Appendix D

Noise and Vibration Management Sub Plan

Western Harbour Tunnel

April 2023

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Document control

Approval and certification

Approved on behalf of ACCIONA	Andrew Marsonet
Signed	
Dated	22 December 2022

Document status

Revision	Date	Description	Approval
A	22.12.2022	For TfNSW review	E. Woodward
B	31.01.2023	For external Consultation	E. Woodward
00	20.03.2023	For DPE Review	E. Woodward
01	14.04.2023	Updated following DPE comments; for approval	E. Woodward
02	26.04.2023	Updated following DPE comments; for approval	E. Woodward

Contents

List of Tables

Glossary/ Abbreviations

Abbreviations	Expanded Text
AA	Acoustics Advisor
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.
Ancillary facility	A temporary facility for construction of the CSSI including an office and amenities compound, construction compound, material crushing and screening plant, materials storage compound, maintenance workshop, testing laboratory, material stockpile area and car parking facilities. *Note: where an approved management plan contains a stockpile management protocol, a material stockpile area located within the construction boundary is not considered to be an ancillary facility*
AVTG	Assessing Vibration – a technical guideline (DEC 2006)
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime, 2016)
CNVIS	Construction Noise and Vibration Statements
CSSI	Critical State Significant Infrastructure
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	Department of Environment and Conservation (now EPA)
DEC	DECC Department of Environment and Climate Change (now EPA)
DECCW	DECCW Department of Environment, Climate Change and Water (now EPA)
DPE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
Environmental objective	Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	NSW Environment Protection Authority
EPL	Environmental Protection Licence
ER	Environmental Representative
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations

Abbreviations	Expanded Text
	and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Highly noise intensive works	Works which are defined as annoying under the Interim Construction Noise Guideline (DECC, 2009) including (but not limited to): (a) use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work; (b) grinding metal, concrete or masonry; (c) rock drilling; (d) line drilling; (e) vibratory rolling; (f) bitumen milling or profiling; (g) jackhammering, rock hammering or rock breaking; and (h) impact piling
ICNG	Interim Construction Noise Guideline (DECC, 2009)
IPIAP	Independent Property Impact Assessment Panel
LAeq (15min)	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
LA (max)	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LA1 (1min)	The A-weighted noise level from the construction works under consideration, measured using the fast time weighting on a sound level meter, which is exceeded for more than 1% of the 1 minute measurement period.
LA90 (15min)	The A-weighted noise level excluding the construction works under consideration, measured using the fast time weighting on a sound level meter, which is exceeded for more than 90% of the 15 minute measurement period.
MCoA	Minister's Condition of Approval
MWD	Minimum working distance
NCA	Noise Catchment Area
NML	Noise management level
NIP	Noise Insultation Program (refer to MCoA E84)
Noise Mitigation	Feasible and reasonable measures that would minimise or avoid noise impacts
NVMP	Noise and Vibration Management Plan (this Plan)
OOHW	Out-of-Hours Works – work completed outside of standard construction hours
PPV	Peak Particle Velocity
Project, the	Western Harbour Tunnel project
Project Area	The area required to facilitate the construction of the Project (i.e. construction footprint)

Abbreviations	Expanded Text
RBL	The Rating Background Level for each period is the medium value of the Assessment Background Level values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening, night and shoulder period)
REMM	Revised Environmental Management Measure
Roads and Maritime	Former Roads and Maritime Services, now part of Transport for NSW
RMS	Former Roads and Maritime Services, now part of Transport for NSW
Sensitive land user(s) / Sensitive receiver(s)	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), child care centres and passive recreation areas (including outdoor grounds used for teaching). Receivers that may be considered to be sensitive include commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, and retail spaces) and industrial premises as identified by the Planning Secretary
SSD	State Significant Development
SSI	State Significant Infrastructure
Standard construction hours	Hours during which construction work is permitted by the MCoA. Further defined in Section 6.3
TfNSW	Transport for NSW
WHT	Western Harbour Tunnel (component of the Western Harbour Tunnel and Warringah Freeway Upgrade project)
Works	Any physical work to construct or facilitate the construction of the CSSI, including low impact work, environmental management measures and utility works. However, does not include activities that informs or enables detailed design of the CSSI and generates noise that is no more than 5 dB(A) above the rating background level (RBL) at any sensitive land user(s)

Note: Refer to *Instrument of Approval - SSI-8863* for additional abbreviations and definitions relevant to the Project.

1 Introduction

1.1 Context

This Noise and Vibration Management Sub-Plan (NVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the Western Harbour Tunnel (WHT) (the Project) a component of the Western Harbour Tunnel and Warringah Freeway Upgrade project.

This NVMP has been prepared to address the requirements of the Minister's Conditions of Approval (MCoA) for the Western Harbour Tunnel and Warringah Freeway Upgrade project (SSI #8863), the Western Harbour Tunnel and Warringah Freeway Upgrade Environmental Impact Statement dated January 2020 (the EIS), the Western Harbour Tunnel and Warringah Freeway Upgrade Response to Submissions Report dated September 2020 (the RtS) and applicable guidance and legislation.

This Plan describes how ACCIONA proposes to manage potential noise and vibration impacts during the construction of Stage 3B of the Project.

1.2 Background and project description

The Western Harbour Tunnel and Warringah Freeway Upgrade project comprises a new motorway tunnel connection across Sydney Harbour, and an upgrade of the Warringah Freeway to integrate the new motorway infrastructure with the existing road network and to enable the future connection of the Beaches Link and Gore Hill Freeway Connection project.

The Project will connect the approved M4-M5 Link in Rozelle to the Warringah Freeway at North Sydney/Cammeray. The Project will traverse from Rozelle to Cammeray, primarily comprising twin 6.5-kilometre bored/excavated tunnels with a crossing of Sydney Harbour, supported by surface based ancillary facilities.

The EIS was prepared to assess the impacts of construction and operation of the Western Harbour Tunnel and Warringah Freeway Upgrade project. As part of the EIS development, a Noise and Vibration Impact Assessment (Appendix G (*Technical working paper: Noise and Vibration* of the EIS) were prepared to address noise and vibration issues. The findings of the noise and vibration impact assessment were summarised in Chapter 10 (Construction noise and vibration) and Chapter 11 (Operational noise and vibration) of the EIS.

A RtS report was prepared in response to submissions received on the EIS. The RtS includes clarifications as well as further detail relating to noise and vibration management issues of the Project. The EIS environmental management measures were revised and included in Part D of the RtS report, with specific noise and vibration mitigation measures contained in Table 3-2 of this Plan.

The Western Harbour Tunnel and Warringah Freeway Upgrade project was declared Critical State Significant Infrastructure (CSSI) by the Minister for Planning and Public Space (the Minister) on 9 November 2020 and approved by the Minister on 21 January 2021.

The documents listed in the planning approval concluded that during the construction phase of the Project, sensitive receivers in the vicinity of the Project would be impacted by noise and vibration from construction works, however these impacts would be managed through the implementation of mitigation and management measures described in this NVMP.

1.3 Scope and staging

The scope of this Plan is to describe how ACCIONA will manage potential noise and vibration impacts during construction of the Project.

As described in Transport for New South Wales (TfNSW) Staging Report, this Project will be managed in stages with the CEMP. This document applies to the WHT Package 3B which includes the following scope:

- Excavation of twin mainline tunnels about 2.5 kilometres long and each accommodating three lanes of traffic in each direction, connecting portals adjacent to the Cammeray Golf Course to the Harbour Crossing section of the tunnel at Berrys Bay.
- Excavation of Falcon Street off-ramp tunnel.
- Excavation of Berry Street on-ramp tunnel.
- Cut and cover infrastructure surface construction at the Ridge Street North construction support site (WHT9), Berry Street and the Warringah Freeway portals.
- Integration works including Mechanical and Electrical (M&E) fit out for the Southern and Northern tunnelling sections, paving, surface connections, ventilation cavern fitout, integration and fitout of the Motorway Operation Centre (MOC) and Motorway Control Centre (MCC)
- Establishment and operation of White Bay (WHT3 – southern portion. The northern portion of WHT3 as described in the EIS will not be used); Ridge Street North (WHT9), and Cammeray Golf Course (WHT10) construction support sites.
- Operation of the City West Link Portal tunnelling support site (WHT12) after the completion of Stage 3A.

As such, many requirements will not be triggered by the Stage 3B scope of works.

For more details on staging refer to the Staging Report, which has been prepared in accordance with MCoA A10.

1.4 Interface with other planning documents

This Plan is a component of a suite of documents, prepared as part of the implementation of the Project's Environmental Management System. The Environmental Management System overview is described in Section 1.4 of the CEMP.

The key documents that interface with the NVMP are outlined in Table 1-1.

Table 1-1 Key interfaces with the NVMP

Plan	Interface
Construction Environmental Management Plan	• Provides details on overall project staging, interactions between Sub-Plans of the CEMP, and management of cumulative impacts • Provides a framework for how the construction works will be managed • Identifies procedures, processes and management systems that will apply in relation to construction activities • Provides environmental planning and controls for construction including environmental risk assessment,

Plan	Interface
	regulatory requirements, protection measures and sustainability requirements
Non-Aboriginal heritage	• Sets out how terrestrial non-Aboriginal heritage will be managed during construction of the Project • Details the location of sensitive heritage items for the identification and monitoring of potential vibration effects on these items
Aboriginal Cultural Heritage Management Plan	• Sets out how Aboriginal cultural heritage will be managed during construction of the Project • Details the location of sensitive heritage items for the identification and monitoring of potential vibration effects on these items
Groundwater Management Plan and Monitoring Program	• Details how potential settlement impacts due to groundwater drawdown will be managed and monitored during construction of the Project • Details requirements for groundwater monitoring during construction to monitor and manage the potential to impact on settlement of heritage items
Blast Management Strategy (The Project is not expected to require Blasting, a Blast management Strategy would only be prepared if blasting was required.)	• Details the manner in which any blasting required will be undertaken so that it will not generate unacceptable noise and vibration impacts or pose a significant risk to nearby structures and sensitive receivers
Community Communication Strategy and Complaints Management System	• Describes how community and stakeholder engagement will be managed and facilitates communication about construction of the project with the community as well as relevant councils and agencies • Specifies the process for receiving, addressing, resolving and recording complaints as well as outlines the process required in the escalation of a complaint to an independent mediator

2 Purpose and objectives

2.1 Purpose

The purpose of this NVMP is to describe how ACCIONA will manage potential noise and vibration impacts during construction of Stage 3B of the Project.

This NVMP has been prepared to address applicable statutory requirements and aims to ensure that the commitments in the planning approval are met with regard to impacts to noise and vibration.

2.2 Objectives

The objective of the NVMP is to ensure all mitigation and management measures relevant to noise and vibration are properly implemented.

To achieve this objective, ACCIONA will undertake the following:

- Ensure appropriate controls and procedures are implemented during construction activities to address potential noise and vibration impacts along the Project corridor, as well as manage risks from analysis of relevant construction activities as per MCoA C5
- Ensure appropriate measures are implemented to address the relevant MCoA requirements outlined in Table 3.1 and the safeguards detailed in the Response to Submissions report (RtS) and outlined in Table 3.2
- Ensure that the requirements of Transport for NSW specification G36 Environment Protection (Transport for NSW, June 2020) are met
- Ensure the requirements of the Project's Environment Protection Licence (EPL) are met
- Implement relevant legislation and other requirements described in Section 3.1 of this NVMP.

MCoA C2(d)(i) requires management sub-plans to describe how ACCIONA will meet the performance outcomes stated in Table 28-4 of the EIS. Those performance outcomes relevant to noise and vibration impacts are listed in Table 2-1.

Table 2-1 Performance outcomes Identified in the EIS relevant to this Plan

Performance Outcome	How performance will be addressed	Records
Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on acoustic amenity.	Include effective management of construction noise and vibration in accordance with relevant guidelines, for example through the use of acoustic sheds Minimise surface activity and associated noise at tunnelling sites (noting that once tunnelling starts the majority of the work at these sites would be underground) • Implement the noise and vibration measures in Section 9	Environmental inspection records Construction Noise and Vibration Impact Statements Monitoring records Complaints register

Performance Outcome	How performance will be addressed	Records
	of this Plan which have been developed in accordance with the guidelines in Section 3.1.3 • Undertake training, inspections, auditing and reporting in accordance with Section 10 of this Plan and Section 3.9 of the CEMP.	
	Minimise impacts to the local community by: • Control noise and vibration at the source • Control noise and vibration on the source to receiver transmission path • Control noise and vibration at the receiver • Implement practicable and reasonable measures to minimise the noise and vibration impacts of construction activities on local sensitive receivers • Implement the noise and vibration measures in Section 9 of this Plan • Undertake training, inspections, auditing and recording in accordance with Section 10 of this Plan and Section 3.9 of the CEMP.	Environmental inspection records Construction Noise and Vibration Impact Statements Monitoring records Audit Reports Complaints register

Performance Outcome	How performance will be addressed	Records
Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on the structural integrity of buildings and items including Aboriginal places and environmental heritage.	• Control vibration on the source to receiver transmission path • Implement practicable and reasonable measures to minimise vibration impacts of construction activities on structures • Carry out building / structure condition surveys for properties (and heritage assets) within the zone of influence of tunnel settlement prior to the commencement of construction • Implement the noise and vibration measures in Section 9 of this Plan • Undertake training, inspections, auditing and recording in accordance with Section 10 of this Plan and Section 3.9 of the CEMP.	Environmental inspection records Construction Noise and Vibration Impact Statements Monitoring records Complaints register Pre- and Post-construction condition surveys

2.3 Targets

The following targets have been established for the management of noise and vibration impacts during construction activities:

- Full compliance with relevant legislative requirements, MCoA and environmental management measures (REMMs) – evidenced by internal and independent audit findings
- Meet EPL noise and vibration requirements – evidenced by audit findings, monitoring results and regular internal and independent inspection records
- Implementation of feasible and reasonable noise mitigation measures with the aim of achieving the construction noise management levels detailed in the interim Construction Noise Guideline (DECC, 2009) – evidenced by monitoring results and internal and independent site inspection records
- Only undertake blasting activities at designated times and remain within established/agreed criteria – evidenced through blast records and monitoring results
- Ensure noise and vibration complaints from the community and stakeholders are minimised and managed in accordance with the Complaints Management System, as detailed within the Community Communication Strategy (CCS) evidenced by complaint record and management system.

3 Environmental requirements

3.1 Relevant legislation and guidelines

3.1.1 Legislation and regulatory requirements

Legislation relevant to noise and vibration management for this Project includes:

- *Protection of the Environment Operations Act 1997 (NSW)*
- *Environmental Planning & Assessment Act 1979 (NSW)*

All legislation relevant to this NVMP is included in Appendix A1 of the CEMP.

3.1.2 Licences / Permits

An Environment Protection Licence (EPL) will be obtained for the Project. If required, additional noise and vibration conditions will be incorporated into this NVMP once issued.

3.1.3 Guidelines

The main guidelines, specifications and policy documents relevant to this plan and the Noise and Vibration Monitoring Program (Appendix D2) include:

- Transport for NSW Specification G36 – Environmental Protection (Management System), Transport for NSW, June 2020
- RMS Construction Noise and Vibration Guidelines, Roads and Maritime, 2016
- NSW Industrial Noise Policy, Environment Protection Authority 2000
- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009
- NSW Road Noise Policy, Dept. of Environment, Climate Change and Water 2011
- Noise Policy for Industry (NPfI), Environment Protection Authority 2017
- NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006
- Australian Standard AS/NZS 2107:2000 Acoustics - Recommended design sound levels and reverberation times for building interiors
- 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 2187.2:2006 Explosives - Storage and use - Part 2 Use of explosives
- Australian Standard AS2436:2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites
- Australian Standard 2659.1:1998 Guide to the use of sound measuring equipment – portable sound level meters
- Australian Standard IEC 61672.1:2019 Electroacoustic – Sound Level Meters – Specifications
- Australian Standard 2775:2004 Mechanical Mounting of Accelerometers
- Australian Standard 1055:2018 Acoustics – Description and Measurement of Environmental Noise

- British Standard BS 6472-2008, ‘Evaluation of human exposure to vibration in buildings (1-80 Hz)
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings'
- German Standard DIN4150-2016 Structural vibration Part 3: Effects of vibration on Structures
- 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 6395 Earth-moving machinery - Determination of sound power level - Dynamic test conditions.

3.2 Minister’s Conditions of Approval

The MCoA relevant to this Plan are listed Table 3-1. A cross reference is also included to indicate where the condition is addressed in this Plan or other project management documents.

3.3 Revised Environmental Management Measures

Relevant Revised Environmental Management Measures (REMMs), as identified in Part D of the RtS, are listed in Table 3-2. A cross reference is also included to indicate where the condition is addressed in this Plan or other project management documents.

Table 3-1: Minister's Conditions of Approval

MCoA No.	Condition Requirements	Document Reference	How Addressed
General			
A5	Where the terms of this approval require a document or monitoring program to be prepared or a review to be undertaken in consultation with identified parties, evidence of the consultation undertaken must be submitted to the Planning Secretary with the document. The evidence must include: (a) documentation of the engagement with the party identified in the condition of approval that has occurred before submitting the document for approval; (b) a log of the dates of engagement or attempted engagement with the identified party; (c) documentation of the follow-up with the identified party where engagement has not occurred to confirm that they do not wish to engage or have not attempted to engage after repeated invitations; (d) outline of the issues raised by the identified party and how they have been addressed; and (e) a description of the outstanding issues raised by the identified party and the reasons why they have not been addressed.	Section 4	Evidence of consultation has been submitted to the Planning Secretary with this document.
Acoustics Advisor			
A29	A suitably qualified and experienced Acoustics Advisor(s) (AA) in noise and vibration management, who is independent of the design and construction personnel, must be nominated by the Proponent and engaged for the duration of work (as required by Condition A32) and for no less than six months following completion of construction of the CSSI.	Section 3.4	A suitably qualified and experienced Acoustics Advisor has been engaged for the duration of works and for no less than six months following completion of construction.

MCoA No.	Condition Requirements	Document Reference	How Addressed
A30	Work must not commence until an AA has been nominated by the Proponent and approved by the Planning Secretary.	Section 3.4	Details regarding the roles and responsibilities of Acoustic Advisor, and how ACCIONA will cooperate with the AA are outlined in Section 3.4 of this NVMP.
A31	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.	Section 3.4	
A32	The Proponent may nominate additional suitably qualified and experienced persons to assist the lead AA for the Planning Secretary's approval.	Section 3.4	
A33	Any activities generating noise in excess of 5 dB(A) above the 'Noise affected' Noise Management Levels (NMLs) derived from the Interim Construction Noise Guideline (DECC, 2009) (ICNG) must not commence until an AA, nominated under Condition A29 of this approval, has been approved by the Planning Secretary.	Section 3.4	Any activities generating noise above NMLs did not commence until the Acoustic Advisor was approved by the Planning Secretary, as outlined in Section 6.3.
A34	The approved AA must: (a) receive and respond to communication from the Planning Secretary in relation to the performance of the CSSI in relation to noise and vibration; (b) consider and inform the Planning Secretary on matters specified in the terms of this approval relating to noise and vibration;	Section 3.4	Details regarding the roles and responsibilities of Acoustic Advisor are outlined in the CEMP.

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(c) consider and recommend, to the Proponent, improvements that may be made to avoid or minimise adverse noise and vibration impacts; (d) review all proposed night-time works to determine if sleep disturbance would occur and recommend measures to avoid sleep disturbance or appropriate additional alternative mitigation measures; (e) 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 Planning Secretary (if required to be submitted to the Planning Secretary) or before implementation (if not required to be submitted to the Planning Secretary); (f) 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; (g) notify the Planning Secretary of noise and vibration incidents in accordance with Conditions A43 and A45 of this approval; (h) in conjunction with the ER, the AA must: (i) as may be requested by the Planning Secretary or Community Complaints Mediator (required by Condition B12), help plan, attend or undertake audits of noise and vibration management of the CSSI including briefings, and site visits, (ii) in the event that conflict arises between the Proponent and the community in relation to the noise and vibration performance of the CSSI, follow the procedure in the Community Communication Strategy approved under Condition B2 to attempt to resolve the		

MCoA No.	Condition Requirements	Document Reference	How Addressed
	conflict, and if it cannot be resolved, notify the Planning Secretary, (iii) consider relevant minor amendments made to the Ancillary Site Establishment Management Plan, 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 Planning Secretary and, if satisfied such amendment is necessary, endorse the amendment, (this does not include any modifications to the terms of this approval), (iv) review the noise impacts of minor construction ancillary facilities, and (v) prepare and submit to the Planning Secretary and other relevant regulatory agencies, for information, a Monthly Noise and Vibration Report detailing the AA's actions and decisions on matters for which the AA was responsible in the preceding month. The Monthly Noise and Vibration Report must be submitted within seven days following the end of each month for the duration of the AA's engagement for the CSSI, or as otherwise agreed by the Planning Secretary.		
Construction Environmental Management Plan			
C4	CEMP Sub-plans must be prepared in consultation with the relevant government agencies identified for each CEMP Sub-plan. Details of all information requested by an agency during consultation must be provided to the Planning Secretary as part of any submission of the relevant CEMP Sub-plan, including copies of all correspondence from those agencies as required by Condition A5.	This document	This NVMP has been prepared in accordance with the relevant agencies identified in this condition and describes how ACCIONA will manage noise and vibration during construction works on Stage 3B of the project.

MCoA No.	Condition Requirements	Document Reference	How Addressed
	<table><tr><th></th><th>Required CEMP Sub-plan</th><th>Relevant government agencies to be consulted for each CEMP Sub-plan</th></tr><tr><td>(b)</td><td>Noise and vibration</td><td>NSW Health, relevant council(s)</td></tr></table>		Separate evidence of consultation has been submitted to the Planning Secretary with this document. The Councils consulted include Inner West Council and North Sydney Council.
C5	The CEMP Sub-plans must state how:		
	(a) the environmental performance outcomes identified in the documents listed in Condition A1 will be achieved;	Section 2.2	This NVMP was prepared in accordance with the environmental performance outcomes identified in the documents listed in the EIS and RtS as outlined in Section 2.2.
	(b) the mitigation measures identified in the documents listed in Condition A1 will be implemented;	Table 3-2 Table 9-1	Relevant environmental management measures are detailed in Table 3-2 and including where and how they are addressed in this Plan. Measures to achieve these requirements are detailed in Section 9 of this Plan.
	(c) the relevant terms of this approval will be complied with; and	Table 3-1	Details regarding how ACCIONA will comply with the relevant terms of approval are listed in this Table, including references to the relevant sections of this NVMP.

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(d) issues requiring management during construction (including cumulative impacts), as identified through ongoing environmental risk analysis, will be managed through SMART principles.	Section 9.1 Table 9-1 Environmental Risk Assessment Workshop (Section 3.2.1 of the CEMP)	Noise and vibration issues requiring management during construction of Stage 3B of the Project have been identified through the EIS, RtS and Environmental Risk Assessment Workshop. These issues, including cumulative impacts, have been outlined in Appendix A2 of the CEMP. Environmental risk analysis will be ongoing and regularly reviewed in accordance with Section 3.2.1 of the CEMP Noise and vibration issues, including are detailed in Section 0 of this Plan. Management measures identified in Table 9-1 of this NVMP have been developed with consideration of SMART principles.
C9	The CEMP Sub-plans must be submitted to the Planning Secretary for approval along with, or subsequent to, the submission of the CEMP but in any event, no later than one month before construction.	Section 2 of the CEMP	The CEMP Sub-plans will be submitted for approval to the Planning Secretary with or subsequent to the final submissions of the CEMP, for approval.
C10	Construction must not commence until the CEMP and all CEMP Sub-plans have been approved, unless otherwise agreed by the Planning Secretary. The CEMP and CEMP Sub-plans, as approved by the Planning Secretary, including any minor amendments approved by the ER must be implemented for the duration of construction. Where construction of the CSSI is staged, construction of a stage must not commence until the CEMP and sub-plans	Section 2 of the CEMP Section 1.3	Construction of the Project will not commence until the CEMP and all Sub-plans as per the Staging Report have approved, unless it is otherwise agreed by the Secretary. The CEMP and CEMP

<table>
<tr><th>MCoA No.</th><th>Condition Requirements</th><th>Document Reference</th><th>How Addressed</th></tr>
<tr><td></td><td>for that stage have been endorsed by the ER and approved by the Planning Secretary.</td><td></td><td>Sub-plans will be implemented for the duration of construction.</td></tr>
<tr><td colspan="3">Construction Monitoring Programs</td><td></td></tr>
<tr><td>C11</td><td>The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each to compare actual performance of construction of the CSSI against the performance predicted in the documents listed in Condition A1 or in the CEMP:
<table>
<tr><th></th><th>Required Construction Monitoring Program</th><th>Relevant government agencies to be consulted for each Construction Monitoring Program</th></tr>
<tr><td>(a)</td><td>Noise and Vibration Monitoring Program</td><td>EPA</td></tr>
</table></td><td>Appendix D2</td><td>A Noise and Vibration Monitoring Program has been prepared as Appendix D2 of this NVMP.</td></tr>
<tr><td>C12</td><td>Each Construction Monitoring Program must provide:
(a) details of baseline data available;
(b) details of baseline data to be obtained and when;
(c) details of all monitoring of the project to be undertaken;
(d) the parameters of the project to be monitored;
(e) the frequency of monitoring to be undertaken;
(f) the location of monitoring;
(g) the reporting of monitoring results and analysis results against relevant criteria;</td><td>Appendix D2</td><td>A Noise and Vibration Monitoring Program has been prepared as Appendix D2 of this NVMP.</td></tr>
</table>

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(h) details of the methods that will be used to analyse the monitoring data; (i) procedures to identify and implement additional mitigation measures where the results of the (j) monitoring indicate unacceptable project impacts; (k) a consideration of SMART principles; (l) any consultation to be undertaken in relation to the monitoring programs; and (m) any specific requirements as required by Conditions C13 to C16.		
C13	The Noise and Vibration Monitoring Program must include: (a) noise and vibration monitoring locations determined in consultation with the AA to confirm construction noise and vibration levels; (b) for the purposes of (a), noise monitoring must be undertaken during the day, evening and night-time periods and within the first month of work as well as throughout the construction period and cover the range of activities being undertaken at the sites; (c) a protocol for reviewing the implemented management and mitigation measures, based on the monitoring results, to confirm they are consistent with the CEMP Subplan (Condition C4b), and to identify any additional management and mitigation measures that must be implemented; and (d) a process to undertake real time noise and vibration monitoring. The results of the monitoring must be readily available to the construction team, Proponent, ER and AA. The Planning Secretary and EPA must be provided with access to the results on request.	Appendix D2	A Noise and Vibration Monitoring Program has been prepared as Appendix D2 of this NVMP.

MCoA No.	Condition Requirements	Document Reference	How Addressed
C17	The Construction Monitoring Programs must be developed in consultation with relevant government agencies as identified in Condition C11. Details of all information requested by an agency during consultation must be provided to the Planning Secretary as part of any submission of the relevant Construction Monitoring Programs, including copies of all correspondence from those agencies as required by Condition A5.	Section 8.3 Appendix D2	This Plan, including the Noise and Vibration Monitoring Program (Appendix D2), has been prepared in consultation with the relevant agencies identified in MCoA C4(d). Evidence of consultation will be submitted to the Planning Secretary with this document.
C18	The Construction Monitoring Programs must be endorsed by the ER and then submitted to the Planning Secretary for approval at least one month before the commencement of construction.	Appendix D2	This Plan and the Noise and Vibration Monitoring Program (Appendix D2) will be endorsed by the Environmental Representative and then submitted to the Planning Secretary for approval at least one month before the commencement of construction.
C19	Unless otherwise agreed with the Planning Secretary, construction must not commence until all of the relevant Construction Monitoring Programs have been approved by the Planning Secretary, and all relevant baseline data for the specific construction activity has been collected.	Appendix D2	Construction will not commence until this Plan and the Noise and Vibration Monitoring Program (Appendix D2) has been approved by the Planning Secretary.
C20	The Construction Monitoring Programs, as approved by the Planning Secretary including any minor amendments approved by the ER must be implemented for the duration of construction and for any longer period set out in the monitoring program or specified by the Planning Secretary, whichever is the greater.	Appendix D2	The and the Noise and Vibration Monitoring Program (Appendix D2) as approved by the Planning Secretary, including any minor amendments approved by the Environmental Representative, will be implemented for the duration of construction and for any longer period set out in the monitoring

MCoA No.	Condition Requirements	Document Reference	How Addressed
			program or specified by the Planning Secretary, whichever is the greater.
C21	The results of the Construction Monitoring Programs must be submitted to the Planning Secretary, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program. Note: Where a relevant CEMP Sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP Sub-plan.	Appendix D2	The results of monitoring undertaken in accordance with the and the Noise and Vibration Monitoring Program (Appendix D2) will be submitted to the EPA and the Planning Secretary as required and at the frequency outlined in the that document.
Land Use Survey			
E65	A detailed land use survey must be undertaken to confirm sensitive land user(s) (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration, construction ground-borne noise and operational noise. The survey may be undertaken on a progressive basis but must be undertaken in any one area before the commencement of work which generates construction or operational noise, vibration or ground-borne noise in that area. The results of the survey must be included in the Noise and Vibration CEMP Sub-plan required by Condition C4.	Section 5.1 Appendix D1	A land use survey was carried out, as part of the EIS, refer Appendix D1 of this Plan. Additional detailed land use surveys will be undertaken to confirm any changes in sensitive land user(s) as the construction program progresses. To avoid uncertainty, this means land use surveys will be completed before the commencement of work which generates construction or operational noise, vibration or ground-borne noise in that area. The results of the additional surveys will be updated into Appendix D1 where changes are identified.

MCoA No.	Condition Requirements	Document Reference	How Addressed
Construction Hours			
E66	Work must only be undertaken during the following hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; (b) 8:00am to 6:00pm Saturdays; and (c) at no time on Sundays or public holidays	Section 6.3 Table 9-1	Works will only be scheduled and undertaken during the approved construction hours stated in this condition unless permitted in MCoA E68 or an EPL. Details regarding the approved construction hours are outlined in Section 6.3. The nominated construction hours, restrictions and general requirements for any OOHW will be addressed in the project inductions and specific training or toolboxes, as required and as stated in Section 9.
Highly Noise Intensive Work			
E67	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver must only be undertaken: (a) between the hours of 8:00 am to 6:00 pm Monday to Friday; (b) between the hours of 8:00 am to 1:00 pm Saturday; and (c) if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour. For the purposes of this condition, 'continuously' includes any period during which there is less than one hour between ceasing and recommencing any of the work.	Section 6.3 Table 9-1	Highly noise intensive works that result in an exceedance of the applicable NML will only be scheduled and undertaken at the stated hours, unless otherwise permitted by an EPL or MCoA E68, as outlined in Section 6.3 and Appendix D3 (OOHW protocol) of this NVMP.

MCoA No.	Condition Requirements	Document Reference	How Addressed
Variation to Work Hours			
E68	Notwithstanding Conditions E66 and E67 work may be undertaken outside the hours specified in any of the following circumstances: (a) Safety and Emergencies, including: (i) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (ii) 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. On becoming aware of the need for emergency work in accordance with Condition E68(a)(ii), the Proponent must notify the AA, the ER, the Planning Secretary and the EPA of the reasons for such work. The Proponent must use best endeavours to notify all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work. (b) Low impact, including: (i) construction that causes $L_{Aeq(15\ minute)}$ noise levels: • no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, or • no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); or (ii) construction that causes $L_{AFmax(15\ minute)}$ noise levels no more than 15 dB(A) above the rating background level at any residence; or (iii) construction that causes: • continuous or impulsive vibration values, measured at the	Section 6.3 Appendix D3 Table 9-1	An Out of Hours Work (OOHW) Protocol has been prepared in Appendix D3 of this Plan to address the circumstances which works may be undertaken outside the hours. ACCIONA will notify the Acoustic Advisor, the ER and the EPA on becoming aware of the need for emergency works, as outlined in the OOHW Protocol included in Appendix D3 of this Plan.

MCoA No.	Condition Requirements	Document Reference	How Addressed
	most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), or • intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006). (c) By Approval, including: (i) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or (ii) works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition E69; or (iii) negotiated agreements with directly affected residents and sensitive land user(s). (d) By Prescribed Activity, including: (i) tunnelling (excluding cut and cover tunnelling and surface works) and tunnel fit out works (excluding surface works) are permitted 24 hours a day, seven days a week; or (ii) delivery of material that is required to occur outside of standard construction hours in Condition E66 to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to/from WHT7 at Berrys Bay which could result in a sleep disturbance event for receivers in the proximity of Bay Road and Balls Head Road, Waverton; or (iii) works within an acoustic shed where there is no exceedance of the NMLs; or		

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(iv) trailer suction hopper dredging; or (v) along the Warringah Freeway corridor in accordance with Condition E88.		
Out-Of-Hours Work Protocol – Works Not Subject to an EPL			
E69	An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of work which is outside the hours defined in Conditions E66, and that are not subject to an EPL. The Protocol must be approved by the Planning Secretary before commencement of the Out-of-Hours Work. The Protocol must be prepared in consultation with the ER, AA and EPA. The Protocol must provide: (a) identification of low and high-risk activities and an approval process that considers the risk of activities, proposed mitigation, management, and coordination, including where: (i) the ER and AA review all proposed out-of-hours activities and confirm their risk levels, (ii) low risk activities can be approved by the ER in consultation with the AA, and (iii) high risk activities that are approved by the Planning Secretary; (b) a process for the consideration of out-of-hours work against the relevant NML and vibration criteria; (c) a process for selecting and implementing mitigation measures for residual impacts in consultation with the community at each affected location, including respite periods consistent with the requirements of Condition E83. The measures must take into account the predicted noise levels and the likely frequency and duration of the out-of-hours works that sensitive land user(s) would be exposed to, including the	Section 6.3 Appendix D3 Table 9-1	An OOHW Protocol has been included in Appendix D3 of this NVMP to identify a process for the consideration, management and approval of works which are outside the standard construction hours, and that are not subject to an EPL. The Protocol will be approved by the Planning Secretary before commencing the out of hours works and will be prepared in consultation with the EPA and the Acoustic Advisor. Out-of-hours-works not subject to an EPL, will be scheduled, approved and undertaken in accordance with the OOHW Protocol (Appendix D3) prepared in accordance with MCoA E69.

MCoA No.	Condition Requirements	Document Reference	How Addressed
	number of noise awakening events; (d) procedures to facilitate the coordination of out-of-hours work including those approved by an EPL or undertaken by a third party, to ensure appropriate respite is provided; and (e) notification arrangements for affected receivers for all approved out-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works. This condition does not apply if the requirements of Condition E68(b) are met.		
Construction Noise Management Levels and Vibration Criteria			
E70	Mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration objectives:	Section 6 Table 9-1	Mitigation measures outlined in Section 9 of this Plan will be implemented with the aim of achieving the construction NMLs and vibration criteria. The residential receptor NMLs for project works is included in Section 6 of this Plan. Any works identified as exceeding the NMLs and/or vibration criteria will be managed in accordance with this Plan.
	(a) construction 'Noise affected' NML established using the Interim Construction Noise Guideline (DECC, 2009);	Section 6.4	
	(b) vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure);	Section 6.6.1	
	(c) Australian Standard AS 2187.2 - 2006 "Explosives - Storage and Use - Use of Explosives";	Section 6.7	
	(d) BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they are "applicable to Australian conditions"; and	Section 6.6.2	

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(e) the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage). Any work identified as exceeding the noise management levels and/or vibration criteria must be managed in accordance with the Noise and Vibration CEMP Sub-plan. *Note: The ICNG identifies 'particularly annoying' activities that*	Section 6.6.3	
E71	Mitigation measures must be applied when the following residential ground-borne noise levels are exceeded: (a) evening (6:00 pm to 10:00 pm) — internal LAeq(15 minute): 40 dB(A); and (b) night (10:00 pm to 7:00 am) — internal LAeq(15 minute): 35 dB(A). The mitigation measures must be outlined in the Noise and Vibration CEMP Sub-plan, including in any Out-of-Hours Work Protocol, required by Condition E69	Section 6.4 Section 9 Table 9-1	Mitigation measures outlined in Section 9 will be implemented with the aim of achieving the construction NMLs and vibration criteria. Ground-borne noise management levels are presented in Section 6.4.3. Any works identified as exceeding the NMLs and/or vibration criteria will be managed in accordance with this Plan.
E72	Noise generating work in the vicinity of potentially-affected community, religious, educational institutions, noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institutions are made at no cost to the affected institution.	Section 6.4 Section 9 Table 9-1	A mitigation measure has been provided in Section 9 to avoid sensitive periods when undertaking noise generating works in the vicinity of potentially affected community, religious, educational institutions and noise and vibration sensitive businesses and critical working areas.

MCoA No.	Condition Requirements	Document Reference	How Addressed
E73	At no time can noise generated by construction exceed the National Standard for exposure to noise in the occupational environment of an eight-hour (8hr) equivalent continuous A-weighted sound pressure level of LAeq,8h of 85 Db(A) for any employee working at a location near the CSSI.	Section 6.4	Noise generated by construction will not exceed the National Standard for exposure to noise in the occupational environment. This will be managed under the Project's workplace health and safety documentation and will not be addressed herein.
Construction Noise and Vibration Mitigation and Management			
E74	Industry best practice construction methods must be implemented where reasonably practicable to ensure that noise levels are minimised. Practices must include, but are not limited to:	Section 9.1 Table 9-1	Mitigation measures have been provided in Section 9 which will be implemented during construction works to minimise noise levels.
	(a) use of regularly serviced low sound power equipment;		
	(b) early occupation and later release of road carriageways and construction sites;		
	(c) scheduling of noisiest works before 11.00 pm Sunday to Thursday and before 12 midnight Friday and Saturday;		
	(d) temporary noise barriers (including the arrangement of plant and equipment) around noisy equipment and activities such as rockhammering and concrete cutting; and		
	(e) use of alternative construction and demolition techniques.		

MCoA No.	Condition Requirements	Document Reference	How Addressed
E75	Construction Noise and Vibration Impact Statements (CNVIS) must be prepared for any work that may exceed the noise management levels, vibration criteria and/or ground-borne noise levels specified in Condition E70 and Condition E71 at any residence outside construction hours identified in Condition E66, or where receivers will be highly noise affected. The CNVIS must include specific mitigation measures identified through consultation with affected sensitive land user(s) and the mitigation measures must be implemented for the duration of the works. A copy of the CNVIS must be provided to the AA and ER prior to the commencement of the associated works. The Planning Secretary may request a copy/ies of CNVIS.	Section 8.2 Table 9-1	CNVIS(s) will be prepared before works commence that may exceed the NMLs and / or vibration criteria, as detailed in Section 8.2 and Table 9-1. The CNVIS will include specific mitigation measures identified through consultation with affected sensitive land user(s) which will be implemented for the duration of the works.
E76	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before work that generates vibration commences in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owners and occupiers are to be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier. These properties must be identified and considered in the Noise and Vibration CEMP Sub-plan required by Condition C4 and the Community Communication Strategy required by Condition B1.	Section 9.1 Table 9-1	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage will be notified before works that generate vibration commences in the vicinity of those properties, as detailed in Section 9.1. Pre-construction building/structure condition surveys will be offered for all properties identified as being at risk of exceeding the screening criteria.
Construction Noise Mitigation - Acoustic Sheds			
E77	All surface based tunnelling support activities that generate noise levels above the noise management levels in Condition E70 must occur within an acoustic shed	Section 9.1 Table 9-1	All surface based tunnelling support activities that generate noise levels above the noise management levels in Condition E70 will occur within an acoustic shed as stated in Table 9-1.

MCoA No.	Condition Requirements	Document Reference	How Addressed
E78	All acoustic sheds must be designed and used so that activities carried out within them do not result in the exceedance of the NMLs.	Section 9.1 Table 9-1	All acoustic sheds will be designed and used so that activities carried out within them do not result in the exceedance of the NMLs, as stated in Table 9-1.
Construction Vibration Mitigation - Heritage			
E79	The Proponent must conduct vibration testing during vibration generating activities that have the potential to impact on heritage items to identify minimum working distances (MWDs) to prevent cosmetic damage. In the event that the vibration testing and attended 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.	Appendix D2 Table 9-1	Vibration testing will be conducted during vibration generating activities that have the potential to impact on heritage items, as outlined in the Noise and Vibration Monitoring Program (Appendix D2) .
E80	Advice from a heritage specialist must be sought on methods and locations for installing equipment used for vibration, movement and noise monitoring at heritage-listed structures.	Appendix D2	The advice of a heritage specialist will be sought, as detailed in the Noise and Vibration Monitoring Program included in Appendix D2.
E81	Before conducting at-property treatment at any heritage item identified in the documents listed in Condition A1, the advice of a suitably qualified and experienced built heritage expert must be obtained and implemented to ensure any such work does not have an adverse impact on the heritage significance of the item.	Appendix D2	The advice of a built heritage expert will be used, as detailed in the Noise and Vibration Monitoring Program included in Appendix D2.

MCoA No.	Condition Requirements	Document Reference	How Addressed
Utility Coordination and Respite			
E82	All work undertaken for the delivery of the CSSI, including those undertaken by third parties (such as utility relocations), must be coordinated to ensure respite periods are provided. The Proponent must: (a) reschedule any work to provide respite to impacted noise sensitive land user(s) so that the respite is achieved in accordance with Condition E83; or (b) consider the provision of alternative respite or mitigation to impacted noise sensitive land user(s); and (c) provide documentary evidence to the AA in support of any decision made by the Proponent in relation to respite or mitigation. The consideration of respite must also include all other CSSI, SSI and SSD projects which may cause cumulative and/or consecutive impacts at receivers affected by the delivery of the CSSI.	Section 9.8 Appendix D3	All works, including those undertaken by third parties (such as utility relocations), will be coordinated to ensure respite periods are provided, as identified in Section 9.8 and the OOHW Protocol included in Appendix D3 of this Plan.

MCoA No.	Condition Requirements	Document Reference	How Addressed
Out-of-Hours Works – Community Consultation on Respite			
E83	In order to undertake out-of-hours work outside the hours specified under Condition E66, the Proponent must identify appropriate respite periods for the out-of-hours work in consultation with the community at each affected location on a regular basis. This consultation must include (but not be limited to) providing the community with: (a) a progressive schedule for periods no less than three months, of likely out-of-hours work; (b) a description of the potential work, location and duration of the out-of-hours work; (c) the noise characteristics and likely noise levels of the work; and (d) likely mitigation and management measures which aim to achieve the relevant noise management levels under Condition E70 (including the circumstances of when respite or relocation offers will be available and details about how the affected community can access these offers). The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hour work must be provided to the AA, ER, EPA and the Planning Secretary. *Note: Respite periods can be any combination of days or hours where out-of-hours work would not be more than 5 dB(A) above the rating background noise level at any residence*	Section 4.3 Section 6.3 Table 9-1	Appropriate respite periods will be identified for out of hours works as described in Section 4.3, Section 6.3 and the out of hours works (OOHW) Protocol. The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out of hours works will be provided to the Acoustic Advisor, EPA and Planning Secretary in a manner/format agreed to with each.

MCoA No.	Condition Requirements	Document Reference	How Addressed
Warringah Freeway Upgrade – Noise Mitigation Measures			
E86	The offer for at-property treatment or the application of other noise and vibration mitigation measures does not expire until the out-of-hours work affecting that property are completed, even if the landowner initially refuses the offer.	Section 9.2	At-property treatments are outlined in Section 9.2.
E87	The implementation of at-property treatment does not preclude the application of other noise and vibration mitigation and management measures including temporary and long term accommodation.	Section 9.2	At-property treatments are outlined in Section 9.2.
Warringah Freeway Upgrade – Out-of-Hours Work periods			
E88	Out-of-Hours Work along the Warringah Freeway corridor which results in an exceedance of the relevant NML at the same sensitive land user(s) may be undertaken in accordance with the following criteria: (a) two consecutive evenings and/or nights per week; or (b) three non-consecutive evenings and/or nights per week; or (c) 10 evenings and/or nights per month; or (d) except as identified by an EPL; or (e) in accordance with an agreement with a potentially impacted receiver(s) as required by Condition E68(c)(iii) or Condition E83. *Note: These parameters may be increased subject to the development of a framework, which is prepared in consultation with the community and EPA and with consideration of the delivery of the NIP.*	Section 6.3 Section 9.3	These OOHW restrictions have been included in Section 6.3 of this Plan. The management procedure for OOHW is summarised in Section 9.3. An OOHW Protocol has been prepared in Appendix D3 of this Plan to address the circumstances which works may be undertaken outside the hours.

E89	The Proponent must prepare an Operational Noise Review (ONR) to confirm noise control measures that would be implemented for the operation of the CSSI. The ONR must be prepared in consultation with the Planning Secretary, relevant council(s), and the EPA and must: (a) confirm the appropriate operational noise objectives and levels for surrounding development, including existing sensitive land user(s); (b) confirm the operational noise predictions based on the final design. Confirmation must be based on an appropriately calibrated noise model (which has incorporated noise monitoring, and concurrent traffic counting, where necessary for calibration purposes). The assessment must specifically include verification of noise levels at all fixed facilities, based on noise monitoring undertaken at appropriately identified noise catchment areas surrounding the facilities; (c) confirm the operational noise impacts at adjoining development based on the final design of the CSSI, including operational daytime LAeq,15 hour and night-time LAeq, 9-hour traffic noise contours; (d) review the suitability of the operational noise mitigation measures identified in the documents listed in Condition A1 and, where necessary, investigate and identify additional noise and vibration mitigation measures required to achieve the noise criteria outlined in the NSW Road Noise Policy (DECCW, 2011) and NSW Noise Policy for Industry (EPA, 2017) as relevant, including the timing of implementation; (e) include a consultation strategy to seek feedback from directly affected landowners on the noise and vibration mitigation measures; and (f) procedures for the management of operational noise and vibration complaints. The ONR must be verified by an independent acoustic expert. The ONR must be undertaken at the Proponent's expense and submitted to the Planning Secretary within 12 months of the commencement of construction unless otherwise agreed by the Planning Secretary.	Section 9.2.2	An ONR will be prepared in accordance with this condition to inform operational noise control measures, and provide for the early establishment of these measures to assist in construction noise mitigation.

MCoA No.	Condition Requirements	Document Reference	How Addressed
	The Proponent must implement the identified noise and vibration control measures and make the ONR publicly available. Note: The design of noise barriers and the like must be undertaken in consultation with the community as part of the Place Design and Landscape Plan required under Condition E177.		
E90	Operational noise mitigation measures as identified in Condition E89 that will not be physically affected by work, must be implemented within six months of submitting the ONR, unless otherwise agreed by the Planning Secretary. Where implementation of operational noise mitigation measures are not proposed to be implemented in accordance with this requirement, the Proponent must submit to the Planning Secretary a report providing justification as to why, along with details of temporary measures that would be implemented to reduce construction noise impacts, until such time that the operational noise mitigation measures are implemented. The report must be endorsed by the AA and submitted to the Planning Secretary within six months of submitting the ONR. Note: Not having finalised detailed design is not sufficient justification for not implementing the proposed mitigation measures.	Section 9.2.2	An ONR will be prepared in accordance with this condition to inform operational noise control measures, and provide for the early establishment of these measures to assist in construction noise mitigation.

MCoA No.	Condition Requirements	Document Reference	How Addressed
Blasting			
E95	Blasting associated with the CSSI must only be undertaken during the following hours: (a) 9:00am to 5:00pm, Monday to Friday, inclusive; (b) 9:00am to 1:00pm on Saturday; and (c) at no time on Sunday or public holidays; or (d) as authorised through an EPL. This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.	Section 9.9 Table 9-1	Should blasting be required for the Project, this will only be carried out within these hours. These hours will be included in the Blast Management Strategy, as discussed in Section 9.9.
E96	A Blast Management Strategy must be prepared and must 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.	Table 9-1	Should blasting be required for the Project, a standalone Blast Management Strategy will be prepared as described in Section 9.9.
E97	The Blast Management Strategy must be endorsed by a suitably qualified and experienced person.	Section 9.9 Table 9-1	The Blast Management Strategy will be endorsed by a suitably qualified and experienced person, as described in Section 9.9.

MCoA No.	Condition Requirements	Document Reference	How Addressed
E98	The Blast Management Strategy must be prepared in accordance with relevant guidelines and in consultation with the EPA, in order to ensure 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 land user(s).	Section 9.9 Table 9-1	The Blast Management Strategy will be prepared in accordance with relevant guidelines and in consultation with the EPA, as discussed in Section 9.9. All blasting and associated activities will be carried out so as not to generate unacceptable noise and vibration impacts or pose a significant risk to sensitive land user(s), as discussed Section 9.9.
E99	The Blast Management Strategy must be submitted to the Planning Secretary for information no later than one month before the commencement of blasting. The Strategy as submitted to the Planning Secretary, must be implemented for all blasting activities.	Section 9.9 Table 9-1	The Blast Management Strategy will be submitted to the Planning Secretary no later than one month before the commencement of blasting, as discussed in Section 9.9.

MCoA No.	Condition Requirements	Document Reference	How Addressed
Condition Survey			
E107	The Proponent must offer pre-construction surveys and must undertake and prepare Preconstruction Condition Survey Reports where the offer is accepted, on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model described in Condition E102 and the CNVIS required by Condition E75 or as directed by the Independent Property Impact Assessment Panel (IPIAP) established under Condition E111. The Pre-construction Condition Survey Reports must be prepared by a suitably qualified and experienced person(s) and must be provided to the owners of the surface and sub-surface structures for review prior to the commencement of potentially impacting works	Section 9.5 Table 9-1	This has been included as management measure NVMP33 in Table 9-1 of this Plan. Property surveys and issues rectification are outlined in Section 9.5
E108	Where pre-construction surveys have been undertaken in accordance with Condition E107, subsequent post-construction surveys must be undertaken to assess damage to the surface and sub-surface structures that may have resulted from construction within three months of landowner(s) requests.	Section 9.5 Table 9-1	This has been included as management measure NVMP33 in Table 9-1 of this Plan. Property surveys and issues rectification are outlined in Section 9.5
E109	The results of the post-construction surveys undertaken under Condition E108 must be documented in Post-construction Condition Survey Reports for each surface and sub-surface structure surveyed. The Post-construction Condition Survey Reports must be prepared by a suitably qualified and experienced person(s). Copies of the Post-construction Condition Survey Reports must be provided to the owner(s) of the structures surveyed no later than four months following the completion of construction activities that have the potential to impact on the subject surface / subsurface structure.	Section 9.5 Table 9-1	Property surveys and issues rectification are outlined in Section 9.5

MCoA No.	Condition Requirements	Document Reference	How Addressed
E110	Where damage has been determined to occur as a result of the project, the Proponent must carry out rectification at its expense and to the reasonable requirements of the surface and sub-surface structure owner(s) within 12 months of completion of construction unless another timeframe is agreed with the owner of the affected surface or sub-surface structure.	Section 9.5 Table 9-1	Property surveys and issues rectification are outlined in Section 9.5
E111	The Proponent must establish an IPIAP before works that have the potential to result in property impacts commence. The IPIAP must comprise geotechnical and engineering experts independent of the design and construction team. The IPIAP will be responsible for independently reviewing Pre- and Post-construction Condition Survey Report templates prepared under Conditions E107 and E109, any Pre- and Post-construction Condition Survey Reports where there is a dispute, and the resolution of property damage disputes, and the establishment of ongoing settlement and vibration monitoring requirements. The Planning Secretary must be notified of the members of the IPIAP prior to the commencement of any works which may potentially result in property impacts.	Section 9.5	Requirements of the IPIAP are included in Section 9.5
E112	Either the affected owner or the Proponent may refer unresolved disputes arising from potential and/or actual property impacts to the IPIAP for resolution. All costs incurred in establishing and implementing the IPIAP must be borne by the Proponent regardless of which party makes a referral to the IPIAP. The findings and recommendations of the IPIAP are final and binding on the Proponent.	Section 9.5	Requirements of the IPIAP are included in Section 9.5
E113	The governance framework for the IPIAP must be made publicly available on the CSSI's project page as required by Condition B15.	Section 9.5	Requirements of the IPIAP are included in Section 9.5

Table 3-2: Environmental management measures relevant to this NVMP

Ref #	Commitment	Document reference	How addressed
CNV1	A Construction Noise and Vibration Management Plan will be developed for the project. This plan will:	This NVMP	
	(a) Identify relevant criteria and management levels in relation to noise and vibration	Section 6	Criteria have been identified in Section 6 of this Plan.
	(b) Identify noise and vibration sensitive receivers and features in the vicinity of the project	Section 5.1, Appendix D1	Noise and vibration sensitive receivers have been identified in the Land Use Survey attached as Appendix D1.
	(c) Include standard and additional mitigation from the Construction Noise and Vibration Guideline (Roads and Maritime, 2016a) and detail how and when these will be applied in the project	Section 9	Standard and additional mitigation measures have been identified in Section 9 of this Plan.
	(d) Describe the approach that will be adopted for carrying out location and activity specific construction noise and vibration impact assessments to assist with designing and selecting of the appropriate mitigation and management measures	Section 8.2 Table 9-1	The approach for carrying out location and activity specific noise and vibration impact assessments is outlined in Section 8.2 of this Plan.
	(e) Include protocols that will be adopted to manage works required outside standard construction hours	Section 9.3, Out of Hours Work (OOHW) Protocol	An out of hours work protocol has been developed for the Project.
	(f) Detail the methodology and approach for managing residual construction noise impacts	Section 9.7	The management of residual construction noise impacts is detailed in Section 9.7 of this Plan.

Ref #	Commitment	Document reference	How addressed
	(g) Detail the process for managing construction vibration, including heritage structures considering all types of vibration generating works, including blasting	Section 9.4 Section 9.9 Table 9-1	Management of construction vibration is detailed in Section 9.4 and Section 9.9 of this Plan.
	(h) Outline the procedures and approach for noise and vibration monitoring to be carried out to confirm construction noise and vibration levels in relation to noise and vibration management	Appendix D2 Table 9-1	A noise and vibration monitoring program has been developed for the Project in line with this requirement.
	(i) Where feasible and reasonable, detail how construction noise impacts from concurrent or consecutive nearby construction works associated with the project will be managed.	OOHW protocol Table 9-1	Cumulative noise impacts would be managed in line with the requirements set out in the Out of Hours work protocol.
	The Construction Noise and Vibration Management Plan will be implemented for the duration of construction of the project	Section 1.3 Section 2 of the CEMP	This Plan will be implemented throughout construction of Stage 3B of the Project.
CNV2	Detailed Construction Noise and Vibration Impact Statements will be carried out for all construction support sites and major construction works required for the project prior to the commencement of construction. The Statements will consider the proposed site layouts and noise and vibration generating activities that will take place during all major stages of the construction support site, assess predicted noise and vibration levels against the relevant management levels, and incorporate feasible and reasonable mitigation and management measures in accordance with the requirements of the Interim Construction Noise Guideline (DECC, 2009) and the Construction Noise and Vibration Guideline (Roads and Maritime, 2016a).	Section 8.2 Table 9-1	Construction Noise and Vibration Impacts statements will be prepared for the Project in line with this mitigation measure.

Ref #	Commitment	Document reference	How addressed
CNV3	An out of hours works protocol will be developed for the construction of the project. The protocol will include:	Section 9.3, Appendix D3 NVMP15	An out of hours works protocol has been developed for the Project in line with the requirements outlined in this mitigation measure.
	a) Details of works required outside standard construction hours, including acceptable justifications for works outside of standard construction hours, what types of works are allowed to take place outside of construction hours, and justifications of why the activities are required outside standard construction hours	Section 6.3 Appendix D3	
	b) Details of the assessment and approval process (internal and external) for works proposed outside standard construction hours	Appendix D3	
	c) Noise and vibration mitigation and management measures that are to be considered and implemented where appropriate to manage potential impacts associated with works outside standard construction hours	Table 9-1 Appendix D3	
	d) The noise and vibration impact assessment processes that will be followed to identify potentially affected receivers, clarify potential impacts and determine appropriate mitigation and management measures. The protocol will be prepared in consultation with the Department of Planning, Industry and Environment and the NSW Environment Protection Authority, and independently endorsed. The project protocol will be implemented during the duration of the construction of the project.	Section 8.2	

Ref #	Commitment	Document reference	How addressed
CNV4	Construction noise and vibration impacts will be monitored periodically throughout all stages of the construction support sites to ensure that: a) Impacts are consistent with the noise and vibration levels detailed in the relevant Construction Noise and Vibration Impact Statements b) Noise and vibration impacts are being appropriately managed c) Mitigation measures are effective.	Table 9-1	A noise and vibration monitoring program has been developed for the Project in line with this requirement.
CNV5	Where feasible and reasonable, unless compliance with the relevant traffic noise criteria can be achieved, or alternative arrangements have been agreed with affected receivers, construction vehicle movements will not occur on local roads beyond those required for direct access to construction sites.	TTAMP Table 9-1	The Project will not utilise local roads for construction site access.
CNV6	Vibration generating activities will be managed through the establishment of minimum buffer distances to achieve screening levels. Where vibration levels are predicted to exceed the screening levels, a more detailed assessment of the impacted structure and attended vibration monitoring will be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items, the more detailed assessment will specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed. Any damage caused by the project will be rectified.	Section 8.6.1 Section 9.4 Table 9-1	Requirements regarding construction vibration impacts are detailed in Section 8.6.1 and Section 9.4 of this Plan.
CNV7	Feasible and reasonable measures will be implemented to minimise ground-borne noise where exceedances are predicted.	Table 9-1	Ground borne noise will be mitigated through the implementation of standard mitigation measures outlined in this Plan.

Ref #	Commitment	Document reference	How addressed
CNV8	Mitigation measures will be implemented for surface road works, local area and utility works, where construction activities are predicted to exceed noise management levels at receivers. Where feasible and reasonable the approaches that will be used include: a) Carrying out works during the daytime period when near residential receivers b) Selection of plant and equipment to minimise noise and vibration impacts c) Management of plant and equipment to minimise the generation of noise and vibration impacts d) Community consultation, engagement and notification e) Detailed programming and respite protocols f) Where out of hours works are required, programming the noisiest activities to occur during the less sensitive time periods g) Out of hours works protocols h) Limiting timing of noise intensive work i) Use of portable noise barriers around particularly noisy equipment such as concrete saws and rock hammers in cases where it will effectively reduce noise levels at nearby receivers j) Management of construction traffic to minimise movements during the night periods along local roads k) Establishing minimum vibration buffer distances for vibration intensive works l) Vibration and blasting trials and/or monitoring along with building condition surveys.	Table 9-1	Standard mitigation measures have been included in this Plan to address these requirements.

Ref #	Commitment	Document reference	How addressed
CNV9	A Blast Management Strategy will be prepared in consultation with the NSW Environment Protection Authority to demonstrate that all blasting and associated activities will be carried out in a manner that will not generate unacceptable noise and vibration impacts or pose a significant risk impact to structures and sensitive receivers. The strategy will: a) Detail the blasting to be performed including location, method and justification of the need to blast b) Identify any potentially affected noise and vibration sensitive sites including heritage buildings and utilities c) Establish appropriate criteria for blast overpressure and ground vibration levels at each category of noise sensitive site d) Detail storage and handling arrangements for explosive materials and the proposed transport of those materials to the construction support site e) Identify 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) Determine potential noise and vibration and risk impacts from blasting and appropriate best management practices g) Detail community consultation procedures.	Table 9-1	If Blasting is required for the Project, a Blast Management Strategy will be prepared prior to any Blasting occurring.
CNV10	Construction noise from concurrent and consecutive construction works will be managed to minimise cumulative construction noise impacts. Where feasible and reasonable the approaches that will be used include: a) Coordinating work between project construction sites and construction works to avoid cumulative noise impacts	Table 9-1	Cumulative noise impacts would be managed in line with the requirements set out in the Out of Hours work protocol.

Ref #	Commitment	Document reference	How addressed
	b) Consideration of additional at source or near source mitigation where construction noise levels may result in cumulative construction noise impacts, where programming is not practical to avoid cumulative noise impacts		
	c) Community consultation throughout the project to gauge construction key noise impacts and issues and any unknown impacts from concurrent or consecutive sets of constructions works		
	d) Incorporating additional noise mitigation and management measures with consideration of cumulative and consecutive construction noise impacts based upon coordination between projects.		
NAH4	Should at-property noise treatment be required at a premises that is heritage listed, this will be carried out in a manner to minimise heritage impact, and advice of a heritage conservation architect will be sought prior to undertaking the works. Any treatment will be sympathetic to the heritage values of the item, designed with heritage architect input and be reversible where feasible and reasonable.	Section 9.2	At-property treatments are outlined in Section 9.2.
NAH22	Environmental management measure CNV6 will be applied to manage vibration impacts to heritage structures. This includes, but is not limited to: • Balls Head Coal Loader wharf • Yurulbin Park maritime infrastructure.	Table 9-1 Refer also to the Non-Aboriginal Heritage Management Sub-Plan	Requirements regarding construction vibration impacts to heritage structures have been included in this Plan.
NAH23	For the Balls Head Coal Loader and seawall, where vibration levels are predicted to exceed the standard minimum buffer distances to achieve screening levels, a detailed structural assessment will be carried out before	Table 9-1 Refer also to the Non-	Requirements regarding construction vibration impacts to heritage structures have been included in this Plan.

Ref #	Commitment	Document reference	How addressed
	construction commences to determine appropriate vibration criteria and site-specific minimum working distances to achieve this criteria. The detailed assessment will specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is protected. During detailed design, the construction methodology will be refined as needed to ensure the adopted criteria and site-specific minimum working distances for all vibration-intensive activities (eg Compaction, rock hammering, piling) can be met. During construction, site-specific buffer distances will be maintained to comply with relevant vibration limits for cosmetic damage, and vibration monitoring will be carried out to ensure vibration levels remain below the appropriate limits for the structure.	Aboriginal Heritage Management Sub-Plan	
AH2	The following process will be carried out to confirm where vibration monitoring at terrestrial AHIMS sites within 50m of the Project construction footprint will be required: • Terrestrial Aboriginal site condition surveys will be completed using photogrammetry and 3D-capture techniques to determine which AHIMS sites are considered to be structurally unsound • Where this determination cannot be made, the AHIMS site will be considered to be structurally unsound • A screening of vibration intensive activities within 50 metres of structurally unsound sites will be carried out to identify activities that have the potential to exceed vibration levels of 2.5 millimetres per second.	Table 9-1 Refer also to the Aboriginal Cultural Heritage Management Sub-Plan	A noise and vibration monitoring program has been developed for the Project in line with this requirement.

Ref #	Commitment	Document reference	How addressed
	Sites identified as being both structurally unsound and having potential for exceedance in vibration levels of 2.5 millimetres per second will be identified as requiring vibration monitoring.		
AH3	Vibration monitoring will be carried out at AHIMS sites that have been identified as requiring monitoring in accordance with the process outlined in mitigation measure AH2. Where possible, works will be conducted in a manner to minimise vibration levels, to less than 2.5 millimetres per second at all structurally unsound AHIMS sites.	Table 9-1 Refer also to the Aboriginal Cultural Heritage Management Sub-Plan	A noise and vibration monitoring program has been developed for the Project in line with this requirement.
AH4	If vibration monitoring identifies that vibration levels exceed 2.5 millimetres per second at AHIMS sites that have been identified as requiring monitoring, a site visit will be organised with a representative from Metro LALC to record any changes to the integrity of the site that may have resulted from construction vibration, and updated site cards must be prepared accordingly. Condition surveys may include further photogrammetry and 3D-capture techniques.	Table 9-1 Refer also to the Aboriginal Cultural Heritage Management Sub-Plan	A noise and vibration monitoring program has been developed for the Project in line with this requirement.
SG4	Pre-construction building/structure condition surveys will be offered and prepared for properties (and heritage assets) within the zone of influence of tunnel settlement (for example within the 5 millimetre predicted surface settlement contour and within 50 metres of surface works) and within the minimum working distances for cosmetic and structural damage due to vibration. The surveys will be carried out by a suitably qualified person prior to the commencement of the tunnelling and vibration-intensive activities in the vicinity with the potential to affect the building/structure.	Table 9-1 Refer also to the Groundwater Management Sub-Pan	Pre-construction surveys will be undertaken prior to the commencement of tunnelling and/or vibration intensive activities in the vicinity with the potential to affect the building/structure.

Ref #	Commitment	Document reference	How addressed
	Within three (3) months of the completion of construction activities that have the potential to impact on the subject surface/subsurface structure, all property owners of buildings for which a preconstruction building condition survey was carried out will be offered a second building condition survey. Where an offer is accepted, post-construction building condition surveys will be carried out by a suitably qualified person. The results of the surveys will be documented in a post-construction building condition survey report for each building surveyed. Copies of building condition survey reports will be provided to the owners of the buildings surveyed within one (1) month of the survey being completed. Any property damage caused by the project will be rectified.		

3.4 Acoustics Advisor

As required by MCoA A29 through A34, a suitably qualified and experienced Acoustics Advisor (AA) in noise and vibration management, who is independent of the design and construction personnel, has been nominated the TfNSW and engaged for the duration of works and for no less than six months following completion of construction. The Acoustics Advisor was approved by the Planning Secretary prior to the commencement of any work (as outlined in MCoA 30).

In accordance with MCoA A31, ACCIONA will 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

c) considering any recommendations to improve practices and demonstrating, to the satisfaction of the AA, why any recommendation is not adopted.

Acciona will provide the AA with OOHW Permits for review and consideration of risk (as per the OOHW Protocol), provide direct communication with the Environmental Manager, establish collaborative teams and encourage open sharing of information.

In accordance with MCoA A34, the AA must:

a) receive and respond to communication from the Planning Secretary in relation to the performance of the Project in relation to noise and vibration

b) consider and inform the Planning 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 avoid or minimise adverse noise and vibration impacts

d) review all proposed night-time works to determine if sleep disturbance would occur and recommend measures to avoid sleep disturbance or appropriate additional alternative mitigation measures

e) 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 Planning Secretary (if required to be submitted to the Planning Secretary) or before implementation (if not required to be submitted to the Planning Secretary)

f) 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

g) notify the Planning Secretary of noise and vibration incidents in accordance with Conditions A43 and A45 of this approval

h) in conjunction with the ER, the AA must:

   i. as may be requested by the Planning Secretary or Community Complaints Mediator (required by Condition B12), help plan, attend or undertake audits of noise and vibration management of the CSSI including briefings, and site visits,

   ii. in the event that conflict arises between the Proponent and the community in relation to the noise and vibration performance of the CSSI, follow the procedure in the

Community Communication Strategy approved under Condition B2 to attempt to resolve the conflict, and if it cannot be resolved, notify the Planning Secretary

iii. consider relevant minor amendments made to the Ancillary Site Establishment Management Plan, 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 Planning Secretary and, if satisfied such amendment is necessary, endorse the amendment, (this does not include any modifications to the terms of this approval)

iv. review the noise impacts of minor construction ancillary facilities, and

v. prepare and submit to the Planning Secretary and other relevant regulatory agencies, for information, a Monthly Noise and Vibration Report detailing the AA's actions and decisions on matters for which the AA was responsible in the preceding month. The Monthly Noise and Vibration Report must be submitted within seven days following the end of each month for the duration of the AA's engagement for the CSSI, or as otherwise agreed by the Planning Secretary.

Details regarding the roles and responsibilities of Acoustics Advisor are also outlined in Section 3.3 of the CEMP.

4 Consultation

4.1 Consultation for NVMP Preparation

Consultation for the following documents has/will occur as described below:

- This Plan has been developed and finalised in consultation with NSW Department of Planning and Environment (DPE), Inner West Council, North Sydney Council and NSW Health as required in MCoA C4(b), and in accordance with MCoA A5
- The Noise and Vibration Monitoring Program included in Appendix D2 has been finalised in consultation with the NSW Environment Protection Authority (EPA) as required by MCoA C11(a), and in accordance with MCoA A5.
- The Out of Hours Works (OOHW) Protocol included in Appendix D3 has been developed and finalised in consultation with the EPA in accordance with MCoA E69.
- As discussed in Section 9.9, should blasting be required for the Project, a standalone Blast Management Strategy will be prepared in consultation with the EPA. Records of EPA consultation will be submitted in conjunction with the Blast Management Strategy.

Consultation with each agency, including responses received and how any issues raised were addressed in the development of this Plan has been provided to the Planning Secretary along with the relevant document for submission.

4.2 Ongoing consultation

Residents, property owners, businesses and community facilities near construction sites will have a wide range of needs and concerns regarding construction impact. ACCIONA 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. In accordance with MCoA E83, consultation with the affected community must be undertaken on a regular basis.

Any other ongoing consultation with agencies, where required, will be undertaken in accordance with Section 9 of this Plan. Community feedback and complaints relating to noise and vibration will be managed in accordance with the Community Communication Strategy and Complaints Management System.

The outcomes of this consultation will be fed back into the construction noise and vibration management system and will assist with the final timetabling, respite periods and detailed design of mitigation measures for the site, where reasonable and feasible.

Consultation will include the provision of the following information to affected receivers:

- A progressive schedule of likely out-of-hours work for a period of no less than three (3) months,
- A description of the potential out-of-hours, including location and duration,
- The noise characteristics and likely noise levels of the works, and
- Likely mitigation and management measures.

The outcomes of the community consultation, the identified respite periods and the scheduling of the likely OOHW will be provided to the AA, ER, EPA and the Secretary.

4.3 Out of Hours Work Respite Consultation

Ongoing consultation pertaining to the Project's noise and vibration impacts will be required with relevant councils and other stakeholders, including the identification of appropriate respite periods for OOHW with affected receivers identified in the noise assessment. This process is further outlined in the OOHW Protocol (refer Appendix D3)

In accordance with the CCS Appendix B – Out of Hours Communication Framework the following suite of communication tools will be considered as part of OOHW respite consultation, where required:

- OOHW notifications (letterbox drops and emails), providing overarching community notification of upcoming OOHW
- OOHW notices (email, SMS, phone calls and flyers), reminder to potentially affected residents of commencement of OOHW
- Face to face meetings
- Negotiated agreements
- Alternative accommodation letters of offer- Offer alternative accommodation to highly noise affected residents
- Website updates, providing a list of upcoming OOHW
- Phone calls, providing personalised contact and tailored advice about upcoming OOHW.

5 Existing environment

The Project is located within the Inner West and North Sydney local government areas (LGAs).

The areas surrounding the project alignment and construction support sites are mostly residential, except for clusters of commercial and industrial receivers around Glebe Island, the North Sydney central business district and Sydney Harbour.

The acoustic environment in these residential areas is mostly influenced by noise from the major arterial roads such as the City-West Link, Victoria Road and Warringah Freeway, as well as local transport activities.

Traffic volumes on these main roads, and resulting noise levels, are generally highest in the morning between 7.00 am and 9.00 am, and lowest between 2.00 am and 3.00 am. Traffic noise on major arterial roads is more continuous, rather than intermittent.

Noise generated by shops, restaurants, employment and entertainment areas can influence the surrounding acoustic environment and may contribute to higher ambient noise levels which locally mask road traffic noise.

5.1 Sensitive receivers

As the Project is being constructed within a developed urban area, the Project is surrounded by sensitive receivers. A land use survey was originally undertaken as part of the EIS to identify the receiver types and uses of buildings that could potentially be impacted by noise or vibration from the Project, to assist with defining appropriate management objectives for the sensitive receivers.

To meet the requirements of MCoA E65 and to provide a more contemporary understanding of potentially affected receivers, additional land use surveys of current noise-sensitive receivers has been completed. The results of the additional surveys are included in Appendix D1.

The noise and vibration-sensitive receivers are generally separated into the following major categories, with further details of the breakdowns of categories and noise and vibration objectives presented in Section 6:

- Residential receivers (including mixed use buildings and aged care facilities)
- Other noise and vibration-sensitive receivers, including:
    - Classrooms at schools and other educational institutions
    - Hospital wards and operating theatres
    - Places of worship
    - Childcare centres
    - Active recreation areas (e.g. sports fields/activities which generate their own noise and are generally less sensitive to external noise)
    - Passive recreation areas (e.g. areas used for low intensity and low noise producing activities which have the potential to be impacted by external noise such as reading or meditation)
    - Community centres
    - Special noise and/or vibration-sensitive receivers (e.g. laboratories, recording studios)
- Commercial premises (including offices and retail outlets)
- Industrial premises

5.2 Noise Catchment Areas

To facilitate the assessment of noise impacts from the Project, receivers along the route have been divided into Noise Catchment Areas (NCAs). NCAs group individual sensitive receivers by common traits such as existing noise environment and location in relation to the Project. The project has been divided into 48 NCAs which are presented in Appendix D1.

5.3 Ambient Noise

During preparation of the EIS noise monitoring was carried out along the Project extent to quantify the existing noise environment in areas where receivers may potentially be affected by construction noise. Noise management levels (NMLs) for the assessment of construction noise are derived from measurements of existing noise levels in an area. The rating background level (RBL) is used to determine noise management levels at residential receiver locations.

The long-term noise monitoring results for the Project are presented in Table 5-1.

Table 5-1 Long-term noise monitoring results

Monitoring location ID	NCA	Address	L_{A90} Rating Background Level (RBL)			L_{Aeq} Ambient noise		
			Day	Evening	Night	Day	Evening	Night
1	1.5	22 The Crescent, Annandale	51	45	33	66	65	60
2	1.5	2/277 Johnston Street, Annandale	50	47	36	65	64	59
3	3.3	16 Railway Parade, Annandale	50	51	44	58	58	53
4	5.3	109 Denison Street, Rozelle	49	46	37	61	60	53
5	2.1	14 Oxley Street, Glebe	51	52	45	57	55	52
6	4.3	28 Lilyfield Road, Rozelle	52	52	45	58	58	55
7	10.1	203/38 Refinery Drive, Pyrmont	48	45	44	52	49	48
8	7.1	31 Cambridge Street, Rozelle	43	41	34	57	57	48
9	9.1	C13/1 Buchanan Street, Balmain	49	49	46	54	51	49
10	8.1	23 Smith Street, Rozelle	42	44	38	54	51	49
11	11.4	31 Wharf Road, Birchgrove	40	42	37	52	48	43
12	12.1	9 Numa Street, Birchgrove	46	45	40	58	56	53
13	13.1	6 O'Connell Street, Grenwich	41	38	32	54	49	43
14	14.1	5 Balls Head Road, Waverton	41	37	33	51	47	45
15	15.2	1/16 Munro street, McMahons Point	42	41	38	52	46	44

Monitoring location ID	NCA	Address	L_{A90} Rating Background Level (RBL)			L_{Aeq} Ambient noise		
			Day	Evening	Night	Day	Evening	Night
16	16.1	401/102 Alfred Street, Milsons Point	60	60	50	63	62	58
17	17.2	6 McDougall Street, Kirribilli	55	54	45	60	58	56
19	19.1	91 Ridge Street, North Sydney	52	52	45	57	57	52
20	18.3	14 Montpellier Road, Neutral Bay	54	52	43	59	57	53
21	22.1	306 Miller Street, North Sydney	52	47	36	65	63	58
22	23.2	1/1 Bardsley Gardens, Crows Nest	53	49	41	68	67	63
23	23.1	288 Falcon Street, Neutral Bay	61	54	44	69	68	65
25	26.2	317 Ernest Street, Cammeray	58	54	41	69	66	62
26	25.2	225 Ernest Street, Cammeray	56	52	37	68	66	61
27	25.1	77 Rosalind Street, Cammeray	58	55	43	62	60	57
28	29.1	53 Bellevue Street, Cammeray	64	63	47	67	67	64
29	28.1	12 Warringa Road, Cammeray	47	45	37	54	51	48
30	27.1	57 Park Avenue, Cremorne	49	48	39	59	57	54
31	30.1	18/22-24 Donnelly Road, Crows Nest	58	56	38	62	61	58
32	31.3	79 Brook Street, Naremburn	56	49	37	71	69	65
33	33.2	20/2 Parkes Road, Artarmon	67	63	46	72	70	67
34	33.1	3/2 Cleland Road, Artarmon	55	53	40	59	58	55
35	32.1	1 Chelmsford Avenue, Naremburn	59	55	40	63	61	58
36	34.1	2 Burra Road, Artarmon	44	44	37	53	50	46
37	36.1	16 Walter Street, Willoughby	50	48	38	55	52	49
38	37.1	27 Garland Street, Naremburn	45	44	34	53	52	48
39	38.1	2 Pyalla Street, Northbridge	52	48	37	60	56	57

6 Noise and vibration criteria for NSW

6.1 Standards and guidelines

The MCoA require construction noise and vibration be managed in accordance with the standards and guidelines outlined in MCoA E70. The standards and guidelines adopted for the Project are listed in Section 3.1.1.

Relevant elements of these documents are summarised and discussed in the following sections.

6.2 Construction noise and assessment objectives

As outlined in MCoA E70, the *Interim Construction Noise Guideline* (DECC, 2009) provides guidelines for the assessment and management of construction noise. The ICNG focuses on applying a range of work practices to minimise construction noise impacts rather than focusing on achieving numeric noise levels.

The main objectives of the ICNG are to:

- Identify and minimise noise from construction works
- Focus on applying all ‘feasible’ and ‘reasonable’ work practices to minimise construction noise impacts
- Encourage construction during the recommended standard hours only, unless approval is given for works that cannot be undertaken during these hours
- Reduce time spent dealing with complaints at the project implementation stage
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

6.3 Approved construction work hours

Approved working hours for the Project are defined by the MCoA and EPL (to be obtained) as per Table 6-1. This document will be updated as required, once the EPL is issued.

It is noted that highly noise intensive works that result in an exceedance of the applicable NML will only be scheduled and undertaken during hours stated in MCoA E67 unless otherwise permitted by an EPL or MCoA E68, or as approved OOHW.

Table 6-1 Construction working hours

MCoA	Construction Activity	Working hours applicable to Condition[1]		
		Monday to Friday	Saturday	Sun/ Public holiday
E66	Works must be undertaken during the following hours: (a) 7:00 am to 6:00 pm Mondays to Fridays, inclusive (b) 8:00 am to 6:00 pm Saturdays (c) at no time on Sundays or public holidays	7:00am to 6:00pm	8:00am to 6:00pm	No work
E67	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver must only be undertaken: (a) between the hours of 8:00 am to 6:00 pm Monday to Friday (b) between the hours of 8:00 am to 1:00 pm Saturday (c) if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour. For the purposes of this condition, 'continuously' includes any period during which there is less than one hour between ceasing and recommencing any of the work.	8:00am to 6:00pm (plus respite[2])	8:00am to 1:00pm (plus respite[2])	No work
E68	Notwithstanding Conditions E66 and E67 work may be undertaken outside the hours specified in any of the following circumstances (Refer Section 9.3 and Appendix D3): (a) Safety and Emergencies, including: i. for the delivery of materials required by the NSW Police Force or other authority for safety reasons ii. 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 On becoming aware of the need for emergency work in accordance with Condition E8(a)ii, the Proponent must notify the AA, the ER, the Planning Secretary and the EPA of the reasons for such work. The Proponent must use best endeavours to notify all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work. (b) Low impact, including: i. construction that causes $L_{Aeq(15\ minute)}$ noise levels: • no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, or • no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); or ii. construction that causes $L_{AFmax(15\ minute)}$ noise levels no more than 15 dB(A) above the rating background level at any residence; or iii. construction that causes:	Outside Standard Construction Hours. Refer Appendix D3 – OOHW Protocol		

MCoA	Construction Activity	Working hours applicable to Condition[1]		
		Monday to Friday	Saturday	Sun/ Public holiday
	• continuous or impulsive vibration values, measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), or • intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006). (c) By Approval, including: i. where different construction hours are permitted or required under an EPL in force in respect of the Project; or ii. works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition E69; or iii. negotiated agreements with directly affected residents and sensitive land user(s). (d) By Prescribed Activity, including: i. tunnelling (excluding cut and cover tunnelling and surface works) and tunnel fit out works (excluding surface works) are permitted 24 hours a day, seven days a week; or ii. delivery of material that is required to occur outside of standard construction hours in Condition E66 to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to/from WHT7 at Berrys Bay which could result in a sleep disturbance event for receivers in the proximity of Bay Road and Balls Head Road, Waverton; or iii. works within an acoustic shed where there is no exceedance of the NMLs; or iv. trailer suction hopper dredging; or v. along the Warringah Freeway corridor in accordance with Condition E88.			

MCoA	Construction Activity	Working hours applicable to Condition[1]		
		Monday to Friday	Saturday	Sun/ Public holiday
E88	Out-of-Hours Work along the Warringah Freeway corridor which results in an exceedance of the relevant NML at the same sensitive land user(s) may be undertaken in accordance with the following criteria: (a) two consecutive evenings and/or nights per week; or (b) three non-consecutive evenings and/or nights per week; or (c) 10 evenings and/or nights per month; or (d) except as identified by an EPL; or (e) in accordance with an agreement with a potentially impacted receiver(s) as required by Condition E68(c)(iii) or Condition E83. Note: These parameters may be increased subject to the development of a framework, which is prepared in consultation with the community and EPA and with consideration of the delivery of the NIP.	Outside Standard Construction hours in accordance with the restrictions described in this condition. Refer Appendix D3 – OOHW Protocol		

Notes:

1. No work unless permitted as OOHW and approved in accordance with an EPL
2. Minimum respite in continuous blocks of no more than 3 hours, with at least 1 hour respite between each block of work generating high noise impact, where the location of the work and activities is likely to impact the same noise sensitive receivers; except as expressly permitted by another condition of this licence.

6.4 Quantitative noise assessment criteria

6.4.1 Airborne Noise

6.4.1.1 Residential Receivers

The noise management levels (NMLs) for residential receivers set in accordance with the Construction Noise and Vibration Guideline are provided in Table 6-2. Construction noise impacts on residential receivers are assessed using these noise management levels, set with reference to time of day and background noise (Rating Background Level (RBL)). The RBL for each location was determined based on the quietest period of the day, evening or night assessment period in accordance with the NPfI.

Where noise levels are above the noise management levels, reasonable and feasible noise mitigation needs to be considered. Reasonable and feasible noise mitigation includes site specific measures for noise management, mitigation and treatment measures such as construction noise barriers, acoustic sheds, acoustic enclosures, and restricted construction hours and activities.

Where exceedances of the NMLs are expected, the additional mitigation measures outlined in the CNVG will be implemented to mitigate residual impacts, refer Section 9.7.

There is also a highly noise affected level for construction, above which further mitigation needs to be considered, such as additional consultation and notification, additional respite periods, and alternative accommodation.

Table 6-2 Construction noise management levels – residential receivers

Time of Day	NML, $L_{Aeq,15min}$, dB(A)[1]	How to Apply
Approved construction hours[2]: Monday to Friday 7 am to 6 pm Saturday 8 am to 6 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. 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

Time of Day	NML, $L_{Aeq,15min}$, dB(A)[1]	How to Apply
		mid-afternoon for works near residences 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside approved construction hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 (ICNG).

Notes:

1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.
2. Approved construction hours are Monday to Friday 7 am to 6 pm and Saturday 8 am to 6 pm, no work on Sundays or public holidays. Refer CoA E66.

6.4.1.2 Non-residential receivers

The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 6-3. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 6-3 Noise management levels at other noise sensitive land uses

Land Use	Where objective applies	Noise management level $L_{Aeq,15min}$
Classrooms at schools, and other educational institutions	Internal noise level	45 dB(A)
Hospital wards and operating theatres	Internal noise level	45 dB(A)
Places of worship	Internal noise level	45 dB(A)
Childcare centre	External noise level	50 dB(A)

Land Use	Where objective applies	Noise management level $L_{Aeq,15min}$
Active recreation areas (e.g. sports fields/activities which generate their own noise and are generally less sensitive to external noise)	External noise level	65 dB(A)
Passive recreation areas (e.g. area used for low intensity and low noise producing activities which could be impacted by external noise such as reading or meditation)	External noise level	60 dB(A)
Community centres	Depends on the intended use of the centre.	Refer to the 'maximum' internal levels in AS2107 for specific uses.
Commercial premises (including offices and retail outlets)	External noise level	70 dB(A)
Industrial premises	External noise level	75 dB(A)
Special noise and/or vibration sensitive (e.g. laboratories, recording studios)	Depends on the intended use	Refer to the 'maximum' internal levels in AS2107 for specific uses.

6.4.1.3 Sleep Disturbance Criteria

Considering the ICNG and RNP guidance, a night-time sleep disturbance 'screening criterion' noise goal of RBL +15 dB(A) (external) is used to identify the receivers where there is potential for sleep disturbance.

Where the sleep disturbance screening criterion is exceeded, further assessment is conducted to determine whether the 'awakening reaction' level of L_{Amax} 65 dB(A) (external) would be exceeded and the likely number of these events. The awakening reaction level is the level above which sleep disturbance is considered likely.

6.4.2 Construction Traffic noise

For locations within the construction footprint, where noise levels would increase by more than 2 dB(A) due to construction traffic volumes or a temporary re-route due to a road closure, further assessment will be completed as per the Noise Criteria Guideline (Roads and Maritime, 2015).

6.4.3 Ground-borne noise

Ground-borne noise is generated by vibration transmitted through the ground into a structure and is more likely to be noticeable during the evening and night periods, when masking by airborne noise is less likely. Ground-borne noise objectives set in accordance with MCoA E71 and the Construction Noise and Vibration Guideline are provided in Table 6-4.

Table 6-4 Ground-borne noise objectives

Receiver Type	Ground-borne noise objectives $L_{Aeq,15min}$
Residential (day – 7am to 6pm)	Not applicable
Residential (evening – 6pm to 10pm)	40 dB(A) internal
Residential (night – 10pm to 7am)	35 dB(A) internal

6.5 Adopted project noise management levels

The project-specific noise objectives for each representative monitoring location for works within and outside approved working hours are presented in Table 6-5.

Figures showing the locations of the referenced NCAs as well as noise sensitive receivers are shown in Appendix D1.

Table 6-5 Adopted project noise management levels

NCA Reference	Reference Logger	Approved Hours (RBL + 10 dB)	Outside approved hours: Out of Hours Works (OOHW) (RBL + 5)			Screening Level, L_{Amax} (RBL+15dB)
		Day	Day	Evening	Night	Night
1.1	L2	60	55	52	41	51
1.2	L2	60	55	52	41	51
1.3	L2	60	55	52	41	51
1.4	L2	60	55	52	41	51
1.5	L2	60	55	52	41	51
2.1	L5	61	56	56	50	60
3.1	L3	60	55	55	49	59
3.2	L3	60	55	55	49	59
3.3	L3	60	55	55	49	59
3.4	L3	60	55	55	49	59
4.1	L6	62	57	57	50	60
4.2	L6	62	57	57	50	60
4.3	L6	62	57	57	50	60
4.4	L6	62	57	57	50	60
4.5	L6	62	57	57	50	60
5.1	L4	59	54	51	42	52
5.2	L4	59	54	51	42	52
5.3	L4	59	54	51	42	52
6.1	L41	73	68	63	48	58
6.2	L41	73	68	63	48	58
6.3	L41	73	68	63	48	58
6.4	L41	73	68	63	48	58

NCA Reference	Reference Logger	Approved Hours (RBL + 10 dB)	Outside approved hours: Out of Hours Works (OOHW) (RBL + 5)			Screening Level, L_{Amax} (RBL+15dB)
		Day	Day	Evening	Night	Night
6.5	L41	73	68	63	48	58
7.1	L8	53	48	46	39	49
7.2	L8	53	48	46	39	49
8.1	L10	52	47	47	43	53
9.1	L9	59	54	54	51	61
9.2	L9	59	54	54	51	61
10.1	L7	58	53	50	49	59
10.2	L7	58	53	50	49	59
11.1	L11	50	45	45	42	52
11.2	L11	50	45	45	42	52
11.3	L11	50	45	45	42	52
11.4	L11	50	45	45	42	52
11.5	L11	50	45	45	42	52
11.5	L11	50	45	45	42	52
12.1	L12	56	51	50	45	55
12.2	L12	56	51	50	45	55
13.1	L13	51	46	43	37	47
13.2	L13	51	46	43	37	47
14.1	L14	51	46	42	38	48
15.1	15	52	47	46	43	53
15.2	15	52	47	46	43	53
15.3	15	52	47	46	43	53
15.4	15	52	47	46	43	53
16.1	16	70	65	65	55	65
16.2	16	70	65	65	55	65
16.3	16	70	65	65	55	65
17.1	17	65	60	59	50	60
17.2	17	65	60	59	50	60
17.3	17	65	60	59	50	60
17.4	17	65	60	59	50	60
18.1	20	64	59	57	48	58
18.2	20	64	59	57	48	58
18.3	20	64	59	57	48	58
19.1	19	62	57	57	50	60
20.1	19	62	57	57	50	60
21.1	22	63	58	54	46	56

NCA Reference	Reference Logger	Approved Hours (RBL + 10 dB)	Outside approved hours: Out of Hours Works (OOHW) (RBL + 5)			Screening Level, L_{Amax} (RBL+15dB)
		Day	Day	Evening	Night	Night
21.2	22	63	58	54	46	56
22.1	21	62	57	52	41	51
22.2	21	62	57	52	41	51
22.3	21	62	57	52	41	51
23.1	23	71	66	59	49	59
23.2	23	71	66	59	49	59
24.1	26	66	61	57	42	52
25.1	27	68	63	60	48	58
26.1	25	68	63	59	46	56
26.2	25	68	63	59	46	56
27.1	30	59	54	53	44	54
28.1	29	57	52	50	42	52
29.1	28	74	69	68	52	62
30.1	31	68	63	61	43	53
30.2	31	68	63	61	43	53
30.3	31	68	63	61	43	53
30.4	31	68	63	61	43	53
31.1	32	66	61	54	42	52
31.2	32	66	61	54	42	52
31.3	32	66	61	54	42	52
32.1	35	69	64	60	45	55
33.1	34	65	60	58	45	55
33.2	34	65	60	58	45	55
33.4	34	65	60	58	45	55
34.1	36	54	49	49	42	52
35.1	33	77	72	68	51	61
36.1	37	60	55	53	43	53
37.1	38	55	50	49	39	49
38.1	39	62	57	53	42	52
38.2	39	62	57	53	42	52
38.3	39	62	57	53	42	52

Notes:

1. As per section 2.3 of the NPfI, as the community generally expects greater control of noise during the more sensitive evening and night-time periods than during the less sensitive daytime period, the project noise management levels for evening are set at no greater than daytime level, and the night-time is set to be no greater than the day or evening levels.

6.6 Vibration criteria

Construction vibration is associated with three main types of impact:

- Disturbance to building occupants
- Potential damage to buildings
- Potential damage to sensitive equipment in a building.

Generally, if disturbance to building occupants is controlled, there is limited potential for structural damage to buildings.

6.6.1 Human exposure to vibration

Tactile vibration potentially disturbing human occupants of buildings is managed by reference to Assessing Vibration; a technical guideline (DECC, 2006). This document provides criteria which are based on the British Standard BS 6472-2008 Evaluation of human exposure to vibration in buildings (1-80Hz).

Vibration sources are defined as Continuous, Impulsive or Intermittent. Table 6-6 provides a definition and examples of each type of vibration.

Table 6-6 Types of vibration

Types of vibration	Definition	Examples
Continuous	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time)	Machinery, steady road traffic, continuous construction activity (such as roadheader excavation).
Impulsive	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing the duration is short (typically less than 2 seconds)	Infrequent: Activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer, they would be assessed against impulsive vibration criteria.

Preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced below in Table 6-7.

Table 6-7 Preferred and maximum levels for human comfort (continuous and impulsive vibration)

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration[3] (weighted rms Acceleration, m/s2, 1-80Hz)					
Critical areas[2]	Day or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
Workshops	Day or night-time	0.04	0.029	0.080	0.058
Impulsive vibration[3] (Weighted rms Acceleration, m/s2, 1-80Hz)					
Critical areas[2]	Day or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Notes:

1. Daytime is 7.00am to 10.00pm and night-time is 10.00pm to 7.00am
2. 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 specified above. Stipulation of such criteria is outside the scope of their policy and other guidance documents (e.g. relevant standards) and should be referred to. Source: BS 6472-2008
3. Source: Table 2.2, Assessing Vibration; a technical guideline, Department of Environment and Climate Change 2006.

Preferred and maximum values for human comfort are presented in Table 6-8.

Table 6-8 Preferred and maximum levels for human comfort (intermittent vibration)

Location	Assessment period[1]	Preferred values	Maximum values
Intermittent vibration[3] (Vibration Dose Values, VDV, m/s1.75, 1-80Hz)			
Critical areas[2]	Day or night-time	0.10	0.20
Residences	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Notes:

1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas, as noted in BS 6472–1992
3. Source: Table 2.4, Assessing Vibration; a technical guideline, Department of Environment & Climate Change 2006.

6.6.2 Structural damage to buildings

Potential structural damage of buildings by vibration is typically managed by ensuring vibration impacting the structure does not exceed certain limits and standards, such as British Standard 7385: Part 2 and German Standard DIN 4150-3. As outlined in the Roads and Maritime's CNVG, guidance for cosmetic damage of structures is provided in the British Standard 7385: Part 2, while German Standard DIN 4150-3 has criteria of particular reference for heritage structures.

There is no current Australian Standard for assessing structural building damage caused by vibration.

British Standard BS 7385: Part 2 Evaluation and measurement of vibration in buildings can be used as a guide to assess the likelihood of building damage from ground vibration. The standard suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur. Damage consists of 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.

BS 7385 is based on peak particle velocity and specifies damage criteria for frequencies within the range 4 Hz to 250 Hz, being the range usually encountered in buildings. At frequencies below 4 Hz, a maximum displacement value is recommended. The values set in the standard relate to transient vibrations and to low-rise buildings. Continuous vibration can give rise to dynamic magnifications due to resonances and may need to be reduced by up to 50 per cent. Table 6-9 sets out the BS 7385 safe limits for cosmetic damage.

Table 6-9 BS 7385 cosmetic damage safe limits

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Un-reinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

For most construction activities involving intermittent vibration sources such as rock hammers, 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, the following vibration level (PPV) has been adopted as the assessment criteria for sound structures:

- Reinforced or framed structures – 25 mm/s
- Unreinforced or light framed structures – 7.5 mm/s.

For assessment purposes, a conservative vibration damage screening level of 7.5 mm/s has been adopted for sound structures to identify where further investigation is required.

For structures 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 done during detailed design to determine the applicable safe vibration level and approach to construction near the structure.

6.6.3 Heritage items

Heritage items are considered on a case by case basis, and care should be taken as these structures can be difficult to repair in the case of damage. British Standard BS 5228-2:2009 states that ‘a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive’ (p.39) when compared to other structures. The testing of vibration generating construction activities will be undertaken and the advice of a heritage specialist sought, as outlined in the Noise and Vibration Monitoring Program provided in Appendix D2.

Where a structure of heritage value is found to have defects, or is structurally unsound following an inspection, maximum vibration criteria are to be established for that specific structure for works to not further damage the structure. As stated previously, German Standard DIN 4150: Part 3 provides guidance for structures that are sensitive to vibration (e.g. structurally unsound).

A conservative vibration damage screening level of 2.5 mm/s has been adopted for heritage structures found to be unsound. This does not necessarily reflect that there would be a vibration impact on the structure if this level is exceeded, instead it is a suitable vibration level that is used as part of the construction vibration management process to trigger further investigation.

Any heritage structure predicted to exceed the screening level would be further investigated during detailed design, and appropriate vibration criteria for the structure adopted. If a heritage building or structure is found to be structurally unsound (following inspection), the conservative cosmetic damage objective of 2.5 mm/s peak component particle velocity (from DIN 4150) would be considered, and appropriate protections put in place.

The general approach to managing potential vibration impacts on heritage items would be to:

1. Identify heritage items where the 2.5 mm/s peak component particle velocity objective may be exceeded during specific construction activities
2. Carry out a structural engineering report on identified heritage items, to confirm structural integrity of the building and confirm if item is 'structurally sound'
3. Adopt the appropriate screening level from BS7385 Part 2 if the item was confirmed as 'structurally sound', or
4. Adopt the more conservative cosmetic damage level of 2.5 mm/s peak component particle velocity if the item was confirmed as 'structurally unsound'.

6.6.4 Damage to vibration-sensitive equipment

Some high technology manufacturing facilities, hospitals and laboratories use equipment that is highly sensitive and susceptible to vibration, for example scanning electron microscopes and micro-electronic manufacturing facilities. In addition, buildings housing sensitive computer or telecommunications equipment may require assessment against stricter criteria than those nominated for building damage.

There is no explicit guidance on acceptable vibration levels for sensitive equipment, so recommended vibration levels should be obtained from instrument manufacturers. In the absence of equipment-specific data provided by manufacturers, there are generic vibration limits that can be used to assess the impact of vibration-generating activities on buildings housing vibration-sensitive equipment.

Vibration Criterion (VC) curves are often referred to as they are generic and apply to all tools/equipment types within each category. The VC curves are defined over the frequency range eight to 100Hz.

Table 6-10 summarises a range of suitable vibration limits that are applicable to buildings housing vibration-sensitive equipment which may potentially be affected by construction works associated with the project.

Table 6-10 Acceptable vibration limits on building structure housing sensitive equipment

Equipment requirements	Vibration limit[1] mm/s		Description of Use
	rms	Peak[4]	
Computer areas[2]	0.7	1.0	Barely perceptible vibration. Adequate for computer equipment accommodation environments.
Medical[2,3]	0.1	0.14	Vibration not perceptible. Suitable in most instances for microscopes to 100X and for other equipment of low sensitivity.
VC-A[3]	0.05	0.07	Vibration not perceptible. Adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc

Notes:

1. As measured in one-third octave bands of frequency over the frequency range 8 to 100 Hz. Vibration measured on the building structure near vibrating equipment or in areas containing sensitive equipment
2. Based on AS 2834 Computer Accommodation
3. Gordon CG Generic Vibration Criteria for Vibration-sensitive Equipment

4. In the absence of Peak limits, rms limits are converted to Peak by conservatively assuming the vibration signal is sinusoidal and random with a nominal crest factor of 1.414.

6.6.5 Existing rail tunnels

Any development that occurs within a distance of 25 metres horizontally from first reserve (dependent on tunnel dimensions), as defined in Asset Standards Authority (ASA) standard Development Near Rail Tunnels (ASA 2018), must consider vibration impacts on existing rail tunnels. The assessment requirement is a maximum peak particle velocity (PPV) of 15 mm/s at the tunnel lining for brick or mass concrete in good condition, or maximum PPV of 20 mm/s at the tunnel lining for cast iron, steel or concrete segment lining.

Prior to works commencing within this zone of influence, ACCIONA will undertake a design analysis for these crossings and develop appropriate third party agreements to address rail crossings with specific requirements.

6.6.6 Damage to buried utilities

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. These values, which apply at the wall of the pipe, are reproduced and presented in Table 6-11. As part of detailed design, these vibration limits would be considered to minimise the potential for damage to buried utilities from vibration impacts.

Table 6-11 Acceptable vibration limits for effects of short-term vibration on buried pipework

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

Notes:

1. Consideration must also be given to pipe junctions within the building structure as potential substantial changes in mechanical loads on the pipe must be considered.

For long-term vibration, the vibration limits presented in Table 6-11 should be halved.

Recommended vibration goals for electrical cables and telecommunication utilities such as fibre optic cables range from 50 mm/s to 100 mm/s. Although cables may sustain these vibration levels, the utilities they are connected to, such as transformers and switch blocks, may not. If such equipment is encountered during the construction process, an individual vibration assessment would be carried out addressing impact on the utility, and consultation with the utility provider, to confirm specific vibration requirements.

6.6.7 Minimum Working Distances for Vibration Intensive Works

Minimum working distances (MWD) for typical vibration intensive construction equipment are provided in the CNVG and are shown in Table 6-12. The minimum working distances are for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (from AVTG). They are calculated from empirical data which suggests that where work is further from receivers than the quoted minimum distances then impacts are not considered likely.

Table 6-12 Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Rating/Description	Minimum Distance		
		Cosmetic Damage		Human Response (AVTG)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
Vibratory Roller	<50 kN (1–2 tonne)	5 m	11 m	15 m to 20 m
	<100 kN (2–4 tonne)	6 m	13 m	20 m
	<200 kN (4–6 tonne)	12 m	25 m	40 m
	<300 kN (7–13 tonne)	15 m	31 m	100 m
	>300 kN (13–18 tonne)	20 m	40 m	100 m
	>300 kN (>18 tonne)	25 m	50 m	100 m
Compactor[1]	32t (non-vibratory)	15 m	30 m	40 m
Bulldozer[1]	D10 with ripper	2 m	10 m	20 m
Excavators[1]	<30 tonne (travelling/digging)	10 m	15 m	15 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	7 m	15 m	23 m
Large Hydraulic Hammer	1,600 kg (18 to 34 t excavator)	22 m	44 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Impact Piling[1]	Typical driven pile	20 m	30 m	110 m
	338kJ per stroke (23 tonne hammer with 1.5m stroke)	70 m	140 m	330 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m
Truck Traffic[1]	On uneven construction haul roads	5 m	10 m	20 m
Concrete Saw[4]	On roads and pavements	1 m	2 m	2 m

Notes:

1. Additional MWDs included from the EIS.

2. Additional MWDs included from the Stage 1A Early Works NVMP.

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

6.7 Blasting noise and vibration criteria

Should underground controlled blasting be required during construction, a standalone blast management strategy will be prepared in consultation with the EPA to demonstrate that all blasting and associated activities will be carried out in a manner that would not generate unacceptable noise and vibration impacts or pose a significant risk to nearby structures and sensitive receivers.

7 Environmental aspects and impacts

7.1 Construction activities

This stage of the Project will involve a range of activities incorporating various heavy machinery, plant and equipment that will operate in a number of locations across the Project. To assess the level of potential impact on noise and vibration sensitive receivers, the broad categories of construction activity likely to interact with these receivers are identified below:

In summary, the key construction activities would include:

- Site establishment
    - Property acquisition and condition surveys
    - Vegetation clearing, earthworks and demolition of structures
    - Utilities installation, protection, adjustment and relocation
    - Land remediation and heritage salvage and/or conservation works (where required)
    - Installation of site fencing, environmental controls (including noise attenuation and project erosion and sediment controls) and traffic management controls
    - Construction of minor access roads and the provision of property access including the temporary relocation of pedestrian and cycle paths and adjustments to existing intersections, where required
    - Establishment of construction support sites and acoustic sheds, where required.
- Tunnel works
    - Excavation of tunnel construction accesses (declines and shafts)
    - Construction of driven tunnels. It should be noted that controlled blasting may be used for cross passages excavation and bench removal in mainline and ramp tunnels to improve the efficiency of excavation activities and shorten the overall construction program. This would be confirmed during detailed construction planning
    - Construction of cut and cover and trough structures
    - Casting and installation of concrete structures
    - Civil finishing and tunnel fitout, including pavement works to tie-in to surface roads in Rozelle, North Sydney and Cammeray
- Site rehabilitation
    - Removal of construction support sites facilities, including acoustic sheds and offices
    - Earthworks require to provide final landscape
    - Rehabilitation and revegetation of disturbed areas
    - Removal of temporary environmental and traffic controls.
- Local Area Works
    - Blister removal
    - Mill and re-sheet of road surface
    - Minor utilities relocations
    - Line-marking

- Kerb, median strip and traffic island adjustments
- Road drainage adjustments

Further detail on the construction activities required for the Project are included in the CEMP.

7.2 Noise and Vibration Impacts

7.2.1 Potential Impacts

The potential for noise and vibration impacts on sensitive receivers or structures will depend on several factors. Typically, these might include:

- The type of plant and equipment in use
- The number of plant and equipment simultaneously in use
- Proximity to sensitive receivers
- Topography and other physical barriers
- Hours/duration of construction works
- Ground condition
- The condition of sensitive receivers
- Cumulative impacts from other project's works
- Proximity of heavy traffic areas such as the highway
- Presence of existing background noise (e.g. from heavy traffic areas).

Noise and vibration impacts attributable to the Project are anticipated (Refer to Table 7-1). Chapter 9 provides a suite of mitigation measures that will be implemented to avoid or minimise impacts on the receiving community and/or built environment. Assessment of noise and vibration impacts are undertaken at three key stages, which are discussed in the following chapters:

1. Risk assessment workshop – high level assessment for establishing appropriate control measures (refer to the CEMP) and identifying project-specific or site-specific controls which should be applied.
2. Where works may exceed the noise management levels, vibration criteria and/or ground-borne noise levels at any residence outside approved construction hours or where receivers will be highly noise affected, construction noise and vibration impact statements (CNVIS) would be prepared prior to commencement of those works.
3. During planning for out-of-hours works not included in the CNVIS (eg utilities relocations or similar), impacts will be assessed as part of the OOHW Permit (refer to Section 1) using project-specific noise and vibration assessment tool, which have been developed by the project acoustic consultant and utilised by the project team.

7.2.2 Potential Heritage Impacts

The potential for impacts on non-Aboriginal heritage and Aboriginal Cultural heritage has been assessed as part of the Project EIS. Construction activities that have the potential to impact on Aboriginal and Non-Aboriginal heritage both directly and indirectly.

The Project Non-Aboriginal heritage Management Plan (NAHMP) and Aboriginal Cultural Heritage Management Plan (ACHMP) detail how heritage items will be protected throughout the Project via the implementation of appropriate mitigation measures.

Table 7-1 Noise and Vibration impact summary

Construction Activity	NCA likely affected	Risk Level prior to mitigation	Mitigation measures	Risk Level following mitigation
Utilities works including overhead and underground utilities relocation	20.1, 19.1, 21.2, 23.2, 22.1, 23.1, 26.1, 26.2	Moderate to high	REMM CNV3, CNV4, CNV05, CNV6, CNV8, CNV10 CoA E67, E83, E84 E88, E101, E72, E74, E75	Low - Moderate
Site preparation works including clearing of vegetation, installation of temporary fencing and hoarding, installation of environmental controls including erosion and sedimentation controls	4.5, 10.1, 2.1, 9.1, 9.2, 10.2, 20.1, 19.1, 21.2, 23.2, 22.1, 23.1, 26.1, 26.2	Moderate to high	REMM CNV3, CNV4, CNV05, CNV6, CNV8, CNV10 CoA E67, E83, E84 E88, E72, E74, E75, E76, E79	Low - Moderate
Establishment of ancillary facilities at White Bay (WHT3), Ridge St North (WHT9), Cammeray (WHT10), City West Link Cut and Cover (WHT12).	4.5, 10.1, 2.1, 9.1, 9.2, 10.2, 20.1, 19.1, 21.2, 23.2, 22.1, 23.1, 26.1, 26.2	Moderate to high	REMM CNV3, CNV4, CNV05, CNV6, CNV8, CNV10 CoA E67, E83, E84 E88, E101, E72, E74, E75	Low - Moderate
Construction of cut and cover structures and erection of acoustic sheds including, piling, concrete works, excavation	4.5, 10.1, 2.1, 9.1, 9.2, 10.2, 20.1, 19.1, 21.2, 23.2, 22.1, 23.1, 26.1, 26.2	Moderate to high	REMM CNV3, CNV4, CNV05, CNV6, CNV8, CNV10 CoA E67, E83, E84 E88, E101, E72, E74, E75	Low - Moderate
Mined tunnel excavation including spoil handling	20.1, 19.1, 21.2, 23.2, 22.1, 23.1, 26.1, 26.2, 3.3	Moderate to high	REMM CNV3, CNV4, CNV05, CNV6, CNV8, CNV10 CoA E67, E83, E84 E88, E101, E72, E74, E75	Low - Moderate
Tunnel Civils including fit out of mined tunnels and material deliveries.	20.1, 19.1, 21.2, 23.2, 22.1, 23.1, 26.1, 26.2, 3.3, 4.5, 10.1, 2.1, 9.1, 9.2, 10.2	Moderate to high	REMM CNV3, CNV4, CNV05, CNV6, CNV8, CNV10 CoA E67, E83, E84 E88, E101, E72, E74, E75	Low - Moderate

8 Construction noise and vibration assessment

The Western Harbour Tunnel and Warringah Freeway Upgrade Appendix G (Technical Working Paper: Noise and Vibration) of the EIS detailed a construction noise and vibration impact assessment. This was completed using three-dimensional models which included all noise sources, receiver locations, topographical and man-made features, and feasible and reasonable noise mitigation measures developed for this project. Models were developed for each of the major stages of construction across the project based on preliminary site layouts and reasonable worst case construction plant and equipment. Feasible and reasonable noise treatment measures and management methods were identified and incorporated into the models to assist in attenuating and managing noise from construction activities.

It was acknowledged in the EIS that actual noise levels would vary greatly depending on a range of factors including the location of the construction works within each construction works area, the distance between noise sources and nearby receivers, the noise intensity of works taking place and the time-of-day specific activities take place.

8.1 Construction scenarios

Construction noise from major works areas for the Project are assessed in detail in Section 5.2 through to Section 5.8 and Section 5.11 through to 5.12 of Appendix G (Technical Working Paper: Noise and Vibration) of the EIS. The below table summarises construction scenarios applicable to Stage 3B of the Project. Each key 'Construction Scenario' is likely to have multiple phases of work, referred to in assessment as 'Activities' which require individual assessment, particularly for initial site establishment and surface works.

Table 8-1 Stage 3B key construction scenarios

Location	Scenario	Construction hours[1]
Tunnel construction support sites		
WHT3 - White Bay (No excavation would take place at this site) WHT10 – Cammeray Golf Course WHT12 – WHT Cut and Cover Structure	Site establishment, surface construction work, site rehabilitation	Standard
	Tunnelling and tunnel construction support	24 Hours
	Tunnel mechanical and electrical fit out, and commissioning	24 Hours
	Construction of permanent operational facilities	Standard
Surface road works in the Warringah Freeway and surrounds		
WHT8 - Berry Street north WHT9 - Ridge Street north	Early Works	Standard
	Utilities, sewerage and local area upgrade works	Standard
	Bridge and concrete works (cut and cover, ramp pavements, bridge demolition / construction)	Standard
Tunnelling		

Berry's Bay to North Sydney	Ramps	24 Hours
	Heading & Benching	24 Hours
	Cross passages	24 Hours
	M&E fitout	24 Hours

Note 1: This does not preclude the use of Shoulder Periods or Out of Hours Works as described in this document.

8.2 Construction noise impacts

For the scenarios identified in the EIS and listed above, site-specific construction noise and vibration impact statements (CNVIS) will be prepared by an appropriately qualified and experienced acoustic consultant in accordance with MCoA E75, to model noise and vibration impacts and identify appropriate management of the works.

The CNVIS will be prepared for any Activity that may exceed the noise management levels, vibration criteria and/or ground-borne noise levels specified in MCoA E70 and E71 at any residence outside construction hours identified in MCoA E66, or where receivers will be highly noise affected.

The CNVIS will include specific mitigation measures identified through consultation with affected sensitive land user(s) and the mitigation measures must be implemented for the duration of the works. A copy of the CNVIS will be provided to the AA and ER for endorsement prior to the commencement of the associated works. The Planning Secretary may request a copy/ies of CNVIS.

The CNVIS will address:

- Scope of work covered by CNVIS
- Justification for OOHW (where required)
- Nearest noise and vibration sensitive land user(s), based on land use survey
- Construction noise and vibration objectives (outlined in Section 6.2)
- Construction noise and vibration assessment
- Specific mitigation measures and preferred management measures, including noise barriers and acoustic enclosures as relevant
- Additional mitigation measures as described in Section 9.7
- Noise and vibration monitoring requirements
- Community notification requirements.

Noise and vibration monitoring data will be collected throughout the delivery of the project construction works in accordance with the Noise and Vibration Monitoring Program (Appendix D2) and the CNVIS. This will allow for ongoing review and verification of the predictive model.

The key overarching construction activities to be included in the CNVIS documents for this stage of the Project are listed below:

1. Site Establishment
2. Cut and Cover Construction
3. Mined Tunnel Excavation (Excavation support and spoil handling)
4. Mined Tunnel Civils (pavement & surface works)
5. Mechanical & Electrical installation activities
6. Ventilation Building Construction

7. Water Deluge Tank Construction
8. Ventilation Outlet Construction

The following process for assessing construction noise and vibration will be implemented during preparation of each CNVIS.

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 5.1
2. Identify construction stages for each key construction area:
    - Identify construction aspects of the proposed Activities, including:
        - Site location
        - Times of operation
        - Activities involved
        - Plant and equipment (including size/type)
    - Identify construction works in the vicinity of the project. Liaise with the Utilities Coordination Manager and other construction projects in the vicinity of the works to ensure cumulative noise and vibration impacts are managed, in particular for 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
- Establish noise model for construction activity. 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, fence, barriers etc.)
    - Effects of standard noise mitigation measures
    - Evaluate façade transmission loss of affected receivers to determine internal noise levels
- Calculate the $L_{Aeq(15\ minute)}$ noise levels (external and internal) 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 the sleep disturbance criterion (RBL +15), applied at the external façade and determine whether the ‘awakening reaction' level of L_{Amax} 65 dB(A) (external) would be exceeded. The number of noise awakening events also needs to be predicted in accordance with CoA E69(c).

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 (refer to Chapter 10 of the EIS). Note that minimum working distances may differ for heritage items
- Where plant and equipment may operate within minimum working distances, or for heritage items:

- Use vibration levels versus 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 and particular sensitivities of equipment

4. Assess noise and vibration impacts. Where predicted noise and vibration exceeds the objectives identified in Step 1:
   - Identify key hours of impact for affected sensitive receivers (refer to Section 5.1)
   - Implement appropriate reasonable/feasible standard mitigation measures (refer to Section 9)
   - Predict noise and vibration impact at receivers, incorporating nominated mitigation measures, based on the expected noise reduction from mitigation measures
   - Consider additional mitigation measures and apply as appropriate.

8.3 Noise and vibration management tool

KNOWnoise™, a project specific noise and vibration prediction tool will be used to prepare site-specific or activity-specific noise and vibration assessments where any new activities and/or variations to the activities or locations are proposed during delivery, such as out-of-hours work..

The three-dimensional noise prediction tool uses SoundPlan, considers topography at a 1m digital elevation and has been developed to predict noise in accordance with ISO 9613-2:1996 and Vibration in accordance with safe working distances outline in the TfNSW CNVG. The noise and vibration prediction tool would:

- Populate sensitive receivers
- Plant and machinery to be used and Sound Power Level (SWL) and safe working distances
- Specific WHT work areas.

The noise and vibration prediction tool would model noise level predictions at sensitive receivers and the assessment can be viewed in various formats including maps, tables and excel spreadsheets.

Verification of the prediction tool will occur throughout construction via monitoring. Noise and vibration monitoring data will be collected in accordance with the Noise and Vibration Construction Monitoring Program and compared to the outcomes of the model (in cases where model descriptors, such as plant numbers, type and proximity, have been accurately met during the model). Where there are notable inconsistencies between noise model predictions and monitoring results further investigation will be undertaken to understand the cause. This may include additional site specific background monitoring and plant noise output spot checks. This feedback will ensure the prediction tool is suitably accurate across various areas of works.

More information about KNOWnoise™ can be accessed at https://hutchisonweller.com/knownoise/.

8.4 Ground-borne construction noise

Ground-borne noise objectives are presented in Table 6-4. The estimated number of potential ground-borne affected receiver buildings from road header tunnelling and rock hammer tunnelling are summarised in Appendix G[1] (Technical working paper: Noise and vibration) of the EIS.

The results from the EIS noted the following:

[1] Sections 5.2.4, 5.3.4, 5.5.4, 5.7.4, 5.8.4, 5.11.1.1 and 5.11.1.2

- Up to 22 residential buildings could experience ground-borne noise levels between 35 and 40 dB(A) and one residential building could experience ground-borne noise levels above 40 dB(A). Evening and night time ground-borne noise management levels have the potential to be exceeded at these receivers
- One non-residential sensitive receiver building could experience ground-borne noise levels above the noise management level
- Other commercial and industrial buildings are not predicted to experience ground-borne noise levels above their relevant ground-borne noise management level.

Roadheader progress is estimated to be 20 to 30 metres a week depending on the type and size of the tunnel section. The ground-borne noise level is expected to drop away as the tunnelling moves further away from the receiver.

Rock-hammers may be used for clearing the bench of the tunnel and would follow behind the roadheader. Rock hammering is typically a more noise and vibration intensive activity than Roadheadering, therefore more receivers could be impacted during rock-hammering than roadheader tunnelling. However, rock-hammering work would be programmed outside evening and night time periods to avoid or reduce ground-borne noise level exceedances on sensitive receivers' buildings where feasible and reasonable.

Ground-borne noise affected receiver buildings will require, as a minimum, letterbox notification to advise that tunnelling would be occurring and that noise levels are likely to be clearly audible during tunnelling works. It should be noted that even when the ground-borne noise levels achieve the objectives, they may still be audible or perceivable within residences. However, as tunnelling progresses, the tunnelling equipment approaches or moves away from individual receiver locations. The noise levels are expected to drop away as the tunnelling moves further away from the receiver, with individual receivers potentially exposed to noise levels above the ground-borne noise management levels for only relatively short periods of time.

As stated earlier in Section 8.2, in accordance with MCoA E75, CNVIS will be prepared for any work that may exceed the ground-borne noise levels specified in E71 at any residence outside construction hours identified in MCoA E66.

8.5 Construction Traffic Noise

Construction road traffic management and vehicle movements associated with the Project are unlikely to increase road traffic noise levels by more than 2 dB(A). This change represents a minor impact that is likely to be barely perceptible.

The EIS assessed road traffic noise impacts for each construction site, these are summarised below:

- White Bay: the number of night period truck movements generated by the site is small compared to existing heavy vehicle numbers on City West Link/The Crescent and James Craig Road, the number of maximum noise events that could disturb sleep is not likely to increase substantially.
- Ridge Street: A reduced speed limit during traffic management arrangements along the Warringah Freeway surface road works is unlikely produce a perceptible change in road traffic noise levels at residential receiver buildings adjacent to the carriageway
- Cammeray Golf Course: Since the number of truck movements generated by the site is not significant compared to existing heavy vehicle numbers on the Warringah Freeway, the number of maximum noise events that could disturb sleep is not likely to increase substantially.

8.6 Construction vibration

8.6.1 Vibration assessment

The vibration generated from construction works for the Project would vary depending on the level and type of activity carried out. The major construction activities that would include vibration-intensive works would be:

- Early works and establishment of construction support site facilities
- Piling cut and cover and trough structures.
- Decline and shaft excavation and construction
- Tunnelling

Where vibration intensive activities are required, site-specific buffer distances for these activities (e.g. compaction, rock hammering) will be measured on sites where plant and equipment are likely to operate close to or within the typical MWDs. Site-specific buffer distances will then be maintained to comply with relevant vibration limits.

Vibration impacts from roadheader tunnelling are predicted in the EIS to be below the vibration limit for human disturbance at all receivers. Vibration from roadheader tunnelling therefore presents a minor risk of impact.

However, vibration-intensive equipment such as large rock hammers could be used as part of excavation for the mainline tunnels, cross passages and areas of sandstone within the cut and cover structures. MWDs for this equipment would be around 22 metres for sound structures, 30 metres for unsound structures and 73 metres for human response. These MWDs indicate the potential for vibration impacts.

A range of other vibration-intensive plant may be used as part of the Project works. The typical MWDs for other vibration-intensive plant items that may be used in the works are presented in Table 6-12 (Section 6.6.7).

The number of receiver buildings that are within the MWDs across the major works areas were assessed and are presented in Appendix G[2] (Technical Working Paper: Noise and Vibration) of the EIS. Potential vibration impacts to receivers would depend on vibration source levels, the separation distance, the intervening soil and rock strata, dominant frequencies of vibration and the receiver structure.

The EIS noted that vibration impacts from the operation of roadheaders are predicted to be below the vibration limits for human disturbance at all receivers.

Up to 258 receiver buildings are predicted to be exposed to construction vibration levels above the human comfort criteria from the operation of rock-hammers. For these receivers, standard and additional mitigation measures from the Construction Noise and Vibration Guideline would be implemented, which may include notification and respite.

Five heritage listed items located in NCAs 14.1 and 23.2 would potentially exceed the vibration screening criterion for heritage buildings. Identified heritage items would be further investigated to determine specific vibration criteria and mitigation and management measures.

As noted above, site-specific construction noise and vibration impact statements (CNVIS) will be prepared in accordance with MCoA E75. While works are ongoing vibration testing would be completed in accordance with MCoA E79.

[2] Section 5.3.5, 5.4.5, 5.5.5, 5.6.5, 5.7.5, 5.8.5 and 5.11.2

8.7 Controlled blasting

Controlled blasting may occasionally be required during mainline tunnelling or excavation works and it's use will be determined during detailed design.

If controlled blasting is required, potential vibration and air blast overpressure impacts will be managed primarily through site and blast-specific assessments. Overpressure and vibration will be predicted during blast design.

It is important that the actual buffer zone around each blast site is identified and appropriate measures are taken to limit blast over-pressure and vibration to acceptable levels at the nearest affected receiver locations. Blast charge masses and configurations would therefore be selected to ensure the objectives identified in Section 6.7 are not exceeded. Due to some buildings being close to potential blast locations, a series of initial test blasts at reduced charge would be carried out before any full-scale blasting.

Vibration and any air blast overpressure would be measured from test blasts to establish site-specific propagation characteristics and increase the accuracy of blasting predictions. This information would be used to define allowable blast sizes to meet the air blast overpressure and ground vibration limits. However, as blasting is proposed within the mainline tunnels and cross passages, air blast overpressure and airborne noise impacts would likely be negligible at sensitive receivers nearby to the project.

Should controlled blasting be required, a standalone blast management strategy will be prepared in accordance with MCoA E96-E99 and in consultation with the EPA to demonstrate that all blasting and associated activities will be carried out in a manner that would not generate unacceptable noise and vibration impacts or pose a significant risk to nearby structures and sensitive receivers. Measures to mitigate and manage impacts from blasting are provided in Section 9.

9 Environmental mitigation and management measures

9.1 Noise and vibration mitigation and management measures

In accordance with MCoA E70, mitigation measures (such as those listed within Chapter 6 of the ICNG and Appendix B of the CNVG) must be implemented with the aim of achieving the construction noise management levels and vibration objectives.

Specific measures and requirements to address contract specifications, MCoA and REMMs in relation to impacts from noise and vibration are outlined in Table 9-1. These measures have been developed with consideration of SMART (specific, measurable, achievable, realistic and time-based) principles.

Table 9-1: Noise and vibration management and mitigation measures

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
Construction Noise and Vibration Impact Statements (CNVIS)						
NVMP1.	Detailed Construction Noise and Vibration Impact Statements (CNVIS) will be carried out for all construction support sites and major construction works required for the project prior to the commencement of construction. The Statements will consider the proposed site layouts and noise and vibration generating activities that will take place during all major stages of the construction support site, assess predicted noise and vibration levels against the relevant management levels, and incorporate feasible and reasonable mitigation and management measures in accordance with the requirements of the Interim Construction Noise Guideline (DECC, 2009) and the Construction Noise and Vibration Guideline (Roads and Maritime, 2016a).	CNVIS	Prior to construction	Environment Manager Project Manager	REMM CNV2 MCoA E75	CNVIS
Construction Traffic and Construction Plant Noise						
NVMP2.	Where feasible and reasonable, unless compliance with the relevant traffic noise criteria can be achieved, or alternative arrangements have been agreed with affected receivers, construction vehicle movements will not occur on local roads beyond those required for direct access to construction sites.	Noise and Vibration Monitoring Program CNVIS	Construction	Environment Manager Project Manager	REMM CNV5	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP3.	Prior to arriving on site, drivers will be advised of designated vehicle routes, parking locations, acceptable delivery hours specific to the site and other relevant practices (i.e. minimising the use of engine brakes and no extended periods of engine idling). This will be communicated by ACCIONA using notifications under contract provisions and communication with schedulers from companies using heavy vehicles.	Induction materials	Construction	Foreman Site Engineer	ACCIONA Practice	Vehicle movement plans Traffic control plans Induction records
NVMP4.	Horns or other noisy methods not to be used for signalling. No loud radios, Bluetooth speakers or the like.	Induction materials	Construction	Foreman Site Engineer Environment Manager	ACCIONA Practice	Induction records
NVMP5.	Out-of-hours deliveries will be minimised where possible. Where out of hours deliveries are required, due care will be taken to minimise impacts (i.e. no extended periods of engine idling, use of radios instead of shouting, non-tonal reversing beepers where possible, unloading/loading to be undertaken during approved hours, loads to be pre-slung as much as practicable, slings to be used instead of chains unless chains are mandated by lifting or restraint requirements).	Induction materials CNVIS	Construction	Foreman Site Engineer	ACCIONA Practice	Induction records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP6.	All construction plant and equipment used on Site must be, in addition to other requirements: (a) fitted with properly maintained noise suppression devices in accordance with the manufacturers specifications (where appropriate) (b) regularly inspected and maintained in an efficient condition in accordance with daily pre-start checklist requirements; (c) operated in a proper and efficient manner.	Plant risk assessment Manufacturer's specifications	Construction	Supervisor/ Foreman	G36	Plant inspection record
NVMP7.	Plant and Machinery to be used on site would be of appropriate size and power for the relevant construction task	Plant risk assessment Manufacturer's specifications	Construction	Supervisor/ Foreman	CNVG	Plant inspection record
NVMP8.	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.	Plant risk assessment Manufacturer's specifications	Construction	Supervisor/ Foreman	CNVG	Plant inspection record
NVMP9.	Where possible, maintenance work on plant and equipment will be undertaken off site. If maintenance is to be onsite the task will be carried out away from noise sensitive receivers and during approved hours where reasonable and feasible.	Toolbox talk SWMS	Construction	Foreman	ACCIONA Practice	Induction records SWMS Meeting minutes Toolbox talk record

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP10.	Stationary noise sources would be enclosed or shielded where reasonable and feasible. This would apply to plant and equipment such as generators, stationary concrete cutters, stationary asphalt corers, stationary vacuum trucks, and stationary jack hammers	SWMS	Construction	Project Manager Foreman	ACCIONA Practice	Site inspection records SWMS
General Construction Hours						
NVMP11.	Construction activities associated with the Project will be carried out in accordance with the hours in the NVMP. Early occupation and later release of road carriageways and construction sites will be considered, where feasible to minimise noise impacts to receivers from night works.	Induction materials	Construction	Project Manager	MCoA E66, E67, E68 MCoA E74 (b)	Induction records Site inspection records ROLs
NVMP12.	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver will only be carried out: • Between 8:00 am and 6:00 pm Monday to Friday • Between 8:00 am and 1:00 pm Saturday • In continuous blocks not exceeding three (3) hours each with a minimum respite from those activities and works of not less than one (1) hour between each block.	Induction materials Project EPL	Construction	Project Manager Environment Manager	MCoA E67, E74 (c)	Induction records Site inspection records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	Noisiest works will be scheduled before 11.00 pm Sunday to Thursday and before 12 midnight Friday and Saturday.					
NVMP13.	OOHW is to be carried out in accordance with: • Project Out-of-Hours-Works Protocol • Project EPL	Induction materials OOHW Protocol (Appendix D3) Project EPL	Construction	Project Manager Environment Manager	MCoA E69 REMM CNV3 EPL (Appendix D3)	Induction records OOHW Permits Site inspection records
Noise barriers and acoustic sheds						
NVMP14.	Noise barriers (such as site hoardings) will be constructed around ancillary facilities. Temporary noise barriers will be used around noisy equipment and activities such as rock-hammering and concrete cutting.	CNVIS	Prior to construction Construction	Project Manager	MCoA E74 (d)	Site inspection records
NVMP15.	Structures will be used as noise barriers at compounds where appropriate.	CNVIS Site layout drawings	Construction	Project Manager Environment Manager	ACCIONA Practice	Site inspection records
NVMP16.	All surface based tunnelling support activities that generate noise levels above the noise management levels in Condition E70 must occur within an acoustic shed	Acoustic shed/s	Construction	Project Manager	MCoA E77	Site inspection records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP17.	All acoustic sheds must be designed and used so that activities carried out within them do not result in the exceedance of the NMLs.	Acoustic shed/s	Construction	Project Manager	MCoA E78	Monitoring records
Consultation and Complaints Management						
NVMP18.	Residences/sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the Community Strategy. Information provided will include: • The types of activities to be undertaken • The timing of activities including expected start and finish • The location of activities • Details of the community information line and how to make an enquiry and/or complaint. If the potential vibration exceedance is to occur more than once or extend over a period of 24 hours, owner and occupiers will be provided a monthly schedule of potential exceedances for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier.	Community Strategy CEMP	Prior to construction Construction	Project Manager Environment Manager	ACCIONA Practice EPL MCoA E83	Community notifications

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP19.	Where noise assessments predict noise levels above the NMLs at community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas, consultation with the potentially affected receiver will be undertaken to identify sensitive periods and minimise impacts, where possible.	CNVIS	Prior to construction Construction	Project Manager Environment Manager Communications & Stakeholder Manager	MCoA E72	Consultation records
NVMP20.	All complaints will be managed in accordance with the CCS and EPL.	Communications Strategy	Construction	Communications & Stakeholder Manager	G36 Sect 3.7.4	Complaints register
NVMP21.	Owners and occupiers at risk of exceeding the screening criteria for cosmetic damage will be notified before works that generate vibration commence in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owner and occupiers will be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier. These receivers will be identified in the CNVIS.	Vibration Screening Criteria Drawings Community Strategy	Prior to construction Construction	Project Manager Environment Manager Communications & Stakeholder Manager	MCoA E76	Consultation records
NVMP22.	Monitoring will be undertaken in response to complaints, as determined on a case by case basis.	Noise and Vibration Monitoring	Construction	Communications & Stakeholder Manager	ACCIONA Practice	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
		Program (Appendix D2)		Environment Manager		
Ground-borne Noise Mitigation Measures						
NVMP23.	Specific notifications will be provided to receivers where the ground-borne noise levels are predicted to exceed the evening and night-time NML.	Communications Strategy	Construction	Project Manager	MCoA E71 REMM CNV7	Community notifications
NVMP24.	A ground-borne noise assessment will be undertaken for the Project. Ground-borne noise mitigation measures will be implemented in accordance with the assessment, this NVMP and relevant CoA.	NVMP	Construction	Environment Manager Project Manager	MCoA E70, E71	Site inspection records
Vibration Mitigation Measures						
NVMP25.	Vibration generating activities will be managed through the establishment of minimum buffer distances to achieve screening levels. Where vibration levels are predicted to exceed the screening levels, a more detailed assessment of the impacted structure and attended vibration monitoring will be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items the more detailed assessment (in accordance with NAH23) will specifically	NVMP Assessments for heritage items as required	Pre-construction and Construction	Project Manager Foreman Environment Manager	REMM CNV6 REMMs NAH22, NAH23 Refer also to the Non-Aboriginal Heritage	Detailed assessments Reporting

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed. Any damage caused by the project will be rectified.				Management Sub-Plan	
Blast Management Measures						
NVMP26.	Should blasting be required, a standalone Blast Management Strategy will be prepared in consultation with the EPA.	Blast Management Strategy	Prepare prior to blasting and implement during blasting	Project Manager Project Engineer Foreman Specialist Sub-contractor Environment Manager	G36 MCoA E96-E99 REMM CNV9	Blast Management Strategy
NVMP27.	Should blasting be required, blasting will only be undertaken during the following hours: a) 9:00am to 5:00pm, Monday to Friday, inclusive; b) 9:00am to 1:00pm on Saturday; and c) at no time on Sunday or public holidays; or d) as authorised through an EPL.	Blast Management Strategy	Construction	Project Manager Project Engineer Foreman Specialist Sub-contractor Environment Manager	MCoA E95	Blast Management Strategy
Survey, Monitoring and Reporting						

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP28.	Noise and vibration monitoring will be carried out in accordance with the Project's Noise and Vibration Monitoring Program. Construction noise and vibration impacts will be monitored periodically throughout all stages of the construction support sites to ensure that: a) Impacts are consistent with the noise and vibration levels detailed in the relevant Construction Noise and Vibration Impact Statements b) Noise and vibration impacts are being appropriately managed c) Mitigation measures are effective.	Noise and Vibration Monitoring Program (Appendix D2)	Construction	Environmental Manager	ACCIONA Practice REMMs AH3, AH4, CNV4	Monitoring records
NVMP29.	The following process will be carried out to confirm where vibration monitoring at terrestrial AHIMS sites within 50m of the Project construction footprint will be required: • Terrestrial Aboriginal site condition surveys will be completed using photogrammetry and 3D-capture techniques to determine which AHIMS sites are considered to be structurally unsound • Where this determination cannot be made, the AHIMS site will be considered to be structurally unsound	Site condition surveys	Pre-construction	Environment Manager	REMM AH2 Refer also to the Aboriginal Cultural Heritage Management Sub-Plan	Aboriginal site condition surveys

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	• A screening of vibration intensive activities within 50 metres of structurally unsound sites will be carried out to identify activities that have the potential to exceed vibration levels of 2.5 millimetres per second. Sites identified as being both structurally unsound and having potential for exceedance in vibration levels of 2.5 millimetres per second will be identified as requiring vibration monitoring.					
NVMP30.	ACCIONA will conduct vibration monitoring before and during vibration generating activities that have the potential to impact on heritage items (including Aboriginal cultural heritage). Monitoring will identify MWDs to prevent cosmetic damage. Where possible, works will be conducted in a manner to minimise vibration levels, to less than 2.5 millimetres per second at all structurally unsound AHIMS sites. If vibration monitoring identifies that vibration levels exceed 2.5 mm/s at Aboriginal cultural heritage sites that have been identified as requiring monitoring, a site visit will be organised with a representative from Metro LALC to record any changes to the integrity of the site that may have resulted from construction vibration, and updated site cards must be prepared accordingly. Condition	Noise and Vibration Monitoring Program (Appendix D2)	Construction	Environment Manager	MCoA E79, REMMs AH3, AH4 Refer also to the Aboriginal Cultural Heritage Management Sub-Plan	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	surveys may include further photogrammetry and 3D-capture techniques					
NVMP31.	ACCIONA will offer pre-construction condition surveys on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model. The surveys and subsequent condition survey reports will be prepared by a suitable qualified and experienced person and will be provided to owners of the structure prior to the commencement of potentially impacting works. Where a pre-construction survey was undertaken, owners will be offered a post-construction survey within three months of the completion of construction. Any property damage caused by the project will be rectified.	Communications Strategy	Prior to Construction Construction	Project Manager	G36 Sect 4.7 MCoA E107, E108, E109, E110, REMM SG4	Monitoring records Condition survey reports
NVMP32.	The condition survey report will include as a minimum: • Photograph of the subject building • Record site details – age, construction, site slope and provision for drainage, presence of trees • Types of defects and their positions and extents on the floor plan • Photograph of external view and photograph of all defects of significance (especially if of	Communications Strategy	Prior to Construction Construction	Project Manager	G36 Sect 4.7	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	concern to the owner), or typical examples of say, hairline plaster cornice cracks • Details of the inspector's qualification and expertise					
Other Mitigation Measures						
NVMP33.	Safe working distances for vibration intensive plant would be complied with where feasible and reasonable. This would include the consideration of smaller equipment when working in close proximity to existing structures. Where the safe working distance cannot be achieved vibration monitoring will be carried out in accordance with the Noise and Vibration Monitoring Program (Appendix D2).	Noise and Vibration Monitoring Program	Construction	Foreman Environment Manager	G36 Sect 4.7	Induction records Site inspection records
NVMP34.	The use of alternative construction and demolition techniques will be considered where predicted noise levels exceed the NML	NVMP	Construction	Foreman Environment Manager	MCoA E74 (e)	Site inspection records
NVMP35.	The Project will use regularly serviced low sound power equipment where reasonable and feasible	NVMP	Construction	Foreman Environment Manager	MCoA E74 (a)	Site inspection records
Impact From Concurrent Works						

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP36.	Work will be coordinated between project construction sites and / or non-project construction works to avoid cumulative noise impacts.	N/A	Construction	Utilities Coordination Manager Project Manager Environment Manager	REMMs CNV1 and CNV10	Meetings with relevant authorities
NVMP37.	Additional at source or near source mitigation will be considered where construction noise levels may result in cumulative construction noise impacts, where programming is not practical to avoid cumulative noise impacts.	N/A	Construction	Project Manager Environment Manager	REMMs CNV1 and CNV10	Site inspection records
NVMP38.	Community consultation will be undertaken throughout the project to gauge impacts from construction noise and any unknown impacts from concurrent or consecutive sets of construction works.	N/A	Construction	Project Manager Communications & Stakeholder Manager	REMMs CNV1, CNV8 (d) and CNV10	Community notification

9.2 At-property treatment

9.2.1 Noise Insulation

The NIP is a requirement of MCoA E84 and is not applicable to the Project Stage 3B.

Should any additional at-property treatments be identified by the Project for the management of construction or construction vehicle noise, that is at a heritage listed premise, this will be carried out in a manner to minimise heritage impact, and advice of a heritage conservation architect will be sought prior to undertaking the works. Any treatment will be sympathetic to the heritage values of the item, designed with heritage architect input and be reversible where feasible and reasonable.

The implementation of at-property treatment does not preclude the application of other noise and vibration mitigation and management measures including temporary and long term accommodation.

9.2.2 Early implementation of operational noise mitigation measures

Operational noise mitigation measures will be confirmed within the ONR described within MCoA E89. The ONR is to be provided to the Planning Secretary within 12 months of the start of construction and its measures implemented within 6 months following submission where operational noise mitigation measures will not be physically affected by works.

Where implementation of operational noise mitigation measures is not proposed early in accordance with MCoA E89 and MCoA 90, TfNSW will prepare a report providing justification as to why, along with details of temporary measures that would be implemented to reduce construction noise impacts, until such time that the operational noise mitigation measures identified in the ONR are implemented.

In accordance with MCoA E90 this report will be endorsed by the AA and submitted to the Planning Secretary within 6 months of submitting the ONR.

9.3 Management procedures for OOHW

In accordance with MCoA E69, an Out-of-Hours Work (OOHW) Protocol has been prepared in consultation with the EPA, ER and AA and submitted to the Planning Secretary for approval. The OOHW Protocol defines the process for seeking approval for out of hours works, including consultation (refer Appendix D3).

The protocol will address out of hours works which are not subject to the EPL and will include a process for approval and hold points relating to:

- identification of low and high-risk activities and an approval process that considers the risk of activities, proposed mitigation, management, and coordination including where:
    i. the ER and AA review all proposed out-of-hours activities and confirm their risk levels
    ii. low risk activities can be approved by the ER in consultation with the AA
    iii. high risk activities that are approved by the Planning Secretary
- a process for the consideration of out-of-hours work against the relevant NML and vibration criteria
- a process for selecting and implementing mitigation measures for residual impacts in consultation with the community at each affected location, including respite periods consistent with the requirements of CoA E83. The measures must take into account the predicted noise levels and the likely frequency and duration of the out-of-hours works that sensitive land user(s) would be exposed to, including the number of noise awakening events

- procedures to facilitate the coordination of out-of-hours work including those approved by an EPL or undertaken by a third party, to ensure appropriate respite is provided
- notification arrangements for affected receivers for all approved out-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works.

All other OOHW will be managed in accordance with the EPL.

All OOHW (except in emergency situations) will be documented and approved via the OOHW Permit.

In accordance with MCoA E88, Out-of-Hours Work along the Warringah Freeway corridor which results in an exceedance of the relevant NML at the same sensitive land user(s) may be undertaken in accordance with the following criteria:

a) two consecutive evenings and/or nights per week; or

b) three non-consecutive evenings and/or nights per week; or

c) 10 evenings and/or nights per month; or

d) except as identified by an EPL; or

e) in accordance with an agreement with a potentially impacted receiver(s) as required by Condition E68(c)(iii) or Condition E83.

9.4 Vibration Screening Criteria for properties and heritage items

9.4.1 Properties

Properties at risk of cosmetic damage would be identified through review of the proposed vibration intensive construction activities and the vibration screening criteria nominated in Sections 6.6.2 and 6.6.3. In accordance with MCoA E76, owners and occupiers of identified properties will be notified before works that generate vibration commence near these properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owner and occupiers will be provided a monthly schedule of potential exceedances for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier.

9.4.2 Non-Aboriginal Heritage items

As required by REMM CNV6, where vibration levels are predicted to exceed the screening levels, a more detailed assessment of the impacted structure and attended vibration monitoring will be carried out to ensure vibration levels remain below appropriate limits for that structure.

For heritage items, the more detailed assessment will specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed. Any damage caused by the project will be rectified.

During construction, site-specific buffer distances will be maintained to comply with relevant vibration limits for cosmetic damage, and vibration monitoring will be carried out to ensure vibration levels remain below the appropriate limits for the structure.

9.4.3 Aboriginal cultural heritage items

Aboriginal cultural heritage items will be managed in accordance with REMMs AH2, AH3, AH4 and AH10, as detailed below:

The following process will be carried out in accordance with REMM AH2 to confirm where vibration monitoring at terrestrial AHIMS sites within 50m of the Project construction footprint will be required:

- Terrestrial Aboriginal site condition surveys will be completed using photogrammetry and 3D-capture techniques to determine which AHIMS sites are considered to be structurally unsound
- Where this determination cannot be made, the AHIMS site will be considered to be structurally unsound

- A screening of vibration intensive activities within 50 metres of structurally unsound sites will be carried out to identify activities that have the potential to exceed vibration levels of 2.5 millimetres per second.

Sites identified as being both structurally unsound and having potential for exceedance in vibration levels of 2.5 millimetres per second will be identified as requiring vibration monitoring.

Vibration monitoring will be carried out at AHIMS sites that have been identified as requiring monitoring in accordance with the process outlined in mitigation measure AH2. Where possible, works will be conducted in a manner to minimise vibration levels, to less than 2.5 millimetres per second at all structurally unsound AHIMS sites (REMM AH3).

If vibration monitoring identifies that vibration levels exceed 2.5 millimetres per second at AHIMS sites that have been identified as requiring monitoring, a site visit will be organised with a representative from Metro LALC to record any changes to the integrity of the site that may have resulted from construction vibration, and updated site cards must be prepared accordingly. Condition surveys may include further photogrammetry and 3D-capture techniques (REMM AH4).

9.5 Property surveys, issues rectification and the IPIAP

In line with MCoA 107, ACCIONA will offer and undertake pre-construction condition surveys on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model described in MCoA E102 or as identified in the CNVIS. The pre-construction condition surveys and reports will be prepared by a suitably qualified and experienced person(s) and the report will be provided to the owners of the surface and sub-surface structures for review prior to the commencement of potentially impacting works.

Where pre-construction condition surveys have been undertaken in accordance with MCoA E107, subsequent post-construction condition surveys will be offered and undertaken where accepted by the landowner to assess damage to the surface and sub-surface structures that may have resulted from the construction of the Project within three months of the construction completion (MCoA E108).

The results of the surveys will be documented in Pre-construction and Post-construction Condition Survey Reports for each surface and sub-surface structure surveyed. Copies of the Condition Survey Reports will be provided to the owner(s) of the structures surveyed for review prior to the commencement of potentially impacting works and no later than four months following the completion of construction that have the potential to impact the subject structure. Where damage has been determined to occur as a result of the Project, rectification would occur at the Contractors expense and to the reasonable requirements of the surface and sub-surface structure owner(s) within twelve months of completion of construction unless another timeframe is agreed with the owner of the affected surface or sub-surface structure.

As required by MCoA E111, Transport for NSW will establish an Independent Property Impact Assessment Panel (IPIAP) before works that have the potential to result in property impacts commence. The IPIAP must comprise geotechnical and engineering experts independent of the design and construction team. The IPIAP will be responsible for independently reviewing Pre- and Post-construction Condition Survey Report templates prepared under Conditions E107 and E109, any Pre- and Post-construction Condition Survey Reports where there is a dispute, and the resolution of property damage disputes, and the establishment of ongoing settlement and vibration

monitoring requirements. The Planning Secretary will be notified of the members of the IPIAP prior to the commencement of any works which may potentially result in property impacts.

Either the affected owner or Transport for NSW may refer unresolved disputes arising from potential and/or actual property impacts to the IPIAP for resolution. All costs incurred in establishing and implementing the IPIAP must be borne by the Proponent regardless of which party makes a referral to the IPIAP. The findings and recommendations of the IPIAP are final and binding on the Proponent (MCoA E112).

The governance framework for the IPIAP will be made publicly available on the CSSI's project page as required by Condition B15 (MCoA E113).

9.6 Heavy vehicle transport noise

Construction traffic (Including heavy vehicles) will be managed in accordance with the Traffic, Transport and Access Management Plan (TTAMP).

The Project Team will track heavy vehicle movements to and from sites and manage truck numbers with the aim of limiting any associated increases in road traffic noise levels on public roads during the night-time period to no more than 2 dB(A), within 600 m of the Project sites. Increases in road traffic noise of more than 2 dB(A) during the night-time period will be managed in accordance with the CNVG. The proposed heavy vehicle numbers will be assessed for predicted noise increase prior to the night-time operation of that number of heavy vehicles in the CNVIS prepared for each construction ancillary facility (refer to Section 8.2).

9.7 Additional noise and vibration mitigation measures

In instances where noise levels are still predicted to exceed the NML at receivers, after the application of noise mitigation and management measures (refer to Section 9.1), the CNVG directs that the Project should consider implementing the additional mitigation measures such as (refer to Appendix C of the CNVG for more detail):

- Notification (letterbox drop or equivalent) detailing work activities, time periods of which these will occur, impacts and mitigation measures
- Specific notifications, which provide additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops
- Phone calls, which detail relevant information to identified/affected stakeholders and provide personalised contact, tailored advice and the opportunity to comment on the proposed work
- Individual briefings, which inform stakeholders about the impacts of high noise activities and mitigation measures, and provide personalised contact, tailored advice and the opportunity to comment on the proposed work
- Respite offers, to provide residents with respite from an ongoing impact
- Respite period 1, where out-of-hours construction noise in OOHW Period 1 is generally limited to no more than three consecutive evenings per week
- Respite period 2, where night-time construction noise in OOHW Period 2 is generally limited to two consecutive nights
- Duration respite, which is where the work duration, number of evenings and/or nights is increased so the Project can be completed more quickly
- Alternative accommodation (in accordance with Appendix B3 of the Community Communications Strategy)
- Alternative construction methodology, and/or
- Verification, including measurement of the background noise level and construction noise.

The relevant Additional Mitigation Measures Matrix (AMMM) from the CNVG are to be used to determine the additional measures to be implemented. The AMMM for airborne noise is reproduced in Table 9-2 and the AMMM for the ground-borne noise and ground-borne vibration are reproduced in Table 9-3 and Table 9-4.

Table 9-2: Airborne Noise - Additional Mitigation Measures Matrix

Predicted Airborne ($L_{Aeq, 15min}$) noise level at receiver			**Additional Mitigation Measures**
Perception	**dBA above RBL**	**dBA above NML**	**Type[1]**
All hours			
75 dBA or greater			N,V,PC,RO
Approved Hours: Mon - Fri (7am - 6pm), Sat (8am - 6pm), Sun/Pub Hol (Nil)			
Noticeable	5 to <10	0	-
Clearly Audible	10 to <20	<10	-
Moderately Intrusive	20 to 30	10 to 20	N, V
Highly Intrusive	> 30	> 20	N, V
OOHW Period 1: Mon - Fri (6pm - 10pm), Sat (7am - 8am & 6pm - 10pm), Sun/Pub Hol (8am - 6pm)			
Noticeable	5 to <10	< 5	-
Clearly Audible	10 to <20	5 to <15	N, R1, DR
Moderately Intrusive	20 to 30	15 to 25	V, N, R1, DR
Highly Intrusive	> 30	> 25	V, IB, N, R1, DR, PC, SN
OOHW Period 2: Mon - Fri (10pm - 7am), Sat (10pm - 8am), Sun/Pub Hol (6pm - 7am)			
Noticeable	5 to <10	< 5	N
Clearly Audible	10 to <20	5 to <15	V, N, R2, DR
Moderately Intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR
Highly Intrusive	> 30	> 25	AltA, V, IB, N, PC, SN, R2, DR

Notes:

1. AltA = Alternative Accommodation, V = Verification, IB = Individual Briefings, N = Notification, R1 = Respite period 1, R2 = Respite Period 2, DR = Duration Respite, PC = Phone Calls, SN = Specific Notifications.
2. NML = Noise Management Level, HA = Highly Affected (>75 dBA – applies to residences only).

Table 9-3: Ground-borne Noise - Additional Mitigation Measures Matrix

Predicted Ground-borne ($L_{Aeq, 15min}$) noise level at receiver		**Additional Mitigation Measures**	
Perception	**dBA above GB NML**	**Type[1]**	**Apply to[2]**
Approved Hours: Mon - Fri (7am - 6pm), Sat (8am - 6pm), Sun/Pub Hol (Nil)			
N/A	Ground Borne Noise only applicable during approved hours		
OOHW Period 1: Mon - Fri (6pm - 10pm), Sat (7am - 8am & 6pm - 10pm), Sun/Pub Hol (8am - 6pm)			
Clearly Audible	<10	N	All
Moderately Intrusive	10 to 20	V, N, R1, DR, SN	All
Highly Intrusive	>20	V, IB, N, PC, SN, R1, DR	All
OOHW Period 2: Mon - Fri (10pm - 7am), Sat (10pm - 8am), Sun/Pub Hol (6pm - 7am)			
Clearly Audible	<10	V, N, SN	All
Moderately Intrusive	10 to 20	AltA, V, IB, N, PC, RP, SN, R2, DR	All
Highly Intrusive	>20	AltA, V, IB, N, PC, RP, SN, R2, DR	All

Notes:

1. AltA = Alternative Accommodation, V = Validation of predicted levels, IB = Individual Briefings, N = Notification, R1 = Respite period 1, R2 = Respite Period 2, DR = Duration Respite, PC = Phone Calls, SN = Specific Notifications.
2. All affected receivers.

Table 9-4: Vibration - Additional Mitigation Measures Matrix

Predicted vibration level at receiver		Additional Mitigation Measures	
Perception	**Trigger**	**Type[1]**	**Apply to[2]**
Approved Hours: Mon - Fri (7am - 6pm), Sat (8am - 6pm), Sun/Pub Hol (Nil)			
Predicted Vibration Exceeds Human Comfort Screening Levels		V, N, RO	All
Predicted Vibration Exceeds Structural Damage Screening Levels		V, AC	All
OOHW Period 1: Mon - Fri (6pm - 10pm), Sat (7am - 8am & 6pm - 10pm), Sun/Pub Hol (8am - 6pm)			
Predicted Vibration Exceeds Human Comfort Screening Levels		V, IB, N, RO, PC, RO, SN	All
Predicted Vibration Exceeds Structural Damage Screening Levels		V, AC	All
OOHW Period 2: Mon - Fri (10pm - 7am), Sat (10pm - 8am), Sun/Pub Hol (6pm - 7am)			
Predicted Vibration Exceeds Human Comfort Screening Levels		AltA, V, IB, N, PC, RO, SN	All
Predicted Vibration Exceeds Structural Damage Screening Levels		V, AC	All

Notes:

1. AltA = Alternative Accommodation, AC = Alternative Construction Methodology, V = Validation of predicted levels, IB = Individual Briefings, N = Notification, RO = Respite Offer (project specific), PC = Phone Calls, SN = Specific Notifications.
2. All affected receivers.

9.8 Respite

In accordance with CoA E82, all work undertaken for the delivery of the Project, including those undertaken by third parties (such as utility relocations) and other Critical/State Significant Infrastructure, and State Significant Development, must be coordinated to ensure respite periods are provided. ACCIONA must:

- Reschedule any work to provide respite to impacted noise sensitive receivers so that the respite is achieved in accordance with CoA E83; or
- Consider the provision of alternative respite or mitigation to impacted noise sensitive land user(s); and
- Provide documentary evidence to the Acoustic Advisor in support of any decision made by ACCIONA in relation to respite or mitigation. This will be provided as part of the OOHW permit

Further respite requirements are outlined in Appendix D3.

9.9 Blast Management Strategy

Should blasting be required for the Project, a standalone Blast Management Strategy will be prepared in consultation with the EPA in accordance with the requirements of MCoA E96 to E98. The strategy will:

- Identify relevant guidelines and performance criteria in relation to potential noise and vibration impacts due to blasting
- Include:
  - (a) sequencing and review of trial blasting to inform blasting
  - (b) regularity of blasting
  - (c) intensity of blasting
  - (d) periods of relief
  - (e) blasting program
- Be endorsed by a suitably qualified and experienced person
- Ensure 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 land user(s)

In addition, and as required by REMM CNV9, the blast management strategy will also:

- Detail the blasting to be performed including location, method and justification of the need to blast
- Identify any potentially affected noise and vibration sensitive sites including heritage buildings and utilities
- Establish appropriate criteria for blast overpressure and ground vibration levels at each category of noise sensitive site
- Detail storage and handling arrangements for explosive materials and the proposed transport of those materials to the construction support site
- Identify 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
- Determine potential noise and vibration and risk impacts from blasting and appropriate best management practices
- Detail community consultation procedures.

Records of consultation with the EPA will be included in the Blast Management Strategy.

As required by MCoA E99, the Blast Management Strategy will be submitted to the Planning Secretary for information no later than one month before the commencement of blasting and will implemented for all blasting carried out as part of the Project.

As required by MCoA E95, any blasting associated with the Project will only be undertaken during the following hours:

- 9:00am to 5:00pm, Monday to Friday, inclusive;
- 9:00am to 1:00pm on Saturday; and
- at no time on Sunday or public holidays; or
- as authorised through an EPL.

This requirement will be included in the Blast Management Strategy.

10 Compliance management

10.1 Roles and responsibilities

The ACCIONA Project Team's organisational structure and overall roles and responsibilities as well as the Environmental Representative, Acoustic Advisor and required specialists are outlined in Section 3.3 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 9 of this NVMP.

10.2 Training

All employees, contractors and utility staff will undergo site induction training relating to noise and vibration management issues. The induction training will address site and/or construction activity specific impacts relating noise and vibration management, including:

- Existence and requirements of this Plan
- Relevant legislation and guidelines
- Normal construction hours and exemptions
- The process for seeking approval for OOHW, including consultation
- Location of noise sensitive areas
- Complaints reporting and recording
- How to implement noise and vibration management measures
- Specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with the works.

Specific training, such as toolboxes or site inductions will also be implemented to disseminate noise and vibration management and requirements, such as:

- Avoiding use of radios or stereos outdoors during standard working hours where especially sensitive receivers may be impacted, and at all times during OOH work
- Avoiding shouting and minimise talking loudly and slamming vehicle doors
- Avoiding communicating and signalling using horns
- Where practical, operate machines at low speed or power and switch off when not used rather than left idling for prolonged periods
- Minimising reversing
- Avoiding dropping materials from height and avoiding metal to metal contact on material

Further details regarding staff induction and training are outlined in Section 3.5 of the CEMP.

10.3 Monitoring and inspections

Requirements and responsibilities in relation to monitoring and inspections are documented in Section 3.9.1 and 3.9.2 of the CEMP.

Noise and vibration monitoring will be undertaken in accordance with the Noise and Vibration Monitoring Program (Appendix D2), prepared in line with MCoA C11(a), MCoA C12 and MCoA C13.

10.4 Complaints

Complaints will be recorded and managed as detailed in Section 3.7.4 of the CEMP.

10.5 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this Plan, MCoA and other relevant approvals, licences and guidelines.

Audit requirements are detailed in Section 3.9.3 of the CEMP.

10.6 Incidents and Non-compliances

All incidents will be managed in accordance with Section 3.8 of the CEMP.

All non-compliances will be managed in accordance with Section 3.10 of the CEMP.

10.7 Reporting

Reporting requirements and responsibilities are documented in Section 3.9.4 and 3.9.5 of the CEMP. Additional reporting will also be generated as required in assessment documents and the Construction Noise Monitoring Program.

Specific reports prepared in response to noise and vibration will include:

- Reporting required in accordance with the POEO Act and Regulations
- Monthly Noise and Vibration Reports, prepared by the AA and submitted to the Secretary and other relevant regulatory agencies for information, which will detail the AA's actions and decisions on matters for which the AA was responsible in the preceding month
- Construction Noise and Vibration Monitoring reports identified in the Noise and Vibration Monitoring Program in Appendix D2.

11 Review and improvement

11.1 Continuous improvement

As outlined in Section 6 of the CEMP, management reviews will be undertaken as part of the continual improvement process. The reviews will be initiated by the Environmental Manager and include relevant project team members and stakeholders. Continuous improvement of this plan and of monitoring requirements detailed in Section 10.3 of this Plan will be achieved by the ongoing evaluation of environmental management performance against planning approval requirements, environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance
- Determine the cause or causes of non-conformances and deficiencies
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies
- Verify the effectiveness of the corrective and preventative actions
- Document any changes in procedures resulting from process improvement
- Make comparisons with objectives and targets outlined in Section 2.2 and Section 2.3 of this Plan.

11.2 NVMP update and amendment

The auditing and review processes described in Section 5.13 of the CEMP may result in the need to update or revise this Plan. This will occur whenever there is a change to the construction scope or methodology that may increase the potential impacts from Noise and Vibration or to address relevant updates to a related Sub-Plan or monitoring program (as identified in Table 1-1).

Only the Environment Manager can amend this NVMP. Any update of this Plan will require endorsement by the Environmental Representative and depending on the change, process outlined in Section 6 of the CEMP must be followed where approval from the Planning Secretary prior to implementation of the update is required.

Appendix D1 – Land Use Survey

hutchison weller

Technical note

Land Use Survey – progress status

Project Western Harbour Tunnel
Client ACCIONA

27 April 2023

Introduction

Hutchison Weller is progressively confirming sensitive land uses (the Land Use Survey, or LUS) for the Western Harbour Tunnel project in accordance with the project's condition of approval (CoA) E65, provided below:

> *A detailed land use survey must be undertaken to confirm sensitive land user(s) (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration, construction ground-borne noise and operational noise.*
>
> *The survey may be undertaken on a progressive basis but must be undertaken in any one area before the commencement of work which generates construction or operational noise, vibration or ground-borne noise in that area.*
>
> *The results of the survey must be included in the Noise and Vibration CEMP Sub-plan required by Condition C4.*

The LUS includes all buildings / land uses within 300 metres of the project boundary for surface works, and 100 metres for tunnelling. In accordance with CoA E65, the LUS will be progressively completed for any area of the project prior to commencement of work which generates construction or operational noise, vibration or ground-borne noise in that area.

A summary of progress to date and notable changes from the LUS provided in the EIS[1] is provided in Table 1. The updated land use survey maps are included in Appendix A.

Table 1 Progress status – Land Use Survey for Western Harbour Tunnel

Date of survey	Area surveyed	Comments
9 March 2023	Cammeray ancillary site and surrounds	Minor amendments to EIS survey. Some commercial/hotels were reclassified as residential.
22 March 2023	Ridge Street ancillary site and surrounds	Minor amendments to EIS survey. Some residential land uses were classified as educational.

[1] Appendix B of the Noise and Vibration Technical Paper prepared for the EIS (Appendix G of the EIS)

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Appendix A Land use survey maps

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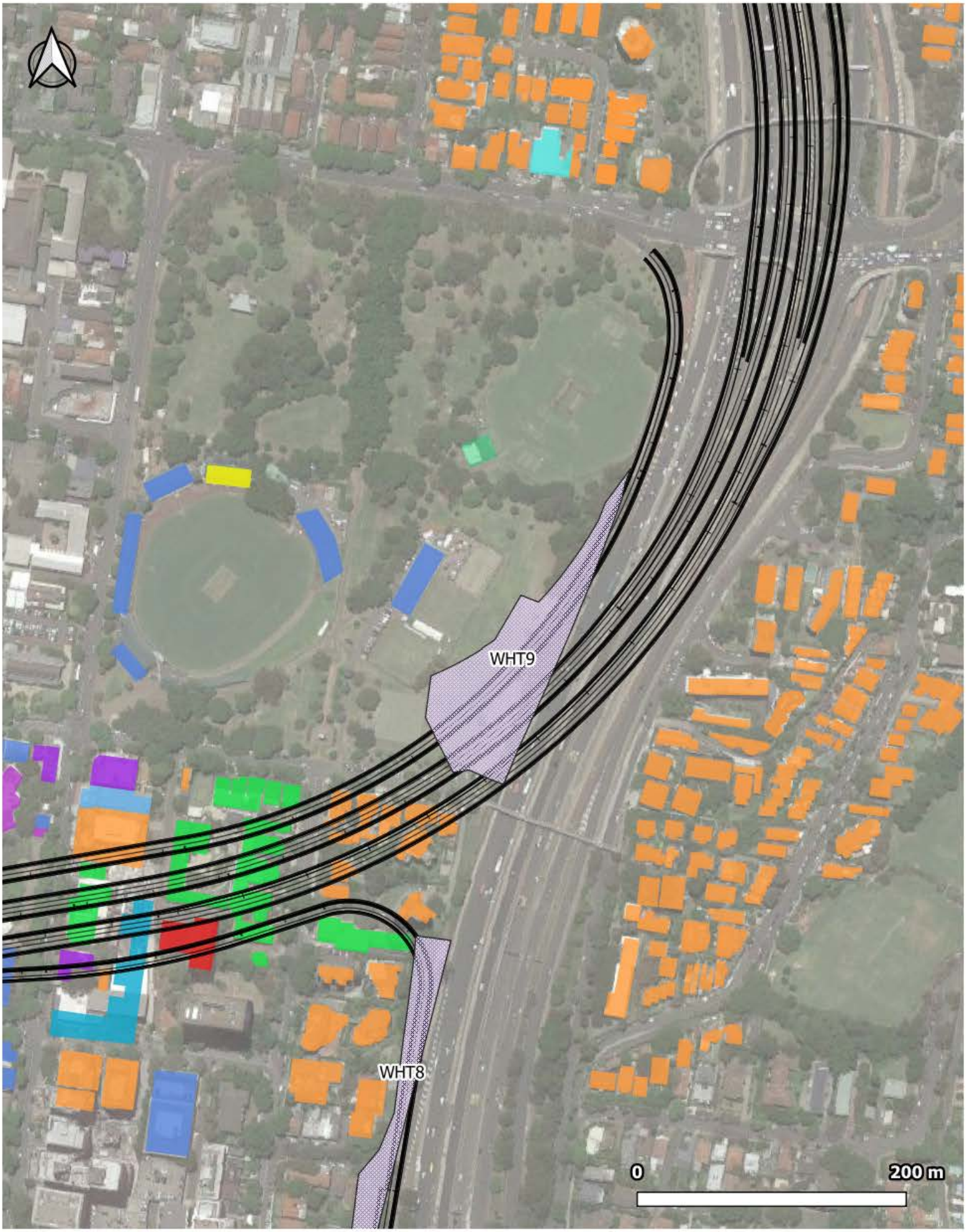
Legend

- Construction site
- Modification Alignment

Receiver Type

- Commercial
- Educational
- Mixed use
- Mixed Use
- OSR (Active recreation)
- OSR (Childcare)
- OSR (Educational)
- OSR (Hotel)
- OSR (Library)
- OSR (Theatre)
- Recreational - Active
- Residential
- Sydney Metro Construction site



Legend

- Construction site
- Modification Alignment

Receiver Type

- Commercial
- Educational
- Mixed use
- Mixed Use
- OSR (Active recreation)
- OSR (Childcare)
- OSR (Educational)
- OSR (Hotel)
- OSR (Library)
- OSR (Theatre)
- Recreational - Active
- Residential
- Sydney Metro Construction site

Appendix D2 - Noise and Vibration Monitoring Program

Noise and Vibration Monitoring Program

Noise and Vibration Management Sub-Plan –

Appendix D2

Western Harbour Tunnel Project

SSI 8863

April 2023

Document control

Approval and authorisation

Approved on behalf of ACCIONA by	Andrew Marsonet
Signed	
Dated	22 December 2022

Document Status

Revision	Date	Description	Approval
Rev A	22.12.2022	For TfNSW review	E. Woodward
Rev B	31.01.2023	For external consultation	E. Woodward
Rev 00	20.03.2023	For DPE review	E. Woodward
Rev 01	14.04.2023	For DPE review	E. Woodward

Contents

Terms and definitions

Abbreviations	Expanded Text
AA	Acoustics Advisor
Acoustic enclosure	Can include an engineered and designed shed or enclosure, with airborne noise pathways minimised and treated where feasible and reasonable, endeavouring to achieve the Noise Management Levels in the Interim Construction Noise Guidelines (DECC, 2009). Example treatments include noise curtains, shipping containers, acoustic barriers or fast operating doors to limit breakout noise from enclosures
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.
Ancillary facility	A temporary facility for construction of the CSSI including an office and amenities compound, construction compound, material crushing and screening plant, materials storage compound, maintenance workshop, testing laboratory, material stockpile area and car parking facilities. Note: where an approved management plan contains a stockpile management protocol, a material stockpile area located within the construction boundary is not considered to be an ancillary facility
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline (DEC 2006)
CEMP	Construction Environmental Management Plan
CNVIS	Construction Noise and Vibration Statements
CSSI	Critical State Significant Infrastructure
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	Department of Environment and Conservation (now EPA)
DEC	DECC Department of Environment and Climate Change (now EPA)
DECCW	DECCW Department of Environment, Climate Change and Water (now EPA)
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
EMM	Environmental Management Measure
EPA	NSW Environment Protection Authority
EPL	Environmental Protection Licence
ER	Environmental Representative
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable

	relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Highly noise intensive works	Works which are defined as annoying under the Interim Construction Noise Guideline (DECC, 2009) including: (a) use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work; (b) grinding metal, concrete or masonry; (c) rock drilling; (d) line drilling; (e) vibratory rolling; (f) bitumen milling or profiling; (g) jackhammering, rock hammering or rock breaking; and (h) impact piling
ICNG	Interim Construction Noise Guideline (DECC, 2009)
LAeq (15min)	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
LA (max)	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LA1 (1min)	The A-weighted noise level from the construction works under consideration, measured using the fast time weighting on a sound level meter, which is exceeded for more than 1% of the 1 minute measurement period.
LA90 (15min)	The A-weighted noise level excluding the construction works under consideration, measured using the fast time weighting on a sound level meter, which is exceeded for more than 90% of the 15 minute measurement period.
MCoA	Minister's Condition of Approval
NCA	Noise Catchment Area
NML	Noise management level
Noise Mitigation	Feasible and reasonable measures that would minimise or avoid noise impacts
NVMP	Noise and Vibration Management Plan
OOHW	Out-of-Hours Works – work completed outside of standard construction hours
PPV	Peak Particle Velocity
Project, the	Western Harbour Tunnel project
Project Area	The area required to facilitate the construction of the Project (i.e. construction footprint)
RBL	The Rating Background Level for each period is the medium value of the Assessment Background Level values for the period over all of the

	days measured. There is therefore an RBL value for each period (day, evening, night and shoulder period)
REMM	Revised Environmental Management Measure
Roads and Maritime	Former Roads and Maritime Services, now part of Transport for NSW
RMS	Former Roads and Maritime Services, now part of Transport for NSW
Sensitive land user(s) / Sensitive receiver(s)	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), child care centres and passive recreation areas (including outdoor grounds used for teaching). Receivers that may be considered to be sensitive include commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, and retail spaces) and industrial premises as identified by the Planning Secretary
Standard construction hours	Hours during which construction work is permitted by the MCoA.
TfNSW	Transport for NSW
WHT	Western Harbour Tunnel (component of the Western Harbour Tunnel and Warringah Freeway Upgrade project)
Works	Any physical work to construct or facilitate the construction of the CSSI, including low impact work, environmental management measures and utility works. However, does not include activities that informs or enables detailed design of the CSSI and generates noise that is no more than 5 dB(A) above the rating background level (RBL) at any sensitive land user(s)

1 Introduction

1.1 Context

This Noise and Vibration Monitoring Program (Monitoring Program) has been prepared for the Western Harbour Tunnel (the Project).

This monitoring program has been prepared to address the requirements of the Minister's Condition of Approval (MCoA) C11(a), C12 and C13 and should be read in conjunction with the Noise and Vibration Management Plan (NVMP) prepared in accordance with MCoA C4(b).

1.2 Scope of the monitoring program

The scope of this monitoring program is to describe how ACCIONA proposes to carry out noise and vibration monitoring during construction of the Stage 3B of the Project. This monitoring Program will be updated as required for future stages.

The program addresses attended and unattended monitoring of airborne and ground borne noise and vibration in line with CoA C12 and C13, which are reproduced for reference in Table 1-1.

Marine and Operational noise and vibration monitoring does not fall within the scope of this monitoring program and therefore is not included within the processes contained within this Monitoring Program.

Table 1-1 Conditions of Approval

Condition	Requirement	Document reference
C12	Each Construction Monitoring Program must provide:	
	(a) details of baseline data available;	2
	(a) details of baseline data to be obtained and when;	2
	(b) details of all monitoring of the project to be undertaken;	Section 3 Section 4
	(c) the parameters of the project to be monitored;	
	(d) the frequency of monitoring to be undertaken;	
	(e) the location of monitoring;	
	(f) the reporting of monitoring results and analysis results against relevant criteria;	Section 3 Section 4 Section 8
	(g) details of the methods that will be used to analyse the monitoring data;	Section 3 Section 4
	(h) procedures to identify and implement additional mitigation measures where the results of the monitoring indicate unacceptable project impacts;	Section 7
	(i) a consideration of SMART principles;	Section 7
	(j) any consultation to be undertaken in relation to the monitoring programs; and	Section 1.6
	(k) any specific requirements as required by Conditions C13 to C16.	See below

Condition	Requirement	Document reference
C13	The Noise and Vibration Monitoring Program must include:	
	a) noise and vibration monitoring locations determined in consultation with the AA to confirm construction noise and vibration levels;	Section 3 Section 4
	b) for the purposes of (a), noise monitoring must be undertaken during the day, evening and night-time periods and within the first month of work as well as throughout the construction period and cover the range of activities being undertaken at the sites;	Noted
	c) a protocol for reviewing the implemented management and mitigation measures, based on the monitoring results, to confirm they are consistent with the CEMP Subplan (Condition C4b), and to identify any additional management and mitigation measures that must be implemented; and	Section 7
	d) a process to undertake real time noise and vibration monitoring. The results of the monitoring must be readily available to the construction team, Proponent, ER and AA. The Planning Secretary and EPA must be provided with access to the results on request.	Section 3 Section 4

Table 1-2 Revised Environmental Management Measures

REMM	Environment management measure	Document reference
CNV6	Vibration generating activities will be managed through the establishment of minimum buffer distances to achieve screening levels. Where vibration levels are predicted to exceed the screening levels, a more detailed assessment of the impacted structure and attended vibration monitoring will be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items, the more detailed assessment will specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed. Any damage caused by the project will be rectified.	Section Monitoring triggers4.1
NAH23	During construction, site-specific buffer distances will be maintained to comply with relevant vibration limits for cosmetic damage, and vibration monitoring will be carried out to ensure vibration levels remain below the appropriate limits for the structure.	Section Monitoring triggers4.1

REMM	Environment management measure	Document reference
AH2	The following process will be carried out to confirm where vibration monitoring at terrestrial AHIMS sites will be required: • Terrestrial Aboriginal site condition surveys will be completed using photogrammetry and 3D-capture techniques to determine which AHIMS sites are considered to be structurally unsound • Where this determination cannot be made, the AHIMS site will be considered to be structurally unsound • A screening of vibration intensive activities within 50 metres of structurally unsound sites will be carried out to identify activities that have the potential to exceed vibration levels of 2.5 millimetres per second Sites identified as being both structurally unsound and having potential for exceedance in vibration levels of 2.5 millimetres per second will be identified as requiring vibration monitoring.	Section Monitoring triggers4.1 Section 6
AH3	Vibration monitoring will be carried out at AHIMS sites that have been identified as requiring monitoring in accordance with the process outlined in mitigation measure AH2. Where possible, works will be conducted in a manner to minimise vibration levels, to less than 2.5 millimetres per second at all structurally unsound AHIMS sites.	Section Monitoring triggers4.1 Section 6
AH4	If vibration monitoring identifies that vibration levels exceed 2.5 millimetres per second at AHIMS sites that have been identified as requiring monitoring, a site visit will be organised with a representative from Metro LALC to record any changes to the integrity of the site that may have resulted from construction vibration, and updated site cards must be prepared accordingly. Condition surveys may include further photogrammetry and 3D-capture techniques.	Section Monitoring triggers4.1 Section 6

1.3 Purpose and objectives

The purpose of this Monitoring Program is to describe how ACCIONA proposes to conduct noise and vibration monitoring during construction of the Project.

This Monitoring Program will apply for the duration of the current stage of the Project's construction works, unless a longer period is specified by the Secretary of the Department of Planning and Environment (DPE).

The key objective of the Monitoring Program is to ensure all MCoA, environmental management measures and licence/permit requirements relevant to noise and vibration monitoring, as outlined in the EIS are described, scheduled and assigned responsibility.

1.4 SMART principles

This monitoring program follows SMART principles which require the goals and actions are:

- Specific – The timing, frequency, locations and methods described in this document are sufficiently detailed
- Measurable – Records of monitoring can demonstrate the objectives of this program are being met

- Achievable – Onerous or impractical monitoring has been omitted from this program
- Realistic – the methods described in the program can be implemented within the framework of the Project
- Time-based – The duration and frequency of monitoring is this program are established against appropriate timeframes

1.5 Environmental requirements

Legislation, guidelines and specifications relevant to this Monitoring Program is included in Section 3.

1.6 Consultation

This Monitoring Program will be provided to the Environment Protection Agency (EPA) in accordance with MCoA C11(a) for review and comment. Evidence of compliance with MCoA C11 (a) has been prepared as required under MCoA A5 and provided to DPE.

Community feedback and complaints relating to noise and vibration will be dealt with in accordance with the Noise and Vibration Management Plan (NVMP) and related documents.

2 Baseline monitoring data

As part of the Environment Impact Statement (EIS) process, baseline noise monitoring was conducted in 2017. The baseline noise monitoring locations were selected as representative of the appropriate Noise Catchment Areas (NCAs) within and around the Project, across a mix of existing land uses including residential, commercial, educational and open space. Detail is included in Chapter 10 of the EIS.

The EIS noise monitoring was undertaken along the Project extent to quantify the existing noise environment in areas where receivers may potentially be affected by construction noise. Noise management levels (NMLs) for the assessment of construction noise are derived from measurements of existing noise levels in an area. The rating background level (RBL) is used to determine noise management levels at residential receiver locations.

The long-term noise monitoring results for the Project are presented in Table 2-1.

Table 2-1 Long-term noise monitoring results

Monitoring location ID	NCA	Address	L_{A90} Rating Background Level (RBL)			L_{Aeq} Ambient noise		
			Day	Evening	Night	Day	Evening	Night
1	1.5	22 The Crescent, Annandale	51	45	33	66	65	60
2	1.5	2/277 Johnston Street, Annandale	50	47	36	65	64	59
3	3.3	16 Railway Parade, Annandale	50	51	44	58	58	53
4	5.3	109 Denison Street, Rozelle	49	46	37	61	60	53
5	2.1	14 Oxley Street, Glebe	51	52	45	57	55	52
6	4.3	28 Lilyfield Road, Rozelle	52	52	45	58	58	55

Monitoring location ID	NCA	Address	L_{A90} Rating Background Level (RBL)			L_{Aeq} Ambient noise		
			Day	Evening	Night	Day	Evening	Night
7	10.1	203/38 Refinery Drive, Pyrmont	48	45	44	52	49	48
8	7.1	31 Cambridge Street, Rozelle	43	41	34	57	57	48
9	9.1	C13/1 Buchanan Street, Balmain	49	49	46	54	51	49
10	8.1	23 Smith Street, Rozelle	42	44	38	54	51	49
11	11.4	31 Wharf Road, Birchgrove	40	42	37	52	48	43
12	12.1	9 Numa Street, Birchgrove	46	45	40	58	56	53
13	13.1	6 O'Connell Street, Grenwich	41	38	32	54	49	43
14	14.1	5 Balls Head Road, Waverton	41	37	33	51	47	45
15	15.2	1/16 Munro street, McMahons Point	42	41	38	52	46	44
16	16.1	401/102 Alfred Street, Milsons Point	60	60	50	63	62	58
17	17.2	6 McDougall Street, Kirribilli	55	54	45	60	58	56
19	19.1	91 Ridge Street, North Sydney	52	52	45	57	57	52
20	18.3	14 Montpellier Road, Neutral Bay	54	52	43	59	57	53
21	22.1	306 Miller Street, North Sydney	52	47	36	65	63	58
22	23.2	1/1 Bardsley Gardens, Crows Nest	53	49	41	68	67	63
23	23.1	288 Falcon Street, Neutral Bay	61	54	44	69	68	65
25	26.2	317 Ernest Street, Cammeray	58	54	41	69	66	62
26	25.2	225 Ernest Street, Cammeray	56	52	37	68	66	61
27	25.1	77 Rosalind Street, Cammeray	58	55	43	62	60	57
28	29.1	53 Bellevue Street, Cammeray	64	63	47	67	67	64
29	28.1	12 Warringa Road, Cammeray	47	45	37	54	51	48
30	27.1	57 Park Avenue, Cremorne	49	48	39	59	57	54
31	30.1	18/22-24 Donnelly Road, Crows Nest	58	56	38	62	61	58

Monitoring location ID	NCA	Address	L_{A90} Rating Background Level (RBL)			L_{Aeq} Ambient noise		
			Day	Evening	Night	Day	Evening	Night
32	31.3	79 Brook Street, Naremburn	56	49	37	71	69	65
33	33.2	20/2 Parkes Road, Artarmon	67	63	46	72	70	67
34	33.1	3/2 Cleland Road, Artarmon	55	53	40	59	58	55
35	32.1	1 Chelmsford Avenue, Naremburn	59	55	40	63	61	58
36	34.1	2 Burra Road, Artarmon	44	44	37	53	50	46
37	36.1	16 Walter Street, Willoughby	50	48	38	55	52	49
38	37.1	27 Garland Street, Naremburn	45	44	34	53	52	48
39	38.1	2 Pyalla Street, Northbridge	52	48	37	60	56	57

The opportunity for baseline monitoring is no longer available, noting that works have already commenced under the Warringah Freeway Scope and the Rozelle Interchange scope, thus the data from the EIS is most reflective of baseline (i.e. pre-construction) conditions.

At this stage, existing baseline data will be sufficient to establish RBLs and NMLs for the project and no further baseline monitoring is proposed. Should this change, unattended monitoring would be undertaken in line with the method outlined in Section 3.1.2.

3 Noise monitoring

3.1 Monitoring triggers

3.1.1 Attended airborne noise monitoring

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

- Monitoring will be carried out at the commencement of new activities (i.e. within the first month) for which a Construction Noise and Vibration Impact Statement (CNVIS) has been prepared to confirm that actual noise and vibration levels are consistent with noise and vibration predictions and the management measures that have been implemented are appropriate.
- Where a change in methodology, plant or equipment is anticipated to result in a significant increase in construction noise impact
- Where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis) and in accordance with EPL conditions
- As otherwise required by the CNVIS or Out of Hours Works (OOHW) Permit
- As directed by an authorised officer of the EPA
- Following the implementation of mitigation measures or noise attenuation due to exceedance of predicted noise levels
- Ongoing spot checks for noise intensive plant and equipment will be undertaken throughout construction to ensure compliance with the maximum noise level goals for construction equipment. Spot checks will be carried out as required on a case-by-case basis, such as in response to a plant/equipment specific noise related complaint and during noise and vibration assessment validation monitoring when it is possible to isolate the noise from one piece of plant or equipment.

In line with CoA C13, monitoring will be undertaken during the day, evening and night-time periods and within the first month of work as well as throughout the construction period.

3.1.2 Unattended airborne noise monitoring

Unattended airborne noise monitoring will also be completed with a noise logger deployed to obtain noise results over longer periods. This may be done:

- for baseline monitoring to supplement noise monitoring data obtained by the EIS and where this data may not be suitably representative of an NCA
- for construction noise monitoring on a campaign basis
- As otherwise required by the CNVIS or Out of Hours Works (OOHW) Permit

3.1.3 Unattended real-time airborne noise

Real-time (unattended) noise monitoring will be undertaken to obtain noise results over longer periods in accordance with MCoA C13(d). This may be done:

- As determined necessary by a CNVIS and/or in consultation with the AA for construction noise monitoring on a ‘campaign basis’ (i.e. high risk activities or works near to especially sensitive receivers) to assist with active management of noise generating work
- In response to a complaint, or series of complaints that warrant real-time data to assist with the active management of a work front.

When real-time monitors are deployed, monitoring data will be readily available to the construction team, TfNSW, ER and AA. The monitoring data will also be made available to DPE and EPA upon request.

3.1.4 Ground-borne noise

Attended and unattended monitoring of ground-borne noise will be undertaken where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis) or as otherwise required by the CNVIS or OOHW Permit.

3.2 Monitoring methodology

3.2.2 Locations

Fixed monitoring locations are generally not helpful in assessing the level of noise at sensitive receiver locations. Instead, attended and unattended noise monitoring locations will be determined on a case-by-case basis by a CNVIS, the Project's predictive noise and vibration tool or in response to complaints.

Where possible, monitoring will be undertaken at the most affected noise sensitive receiver's location in proximity to the Project's construction activities and location selection will consider:

- Previous monitoring locations
- The proximity of the receiver to a Project worksite
- The sensitivity of the receiver to noise
- Background noise levels
- The expected duration of the impact.

Real-time noise unattended monitoring will be undertaken at selected locations determined by the Environment Manager in accordance with the requirements outlined in Section 3.1.3. The locations will most likely correspond to locations where security and power supply can be ensured for the monitors and will be agreed with the Project's Acoustic Advisor.

Specific locations will consider screening, reflections, ancillary site noise sources (e.g. stationary plant), power availability and security. The location of the real-time noise monitoring equipment will be subject to the final work site layouts and availability of mains power and determined in consultation with the AA.

3.2.3 Airborne noise monitoring method

In accordance with the ICNG the duration and frequency of noise monitoring will depend on the scale of the construction activities and extent of expected noise impacts. Noise monitoring will cover a representative period of the construction activity.

Airborne noise monitoring (excluding spot checks of plant and equipment) will be done over 15-minute sample intervals, excluding periods of extraneous noise, until a representative sample has been obtained. All noise monitoring will be undertaken with a fast time constant (i.e. 125 milliseconds), and A-weighted frequency weighting.

All outdoor noise measurements will be undertaken with a windscreen over the microphone and measurements of noise may be disregarded when it is raining and/or the wind speed is greater than 5m/s (18km/h).

Where possible, noise monitoring is to be carried out at least 3.5m from any reflective surface other than the ground and the preferred microphone/measurement height is 1.2-1.5m above the ground while using a tripod. Measurements taken inside buildings should be at least one metre from walls or other reflective surface, and about 1.5 metres from windows, where such instrument siting is possible.

The minimum range of noise metrics to be recorded for each monitoring period includes A-weighted noise levels: LA90, LAeq, LA1 and LA (max).

Where high background noise levels obscure construction noise contribution during attended noise measurements, operators will either:

- Measure closer to the source and calculate back to the required position, or
- Measure with the source noise off and then on (where possible) and calculate the difference, or
- Use the 'pause and back-erase feature on the sound level meter to try to exclude as much of the extraneous noise as possible.

During unattended monitoring, noise loggers will record audio (triggered by noisy events) to allow for the identification of construction noise contribution and the presence of any extraneous noise, if privacy concerns can be overcome. The use of unattended airborne noise monitoring will be determined on a case-by-case basis and will be subject to any access approval.

Instrumentation intended for unattended monitoring (including real-time) will be installed by a person appropriately trained in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures and the establishment of real-time monitoring equipment.

For spot checks of noise intensive plant and equipment, duration of monitoring will depend on the source of noise being monitored. Sources of continuous noise (such as generators), measurements will be monitored over one-to-two-minute intervals. For dynamic plant, such as front-end loaders, spot checks will capture a representative activity, such as one truck-and-dog load cycle.

3.2.4 Ground-borne noise monitoring method

Monitoring will be undertaken in the most affected habitable room of the residence or other sensitive building and will be conducted in conjunction with vibration measurements whenever practicable.

The room selected for noise monitoring should be well shielded from airborne noise intrusions, such as road traffic noise to discern ground-borne noise from non-construction generated airborne noise.

There may be instances where the resident does not allow access to monitor in the most suitable habitable room. In these instances, ACCIONA will endeavour to monitor at the next most suitable available room or location, noting this in the monitoring form.

Given that ground-borne noise is mostly noticed during the evening or at night, noise loggers may also be left in place over night and picked up at a mutually agreed time with the resident. In these instances, noise loggers will record audio to allow for the identification construction noise contribution and the presence of any extraneous noise, if privacy concerns can be overcome. Where the resident or receiver will not allow the noise logger to record audio, attended noise monitoring will be offered instead.

Ground-borne noise levels will be recorded over 15-minute sample intervals, where every 15 minutes the data is to be processed statistically and stored in memory. All noise monitoring will be undertaken with a fast time constant (i.e. 125 milliseconds), and A-weighted frequency weighting. The minimum range of noise metrics to be stored in the memory for later retrieval include the following A-weighted noise levels: LA90, LAeq, LA1 and LA (max).

3.2.5 Records and analysis

For each noise monitoring event, the following information shall be recorded:

- Date, time and location of measurements,
- Name of person undertaking the measurements,

- Type and model number of instruments as well as calibration details
- Meteorological conditions for outdoor monitoring,
- Measurement duration
- Map of area showing measurement location, source location and sensitive receivers
- Measurement location details and number of measurements at each location
- Construction activity subject of the measurement
- Predicted noise levels and NMLs relevant to the monitoring location, period and activity
- Minimum statistical data for the measurement period (LAeq, LA90, LA1, LAmax)
- Description and quantification of ambient noise sources
- Description and quantification of construction noise sources
- Estimated contribution of the Project's activities vs. noise from extraneous and environmental sources (e.g. traffic, aircraft, trains, dogs barking, insects).
- Commentary on compliance with NMLs and/or comparison with predicted levels as relevant.

Monitoring reports will be retained and provided to DPE, EPA, the ER and AA on request.

The real-time monitoring data results will be available to ACCIONA environment team via a web-based portal, and will be readily available to the construction team, Proponent, ER and AA. The Planning Secretary and EPA must be provided with access to the results on request.

Where NMLs are noted to be exceeded or comparison of measured and predicted levels warrants further review, corrective actions will be implemented as described in Section 7.

3.3 Heavy vehicle transport noise

In accordance with Noise and Vibration Management measure MMNV3 of the NVMP, ACCIONA will track heavy vehicle movements to and from sites and manage truck numbers with the aim of limiting any associated increases in road traffic noise levels during the night-time period to no more than 2 dB(A). More detail on this process is described in the Projects Traffic, Transport and Access Management Plan which forms part of the CEMP.

4 Vibration monitoring

4.1 Monitoring triggers

4.1.1 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 or as determined by a vibration assessment.
- At the commencement of vibration generating activities that have the potential to impact on heritage items/AHIMS sites to confirm/identify the minimum working distances to prevent cosmetic damage.
- Where vibration sensitive locations are determined to fall within the 'minimum working distances' established for each item of plant, to refine the indicative minimum working distances.

- Where appropriate in response to a vibration related complaint(s) (determined on a case-by- case basis).
- As otherwise required by the CNVIS or OOHW Protocol.

4.1.2 Unattended real-time vibration monitoring

Where the monitoring duration is planned to extend over a longer period than practicable for attended monitoring, such as when works will remain within the safe minimum working distance for cosmetic damage, monitoring devices may be unattended. In this case, instrumentation will be fitted with the ability to warn plant operators via flashing light, SMS, or email that vibration is approaching levels where additional attention is required.

Real-time (unattended) vibration monitoring will be undertaken to obtain vibration results over longer periods in accordance with MCoA C13(d). This may be done:

- for construction vibration monitoring on a campaign basis to assist with active management of vibration generating work
- In response to a complaint, or series of complaints that warrant real-time data to assist with the active management of a work front.

When real-time monitors are deployed, monitoring data will be readily available to the construction team, TfNSW, ER and AA. The monitoring data will also be made available to DPE and EPA upon request.

4.2 Monitoring methodology

4.2.1 Locations

Fixed monitoring locations are generally not helpful in assessing the level of vibration at sensitive receiver locations. Instead, attended and unattended monitoring locations will be determined on a case-by-case basis by a CNVIS, the Project's predictive noise and vibration tool or in response to complaints.

Where possible, monitoring will be undertaken at the most affected noise sensitive receiver's location in proximity to the Project's construction activities and location selection will consider:

- Previous monitoring locations
- The proximity of the receiver to a Project worksite
- The sensitivity of the receiver to vibration
- The expected duration of the impact.

Real-time unattended vibration monitoring will be undertaken at selected locations determined by the Environment Manager in accordance with the requirements outlined in Section 4.1.2. The locations will most likely correspond to locations where security and power supply can be ensured for the monitors and will be agreed with the Project's Acoustic Advisor.

4.2.2 Vibration monitoring method

Vibration monitoring will be performed in accordance with relevant vibration measurement requirements in the reference standards and documents in Section 1.5.

Where human comfort is a concern, vibration monitoring results will be assessed and reported against the values set out in Tables 2.2 and 2.4 of the EPA's *Assessing Vibration – a technical guideline*.

Where property damage is a concern, vibration monitoring results will be assessed and reported against the British Standard 7385, as presented in the NVMP.

For heritage structures, BS7385-2:1993 does not provide numerical vibration levels to prevent structural damage. The approach that will be adopted for the Project to assess and manage potential vibration impact on heritage structures is outlined in Section 8.6 of the NVMP.

Vibration monitoring shall be undertaken in accordance with the vibration measurement requirements stipulated in the reference standards and documents listed above, including the following aspects of mounting the device:

- 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 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.
- 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 monitors will be installed by a person appropriately trained in the measurement and assessment of construction vibration, who is familiar with the requirements of the relevant standards and procedures and the establishment of real-time monitoring equipment.

All short term attended vibration monitoring will be recorded over a representative sampling interval where the worst-case vibration levels can be captured. Where unattended vibration monitoring is proposed, monitoring will be undertaken continuously whilst the vibrating plant is operational to capture the worst-case vibration levels within the pre-determined ‘minimum working distance’ from the potentially affected building.

4.2.3 Records and analysis

For each vibration monitoring event, the following information shall be recorded:

- Date, time and location of measurements,
- Name of person undertaking the measurements,
- Type and model number of instruments as well as calibration details
- Geotechnical conditions if known,
- Measurement duration
- Map of area showing measurement location, source location and sensitive receivers
- Measurement location details and number of measurements at each location
- Construction activity subject of the measurement
- Minimum statistical data for the measurement period (PPV for each axis, dominant frequency, RMS acceleration if available)
- Description and quantification of construction vibration sources
- Commentary on compliance with vibration guidelines and/or comparison with predicted levels as relevant.

Monitoring reports will be retained in a designated folder accessible to the project team and reports would be provided to DPE, EPA, the ER and AA on request.

The real-time monitoring data will be available to ACCIONA, Transport for NSW, the Environmental Representative (ER) and AA via a web-based portal. The real-time monitoring data will be available to DPE and EPA on request following an initial screening review, to identify any anomalies or corruption in the dataset.

Where vibration guideline values are exceeded or comparison of measured and predicted levels warrants further review, corrective actions will be implemented as described in Section 7.

Typical 'minimum working distances' for construction equipment are presented in the NVMP.

5 Calibration, QA and competency

All monitoring will be undertaken by competent personnel, suitability trained and experienced in undertaking vibration measurements. A competent person must satisfy one or more of the following:

- have qualifications and/or experience sufficient to fulfil the requirements of 'member' grade of the Australian Acoustical Society
- undertake the duties of an acoustic consultant on behalf of a consultancy firm that is a member of the Association of Australasian Acoustical Consultants
- have a recognised tertiary qualification in a discipline pertinent to acoustics, or
- be able to demonstrate competence through professional experience and/or technical expertise.

All instruments will be calibrated in accordance with manufacturers specifications or relevant Australian Standards. Records of monitoring equipment calibration will be maintained by ACCIONA throughout delivery of the Project.

Noise monitoring would be completed using at minimum Type 2 instruments, as per Australian Standard IEC 61672.1.

All monitoring records will be retained throughout delivery of the Project by ACCIONA.

6 Heritage Listed Structures

In accordance with MCoA E79, vibration testing must be undertaken during vibration generating activities that have the potential to impact on heritage items, in order to identify minimum working distances to prevent cosmetic damage.

Potential impact to heritage items has been identified as a vibration monitoring trigger in Section 4.1.1. 'Potential to impact' will be determined by initial modelling undertaken as part of CNVIS.

The process of heritage management with regards to vibration monitoring is as follows:

1. Undertake initial assessment (CNVIS) to confirm 'potential to impact' for all heritage sites within 50m of the works.
2. Where potential exceedances are possible (i.e. works are required within the vibration 'safe working distances) an assessment of the heritage item will be undertaken to confirm structural stability (ref NVMP Section 9.4.2 and 9.4.4)
3. Sites identified as being structurally unsound and with a potential to exceed vibration levels of 2.5 millimetres per second will require monitoring. For all other sites, standard cosmetic damage vibration criteria will apply and an potential exceedances of these will trigger monitoring.
4. In the event that the vibration testing and attended monitoring shows that the criteria is likely to or has been exceeded:
    a. Construction methodology will be reviewed and, if necessary, additional mitigation measures will be implemented.

b. Additional management as described in Section 9 of the NVMP, and the Project's Non-Aboriginal Heritage Management Plan and Aboriginal Cultural Heritage Management Plan will be implemented

Where monitoring equipment is required to be installed at specific heritage listed structures, advice from a heritage specialist must be sought on methods and locations for installing equipment used for vibration, movement and noise monitoring (CoA E80).

7 Continual improvement and corrective action

Monitored noise and vibration levels will be analysed against the noise and vibration objectives and predictions made in the relevant CNVIS or using the Project's predictive tools to allow review of implemented management and mitigation measures.

Where monitored noise or vibration levels are found to be above the relevant objective and/or predicted levels, the following actions will be undertaken:

- Confirm the monitored levels are not being impacted by other noise or vibration sources.
- Confirm the measures implemented are as planned or described in the applicable NVMP/CNVIS/EWMS.
- Confirm if the exceedance is due to an uncharacteristically noisy or vibration-intensive piece of equipment.
- Confirm that predictive modelling reflects the actual activity being undertaken
- Implement other feasible and reasonable measures which may include reducing plant type or size, modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), utilising alternative construction methodology or a combination of these.
- Where the mitigation measures do not result in an improvement in noise scenarios, seek advice from the AA.
- Ensure that the learnings from the above are fed back into the noise modelling assessment process for fine-tuning.
- Continue work where impacts can be reduced,
- Where noise cannot be reduced for this activity, re-assess the extent of impacts based on new information (e.g. revised equipment sound power level) and implement appropriate mitigation and management measures.
- Communicate lessons learnt to relevant personnel.

ACCIONA will review the activity and where possible, modify the work or activity to prevent any recurrence. Lessons learnt will be communicated to personnel in toolbox talks.

8 Reporting of monitoring results

Data from real time noise and vibration monitoring will be reported on a six-monthly basis in a Construction Monitoring Report in line with MCoA C21. The Construction Monitoring Report will be supplied to the AA for review and submitted to the Secretary of the DPE and relevant regulatory authorities for information in accordance with Section 10.7 of the NVMP.

Separate from the Construction Monitoring Report, additional records relating to noise and vibration training, toolbox talks, monitoring results and audit results will be prepared, maintained, and stored in line with the CEMP. The complaints management and reporting procedure is described in the CEMP.

Appendix D3 - Out of Hours Work Protocol