PROJECT MANAGEMENT PLAN

Construction Noise and Vibration Management Plan

Sydney Metro West – Western Tunnelling Package

ISSUE DATE: 12 MAY 2022

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	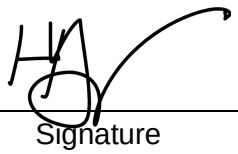	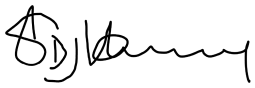
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DOCUMENT CONTROL

The current document version number and date of revision are shown in the document footer. All changes made to the Management Plan during its implementation on a live project are to be recorded in the amendment tables below.

Revision History

Revision	Date	Description of changes	Prepared by	Approved by
A	31 January 2022	First Draft	Steven Luzuriaga (SLR Consulting)_	Simon Hussey
B	04 April 2022	Addressing Stakeholder Comments	Steven Luzuriaga (SLR Consulting)_	Simon Hussey
C	12 May 2022	Addressing Stakeholder Comments	Steven Luzuriaga (SLR Consulting)_	Simon Hussey

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Terms and Definitions

Term	Definition
AA	Acoustics Advisor
AMM	Additional Mitigation Measure
AVTG	Environmental Noise Management Assessing Vibration: A Technical Guideline
CCS	Community Communication Strategy
CEMF	Construction Environmental Management Framework
CEMP	Construction Environmental Management Plan
CNVMP	Construction Noise and Vibration Management Plan
CNVS	Sydney Metro Construction Noise and Vibration Standard
CoA	Conditions of Approval
CSSI	Critical State Significant Infrastructure
DNVIS	Detailed Noise and Vibration Impact Statement
DPE	Department of Planning and Environment (NSW)
EA	Environmental Advisor
EIS	Environmental Impact Statement
EM	Environmental Manager
EMS	Environmental Management System
EPA	Environmental Protection Authority
EPL	Environmental Protection License
EPO	Environmental Performance Outcomes
ER	Environmental Representative
ESR	Environmental Site Representative
GALC	Gamuda Australia – Laing O'Rourke Consortium
ICNG	NSW Interim Construction Noise Guideline
IS	Infrastructure Sustainability
ISC	Infrastructure Sustainability Council
LGA	Local Government Area
MSF	Maintenance and Stabling Facility
NCA	Noise Catchment Areas
NML	Noise Management Levels
NVMoP	Noise and Vibration Monitoring Program
OOHW	Out of Hours Works
PM	Project Manager
PPV	Peak Particle Velocity
RBL	Rating Background Level
REMM	Revised Environmental Mitigation Measures

Term	Definition
RNP	NSW Road Noise Policy
RTA	Road Trains of Australia
SM	Sydney Metro
SMW	Sydney Metro West
SOPA	Sydney Olympic Park Authority
SWL	Sound Power Level
TBM	Tunnel Boring Machine
VC	Vibration Criterion
VDV	Vibration Dose Value
WTP	Western Tunnelling Package

1 INTRODUCTION

1.1 Project Description

The scope of the work being undertaken under the Sydney Metro West Western Tunnelling Package works (WTP) (the Project) includes but is not limited to, the following:

- Westmead Station box excavation, including temporary support, stub tunnels, partially mined station cavern and crossover cavern including permanent lining and support
- Parramatta Station, including excavation of station box and associated support
- Clyde Maintenance and Stabling Facility (MSF), including permanent dive structure, portal, spur running tunnels, spur tunnel junction cavern, bulk earthworks, civil structures, utilities corridor, road crossing and creek diversion
- Rosehill Services Facility, including shaft excavation, permanent lining and lateral support
- A precast segment manufacturing facility at Eastern Creek
- Demolition and site clearance works
- Tunnelling between Sydney Olympic Park (SOP) and Westmead. Tunnelling will be undertaken by placing the tunnel boring machines (TBMs) at the Rosehill Services Facility box and retrieved out at the SOP Station Box and then placed back at the Rosehill Services Facility and retrieved at the Westmead Station Box. No surface works are proposed at SOP except for the retrieval of the TBM.

Refer to Figure 1 for the location of the WTP project.

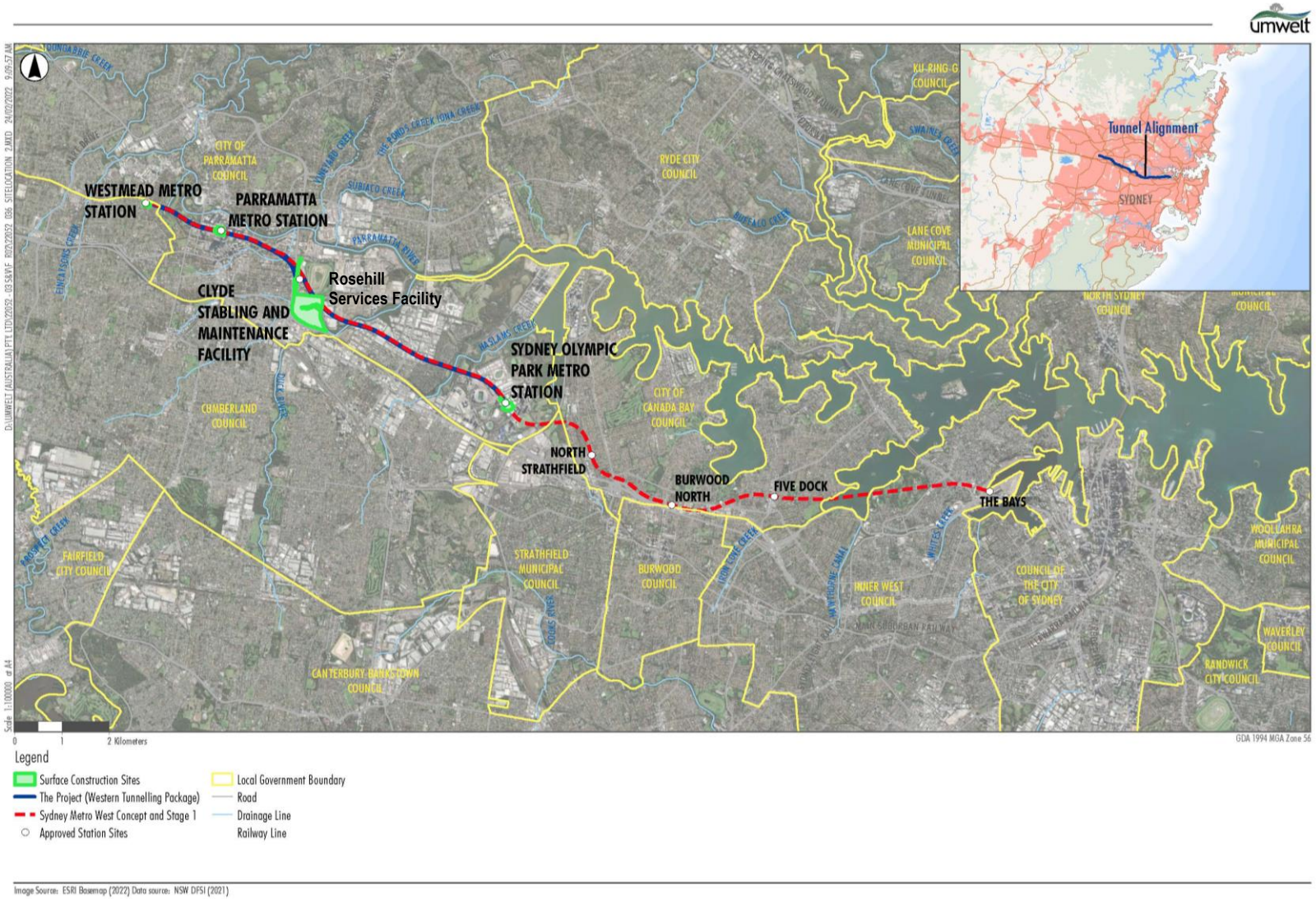


Figure 1: WTP Project Location

1.2 Context

The Construction Environmental Management Plan (CEMP) and sub-plans have been developed for the delivery of the WTP. It will be delivered by Gamuda Australia Laing O'Rourke Consortium (GALC). This Construction Noise and Vibration Management Plan (CNVMP) forms part of the CEMP (SMWSTWTP-GLO-1NL-EV-PLN-000001).

Sydney Metro West – Westmead to The Bays Concept and Stage 1 received planning approval on 11 March 2021 (SSI 10038). The Project comprises the WTP, which is the western portion of Stage 1 of SSI 10038, from Sydney Olympic Park to Westmead. This CNVMP has been prepared to address requirements of the Minister's Conditions of Approval (CoA) and any modifications to the CoA, Revised Environmental Management Measures (REMMs) listed in the Sydney Metro West – Submissions Report, dated 20 November 2020, the Construction Environmental Management Framework (CEMF) requirements and all applicable legislation as they relate to the Project.

1.3 Environmental Management System Overview

An overview of the Environmental Management System (EMS) is provided in the CEMP Section 3.

Key interactions for this sub-plan with other management plans in the EMS include:

- CEMP as it relates to general Environmental Management requirements and governs the implementation of this Sub-plan
- Detailed Noise and Vibration Impact Statement(s) as governed by this Sub-plan
- Construction Noise and Vibration Monitoring Program
- Sustainability Management Plan.
- Overarching Stakeholder and Community Involvement Plan (SM CCS)
- Construction Traffic Management Plans (CTMP)

1.4 Consultation Requirements

In accordance with CoA C5(a), the CNVMP has been prepared in consultation with:

- Sydney Olympic Park Authority (SOPA)
- Parramatta City Council (PCC)
- Cumberland City Council (CCC)
- Department of Planning and Environment (DPE).

In addition, the Noise and Vibration Construction Monitoring Program (NVMoP), has been prepared in consultation with the following stakeholders in accordance with CoA C14.

- Sydney Olympic Park Authority (SOPA)
- Parramatta City Council (PCC)
- Cumberland City Council (CCC)
- Department of Planning and Environment (DPE)
- Environment Protection Authority (EPA).

As outlined in CoA C23, the results of the Construction Monitoring Programs must be submitted to the Planning Secretary (DPE), the Environmental Representative (ER) and relevant regulatory agencies, for information in the form of a Construction Monitoring Report/s at the frequency identified in the relevant Construction Monitoring Program, refer Attachment 5.

Consultation was undertaken over a 21-day period, commencing on 8 April 2022 with the submission of the CNVMP. An introductory meeting was held on the 7 April 2022, which was organised by Sydney Metro and delivered by GALC. At the introductory meeting, GALC introduced themselves, the project team and outlined the scope of the WTP. The 21-day consultation approach was presented and feedback invited on that approach. No issues were raised on the consultation approach during the introductory meeting.

Any comments or feedback made on the CNVMP was requested to be submitted to Sydney Metro within 14 days of consultation commencing. A comment workshop was held during the week commencing 25 April 2022 to discuss any issues raised. The consultation approach provides an opportunity for a second comment workshop to discuss issues that required a bit more technical consideration or further discussion. The second comment workshop was not required for the CNVMP.

Details of issues raised by stakeholders during consultation is provided in Attachment 3, including copies of correspondence in accordance with CoA A6. The approach to consultation is further outlined in the CEMP.

Consultation with the community and potentially affected receivers to inform mitigation of noise and vibration impacts, is discussed further in Section 8.5.

1.5 Certification and Approval

Sydney Metro West – Westmead to The Bays Concept and Stage 1 was subject to environmental impact assessment under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). It was also declared a Critical State Significant Infrastructure (CSSI) by the Minister for Planning & Public Spaces (the Minister).

An Environmental Impact Statement (EIS) has been prepared under Division 5.2 of the EP&A Act and in accordance with Part 3 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000. Following exhibition of the EIS, an Amendment Report and Submissions Report were also prepared. After an assessment was carried out, the Minister determined that the Sydney Metro West – Stage 1 would be approved subject to conditions. Modification 1 of the conditions was approved on 28 July 2021. The response to submission of Modification 2 was submitted on 21 March 2022.

The planning approval (Infrastructure Approval SSI 10038) including modifications and related environmental assessment documents are located at: https://www.planningportal.nsw.gov.au/major-projects/project/25631.

A precast segment manufacturing facility at Eastern Creek has also been proposed as part of this Project, however it is subject to a separate CEMP (and CNVMP) and will be approved under a Review of Environmental Factors (REF).

This CNVMP has been expressly nominated by the Planning Secretary to be endorsed by the ER in accordance with CoA C2-C10. This CNVMP will be submitted for endorsement to the ER (CoA A30d) and AA (CoA A36e) and to DPE for approval no later than one (1) month before the commencement of construction. Construction will not commence until this CNVMP has been endorsed by the ER, unless otherwise agreed by the Planning Secretary.

This CNVMP, as submitted to the ER, including any minor amendments approved by the ER, will be implemented for the duration of construction.

2 PURPOSE AND SCOPE

2.1 Purpose

This Construction Noise and Vibration Management Plan (CNVMP) outlines the noise and vibration management arrangements that will be used to deliver the Sydney Metro West Western Tunnelling Package (WTP, or the Project). The CNVMP details the approach to managing noise in accordance with Gamuda Australia and Laing O'Rourke Consortium's (GALC's) legal, planning, contractual requirements, and environmental management system (EMS).

This Plan outlines the requirements of Detailed Noise and Vibration Impact Statement(s) (DNVIS(s), refer Section 8.1) which will identify a site/activity specific assessment of potential noise and vibration outcomes based on noise and vibration modelling, as well as any noise and vibration mitigation measures required. DNVIS(s) will be developed in consultation with the Environmental Representative (ER) and Acoustics Advisor (AA) and endorsed by the AA prior to implementation.

Attachment 1 outlines Project Environmental Requirements that relate to noise and vibration management, and how they have been addressed by this plan including:

- Conditions of Approval (CoA)
- Revised Environmental Management Measures (REMMs)
- SSI Modifications - Modification 1 Administrative Modification
- SSI Modifications - Modification 2 Clyde Stabling And Maintenance Facility
- Environmental Performance Outcomes (EPOs)
- Sydney Metro Construction Environmental Management Framework (CEMF)
- Sydney Metro Construction Noise and Vibration Standard (CNVS)
- Other Contractual requirements:
  - General Specification
  - Particular specification
- Requirements as stipulated by licenses and approvals.

This Sub-plan also relates to the following elements of the Project EMS, including other plans:

- CEMP as it relates to general Environmental Management requirements and governs the implementation of this Sub-plan
- Detailed Noise and Vibration Impact Statement(s) as governed by this Sub-plan
- Construction Noise and Vibration Monitoring Program
- Sustainability Management Plan.
- Overarching Stakeholder and Community Involvement Plan (SM CCS)
- Construction Traffic Management Plans (CTMP)

The CNVMP enables the Project to manage construction noise and vibration systematically and is applicable to the Project (ie WTP) and all of the Project's activities. Construction will not commence until the CEMP, sub-plans and construction monitoring program are approved/and or endorsed by the ER in accordance with CoAs C10 and C21. The CEMP and CEMP sub-plans and associated construction monitoring program will be implemented for the duration of construction of the WTP.

The performance of the WTP will be monitored against the objectives outlined in Section 3 and performance monitoring will be documented in the compliance reporting and at least on an annual basis as part of auditing requirements (refer to the CEMP).

2.2 Scope

This sub-plan outlines the mitigation and management measures that GALC will use to address potential noise and vibration impacts during construction of the Project, while complying with relevant approval, statutory and contract requirements.

Specifically, this sub-plan addresses environmental aspects and impacts that relate to the following construction activities:

- Demolition and site clearance works
- Westmead Station box excavation, including temporary support, stub tunnels, partially mined station cavern and crossover cavern including permanent lining and support
- Parramatta Station, including excavation of station box and associated support
- Clyde Maintenance and Stabling Facility (MSF), including permanent dive structure, portal, spur running tunnels, spur tunnel junction cavern, bulk earthworks, civil structures, utilities corridor, road crossing and creek diversion
- Rosehill Services Facility, including shaft excavation, permanent lining and lateral support
- Set up of a Tunnel Boring Machine (TBM) launch site at Rosehill
- TBM retrieval and associated work at Westmead and Sydney Olympic Park

2.2.1 Ancillary Works and Facilities

Ancillary works include fencing, hoarding, maintenance access, utility works, drainage, temporary noise barriers, road and transport network works and temporary site offices, laydown and work sites to support construction.

Ancillary facilities include temporary facilities to support the construction e.g. an office and amenities compound, construction compound, material crushing and screening plant, materials storage compound, maintenance workshop, testing laboratory and material stockpile area and parking facilities.

The project will comply with the Minister's Conditions of Approval (CoA) A16 regarding ancillary facilities. Where ancillary facilities have not been identified by description and location in the documents outlined in CoA A1, they will follow the following requirements:

- Ancillary facilities will be located within or immediately adjacent to the Construction Boundary.
- They will not be located next to sensitive land user(s) (including where an access road is between the facility and the receiver) unless the landowner and occupier have given written acceptance to the carrying out of the relevant facility in the proposed location.
- Ancillary facilities will have no impacts on Heritage items (including areas of archaeological sensitivity), threatened species, populations or ecological communities beyond the impacts approved under the conditions of this approval.
- The establishment and use of the facility must be carried out and managed within the outcomes set out in the conditions of this approval.

3 OBJECTIVES AND TARGETS

The key objectives of the CNVMP are to ensure that noise and vibration impacts are minimised and are within the scope permitted by the CoA. To achieve these objectives, the targets in Table 1 have been established for the management of noise and vibration impacts during the Project construction.

Table 1: Objectives and targets

Source/Objective	Target	Measurement Tool
Minimise unreasonable noise and vibration impacts on residents and businesses	• Noise and vibration levels will be minimised by implementing all feasible and reasonable mitigation in accordance with the EPL, CoA and CNVS. • Project noise and vibration levels are at or below modelling predictions • Where two or more complaints are found to result from an activity, or combination of activities, the methodology will be reviewed and modified as much as reasonable and feasible to prevent further complaints. Where the potential for recurrence exists, further consultation will be undertaken with the Environmental Representative (ER) and Acoustic Advisor (AA) • Target high level of noise and vibration related IS rating credits - level 3. To be confirmed in development of the Sustainability Management Plan.	• Site inspection • Verification monitoring • Internal and external audits • Complaint records
Compliance with the CoA, REMMs, CEMF requirements and relevant legislation as it applies to the Project	• Full compliance	• Compliance Reporting
Avoid structural damage to buildings or heritage items as a result of construction vibration	• The Project will avoid any damage to buildings from vibration	• Building condition survey • Monitoring records • Site inspection
Undertake active community consultation	• In alignment with the initial Community Communication strategy: • Be a trusted, flexible and responsive team to stakeholders and the community • Establish relationships with the local community (particularly Indian, Chinese and Sri Lankan communities) to facilitate two-way communication and involvement • Collaborate in communications to minimise cumulative impacts from nearby projects	• Consultation records • Complaints register

Source/Objective	Target	Measurement Tool
	• Work closely with businesses, the Westmead health and education precinct and Westmead Alliance to communicate the works and minimise impact on their employees, students, patients, visitors	
Maintain positive, cooperative relationships with schools, childcare centres, local residents and building owners.	• The community will be consulted with in accordance with the communications strategies and plans. • Complaints are to be managed in accordance with: Sydney Metro's Overarching Community Communications Strategy and Construction Complaint Management System; Contractors Community Communications Strategy and sub-plans. • The DNVIS(s) 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 in accordance with D43.	• Consultation records • Complaints register
Meet IS rating tool requirements and objectives in the Sustainability Management Plan	• Level 3 for credit Dis-2 ‘Noise’ which demonstrates noise mitigation during construction and operation have been identified and implemented, and modelling and monitoring are in accordance with ISCA approved noise guidelines with construction and operation modelling demonstrates no exceedances of noise goals • Level 3 for credit Dis-3 ‘Vibration’ which demonstrates vibration mitigation during construction and operation have been identified and implemented, and the monitoring and modelling done at appropriate intervals and in response to complaints during construction have shown no exceedances of vibration goals for human comfort criteria nor structural damage to buildings and structures.	• Noise and vibration monitoring reports • Construction noise models • Operation noise models • Construction vibration models • Operation vibration models

4 ENVIRONMENTAL REQUIREMENTS

4.1 Legislation and Standards

GALC obligations include satisfying the requirements and complying with the provisions of the relevant legislation, guidelines, and policies, as well as international and Sydney Metro's standards. Details are provided in Table 2.

Table 2: Legislation, standards, policies, and guidelines relevant to the Project

Legislation	*Environmental Planning and Assessment Act 1979* (NSW) *Protection of the Environment Operations Act 1997* (NSW) (POEO Act)
Standards	*British Standard BS6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)* *British Standard BS7385.2-1993, Evaluation and measurement of vibration in buildings* *German Standard DIN4150-1999, Structural vibration Part 3: Effects of vibration on Structures* *Australian Standard AS2436:2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites.*
Guidelines and Specifications	*NSW Department of Environment and Climate Change – NSW Interim Construction Noise Guideline (ICNG), July 2009* *Sydney Metro – Sydney Metro Construction Noise and Vibration Standard (CNVS), September 2020, Version 4.3* *NSW Road Noise Policy (RNP), Department of Environment, Climate Change and Water 2011* *NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006* *Noise Policy for Industry (NPfI), NSW Environment Protection Authority 2017* *IS Technical Manual Version 1.2, Infrastructure Sustainability Council of Australia 2016*

4.2 Approvals, Licenses and Permits

This CNVMP has been developed to satisfy the requirements of CoA C1. A full list of applicable CoAs, REMMs, CEMF requirements and EPL condition requirements is provided in Attachment 1. In the Assessment Report for Sydney Metro West - Stage 1, the Department of Planning, Industry and Environment considers that EIS has adequately assessed noise and vibration issues and that they can generally be managed through the CoA, REMMs, CEMF requirements and EPL condition requirements in Attachment 1. Therefore, no further assessment of noise and vibration impacts has been undertaken for this CNVMP.

Other legislation relevant to this CNVMP is included in Attachment 2 of the CEMP.

4.3 IS Rating Tool Requirements

The Project will pursue a rating of at least 85 under the Infrastructure Sustainability Council's (ISC) ISv1.2 Rating Scheme. The IS Rating Tool requirements relevant to this CNVMP are outlined in Table 3 below.

Table 3: IS Rating credits relevant to this CNVMP

Credit	IS Rating Tool Requirement	Document Reference
Dis-2 L1	• Measures to mitigate noise during construction and operation have been identified and implemented. • Monitoring of noise is undertaken at appropriate intervals and in response to complaints during construction	Section 8 NVMoP – Attachment 5
Dis-2 L2	• Requirements for Dis-2 L1 are achieved. • For construction, modelling and monitoring demonstrates no recurring or major divergences from the noise management process in ISCA approved noise guidelines. • For operation, modelling demonstrates no recurring or major exceedances of noise goals.	DNVIS(s), NVMoP – Attachment 5
Dis-2 L3	• Requirements for Dis-2 L2 are achieved. • For construction, modelling and monitoring demonstrates no divergences from the noise management process in ISCA approved noise guidelines. • For operation, modelling demonstrates no exceedances of noise goals.	DNVIS(s), NVMoP – Attachment 5
Dis-3 L1	• Measures to mitigate vibration during construction and operation have been identified and implemented. • Monitoring of vibration is undertaken at appropriate intervals and in response to complaints during construction.	Section 8 NVMoP – Attachment 5
Dis-3 L2	• Requirements for Dis-2 L1 are achieved. • For construction, modelling and monitoring demonstrates no exceedances of vibration goals for structural damage to buildings and structures. • For operation, modelling demonstrates no recurring or major exceedances of vibration goals for human comfort criteria. • No physical damage has been caused to any buildings or structures by vibration caused by construction	DNVIS(s), NVMoP – Attachment 5
Dis-3 L3	• Requirements for Dis-3 L2 are achieved. • For operation, modelling demonstrates no exceedances of vibration goals for human comfort criteria.	DNVIS(s)

The Project will aim to achieve these objectives subject to further review during the development of the Sustainability Management Plan.

5 EXISTING ENVIRONMENT

The existing environment is detailed in the Sydney Metro West – Westmead to The Bays Concept and Stage 1 EIS, Chapter 11 and Technical Paper 2, published in 2020 and considered relevant for this CNVMP. This section describes the existing environment as it relates to noise and vibration and as detailed in the EIS.

5.1 Construction Sites

The Project is located across the Parramatta and Cumberland Local Government Areas (LGAs). The four main construction sites are described in Table 4 including a brief description of the existing noise environment around these locations as identified in Section 2 of Technical Working Paper 2 in the EIS.

Table 4 Noise environment at the key construction sites

Site	Locality	Existing noise environment
Westmead Metro Station	The station Construction Site is located on the corner of Hawesbury Road and Alexandra Avenue, south of the Westmead Train Station.	Existing noise is dominated by road traffic noise from the local road network and train pass by noise.
Parramatta Metro Station	The station Construction Site is located off Macquarie Street, opposite Parramatta Square, north of the Parramatta Train Station	Existing noise is dominated by road traffic noise from Macquarie Street and Smith Street, some rail noise, and general noise from the Parramatta business district.
Clyde Maintenance and Stabling Facility	The Clyde Maintenance and Stabling Facility and adjacent sites (i.e. Rosehill and Clyde Dive) are located off Unwin Street, adjacent to James Ruse Drive and the Rosehill Gardens Racecourse.	Existing noise is dominated by road traffic noise from James Ruse Drive and the M4 Motorway.
Sydney Olympic Park Station	The station Construction Site is located off Olympic Boulevard, south of the existing Olympic Park Rail Station	Existing noise is dominated by distant road traffic noise from the M4 Motorway and Homebush Bay Drive, some rail noise, and general noise from the sports and entertainment complex.

5.2 Sensitive Receivers

The Project has the potential to impact nearby receivers that may be sensitive to noise and vibration. The type of receivers that may be impacted by the Project are outlined in Table 5 below and Attachment 6.

Table 5 Sensitive Receivers

Receiver Type	Detail
Residential noise sensitive receivers	There are areas of varying density of residential receivers in proximity to the construction sites. Residential receivers dominate the noise catchments in proximity to the Westmead metro station and Clyde stabling facility near the motorway.
Commercial and Industrial sensitive receivers	While commercial and industrial buildings are not considered sensitive as it relates to road and rail noise, they are considered a sensitive receiver in relation to construction noise and are considered in delivering the Project. Commercial receivers are a large portion of the receivers surrounding the Parramatta metro station and Sydney Olympic Park metro station.
Users of recreation areas	Includes active and passive recreation. Various recreational land uses are located surrounding the key construction sites and along the Project alignment.
Other sensitive receivers	Includes schools and other educational institutions, places of worship, Hospitals including wards and operation theatres, hotels, childcare centres, public buildings, recording studios, theatre/auditoriums and stables. Various recreational land uses are located surrounding the key construction sites and along the Project alignment. Key receivers have been identified in Attachment 6.
Vibration sensitive receivers	May include receivers sensitive to disturbance, as well as sensitivity to cosmetic (and potentially structural) damage. Noise sensitive receivers identified above may also be sensitive to vibration emitted as a result of construction.

A detailed Land Use Survey was prepared in accordance with CoA D34 to confirm sensitive receivers (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration and construction ground-borne noise as a result of the Project, refer Attachment 6.

Additional detailed land use surveys will be undertaken to confirm any changes in sensitive land user(s) as the construction program progresses. Any changes to the receiver types resulting from additional surveys will be included in Attachment 6.

5.3 Heritage Properties

The Sydney Metro Construction Noise and Vibration Standard states that heritage buildings and structures should be assessed according to the cosmetic damage screening criteria and should not be assumed to be more sensitive to vibration unless found to be structurally unsound. The following properties have been identified in the DNVIS(s) which may be potentially impacted by the Project:

- Parramatta metro station site – Roxy Theatre to the east, three heritage listed buildings (ie 41-59 George Street, Horse Parapet Façade and Kia Ora) and one heritage listed structure (Convict drain - underground services) within the construction footprint
- Clyde maintenance and stabling facility – The former RTA Depot at 1 Unwin Street, Rosehill, which is a free-standing building facade and is not occupied

Further details in relation to these items are presented in Section 7.2.4. Additional vibration sensitive properties may be identified as part of the Land Use survey, Condition surveys of potentially affected buildings and structures near to the tunnel and excavations will be undertaken prior to the commencement of excavation. These surveys will inform the vibration criteria that applies, as discussed further in Section 6.3.2.1.

5.4 Noise Catchment Areas

The area surrounding each construction site is divided into one or more Noise Catchment Areas (NCAs) that reflect the ambient noise environment of that area, as well as the noise and vibration sensitivity of the surrounding land uses. The NCAs for the Project are outlined in Table 6 and presented in Figure 2, they are based on those detailed in the EIS (detailed in Section 2 of Technical Working Paper 2).

Table 6 Noise Catchment Areas

NCA	Site	Approximate No. of Receivers	Location and receivers
NCA01	Westmead metro station	340	North of the existing rail corridor in Westmead and is mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
NCA02	Westmead metro station	306	South of the existing rail corridor and is mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
NCA03	Parramatta metro station	509	Predominantly covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University – Parramatta, Arthur Phillip High School, Parramatta Public School, and a number of nearby hotels and places of worship.
NCA04	Clyde maintenance and stabling facility	392	South of the Parramatta River and west of James Ruse Drive. The catchment is mainly residential with small areas of commercial receive.
NCA05	Clyde maintenance and stabling facility	477	North of the M4 Motorway and west of James Ruse Drive. The catchment is mainly residential. 'Other sensitive' receivers include Rosehill Public School and a number of hotels and child care centres.
NCA06	Clyde maintenance and stabling facility	207	South of the M4 Motorway in Granville. The catchment is mostly residential adjacent to the motorway, with some commercial use in the south-east.
NCA07	Clyde maintenance and stabling facility	1,952	East of James Ruse Drive, this catchment is mostly commercial and covers Rosehill Gardens racecourse (and associated stables), the Clyde commercial/industrial area, and Silverwater and Newington. Residential receivers and Newington Public School are in the south-east.

NCA	Site	Approximate No. of Receivers	Location and receivers
NCA08	Sydney Olympic Park metro station	95	West of Australia Avenue at Sydney Olympic Park. This NCA is a mixture of commercial, including two stadiums, and outdoor areas including Sydney Olympic Park Athletic Centre, Sydney Olympic Park Hockey Centre, Sydney Olympic Park Aquatic Centre and the Cathy Freeman Park. The nearest receivers are commercial buildings on Dawn Fraser Avenue, Olympic Boulevard, Herb Elliott Avenue and Figtree Drive. Two hotels and the New South Wales Rugby League Centre of Excellence educational building are also located within the catchment.
NCA09	Sydney Olympic Park metro station	32	East of Australia Avenue. This NCA is a mixture of commercial, residential and outdoor active areas including Bicentennial Park, Bressington Park and Mason Park. Residential receivers within the catchment are located on Australia Avenue, Bennelong Parkway and Betty Cuthbert Avenue

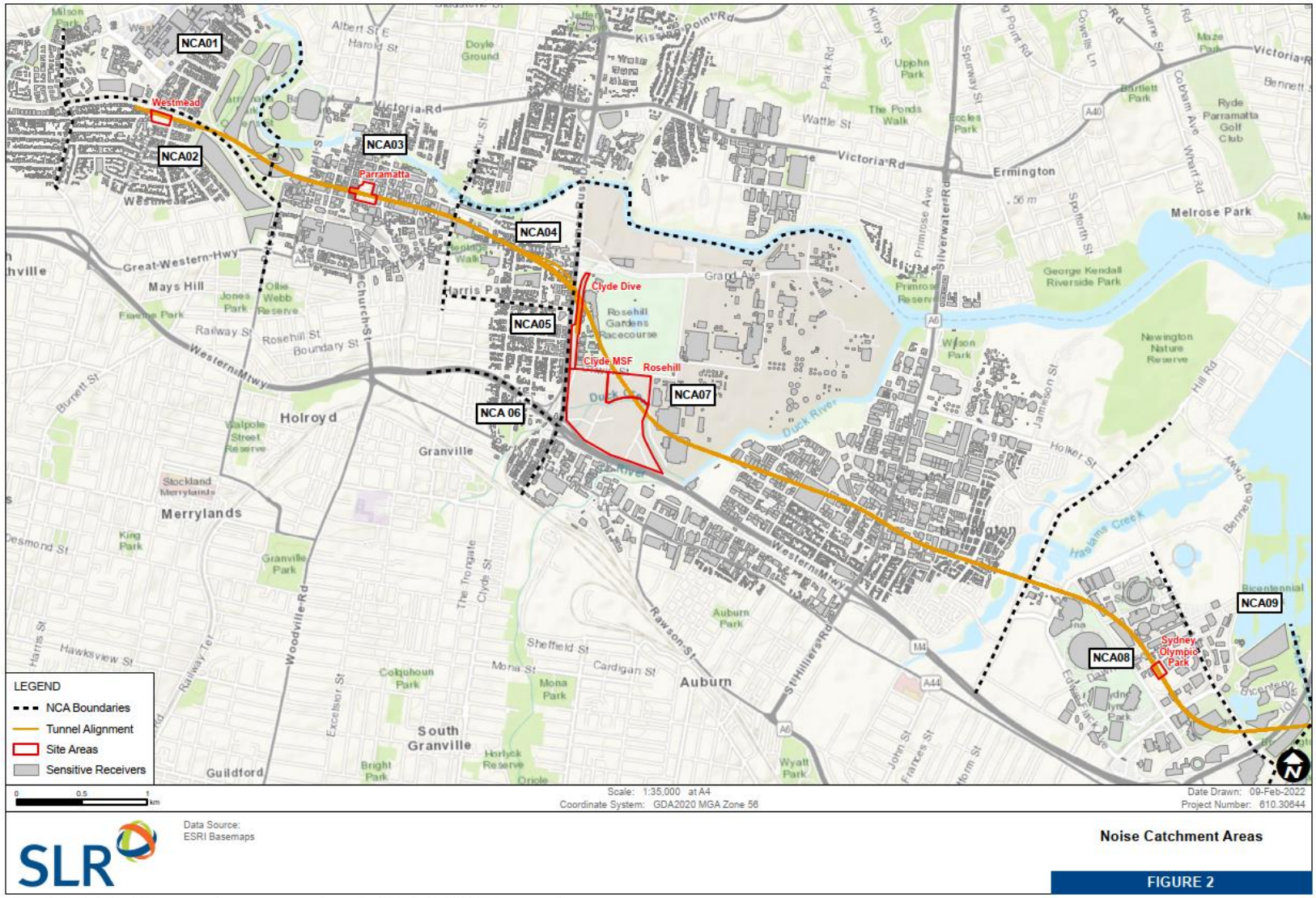


Figure 2 – Noise Catchment Areas

5.5 Ambient Noise Environment

Noise most relevant to construction noise are described below. These may relate to daytime (7am-6pm), evening (6pm-10pm) and night-time (10pm-7am) periods:

- Rating background level (RBL) or L_{A90} – the background noise level in the absence of proposed construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods and is used to set the $L_{Aeq(15\ minute)}$ noise management levels (NMLs) for residential receivers
- Average noise level or $L_{Aeq(period)}$ – the 'energy average noise level' evaluated over a defined measurement period (typically 15 minutes for construction noise or the relevant daytime, evening or night-time period for ambient noise monitoring)
- L_{Amax} or $L_{A1(1min)}$ – the 'typical maximum noise level' for an event, used in the assessment of potential sleep disturbance during night-time periods.

5.5.1 Background Noise Levels

In many cases, noise criteria that applies to the project as well as the assessment of noise impacts relates to the background noise levels in an area. During preparation of the EIS, long-term noise monitoring was undertaken. Results of this monitoring is presented in Table 7.

Measured noise levels in the vicinity of the project generally display a diurnal trend with lower levels during the night-time than the daytime and evening periods. This is characteristic of urban and suburban areas, where the ambient noise environment is primarily influenced by road traffic.

Additional baseline noise monitoring is not proposed for the preparation of the CNVMP or DNVIS(s).

Table 7 Summary of Ambient and Background Noise Levels

Location ID	NCA	RBL (dBA)			Average Noise Level (dBA)		
		Day	Evening	Night	Day	Evening	Night
B.02	NCA01	48	46	41	58	53	51
B.01	NCA02	49	47	37	67	67	62
B.03	NCA03	58	53	43	69	67	62
B.04	NCA04	51	48	41	61	58	57
B.05	NCA05	50	49	45	56	55	53
B.06	NCA06	52	51	44	58	57	55
B.07	NCA07	46	44	41	60	57	55
B.08	NCA08	48	48	46	55	54	52
B.09	NCA09	48	46	41	57	58	53

6 NOISE AND VIBRATION CRITERIA

6.1 Noise and Vibration Guidelines

The ICNG and CNVS establish criteria in the form of noise management levels (NMLs) and vibration levels for the purpose of assessing and managing noise and vibration impacts. These may be modified by the Planning Approval or specifically, conditions of the Approval. The application of these guidelines to the Project and resulting noise and vibration goals are outlined in this section.

6.2 Noise Management Levels

6.2.1 Residential Receivers (airborne noise)

The method for establishing Noise Management Levels (NMLs) for residential receivers is developed using the approach in the ICNG as required under the CNVS and is summarised in Table 8.

Table 8: Construction Noise Management Levels

Time of day	Noise management level LAeq (15 minute)	How to apply
Standard hours: 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 dBA	Where the predicted or measured LAeq(15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.
Highly noise affected Hours as per standard hours, 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. No work on Sundays or public holidays	Highly noise affected 75 dBA	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. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dBA	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.

Sleep disturbance (airborne noise)

For residential receivers it is also important to consider potential sleep disturbance impacts associated with OOHW conducted during the night-time (10pm to 7am).

Consistent with the Noise Policy for Industry (EPA, 2017), A detailed maximum noise level event assessment will be undertaken where night-time noise levels at a residential location exceed the:

- $L_{Aeq(15\ minute)}$ 40 dBA or the prevailing RBL plus 5 dBA, whichever is the greater, and/or
- L_{Amax} 52 dBA or the prevailing RBL plus 15 dBA, whichever is the greater.

The detailed assessment will cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night-time period.

Maximum noise level event assessments should be based on the L_{Amax} descriptor on an event basis under 'fast' time response. The detailed assessment will consider all feasible and reasonable noise mitigation measures with a goal of achieving the above trigger levels for night-time activities.

Based on the ICNG and CNVS methodology summarised above the following construction Noise Management Levels (NMLs) for residential receivers will apply to the Project as presented in Table 9.

Table 9: Residential Construction Noise Management Levels (NML)

Study Area	NCA	Background Monitoring Location	NML - Approved Construction Hours ($L_{Aeq, 15\ min}$)	NML - Outside Approved Construction Hours ($L_{Aeq, 15\ min}$)			Sleep Disturbance (L_{Amax})	Sleep Awakening Level (L_{Amax})[2]
				Daytime[1]	Evening	Night		
Westmead	NCA01	B.02	58	53	51	46	56	65
	NCA02	B.01	59	54	52	42	52	65
Parramatta	NCA03	B.03	68	63	58	48	58	65
Clyde / Rosehill	NCA04	B.04	61	56	53	46	56	65
	NCA05	B.05	59	54	53	49	59	65
	NCA06	B.06	62	57	56	49	59	65
	NCA07	B.07	56	51	49	46	56	65
Sydney Olympic Park	NCA08	B.08	58	53	53	51	61	65
	NCA09	B.09	58	53	51	46	56	65

Notes:

1. Daytime out of hours is 7 am to 8 am on Saturday, and 8 am to 6 pm on Sunday and public holidays, refer Section 6.4.

2. External noise level: assuming receivers have windows partially open for ventilation which results in internal noise levels being around 10 dB lower than the external noise level.

6.2.2 Non-residential Receivers (airborne noise)

Due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories. The external noise levels would be assessed at the most-affected occupied point of the premise:

- Industrial premises: external $L_{Aeq(15\ minute)}$ 75 dBA
- Commercial premises including offices, retail outlets: external $L_{Aeq(15\ minute)}$ 70 dBA

Other noise-sensitive receivers require separate specific noise goals. The ICNG recommends that the internal construction noise levels at these premises are determined based on the 'maximum' internal levels presented in AS 2107. These recommended 'maximum' internal noise levels are provided in Table 10. Levels are consistent as those outlined in the EIS (refer Technical Report 2).

Table 10: Noise Management Levels for Other Receivers

Description	Time Period	Noise management level (dBA) $L_{Aeq(15\ minute)}$	
		Internal	External
Classrooms at schools and other educational institutions	When occupied	45	55[1]
Hospital wards and operating theatres	When occupied	45	65[2]
Places of worship	When in use	45	55[1]
Active recreation areas	When in use	-	65
Passive recreation areas	When in use	-	60
Hotel	Daytime & evening	50	70[2]
	Night time	40	60[2]
Café	When in use	50	70[2]
Bar/Restaurant	When in use	50	70[2]
Childcare centres	Daytime	-	55
outdoor play area		40	50[1]
sleeping area			
Public building	When in use	50	60[1]
Recording studio	When in use	25	45[2]
Theatre/auditorium	When in use	30	50[2]
Rosehill Gardens Racecourse Stables	When in use	-	60[3]

Notes:

1. Receiver conservatively assumed to have openable windows and a 10 dB outside to inside facade performance, which is representative of windows being partially opened to provide ventilation.

2. It is assumed that these receiver types have fixed windows with a conservative 20 dB reduction for external to internal noise levels

3. Rosehill Gardens racecourse stables have been included in the assessment and are assessed as 'other sensitive' active recreation areas. These criteria will be updated following consultation with Rosehill Gardens Racecourse and equine veterinary expert, refer Table 23.

6.2.3 Construction Road Traffic Noise

When trucks and other vehicles are operating within the WTP works area, vehicle noise contributions are included in the overall predicted $L_{Aeq(15minute)}$ construction site noise emissions described in the DNVIS(s). When construction-related traffic moves onto the public road network it is regarded as 'additional road traffic'.

In accordance with the RNP and CNVS, construction traffic NMLs set at 2 dBA above the existing road traffic noise levels during the daytime and night-time periods are considered appropriate to identify the onset of potential noise impacts. Where the road traffic noise levels are predicted to increase by more than 2 dBA as a result of construction traffic, consideration would be given to applying feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity.

In considering feasible and reasonable mitigation measures where the relevant noise increase is greater than 2 dBA, consideration would also be given to the actual noise levels associated with total traffic (i.e. existing traffic + construction traffic) and whether or not these levels comply with the road traffic noise criteria in the RNP, refer to Table 11.

Table 11: Road Traffic Noise Management Levels

Road	Category	Management Level, dBA	
		Daytime	Night time
Freeway/ arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	LAeq(15hour) 60 (external)	LAeq(9hour) 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	LAeq(1hour) 55 (external)	LAeq(1hour) 50 (external)

6.2.4 Ground-borne Noise Management Levels

The following ground-borne noise levels for residences are nominated in the ICNG, CNVS, and CoA D39, and indicate when management actions will be implemented. These levels recognise the temporary nature of construction and are only applicable when ground-borne noise levels are higher than airborne noise levels. Ground-borne noise management levels are summarised in Table 12.

Table 12: Ground-Borne Noise Management Levels

Receiver Type	Management Level, LAeq(15minute) dB		
	Daytime[1]	Evening	Night-time
Residential	45 dBA internal	40 dBA internal[2]	35 dBA internal[2]
Commercial	50 dBA internal	N/A	N/A

Notes:

1. Daytime ground-borne noise NMLs (including commercial) taken from preceding Sydney Metro planning applications for consistency. Daytime ground-borne noise NMLs are not specified in the ICNG or Sydney Metro CNVS.

2. Specified in the Sydney Metro CNVS.

For other sensitive receivers, including commercial receivers such as offices and retail areas, the ICNG and CNVS do not provide guidance in relation to acceptable ground-borne noise levels. For the purpose of this CNVMP, the internal airborne NMLs presented in Table 10 will also be adopted for ground-borne noise.

6.3 Ground-borne Vibration Criteria

Impacts from vibration will be considered under the following three categories:

- effects on building occupants (human comfort)
- effects on the integrity of a building (structural/cosmetic damage)
- effects on the contents of a building (Sensitive scientific and medical equipment).

For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents. Exceptions to this can occur when vibration sensitive equipment, such as electron microscopes or medical imaging equipment, are in buildings near to construction work, refer Section 6.3.3.

In accordance with CoA D39, each of these potential effects will be assessed in accordance with the relevant standard. For human comfort *Assessing Vibration; a technical guideline (AVTG)* (DECC, 2006) and British Standard BS 6472-1992 applies in accordance with the CNVS. For cosmetic or structural damage, the British Standard BS 7385:1993, the German Standard DIN 4150-3 and the Australian Standard AS 2187.2 – 2006, applies in accordance with the CNVS and relevant CoA. Sensitive scientific and medical equipment will be assessed in accordance with the CNVS.

6.3.1 Human Comfort

Assessing Vibration; a technical guideline (DECC, 2006) provides guidance for assessing human exposure to vibration. The publication is based on British Standard BS 6472:1992 which provides guideline values for continuous, transient and intermittent events that are based on a Vibration Dose Value (VDV), refer Table 13.

Table 13: VDV Ranges which Might Result in Various Probabilities of Adverse Comment within Residential Buildings

Place and Time	Low Probability of Adverse Comment ($m/s^{1.75}$)	Adverse Comment Possible ($m/s^{1.75}$)	Adverse Comment Probable ($m/s^{1.75}$)
Residential Buildings 16 hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential Buildings 8 hr night	0.13	0.26	0.51

Source: Table 2.4, Assessing Vibration; a technical guideline, Department of Environment & Climate Change 2006.

To provide greater flexibility and to enable the assessment of potential impact via the Peak Particle Velocity (PPV) parameter (which can be measured and evaluated during works) the following thresholds identified in Table 14 will be applied to assess the probability for adverse comment from residential receivers. These values have been established as per Table C1.1 of the NSW Vibration Guideline and will be applied in combination with the VDV presented in Table 13.

Table 14: Perceptible Vibration Criteria for Exposure to Continuous and Impulsive Vibration

Place	Time	PPV (mm/s)			
		Preferred		Maximum	
		z-axis	x and y-axis	z-axis	x and y-axis
Continuous vibration (weighted rms Acceleration, m/s^2, 1-80Hz)					
Critical areas	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 (weighted rms Acceleration, m/s^2, 1-80Hz)					
Critical areas	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

Source: Table 2.2, Assessing Vibration; a technical guideline, Department of Environment and Climate Change 2006.

6.3.2 Building Damage (structural/cosmetic damage)

To achieve the requirements of the CNVS and CoA D39, vibration from construction activities must not exceed the vibration limits set out in the British Standard BS 7385:1993. The recommended limits from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented in Table 15.

For most construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers, excavators (with hydraulic hammers) and the like, the predominant vibration energy occurs at frequencies greater than 4Hz (and usually in the 10–100Hz range). On this basis, a conservative vibration damage screening level per receiver type is given below:

- Reinforced or framed structures: 25.0mm/s
- Unreinforced or light framed structures: 7.5mm/s

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

Table 15: Building Damage Vibration Management Levels (BS 7385)

Line	Type of Building	PPV (mm/s) in the Frequency Range of Predominant Pulse	
		4Hz to 15Hz	15Hz 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

6.3.2.1 Heritage structures

Heritage buildings and structures will be assessed as per the screening criteria in Table 14.

If a heritage building or structure is found to be structurally unsound (following inspection) a more conservative cosmetic damage criteria of 2.5 mm/s peak component particle velocity (from DIN 4150) would be applied.

6.3.2.2 Other vibration sensitive structures and utilities

In accordance with CoA D58, the WTP must be designed and constructed with the objective of minimising impacts to, and interference with, third party property and infrastructure, and that such infrastructure and property is protected during construction.

Where structures and utilities are encountered which may be considered to be particularly sensitive to vibration, a vibration goal which is more stringent than structural damage goals presented in Table 15 may need to be adopted. Examples of such structures and utilities include:

- tunnels
- gas or other pipelines
- fibre optic cables.

Further guidance is taken from the German Standard DIN 4150-3:2016 Vibration in Buildings – Part 3: Effects on Structures, which sets vibration velocity values for evaluating effects of vibration on buried pipework. Table 16 presents guideline values to evaluate the effects of short-term vibration.

Table 16: Vibration Screening Levels for Underground Utilities

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

In accordance with CoA D59, the services potentially affected by construction must be identified to determine requirements for diversion, protection and / or support. In all cases, protection requirements or alterations to services will be determined by negotiation with the service providers.

Disruption to services resulting from construction will be avoided, wherever possible, and advised to customers where it is not possible.

6.3.3 Sensitive Scientific and Medical Equipment

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

Where it has been identified that vibration sensitive scientific and/or medical instruments are likely to be in use inside the premises of an identified vibration sensitive receiver, objectives for the satisfactory operation of the instrument will be sourced from manufacturer's data. Where manufacturer's data is not available, generic vibration criterion (VC) curves as detailed in the CNVS and presented below in Table 17 will be adopted as vibration goals.

It should be noted that these criteria are conservative, therefore baseline vibration measurements will be undertaken at receivers that are identified to contain sensitive scientific / medical equipment prior to construction activities being undertaken. The baseline data in combination with the VC curves presented below will ascertain project / equipment specific vibration goals.

Table 17: VC Curves for Vibration Sensitive Equipment

Criterion Curve	Max Level (µm/s, RMS)[1]	Detail Size (microns)[2]	Description of Use
VC-A	50	8	Adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc.
VC-B	25	3	An appropriate standard for optical microscopes to 1000X, inspection and lithography equipment (including steppers) to 3 micron line widths.
VC-C	12.5	1	A good standard for most lithography and inspection equipment to 1 micron detail size.
VC-D	6	0.3	Suitable in most instances for the most demanding equipment including electron microscopes (TEMs and SEMs) and E-Beam systems, operating to the limits of their capability.
VC-E	3	0.1	A difficult criterion to achieve in most instances. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems and other systems requiring extraordinary dynamic stability.

Notes:

1. As measured in one-third octave bands of frequency over the frequency range 8 to 100 Hz.

2. The detail size refers to the line widths for microelectronics fabrication, the particle (cell) size for medical and pharmaceutical research, etc. The values given take into account the observation requirements of many items depend upon the detail size of the process.

6.3.4 Recommended Minimum Working Distances

Minimum working distances for typical vibration intensive construction equipment are provided in the TfNSW *Construction Noise and Vibration Strategy* and are shown in Table 18. The minimum working distances below are provided for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (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 18: 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
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
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m

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.

6.3.5 Vibration and Overpressure From Blasting

Not applicable. Blasting will not occur as part of the project.

In the event there is a change of construction methodology and blasting is required, the blasting criteria will be outlined in a Blast Management Strategy required under CoA D54.

6.4 Work Hours

6.4.1 Approved Construction Hours

Construction should only be undertaken during the following approved construction hours:

- 7:00am to 6:00pm Mondays to Fridays, inclusive
- 8:00am to 6:00pm Saturdays, and
- at no time on Sundays or public holidays.

6.4.2 Highly Noise Intensive Work

Highly noise intensive work, as defined in the CoA, are activities considered 'annoying' under the ICNG, including:

- use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work
- grinding metal, concrete or masonry
- rock drilling
- line drilling
- vibratory rolling
- bitumen milling or profiling
- jackhammering, rock hammering or rock breaking
- rail tamping and regulating
- impact piling.

In accordance with CoA D36, 'highly noise intensive work' that result in an exceedance of the NML at the same receiver, except as permitted by an EPL, must be undertaken between the hours of:

- 8:00 am to 6:00 pm Monday to Friday
- 8:00 am to 1:00 pm Saturday.

Work in continuous blocks should not exceed three hours each with a minimum respite from those activities or works of not less than one hour.

6.4.3 Outside of Standard Construction Hours

Table 19 outlines a range of activities which may be undertaken outside of standard construction hours. The activities must comply with the criteria specified and relevant approval sought, and notification made.

Table 19 Works permissible outside of standard construction hours

Activity	Criteria	Approval or activity required	CoA Reference
Tunnelling	• Excluding cut and cover tunnelling and surface works • Tunnelling does not include station box excavation.	No action required	D37(d)(i)
Concrete batching	• At the Clyde construction site only	No action required	D37(d)(ii)

Activity	Criteria	Approval or activity required	CoA Reference
Delivery of material	• If required to be delivered outside of standard construction hours to directly support tunnelling activities • Except between the hours 10:00 pm and 7:00 am to / from the Westmead construction site	No action required	D37(d)(iii)
Haulage of spoil	• Except between the hours of 10:00 pm and 7:00 am to / from the Westmead construction site	No action required	D37(d)(iv)
Work within an acoustic shed	• No exceedance of noise levels under Low impact circumstances identified in this table below, unless otherwise agreed by the Planning Secretary	No action required	D37(d)(v)
Safety and Emergencies	• for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or • 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.	Notify the AA, ER, the Planning Secretary and the EPA must of the reasons for such work. Use best endeavours to notify as soon as practicable all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work.	D37(a)
Low impact	• construction that causes LAeq(15 minute) noise levels: • no more than 5 dBA above the rating background level at any residence in accordance with the ICNG, and • no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); and • construction that causes LAFmax noise levels no more than 15 dBA above the rating background level at any residence; or • construction that causes: – 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 14 or	OOHW Approval	D37(b)

Activity	Criteria	Approval or activity required	CoA Reference
	– intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 14.		
By Approval	• Where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or • Works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol; or • Negotiated agreements with directly affected residents and sensitive land users.	Out of Hours Permit or Evidence of agreement with directly affected land users.	D37I

An Out of Hours Work (OOHW) Protocol has been developed to identify a process for the consideration, management and approval of work which are outside approved construction hours and not subject to an EPL.

The OOHW Protocol has been prepared in consultation with the ER, AA and EPA and will provide:

- Identification of low and high-risk activities and an approval process that considers the risk of activities, proposed mitigation, management, and coordination, including where:
  - the ER and AA review all proposed out-of-hours activities and confirm their risk levels;
  - low risk activities can be approved by the ER in consultation with the AA; and
  - 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. 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.

The OOHW Protocol has been prepared as a stand-alone document by Sydney Metro and is provided in Attachment 4. The OOHW Protocol will be referred to during the assessment, management and approval of all remaining works undertaken out of standard hours.

An application will be made for an EPL for the Project. Once an EPL has been granted, OOHW will be governed by both the EPL and the CoA and this CNVMP will be updated accordingly.

7 ASPECTS, IMPACTS AND RISKS

7.1 Construction Activities

The Project is located across 6 main construction sites and an overview of activities are outlined in Table 20.

Table 20 Key construction sites

Site	Tunnel boring machine launch and support	Tunnel boring machine retrieval	Roadheader works and support	Spoil removal	Station excavation	Services facilities excavation	Construction staff facilities	Stabling and maintenance facility civil	Creek crossings	Tunnel dive structure
Westmead Metro Station		●	●	●	●		●			
Parramatta Metro Station				●	●		●			
Rosehill Site	●			●		●	●			
Clyde Dive Site							●			●
Clyde Maintenance and Stabling Facility				●			●	●	●	
Sydney Olympic Park Station		●		●			●			

Maps showing the key construction sites listed above are provided in Attachment 6 and Attachment 7.

Key construction scenarios will be identified in the activity/site specific DNVIS(s). These assessment scenarios will be developed to identify significant noise and vibration generating plant, equipment and machinery that may be in use or activities that will be undertaken as part of the Project.

A description of the general construction activities that apply to the DNVIS(s) are provided in Table 21 below. Further detail of site-specific construction activities are provided in the DNVIS(s).

Table 21: Description of general noise and vibration generating construction activities

General construction activities	Description
Site preparation works	This involves preparation of construction sites, including demolition of existing buildings, vegetation clearing, erection of hoarding and relocation, adjustment and protection of utilities. This activity would involve the operation of supporting equipment such as generators, cranes, compressors, etc, and loading of heavy vehicles with equipment such as excavators. This category would include the use of noise intensive equipment such as rockbreakers and concrete saws at times, especially during demolition of existing structures. Site preparation work would also involve the following less noise intensive activities including delivery of equipment and facilities to the site and the assembly of site facilities including perimeter hoarding and amenities buildings.
Piling	Piling will be required for foundations of future structures and as linings of station and shaft excavations. Bored piling will be used rather than impact piling. This activity would include operation of supporting equipment such as excavators and cranes, as well as concreting equipment such as concrete mixer heavy vehicles and concrete pumps.
Surface Construction	Civil works and surface structures include roads, hardstand areas, water treatment facilities and site offices. Acoustic sheds will be constructed over excavation and spoil handling areas at Clyde Dive, Rosehill and Westmead sites. This activity would involve the use of general construction equipment such as cranes, generators and hand tools. In addition, noise intensive equipment such as grinders may be used for some activities.
Excavation	Stations and tunnel service/access shafts will be excavated from the surface, commencing once piling is complete. Excavation will initially be performed through soft soil material and then through rock. Equipment may vary from site to site but may include excavators and dozers 'ripping' the material and excavators with rock breaker attachments to penetrate harder rock. Spoil will be removed from site by truck and dog. Once sufficient depth is created, acoustic sheds or panels will be installed to reduce noise impacts on receivers. Trench cutters and clam shell excavators may be utilised for D-wall construction.
Soil and Materials Transport	Heavy vehicles will be required to transport non-tunnel spoil and other materials to and from each Construction Site or to the relevant waste facility.

7.2 Predicted construction impacts

A brief description of the anticipated noise and vibration impacts as identified in the DNVIS(s) are summarised in the sections below. Further detail including noise and vibration impact maps are presented in the DNVIS(s). An environmental risk assessment (including noise and vibration) was also completed as part of the CEMP, for further details refer Section 8 of the CEMP.

7.2.1 Airborne Noise

Outcomes of the DNVIS assessment(s) show the following:

- The airborne noise impacts from Project construction sites vary across the study area depending on the proximity of the nearest receivers. Where receivers are close to construction sites, 'high' worst-case impacts are likely at times during noisy works.
- The highest impacts are predicted at the Westmead station and Clyde Dive construction sites, which is due to sensitive receivers being adjacent to the boundaries of these sites. Receivers in the other study areas are generally further away or less sensitive to construction noise resulting in lower impacts.
- The highest impacts are seen in scenarios where the use of highly noise intensive equipment such as rockbreakers and concrete saws are required. For most scenarios, these works would, however, only be required for a relatively short period of the total construction duration and will be limited to less sensitive periods (i.e. approved hours). Noise levels and impacts where works do not require noise intensive equipment are considerably lower.
- Highly noise intensive works (i.e. concrete sawing, rock hammering and vibratory rolling) will only be undertaken during approved hours to minimise impacts to receivers in more sensitive periods.
- Individual receivers would be subject to a range of worst-case impacts, depending on how far from the works they are. The highest impacts are seen when works are 'near' to receivers and are generally much lower when works are 'far', due to the increased separation distance.
- Construction works during site establishment works, piling, surface construction and excavation are required to move around the various construction sites and a large variation in worst-case noise levels of around 10 dB to 20 dB is predicted during these activities. The impacts when works are 'near' to a particular receiver are likely to be 'moderate' or 'high' for the nearest receivers in most study areas, but when works are 'far' the impacts are substantially lower with many catchments predicted to be compliant with the management levels or result in only 'minor' worst-case impacts.
- During the daytime, the nearest receivers are predicted to be impacted in most study areas to some degree. Noise levels are, however, expected to be compliant during many of the less noisy works. The worst-case daytime impacts are typically associated with highly noise intensive equipment such as rockbreakers and concrete saws occurring in close proximity to receivers.
- The Rosehill Gardens Racecourse stables are a key sensitive receiver, particularly for the Clyde dive site which requires excavation and construction of the Decline Structure in close proximity to this receiver.

7.2.2 Ground-borne Noise

The TBM ground-borne noise assessment shows that:

- The worst-case ground-borne noise impacts from TBM tunnelling during the daytime are predicted to generally be compliant with the NML or result in only 'low' impacts.

- During the night-time, the worst-case impacts are more wide-spread due to a lower and more stringent NML. The worst-case impacts are predicted to be 'moderate' in the Westmead and Clyde Junction study areas.
- The majority of the impacted receivers are residential properties. Several 'other sensitive' receivers are also predicted to impacted to various degrees along the alignment.
- The ground-borne noise predictions are based on the nearest sensitive receivers and most exposed floor (i.e. ground floor for commercial and assumed lowest habitable floor for residential). The ground-borne noise impacts would reduce for sensitive receivers which are further away from the alignment or for receivers higher up in buildings.
- The TBMs are expected to progress at a rate of between 20 to 50 metres per day. This means the worst-case ground-borne noise impacts from tunnelling at a receiver would likely only be apparent for a few days for each TBM as the tunnelling works pass beneath.

7.2.3 Vibration

The Construction vibration assessment shows that:

- Vibration intensive items of equipment that would be required during the Project include vibratory rollers, hydraulic hammers and bored piling rigs. These items of equipment are required during work scenarios such as; Establishing concrete slabs or piling platforms, Station box excavation, and Station box bored piling.
- Exceedances of the cosmetic damage screening criteria are predicted at Parramatta and Clyde MSF due to vibration sensitive structures being adjacent to the boundary of these work areas. The majority of these are heritage listed structures and are presented in Table 22. The non-heritage building located at 240 Church St, Parramatta.
- Exceedances of the human comfort criteria are predicted at Westmead, Parramatta and Clyde Dive Site as sensitive receivers are relatively close to the boundary of these construction sites. This includes the Rosehill Gardens Racecourse Stables adjacent to the Clyde Dive Site.
- Exceedances of the sensitive equipment screening criteria are predicted in Parramatta where receivers have been identified as potentially having vibration sensitive equipment with a VC-A criterion. Exceedances of the sensitive equipment screening criteria are predicted at:
  - SunDoctors Skin Cancer Clinic, 239 Church St, Parramatta
  - Orthodontics Sydney Wide, 35 Smith St, Parramatta
- Where impacts are perceptible, they would likely only be apparent for relatively short durations when vibration intensive equipment is operating nearby.
- Vibration intensive works will only be undertaken during approved hours to minimise impacts to receivers in more sensitive periods.
- Sydney trains and Parramatta light rail infrastructure has been assessed against the Industrial and heavy commercial buildings criteria for cosmetic damage. No exceedances are predicted, and impacts to Sydney trains and Parramatta light rail are not anticipated.
- No vibration generating activities are proposed at the Sydney Olympic Park site, therefore no construction vibration impacts are anticipated at this site.

The TBM vibration assessment shows that:

- No receivers are predicted to exceed the cosmetic damage or sensitive equipment screening criteria during tunnelling work.
- Potential exceedances of the human comfort criteria are likely in the Westmead and Clyde/Rosehill study areas, meaning perceptible levels of vibration may occur when tunnelling works are below these areas.

7.2.4 Heritage Impacts

The potential for impacts on non-Aboriginal heritage and Aboriginal Cultural heritage has been assessed as part of the Project EIS and the DNVIS(s). The Non-Aboriginal heritage impacts were assessed in Chapter 12 and Technical Paper 3. Aboriginal Cultural heritage impacts were assessed in Chapter 13 and Technical Paper 4 of the Project EIS, and revised for the Submissions Report.

The WTP construction activities that have the potential to impact on Aboriginal and Non-Aboriginal heritage are:

- Enabling work including demolition of existing structures, vegetation clearing, site levelling and grading, establishment of site access/internal haul routes, and
- Excavation work at Westmead, Parramatta, Clyde and Rosehill construction sites.

As Aboriginal Cultural Heritage items are generally archaeological in nature it is unlikely that any noise and vibration impacts would affect these types of items.

The Non-Aboriginal Heritage Assessment (Technical Paper 3 of the EIS) prepared by Artefact (2020), also defined the construction sites as the study area and applied a 50m buffer around each of the construction sites.

The DNVIS(s) identified that the WTP vibration instensive works have the potential to impact on listed heritage items as described in Table 22. A full description of the heritage items and assessment of significance can be found in in the EIS (Technical Paper 3), further detail on the construction vibration assessment can be found in the DNVIS(s).

Table 22: Potentially affected heritage items in the study area

Heritage Item	Construction Site	Significance	Potential Impact
41-59 George Street, Parramatta	Parramatta	Parramatta LEP 2011 (I703)	Potential direct impact – vibration
Convict Drain	Parramatta	Parramatta LEP 2011 (I647)	Potential direct impact – vibration
Roxy Theatre	Parramatta	State Heritage Register (00711), Parramatta LEP 2011 (I00711)	Potential direct impact – vibration
Horse Parapet Façade	Parramatta	Parramatta LEP 2011 (I656)	Potential direct impact – vibration
Kia Ora	Parramatta	Parramatta LEP 2011 (I716)	Potential direct impact – vibration
Former RTA Depot	Clyde / Rosehill	Parramatta LEP 2011 (I576)	Potential direct impact – vibration

7.3 Environmental Control Maps

The project Environmental Control Maps (ECMs) have been prepared to assist in the planning and delivery of the project. They are specific to a site or work area and outline the location of protection measures, monitoring requirements, environmental obligations and environmentally sensitive areas. It is the practical application of the proposed control measures and an important tool to communicate these to all personnel including subcontractors. With relation to noise and vibration the ECMs will include the following:

- worksite layout and boundary, including entry/exit points and internal roads
- adjoining land use and nearest noise and/or vibration sensitive receivers (including heritage properties)
- control measures e.g. construction hoarding, acoustics sheds, hours of work, respite requirements.

It is noted that the Sydney Metro West ECMs are 'live' documents and will be updated to reflect the relevant works stage as works progress and will be used in project inductions, work site set-up, reviewing ongoing environmental performance. Further details on the ECMs is porvided in the CEMP.

7.4 Further Impact Assessment

Further assessment of potential noise and vibration impacts for specific tasks will be undertaken through the planning for out of hours works and the preparation of an Out-of-Hours Works Approval application.

8 ENVIRONMENTAL MANAGEMENT

8.1 Detailed Noise and Vibration Impact Statement (DNVIS)

In accordance with CoA D44, Detailed Noise and Vibration Impact Statement(s) (DNVIS(s)) will be prepared for any work that may exceed the NMLs, vibration criteria and/or ground-borne noise goals at any residence outside construction hours, or where receivers will be highly noise affected. The DNVIS(s) will also be used to support any variation to the EPL as required.

The DNVIS(s) must be prepared for each construction site before construction noise and vibration impacts commence and include specific mitigation measures identified through consultation with affected sensitive land users.

The DNVIS(s) will be prepared by an appropriately qualified and experienced acoustic consultant prior to exceeding:

- the noise management levels at any residence outside the approved construction hours,
- vibration criteria at any residence outside the approved construction hours, and/or
- ground-borne noise levels at any residence outside the approved construction hours; or
- where receivers will be highly noise affected (at any time).
- in accordance with REMM NV11, an activity specific DNVIS (in accordance with the requirements of the CNVS) would be developed for rockbreaking in the tunnel and at cross passages, specifically to the activity where it is required between 10pm-7am.

The DNVIS report/s will assess potential noise and vibration impacts by modelling the construction scenarios pertaining to that site/activity, considering plant and equipment and their source noise emission (Sound Power Levels, Lw or SWL). For the site/activity it will outline:

- Scope of work covered by the DNVIS, including work areas, site compounds and access points
- Sensitive receivers, based on land use survey
- The effects of noise shielding provided by site offices, residential fences, noise barriers or natural topographic features
- The effects of noise attenuation or ground attenuation where applicable
- Noise and vibration assessment outlining predicted levels for construction scenarios at sensitive receiver groups, illustrated by noise contour maps where appropriate
- Predicted exceedances against the noise and vibration goals
- Mitigation options and preferred management measures, including those measures identified through consultation with affected sensitive land users
- Safe working distances for vibration intensive activities and further investigation, monitoring and mitigation to be applied where these cannot be met
- Activity specific monitoring requirements.

All noise predictions will include a 5dB penalty for ‘particularly annoying' activities such as rock breaking as outlined in the ICNG.

The DNVIS(s) will be developed to address the (Project) assessment requirements documented in the ICNG, CNVS, CoA and any relevant EPL conditions. The DNVIS(s) will be updated as required for each location or activity to adopt the lowest impact alternative in any given location unless it can be demonstrated, to the satisfaction of the AA, why it should not be adopted.

A copy of the DNVIS(s) must be provided to the AA and the ER for review and endorsement (refer, CoA A36) before the commencement of the associated works. The Planning Secretary and the EPA may request a copy (or copies) of the DNVIS(s).

The DNVIS(s) will be a key site management tool to provide clear instructions for managing noise and vibration by providing activity specific noise and vibration predictions and specific mitigation measures identified through consultation with affected sensitive land user(s) to be implemented for the duration of the works. The DNVIS will also provide data for the OOHW Permit which will demonstrate compliance regarding the assessment of OOHW activities. Further detail is provided in the OOHW Protocol (Attachment 4).

Monitored noise and vibration levels will be analysed against the predictions made in the relevant DNVIS(s) or using the Project’s predictive tools, incorporating standard project mitigation measures as described in Section 8.2. This will allow comparison of actual and predicted noise levels (incorporating relevant mitigation measures) and will allow for ongoing review, verification and, where required, amendment of the predictive model.

Monitoring will be compared against the predictive modelling rather than the EIS to ensure relevant reasonable and feasible mitigation measures are included consistently within the model and on the ground.

8.2 Mitigation Measures

A range of environmental requirements and control measures are outlined in the Approval documents and Sydney Metro documents specifically the CEMF, CNVS, CoAs, REMMs and Gamuda Australia EMS. Mitigations measures that apply to this Project are outlined in Table 23. GALC will ensure these mitigation measures will be implemented through:

- All employees, contractors and subcontractors receiving a Project induction which details specific noise and vibration measures
- Toolbox talks communicating mitigation requirements
- Review of measures implemented during site inspections as relevant.

Specific and standard mitigation measures will be implemented to address the contract specifications, CoA and REMMs in relation to impacts from noise and vibration. Wherever possible throughout construction, GALC will take an innovative approach with standard mitigations to avoid needing to implement additional mitigation measures.

Prioritising measures implemented at the noise source and reducing noise transmission is more effective at reducing noise impacts and potential annoyance for receivers. GALC will take an innovative approach to prioritising these measures to avoid the need for implementation of additional mitigation measures outlined in this section.

Mitigation measures have been developed considering the SMART principles, being specific with measurable outcomes. They are all achievable (notwithstanding assessment of reasonableness and feasibility) and realistic. Each measure is also time-based, applicable before or during construction as indicated.

Table 23 Noise and vibration mitigation measures

ID	Action Required	Details	Timing	Responsibility	Source of Requirement
	Management				
CNV 1	Implement community consultation measures	In accordance with CoA D38, an out-of-hours works (OOHW) Protocol will be prepared in consultation with the EPA and this will include a process for selecting and implementing mitigation measures for residual impacts by engaging with the community at each affected location.	Construction	Community Consultation Officer	CoA D38
CNV 2		In accordance with CoA D50, to undertake OOHW outside the work hours specified under Condition D35, appropriate respite periods for the out-of-hours work will be identified in consultation with the community at each affected location on a regular basis.			CoA D50
CNV 3		In accordance with CoA D45, owners of properties at risk of exceeding the screening criteria for cosmetic damage will be notified before construction that generates vibration commences in the vicinity of their properties.			CoA D45
CNV 4		Engagement and consultation will be carried out with the affected communities to understand their preferences for mitigation and management measures (e.g. Rosehill Gardens Racecourse). SMW will lead discussions with Rosehill Racecourse and liaise with contractor. Consultation with Rosehill Racecourse will ensure that potential impacts to horses are appropriately managed.			CoA D38, D41, D51, REMM NV01, NV15
CNV 5		Undertake consultation with the Rosehill Gardens Racecourse and an equine veterinary expert to inform noise and vibration objectives for this sensitive receiver prior to construction. SMW will lead discussions with Rosehill Racecourse and liaise with contractor.			Clyde MSF Mod NV20

ID	Action Required	Details	Timing	Responsibility	Source of Requirement
CNV 6		Provide appropriate notice to the affected sensitive receivers prior to starting works and before any noisy periods of works. Minimum notification period is 7-day.			CoA D38, D51
CNV 7		Provide signage with a 24-hour contact number.			CoA A48
CNV 8		Where there are complaints regarding noise, review and implement additional control measures, where feasible and reasonable.			CoA B4, D42, Best Practice
CNV 9		A construction representative will be appointed as a "Noise Champion" for each site to proactively manage upcoming works to ensure EPL requirements are met, and noise and vibration impacts are minimised as far as practicable.			Best Practice
CNV 10	Site Inductions & Behavioural Practices	A site-specific induction will be provided to all site personnel, contractors, and sub-contractors with an emphasis on understanding and managing noise impacts from the work activities being undertaken. This will include the location of receivers, specific mitigation measures, site hours of operation, noise complaints procedure, etc. as well as the consequences of not complying with these mitigation measures.	Construction	Environmental Manager	CoA D42, Best Practice
CNV 11		GALC will also educate workers on practices to reduce potential annoyance to adjacent residents and businesses, including enforcing the following behavioural practices on and around site: • No swearing or unnecessary shouting or loud stereos/radios on site. • No dropping of materials from height, throwing of metal items, and slamming of doors.			CoA D42, Best Practice

ID	Action Required	Details	Timing	Responsibility	Source of Requirement
CNV 12	Building Surveys	Condition surveys of buildings and structures near to the tunnel and excavations will be undertaken prior to the commencement of excavation at each site, where appropriate. For heritage buildings and structures the surveys would consider the heritage values of the structure in consultation with a heritage specialist.	Prior to Construction	Environmental Manager	CoA D60, REMM NV16, NV17
CNV 13	Noise and vibration monitoring	Noise monitoring will be undertaken within the first month of work and periodically throughout the construction period and cover the range of activities being undertaken at the site during day, evening and night-time periods	Construction	Environmental Manager	CoA C16
CNV 14		Conduct noise and/or vibration monitoring in response to any formal complaints received.			CoA B4, D42, Best Practice
CNV 15		Noise monitoring should be undertaken at the Rosehill Gardens Racecourse Stables during all work scenarios where NMLs are predicted to be exceeded.			CoA D42, Best Practice
CNV 16		Conduct vibration monitoring if vibration intensive works are to be undertaken within the minimum working distances of sensitive receivers or structures. This monitoring will determine the frequency of the vibration and the corresponding upper limit “component” PPV for nearby structures to revise the safe working distance accordingly. This will ensure the works do not exceed the recommended working distances.			CoA D42, D46 Best Practice
CNV 17		Operator attended noise monitoring and vibration monitoring will be undertaken during the early phases of work to verify predicted noise levels and confirm that vibration levels satisfy the criteria. This will determine the			CoA D42, Best Practice

ID	Action Required	Details	Timing	Responsibility	Source of Requirement
		appropriate mitigation and management measures required for remaining works.			
CNV 18		As required by CoA C14 a Construction Noise and Vibration Monitoring Program will be prepared in consultation with the EPA, Relevant Council(s) and SOPA (in respect of Sydney Olympic Park). This will incorporate the details specified in CoA C16 including the provision of real time noise and vibration monitoring data, which will be made available to the construction team, Sydney Metro, and ER, DPE and EPA.			CoA C14
CNV 19		An activity specific Construction Noise and Vibration Impact Statement (in accordance with the requirements of the Construction Noise and Vibration Standard) would be developed for rockbreaking in the tunnel and at cross passages, specifically addressing the activity where it is required between 10pm-7am.			REMM NV11
	Source control				
CNV 20	Construction Hours and Scheduling	Where feasible and reasonable, construction will be carried out during the approved Project working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods. e.g., Conducting noise-intensive works only during periods when the schools are less sensitive to noise (e.g., before and after school hours); Ensuring that noise-generating construction works are not scheduled during examination or other sensitive time periods, unless other acceptable arrangements can be made, such as the school relocating pupils to classrooms unaffected by the noise.	Construction	Environmental Manager	CoA D35, D41

ID	Action Required	Details	Timing	Responsibility	Source of Requirement
CNV 21		Highly noise intensive works (i.e. concrete sawing, rock hammering and vibratory rolling) will only be undertaken during the following approved hours, unless otherwise assessed and justified: ● between the hours of 8:00 am to 6:00 pm Monday to Friday; ● between the hours of 8:00 am to 1:00 pm Saturday; and ● if continuously, then not exceeding three (3) hours, with a minimum cessation of work of not less than one (1) hour. For the purposes of this condition, 'continuously' includes any period during which there is less than one (1) hour between ceasing and recommencing any of the work.			CoA D36 REMM NV04
CNV 22		Provide appropriate respite periods as per the Sydney Metro CNVS when highly noise intensive works are undertaken or during periods of high noise impacts (e.g. one hour of respite for every three hours of noise intensive work).			CoA D36 REMM NV02, NV03
CNV 23		During night-time works at the Clyde MSF, high noise generating activities should be avoided in the vicinity of the Rosehill Gardens Racecourse Stables (eg <100 m). Work adjacent to the stables should be scheduled for less sensitive periods.			CoA D42, Best Practice
CNV 24		Carry out community consultation to determine the need and frequency of respite periods, as required by the CoA. This will include consultation with the Rosehill Gardens Racecourse.	Construction	Community Consultation Officer,	CoA D38, D41, D51 REMM NV01, NV15

ID	Action Required	Details	Timing	Responsibility	Source of Requirement
CNV 25		Co-ordination will occur between potentially interacting projects to minimise concurrent or consecutive works in the same areas, where possible.		Environmental Manager	CoA D50, REMM NV18
CNV 26	Noise source mitigation	Noise levels of plant and equipment must have operating Sound Power Levels (L_W) compliant with the Sydney Metro CNVS.	Construction	Environmental Manager	CoA D42, Best Practice
CNV 27		Alternative construction methodologies and measures that minimise noise and vibration levels during noise intensive works would be investigated and implemented where feasible and reasonable. For example: use the minimum sized equipment necessary to complete the work and where possible, use alternative, low-impact construction techniques (e.g. excavator grab instead of hydraulic hammer, bored piling instead of impact piling etc) This would also include consideration of: • Sequencing works to shield noise sensitive receivers by retaining building wall elements • Locating demolition load out areas away from the nearby noise sensitive receivers • Providing respite periods for noise intensive works • Minimising structural-borne noise to adjacent buildings including separating the structural connection prior to demolition through saw-cutting and propping, using hand held splitters and pulverisers or hand demolition • Installing sound barrier screening to scaffolding facing noise sensitive neighbours • Using portable noise barriers around particularly noisy equipment, such as concrete saws			CoA D42, REMM NV02, NV09 Best Practice

ID	Action Required	Details	Timing	Responsibility	Source of Requirement
		• Modifying demolition works sequencing / hours to minimise impacts during peak pedestrian times and / or adjoining neighbour outdoor activity periods.			
CNV 28		Plant and machinery will be fitted with manufacturer supplied noise suppression devices and maintained where required.			CoA D42, REMM NV02
CNV 29		Power tools should use mains power where possible rather than generators.			CoA D42, Best Practice
CNV 30		Shut down machinery, including generators, when not in operation.			CoA D42, Best Practice
CNV 31		Avoid dropping materials from a height and dampen or line metal trays, as necessary.			CoA D42, Best Practice
CNV 32		Ensure equipment is operated in the correct manner.			CoA D42, Best Practice
CNV 33		All equipment will be appropriately maintained and fitted with noise control devices, where practicable (e.g. attenuated generators).			CoA D42, Best Practice
CNV 34		Where night-time works are required, equipment/trucks will use broadband reversing alarms.			CoA D42, Best Practice
CNV 35	Heavy Vehicles	On-site spoil storage capacity would be maximised to reduce the need for truck movements during sensitive times. Vehicle movements would be redirected away from sensitive receiver areas and scheduled during less sensitive times.	Construction	Environmental Manager	CoA D42, Best Practice REMM NV14

ID	Action Required	Details	Timing	Responsibility	Source of Requirement
CNV 36		The speed of vehicles will be limited and the use of engine compression brakes would be avoided as far as practicable. Air brake silencers will be used on heavy vehicles that access the construction sites multiple times per night or over multiple nights.			CoA D42, Best Practice REMM NV14
CNV 37		Heavy vehicles will not be permitted to idle near sensitive receivers. Trucks will not idle near to sensitive receivers (e.g. residential receivers or the Rosehill Gardens Racecourse Stables).			CoA D42, Best Practice REMM NV14
CNV 38		Delivery vehicles will be fitted with straps rather than chains for unloading, wherever possible.			CoA D42, Best Practice
CNV 39	Equipment Selection	Long term construction site support equipment and machinery would be low noise emitting and suitable for use in residential areas, where feasible and reasonable. Examples include: ● Low noise water pumps for use in water treatment facilities ● Low noise generators and compressors ● Low noise air conditioner units for use of amenities buildings	Construction	Environmental Manager	REMM NV07
CNV 40	Plan worksites and activities to minimise noise and vibration.	Plan traffic flow, parking, reversing movements and loading/unloading areas to minimise noise and vibration, particularly within the sites at Westmead and Parramatta. Stationary sources of noise, such as generators, should be located away from sensitive receivers.	Construction	Environmental Manager	CoA D42, Best Practice
CNV 41		The proximity of cross passages to nearby receivers and the corresponding construction ground-borne noise and vibration impacts during the excavation works would be			REM NV10

ID	Action Required	Details	Timing	Responsibility	Source of Requirement
		considered when determining locations. Relocation of cross passages to be further away from sensitive receivers to mitigate potential construction impacts would be considered, where feasible and reasonable.			
CNV 42	Minimise disturbance arising from access or deliveries to construction sites.	Construction vehicles will be operated to minimise any construction noise impacts from the construction site. To achieve this the following will occur: ● Loading and unloading of materials/deliveries will occur as far as possible from receivers. ● Site access points and roads will be selected as far as possible away from receivers. ● Dedicated loading/unloading areas to be shielded if close to receivers. ● Delivery vehicles will be fitted with straps rather than chains for unloading, wherever reasonable and feasible. ● Any unsatisfactory noise performance for specific vehicles and/or the operators will be dealt with on a case-by-case basis. ● Drivers to ensure vehicles are compliant and maintained/serviced.	Construction	Environmental Manager	REMM NV14, NV19
CNV 43	Monitoring, tracking and managing spoil removal, haulage, and delivery	GALC will use real-time monitoring and tracking software to manage spoil removal, haulage, and delivery. This software will identify the approved haulage route and access into site for each truck driver and will update GALC immediately if an unapproved route is in use. This will reduce potential impacts to local roads via unapproved road usage, prevent trucks queuing or idling in unapproved areas or prior to approved working hours, and will significantly turnaround times due to improved scheduling of trucks.			CoA D42, Best Practice

ID	Action Required	Details	Timing	Responsibility	Source of Requirement
	Path control				
CNV 44	Shield stationary noise sources such as pumps compressors, fans etc.	Acoustic hoarding around the site perimeters will be erected to control the dispersion of noise offsite.	Construction	Environmental Manager	CoA D42, REMM NV2,6 Best Practice
CNV 45		Additional portable noise barriers will also be used around particularly noisy equipment such as concrete saws, where necessary (eg in close proximity to the Rosehill Gardens Racecourse Stables).			CoA D42, REMM NV02 Best Practice
CNV 46		Implement acoustic treatment of the Spoil shed and Segment shed during establishment of structure, to control the dispersion of noise offsite, such as the excavation sites at Westmead, Clyde Dive Site, Rosehill (refer DNVIS(s) for further details). All significant noise producing equipment that would be used during the night-time will be inside the shed, where feasible and reasonable Noise generating ventilation systems such as compressors, scrubbers, etc, will also be inside the shed and external air intake/discharge ports will be appropriately acoustically treated The door of the acoustic sheds will be kept closed during the night-time period, where feasible and reasonable. Where night-time vehicle access is required, the doors will be designed and constructed to minimise noise breakout.			CoA D42, REMM NV08
CNV 47	Shield sensitive receivers from noisy activities	Use onsite structures to shield sensitive receivers from noise such as site shed placement; hoarding; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.			CoA D42, Best Practice

ID	Action Required	Details	Timing	Responsibility	Source of Requirement
CNV 48	Determining locations of cross passages.	The proximity of cross passages to nearby receivers and the corresponding construction ground-borne noise and vibration impacts during the excavation works will be considered when determining locations. Relocation of cross passages to be further away from sensitive receivers to mitigate potential construction impacts will be considered, where feasible and reasonable.	Construction	Environmental Manager	NV10

8.3 Vibration

8.3.1 Human Comfort

Minimum working distances for typical vibration intensive equipment for human comfort are detailed in Section 6.3.4. Monitoring will be undertaken as described in the NVMoP (Attachment 5) and assessed against the vibration guidelines and criteria presented in Section 6.3.

The properties at risk of exceeding the human comfort screening criteria were identified in the DNVIS(s) and summarised in Section 7.2.

8.3.2 Building Damage

Minimum working distances for typical vibration intensive equipment for buildings and structures is detailed in Section 6.3.4. Monitoring will be undertaken as described in the NVMoP (Attachment 5) and assessed against the vibration guidelines and criteria presented in Section 6.3.

CoA D60 requires a suitably qualified and experienced person to undertake condition surveys of all buildings, structures, utilities and the like identified as being at risk of damage before commencement of any work that could impact on the subject surface / subsurface structure. The results of the surveys must be documented in a Pre-Construction Condition Survey Report for each item surveyed. Copies of Pre-construction Condition Survey Reports must be provided to the relevant owners of the items surveyed in the vicinity of the proposed work, and no later than one (1) month before the commencement of the work that could impact on the subject surface / subsurface structure.

CoA D45 requires owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before the works that generate vibration commences in the vicinity of the 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.

The properties at risk of exceeding the building damage screening criteria were identified in the DNVIS(s) and summarised in Section 7.2.

8.3.3 Heritage Items

Heritage items are considered on a case-by-case basis. It should be noted that 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’ when compared to other structures.

In accordance with CoA D14 before installing protective site boundary hoarding or equipment used for vibration and noise monitoring at any Heritage item 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.

The installation must also consider and avoid impacts to potential historical archaeology and seek advice from the Excavation Director. Similarly, in accordance with CoA D48 before installing at property treatment at a Heritage item, the advice of a suitably qualified and experienced built heritage expert would be obtained and implemented to ensure the installation does not have adverse impacts of the heritage significance of the item.

In accordance with CoA D49 a conservative vibration damage screening level of 2.5 mm/s has been adopted for heritage structures and other sensitive structures of great intrinsic value. Where this screening criteria may be potentially exceeded, this structure will be assessed to confirm whether it is structurally sound, in which case the standard 7.5mm/s criteria will apply (as discussed in Section 6.3. This strategy has been adopted to minimise unnecessary structural assessments where the 2.5mm/s criteria is predicted to be complied with.

In line with Condition D46 vibration testing will be undertaken during activities that have the potential to impact heritage items, above the appointed criteria, to identify minimum working distances to prevent cosmetic damage. Vibration monitoring would be undertaken at heritage assets at the request of the asset owners where feasible and reasonable. In the event that the vibration testing and attended monitoring shows that the preferred values for vibration are likely to be exceeded, the construction methodology will be reviewed and, if necessary, implement additional mitigation measures.

Additionally, per CoA D47 advice from a heritage specialist (being the contractors heritage consultant) will be obtained on methods and locations for installing equipment used for vibration, movement and noise monitoring at heritage-listed structures, prior to monitoring commencing. Relevant asset management groups would also be consulted on the placement of vibration monitoring devices within the curtilage of Heritage items.

8.3.4 Vibration Related Settlement

CoA D63 requires vibration monitoring at buildings close to construction sites and the tunnel route during construction. Where monitoring indicates vibration levels exceeding the criteria in Section 6.3, construction affecting settlement must cease and not resume until rectified or revised methods selected.

Vibration criteria in Section 6.3 are adopted from BS7385-2 (1993) for residential and commercial buildings and DIN 4150-3 (2016) for buildings of heritage value, which may be more sensitive to vibration. However, no specific vibration criteria are recommended within these standards to minimise the risk of settlement.

Annexure C of BS7385-2 (1993) and Annex C of DIN 4150-3 (2016) discuss the potential for settlement due to construction vibration sources. Where soils are non-cohesive, i.e. the grains remain separate from each other and do not form clods, such as uniformly graded sands, silts and gravels, vibration can cause densification or consolidation of the soil. This may lead to differential settlement and higher potential for building damage. BS7385-2 (1993) and research by Massarsch & Fellenius (2014) note a low risk of settlement when peak particle velocity exceeds 10mm/s in loose sand.

The Soil and Water Management Plan notes the station boxes are generally located on Blacktown soil landscape which is classified as a type D, dispersible soil by the Managing Urban Stormwater: Soils and construction - Volume 1 “Blue Book”. These types of soils are not characterised as cohesionless. Since the cosmetic damage vibration criteria for the project are below this level, at 7.5mm/s, these triggers would be met and works stopped or otherwise corrected before reaching a 10mm/s criteria relevant to settlement.

In line with CoA D63, vibration monitoring will be undertaken at the nearest buildings to the construction sites during times of vibration intensive works. Where exceedances of the criteria are recorded, corrective actions in line with CoA D63 would be implemented where soils at risk of vibration-induced settlement are identified.

8.4 Additional Mitigation Measures

The implementation of the standard mitigation measures (Section 8.2 above) with a focus on source and transmission control, as well as community consultation should significantly reduce the noise and vibration impacts on nearby sensitive receivers. Nevertheless, due to the highly variable nature of activities associated with the Project, noise and vibration exceedances will occur under certain circumstances.

A number of additional measures to mitigate such exceedances (primarily aimed at proactive engagement with affected sensitive receivers) as per the requirements of Section 5 of the CNVS have been included in the CNVMP and presented in Table 24 below.

Table 24: Additional Mitigation Measures

Measure	Description	Abbreviation
Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.	AA
Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.	M
Individual briefings	Individual briefings (including doorknocks) are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.	IB
Letter box drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.	LB

Measure	Description	Abbreviation
Project specific respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.	RO
Phone calls and emails	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.	PC
Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.	SN

In circumstances where, after the application of the standard mitigation measures, the construction noise and vibration levels are still predicted to exceed the noise or vibration objectives, the relevant Additional Mitigation Measures (AMM) from the CNVS are to be used to determine the additional measures to be implemented.

Using the relevant AMM, the following steps will be carried out to determine the additional mitigation measures that will be implemented prior to the commencement of construction activities: determine the time period when the work is to be undertaken; determine the level of exceedance; and Identify the relevant additional mitigation measures. The relevant AMM for airborne noise, ground-borne noise and vibration are reproduced in Table 25,

Table 26 and Table 27.

Table 25: Additional Mitigation Measures (AMM) – (Airborne Noise)

Time Period		Mitigation Measures Predicted LAeq(15 minute) noise level above NML			
		0 to 10 dB	10 to 20 dB	20 to 30 dB	>30 dB
Standard	Mon-Fri (7.00 am - 6.00 pm)	-	LB	LB, M, SN	LB, M, SN
	Sat (8.00 am - 6.00 pm)				
	Sun/Pub Hol (No Work)				
OOHW (Evening)	Mon-Fri (6.00 pm - 10.00 pm)	LB	LB, M	LB, M, SN, RO	LB, M, SN, IB, PC, RO
	Sat (6.00 pm - 10.00 pm)				
	Sun/Pub Hol (8.00 am - 6.00 pm)				
OOHW (Night)	Mon-Fri (10.00 pm - 7.00 am)	LB	LB, M, SN, RO	LB, M, SN, IB, PC, RO, AA	LB, M, SN, IB, PC, RO, AA
	Sat (10.00 pm - 8.00 am)				
	Sun/Pub Hol (6.00 pm - 7.00 am)				

Table 26: Additional Mitigation Measures (AMM) – (Ground-borne Noise)

Time Period		Mitigation Measures Predicted LAeq(15 minute) noise level above NML		
		0 to 10 dB	10 to 20 dB	>20 dB
Standard	Mon-Fri (7.00 am - 6.00 pm)	LB	LB	LB, M
	Sat (8.00 am - 6.00 pm)			
	Sun/Pub Hol (No Work)			
OOHW (Evening)	Mon-Fri (6.00 pm - 10.00 pm)	LB	LB, M, SN	LB, M, SN, IB, PC, RO
	Sat (6.00 pm - 10.00 pm)			
	Sun/Pub Hol (8.00 am - 6.00 pm)			
OOHW (Night)	Mon-Fri (10.00 pm - 7.00 am)	LB, M, SN	LB, M, SN, IB, PC, RO, AA	LB, M, SN, IB, PC, RO, AA
	Sat (10.00 pm - 8.00 am)			
	Sun/Pub Hol (6.00 pm - 7.00 am)			

Table 27: Additional Mitigation Measures Matrix (AMMM) – (Ground-borne Vibration)

Time Period		Mitigation Measures Predicted Vibration Levels Exceed Maximum Levels
Standard	Mon-Fri (7.00 am - 6.00 pm)	LB, M, RO
	Sat (8.00 am - 6.00 pm)	
	Sun/Pub Hol (No Work)	
OOHW (Evening)	Mon-Fri (6.00 pm - 10.00 pm)	LB, M, IB, PC, RO, SN
	Sat (6.00 pm - 10.00 pm)	
	Sun/Pub Hol (8.00 am - 6.00 pm)	
OOHW (Night)	Mon-Fri (10.00 pm - 7.00 am)	LB, M, IB, PC, RO, SN, AA
	Sat (10.00 pm - 8.00 am)	
	Sun/Pub Hol (6.00 pm - 7.00 am)	

8.5 Communications and Community Consultation

GALC will facilitate active community consultation and engagement to maintain positive and cooperative relationships with schools, local residents, building owners and occupiers and other members of the community to assist in alleviating concerns and minimising disturbance. Relationships will also facilitate collaboration with regard to OOHW programming and provision of respite as required.

The Project Community Communication Strategy (CCS) details the approach to stakeholder and community engagement in accordance with the Sydney Metro Overarching Community Consultation Strategy. Specific to noise and vibration management, consultation will include periodic notification of work activities and progress and specific notification to potentially impacted community prior to especially noisy activities.

Throughout construction, GALC will continue to work with the Project communications team to consult with relevant councils and community stakeholders, including any unique local noise sensitive receivers such as schools, medical facilities and places of worship. Notification providing progress on construction and updates on any out of hours works will be provided to the local community in accordance with the Community Communications Plan/s prepared in accordance with the CCS.

Further engagement and consultation led by the GALC Community Team will be carried out with:

- affected communities to understand their preferences for mitigation and management measures
- 'Other sensitive' receivers such as schools, medical facilities or places of worship to understand periods in which they are more sensitive to impacts.

Based on this consultation, appropriate mitigation and management options would be considered and implemented where feasible and reasonable to minimise the impacts.

In accordance with Condition of Approval D41, noise generating work in the vicinity of potentially affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs will be timetabled so as to avoid sensitive periods, unless other reasonable arrangements have been made with the affected institutions.

Owners and occupiers of properties identified in the DNVIS(s) as 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, owners 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.

For out-of-hours work, appropriate respite periods would be identified in consultation with the community at each affected location on a regular basis. Consultation would include (but not be limited to) providing the community with:

a) a progressive schedule for periods no less than three (3) 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 NMLs under

Condition D39 (including the circumstances of when respite or relocation offers will be available and details about how the affected community can access these offers).

The EPA, the AA and the Planning Secretary will be provided with the outcomes of the community engagement and any measures developed as a result (including periods of respite).

8.6 Cumulative Impacts

GALC will undertake efforts in co-ordination and consultation to the extent reasonable and feasible, with the relevant stakeholders. This would occur where required to manage the interface of projects under construction at the same time, that are being undertaken within the same affected area. This may include:

- Other parts of Transport for NSW (e.g. Parramatta Light Rail and Sydney Trains)
- Sydney Metro projects
- Other SSI and CSSI projects as determined by DPE.

This process will be managed in cooperation with the Construction Manager (Project Wide), Utilities Manager, Interface Manager and Environment Manager. The process of consultation would include:

- Provision of regular updates to the detailed construction program, construction sites and haul routes
- Identification of key potential conflict points with other construction projects or maintenance activities
- Identification of opportunities to modify program or scope to minimise conflict points
- Opportunities to retain or maximise respite for potentially affected receivers.

The purpose of this coordination will be to ensure appropriate respite is maintained; however, it must be acknowledged that GALC does not have authority over third parties not associated with the Project. Records of consultation will be kept as meeting minutes.

8.7 Complaints Management

Complaints are to be managed in accordance with:

- Sydney Metro's Overarching Community Communications Strategy and Construction Complaint Management System
- Contractors Community Communications Strategy and sub-plans.

Suitably qualified or experienced GALC personnel will be available to investigate, manage and respond to complaints in accordance with these documents.

8.8 Blast Management

A Blast Management Strategy in accordance with CoA D54 is not required as blasting will not be undertaken on the Project

8.9 Plant and Equipment Noise Audit

All significant noise generating items of plant, that are suspected (by the site staff, ER, AA or Environmental Manager) of having an exceedance of the maximum allowable plant sound power levels listed in Table 13 of the CNVS, will have noise audits conducted in accordance with Section 4.4 of the CNVS. Further detail on noise audits is provided in the NVMoP, refer Attachment 5.

8.10 Record Keeping

The following records will be retained electronically on the project's document management system:

- Records of attended and unattended noise and vibration monitoring results against noise and vibration goals
- Records of community enquiries and complaints, investigation into the issue raised and the response provided
- Records of inspections in relation to noise and vibration management.

Records will be controlled in accordance with the requirements detailed in the CEMP. Records will be available to the AA on request. Further details regarding document review and control are outlined in Section 13 of the CEMP.

9 COMPLIANCE MANAGEMENT

9.1 Hold Points

The activities outlined in Table 28. below are not to proceed without objective review and approval by the nominated authority. These hold points will be reflected in the working plans for the project (including the work instructions and construction methodologies). Hold points are presented in Table 28.

Table 28: Hold Points

Hold Point	Release Of Hold Point	By Whom	Reference In This Sub-Plan
Out of hours work	Approval of Out of Hours Work Permit for works not covered by an EPL	Either GALC Environment Manager, ER or DPE	Section 6.4, OOHW Protocol
Potential noise and vibration impact	Land Use Survey	GALC Environment Manager	Section 5.2
Noise and vibration Monitoring	Noise and Vibration Monitoring Program	Endorsed by ER, AA and approved by DPE	NVMoP – Attachment 5
Identified as construction affected buildings	Building Condition survey	Specialist sub-contractor	Section 8

9.2 Roles and Responsibilities

All personnel have a role in ensuring the strategies and procedures set out in this plan are implemented. The key roles and their responsibilities critical to the management of construction noise and vibration are outlined in Table 29.

Table 29: Roles, responsibilities, and authorities.

Role	Responsibilities for Construction Noise and Vibration Management
GALC	
Project Director	• Ensure adequate resources to fulfil environment and sustainability commitments. • Ensure environment and sustainability performance and knowledge is communicated to steering committee and client representatives. • Managing the delivery of the Project including overseeing implementation of noise and vibration management processes, initiatives and procedures.
Environment and Sustainability Manager	• Facilitate adequate resources to fulfil environment and sustainability commitments. • Obtain the EPL and oversee compliance with the EPL and Planning Approval requirements • Provide the AA access to noise and vibration monitoring activities and follow the requirement as of CoA A34(b)-(d) as they take place
Environmental Manager	• Oversee the overall implementation of this CNVMP. • Consider recommendations made by the AA in accordance with the CoA
Noise and Vibration Monitoring Personnel (GALC/ consultants)	• Undertake relevant training to implement the requirements of this CNVMP. • Undertake all monitoring activities in accordance with this CNVMP. • Ensure regular maintenance of monitoring equipment.
Sustainability Manager	• Oversee development of sustainability initiatives and ensure they are implemented throughout design and construction of the Project. • Accountable for ensuring the project obtains its target IS rating • Oversee the alignment of this plan and its implementation with the sustainability goals for the project. • Provides guidance on ensuring documentation and records align with the requirements for evidence to be developed to support the IS rating submission for the Project.
Other roles	
Acoustics Advisor (AA) (Or nominated person)	The AA's role and responsibilities are detailed in CoA A32 to A36. Generally, the AA will: • Receive and respond to communication from the Secretary in relation to the performance of the Critical State Significant Infrastructure (CSSI) in relation to noise and vibration • Review elements of works that may cause impact or nuisance and the approach to mitigation • Review all documentation as it relates to this plan • Regularly monitor the implementation of this plan • Recommend improvements that can be made to minimise or avoid adverse noise impacts • Review incidents as they relate to noise and vibration management
Environmental Representative (ER)	• Review and endorse this plan. • Conduct regular inspections to review and monitor implementation of this plan. • Provide advice in relation to compliance with the Planning Approval
Sydney Metro	• Review and endorse this plan.
Stakeholder and Community Engagement Manager	• Manages key stakeholder relationships, including in relation to any noise and vibration impacts throughout construction • Provision of strategic advice to the leadership team • Identify and mitigate reputational risks, including any relating to construction impacts • Accountable for crisis and incident communications

9.3 Training

All personnel working on the project will undergo a site-specific induction which will include noise and vibration management training developed with an emphasis on understanding and managing impacts from the work activities being undertaken.

This site-specific induction training will include:

- the location of potentially sensitive receivers
- site hours of operation i.e. the permissible hours of work, including deliveries;
- any limitations on high noise generating activities
- construction employee parking areas
- details of the complaints handling procedure
- details of the environmental incident procedures
- consequences of not complying with these measures.

Toolbox meetings will also be undertaken as and when required, covering specific environmental issues and will include noise and vibration control measures where required, including but not limited to:

- locating noisy equipment away from sensitive receivers
- ensuring plant and equipment is well maintained and not making excessive noise
- emphasise that there should be no swearing, shouting or loud stereos/radios on site
- turning off machinery when not in use; and designated loading/unloading areas and procedures
- avoid extended periods of engine idling outside the project site.

Toolbox training on noise and vibration management requirements and measures will be completed by the Environmental Manager (or nominated delegate) during the Project. Records of all training will be filed in accordance with the GALC project filing system.

9.4 Monitoring, Inspections and Reporting

9.4.1 Monitoring

A Construction Noise and Vibration Monitoring Program (NVMoP) will be prepared in consultation with the EPA, SOPA and Relevant Council(s) and included in Attachment 5.

The Construction Monitoring Program will outline the requirements for monitoring as specified in the CNVS and Planning Approval. It will aim to verify the predictive noise modelling and inform refinement of the site and activity specific mitigation measures. It will include but not be limited to monitoring under the following circumstances:

- Commencement of works and at regular intervals throughout works
- Where it has been identified that activities may exceed relevant noise and vibration goals
- In consideration of a complaint received
- During approved OOHW activities
- As identified by additional mitigation measures
- Where ground-born noise or vibration generating activities are undertaken within safe working distances
- Vibration monitoring at sensitive buildings or structures

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

Monitoring will be in the form of unattended logging or operator attended surveys and real time monitoring in accordance with the environmental requirements. The real time data will be available to the construction team, Sydney Metro, ER and AA. DPE and EPA will be provided with access to the real time monitoring data on request. The results of any monitoring undertaken as a requirement of the EPL will be published on the project website within 14 days of obtaining the results.

9.4.2 Inspections

The following inspections will be undertaken with respect to noise and vibration management

- Land use survey, as outlined in Section 5.2.
- Pre-construction building condition surveys, for heritage buildings as outlined in Section 5.3 or other buildings with the potential to be impacted by vibration.
- Post-construction building condition surveys, for heritage buildings as outlined in Section 5.3 or other buildings with the potential to be impacted by vibration.
- Weekly inspections which, as part of the weekly Environmental inspection further outlined in the CEMP, will include inspection of the environmental controls and mitigation measures outlined in the DNVIS(s) and Table 23 of this CNVMP.
- Daily visual inspections, as outlined in the CEMP and undertaken by the Site Foreman. The Site Foreman will also inspect the onsite mitigation required by Out of Hours Work Permits and the DNVIS(s).
- ER and Sydney Metro will also conduct inspections which are independent of GALCs inspections.

9.4.3 Reporting

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

The Project will communicate relevant noise and vibration information both internally and externally, as identified in its communication processes and as required by its compliance obligations.

Project noise and vibration information will be captured and provided to Sydney Metro as outlined in Table 30.

Table 30: Noise and vibration reporting

Form	Frequency	Noise and vibration information to be provided
Construction Monitoring Program Reports	6-monthly	Results of the Noise and Vibration Monitoring undertaken within that period
EPL Monitoring Reports	Monthly	Monitoring data as required by the EPL
	Annually	Monitoring data as required by the EPL

Form	Frequency	Noise and vibration information to be provided
Emergency OOH construction works	As required	Notification of requirements as of Section 4.1 of the Sydney Metro - OOHW Protocol to undertake emergency works out of hours (refer Attachment 4).
Noise or vibration complaint response	As required	Noise or vibration monitoring data collected in response to a complaint On the way the work was being carried out at the time, including onsite mitigation.
Compliance Monitoring and Reporting Program	Prior to Construction	GALC will provide Sydney Metro and the ER documented evidence that all CoA and REMMs which have a pre-construction requirement, have been met and are compliant two weeks prior to the anticipated date for commencement of construction
	Quarterly	GALC will provide Sydney Metro and the ER with all documented evidence demonstrating compliance for each CoA and REMM on a regular basis

9.5 Auditing

The Project shall be audited at planned intervals to provide information on whether it is meeting its compliance obligations to the CNVMP and to determine if the CNVMP is effectively implemented and maintained.

The Project will be audited at planned intervals to provide information on whether the Project:

- is meeting its compliance obligations
- conforms to this Sub-plan
- determines if this Sub-plan is effectively implemented and maintained.

The approach to internal and independent audits, including auditing schedule, is outlined further in the CEMP.

9.6 Environmental Incidents

Management of environmental incidents is detailed in Section 12.2 of the CEMP.

Examples of incidents as they relate to noise and vibration may typically include:

- Generation of noise and vibration during uncontrolled construction activities
- Damage to buildings or structures due to vibration intensive activities

9.7 Complaints Register

All complaints made by the community and stakeholders will be managed in accordance with the Sydney Metro's requirements, the Overarching Community Communication Strategy, including the Sydney Metro Construction Complaints Management System (CCMS) (2021), as well as relevant CoAs (B1 – B6).

The CCMS will be implemented before the commencement of any construction works and maintained for the duration of construction. The CCMS will be available for a minimum for 12 months following completion of construction of Project.

The following information will be available to facilitate community enquiries and manage complaints before the commencement of work and for 12 months following the completion of construction:

a) A 24- hour telephone number for the registration of complaints and enquiries about the Project
b) A postal address to which written complaints and enquires may be sent
c) An email address to which electronic complaints and enquiries may be transmitted
d) A mediation system for complaints unable to be resolved.

This information will be accessible to all in the community regardless of age, ethnicity, disability or literacy level.

An electronic complaints register will be maintained on-site at all times. This register will record information on all complaints received about the Project during construction works and for a minimum of 12 months following the completion of construction. This register will include the following information:

a) Number of complaints received
b) Date and time of the complaint
c) Number of people in the household affected in relation to a complaint, if relevant
d) Method by which the complaint was made
e) Any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect
f) Issue of the complaint
g) Means by which the complaint was addressed and whether resolution was reached, with or without mediation
h) If no action was taken, the reason(s) why no action was taken.

Community members and stakeholders making a complaint will be advised of the following information before, or as soon as practicable after, providing personal information:

a) the complaints register may be forwarded to government agencies, including the Department (Department of Planning Industry and Environment, 4 Parramatta Square, 12 Darcy Street, Parramatta NSW 2150), to allow them to undertake their regulatory duties
b) by providing personal information, the complainant authorises GALC to provide that information to government agencies
c) the supply of personal information by the complainant is voluntary
d) the complainant has the right to contact government agencies to access personal information held about them and to correct or amend that information (Collection Statement).

The Collection Statement will be included on the GALC or Project website to make prospective complainants aware of their rights under the *Privacy and Personal Information Protection Act 1998*. For any complaints made in person, the complainant will be made aware of the Collection Statement.

In accordance with the overarching CCMS, GALC will submit the complaints register in the online Consultation Manager system. Sydney Metro will provide the Complaints Register to the Planning Secretary upon request, within the timeframe stated in the request.

10 REVIEW AND IMPROVEMENT

10.1 Continual Improvement

In order to ensure continual improvement and prevent recurring issues, this CNVMP will be reviewed in response to:

- Corrective actions arising from non-conformance, incidents or audits
- trends in validated noise or vibration complaints
- where noise or vibration exceedances are repeatedly identified (e.g. via monitoring)
- Opportunity for improvement in environmental management performance which may be identified by the project team, ER or Sydney Metro.
- Changes to the Gamuda Australia EMS.

For the duration of the Project, the ER will consider any minor amendments made to this CNVMP and construction monitoring programs without increasing impacts to nearby sensitive receivers. The amended document will be consistent with the CoA, CEMP, CNVMP and construction monitoring programs approved by the Planning Secretary. If satisfied that such amendment is necessary, the ER will approve the amendment. This does not include any modifications to the CoA as outline in the CEMP.

10.2 Document Updates

The Project Management Team will review the status and adequacy of the EMS including this CNVMP. The objective of the review will be to ensure that it meets current Sydney Metro and GALC requirements as well as relevant environmental standards.

The review will be undertaken by the GALC Senior Management Team during the HSEQ relaunch process, which is undertaken at six-monthly intervals.

The processes described above may result in the need to update or revise this sub-plan. This will occur annually as a minimum, or as needed, and may only be approved by the Environmental Manager, or delegate.

The ER and AA (in conjunction with the ER where required) can approve necessary minor changes in accordance with CoA A30(j), A36 (e) and (h)(iii).

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure as outlined in the CEMP.

10.3 Distribution

All project documentation, including environmental records, will be controlled in accordance with GALC Project requirements using the project electronic document management system (Scenario). All GALC personnel and contractors will have access to this CNVMP via the project document control management system.

The approved CNVMP will be published on the GALC website within one week of being approved or before commencement of work that relates to the CNVMP, as per CoA B11(e) and be available until the end of the Construction Period.

The document is uncontrolled when printed.

ATTACHMENTS

Attachment 1 – Construction Noise and Vibration Management Compliance Matrix

Note: the tables below will be fully populated upon update of the CNVMP following project award

Table 31: Conditions of Approval that relate to Noise and Vibration management

ID	Conditions of Approval	Document Reference
C-B7	The CSSI must achieve a minimum Infrastructure Sustainability Council of Australia (ISCA) Infrastructure Sustainability rating of 75 (Version 1.2) (or equivalent level of performance using a demonstrated equivalent rating tool) or a 5-Star Green Star rating (or equivalent level of performance using a demonstrated equivalent rating tool).	Section 4.3
A1	The Proponent must carry out Stage 1 of the CSSI in accordance with the conditions of this approval and generally in accordance with the:	
	a) Sydney Metro West – Westmead to The Bays and Sydney CBD Environmental Impact Statement dated 15 April 2020;	Section 1.5
	b) Sydney Metro West – Westmead to The Bays and Sydney CBD Submissions Report dated 20 November 2020; and	Section 1.5
	c) Sydney Metro West – Westmead to The Bays and Sydney CBD Amendment Report dated 20 November 2020.; and	Section 1.5
	d) Sydney Metro West – Westmead to The Bays and Sydney CBD Modification Request Letter dated 21 June 2021.	Section 1.5
A2	Stage 1 of the CSSI must only be carried out in accordance with all procedures, commitments, preventative actions, performance criteria and mitigation measures set out in the documents listed in Condition A1 of this schedule unless otherwise specified in, or required under, this approval.	Section 2.1 This table
A5	The Proponent must comply with all written requirements or directions of the Planning Secretary, including in relation to:	
	a) the environmental performance of Stage 1 of the CSSI;	Section 1.5
	b) any document or correspondence in relation to Stage 1 of the CSSI;	Section 1.5
	c) any notification given to the Planning Secretary under the conditions of this approval;	Section 1.5

ID	Conditions of Approval	Document Reference
	d) any audit of Stage 1 of the CSSI;	Section 1.5
	e) the conditions of this approval and compliance with the conditions of this approval (including anything required to be done under this approval);	Section 2.1
	f) the carrying out of any additional monitoring or mitigation measures; and	Section 8
	g) in respect of ongoing monitoring and management obligations, compliance with an updated or revised version of a guideline, protocol, Australian Standard or policy required to be complied with under the conditions of this approval.	Section 9
A6	Where the conditions 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;	Section 1.4 Attachment 3
	b) a log of the dates of engagement or attempted engagement with the identified party and a summary of the issues raised by them;	Section 1.4 Attachment 3
	c) documentation of the follow-up with the identified party(s) where feedback has not been provided to confirm that the party(s) has none or has failed to provide feedback after repeated requests;	Section 1.4 Attachment 3
	d) outline of the issues raised by the identified party(s) and how they have been addressed; and	Section 1.4 Attachment 3
	e) a description of the outstanding issues raised by the identified party(s) and the reasons why they have not been addressed.	Section 1.4 Attachment 3
A16	Ancillary facilities that are not identified by description and location in the documents listed in Condition A1 of this schedule can only be established and used in each case if:	

ID	Conditions of Approval	Document Reference
	a) they are located within or immediately adjacent to the Construction Boundary; and	Section 2.2.1
	b) they are not located next to sensitive land user(s) (including where an access road is between the facility and the receiver), unless the landowner and occupier have given written acceptance to the carrying out of the relevant facility in the proposed location; and	Section 2.2.1
	c) they have no impacts on Heritage items (including areas of archaeological sensitivity), threatened species, populations or ecological communities beyond the impacts approved under the conditions of this approval; and	Section 2.2.1
	d) the establishment and use of the facility can be carried out and managed within the outcomes set out in the conditions of this approval, including in relation to environmental, social and economic impacts.	Section 2.2.1
A32	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 A35 of this schedule) and for no less than six (6) months following completion of construction of Stage 1 of the CSSI.	Section 9.2
A33	Work must not commence until an AA has been nominated by the Proponent and approved by the Planning Secretary.	Section 9.2
A34	"The Proponent must cooperate with the AA by:	
	a) providing access to noise and vibration monitoring activities as they take place;	Section 9.2
	b) providing access to the Complaints Register if requested;	Section 9.2
	c) providing for review of noise and vibration documents required to be prepared under the conditions of this approval; and	Section 9.2
	d) considering any recommendations to improve practices and demonstrating, to the satisfaction of the AA, why any recommendation is not adopted.	Section 9.2
A35	The Proponent may nominate additional suitably qualified and experienced persons to assist the lead AA for the Planning Secretary's approval.	Section 9.2
A36	The approved AA must:	

ID	Conditions of Approval	Document Reference
	a) receive and respond to communication from the Planning Secretary in relation to the performance of Stage 1 of the CSSI in relation to noise and vibration;	Section 9.2
	b) consider and inform the Planning Secretary on matters specified in the conditions of this approval relating to noise and vibration;	Section 9.2
	c) consider and recommend, to the Proponent, improvements that may be made to avoid or minimise adverse noise and vibration impacts;	Section 9.2
	d) review all proposed night-time works (with the exception of low risk activities) to determine if sleep disturbance would occur and recommend measures to avoid sleep disturbance or appropriate additional alternative mitigation measures;	Section 9.2
	e) review all noise and vibration documents required to be prepared under the conditions of this approval and, should they be consistent with the conditions 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);	Section 9.2
	f) regularly monitor the implementation of all noise and vibration documents required to be prepared under the conditions of this approval to ensure implementation is in accordance with what is stated in the document and the conditions of this approval;	Section 9.2
	g) review the Proponent's notification of incidents in accordance with Condition A43 of this schedule;	Section 9.2
	h) in conjunction with the ER (where required), the AA must: i. as may be requested by the Planning Secretary or Community Complaints Mediator (required by Condition B8 of this schedule), help plan, attend or undertake audits of noise and vibration management of Stage 1 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 Stage 1 of the CSSI, follow the procedure in the Overarching Community Communication Strategy referenced in Condition C-B1 of this schedule to attempt to resolve the conflict, and if it cannot be resolved, notify the Planning Secretary, iii. if requested by the ER, consider relevant minor amendments made to the 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 conditions of this approval and the management plans and	Section 9.2

ID	Conditions of Approval	Document Reference
	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 conditions of this approval), iv. if requested by the ER, review the noise impacts of minor 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 (7) days following the end of each month for the duration of the AA's engagement for Stage 1 of the CSSI, or as otherwise agreed by the Planning Secretary.	
C1	Construction Environmental Management Plans (CEMPs) and CEMP Sub-plans must be prepared in accordance with the Construction Environmental Management Framework (CEMF) included in the documents listed in Condition A1 of this schedule to detail how the performance outcomes, commitments and mitigation measures specified in the documents listed in Condition A1 of this schedule will be implemented and achieved during construction.	Section 1.3
C2	With the exception of any CEMPs expressly nominated by the Planning Secretary to be endorsed by the ER, all CEMPs must be submitted to the Planning Secretary for approval.	Section 1.5
C3	The CEMP(s) not requiring the Planning Secretary's approval must be submitted to the ER for endorsement no later than one (1) month before the commencement of construction or where construction is phased no later than one (1) month before the commencement of that phase. That CEMP must obtain the endorsement of the ER as being consistent with the conditions of this approval and all undertakings made in the documents listed in Condition A1 of this schedule.	Section 1.5
C4	Any CEMP to be approved by the Planning Secretary must be endorsed by the ER and then submitted to the Planning Secretary for approval no later than one (1) month before the commencement of construction or where construction is phased no later than one (1) month before the commencement of that phase.	Section 1.5
C5	Of the CEMP Sub-plans required under Condition C1 of this schedule, the following CEMP Sub-plans must be prepared in consultation with the relevant government agencies identified for each CEMP Sub-plan. Details of issues raised by a government agency during consultation must be included in the relevant CEMP Sub-plan, including copies of all correspondence from those government agencies as required by Condition A6 of this schedule. Where a government agency (ies) request(s) is not included, the Proponent must provide the Planning Secretary / ER (whichever is applicable) justification as to why: a) Noise and vibration Sub-plan; consult with SOPA (in respect of Sydney Olympic Park), Place Management NSW (in respect of The Bays) and Relevant Council(s)	Section 1.4 Attachment 3

ID	Conditions of Approval	Document Reference
C6	The CEMP Sub-plans must state how:	
	a) the environmental performance outcomes identified in the documents listed in Condition A1 of this schedule will be achieved;	Table 32
	b) the mitigation measures identified in the documents listed in Condition A1 of this schedule will be implemented;	Section 8.2
	c) the relevant conditions of this approval will be complied with; and	This table
	d) issues requiring management during construction (including cumulative impacts), as identified through ongoing environmental risk analysis, will be managed through SMART principles.	Table 34
C7	With the exception of any CEMP Sub-plans expressly nominated by the Planning Secretary to be endorsed by the ER, all CEMP Sub-plans must be submitted to the Planning Secretary for approval.	Section 1.5
C8	The CEMP Sub-plans not requiring the Planning Secretary's approval must obtain the endorsement of the ER as being in accordance with the conditions of approval and all relevant undertakings made in the documents listed in Condition A1 of this schedule. Any of these CEMP Sub-plans must be submitted to the ER with, or subsequent to, the submission of the CEMP but in any event, no later than one (1) month before construction or where construction is phased no later than one (1) month before the commencement of that phase.	Section 1.5
C9	Any of the CEMP Sub-plans to be approved by the Planning Secretary must be submitted to the Planning Secretary with, or subsequent to, the submission of the CEMP but in any event, no later than one (1) month before construction or where construction is phased no later than one (1) month before the commencement of that phase.	Section 1.5
C10	Construction must not commence until the CEMP and all CEMP Sub-plans have been approved by the Planning Secretary or endorsed by the ER (whichever is applicable), unless otherwise agreed by the Planning Secretary. The CEMP and CEMP Sub-plans, as approved by the Planning Secretary or endorsed by the ER (whichever is applicable), including any minor amendments approved by the ER, must be implemented for the duration of construction. Where construction of Stage 1 of the CSSI is phased, construction of a phase must not commence until the CEMP and CEMP Sub-plans for that phase have been approved by the Planning Secretary or certified by the ER upon nomination by the Planning Secretary (whichever is applicable).	Section 1.5
C14	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 Stage 1 of the CSSI against the performance predicted in the documents listed in Condition A1 of this schedule or in the CEMP:	Section 1.4

ID	Conditions of Approval	Document Reference
	a) Noise and vibration Monitoring program; consult with EPA, SOPA (in respect of Sydney Olympic Park), Place Management NSW (in respect of The Bays) and Relevant Council(s)	
C15	Each Construction Monitoring Program must provide:	NVMoP
	a) details of baseline data available including the period of baseline monitoring;	Attachment 5
	b) details of baseline data to be obtained and when;	Attachment 5
	c) details of all monitoring of the project to be undertaken;	Attachment 5
	d) the parameters of the project to be monitored;	Attachment 5
	e) the frequency of monitoring to be undertaken;	Attachment 5
	f) the location of monitoring;	Attachment 5
	g) the reporting of monitoring results and analysis results against relevant criteria;	Attachment 5
	h) details of the methods that will be used to analyse the monitoring data;	Attachment 5
	i) procedures to identify and implement additional mitigation measures where the results of the monitoring indicated unacceptable project impacts;	Attachment 5
	j) a consideration of SMART principles; and	Attachment 5
	k) any consultation to be undertaken in relation to the monitoring programs; and	Attachment 5
	l) any specific requirements as required by Conditions C16 to C17 of this schedule.	Attachment 5
C16	The Noise and Vibration Construction Monitoring Program and Blasting Construction Monitoring Program must include:	NVMoP
	a) noise and vibration monitoring determined in consultation with the AA to confirm the best-achievable construction noise and vibration levels with consideration of all reasonable and feasible mitigation and management measures that will be implemented;	Attachment 5
	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; and	Attachment 5

ID	Conditions of Approval	Document Reference
	c) a process to undertake real time noise and vibration monitoring. The results of the monitoring must be readily available to the construction team, the Proponent, ER and AA. The Planning Secretary and EPA must be provided with access to the results on request.	Attachment 5
C18	With the exception of any Construction Monitoring Programs expressly nominated by the Planning Secretary to be endorsed by the ER, all Construction Monitoring Programs must be submitted to the Planning Secretary for approval.	Attachment 5 (NVMoP)
C19	The Construction Monitoring Programs not requiring the Planning Secretary's approval must obtain the endorsement of the ER as being in accordance with the conditions of approval and all undertakings made in the documents listed in Condition A1 of this schedule. Any of these Construction Monitoring Programs must be submitted to the ER for endorsement at least one (1) month before the commencement of construction or where construction is phased no later than one (1) month before the commencement of that phase.	Attachment 5 (NVMoP)
C20	Any of the Construction Monitoring Programs which require Planning Secretary approval must be endorsed by the ER and then submitted to the Planning Secretary for approval at least one (1) month before the commencement of construction or where construction is phased no later than one (1) month before the commencement of that phase.	Attachment 5 (NVMoP)
C21	Unless otherwise agreed with the Planning Secretary, construction must not commence until the Planning Secretary has approved, or the ER has endorsed (whichever is applicable), all of the required Construction Monitoring Programs and all relevant baseline data for the specific construction activity has been collected.	Attachment 5 (NVMoP)
C22	The Construction Monitoring Programs, as approved by the Planning Secretary or the ER has endorsed (whichever is applicable), 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 or the ER (whichever is applicable), whichever is the greater.	Attachment 5 (NVMoP)
C23	"The results of the Construction Monitoring Programs must be submitted to the Planning Secretary, ER 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."	Attachment 5 (NVMoP)
D14	Before installing protective site boundary hoarding or equipment used for vibration and noise monitoring at any Heritage item identified in the documents listed in Condition A1 of this schedule, 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	Section 8.3.3

ID	Conditions of Approval	Document Reference
	heritage significance of the item. The installation must also consider and avoid impacts to potential historical archaeology and seek advice from the Excavation Director approved under Condition D27 below.	
D34	A detailed land use survey must be undertaken to confirm sensitive receivers (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration and construction ground-borne 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 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 under Condition C5 of this schedule.	Section 5.2 Attachment 6
D35	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 6.4.1
D36	Except as permitted by an EPL, highly noise intensive work that results 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 (3) hours, with a minimum cessation of work of not less than one (1) hour. For the purposes of this condition, 'continuously' includes any period during which there is less than one (1) hour between ceasing and recommencing any of the work.	Section 6.4.2
D37	Notwithstanding **Conditions D35** and **D36** of this schedule work may be undertaken outside the hours specified in the following circumstances:	Section 6.4.3 Attachment 4

ID	Conditions of Approval	Document Reference
	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 (a)(ii) above, the AA, the ER, the Planning Secretary and the EPA must be notified of the reasons for such work. The Proponent must use best endeavours to notify as soon as practicable all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work.	Section 6.4.3 Attachment 4
	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, and ○ no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); and i. construction that causes $L_{Afmax(15\ minute)}$ noise levels no more than 15 dB(A) above the rating background level at any residence; or ii. construction that causes: ○ 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).	Section 6.4.3 Attachment 4
	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 D38 of this schedule; or iii. negotiated agreements with directly affected residents and sensitive land user(s).	Section 6.4.3 Attachment 4

ID	Conditions of Approval	Document Reference
	d) By Prescribed Activity, including: i. tunnelling (excluding cut and cover tunnelling and surface works) are permitted 24 hours a day, seven days a week; or ii. concrete batching at the Clyde construction site is permitted 24 hours a day, seven days a week; or iii. delivery of material that is required to be delivered outside of standard construction hours in Condition D35 of this schedule to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to / from the Five Dock and Westmead construction sites and to / from Burwood North construction site using any roads / streets other than directly from Parramatta Road; or iv. haulage of spoil except between the hours of 10:00 pm and 7:00 am to / from the Five Dock and Westmead construction sites and to / from Burwood North construction site using any roads / streets other than directly from Parramatta Road; or v. work within an acoustic shed where there is no exceedance of noise levels under Low impact circumstances identified in (b) above, unless otherwise agreed by the Planning Secretary. Note: Tunnelling does not include station box excavation.	Section 6.4.3 Attachment 4
D38	An **Out-of-Hours Work Protocol** must be prepared to identify a process for the consideration, management and approval of work which are outside the hours defined in **Conditions D35** and **D36** of this schedule. 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;	Attachment 4
	b) a process for the consideration of out-of-hours work against the relevant NML and vibration criteria;	Attachment 4

ID	Conditions of Approval	Document Reference
	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 D50 of this schedule. 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;	Attachment 4
	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	Attachment 4
	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 D37(b) of this schedule are met. Note: Out-of-hours work is any work that occurs outside the construction hours identified in Condition D35 and D36 of this schedule.	Attachment 4
D39	All reasonable and feasible mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria:	
	a) construction 'Noise affected' noise management levels established using the Interim Construction Noise Guideline (DECC, 2009);	Section 6.2
	b) vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure);	Section 6.3
	c) Australian Standard AS 2187.2 – 2006 "Explosives – Storage and Use – Use of Explosives" (for human exposure);	Section 6.3.1
	d) BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they are "applicable to Australian conditions"; and	Section 6.3.2
	e) the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage for structurally unsound heritage items). 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.	Section 6.3.2

ID	Conditions of Approval	Document Reference
	Note: The ICNG identifies 'particularly annoying' activities that require the addition of 5 dB(A) to the predicted level before comparing to the construction Noise Management Level.	
D40	All reasonable and feasible 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 L_{Aeq} (15 minute): 40 dB(A); and b) night (10:00 pm to 7:00 am) — internal L_{Aeq} (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 D38 of this schedule.	Section 8, 8.2
D41	Noise generating work in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institutions are made at no cost to the affected institution.	Section 8.2, 8.5
D42	Industry best practice construction methods must be implemented where reasonably practicable to ensure that noise levels are minimised around sensitive land user(s). Practices must include, but are not limited to:	
	a) use of regularly serviced low sound power equipment;	Section 8.2
	b) temporary noise barriers (including the arrangement of plant and equipment) around noisy equipment and activities such as rock hammering and concrete cutting; and	Section 8.2
	c) use of alternative construction and demolition techniques.	Section 8.2
D43	**Detailed Noise and Vibration Impact Statements** (**DNVIS**) must be prepared for any work that may exceed the NMLs, vibration criteria and / or ground-borne noise levels specified in **Conditions D39** and **D40** of this schedule at any residence outside construction hours identified in **Condition D35** of this schedule, or where receivers will be highly noise affected. The **DNVIS** 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 **DNVIS** must be provided to the **AA** and **ER** before the commencement of the associated works. The Planning Secretary and the EPA may request a copy(ies) of the **DNVIS**.	Section 8.1

ID	Conditions of Approval	Document Reference
D44	**DNVIS** must be prepared for each construction site before construction noise and vibration impacts commence and include specific mitigation measures identified through consultation with affected sensitive land users.	Section 8.1
D45	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before works that generate vibration commences in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, 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**.	Section 8.3, DNVIS(s)
D46	Vibration testing must be conducted during vibration generating activities that have the potential to impact on Heritage items to identify minimum working distances to prevent cosmetic damage. Ln 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. Such measures must include, but not be limited to, review or modification of excavation techniques.	Section 6.3.2.1, 6.3.4 8.3.3, 9.4.1, NVMoP
D47	The Proponent must seek the advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring at Heritage items.	Section 8.3.3
D48	Before conducting at-property treatment at any Heritage item identified in the documents listed in **Condition A1** of this schedule, 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.	Section 8.3.3
D49	If a Heritage item is found to be structurally unsound (following inspection) a more conservative cosmetic damage criterion of 2.5 mm/s peak component particle velocity (from DIN 4150) must be applied.	Section 6.3.2.1
D50	All work undertaken for the delivery of Stage 1 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 receivers so that the respite is achieved in accordance with Condition D51 of this schedule; or	Section 6.4, 8
	b) consider the provision of alternative respite or mitigation to impacted noise sensitive receivers; and	Section 6.4, 8
	c) provide documentary evidence to the AA in support of any decision made by the Proponent in relation to respite or mitigation.	Section 6.4, 8

ID	Conditions of Approval	Document Reference
	The consideration of respite must also include all other approved Critical SSI, SSI and SSD projects which may cause cumulative and / or consecutive impacts at receivers affected by the delivery of Stage 1 of the CSSI.	
D51	In order to undertake out-of-hours work outside the work hours specified under **Condition D35** of this schedule, appropriate respite periods for the out-of-hours work must be identified 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 (3) 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 NMLs under Condition D39 (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, 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 RBL at any residence.	Section 1.4, 6.4, 8.2, 8.5
D52	Sensitive land uses located along local roads used to divert traffic from the closure of Alexandra Avenue in Westmead that will be affected by additional road traffic noise from the diverted traffic in excess of the criteria identified in the *NSW Road Noise Policy* (the RNP criteria) during construction of Stage 1 of the CSSI (the Affected Properties) are eligible to receive at-property noise mitigation treatments. Owners of Affected Properties must be advised of the range of noise mitigation options that can be installed at or in their property and given a choice as to which of these they agree to have installed. A copy of all noise mitigation guidelines and procedures that will be used to determine at-property treatment at each Affected Property must be provided to the property owner. At property mitigation measures and packages must be determined based on the measured exceedance levels above the RNP criteria. Road traffic noise levels must be measured before and after the altered traffic flow detour.	Not Applicable. The closure of Alexandra Avenue is no longer part of the project design. Refer Consistency assessment (SMW 04)

ID	Conditions of Approval	Document Reference
		Revised Westmead metro station box
D53	Blasting associated with Stage 1 of 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.	Not applicable. Blasting is not part of the project design.
D54	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.	
D55	The **Blast Management Strategy** must be endorsed by a suitably qualified and experienced person.	
D56	The **Blast Management Strategy** must be prepared in accordance with relevant guidelines 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).	
D57	The **Blast Management Strategy** must be submitted to the Planning Secretary for information no later than one (1) month before the commencement of blasting. The **Blast Management Strategy** as submitted to the Planning Secretary, must be implemented for all blasting activities.	
D60	A suitably qualified and experienced person must undertake condition surveys of all buildings, structures, utilities and the like identified in the documents listed in Condition A1 of this schedule as being at risk of damage before commencement of any work that could impact on the subject surface / subsurface structure. The results of the surveys must be	Section 5.2, 5.3

ID	Conditions of Approval	Document Reference
	documented in a Pre-construction Condition Survey Report for each item surveyed. Copies of Pre-construction Condition Survey Reports must be provided to the relevant owners of the items surveyed in the vicinity of the proposed work, and no later than one (1) month before the commencement of the work that could impact on the subject surface / subsurface structure.	
D63	Appropriate equipment to monitor areas in proximity of construction sites and the tunnel route during construction must be installed with particular reference to at risk buildings, structures and utilities identified in the condition surveys required by Condition D60 of this schedule and / or geotechnical analysis as required. If monitoring during construction indicate exceedance of the vibration criteria identified in the DNVIS prepared under Condition D43 of this schedule, then all construction affecting settlement must cease immediately and must not resume until fully rectified or a revised method of construction is established that will ensure protection of affected buildings.	Section 5.2, 5.3

Table 32: Revised Environmental Management Measures that relate to Noise and Vibration management

ID	Revised Environmental Management Measure	Document Reference
NV01	Further engagement and consultation would be carried out with: • The affected communities to understand their preferences for mitigation and management measures. • Other sensitive' receivers such as schools, medical facilities or places of worship to understand periods in which they are more sensitive to impacts. • Based on this consultation, appropriate mitigation and management options would be considered and implemented where feasible and reasonable to minimise the impacts.	Section 1.4, Section 8.2
NV02	Alternative construction methodologies and measures that minimise noise and vibration levels during noise intensive works would be investigated and implemented where feasible and reasonable. This would include consideration of: • The use of hydraulic concrete shears in lieu of hammers/rock breakers • Sequencing works to shield noise sensitive receivers by retaining building wall elements • Locating demolition load out areas away from the nearby noise sensitive receivers • Providing respite periods for noise intensive works • Minimising structural-borne noise to adjacent buildings including separating the structural connection prior to demolition through saw-cutting and propping, using hand held splitters and pulverisers or hand demolition • Installing sound barrier screening to scaffolding facing noise sensitive neighbours • Using portable noise barriers around particularly noisy equipment, such as concrete saws • Modifying demolition works sequencing / hours to minimise impacts during peak pedestrian times and / or adjoining neighbour outdoor activity periods.	Section 8.2
NV03	Appropriate respite would be provided to affected receivers in accordance with the Sydney Metro Construction Noise and Vibration Standard. This would include consideration of impacts from Stage 1 utility and power supply works when determining appropriate respite periods for affected receivers. When determining appropriate respite, the need to efficiently undertake construction would be balanced against the communities' preferred noise and vibration management approach.	Section 6.4
NV04	The use of noise intensive equipment at construction sites with 'moderate' and 'high' out-of-hours noise management level exceedances would be scheduled for standard construction hours, where feasible and	Section 6.4.2

ID	Revised Environmental Management Measure	Document Reference
	reasonable. Where this is not feasible and reasonable, the works would be undertaken as early as possible in each work shift.	
NV05	Air brake silencers would be used on heavy vehicles that access construction sites multiple times per night or over multiple nights.	Section 8.2
NV06	Perimeter site hoarding would be designed with consideration of on-site heavy vehicle movements with the aim of minimising sleep disturbance impacts.	Section 8.2
NV07	Long term construction site support equipment and machinery would be low noise emitting and suitable for use in residential areas, where feasible and reasonable. Examples include: • Low noise water pumps for use in water treatment facilities • Low noise generators and compressors • Low noise air conditioner units for use of amenities buildings.	Section 8.2
NV08	For all sites where acoustic sheds are proposed, the sheds would be designed and constructed to minimise noise emissions. This would likely include the following considerations: All significant noise producing equipment that would be used during the night-time would be inside the shed, where feasible and reasonable Noise generating ventilation systems such as compressors, scrubbers, etc, would also be inside the shed and external air intake/discharge ports would be appropriately acoustically treated The door of the acoustic shed would be kept closed during the night-time period, where feasible and reasonable. Where night-time vehicle access is required, the doors would be designed and constructed to minimise noise breakout.	Section 8.2
NV09	Feasible and reasonable measures would be implemented to minimise ground-borne noise where exceedances are predicted. This may require implementation of less ground-borne noise and less vibration intensive alternative construction methodologies.	Section 8.2
NV10	The proximity of cross passages to nearby receivers and the corresponding construction ground-borne noise and vibration impacts during the excavation works would be considered when determining locations. Relocation of cross passages to be further away from sensitive receivers to mitigate potential construction impacts would be considered, where feasible and reasonable.	Section 8.2

ID	Revised Environmental Management Measure	Document Reference
NV11	An activity specific Construction Noise and Vibration Impact Statement (in accordance with the requirements of the Construction Noise and Vibration Standard) would be developed for rockbreaking in the tunnel and at cross passages, specifically addressing the activity where it is required between 10pm-7am.	Section 8.1
NV12	Blasting would be planned during hours that would cause the least disruption and disturbance to the nearest receivers. Notification protocols prior to blasting for the nearest sensitive receivers would be established.	Not applicable
NV13	Vibration and overpressure measurements would be completed at the start of any blasting activities to confirm that vibration levels are within the blasting criteria.	Not applicable
NV14	Further assessment of construction traffic would be completed during detailed design, including consideration of the potential for exceedances of the NSW Road Noise Policy base criteria (where greater than 2 dB increases are predicted). The potential impacts would be managed using the following approaches, where feasible and reasonable: On-site spoil storage capacity would be maximised to reduce the need for truck movements during sensitive times Vehicle movements would be redirected away from sensitive receiver areas and scheduled during less sensitive times The speed of vehicles would be limited and the use of engine compression brakes would be avoided Heavy vehicles would not be permitted to idle near sensitive receivers.	Section 7.3 and 8
NV15	Consultation with the owners and operators of the horse stables near the Clyde stabling and maintenance facility construction site would be carried out so that potential impacts to horses are appropriately managed.	Section 8.2
NV16	Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure (in consultation with a structural engineer) and vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items, the more detailed assessment would specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.	Section 6.3, 8.3 and 9.4.1
NV17	Condition surveys of buildings and structures near to the tunnel and excavations would be undertaken prior to the commencement of excavation at each site, where appropriate. For heritage buildings and structures the surveys would consider the heritage values of the structure in consultation with a heritage specialist.	Section 5

ID	Revised Environmental Management Measure	Document Reference
NV18	The likelihood of cumulative construction noise impacts would be reviewed during detailed design when detailed construction schedules are available. Co-ordination would occur between potentially interacting projects to minimise concurrent or consecutive works in the same areas, where possible. Specific mitigation strategies would be developed to manage impacts. Depending on the nature of the impact, this could involve adjustments to construction program or activities of Sydney Metro West or of other construction projects.	Section 8.2
NV19	Further assessment of operational road traffic noise mitigation would be undertaken for receivers identified as being eligible for consideration of treatment. The mitigation would likely include at-property treatment. Receivers that are identified as requiring at-receiver noise mitigation would be identified and, where possible, offered treatment prior to the start of construction works which have the potential to affect them.	Not Applicable. The closure of Alexandra Avenue is no longer part of the project design. Refer Consistency assessment (SMW 04) Revised Westmead metro station box. Therefore no receivers are considered eligible for operational road noise treatment.
NV20	Noise impacts to horses at the Rosehill Racecourse Stables (consultation): Undertake consultation with the Rosehill Gardens Racecourse and an equine veterinary expert to inform construction noise and vibration objectives for this sensitive receiver. Achievement of objectives are to be demonstrated in accordance with Noise and Vibration Construction Monitoring Program required by Conditions C15 and C16 and would include reference to equine behavioural responses where feasible.	Section 8.2
NV21	Noise impacts to horses at the Rosehill Racecourse Stables (consultation): Consider the use of additional noise mitigation measures such as noise barriers where feasible and reasonable.	Section 8.2

Table 33: Environmental Performance Outcomes that relate to Noise and Vibration management

Field	Revised Environmental Performance Outcome	Document Reference
Construction Noise and Vibration	Construction noise and vibration impacts on local communities are minimised by controlling noise and vibration at the source, on the source to receiver path and at the receiver	Section 8.2
	Structural damage to buildings and heritage items from construction vibration is avoided	Section 8.2, 8.3
	Local communities are engaged during construction, including on noise mitigation in areas predicted to be affected by high noise impacts.	Section 8.1, 8.2, 8.3, 8.5

Table 34: Environmental Requirements in the Sydney Metro Construction Environment Management Framework that relate to Noise and Vibration management

Clause	Requirement	Document Reference
8.1 (a)	The following noise and vibration management objectives will apply to construction:	Section 3
	i. Minimise unreasonable noise and vibration impacts on residents and businesses;	Section 3
	ii. Avoid structural damage to buildings or heritage items as a result of construction vibration;	Section 3
	iii. Undertake active community consultation; and	Section 3
	iv. Maintain positive, cooperative relationships with schools, childcare centres, local residents and building owners.	Section 3
8.2 (a)	Principal Contractors will develop and implement a Construction Noise and Vibration Management Plan for their scope of works consistent with the Interim Construction Noise Guidelines (Department of Environment and Climate Change, 2009). The Construction Noise and Vibration Management Plan will include as a minimum: i. Identification of work areas, site compounds and access points;	Attachment 6,7 Section 5.1
	ii. Identification of sensitive receivers and relevant construction noise and vibration goals;	Section 5.2, Attachment 6
	iii. Be consistent with, and include the requirements of the noise and vibration mitigation measures as detailed in, the environmental approval documentation and the Sydney Metro Construction Noise and Vibration Strategy (CNVS);	Section 8.2

Clause	Requirement	Document Reference
	iv. Details of construction activities and an indicative schedule for construction works, including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios) that have the potential to generate noise or vibration impacts on surrounding sensitive receivers, in particular residential areas;	Section 5.1 and 7.1, DNVIS(s)
	v. Identification of feasible and reasonable procedures and mitigation measures to ensure relevant vibrations and blasting criteria are achieved, including a suitable blast program;	Not applicable
	vi. Community consultation requirements and Community notification provisions specifically in relation to blasting;	Not applicable
	vii. The requirements of any applicable licence or approval (for example EPL);	Section 4.2, Attachment 1
	viii. Additional requirements in relation to activities undertaken 24 hours of the day, 7 days per week;	Section 6.4
	ix. Pre-construction compliance requirements and hold points;	Section 9.1
	x. The responsibilities of key project personnel with respect to the implementation of the plan;	Section 9.2
	xi. Noise monitoring requirements;	Section 9.4.1
	xii. Compliance record generation and management; and	Section 9.4.3 and 10
	xiii. An Out of Hours Works Protocol applicable to all construction methods and sites.	Attachment 4
8.2 (b)	Detailed Construction Noise and Vibration Impact Statements will be prepared for noise-intensive construction sites and or activities, to ensure the adequacy of the noise and vibration mitigation measures. Specifically, Construction Noise and Vibration Impact Statements will be prepared for works proposed to be undertaken outside of standard construction hours and to support applications to undertake out of hours works (this includes variations of EPL's and applications to relevant agencies).	Section 8.1, See DNVIS(s)
8.2 (c)	Noise and vibration monitoring would be undertaken for construction as specified in the CNVS.	Section 9.4, NVMoP
8.2 (d)	The following compliance records would be kept by Principal Contractors: Records of noise and vibration monitoring results against appropriate NMLs and vibration criteria; and Records of community enquiries and complaints, and the Contractor's response.	Section 8.7, 8.10

Table 35: Environmental Requirements in the Sydney Metro Construction Noise and Vibration Standard

Section	CNVS Requirement	Document Reference
1.4.2	Where works will cause significant noise and vibration impacts upon sensitive receivers Principal Contractors will be required to prepare and implement CNVMP's. These documents form part of the CEMP suite of documentation. The function of the CNVMP is to provide a strategic overview of how the requirements of the CNVS will be applied to activities or locations under the control of the Principal Contractor. This overview includes an outline of how quantitative noise and vibration assessments will be undertaken across worksites and/or activities, and an indicative construction schedule. The CNVMP also links to Community and Stakeholder consultation processes and explains how commercial and residential receivers will be consulted throughout the construction phase with regard to mitigating impacts upon them.	This document
1.4.4	While quantitative noise assessments are documented in environmental assessments, Principal Contractors will have a better understanding of the exact equipment list and construction methodology to be used in carrying out their works. As a result, certain assumptions made in the Noise and Vibration Technical Paper can be clarified in a secondary quantitative assessment undertaken by the Principal Contractor. These documents are called Detailed Noise and Vibration Impact Statements. They are typically written with a focus on specific activities or locations and consider works carried out inside and outside of standard working hours. Where 24/7 works are approved under an SSI approval, a separate DNVIS should be carried out specifically for these activities.	See DNVIS(s)
1.4.5	General Noise and Vibration Impact Statements are also secondary assessments and have the same purpose as DNVIS's except that the assessment process is simplified. A GNVIS may be undertaken for works not being carried out under an SSI Approval. Work described in a GNVIS's cannot proceed until the GNVIS is approved by Sydney Metro. Should the scope of work or the timing of works change, the Principal contractor must update the GNVIS and seek subsequent approval for the new version.	See GNVIS(s)
4	This section sets out the standard construction noise and vibration mitigation measures to be implemented on all Sydney Metro projects and delivered via relevant procedures, systems, environmental assessment, construction environmental management and all relevant contract documentation. For all Sydney Metro construction projects, the standard mitigation measures in Table 11 shall be applied by default where feasible and reasonable in order to minimise the potential noise and vibration impacts at the surrounding Noise	Section 8

Section	CNVS Requirement	Document Reference
	Sensitive Receivers. The effect of applying standard mitigation measures may be considered in noise and vibration assessments to achieve NML's.	

Table 36: Environmental Requirements in licenses and approvals that relate to Noise and Vibration management

Approval and clause	Requirement	Document Reference
TBC	TBC	TBC

Note: Currently no environmental requirements as a result of licenses, however this will be updated following the receipt of the EPL and other licenses or permit which may be relevant.

Attachment 2 – Acoustic Terminology

Source: SLR Consulting

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

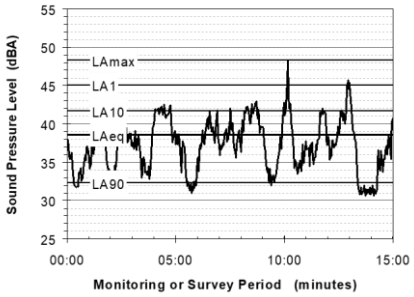
3. Sound Power Level

The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W. The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

LAmax The A-weighted maximum sound pressure level of an event measured with a sound level meter.

5. Frequency Analysis

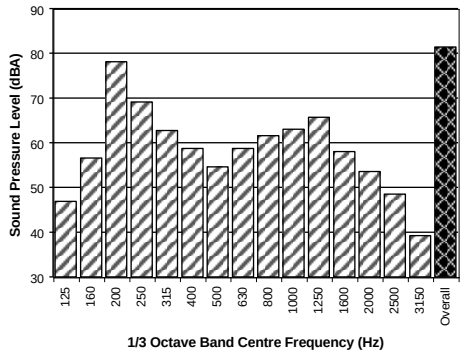
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

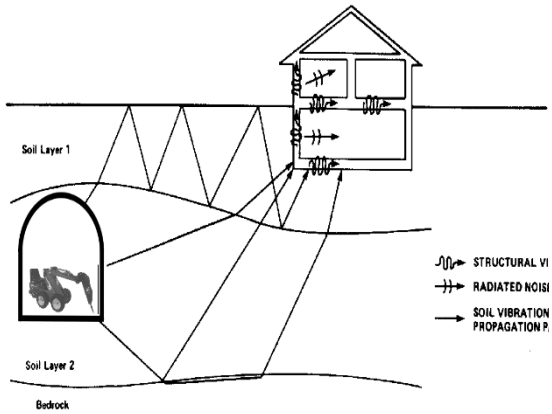
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

Attachment 3 – Stakeholder Consultation

Engagement Log

Stakeholder	Date of Engagement/ Attempted Engagement	Date of Any Follow-Up Engagement
EPA	8 April 2022	2 May 2022
SOPA	8 April 2022	27 April 2022
PCC, CCC	8 April 2022	No Comments

Comments Register

Stakeholder	Comment Raised	GALC Response	Where Addressed
EPA	The EPA generally does not review, approve or endorse monitoring plans, as the role of the EPA is to set objectives for environmental protection and management and not to be directly involved in the development of strategies to comply with such objectives.	Noted.	N/A
SOPA	The Abattoir Heritage Precinct has not been identified as a heritage property that may be impacted by the development and measures to protect these buildings from impacts, or to monitor impacts has not been included. Because of the heritage significance of this precinct, SOPA expect that the Abattoir Precinct would be specifically listed in section 5.3 of the Plan, and that the 'measurement tools' listed in Table 1 (Objectives and targets), would be applied to all buildings within this precinct, with appropriate precautions taken during works that pose a risk to these buildings.	The Abattoir heritage precinct is not identified in Section 5.3 as the scope of this CNVMP will not impact the precinct. As outlined in Section 7.2.3: "No vibration generating activities are proposed at the Sydney Olympic Park site, therefore no construction vibration impacts are anticipated at this site."	Section 7.2.3

Comments Register – Outstanding Issues

Stakeholder	Comment Raised	GALC Response	Proposed Action
N/A	N/A	N/A	N/A

Attachment 4 – Out of Hours Works Protocol

Sydney Metro West OOHW Protocol:
https://www.sydneymetro.info/sites/default/files/2022-03/West-OOHW-Protocol.pdf

Attachment 5 – Noise and Vibration Monitoring Program

Attachment 6 – Land Use Survey