer to Appendix E).

The real-time monitoring data will be available to LL, Sydney Metro, ER, AA, and DP&E via a web based portal.

9.3 Heritage-listed structures

LL will seek the advice of a Heritage Engineer on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage-listed structures. Heritage structures near the works are identified in Section 4.2.2.

9.4 Consultation and documentation

Site specific monitoring requirements for Project construction works will be identified in the relevant CNVIS.

Additionally, PPA Condition C12 requires Construction Monitoring Programs to be developed in consultation with relevant government agencies as identified in PPA Condition C9.

Records of consultation with relevant agencies are provided in APPENDIX F.

9.5 Monitoring in response to complaints

LL must offer to undertake attended noise or vibration monitoring at a complaint's premises where:

- An investigation identifies works or activities being undertaken on the licensed premises as the likely source of the complaint
- The relevant Project construction works are on-going.

The attended measurements will need to be carried out by an appropriately trained person in the measurement and assessment of construction noise, who is familiar with the requirements of the relevant standards and procedures (Appendix E).

9.6 Continual improvement and corrective action

Where:

- Monitored ambient noise levels or vibration levels are above modelling predictions; or
- LL receives two or more complaints found to result from the activity, work or combination of simultaneous activities or works

LL will review the work or activity or combination of simultaneous works or activities as soon as practicable and where possible, modify the work or activity to prevent any recurrence. In the case of above prediction monitoring results, the need for modelling to be reviewed will also be considered. Lessons learnt will be communicated to relevant personnel in toolbox talks (see Part B, Element 1.3)

9.7 Reporting of monitoring results

The results of noise and vibration monitoring shall be documented in a 6 monthly noise and vibration monitoring report, and submitted to the Secretary for information after AA endorsement.

PPA Condition 16 includes the following requirements:

> *The results of the Construction Monitoring Programs must be submitted to the Secretary for information, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.*

Additional records relating to noise and vibration training, toolbox talks, monitoring results and audit results are described in Part B, Elements 1 to 3. The complaints management and reporting procedure is described in Section 7.3.4.

Part B – Systems and tools

Part B of this Plan explains how the noise and vibration impacts of the Project will be minimised. Compliance with all elements of these systems and tools is required at all times to minimise the likelihood of causing unauthorised environmental harm and maximise the uptake of opportunities to reduce environmental impact.

Part B contains the following:

Environmental Elements and Expectations: These describe what is required of the SMCSW Works to implement the objectives of LL's environment and sustainability policy:

- Element – Key aspects for managing this function in delivering the Project demolition and construction works
- Intent – A one-line statement describing the overall purpose of the Element
- Expectation – The outcomes achieved as part of each Element.

Requirements: These are the specific actions performed to demonstrate compliance with the Elements and Expectations.

Responsibility and Key Contributor: This information is included to ensure absolute clarity as to those people responsible for achieving compliance with the stated Expectation, as well as those that will need to assist/contribute to achieving compliance.

Deliverables: This column of the table lists the tangible outcomes to be produced to demonstrate compliance with the environmental Elements and Expectations, and the relevant section of the CNVMP.

A definition of the Roles and Responsibilities of key project personnel in ensuring implementation, management, update and review of this plan are provided below:

Role	Definition and Responsibilities
Project Environment Manager	Oversee the implementation of all noise and vibration management initiatives including coordinating responses to noise and vibration complaints. Manage review and continual improvement of the CNVMP. Ensure that sufficient resources are allocated for the implementation of the CNVMP. Consider and advise senior management on compliance obligations regarding noise and vibration. Ensure that the outcomes of compliance monitoring / incident reporting are systematically evaluated as part of ongoing management of construction activities. Ensure all appropriate noise and vibration mitigation measures are implemented.
Site Supervisor	Ensure that all requirements of the CNVMP are effectively implemented. Ensure all appropriate noise and vibration mitigation measures are implemented.

Role	Definition and Responsibilities
Environment Co-ordinators	Assist the Project Environment Manager and Construction Managers in implementing the CNVMP. Oversee noise and vibration training including inductions, toolbox talks and specific technical training on monitoring equipment. Ensure all appropriate noise and vibration mitigation measures are implemented. Monitoring and reporting on compliance.
Site Engineers	Assist the Construction Manager in implementing the CNVMP.
Project Noise and Vibration Consultant	Provide Lendlease with specialist noise and vibration input and advice including development of the CNVMP, CNVIS and discussions regarding progressive construction works. Undertaking noise and vibration monitoring when required. Assisting in community consultation when required.
Construction Manager	Manage the delivery of the construction process, in relation to noise and vibration management across the site together with the Environment Manager. Ensure that all requirements of the CNVMP are effectively implemented, including all subcontractors.
Stakeholder and Community Relations Manager	Manage notifications and consultation for noise and vibration and liaise with the Environment Manager about management of noise and vibration complaints. Assist in coordinating responses to noise and vibration complaints.
Heritage Consultant	Provide Lendlease with advice regarding potential noise and vibration impacts on heritage items, and associated management measures.
Demolition Subcontractor	Ensure compliance with the CNVMP and associated management measures.

Element 1 – Training

All staff, employees and subcontractors will actively drive continuous improvement in the environmental performance of the SMCSW Works

Expectations	Proposed actions	Responsible Key Contributor	Deliverables
All personnel have completed an induction containing relevant environmental information before they are authorised to work on the Project	The noise and vibration component of the site induction will include information on: - Standard construction hours - Out of hours works - Sensitive receivers - Noise and vibration mitigation and management measures	Project Environment Manager	Induction presentation
Personnel are trained and assessed according to the training plan	Targeted environmental training will be provided including: - Training in noise modelling targeted at engineers, environment and community personnel - Training in noise, vibration, and ground-borne noise monitoring targeted at engineers, environment and community personnel	Project Environment Manager	Training matrix Training records Training evaluation forms
Toolbox talks are used to reinforce key management requirements and lessons learnt	Toolbox talks will be held regularly on CNVIS requirements and reinforce and reiterate information from inductions. The toolbox talks will be presented when changes in work practices (e.g. OOHW) or seasonal weather increases the risk of adverse impacts from noise and/or vibration. Toolboxing will also be used to reinforce and reiterate information from inductions and any relevant complaints and/or incidents and lessons learnt	Project Environment Manager Site Supervisor	Toolbox records

Element 2 – Monitoring and Reporting

All staff, employees and subcontractors will actively drive complaint environmental performance of the SMCSW Works

Expectations	Proposed actions	Responsible Key Contributor	Deliverables
Worksites are regularly inspected to ensure the adequacy of controls	Site Supervisor to undertake daily inspections of worksite to ensure management of noise and vibration controls. Weekly inspection of onsite noise and vibration management controls will be undertaken as part of Joint Environment Inspections.	Project Environment Manager Site Supervisors	Environment Inspection Reports Site Diary entries Noise and vibration monitoring records
Monitoring is performed to establish baseline data and ensure compliance is maintained	Monitoring is carried out to establish pre-construction benchmarks, confirm compliance with the conditions of environmental approvals and laws, and to provide early indication of potential adverse impacts to the environment or community. The Project Environment Manager is accountable for managing environmental monitoring as required under this Plan and the Environment Procedures. Results of monitoring will be used for: • The evaluation of performance relative to legal, regulatory, contract, permit, licence and other commitments • The prompt identification and correction of incidents or possible incidents • Providing feedback on this Plans, • Providing the basis of internal and external reporting. Refer to Section 9 for more detail	Project Environment Manager Environment Co-ordinators Site Engineers	Construction Noise Impact Statements Noise and vibration monitoring records
Noise and vibration monitoring records are maintained	The results of noise and vibration monitoring shall be documented and published monthly on the Projects website in line with the requirements of the part of the Construction Monitoring Report required under planning approval condition C16,.	Project Environment Manager	Construction Monitoring Report

Element 3 – Auditing, Review and Improvement

We will continually improve our environmental systems and environmental performance by monitoring and reviewing their effectiveness

Expectations	Proposed actions	Responsible Key Contributor	Deliverables
Audits are undertaken to ensure compliance with the requirements of this Plan	Procedures for corrective actions are addressed in the Construction Environmental Management Plan. If monitoring identifies that noise or vibration levels are above predictions an investigation will be undertaken to determine the cause and if additional mitigation is required. Supervision of activities on site may identify procedures that require additional management to minimise potential impact. Audits will be performed in line with the CEMP and we will update this Plan and/or associated CNVIS or procedures if required	Project Environment Manager Environment Co-ordinators	Audit Reports Corrective Action Reports
All non-compliances are reported and actioned	A noise or vibration non-conformance can generally be defined as a failure to comply with: - Project Planning Approval - Environment Protection Licence Where a non-conformance is raised as part of an audit or an incident or complaint investigation the audit, incident or complaint report may be used to close out the non-conformance and it is not necessary to raise a separate non-conformance reporting process. Corrective and Preventative Actions may also be raised in accordance with the Construction Environmental Management Plan. See Section 9.6.	Project Environment Manager Environment Co-ordinators	If triggered
Any amendments to the CNVMP must be submitted to relevant stakeholders for approval in accordance with the Project Conditions of Approval.	Should changes or minor amendments to the CNVMP be required, these will be submitted to the ER for approval / endorsement. Construction for any stage of the works cannot commence until the relevant CEMP and sub-plans have been approved by the Secretary. The Noise and Vibration Construction Monitoring Program required the provision of real time noise and vibration monitoring data. This shall be made available to the Proponent, AA, ER and EPA in real time. The monitoring program must be endorsed by the ER.	Project Environment Manager Environment Co-ordinators	CNVMP Noise and Vibration Construction Monitoring Program Real time noise and vibration data

Element 4 – Project Specific Requirements

Construction Environmental Management Framework

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant CNVMP section
9.1 a	The following noise and vibration management objectives will apply to construction: i) Minimise unreasonable noise and vibration impacts on residents and businesses; ii) Avoid structural damage to buildings or heritage items as a result of construction vibration; iii) Undertake active community consultation; and iv) Maintain positive, cooperative relationships with schools, childcare centres, local residents and building owners.	See Section 1.4, 1.7, 3, 6, 7.1, and 9.	Project Environment Manager Project Noise and Vibration Consultant	Construction	This plan Section 1.4
9.2 a	Principal Contractors will develop and implement a Construction Noise and Vibration Management Plan for their scope of works consistent with the Interim Construction Noise Guidelines (Department of Environment and Climate Change, 2009). The Construction Noise and Vibration Management Plan will include as a minimum:	Development of this plan	Project Environment Manager Project Noise and Vibration Consultant	Construction	This plan
(i)	Identification of work areas, site compounds and access points;				Appendix C
(ii)	Identification of sensitive receivers and relevant construction noise and vibration goals;				Section 4 and Appendix B
(iii)	Be consistent with, and include the requirements of the noise and vibration mitigation measures as detailed in, the environmental approval documentation and the Sydney Metro Construction Noise and Vibration Strategy (CNVS);				Section 3.5 and Section 8
(iv)	Details of construction activities and an indicative schedule for construction works, including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios) that have the potential to generate noise or vibration impacts on surrounding sensitive receivers, in particular residential areas;				Section 5.3 and Appendix D
(v)	Identification of feasible and reasonable procedures and mitigation measures to ensure relevant vibrations and blasting criteria are achieved, including a suitable blast program;				Section 8 (Blasting is not currently proposed and so has been excluded from this CNVMP)

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant CNVMP section
(vi)	Community consultation requirements and Community notification provisions specifically in relation to blasting;				Section 7.3 and Section 8.2 (Blasting is not currently proposed and so has been excluded from this CNVMP)
(vii)	The requirements of any applicable EPL conditions;				Section 6
(viii)	Additional requirements in relation to activities undertaken 24 hours of the day, 7 days per week;				Section 5.2
(ix)	Pre-construction compliance requirements and hold points;				Section 7
(x)	The responsibilities of key project personnel with respect to the implementation of the plan;				Part B
(xi)	Noise monitoring requirements;				Section 9 and Appendix E
(xii)	Compliance record generation and management; and				Section 9.7 and Part B Element 2 – Monitoring and Reporting
(xiii)	An Out of Hours Works Protocol applicable to all construction methods and sites.				Section 5.2.1
9.2 b	Detailed Construction Noise and Vibration Impact Statements will be prepared for noise-intensive construction sites and or activities, to ensure the adequacy of the noise and vibration mitigation measures. Specifically, Construction Noise and Vibration Impact Statements will be prepared for EPL variation applications and works proposed to be undertaken outside of standard construction hours.	CNVISs will be prepared progressively for all worksites, under this Plan. See Compliance Matrix and Sections 1.5.3 and 7.1.	Project Environment Manager Project Noise and Vibration Consultant	Prior to the commencement of relevant construction activities	Sections 1.5.3, 7.1 and Part B, Element 4
9.2 c	Noise and vibration monitoring would be undertaken for construction as specified in the CNVIS.	This CNVMP outlines the monitoring expectations for this project (Section 9). In addition, the Sydney Metro CNVS outlines monitoring requirements.	Project Environment Manager Project Noise and Vibration Consultant	As specified in CNVIS and Section 9	Part B, Element 4

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant CNVMP section
9.2 d	The following compliance records would be kept by Principal Contractors: i) Records of noise and vibration monitoring results against appropriate NMLs and vibration criteria; and ii) Records of community enquiries and complaints, and the Contractor's response.	Records of noise monitoring will be kept as outlined in Section 9.4 and Section 9.7	Project Environment Manager Project Noise and Vibration Consultant	Construction	Part B, Element 4
9.3 a	All feasible and reasonable mitigation measures would be implemented in accordance with the CNVS. Examples of noise and vibration mitigation measures include: i) Construction hours will be in accordance with the working hours specified in Section 5.1; ii) Hoarding and enclosures will be implemented where required to minimise airborne noise impacts; and iii) The layout of construction sites will aim to minimise airborne noise impacts to surrounding receivers.	The CNVIS for SMCSW worksite activities will form the key to manage noise and vibration impact. All reasonable and feasible measures detailed in the CNVIS will be adhered to by the relevant construction manager. See Section 7.1 and Section 8	Construction Manager Project Environment Manager Environment Co-ordinators Project Noise and Vibration Consultant	Construction	Section 8

Project Planning Approval

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant CNVMP section
A24	From commencement of construction until completion of construction, the approved ER must: (a) receive and respond to communications from the Secretary in relation to the environmental performance of the CSSI; (b) consider and inform the Secretary on matters specified in the terms of this approval; (c) consider and recommend any improvements that may be made to work practices to avoid or minimise adverse impact to the environment and to the community; (d) review documents identified in Conditions C1, C3 and C9 and any other documents that are identified by the Secretary, to ensure they are consistent with requirements in or under this approval and if so: i. make a written statement to this effect before submission of such documents to the Secretary (if those documents are required to be approved by the Secretary), or ii. make a written statement to this effect before the implementation of such documents (if those documents are required to be submitted to the Secretary for information or are not required to be submitted to the Secretary); (e) regularly monitor the implementation of environmental management related documents to ensure implementation is being carried out in accordance with what is stated in the document and the terms of this approval; (f) review the Proponent's notification of incidents in accordance with Condition A41 of this approval; (g) as may be requested by the Secretary, help plan, attend or undertake Department audits of the CSSI, briefings, and site visits; (h) if conflict arises between the Proponent and the community in relation to the environmental performance of the CSSI, follow the procedure in the Community Communication Strategy approved under Condition B3 of this approval to attempt to resolve the conflict, and if it cannot be resolved, notify the Secretary; (i) review any draft consistency assessment that may be carried out by the Proponent, and provide advice on any additional mitigation measures required to minimise the impact of the work; (j) consider any minor amendments to be made to the documents listed in Conditions C1, C3 and C9 and any document that requires the approval of the Secretary (excluding noise and	Requirement held by Sydney Metro. The ER has been approved by the Secretary of DP&E See Section 3.7	N/A	N/A	Section 3.6 and 3.7

	vibration documents) that comprise updating or are of an administrative or minor nature, and are consistent with the terms of this approval and the documents listed in Conditions C1, C3 and C9 or other documents approved by the Secretary and, if satisfied such amendment is necessary, approve the amendment. This does not include any modifications to the terms of this approval; (k) assess the impacts of minor ancillary facilities as required by Condition A18 of this approval; and (l) prepare and submit to the Secretary and other relevant regulatory agencies, for information, a monthly Environmental Representative Report detailing the ER's actions and decisions on matters for which the ER was responsible in the preceding month (or other timeframe agreed with the Secretary). The Environmental Representative Report must be submitted within seven (7) days following the end of each month for the duration of works and construction of the CSSI, or as otherwise agreed with the Secretary.				
A25	A suitably qualified and experienced Acoustics Advisor (AA), who is independent of the design and construction personnel, must be nominated by the Proponent and engaged for the duration of construction and for no less than six (6) months following operation of the CSSI. The details of the nominated AA must be submitted to the Secretary for approval no later than one (1) month before commencement of works, or within another timeframe as agreed with the Secretary. The Proponent may nominate additional suitably qualified and experienced persons to assist the lead Acoustics Advisor for the Secretary's approval. The Proponent must cooperate with the AA by: (a) providing access to noise and vibration monitoring activities as they take place; (b) providing for review of noise and vibration plans, assessments, monitoring reports, data and analyses undertaken; and (c) considering any recommendations to improve practices and demonstrating, to the satisfaction of the AA, why any recommendation is not adopted.	Requirement held by Sydney Metro. The AA has been approved by the Secretary of DP&E See Section 3.7	N/A	N/A	Section 3.6 and 3.7
A26	Any activities generating noise and vibration in excess of the Noise Management Level derived from the Interim Construction Noise Guideline must not commence until an AA, nominated under Condition A25 of this approval, has been approved by the Secretary.	Requirement held by Sydney Metro. AA has been appointed by DP&E	N/A	N/A	Section 3.6 and 3.7
A27	The approved AA must: (a) receive and respond to communication from the Secretary in relation to the performance of the CSSI in relation to noise and vibration; (b) consider and inform the Secretary on matters specified in the terms of this approval relating to noise and vibration; (c) consider and recommend, to the Proponent, improvements that may be made to work practices to avoid or minimise adverse noise and vibration impacts; (d) review all noise and vibration documents required to be prepared under the terms of this approval and, should they be consistent with the terms of this approval,	Requirement held by Sydney Metro. AA has been appointed by DP&E See Section 3.7	N/A	N/A	Section 3.6 and 3.7

	endorse them before submission to the Secretary (if required to be submitted to the Secretary) or before implementation (if not required to be submitted to the Secretary); (e) regularly monitor the implementation of all noise and vibration documents required to be prepared under the terms of this approval to ensure implementation is in accordance with what is stated in the document and the terms of this approval; (f) review the Proponent's notification of noise and vibration incidents in accordance with Condition A41 of this approval; (g) in conjunction with the ER (where required), the AA must: i. consider requests for out of hours construction activities and determine whether to endorse the proposed activities in accordance with Condition E47; ii. as may be requested by the Secretary or Complaints Mediator, help plan, attend or undertake audits of noise and vibration management of the CSSI including briefings, and site visits; iii. if conflict arises between the Proponent and the community in relation to the noise and vibration performance during construction of the CSSI, follow the procedure in the Community Communication Strategy approved under Condition B3 of this approval to attempt to resolve the conflict, and if it cannot be resolved, notify the Secretary; iv. consider relevant minor amendments made to any noise and vibration document approved by the Secretary that require updating or are of an administrative or minor nature, and are consistent with the terms of this approval and the document approved by the Secretary and, if satisfied such amendment is necessary, approve the amendment. This does not include any modifications to the terms of this approval; v. assess the noise impacts of minor ancillary facilities as required by Condition A18 of this approval; and vi. prepare and submit to the Secretary and other relevant regulatory agencies, for information, a monthly Noise and Vibration Report detailing the AAs actions and decisions on matters for which the AA was responsible in the preceding month (or other timeframe agreed with the Secretary). The Noise and Vibration Report must be submitted within seven (7) days following the end of each month for the duration of construction of the CSSI, or as otherwise agreed with the Secretary.				
C3	The following CEMP sub-plans must be prepared in consultation with the relevant government agencies identified for each CEMP sub-plan and be consistent with the CEMF and CEMP referred to in Condition C1.	Development of this plan	Project Environment Manager Project Noise and Vibration Consultant	Construction	APPENDIX F

	Required CEMP sub-plan	Relevant government agencies to be consulted for each CEMP sub-plan				
	(a) Noise and vibration	Relevant Council(s)				
C4	The CEMP sub-plans must state how: (a) the environmental performance outcomes identified in the EIS as amended by the documents listed in A1will be achieved; (b) the mitigation measures identified in the EIS as amended by documents listed in A1 will be implemented; (c) the relevant terms of this approval will be complied with; and (d) issues requiring management during construction, as identified through ongoing environmental risk analysis, will be managed.		Development of this plan	Project Environment Manager Project Noise and Vibration Consultant	Construction	Section 3.3 Part B Element 4 – Project Specific Requirements Section 7 Construction Environmental Management Plan
C5	The CEMP sub-plans must be developed in consultation with relevant government agencies. Where an agency(ies) request(s) is not included, the Proponent must provide the Secretary justification as to why. Details of all information requested by an agency to be included in a CEMP sub-plan as a result of consultation and copies of all correspondence from those agencies, must be provided with the relevant CEMP sub-plan.			Project Environment Manager	N/A	APPENDIX F
C6	Any of the CEMP sub-plans may be submitted to the Secretary along with, or subsequent to the submission of the CEMP but in any event, no later than one (1) month before commencement of construction			Project Environment Manager	N/A	This plan and Part B Element 3 Amendments to CNVMP
C7	The CEMP must be endorsed by the ER and then submitted to the Secretary for approval no later than one (1) month before the commencement of construction or within another timeframe agreed with the Secretary			Project Environment Manager	N/A	This plan and Part B Element 3 Amendments to CNVMP
C8	Construction must not commence until the CEMP and all CEMP sub-plans have been approved by the Secretary. The CEMP and CEMP sub-plans, as approved by the Secretary, including any minor amendments approved by the ER (or AA in regards to the Noise and Vibration sub-plan), must be implemented for the duration of construction. Where the CSSI is being staged, construction of that stage is not to commence until the relevant CEMP and sub-plans have been approved by the Secretary			Project Environment Manager Construction Managers	N/A	This plan and Part B Element 3 Amendments to CNVMP
C9	The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each Construction Monitoring Program to compare actual performance of construction of the CSSI against predicted performance.		This CNVMP outlines the monitoring expectations for this project (Section 9). In addition, the Sydney Metro CNVS outlines monitoring requirements.	Project Environment Manager Project Noise and Vibration Consultant	Construction	Section 9 Appendix E APPENDIX F
		Required Construction Monitoring Programs	Relevant government agencies to be consulted for each Construction Monitoring Program			
		(a) Noise and Vibration	EPA and Relevant Council(s)			

C10	Each Construction Monitoring Program must provide:	This CNVMP outlines the monitoring expectations for this project (Section 9). In addition, the Sydney Metro CNVS outlines monitoring requirements.	Project Environment Manager Project Noise and Vibration Consultant	Construction	Section 9 and Appendix E
	(a) details of baseline data available;				Section 9.1.1
	(b) details of baseline data to be obtained and when;				Section 9.1.1
	(c) details of all monitoring of the project to be undertaken;				Section 9.1.3, 9.1.4, 9.1.5, and 9.1.6
	(d) the parameters of the project to be monitored;				Section 9.1.2
	(e) the frequency of monitoring to be undertaken;				Section 9.1.3, 9.1.4, 9.1.5, and 9.1.6
	(f) the location of monitoring;				Section 9.1.3, 9.1.4, 9.1.5, and 9.1.6
	(g) the reporting of monitoring results;				Section 9.7
	(h) procedures to identify and implement additional mitigation measures where results of monitoring are unsatisfactory; and				Section 9.5 and 9.6
	(i) any consultation to be undertaken in relation to the monitoring programs.				Section 9.4
C11	The Noise and Vibration Construction Monitoring Program and Blast Construction Monitoring Program must include provision of real time noise and vibration monitoring data. The real time data must be available to the construction team, Proponent, ER and AA in real time. The Department and EPA must be provided with access to the real time monitoring data in real time.	This CNVMP outlines the monitoring expectations for this project (Section 9). In addition, the Sydney Metro CNVS outlines monitoring requirements.	Project Environment Manager Construction Managers	Construction	See Section 9.1.6, Section 9.2.2 Part B Element 3 Noise and Vibration Construction Monitoring Program
C12	The Construction Monitoring Programs must be developed in consultation with relevant government agencies as identified in Condition C9 of this approval and must include, to the written satisfaction of the Secretary, information requested by an agency to be included in a Construction Monitoring Programs during such consultation. Details of all information requested by an agency including copies of all correspondence from those agencies, must be provided with the relevant Construction Monitoring Program.		Project Environment Manager		Section 3.7 and Section 9.4 APPENDIX F
C13	The Construction Monitoring Programs must be endorsed by the ER (or AA in regards to the Noise and Vibration Construction Monitoring Program) and then submitted to the Secretary for approval at least one (1) month before commencement of construction or within another timeframe agreed with the Secretary.		Project Environment Manager		Section 9 Part B Element 3 Noise and Vibration Construction Monitoring Program Appendix E

C14	Construction must not commence until the Secretary has approved all of the required Construction Monitoring Programs, and all relevant baseline data for the specific construction activity has been collected.		Project Environment Manager Construction Managers		Section 9 and Appendix E
C15	The Construction Monitoring Programs, as approved by the Secretary including any minor amendments approved by the ER (or AA in regards to the Noise and Vibration Construction Monitoring Program), must be implemented for the duration of construction and for any longer period set out in the monitoring program or specified by the Secretary, whichever is the greater.		Project Environment Manager		Section 9 and Appendix E
C16	The results of the Construction Monitoring Programs must be submitted to the Secretary for information, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.		Project Environment Manager		Section 9 and Appendix E
C17	Where a relevant CEMP sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP sub-plan	This CNVMP outlines the monitoring expectations for this project	Project Environment Manager Construction Managers		Section 9 and Appendix E
E28	The Proponent must ensure that vibration from construction activities does not exceed the vibration limits set out in the British Standard BS 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from ground-borne vibration.	Vibration impact to be assessed for the worksite in CNVIS. See Sections 6.7, Section 6.8	Project Environment Manager Construction managers Environment coordinators Project Noise and Vibration Consultant	Construction	Sections 6.7, Section 6.8
E28.1	If the modifications to this approval as described in A1(e) proceed, the vibration screening criterion for 50 Martin Place must remain at 7.5 mm/s, unless a detailed investigation of the construction of the building determines that increasing the screening criterion to 25 mm/s is acceptable. The investigation must be undertaken by a suitably qualified structural engineer with experience assessing heritage structures and approved by the Secretary and must be supported by evidence to demonstrate the higher criterion is appropriate.	1) Vibration screening criterion for 50 Martin Place set at 7.5 mm/s 2)If required, a suitably qualified structural engineer with experience assessing heritage structures will review the appropriate vibration criterion for 50 Martin Place	Project Environment Manager Construction managers Environment coordinators Project Noise and Vibration Consultant	Construction	Section 6.8.1

E29	Owners of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before construction that generates vibration commences in the vicinity of those properties. The management of construction works in the vicinity of properties at risk of exceeding the screening criteria for cosmetic damage must be considered in the Noise and Vibration management sub plan required by Condition C3.	Properties will be identified in the CNVIS and notified.	Project Environment Manager Construction managers Environment coordinators Project Noise and Vibration Consultant	Prior to relevant construction activities	Section 7.3, Section 8.2.3
E30	The Proponent must conduct vibration testing before and during vibration generating activities that have the potential to impact on heritage items to identify minimum working distances to prevent cosmetic damage. In the event that the vibration testing and monitoring shows that the preferred values for vibration are likely to be exceeded, the Proponent must review the construction methodology and, if necessary, implement additional mitigation measures.	Monitoring will be conducted as required under the CNVIS. See Section 9.2.	Project Environment Manager Construction managers Environment coordinators Project Noise and Vibration Consultant	Prior to and during relevant construction activities	Section 9.2.
E31	The Proponent must seek the advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage-listed structures.	Advice will be sought, as noted in Section 9.3	Project Environment Manager Construction managers Environment coordinators	Prior to monitor installation	Section 9.3
E32	The Proponent must review the Sydney Metro City and Southwest Construction Noise and Vibration Strategy in the PIR during detailed construction planning to consider scale and duration of impacts, the requirements of this approval and all measures to limit construction noise impacts to sensitive receivers including: (a) at property or architectural treatment; (b) relocation; and (c) other forms of mitigation where impacts are predicted to be long term and significant. The revised Sydney Metro City and Southwest Construction Noise and Vibration Strategy must be submitted to the Secretary for approval at least one (1) month before construction commences.	Already undertaken by Sydney Metro. Refer to Section 3.5.	N/A	N/A	Section 3.5.
E33	Construction Noise and Vibration Impact Statements must be prepared for each construction site before construction noise and vibration impacts commence and include specific mitigation measures identified through consultation with affected sensitive receivers.	CNVISs will be prepared for all stages of work,	Project Noise and Vibration Consultant	Prior to relevant construction activities	Sections 1.5.3 and 7.1

		under this Plan. See Sections 1.5.3 and 7.1	Project Environment Manager		
E34	Noise generating works in the vicinity of potentially-affected religious, educational, community institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) must not be timetabled within sensitive periods, unless other reasonable arrangements to the affected institutions are made at no cost to the affected institution or as otherwise approved by the Secretary.	Allocation to be confirmed with Sydney Metro Under this plan, consultation will be carried out with affected receivers so that timing of works will be managed to minimise impacts, where practicable.	Stakeholder and Community Relations Manager Project Environment Manager	Prior to relevant construction activities	Section 7.3.3
E35	The Proponent must review alternative methods to rock hammering and blasting for excavation as part of the detailed construction planning with a view to adopting methods that minimise impacts on sensitive receivers. Construction Noise and Vibration Impact Statements must be updated for each location or activity to adopt the least impact alternative in any given location unless it can be demonstrated, to the satisfaction of the AA, why it should not be adopted.	See Section 5.3.3.	Construction Managers Project Environment Manager Environment coordinators	Prior to relevant construction activities as part of relevant CNVIS	See Section 5.3.3.
E36	Construction, except as allowed by Condition E48 (excluding cut and cover tunnelling), must only be undertaken during the following standard construction hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; (b) 8:00am to 1:00pm Saturdays; and (c) at no time on Sundays or public holidays.	See Section 5.	Construction Managers Project Environment Manager Environment coordinators Project Noise and Vibration Consultant	Construction	See Section 5.
E37	The Proponent must identify all receivers likely to experience internal noise levels greater than Leq(15 minute) 60 dB(A) inclusive of a 5 dB penalty, if rock breaking or any other annoying activity likely to result in regenerated (ground-borne) noise or a perceptible level of vibration is planned (including works associated with utility adjustments), between 7am – 8pm at: (a) Crows Nest, Victoria Cross, Blues Point, Barangaroo, Martin Place, Pitt Street, and Central; and (b) Marrickville, Newtown, St Peters, Sydenham and Tempe for works specified in SSI 7400_MOD 4 referenced in Condition A1 (c).	See Section 6.4.	Stakeholder and Community Relations Manager Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities as part of relevant CNVIS	See Section 6.4.

E38	The Proponent must consult with all receivers identified in accordance with Condition E37 with the objective of determining appropriate hours of respite so that construction noise (including ground-borne noise), does not exceed internal noise levels of: (a) Leq(15 minute) 60 dB(A) inclusive of a 5 dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am – 8pm for more than 50 percent of the time; and (b) Leq(15 minute) 55 dB(A) inclusive of a 5 dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am – 8pm for more than 25 percent of the time, unless an agreement is reached with those receivers. This condition does not apply to noise associated with the cutting surface of a TBM as it passes under receivers. Note This condition requires that noise levels be less than Leq(15 minute) 60 dB(A) for at least 6.5 hours between 7am and 8pm, of which at least 3.25 hours must be below Leq(15 minute) 55 dB(A). Noise equal to or above Leq(15 minutes) 60 dB(A) is allowed for the remaining 6.5 hours between 7am and 8pm.	See Section 6.4.	Stakeholder and Community Relations Manager Construction Managers Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities	See Section 6.4.
E39	The Proponent must consult with proponents of other construction works in the vicinity of the CSSI and take reasonable steps to coordinate works to minimise cumulative impacts of noise and vibration and maximise respite for affected sensitive receivers.	See Section 7.3.	Stakeholder and Community Relations Manager Construction managers Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities	Section 7.3.
E40	The Proponent must ensure all works (including utility works associated with the CSSI where undertaken by third parties) are coordinated to provide the required respite periods identified in accordance with the terms of this approval.	All work undertaken will be assessed as noted in this Plan, see Section 7.1.	Construction managers Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities	Section 7.1.
E41	The Proponent must ensure that residential receivers, located in non-residential zones, likely to experience an internal noise level exceeding Leq(15 minute) 60 dB(A) between 8pm and 9pm or Leq(15 minute) 45 dB(A) between 9pm and 7am (inclusive of a 5 dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise, or a perceptible level of vibration is planned (including works associated with utility adjustments)) must be offered additional mitigation in accordance with the Sydney Metro City and South West Noise and Vibration Strategy referenced in Condition E32.	See Section 7.1.2 and Section 8	Construction managers Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities	Section 7.1.2 and Section 8

E42	The Proponent must ensure that residential receivers in residential zones likely to experience an internal noise level of Leq(15 minute) 45 dB(A) or greater between 8pm and 7am (inclusive of a 5 dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise, or a perceptible level of vibration is planned (including works associated with utility adjustments)) must be offered additional mitigation in accordance with the Sydney Metro City and South West Noise and Vibration Strategy referenced in Condition E32.	See Section 7.1.2 and Section 8	Construction managers Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities	Section 7.1.2 and Section 8
E43	At no time can noise generated by construction exceed the National Standard for exposure to noise in the occupational environment of an eight-hour equivalent continuous A-weighted sound pressure level of LAeq,8h, of 85dB(A) for any employee working at a location near the CSSI.	See Section 6.9	Construction managers Project Environment Manager	Construction	Section 6.9
E44	Notwithstanding Condition E36 construction associated with the CSSI may be undertaken outside the hours specified under those conditions in the following circumstances: (a) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (b) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or (c) where different construction hours are permitted or required under an EPL in force in respect of the construction; or (d) construction that causes LAeq(15 minute) noise levels: i) no more than 5 dB(A) above the rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC, 2009), and ii) no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC, 2009) at other sensitive land uses, and iii) continuous or impulsive vibration values, measured at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), and iv) intermittent vibration values measured at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006); or (e) where a negotiated agreement has been reached with a substantial majority of sensitive receivers who are within the vicinity of and may be potentially affected by the particular construction, and the noise management levels and/or limits for ground-borne noise and vibration (human comfort) cannot be achieved. All agreements must be in writing and a copy forwarded to the Secretary at least one (1) week before the works commencing; or (f) construction approved through an Out of Hours Work Protocol referred to in Condition E47, provided the relevant council, local residents and other affected stakeholders and sensitive receivers are informed of the timing and duration at least five (5) days and no more	See Section 5.2 and Section 7.4	Construction Managers Project Environment Manager	Construction	Section 5.2 and Section 7.4

	than 14 days before the commencement of the works. Note: This condition does not apply where an EPL is in force in respect of the construction. Note: This condition does not apply where an EPL is in force in respect of the construction.				
E45	On becoming aware of the need for emergency construction in accordance with Condition E44(b), the Proponent must notify the AA, the ER and the EPA (if an EPL applies) of the need for those activities or work. The Proponent must also use best endeavours to notify all affected sensitive receivers of the likely impact and duration of those works.	See Section 7.1	Construction managers Project Environment Manager	If emergency works required	Section 7.1 and Section 7.4
E46	Notwithstanding Conditions E44 and E48, rock breaking and other particularly annoying activities for station shaft or cut and cover stations is not permitted outside of standard construction hours, except at Central (excluding Central Walk works at 20-28 Chalmers Street, Surry Hills); or (a) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or (b) where different construction hours are permitted or required under an EPL in force in respect of the construction; or (c) construction that causes LAeq(15 min) noise levels: i. no more than 5 dB(A) above the rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC, 2009); and ii. no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC, 2009) at other sensitive land uses; and iii. continuous or impulsive vibration values, measures at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006); and iv. intermittent vibration values measured at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006).	See Section 5.2 and Section 7.4	Construction managers Project Environment Manager	Construction	Section 5.2 and Section 7.4
E47	An Out of Hours Work Protocol for the assessment, management and approval of work outside of standard construction hours, as defined in Condition E36 of this approval, must be prepared in consultation with the EPA and submitted to the Secretary for approval before construction commences for works not subject to an EPL. The protocol must include: • the identification of low and high risk construction activities; • a risk assessment process in which the AA reviews all proposed out of hours activities and identifies their risk levels; • a process for the endorsement of out of hours activities by the AA and approval by the ER for construction activities deemed to be of: i. low environmental risk; or ii. high risk where all construction works cease by 9pm.	See Section 7.4. OOHW Protocol per PPA Condition E47 has be prepared	Construction managers Project Environment Manager	Prior to commencement of OOHW not subject to the EPL	Section 7.4

	All other high risk out of hours construction must be submitted to the Secretary for approval unless otherwise approved through an EPL. The protocol must detail standard assessment, mitigation and notification requirements for high and low risk out of hours works, and detail a standard protocol for referring applications to the Secretary.				
E48	Notwithstanding Condition E36 of this approval and subject to Condition E47, the following activities may be undertaken 24 hours per day, seven (7) days per week: (a) tunnelling and associated support activities (excluding cut and cover tunnelling, and excluding the installation and decommissioning of the Blues Point acoustic shed except where compliance with Condition E44 is achieved); (b) excavation within an acoustic enclosure (excluding the Blues Point temporary site except where compliance with Condition E44 is achieved); (c) excavation at Central (excluding Central Walk works at 20-28 Chalmers Street, Surry Hills) without an acoustic enclosure; (d) station and tunnel fit out; and (e) haulage and delivery of spoil and materials. E48.1 Notwithstanding E48(a), the Proponent must use best endeavours to schedule annoying activities, including steel hammering and movement of the self-propelled modular trailer, at the Blues Point temporary site between 7am and 8pm.	See Section 5.2	Approvals, Environment and Sustainability Manager Construction managers Project Environment Manager Construction	Construction	Section 5.2
E49	All acoustic sheds must be erected as soon as site establishment works at the facilities are completed and before undertaking any works or activities which are required to be conducted within the sheds.	N/A	Approvals, Environment and Sustainability Manager Construction managers Project Environment Manager Construction	Prior to commencement of relevant construction activities	N/A
E50	A Blast Management Strategy must be prepared and include: (a) sequencing and review of trial blasting to inform blasting; (b) regularity of blasting; (c) intensity of blasting; (d) periods of relief; and (e) blasting program.	Blasting is not currently proposed and so has been excluded from this CNVMP	Construction managers Project Environment Manager	Prior to construction (if required). Blasting is not currently proposed	N/A
E51	The Blast Management Strategy must be endorsed by a suitably qualified and experienced person and reviewed by an independent specialist.	Blasting is not currently proposed and so has been excluded from this CNVMP	Project Environment Manager Construction Managers	Prior to construction (if required). Blasting is not	N/A

				currently proposed	
E52	The Blast Management Strategy must be prepared so that all blasting and associated activities are carried out so as not to generate unacceptable noise and vibration impacts or pose a significant risk to sensitive receivers. The Blast Management Strategy must be prepared in accordance with relevant guidelines including the principles outlined in Hazardous Industry Planning Advisory Paper No 6: Hazard Analysis (Department of Planning, January 2011) and Assessment Guideline: Multi-Level Risk Assessment (Department of Planning and Infrastructure, May 2011) for the handling and storage of hazardous materials and include: (a) details of blasting to be performed, including location, timing, method and justification of the need to blast; (b) identification of all potentially affected noise and vibration sensitive sites including heritage buildings and utilities; (c) establishment of appropriate criteria for blast overpressure and ground vibration levels at each category of noise sensitive site; (d) details of the storage and handling arrangements for explosive materials and the proposed transport of those materials to the construction site; (e) identification of hazardous situations that may arise from the storage and handling of explosives, the blasting process and recovery of the blast site after detonation of the explosives; (f) determination of potential noise and vibration and risk impacts from blasting and appropriate best management practices; and (g) community consultation procedures.	Blasting is not currently proposed and so has been excluded from this CNVMP	Construction managers Project Environment Manager	Prior to construction (if required). Blasting is not currently proposed	N/A
E53	The Blast Management Strategy must be submitted to the Secretary one (1) month before blasting commences, or as agreed by the Secretary. The Blast Management Strategy as submitted to the Secretary, must be implemented for all blasting activities.	Blasting is not currently proposed and so has been excluded from this CNVMP	Construction managers Project Environment Manager	Prior to construction (if required). Blasting is not currently proposed	N/A
E54	Blasting associated with the CSSI must not exceed the following criteria, measured at the most affected residence or other sensitive receiver as specified below: (a) airblast overpressure (dB(Lin Peak)) 125 dBL; and (b) vibration (PPV): i. 25 mm/s generally; or ii. 7.5mm/s for heritage structures except where detailed investigation of the construction of the building determines that increasing the screening criterion to 25 mm/s is acceptable. The investigation must be undertaken by a suitably qualified structural engineer with experience assessing heritage structures that is approved by the Secretary. Any decision to	Blasting is not currently proposed and so has been excluded from this CNVMP	Construction managers Project Environment Manager	Prior to construction (if required). Blasting is not currently proposed	N/A

	adopt the higher vibration criterion must be supported by evidence to demonstrate the higher criterion is appropriate.				
E55	Blasting must be limited to a single detonation in any one day, and a maximum of six per week, at each station location, or any other frequency agreed by the Secretary. Note: for the purpose of this Condition, a single detonation may involve a number of individual blasts fired in quick succession in a discrete area.	Blasting is not currently proposed and so has been excluded from this CNVMP	Construction managers Project Environment Manager	Prior to construction (if required). Blasting is not currently proposed	N/A
E56	Blasting associated with the project must be undertaken at a time to have the least impact on the nearby sensitive receivers determined in consultation with those receivers. All sensitive receivers affected by any blast must be advised fortnightly of the proposed blasting schedule. The Secretary must also be advised of the advance blasting schedule for any location.	Blasting is not currently proposed and so has been excluded from this CNVMP	Construction managers Project Environment Manager	Prior to construction (if required). Blasting is not currently proposed	N/A
E58	The CSSI must be designed and constructed with the objective of minimising impacts to, and interference with, third party property and infrastructure, and that such infrastructure and property is protected during construction	Addressed in Demolition and Construction Management Plans, Design Management Plan and Design Reports	Construction managers Project Environment Manager	During design and construction	N/A
E59	Before commencement of construction, all property owners of buildings identified as being at risk of damage must be offered a building condition survey. Where an offer is accepted a structural engineer must undertake the survey. The results of the surveys must be documented in a Building Condition Survey Report for each building surveyed. Copies of Building Condition Survey Reports must be provided to the owners of the buildings surveyed, and if agreed by the owner, the Relevant Council within three (3) weeks of completing the Survey Report and no later than one (1) month before the commencement of construction.	See Building Condition Survey Report (to be prepared)	Construction managers Project Environment Manager	Pre-construction	Table 8.4
E60	Within three (3) months of the completion of construction, all property owners of buildings for which a building condition survey was carried out in accordance with Condition E59 must be offered a second building condition survey. Where an offer is accepted, building condition surveys must be undertaken by a structural engineer. The results of the surveys must be documented in a Building Condition Survey Report for each building surveyed. Copies of Building Condition Survey Reports must be provided to the owners of the buildings surveyed within one (1) month of the survey being completed.	See Building Condition Survey Report (to be prepared)	Construction managers Project Environment Manager	Post construction	Table 8.4

Revised Environmental Management Measures

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant CNVMP section
NV1	The Construction Noise and Vibration Strategy would be implemented with the aim of achieving the noise management levels where feasible and reasonable. This would include the following example standard mitigation measures where feasible and reasonable: • Provision of noise barriers around each construction site • Provision of acoustic sheds at Chatswood dive site, Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, Waterloo and Marrickville dive site • The coincidence of noisy plant working simultaneously close together would be avoided • Offset distances between noisy plant and sensitive receivers would be increased • Residential grade mufflers would be fitted to all mobile plant • Dampened rock hammers would be used • Non-tonal reversing alarms would be fitted to all permanent mobile plant • High noise generating activities would be scheduled for less sensitive period considering the nearby receivers • The layout of construction sites would consider opportunities to shield receivers from noise. • This would also include carrying out the requirements in relation to construction noise and vibration monitoring	All example NV1 mitigation measures will be considered in the development of CNVIS assessments. Relevant requirements of the Sydney Metro CNVS form part of this CNVMP, as noted in Section 3.5. Relevant requirements of the Sydney Metro CNVS will be incorporated into the CNVIS prepared for each SMCSW worksite/ activity outlined in Section 7.1. Additional mitigation measures, as defined by the Sydney Metro CNVS, are outlined in Section 8.2. Indicative mitigation and management measures applied across the project are summarised in Section 8.	Environment Manager Construction Managers	Construction	Section 3.5 / Section 7.1 / Section 8

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant CNVMP section
NV2	Unless compliance with the relevant traffic noise criteria can be achieved, night-time heavy vehicle movements at the Chatswood dive site, Crows Nest Station, Victoria Cross Station sites and Waterloo Station would be restricted to: • The Pacific Highway and Mowbray Road at the Chatswood dive site • The Pacific Highway, Hume Street and Oxley Street at the Crows Nest Station construction site • McLaren Street, Miller Street and Berry Street at the Victoria Cross Station construction site • Botany Road and Reglan Street and Waterloo Station Contraction site	N/A	N/A	N/A	N/A
NV3	Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure and attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items, the more detailed assessment would specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.	Vibration criteria, including screening criteria are outlined in Section 6.7. Criteria for vibration sensitive and special structures (including heritage) are outlined in Section 6.8. Attended vibration measurements are required to verify that vibration levels comply with the relevant criteria (Section 6.6 to 6.8) These will be adopted and used to assess impact and determine appropriate mitigation in all CNVIS prepared for the project.	Construction Managers Project Noise and Vibration Consultant Heritage Consultant Project Environment Manager	Prior to the start of demolition/construction	Section 6.8 / Section 9.2
NV4	Feasible and reasonable measures would be implemented to minimise ground-borne noise where exceedances are predicted.	All CNVIS review potential ground-borne noise impact and identify feasible and reasonable measures to manage this. See Section 8.2.2.	Construction Managers Project Noise and Vibration Consultant	Prior to the start of demolition/construction stage	Section 6.3 / Section 8.2.2.

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant CNVMP section
NV5	Feasible and reasonable mitigation measures would be implemented where power supply works would result in elevated noise levels at receivers. This would include: • Carrying out works during the daytime period when in the vicinity of residential receivers • Where out of hours works are required, scheduling the noisiest activities to occur in the evening period (up to 10 pm) • Use of portable noise barriers around particularly noisy equipment such as concrete saws.	Not applicable to Martin Place Works	N/A	N/A	N/A
NV6	Transport for NSW would engage an Independent Acoustic Advisor to act independently of the design and construction teams and provide oversight of construction methods, construction noise and vibration planning, management and mitigation, and construction noise and vibration monitoring and reporting. The key responsibilities of the Independent Acoustic Advisor would include: • Assurance of contractor noise and vibration planning, modelling, management and monitoring practices • Verification of compliance with relevant guidelines and approval requirements • Audit noise and vibration management practices	Independent Acoustic Advisor engaged by Sydney Metro (Section 3.6 and Section 3.7).	N/A	N/A	Section 3.6 and Section 3.7

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant CNVMP section
NV7	Alternative demolition techniques that minimise noise and vibration levels would be investigated and implemented where feasible and reasonable. This would include consideration of: • The use of hydraulic concrete shears in lieu of hammers/rock breakers • Sequencing works to shield noise sensitive receivers by retaining building wall elements • Locating demolition load out areas away from the nearby sensitive receivers • Providing respite periods for noise intensive works • Methods to minimise structural-borne noise to adjacent buildings including separating the structural connection prior to demolition through saw-cutting and propping, using hand held splitters and pulverisers or hand demolition • Installing sound barrier screening to scaffolding facing noise sensitive neighbours • Modifying demolition works sequencing/hours to minimise impacts during peak pedestrian times and/or adjoining neighbour outdoor activity periods.	See Alternative construction methods to rock hammering and blasting CNVIS for each activity will include the least impact alternative, where reasonable and feasible to do so. All example NV7 mitigation measures will be considered in the development of CNVIS assessments.	Construction Manager Project Environment Manager Demolition Subcontractor	Prior to construction commencement	Section 5.3.3

Revised Environmental Performance Outcomes

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	No.	Relevant CNVMP section
Table 11-2	Noise and vibration – amenity Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimize adverse impacts on acoustic amenity.	Noise levels would be minimised with the aim of achieving the noise management levels where feasible and reasonable.	This Plan has been prepared in accordance with the noise and vibration guidelines for NSW, which aim to protect noise and vibration amenity. See Section 6 and Section 8	Construction managers Project Environment Manager	Construction	This plan Section 1.4
Table 11-2	Noise and vibration – structural Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimize adverse impacts on the structural integrity of buildings and items including Aboriginal places and environmental heritage.	The project would avoid any damage to buildings from vibration	As outlined in this Plan, see Table 8.3 in Section 8, Section 6.7, Section 6.8 and Section 8.3	Construction managers Project Environment Manager	Construction	This plan Section 1.4

References

1. Department of Environment and Climate Change 2009 NSW Interim Construction Noise Guideline
2. Environment Protection Authority 1999 NSW Environmental Criteria for Road Traffic Noise
3. Department of Environment Conservation NSW 2006 Assessing Vibration; a technical guideline
4. British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)
5. German Standard DIN 4150-3: 1999-02, Structural vibration - Effects of vibration on structures, February 1999
6. ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control, pp47.39-47.40
7. Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration, p16
8. Australian Standard AS/NZS 2107:2016 *Acoustics - Recommended design sound levels and reverberation times for building interiors*
9. Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
10. Gordon CG 1991 Generic Vibration Criteria for Vibration Sensitive Equipment *Proceedings of International Society for Optical Engineering (SPIE)*, Vol. 1619, San Jose, CA, November 4-6, 1991, pp. 71-85
11. Transport for NSW Construction Noise Strategy (ref: 7TP-ST-157/2.0) April 2012
12. Australian Standard AS2187:2-1993 Explosives - Storage and use Part 2: Use of explosives (superseded by AS2187:2-2006)
13. Sydney Metro City and Southwest Chatswood to Sydenham Out of Hours Works Protocol , Document reference: SM ES-PW-317, Revision 2.0 (FINAL), 14 July 2018
14. Sydney Metro Overarching Community Communications Strategy, Sydney Metro Document Reference: A5732897, Revision 5.3 (FINAL), 12 April 2017
15. Sydney Metro City & Southwest – TSE Works - Alternative construction methods to rock hammering and blasting *(*ref. SMCSTSE-JCG-TPW-EN-RPT-097229). 06 June 2017

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Absorption Coefficient α	The absorption coefficient of a material, usually measured for each octave or third-octave band and ranging between zero and one. For example, a value of 0.85 for an octave band means that 85% of the sound energy within that octave band is absorbed on coming into contact with the material. Conversely, a low value below about 0.1 means the material is acoustically reflective.
Adverse weather	Weather effects that enhance noise (particularly wind and temperature inversions) occurring at a site for a significant period of time. In the NSW INP this occurs when wind occurs for more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of nights in winter.
Active recreation	Active recreation area, characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion, e.g. school playground, golf course
Air-borne noise	Noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise source and receiver.
Alternate Solution	An Alternative Solution is a design that complies with the relevant Performance Requirements of the National Construction Code other than by using Deemed-to-Satisfy Provisions.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Amenity	A desirable or useful feature or facility of a building or place.
AS	Australian Standard
Assessment period	The time period in which an assessment is made. e.g. Day 7am-6pm, Evening 6pm-10pm, Night 10pm-7am.
Assessment Point	A location at which a noise or vibration measurement is taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.
Barrier (Noise)	A natural or constructed physical barrier which impedes the propagation of sound and includes fences, walls, earth mounds or berms and buildings.
Berm	Earth or overburden mound.
Buffer	An area of land between a source and a noise-sensitive receiver and may be an open space or a noise-tolerant land use.
Bund	A bund is an embankment or wall of brick, stone, concrete or other impervious material, which may form part or all of the perimeter of a compound.
BS	British Standard
CoRTN	United Kingdom Department of Environment entitled "Calculation of Road Traffic Noise (1988)"

Decibel [dB]	The units of sound measurement. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear, defined as 20 micro Pascal 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibel. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies. The dB(C) level is not widely used but has some applications.
Diffraction	The distortion of sound waves caused when passing tangentially around solid objects.
DIN	German Standard
DnT,w	Weighted Standardised Field Level Difference A measure of sound insulation performance of a building element. It is characterised by the difference in noise level on each side of a wall or floor. It is measured in-situ. It is a field measurement that relates to the Rw laboratory measured value but is not equal to it because an in-situ space is not of the same quality as a laboratory space. The value is indicative of the level of speech privacy between spaces. The higher its value the better the insulation performance.
ECRTN	Environmental Criteria for Road Traffic Noise, NSW, 1999
EPA	Environment Protection Authority
Field Test	A test of the sound insulation performance in-situ. See also 'Laboratory Test' The sound insulation performance between building spaces can be measured by conducting a field test, for example, early during the construction stage or on completion. A field test is conducted in a non-ideal acoustic environment. It is generally not possible to measure the performance of an individual building element accurately as the results can be affected by numerous field conditions.
Fluctuating Noise	Noise that varies continuously to an appreciable extent over the period of observation.
Free-field	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Ground-borne noise	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.

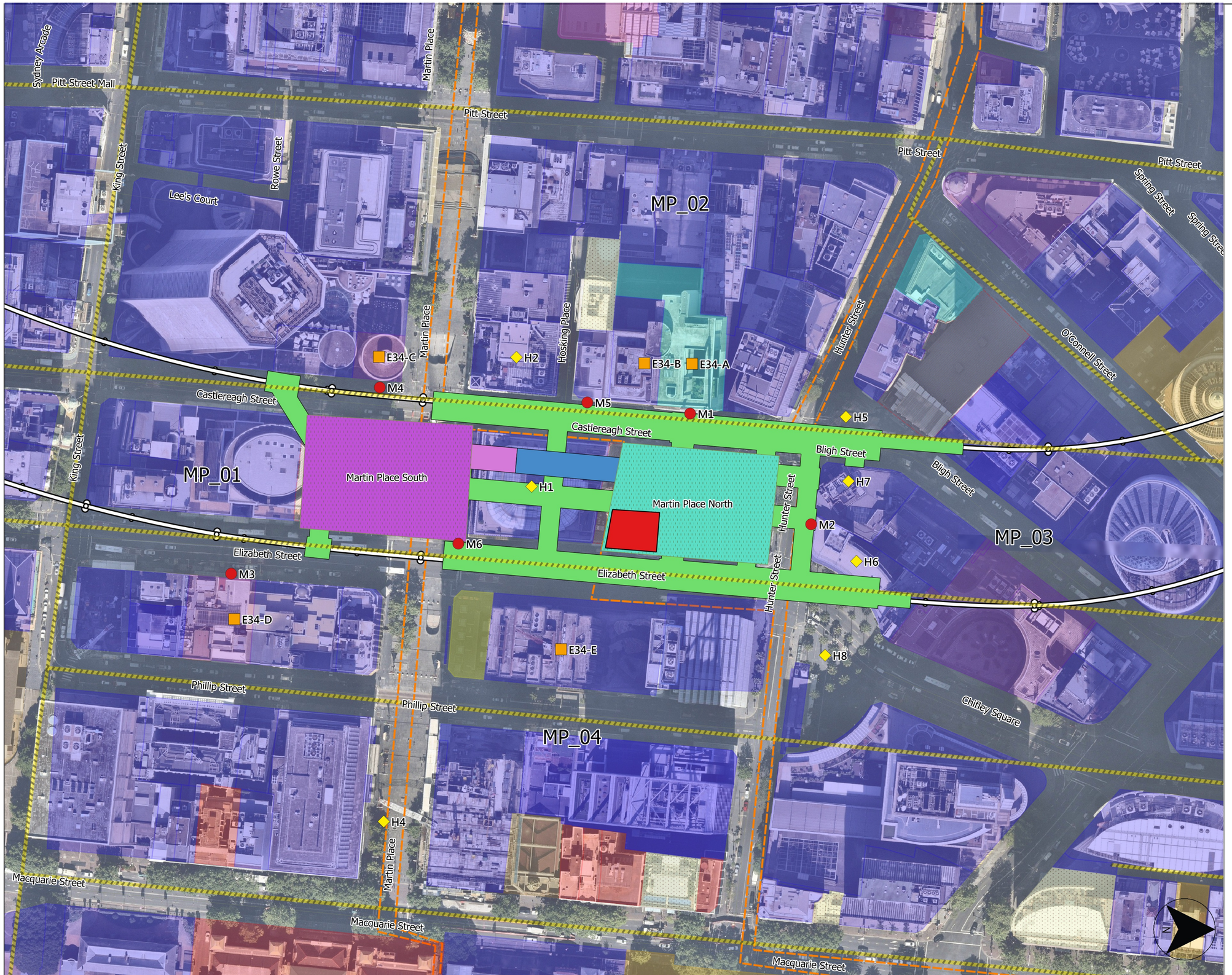
Habitable Area	Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom. Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.
Heavy Vehicle	A truck, transporter or other vehicle with a gross weight above a specified level (for example: over 8 tonnes).
Impact Noise	The noise in a room, caused by impact or collision of an object onto the walls or the floor. Typical sources of impact noise are footsteps on the floor above a tenancy and the slamming of doors on cupboards mounted on the common wall between tenancies.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
INP	NSW Industrial Noise Policy, EPA 1999
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
Intrusive noise	Refers to noise that intrudes above the background level by more than 5 dB(A).
ISEPP	State Environmental Planning Policy (Infrastructure), NSW, 2007
ISEPP Guideline	Development Near Rail Corridors and Busy Roads - Interim Guideline, NSW Department of Planning, December 2008
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
$L_{10(1hr)}$	The L10 level measured over a 1 hour period.
$L_{10(18hr)}$	The arithmetic average of the L10(1hr) levels for the 18 hour period between 6am and 12 midnight on a normal working day.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{Aeq} or L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a fluctuating sound level. When A-weighted, this is written as the L_{Aeq}.
$L_{Aeq(1hr)}$	The L_{Aeq} noise level for a one-hour period. In the context of the NSW EPA's Road Noise Policy it represents the highest tenth percentile hourly A-weighted L_{eq} during the period 7am to 10pm, or 10pm to 7am (whichever is relevant).
$L_{Aeq(8hr)}$	The L_{Aeq} noise level for the period 10pm to 6am.
$L_{Aeq(9hr)}$	The L_{Aeq} noise level for the period 10pm to 7am.
$L_{Aeq(15hr)}$	The L_{Aeq} noise level for the period 7am to 10pm.
$L_{Aeq\ (24hr)}$	The L_{Aeq} noise level during a 24 hour period, usually from midnight to midnight.
L_{max}	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the L_{Amax}.
L_{min}	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the L_{Amin}.
Ln,w	Weighted Normalised Impact Sound Pressure Level A measure of the sound level transmitted from impacts on a floor to a tenancy below. It is measured in very controlled conditions in a laboratory and is characterised by how much sound reaches the receiving room from a standard tapping machine. A lower value indicates a better performing floor.

LnT,w	Weighted Standardised Field Impact Sound Pressure Level As for Ln,w but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement. The equivalent measurement in a laboratory is the Ln,w. A lower value indicates a better performing floor.
Laboratory Test	The performance of a building element when measured in a laboratory. The sound insulation performance of a building element installed in a building however can differ from its laboratory performance for many reasons including the quality of workmanship, the size and shape of the space in which the measurement is conducted, flanking paths and the specific characteristics of the material used which may vary from batch to batch.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on. That is, the sound of 85 dB is four times or 400% the loudness of a sound of 65 dB.
Microphone	An electro-acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.
NCA	Noise Catchment Area. An area of study within which the noise environment is substantially constant.
Noise	Unwanted sound
NRC	Noise Reduction Coefficient. A measure of the ability of a material to absorb sound. The NRC is generally a number between 0 and 1 but in some circumstances can be slightly greater than 1 because of absorption at the edges of the material. A material with an NRC rating of 1 absorbs 100% of incoming sound, that is, no sound is reflected back from the material. The NRS is the average of the absorption coefficient measured in the octave bands 250Hz, 500Hz, 1kHz & 2kHz which correspond to the predominant frequencies associated with the human voice.
Passive recreation	Area specifically reserved for passive recreation, characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion e.g. reading, meditation
PPA	Project Planning Approval
Reflection	Sound wave reflected from a solid object obscuring its path.
Reverberation Time	The time (in seconds) it takes for a noise signal within a confined space to decay by 60dB. The longer the reverberation time (usually denoted as RT60), the more echoic a room. Longer reverberation times generally result in higher noise levels within spaces.
RMS	Root Mean Square value representing the average value of a signal.
Rw	Weighted Sound Reduction Index A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory. The term supersedes the value STC which was used in older versions of the Building Code of Australia. Rw is measured and calculated using the procedure in ISO 717-1. The related field measurement is the DnT,w. The higher the value the better the acoustic performance of the building element.
R'w	Weighted Apparent Sound Reduction Index. As for Rw but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement. The higher the value the better the acoustic performance of the building element.
RNP	Road Noise Policy, NSW, March 2011
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.

Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy by conversion to thermal energy.
Sound Insulation	Sound insulation refers to the ability of a construction or building element to limit noise transmission through the building element. The sound insulation of a material can be described by the Rw and the sound insulation between two rooms can be described by the DnT,w.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 pico watt.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 mico Pascal.
Spoil	Soil or materials arising from excavation activities.
Standardised	A method of adjusting the measured noise indices in-situ so that they are independent of the measuring space. The noise level in a room is affected by reverberation in the room. For example, the L'n,w impact sound pressure level measured in a room is dependent upon the amount of absorptive material in the receiving room. The value is adjusted to what would be measured if the reverberation time in the receiving room is set at 0.5 seconds. This enables the same value to be reported independent of whether the room contains carpet and furnishings and the like. See also 'Normalised'.
STC	Sound Transmission Class A measure of the sound insulation performance of a building element. It is measured in controlled conditions in a laboratory. The term has been superseded by Rw.
Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.
Tonal Noise	Sound containing a prominent frequency and characterised by a definite pitch.
Transmission Loss	The sound level difference between one room or area and another, usually of sound transmitted through an intervening partition or wall. Also the vibration level difference between one point and another. For example, if the sound level on one side of a wall is 100dB and 65dB on the other side, it is said that the transmission loss of the wall is 35dB. If the transmission loss is normalised or standardised, it then becomes the Rw or R'w or DnT,w.

APPENDIX B Land Use Survey and Noise Catchment Areas (NCA)

Note: Further noise catchments may be assessed in supplementary construction noise and vibration impact statements completed as the project progresses.



NOTES:

1. ALL DIMENSIONS ARE IN MILIMETRES UNLESS STATED OTHERWISE.
2. ALL DETAILS AND DIMENSIONS ARE SUBJECT TO FINAL DESIGN CONFIRMATION.

Legend

NCAs

Land Uses
- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
- Residential
- Theatre/Auditorium
- Under construction

Station
- Martin Place North
- Martin Place South

Tunnels/ Adits/ Caverns/ Pedetrian Link
- Pedestrian Link (Completed by Lendlease)
- Pedestrian Link (Completed by TSE Contractors)
- Tunnels/ Adits/ Station Carvern

Demolition works
- 9-19 Elizabeth Street Demolition Works

Table 4.2 Identified Heritage Receivers
- H1 - Commonwealth Bank of Australia
- H2 - Former "MLC Building"
- H4 - Martin Place Railway Station
- H5 - Richard Johnson Square including monument and plinth
- H6 - Former "Qantas House" including interiors
- H7 - Former "City Mutual Life Assurance" Building including interiors
- H8 - Chifley Square
- H3 - Bennelong Stormwater Channel No 29

Table 7.1 E34 affected receiver locations
- E34-A - Castlereagh Street Early Learning Centre
- E34-B - Explore and Develop
- E34-C - CTA Business Club
- E34-D - Travelodge Hotel
- E34-E - Channel 7

Nominated verification monitoring locations
- M1 - 9 Castlereagh Street
- M2 - 70 Hunter Street
- M3 - 165 Phillip Street
- M4 - 27-39 Castlereagh Street
- M5 - 17 Castlereagh Street
- M6 - 50 Martin Place

FOR INFORMATION ONLY

RENZO TONIN & ASSOCIATES
inspired to achieve

REV.	BY	DATE	DESCRIPTION	APPD.
r0	MN	18/12/2018	Prepare figures	CW

SCALES: 10 0 10 20 30 40 m — 1:825 FULL SIZE A1

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

INDEPENDENT CERTIFIER CERTIFICATE

CLIENT: NSW GOVERNMENT Transport for NSW

SERVICE PROVIDERS: lendlease

DRAWN	MN
DESIGNED	MN
DRG CHECK	MN
DESIGN CHECK	MN
APPROVED	CW

MARTIN PLACE METRO

STATUS: ISSUED | SHEET 1 OF 1 | ©

TSE Drg No. | TSE REV.

A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing.

APPENDIX C Work areas, site layout and access points

Note: Site layout and access points will be detailed in the project Construction Management Plan and Construction Traffic Management Plan.

APPENDIX D Indicative schedule of construction activities and key noise and/or vibration generating construction equipment and plant

Table D1: Construction Timetable/ Activities/ Equipment **9-19 ELIZABETH STREET DEMOLITION**

Activity/ Work Area	Aspect	Duration/Commencement	Plant/ Equipment	Net Power kW	Operating Weight kg	Day	Evening	Night	Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)		Notes
						7am - 6pm	6pm - 10pm	10pm - 7am	L_{Aeq}	L_{A1}	
Demolition	Typical daily activities include power supply, deliveries;		Power Generator	25 kVA		1	-	-	94		
			Road truck (deliveries to site)			2	-	-	108		
			Light vehicle			5	-	-	89		
			Compressor	110	2660	1	-	-	102		
			Hand tools			5	-	-	104		
			Powered Hand Tools			5	-	-	109		
			Vac Truck			1	-	-	108		
			Telescopic forklift/forklift	55kW		1	-	-	99		
			Water cart/ Street Sweeper		15000L (body truck)	1	-	-	107		
			Franna Crane	205	20t	1	-	-	99	106	
	Material Load out (including hazadous material)		Excavator w bucket	20t-30t		1	-	-	105		
			Bin Truck			3 loads/day	-	-	108		No bin trucks during demolition
			Delivery Truck - hooklift (skip bins)			12 loads/day	-	-	108	122	
			Bobcat			2	-	-	109		
	Structural demolition		Excavator w: pulverisor, shears,	5-45t		1	-	-	108		
			Excavator w: hammer	5-45t		1	-	-	123 + 5 pen		
			Hand tools			2	-	-	109		
			Bobcat			1	-	-	109		
			Generator	10Kva		1	-	-	94		

Table D2: Construction timetable/ activities/ equipment **MARTIN PLACE METRO STATION**

Activity/ Work Area	Aspect	Plant/ Equipment	Net Power kW	Operating Weight	Day	E1	E2	Night	Timing of Activity	Notes	Sound Power Level (Lw re: 1pW)	
					7am - 6pm	6pm - 8pm	8pm - 10pm	10pm - 7am			L_{Aeq}	L_{A1}
Construction Compound & Site vehicle parking	General worksite and Car parking	Light vehicle			1	1	1	1			89	
Site sheds, workshop, car parking & laydown areas		Water treatment plant pumps			1	1	1	1			97	
	Workshop; Deliveries; Maintenance; Storage	Road truck (deliveries to site)			1	1	-	-			108	
		Compressor			1	1	-	-			111	
		Generator			1	1	-	-			97	
		Workshop Hand Tools			1	1	-	-			107	
		Forklift			1	1	-	-			105	
		Franna Crane			1	1	-	-			99	106
Retaining work	Piling Activities	Piling rig (impact)			2	2	-	-		Piling rigs will be rotation only - i.e. no top hammer or down the hole hammer	114 + 5 pen	
		Concrete truck and pump			1	1	-	-			108	117
		Anchor Rigs			2	2	-	-			120 + 5 pen	
		Road Saw			1	1	-	-			119 + 5 pen	
		Excavator w rockhammer			1	1	-	-			123 + 5 pen	
	Reinforced concrete works	Handheld saw			1	1	-	-			119 + 5 pen	
		Handheld Grinders			4	4	-	-			103	
		Franna crane			1	1	-	-			98	
		Concrete truck and pump			2	2	-	-			108	117
		Concrete vibrators			2	2	-	-			97	
	Precast Install	Crawler Crane			1	1	-	-			106	
		Trucks			1	1	-	-			108	117
		Franna Crane			1	1	-	-			98	
	Backfilling behind retaining walls	Excavator w bucket			1	1	-	-			107	
		Dump trucks			1	1	-	-			108	117
		Roller (10 tonne)			1	1	-	-			112	
		Compaction plates			1	1	-	-			106	
							-	-				
Shaft Excavation & Construction	Excavation of soil and rock; Hammering/rock breaking; Drilling; Loading; Haulage.	Piling rig (impact)			1	1	-	-			114 + 5 pen	
		Crane (100t)			1	1	-	-			99	
		Water pump (diaphragm pump)			1	1	-	-			97	
		Excavator w bucket			2	2	-	-			103	
		Excavator w rockhammer			2	2	-	-		Will not be used duing Bulk Excavation Stage 3	123 + 5 pen	
		Excavator w Rock Saw			1	1	-	-			119 + 5 pen	
		D10 Dozer with ripper			1	1	-	-		Will be used for the majority of excavation	116	
		Truck (spoil haulage)			26 per hour	26 per hour	10 per hour	10 per hour			108	117
		FE Loader			1	1	1	1			110	
	Support works - concreting with concrete trucks, concrete vibrators	Rock drilling machine			1	1	-	-		For spot bolting only	120 + 5 pen	
		Concrete truck			1	1	-	-			108	117
		Concrete pump (boom pump on semi)			1	1	-	-			99	
		Shotcrete rig			1	1	-	-			104	
		Hand tools			1	1	-	-		For spot areas only	97	
Concourse Link Tunnel	Excavation of soil and rock; Hammering/rock breaking; Loading; Haulage; Support works - concreting with concrete trucks, concrete vibrators	Road Header 1,000V Electric		65t	1	1	1	1		Located underground	113	
		Excavator w bucket		13t	1	1	1	1		Located underground	103	
		Excavator w rockhammer			1	1	1*	1*		Located underground/ Subject to noise verification/ Not included in noise model	123 + 5 pen	
		Rock drilling machine		15t	1	1	1	1		Located underground	120 + 5 pen	
		Dust Scrubber	150		1	1	1	1			107	
		Vent fan	150		1	1	1	1			107	
		Truck (spoil haulage)			26 per hour	26 per hour	10 per hour	10 per hour		Rigid road-going trucks loaded at street level	108	117
		FE Loader		15t	1	1	1	1		Located underground	106	
	Support works - concreting with concrete trucks, concrete vibrators	Rock drilling machine			1	1	1	1		Located underground	120 + 5 pen	
		Concrete truck			4 per shift	4 per shift	4 per shift	4 per shift		Deliveries from external batch plant	108	117
		Concrete pump (boom pump on semi)			1	1	1	1			99	99
		Shotcrete rig			1	1	1	1		Located underground (GBN only)	104	104
		Power tool			1	1	1	1			97	
Basements Structure/ Core Structure/Fitout	Footings, foundations and platforms; Columns, beams and reinforced concrete slabs / walls; Internal fitout of station building	Piling rig (impact)			1	1	-	-			114 + 5 pen	
		Hand held saw			1	1	1	1			119 + 5 pen	
		Table saw			1	1	-	-			113	
		Handheld Grinders			4	4	4	4			103	
		Road Saw			1	1	-	-			119 + 5 pen	
		Franna crane			1	1	-	-			98	
		Mobile Crane			1	1	-	-			106	
		Tower Cranes			3	3	-	-			106	
		Hoist / Alimak			3	3	3	3			95	
		Concrete Truck			4 per shift	4 per shift	-	-			108	117
		Concrete pump			1	1	-	-			108	117
		Concrete vibrators			1	1	-	-			97	
		Trucks			4 per shift	4 per shift	-	-			110	
		Fork lift			1	1	1	1			104	
		Hand tools			1	1	1	1			97	
Landscape And Surface Finishing Works	Landscaping - Hard and Soft Install	Hand held tools			1	1	-	-			97	
		Franna crane			1	1	-	-			98	
		Trucks			1	1	-	-			108	117
		Excavator w bucket			1	1	-	-			109	
		Bobcat			1	1	-	-			107	
		Fork lift			1	1	-	-			104	

APPENDIX E Monitoring procedures

Specification for Determining the Sound Power of Construction Plant and Equipment

Scope

This document specifies methods for determination of sound power levels for construction plant including earthmoving equipment and other ancillary plant and equipment used during construction.

Referenced Standards

- AS IEC 61672.1 Electroacoustic - Sound Level Meters – Specifications;
- AS 2012.1 Acoustics - Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors - Stationary test condition - Determination of compliance with limits for exterior noise
- ISO 3744 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane
- ISO 3746 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane
- ISO 6393 Earth-moving machinery - Determination of sound power level - Stationary test conditions
- ISO 6395 Earth-moving machinery - Determination of sound power level - Dynamic test conditions

Testing Procedures – Earthmoving Machinery

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking acoustic measurements.

Each significant plant item shall be tested in terms of both the 'stationary' and the 'dynamic' testing procedures detailed below.

All sound level meters used must be Type 1 instruments as described in AS IEC 61672.1 2004 "Electroacoustic - Sound Level Meters" and calibrated to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics). The calibration of the meters shall be checked in the field before and after the noise measurement period.

Stationary Testing

Stationary measurements shall be performed on all earthmoving plant according to the method of AS 2012.1 and/or ISO 6393.

In addition to measuring overall A-weighted noise levels, octave band frequency LAeq,T noise levels shall also be measured at each measurement location from 63Hz to 8kHz inclusive. Background noise shall also be recorded in the same octave band frequency range, and corrections to measured octave-band noise levels shall be applied as described in Table 1 of AS2012.1.

Each plant item should be tested in isolation, without any other noisy plant on site operating. Where this cannot be done for practical reasons, then the noise of the plant being tested shall be at least 5dB greater than the background noise from other nearby plant, both in terms of the overall A-weighted level and in all octave band frequencies.

Measured octave-band LAeq,T noise levels shall also be processed as described in Section 8 of that Standard to establish octave-band sound power levels.

The overall A-weighted sound power levels to be determined shall be in terms of both the LAeq,T and LA10,T noise metrics. The measurement sample time shall be selected so that it is representative of the operating cycle/s of the plant being tested.

Where the plant tested or noise measurements are taken within 3.5 metres of large walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

All measured noise level data and determined sound power levels shall be included in the test reports.

Dynamic Testing

Details of equipment operation during testing will vary depending on the equipment type. Dynamic measurements shall be performed on all earthmoving plant according to the method in International Standard ISO 6395.

In addition to measuring overall A-weighted noise levels, octave band frequency $L_{Aeq,T}$ noise levels shall also be measured at each measurement location from 63Hz to 8kHz inclusive. Background noise shall also be recorded in the same octave band frequency range, and corrections to measured octave-band noise levels shall be applied as described in International Standard ISO 6395.

Each plant item should be tested in isolation, without any other noisy plant on site operating. Where this cannot be done for practical reasons, then the noise of the plant being tested shall be at least 5dB greater than the background noise from other nearby plant, both in terms of the overall A-weighted level and in all octave band frequencies.

Measured octave-band $L_{Aeq,T}$ noise levels shall also be processed to establish octave-band sound power levels.

Where the plant tested or noise measurements are taken within 3.5 metres of large walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

The overall A-weighted sound power levels to be determined shall be in terms of both the $L_{Aeq,T}$ and LA10,T noise metrics. The measurement sample time shall be selected so that it is representative of the operating cycle/s of the plant being tested.

All measured noise level data and determined sound power levels shall be included in the test reports.

Testing Procedures – Other Construction Plant

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking acoustic measurements.

All sound level meters used must be Type 1 instruments as described in AS IEC 61672.1 'Electroacoustic - Sound Level Meters'. The calibration of the meters shall be checked in the field before and after the noise measurement period.

Noise measurements shall be performed on all non-earthmoving construction plant according to the methods of either ISO 3744 or ISO 3746, whichever is applicable to the items of plant being tested.

Machinery shall be operated at high idle speed. In the case of drilling, boring and rock-breaking machines, the testing location shall allow for these machines to be operated in rock of characteristics that are typical for the project site.

In addition to measuring overall A-weighted noise levels, octave band frequency $L_{Aeq,T}$ noise levels shall also be measured at each measurement location from 63Hz to 8kHz inclusive. Background noise shall also be recorded in the same octave band frequency range, and corrections to measured octave-band noise levels shall be applied as described in Table 1 of AS2012.1.

Each plant item should be tested in isolation, without any other noisy plant on site operating. Where this cannot be done for practical reasons, then the noise of the plant being tested shall be at least 5dB greater than the background noise from other nearby plant, both in terms of the overall A-weighted level and in all octave band frequencies.

Measured octave-band $L_{Aeq,T}$ noise levels shall also be processed as described in Section 8 of that Standard to establish octave-band sound power levels.

The overall A-weighted sound power levels to be determined shall be in terms of both the $L_{Aeq,T}$ and $L_{A10,T}$ noise metrics. The measurement sample time shall be selected so that it is representative of the operating cycle/s of the plant being tested.

Where the plant tested or noise measurements are taken within 3.5 metres of large walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures. All measured noise level data and determined sound power levels shall be included in the test reports.

Specification for Construction Noise Monitoring

Scope

This document specifies methods for undertaking noise monitoring during the construction phase of the project.

Referenced Standards & Guidelines

- AS IEC 61672.1 Electroacoustic - Sound Level Meters – Specifications;
- AS 1055 Acoustics - Description and Measurement of Environmental Noise;
- DECCW NSW Interim Construction Noise Guideline 2009; and
- EPA NSW Industrial Noise Policy 2000.

Testing Procedures

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking acoustic measurements.

All noise monitoring equipment used must be at least Type 2 instruments as described in AS IEC 61672.1 2004 'Electroacoustic - Sound Level Meters - Specifications' and calibrated to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics). The calibration of the monitoring equipment shall also be checked in the field before and after the noise measurement period, and in the case of long-term noise monitoring, calibration levels shall be checked at minimum weekly intervals.

Long-term noise monitoring equipment or Noise Loggers, consist of sound level meters and computers housed in weather resistant enclosures. The operator may either retrieve the data at the conclusion of each monitoring period either in person or via a telephone modem if the logger is fitted with a mobile phone option.

All environmental noise measurements shall be taken with the following meter settings:

- Time Constant - FAST (i.e. 125 milliseconds)
- Frequency Weightings - A-weighting
- Sample Period - 15 minutes

All outdoor noise measurements shall be undertaken with a windscreen over the microphone. Windscreens reduce wind noise at the microphones.

Measurements of noise should be disregarded when it is raining and/or the wind speed is greater than 5 m/s (18 km/HR).

Long-term (unattended) Monitoring

Noise monitoring shall be undertaken in accordance with the environmental noise measurement requirements stipulated in the reference standards and documents listed above.

Noise monitoring equipment shall be placed at positions which have unobstructed views of general site activities, whilst shielded as much as possible from non-construction site noise (e.g. road traffic, rail noise and other surrounding noise).

Noise levels are to be recorded at a minimum rate of 10 samples per second. Every 15 minutes, the data is to be processed statistically and stored in memory. The minimum range of noise metrics to be stored in memory for later retrieval is the following A-weighted noise levels: Lmin, L90, Leq, L10, L1 and L_{max}.

Where the noise monitors are placed within 3.5 metres of building facades, walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

Meteorological conditions such as wind velocity, wind direction and rainfall shall also be either monitored on site or recorded from the nearest weather station to the project site, over the entire noise monitoring period.

Short-term (attended) Monitoring

All attended short-term noise monitoring shall be recorded over 15 minute sample intervals. Noise levels are to be recorded at a minimum rate of 10 samples per second. Every 15 minutes, the data is to be processed statistically and stored in memory. The minimum range of noise metrics to be stored in memory and reported are the following A-weighted noise levels: L_{min}, L_{90}, L_{eq}, L_{10}, L_1 and L_{max}.

In addition to measuring and reporting overall A-weighted noise levels, statistical L_{90}, L_{eq}, L_{10} noise levels shall also be measured and reported in third-octave band frequencies from 31.5Hz to 8kHz.

Outdoor noise monitoring is to be undertaken at least 3.5m from any reflecting structure other than the ground. The preferred measurement height is 1.2-1.5m above the ground. Where the noise monitors are placed within 3.5 metres of building facades, walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

Measurements inside buildings should be at least 1m from the walls or other major reflecting surfaces, 1.2 m to 1.5m above the floor, and about 1.5m from windows.

Conditions such as wind velocity, wind direction, temperature, relative humidity and cloud cover shall also be recorded during short-term noise monitoring.

Noise monitoring shall be undertaken in accordance with the environmental noise measurement requirements stipulated in the reference standards and documents listed above.

The following information shall be recorded:

- Date and time of measurements
- Type and model number of instrumentation
- Results of field calibration checks before and after measurements
- Description of the time aspects of each measurement (i.e. sample times, measurement time intervals and time of day)
- Sketch map of area
- Measurement location details and number of measurements at each location
- Weather conditions during measurements
- Operation and load conditions of the noise sources under investigation
- Any adjustment made for presence or absence of nearby reflecting surfaces
- Noise due to other sources (e.g. traffic, aircraft, trains, dogs barking, insects etc.)

Specification for construction vibration monitoring

Scope

This document specifies methods for undertaking vibration monitoring during the construction phase of the project.

Referenced Standards and Guidelines

- AS 2775 Mechanical Mounting of Accelerometers
- AS 2670.2 Part 2: Evaluation of human exposure to whole body vibration
- DECC NSW Assessing Vibration: A Technical Guideline
- DIN 4150.3 Structural Vibration in Buildings – Effects on Structures

- BS 7385:1 Evaluation and Measurement for Vibration in Buildings – Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings
- BS 7385:2 Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Groundborne Vibration
- ISO 4866 Mechanical Vibration & Shock – Vibration of Buildings – Guidelines for the Management of the Vibrations and Evaluation of their Effects on Buildings

Testing Procedures

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking vibration measurements.

All vibration monitoring equipment used must be calibrated at least once every two years to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics). The monitoring system should also have a measurement frequency range down to 1Hz.

Short-Term (Attended) Monitoring

Vibration monitoring shall be undertaken at the following locations:

- at the commencement of operation for each plant or activity on site, which has the potential to generate significant vibration levels, so to refine the indicative minimum working distances and provide a site-specific table of minimum working distances
- vibration sensitive locations determined to fall within the 'buffer distances' established for each item of plant. Areas likely to require vibration monitoring are identified in this report; and
- where vibration complaints or requests from relevant authorities, at the requested location and at any other relevant vibration receiver location with closest proximity to the construction activities.

Vibration monitoring shall be undertaken over the following period(s):

- for plant operating within the 'buffer distances', during the commencement of use of each plant on site until site-specific minimum working distances are established; and
- for complaints or requests from relevant authorities, during the of use of requested plant until site-specific minimum working distances are established.

All attended short-term vibration monitoring shall be recorded over 15 minute sample intervals. The magnitude of vibration is to be recorded at a minimum rate of 10 samples per second. The following minimum range of vibration metrics should be stored in memory and reported:

- Vibration Dose Values (VDVs)

- root-mean-square (rms) – maximums and statistical levels
- peak-particle velocity (ppv) – maximums and statistical levels.

In addition to measuring and reporting overall vibration, statistical vibration shall also be measured and reported in third-octave band frequencies from 1Hz to 250Hz.

Vibration monitoring shall be undertaken in accordance with the vibration measurement requirements stipulated in the reference standards and documents listed above. The following notes of importance are included here:

- vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest, closest to the vibrating plant;
- the surface should be solid and rigid in order to best represent the vibration entering the structure of the building under investigation;
- the vibration sensor or transducer shall not be mounted on loose tiles, loose gravel or other resilient surfaces;
- the vibration sensor or transducer shall be directly mounted to the vibrating surface using either bees wax or a magnetic mounting plate onto a steel washer, plate or bracket which shall be either fastened or glued to the surface of interest; and
- where a suitable mounting surface is unavailable, then a metal stake of at least 300mm in length shall be driven into solid ground adjacent to the building of interest, and the vibration sensor or transducer shall be mounted on that.

The following information shall be recorded:

- Date and time of measurements;
- Type and model number of instrumentation;
- Description of the time aspects of each measurement (i.e. sample times, measurement time intervals and time of day);
- Sketch map of area;
- Measurement location details and number of measurements at each location;
- Operation and load conditions of the vibrating plant under investigation; and
- Possible vibration influences from other sources (e.g. domestic vibrations, other mechanical plant, traffic, etc.).

Long-Term (Unattended) Monitoring

Vibration monitoring shall be undertaken at vibration sensitive locations determined to fall within the 'minimum working distances' established for each item of plant during the commencement of use of each plant on site.

Vibration monitoring shall be undertaken over the following period(s):

- continuously whilst the vibrating plant is operational within the pre-determined 'minimum working distance' from the potentially affected building.

Vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest, closest to the vibrating plant.

Vibration is to be recorded at a minimum rate of 10 samples per second. The data is to be processed statistically and stored in memory. The minimum range of vibration metrics to be stored in memory for later retrieval is the following:

- Vibration Dose Values (VDVs)
- vector-sum root-mean-square (rms) – maximums and statistical metrics; and
- vector-sum peak-particle velocity (ppv) – maximums and statistical metrics.

Vibration monitoring shall be undertaken in accordance with the vibration measurement requirements stipulated in the reference standards and documents listed above. The following notes of importance are included here:

- vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest, closest to the vibrating plant;
- the surface should be solid and rigid in order to best represent the vibration entering the structure of the building under investigation;
- the vibration sensor or transducer shall not be mounted on loose tiles, loose gravel or other resilient surfaces;
- the vibration sensor or transducer shall be directly mounted to the vibrating surface using bees wax or a magnetic mounting plate onto a steel plate or bracket either fastened or glued to the surface of interest;
- where a suitable mounting surface is unavailable, then a metal stake of at least 300mm in length shall be driven into solid ground adjacent to the building of interest, and the vibration sensor or transducer shall be mounted on that; and
- a flashing light alarm should be attached in a visible position from the construction work area. When vibration exceeds the set threshold, the light will flash notifying the operator that works in that area should cease immediately.

APPENDIX F Records of Agency Consulation

Report Section	Agency Comment	Lendlease Response
City of Sydney Council		
n/a	n/a	An overview of the CNVMP and CNVIS (for Demolition of 9-19 Elizabeth Street) was given to City of Sydney Council on 17 August 2018.
MARTIN PLACE METRO CSSI Construction Noise and Vibration Impact Statement for Demolition of 9-19 Elizabeth Street	In Appendix D, Table D1 [CNVIS for demolition of 9-19 Elizabeth Street] details the different stages of the demolition, it states that the Childcare at 9 Castlereagh St. will be affected by of levels between 60 – 78 dB [external].	Appendix D, Table D1 provides predicted external noise levels at sensitive receivers for various construction scenarios. Based on discussions with the AA and EPA, it has been requested for noise level predictions to be made based on NMLs in the NSW Interim Construction Noise Guideline (IGNG) and also the Conditions of Approval.
Appendix D, Table D1	A noise level above 75 dB is considered 'highly noise affected'. The exposure of children to highly intrusive noise is not acceptable.	The process of establishing internal NMLs is discussed in Section 6.2.3 of the CNVMP. Table 6.4 of the CNVMP nominates an internal NML of 45 dB(A) for classrooms / educations institutions, consistent with Table 3 of ICNG and AS2107. In a typical suburban environment, an outdoor to indoor noise reduction of 10 dB(A) (assuming windows / doors open) is typically applied to establish an equivalent external NML of 55 dB(A). This is the NML value shown in column 5 of CNVIS Table D1. However, for CBD environs (Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt St and Central), the Conditions of Approval account for the fact that noise-sensitive receivers predominantly have fixed glazing, rather than openable windows to attenuate traffic noise and mechanical plant noise. Internal NMLs are therefore applicable per Conditions E37/E38 and E41/E42 in these precincts. For childcare centres, an internal NML of 60 dB(A) is applicable per Conditions E37/E38 and based on a typical external to internal noise reduction of 25 dB(A), an equivalent external NML of 85 dB(A) is applicable per column 12 of CNVIS Table D1. At the childcare centre (9 Castlereagh Street), worst-case predictions during use of rockbreakers is up to 78 dB(A) external and 53 dB(A) internal. This level of 53 dB(A) internal is 8 dB(A) higher than the AS2107 recommended level of 45 dB(A), but well below the Condition E37/E38 level of 60 dB(A). Section 6.2.2 of the CNVIS notes the following "In accordance with Condition E34, these receivers [including the childcare centre] are to be consulted as part of the management of the works so that activities are not undertaken within sensitive periods for each receiver, or other suitable arrangements are agreed to." We note that the "highly affected" external noise level of 75 dB(A) is applicable to residential receivers. Children at the childcare centre (internal) are predicted to experience noise levels more than 20 dB(A) below this level.
	A number of other commercial and residential premises are also predicted to be impacted by >10dB (indicated in dark blue)	Refer above response

Report Section	Agency Comment	Lendlease Response
	The noise mitigation measures intended to be implemented are; Letter box drops and Verification Monitoring. (Appendix E)	The monitoring and letter box drops are part of the mandated additional mitigations from Sydney Metro's Construction Noise Strategy that Lendlease will implement throughout the works.
	These are not adequate mitigation measures as they do not contribute to the reduction of the noise impact from the site.	Refer to Section 5.3.3 which outlines alternative methods to rock hammering - including use of pulveriser (hydraulic jaw attachment to crush concrete instead of hammer it).
	Further action should be specified in relation to the exceedances and effective mitigation measures be put in place to reduce the noise impact.	Please refer to Section 8, Table 8.1 and 8.2 which lists reasonable and feasible mitigation measures.
MARTIN PLACE METRO CSSI Construction Noise and Vibration Management Plan (Version 12) and Construction Noise Impact Statement for Martin Place Metro Excavation and Construction (version 1)	Latest versions of CNVMP and CNVIS were provided to City of Sydney Council for review and responded that no changes are proposed. Revision 14: The CNVMP has been reviewed by Council's Health Unit and they have advised that they have no additional comments to add. If noise & vibration monitoring demonstrate that there is an impact on surrounding receivers, construction management levels and equipment can be reviewed to reduce the impact back within the established goals. Consultation with the City in response to the relevant conditions is considered to be addressed.	n/a

Report Section	Agency Comment	Lendlease Response
NSW Environment Protection Authority		
n/a	Thank you for forwarding the documents for our records. The EPA encourages the development of such plans to ensure that proponents have determined how they will meet their statutory obligations and designated environmental objectives. However, it is not EPA policy to approve or endorse these documents. The EPA's role is to set environmental objectives/requirements for environmental management, rather than being directly involved in the development of strategies to achieve those objectives/requirements. You may however wish to submit the CNVMP, or parts thereof, as supporting information for your future Environment Protection Licence (EPL) application. Information in the CNVMP would be a relevant consideration for EPA in exercising its functions under Section 45 of the Protection of the Environment Operations Act 1997. Any required application to EPA to vary a licence, or for the issue of a licence for scheduled development work or a licenced activity should be made in a timely manner to allow for processing of the application. The Act provides that a licence application is deemed to have been refused after 60 days.	NSW EPA was provided a copy of the CNVMP (Report TK422-F03 (r4) Martin Place CSSI CNVMP.docx) and CNVIS (for Demolition of 9-19 Elizabeth Street) (Report TK422-F04 9-19 Elizabeth Street Demolition CNVIS.docx) for review. Current versions of the CNVMP and CNVIS will be submitted to EPA as supporting information in if an EPA Licence is required.

Report Section	Agency Comment	Lendlease Response
MARTIN PLACE METRO CSSI Construction Noise and Vibration Management Plan (Version 12) and Construction Noise Impact Statement for Martin Place Metro Excavation and Construction (version 1)	I refer to the Sydney Metro Martin Place ISD Construction Noise and Vibration Management Plan and corresponding Construction Noise and Vibration Impact Statement forwarded to EPA via email on 21 December 2018. Thank you for forwarding these documents for our records. The EPA encourages the development of such plans to ensure that proponents have determined how they will meet their statutory obligations and designated environmental objectives. However, it is not EPA policy to approve or endorse these documents. The EPA's role is to set environmental objectives/requirements for environmental management, rather than being directly involved in the development of strategies to achieve those objectives/requirements. You may however wish to submit the mentioned documents, or parts thereof, as supporting information for your future Environment Protection Licence (EPL) application. Information in the documents would be a relevant consideration for EPA in exercising its functions under Section 45 of the Protection of the Environment Operations Act 1997. Any required application to EPA to vary a licence, or for the issue of a licence for scheduled development work or a licenced activity should be made in a timely manner to allow for processing of the application. The Act provides that a licence application is deemed to have been refused after 60 days.	n/a
Sydney Metro		
Numerous sections and comments		Sydney Metro provided a number of comments in marked-up versions of the CNVMP and CNVIS (for Martin Place Metro Excavation and Construction). These comments primarily related to the provision of additional information relating to the location of sensitive receivers. These comments have been captured in the updated figure in Appendix B.

Report Section	Agency Comment	Lendlease Response
Acoustics Advisor and Environmental Representative		
Numerous sections and comments		The AA and ER made several comments on the CNVMP, CNVIS (for Demolition of 9-19 Elizabeth Street) and CNVIS (for Martin Place Metro Excavation and Construction). These comments were captured in a Stakeholder Comment Tracker spreadsheet. All comments have been addressed to the satisfaction of the AA and ER in the current versions of the CNVMP and CNVISs.

APPENDIX G Recent dates of completed meetings with affected receivers

Completed stakeholder meeting overview: Sydney Metro Martin Place ISD		
Name	**Date**	**Purpose**
Explore and Develop Childcare	21 February 2019	Sensitive receiver
Little Academics Early Learning Centre	18 March 2019	Sensitive receiver
CTA	27 February 2019	Sensitive receiver
Travelodge	27 February 2019	Sensitive receiver
Channel 7	26 February 2019	Sensitive receiver
Guardian Early Learning Group	26 February 2019	Sensitive receiver
Macquarie	19 March 2019	Sensitive receiver
Sofitel Wentworth Hotel	28 March 2019	Sensitive receiver
Macquarie Street Medical Centre	declined meeting, will doorknock	Sensitive receiver
Little Academics Early Learning Centre	18 March 2019	Sensitive receiver
Radisson Blu	2 April 2019 (TBC)	Sensitive receiver