Appendix B2

Noise and Vibration Management Sub Plan

Western Harbour Tunnel and Warringah Freeway Upgrade

Stage 1A Early and Enabling Works - Critical utility installation, relocation and protection works

April 2021

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Document control

Approval and certification

Title	Stage 1A – Early and enabling works – Critical utility installation, relocation and protection works Noise and Vibration Management Sub-plan
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Signed	
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1	23/03/21	Updated in response to stakeholder comments	JN
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5	22/04/21	Updated following DPIE comments	JN

Glossary/ Abbreviations

Abbreviations	Expanded Text
AA	Acoustic Advisor
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Attenuation	The reduction in the level of sound or vibration.
CCS	Community Communication Strategy
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline
CNVS	Construction Noise and Vibration Strategy
CNVIS	Construction Noise and Vibration Impact Statement
CoA	Condition of Approval
Critical utility works	Stage 1A Early and enabling works - Critical utility installation, relocation and protection works
CSSI	Critical State Significant Infrastructure
CUT	Stage 1A Early and enabling works - Critical utility installation, relocation and protection works
Daytime, day	The period from 7 am to 6 pm (Monday to Saturday) and 8 am to 6 pm (Sundays and public holidays).
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	Department of Environment and Conservation NSW
DECC	Department of Energy and Climate Change
DPIE	NSW Department of Planning, Industry and Environment
EIS	Western Harbour Tunnel and Warringah Freeway Upgrade Environmental Impact Statement (January 2020)
ENMM	Environmental Noise Management Manual
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment.

Abbreviations	Expanded Text
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
Environmental objective	Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
ER	Environmental Representative
Evening	Refers to the period from 6 pm to 10 pm
Extraneous noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Heritage item	A place, building, work, relic, archaeological site, tree, movable object or precinct of heritage significance, that is listed under one or more of the following registers: the State Heritage Register under the *Heritage Act 1977* (NSW), a state agency heritage and conservation register under section 170 of the *Heritage Act 1977* (NSW), a Local Environmental Plan under the EP&A Act, the World, National or Commonwealth Heritage lists under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), and an "Aboriginal object" or "Aboriginal place" as defined in section 5 of the *National Parks and Wildlife Act 1974* (NSW)
Highly noise affected	As defined in the Interim Construction Noise Guideline (DECC, 2009)
Highly noise intensive	Works which are defined as annoying under the Interim Construction Noise Guideline (DECC, 2009) including: a. Use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work b. Grinding metal, concrete or masonry

Abbreviations	Expanded Text
	c. Rock drilling d. Line drilling e. Vibratory rolling f. Bitumen milling or profiling g. Jackhammering, rock hammering or rock breaking h. Impact piling.
ICNG	Interim Construction Noise Guidelines
LA (max)	The A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LAeq (15min)	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
NCA	Noise Catchment Area
NCG	Noise Criteria Guideline
Night	The period from 10 pm to 7 am (Monday to Saturday), and 10 pm to 8 am (Sundays and public holidays)
NMG	Noise Mitigation Guideline
NML	Noise Management Level
NPI	Noise Policy for Industry, Environment Protection Agency 2017
NVMP	Noise and Vibration Management Sub-Plan (or Plan)
OOHW	Out of Hours Work
POEO Act	*Protection of the Environment Operations Act 1997*
PPV	Peak-Particle Velocity
Project, the	Western Harbour Tunnel and Warringah Freeway Upgrade
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
REMM	Revised Environmental Management Measure
RMS	Roads and Maritime Services (now Transport for New South Wales)
RNP	Road Noise Policy

Abbreviations	Expanded Text
ROL	Road Occupancy Licence
RTA	Roads and Traffic Authority (now Transport for New South Wales)
RtS	Western Harbour Tunnel and Warringah Freeway Upgrade Response to Submissions (July 2020)
SMART	Specific, measurable, achievable, relevant, and time-based
SPA	Sydney Program Alliance
TfNSW	Transport for New South Wales
VDV	Vibration Dose Value

1 Introduction

1.1 Context and Scope

This Noise and Vibration Management Sub Plan (NVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the Stage 1A Early and Enabling Works – critical utility installation, relocation and protection works (refer to herein as “the critical utility works’ or ‘CUT’) which will support the delivery program of the Main Works of the Western Harbour Tunnel and Warringah Freeway Upgrade (the Project). Sydney Program Alliance (SPA) has been appointed by Transport for New South Wales (TfNSW) to deliver the WFU CUT works.

This NVMP has been prepared to address the requirements of the Minister’s Conditions of Approval (CoA), Western Harbour Tunnel and Warringah Freeway Upgrade Environmental Impact Statement (EIS), the revised environmental management measures (REMMs) listed in the Western Harbour Tunnel and Warringah Freeway Upgrade Response to Submissions Report (RtS) and all applicable legislation. It describes how SPA proposes to manage potential noise and vibration impacts during critical utility works stage of the Project. Other construction stages and operational noise and vibration impacts and operation measures do not fall within the scope of this NVMP and therefore are not included within the processes contained within this NVMP.

1.2 Background and project description

The Western Harbour Tunnel and Warringah Freeway Upgrade EIS (January 2020) assessed noise and vibration impacts on sensitive receivers and structures from construction of the Project.

As part of the EIS development, a detailed construction and operational noise and vibration assessment was prepared based on the Concept Design to address the Environmental Assessment Requirements issued by the Department of Planning, Industry and Environment (DPIE). The noise and vibration assessment was included in the EIS, within Chapter 10 and the Noise and Vibration Technical Paper (Appendix G of the EIS).

The project description is outlined in Sections 1.1 to 1.3 of the CEMP.

1.3 Environmental management systems overview

The environmental management system overview is described in Section 1.6 of the CEMP. This sub-plan forms part of a suite of sub-plans and procedures which sit under the CEMP, as summarised in Figure 1-1.

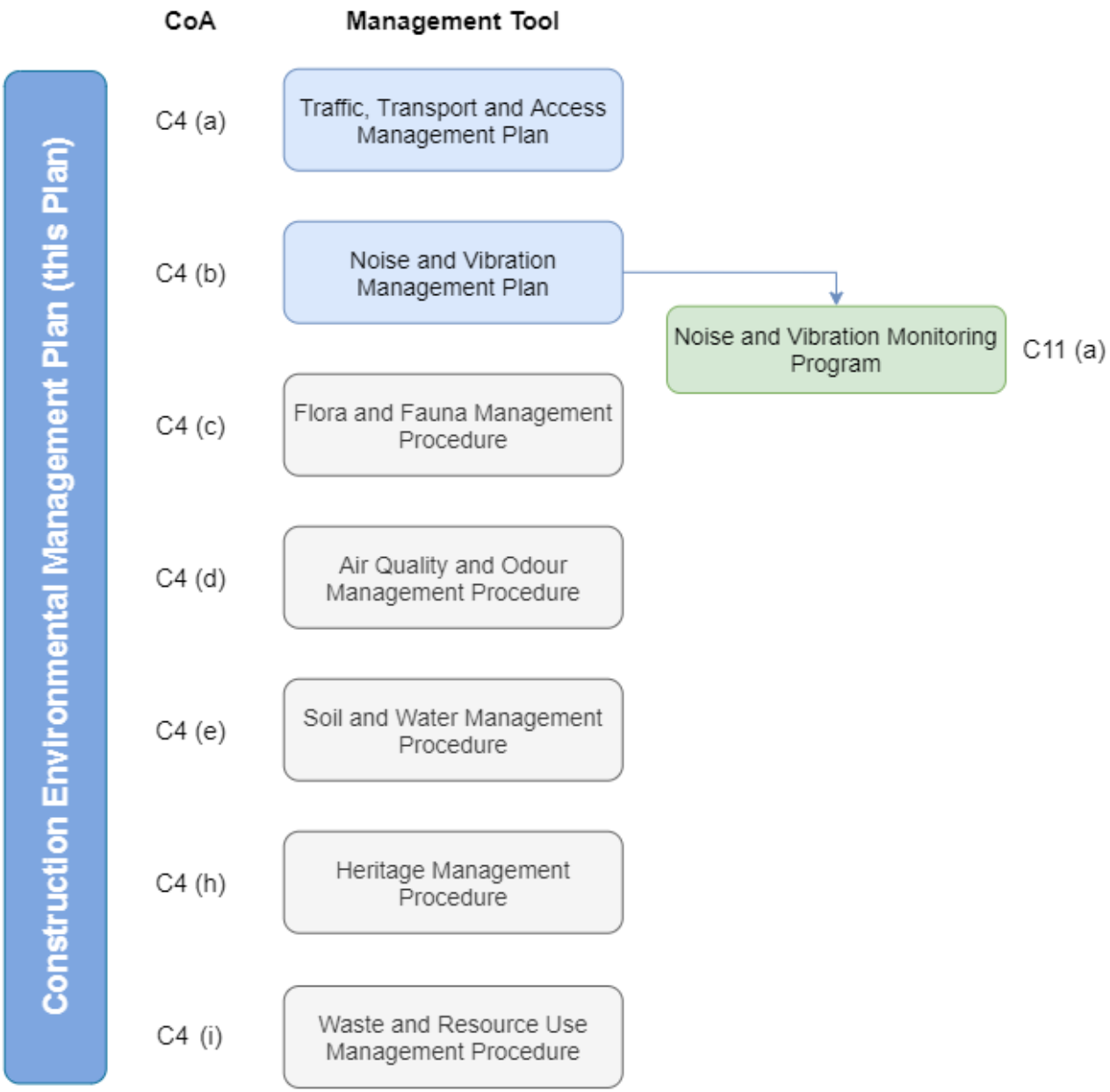

Figure 1-1 Structure of Construction Environmental Management Plan, Sub-Plans and Procedures

2 Purpose and objectives

2.1 Purpose

The purpose of this Plan is to describe how SPA proposes to manage potential noise and vibration impacts during the critical utility works.

2.2 Objectives

The key objectives of the NVMP are to:

- Comply with the relevant legislative requirements, CoA and REMMs
- Implement feasible and reasonable noise mitigation measures with the aim of achieving the construction noise management levels (NMLs) detailed in the Interim Construction Noise Guideline (DECC, 2009) and Noise Policy for Industry (NSW EPA, 2017)
- Minimise complaints from the community and stakeholders
- Cause no structural or cosmetic damage to buildings, infrastructure or items of heritage conservation significance from vibration.

To achieve these objectives, SPA will meet the performance outcomes from the EIS, as identified in Appendix A.

3 Environmental requirements

3.1 Relevant legislation

3.1.1 Legislation

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

- *Protection of the Environment Operations Act 1997 (POEO Act)*
- *Protection of the Environment Operations (Noise Control) Regulation 2008.*

All legislation relevant for the Project is included in Appendix A3 of the CEMP.

3.1.2 Licences / Permits

An Environment Protection Licence (EPL) will be obtained for the Project. Noise and vibration conditions will be incorporated into this NVMP once issued.

3.1.3 Guidelines

The main guidelines, specifications and policy documents relevant to this Plan include:

- Roads and Maritime QA Specification G36 – Environmental Protection (Management System)
- Roads and Maritime Construction Noise and Vibration Guidelines (CNVG) (RMS 2016)
- Roads and Maritime Noise Criteria Guideline (NCG) RMS 2014
- Roads and Maritime Noise Mitigation Guideline (NMG) RMS 2014
- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009
- NSW Road Noise Policy, Department of Environment, Climate Change and Water 2011
- Noise Policy for Industry, Environment Protection Authority 2017
- NSW Assessing Vibration – a technical guideline, Department of Environment and Conservation 2006
- Procedure: Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report, RMS 2013
- Environmental Noise Management Manual (ENMM) RTA 2001
- Australian Standard 2659.1 – 1998 Guide to the use of sound measuring equipment – portable sound level meters
- Australian Standard IEC 61672.1 Electroacoustic – Sound Level Meters – Specifications
- Australian Standard 2775 Mechanical Mounting of Accelerometers
- Australian Standard 1055 Acoustics – Description and Measurement of Environmental Noise
- Australian Standard AS/NZS 2107:2000 Acoustics - Recommended design sound levels and reverberation times for building interiors
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
- Australian Standard AS2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites

- British Standard BS 6472-2008, ‘Evaluation of human exposure to vibration in buildings (1-80Hz)
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings'
- German Standard DIN4150-1999 Structural vibration Part 3: Effects of vibration on Structures,
- Construction Noise and Vibration Strategy ST-157/4.1 - 2019 (CNVS), Transport for NSW 2018.

3.2 Minister’s Conditions of Approval

The CoA relevant to this Plan are listed Appendix B. A cross reference is also included to indicate where the condition is addressed in this Plan or other project management documents.

This NVMP has been prepared to meet the requirements of CoA C4(b) and CoA C5. In accordance with CoA C9 the NVMP will be submitted to DPIE for approval no later than one month prior to the commencement of construction. Construction will not commence until this NVMP, the CEMP and relevant CEMP Sub-plans have been approved by DPIE in accordance with CoA C10.

3.3 Revised Environmental Management Measures

Relevant REMMs are listed Appendix B. This includes reference to required outcomes, the timing of when the commitment applies, relevant documents or sections of the environmental assessment influencing the outcome and implementation.

4 Consultation

4.1 Consultation for this Plan

This NVMP including the Out of Hours Works (OOHW) Protocol, will be provided to NSW Health and North Sydney Council in accordance with CoA C4 (b) and CoA E69. The OOHW Protocol will also be provided to NSW Environment Protection Authority (EPA), in accordance with CoA E69. The outcomes of the agency consultation are outlined in the Critical Utilities CEMP Consultation Report.

4.2 Out of Hours Work Respite Consultation

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

The Community Communication Strategy (CCS) outlines how the Project will engage with and notify the community of upcoming works. In accordance with the CCS Appendix B – Out of Hours Communication Framework the following suite of communication tools will be considered as part of OOHW respite consultation, where required:

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

4.3 Endorsement and approval

In accordance with Section 2 of the CEMP, the Environmental Representative (ER) and Acoustic Advisor must endorse this NVMP prior to lodgement to DPIE for approval. This NVMP must be lodged to DPIE for approval at least one month prior to the commencement of CUT construction works.

5 Existing environment

5.1 Sensitive land user(s)

A land use survey has been carried out to identify the receiver types and uses of buildings and to confirm sensitive land user(s) (including critical working areas such as operating theatres and precision laboratories) that could potentially be impacted by noise and vibration from the critical utility works. This activity builds upon the information that was provided in the EIS through both desktop and ground-truthing exercises in critical areas where works will occur. The land use survey maps prepared in accordance with CoA E65 are presented in Appendix E.

5.2 Noise catchment areas

To facilitate the assessment of noise impacts from the Project, during the development of the EIS receivers within the vicinity of the Project were divided into Noise Catchment Areas (NCAs), which reflect land uses and the nature and types of receivers within each area.

A summary of the NCAs relevant to the critical utility works component of the Project is provided in Table 5-1 with a brief description of the key characteristics of each area. A map showing the location of each NCA is provided in Appendix C.

Noise monitoring was undertaken as part of the EIS to establish existing background and traffic noise levels within each of the NCAs. The monitoring results were utilised to determine appropriate Rating Background Levels (RBLs) and Noise Management Levels (NMLs) for each NCA for daytime, evening and night-time periods. These periods are defined as follows:

- **Day** is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays
- **Evening** is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays
- **Night** is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays.

Table 5-1 outlines the NCAs that are relevant to the critical utility works component of the Project (refer to Section 5.2), as identified in the EIS, Appendix C of Noise and Vibration Technical Paper (Appendix G).

Table 5-1 NCAs applicable to critical utility works (Reference: EIS, Appendix C of Noise and Vibration Technical Paper (Appendix G))

NCA	Description
Alfred Street North, Neutral Bay	
NCA 17.3	Residential and commercial receivers to the east of Warringah Freeway and north of High Street
NCA 17.4	Residential receivers to the east of Warringah Freeway and north of Kurraba Road
NCA 18.1	Residential and commercial receivers to the east of Broughton Street and south of High Street
NCA 18.2	Residential and commercial receivers to the east of Hipwood Street and north of High Street

NCA	Description
NCA 18.3	Residential, commercial and place of worship receivers to the east of Bent Street and south of Yeo Street
NCA 19.1	Residential and educational receivers to the east of Walker Street and west of Warringah Freeway
NCA 20.1	Residential receivers bounded by Ridge Street, Warringah Freeway and Walker Street
NCA 21.2	Residential, educational and commercial receivers to the south of Ridge Street, east of Miller Street and west of Walker Street
NCA 22.1	Residential, educational, commercial, place of worship and medical receivers to the west of Miller Street, east of West Street and north of McLaren Street
NCA 23.2	Commercial and educational receivers to the west of Warringah Freeway and north of Ridge Street
NCA 23.1	Residential receivers to the east of Merlin Street construction footprint (WFU7)
Arthur St, North Sydney	
NCA 15.2	Residential and commercial receivers to the west of Blues Point Road and south of Union Street
NCA 15.3	Residential, educational and commercial receivers to the west of Pacific Highway
NCA 15.4	Residential and place of worship receivers to the east of Blues Point Road and west of Lavender Bay
NCA 16.1	Residential and commercial receivers to the south of Lavender Street and west of Milsons Point Station
NCA 16.2	Commercial receivers to the west of Pacific Highway and east of Miller Street
NCA 16.3	Commercial and educational receivers to the west of Arthur Street construction footprint (WFU4)
NCA 17.1	Residential, educational and commercial receivers to the east of Cahill Expressway and bounded by Sydney Harbour
NCA 17.2	Residential receivers to the east of Cahill Expressway and south of High Street
Cammeray Avenue / Ernest Street / Cammeray Golf Course, Cammeray	
NCA 21.1	Residential and place of worship receivers to the north of Falcon Street and east of Miller Street
NCA 22.3	Residential, educational and commercial receivers to the south of Ernest Street and west of Miller Street
NCA 23.1	Residential receivers to the east of Merlin Street construction footprint (WFU7)

NCA	Description
NCA 23.2	Residential receivers to the south of Ernest Street and west of Warringah Freeway
NCA 24.1	Residential receivers to the south of Ernest Street
NCA 25.1	Residential and educational receivers, and ANZAC Park to the north of Ernest Street and west of Warringah Freeway
NCA 26.1	Residential receivers to the east of Cammeray Golf Club and north of Ernest Street
NCA 26.2	Cammeray Golf Club
NCA 27.1	Residential receivers to the east of Cammeray Golf Club and north of Grasmere Road
NCA 28.1	Residential receivers to the north of Cammeray Golf Club
NCA 29.1	Residential and commercial receivers to the south of Warringah Freeway and north of Rosalind Street
NCA 30.3	Residential and commercial receivers to the east of Warringah Freeway and north of Amherst Street
NCA 31.2	Residential and educational receivers to the north of Palmer Street and west of Bellevue Street

5.3 Cumulative noise impact from concurrent works

Critical utility works (Stage 1A) will run concurrently with other major infrastructure projects in the region, including the subsequent Warringah Freeway Upgrade early works (Stage 2A), the Warringah Freeway Upgrade main works (Stage 2B) and the Western Harbour Tunnel (Stage 3) project. The noise impacts of multiple projects occurring concurrently or consecutively will be addressed by complying with the relevant CoA and REMMs, particularly CoA E69 (Out-of-Hours Protocol – Works Not Subject to an EPL), E82 (Utility Coordination and Respite) and E83 (Out-of-Hours Works – Community Consultation on Respite).

Mitigation measures to minimise these cumulative construction noise impacts are considered in Section 8 of the NVMP and OOHW Protocol.

6 Relevant noise and vibration criteria

The Infrastructure Approval requires construction noise and vibration be managed in accordance with the standards and guidelines (CoA E70) outlined in Table 6-1 below. Relevant elements of these documents are summarised and discussed in the following sections.

Table 6-1 Policies and standards applicable to construction noise and vibration management

Environmental Impact	Relevant policy/standard used to establish noise and vibration management level
Construction hours	CoA
Airborne noise	NSW Interim Construction Noise Guideline (ICNG) (DECC 2009) Construction Noise and Vibration Guideline (CNVG) (RMS 2016) Construction Noise and Vibration Strategy (CNVS) (TfNSW 2018)
Sleep disturbance and maximum noise events	NSW Environmental Criteria for Road Traffic Noise (EPA 1999) Road Noise Policy– (RNP) (EPA 2011) Environmental Noise Management Manual (ENMM) Practice Note 3 (RTA 2001)
Ground-borne noise	NSW Interim Construction Noise Guideline (ICNG) (DECC 2009) Australian Standard AS/NZS 2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors Construction Noise and Vibration Guideline (CNVG) (RMS 2016) Construction Noise and Vibration Strategy (CNVS) (TfNSW 2018)
Construction-related road traffic noise	No specific guidelines, but guidance taken from the Road Noise Policy (RNP) (EPA 2011).
Vibration (disturbance to building occupants)	NSW DEC's *Assessing vibration; a technical guideline*, published in February 2006, in line with CoA E70(b), which incorporates British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz) (DECC 2006) Construction Noise and Vibration Guideline (CNVG) (RMS 2016) Construction Noise and Vibration Strategy (CNVS) (TfNSW 2018)
Vibration (structural damage to buildings)	British Standard 7385:1993 Evaluation and measurement of vibration in buildings – Part 2 Guide to damage from ground-borne vibration Construction Noise and Vibration Guideline (CNVG) (RMS 2016) Construction Noise and Vibration Strategy (CNVS) (TfNSW 2018)
Vibration (structural damage to buried services and screening criteria for heritage structures)	German Standard DIN 4150:2016 – Part 3 Structural vibration in buildings – Effects on structures

Environmental Impact	Relevant policy/standard used to establish noise and vibration management level
Vibration (sensitive scientific and medical equipment) (guidance only)	ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control Gordon GC 28 September 1999 Generic Vibration Criteria for Vibration Sensitive Equipment Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
Blast noise and vibration	Australian Standard AS 2187.2-2006 Explosives – Storage and use – Part 2 Use of explosives British Standard 7385: Part 2 Evaluation and measurement of vibration in buildings

6.1 Construction hours

Standard construction hours for the Project are defined by CoA E66 and E67. CoA E68 and E69 define where work may be undertaken outside of these standard hours. Work will be scheduled in accordance with the nominated conditions, except as permitted by an EPL.

6.1.1 Standard construction hours

In accordance with CoA E66, work must only be undertaken during the following hours:

(a) 7:00am to 6:00pm Mondays to Fridays, inclusive;

(b) 8:00am to 6:00pm Saturdays; and

(c) at no time on Sundays or public holidays.

6.1.2 Highly noise intensive work

In accordance with CoA E67, except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver must only be undertaken:

(a) between the hours of 8:00 am to 6:00 pm Monday to Friday;

(b) between the hours of 8:00 am to 1:00 pm Saturday; and

(c) if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

For the purposes of this condition, 'continuously' includes any period during which there is less than one hour between ceasing and recommencing any of the work.

In accordance with CoA E70 ‘particularly annoying’ activities require a penalty of 5dB(A) to noise predictions and results when comparing against NMLs. Refer to Section 6.2.1 for NML for the critical utility works. Please note, the ICNG defines ‘particularly annoying’ activities as being similar to the definition of ‘highly noise intensive’ provided in the Infrastructure Approval.

6.1.3 Variation to work hours

In accordance with CoA E68, works may be undertaken outside the standard construction hours. It is noted that CoA E68(d) is not relevant for the Stage 1A critical utility works.

Notwithstanding Conditions E66 and E67 work may be undertaken outside the hours specified in any of the following circumstances:

(a) Safety and Emergencies, including:

(i) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or

(ii) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm.

On becoming aware of the need for emergency work in accordance with Condition E68(a)(ii), the Proponent must notify the Acoustic Advisor, the ER, the Planning Secretary and the EPA of the reasons for such work. The Proponent must use best endeavours to notify all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work.

(b) Low impact, including:

(i) construction that causes LAeq(15 minute) noise levels:

• no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, or

• no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); or

(ii) construction that causes LAFmax(15 minute) noise levels no more than 15 dB(A) above the rating background level at any residence; or

(iii) construction that causes:

• continuous or impulsive vibration values, measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), or

• intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006).

(c) By Approval, including:

(i) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or

(ii) works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition E69; or

(iii) negotiated agreements with directly affected residents and sensitive land user(s).

(d) By Prescribed Activity, including:

(i) tunnelling (excluding cut and cover tunnelling and surface works) and tunnel fit out works (excluding surface works) are permitted 24 hours a day, seven days a week; or

(ii) delivery of material that is required to occur outside of standard construction hours in Condition E66 to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to/from WHT7 at Berrys Bay which could result in a sleep disturbance event for receivers in the proximity of Bay Road and Balls Head Road, Waverton; or

(iii) works within an acoustic shed where there is no exceedance of the NMLs; or

(iv) trailer suction hopper dredging; or

(v) along the Warringah Freeway corridor in accordance with Condition E88.

CoA E68(d)(i), (ii), (iii) and (iv) are not applicable to the CUT works.

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

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

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

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

(d) except as identified by an EPL; or

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

Table 6-2 below summarised the CUT construction activities and their locations that have the potential to exceed NML or are expected to trigger the requirement to carry out OOHW.

Table 6-2 Construction activities and locations with the potential to exceed NMLs or be required to be undertaken as OOHW

Area	Activity	Activities with potential to exceed NML			Reason for OOWH	Timing
		Day	Evening	Night		
Alfred Street North, Neutral Bay	Utility relocations (Power, Comms, Sewer)	Pavement sawing Excavation through rock Backfilling	-	-	-	Q2 2021 – Q4 2021
Alfred Street North, Neutral Bay	Utility relocations (Power, Communications, Sewer)	-	Utility cutovers	Utility cutovers	Utility authority approvals	Q2 2021 – Q4 2021
Alfred Street North, Neutral Bay	Traffic switch	-	Line removal Line marking Sweeping Barrier install	Line removal Line marking Sweeping Barrier install	Issue of Road Occupancy Licence	Q4 2021
Arthur Street, North Sydney	Traffic switch	-	Line removal Line marking Sweeping Barrier install	Line removal Line marking Sweeping Barrier install	Issue of Road Occupancy Licence	Q2 2021 – Q1 2022

High Street, North Sydney	Communications relocation	-	Utility cutovers	Utility cutovers	Utility authority approvals	Q3 2021 – Q4 2021
Arthur Street, North Sydney	Utility works (Ausgrid, Communications, Water)	-	Pavement sawing Excavation through rock	Pavement sawing Excavation through rock	Issue of Road Occupancy Licence	Q2 2021 – Q1 2022
Ernest Street, Cammeray	Utility relocations (Power, Communications, Sewer)	Pavement sawing Excavation through rock Backfilling	Pavement sawing Excavation through rock Backfilling	Pavement sawing Excavation through rock Backfilling	Issue of Road Occupancy Licence	Q2 2021 – Q4 2021
Cammeray Avenue, Cammeray	Utility relocations (Power, Communications, Sewer)	Pavement sawing Excavation through rock Backfilling	-	-	-	Q2 2021 – Q4 2021
Warringah Freeway, from Falcon Street to Miller Street	ITS installation	-	Pavement sawing Excavation through rock Backfilling	Pavement sawing Excavation through rock Backfilling	Issue of Road Occupancy Licence	Q3 2021 – Q4 2021
Miller Street off ramp, Cammeray	ITS installation	-	Pavement sawing	Pavement sawing	Issue of Road Occupancy Licence	Q3 2021 – Q4 2021

			Excavation through rock Backfilling	Excavation through rock Backfilling		
Mount Street, North Sydney and Sydney Harbour Tunnel approach	Utility relocation (Water)	-	Pavement sawing Excavation through rock Backfilling	Pavement sawing Excavation through rock Backfilling	Issue of Road Occupancy Licence	Q2 2021 – Q4 2021
Arthur Street, North Sydney	Clearing	Clearing	Clearing	Clearing	Issue of Road Occupancy Licence	Q2 2021 – Q3 2021
Alfred Street North, Neutral	Clearing	Clearing	Clearing	Clearing	Issue of Road Occupancy Licence	Q2 2021 – Q3 2021
Ernest Street, Cammeray Bay	Clearing	Clearing	Clearing	Clearing	Issue of Road Occupancy Licence	Q2 2021 – Q3 2021
Cammeray Avenue, Cammeray	Clearing	Clearing	Clearing	Clearing	Issue of Road Occupancy Licence	Q2 2021 – Q3 2021
Rosalind Street, Cammeray	Clearing	Clearing	Clearing	Clearing	Issue of Road Occupancy Licence	Q2 2021 – Q3 2021
Arthur Street, North Sydney	Restoration	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Issue of Road Occupancy Licence	Q1 2022

Alfred Street North, Neutral	Restoration	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Issue of Road Occupancy Licence	Q1 2022
Ernest Street, Cammeray Bay	Restoration	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Issue of Road Occupancy Licence	Q1 2022
Cammeray Avenue, Cammeray	Restoration	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Issue of Road Occupancy Licence	Q1 2022
Ridge Street, North Sydney	Construction support activities	-	Vehicle movements Material handling Stockpiling	Vehicle movements Material handling Stockpiling	Issue of Road Occupancy Licence for other work areas	Q2 2021 – Q1 2022

6.1.4 Out-of-Hours Work Protocol – works not subject to an EPL

The requirements for an Out-of-Hours Work Protocol for works that are not subject to an EPL are identified in CoA E69.

An Out-of-Hours Work Protocol must be prepared (refer to Appendix D) to identify a process for the consideration, management and approval of work which is outside the hours defined in Conditions E66, and that are not subject to an EPL. The Protocol must be approved by the Planning Secretary before commencement of the Out-of-Hours Work. The Protocol must be prepared in consultation with the ER, Acoustic Advisor 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 Acoustic Advisor 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 Acoustic Advisor, and

(iii) high risk activities that are approved by the Planning Secretary;

(b) a process for the consideration of out-of-hours work against the relevant NML and vibration criteria;

(c) a process for selecting and implementing mitigation measures for residual impacts in consultation with the community at each affected location, including respite periods consistent with the requirements of Condition E83. The measures must take into account the predicted noise levels and the likely frequency and duration of the out-of-hours works that sensitive land user(s) would be exposed to, including the number of noise awakening events;

(d) procedures to facilitate the coordination of out-of-hours work including those approved by an EPL or undertaken by a third party, to ensure appropriate respite is provided; and

(e) notification arrangements for affected receivers for all approved out-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works.

Out-of-hours-works, not subject to an EPL, will be scheduled, approved and undertaken in accordance with the OOHW Protocol (Appendix D) prepared in accordance with CoA E69. This condition does not apply if the requirements of Condition E68(b) are met.

6.2 Construction noise management levels

All feasible and reasonable noise mitigation measures will be implemented, with the aim of achieving the construction noise management levels detailed in the DECC Interim Construction Noise Guideline (ICNG). The construction NMLs adopted for the critical utilities work component of the Project are based on the ICNG NMLs for residential, sensitive land uses and commercial/ industrial premises.

In accordance with CoA A33, any activities generating noise in excess of 5 dB(A) above the 'Noise affected' NMLs derived from the ICNG will not commence until an Acoustic Advisor has been approved by the DPIE.

6.2.1 NMLs for residential receivers

Table 6-3 provides the NMLs for residential receivers applicable to each NCA for standard construction hours, out of hours works and sleep disturbance, as identified in the EIS, Appendix B.2 of the Noise and Vibration Technical Paper (Appendix G of the EIS). These NMLs presented are in the L_{Aeq} metric, except for "sleep disturbance" which is presented in L_{Amax}.

Where construction works are planned to extend over more than two consecutive nights, maximum noise levels and the extent and frequency of maximum noise level events exceeding the RBL will be considered to assess the likelihood of sleep disturbance. Where the calculated noise management levels for sleep disturbance in Table 6-3 is less than 55 dB(A), a minimum screening level of 55 dB(A) will be set. Further guidance as to how sleep disturbance impacts are determined is provided in Section 6.2.2.

Table 6-3 Residential receptor NMLs for critical utility works

NCA (representative monitoring locations)	Standard hours NML (RBL +10 dBA)	Out of hours NML (RBL + 5 dBA)			
	Day $L_{Aeq(15min)}$	Day $L_{Aeq(15min)}$	Evening $L_{Aeq(15min)}$	Night $L_{Aeq(15min)}$	Sleep disturbance (RBL + 15 dBA) L_{Amax}
NCA 15.2 (L15)	52	47	46	43	53
NCA 15.3 (L15)	52	47	46	43	53
NCA 15.4 (L15)	52	47	46	43	53
NCA 16.1 (L16)	70	65	65	55	65
NCA 16.2 (L16)	70	65	65	55	65
NCA 16.3 (L16)	70	65	65	55	65
NCA 17.1 (L17)	65	60	59	50	60
NCA 17.2 (L17)	65	60	59	50	60
NCA 17.3 (L17)	65	60	59	50	60
NCA 17.4 (L17)	65	60	59	50	60
NCA 18.1 (L20)	64	59	57	48	58
NCA 18.2 (L20)	64	59	57	48	58
NCA 18.3 (L20)	64	59	57	48	58
NCA 19.1 (L19)	62	57	57	50	60
NCA 20.1 (L19)	62	57	57	50	60
NCA 21.1 (L22)	63	58	54	46	56
NCA 21.2 (L22)	63	58	54	46	56
NCA 22.1 (L21)	62	57	52	41	51
NCA 22.3 (L21)	62	57	52	41	51

NCA (representative monitoring locations)	Standard hours NML (RBL +10 dBA)	Out of hours NML (RBL + 5 dBA)			
	Day $L_{Aeq(15min)}$	Day $L_{Aeq(15min)}$	Evening $L_{Aeq(15min)}$	Night $L_{Aeq(15min)}$	Sleep disturbance (RBL + 15 dBA) L_{Amax}
NCA 23.1 (L23)	71	66	59	49	59
NCA 23.2 (L23)	71	66	59	49	59
NCA 24.1 (L26)	66	61	57	42	52
NCA 25.1 (L27)	68	63	60	48	58
NCA 26.1 (L25)	68	63	59	46	56
NCA 26.2 (L25)	68	63	59	46	56
NCA 27.1 (L30)	59	54	53	44	54
NCA 28.1 (L29)	57	52	50	42	52
NCA 29.1 (L28)	74	69	68	52	62
NCA 30.3 (L31)	68	63	61	43	53
NCA 31.2 (L32)	66	61	54	42	52

Notes:

- Noise monitoring was carried out at various locations along the Project extent to quantify the Rating Background Level (RBL). The relevant noise monitoring location / reference logger for each NCA is identified in Appendix B.2 of the Noise and Vibration Technical Paper (Appendix G of the EIS). Representative monitoring locations are shown in Appendix C of this Plan.
- Standard day hours are Monday to Friday 7 am to 6 pm and Saturday 8 am to 6 pm
- OOHW Day hours are Sunday / Public holiday 8 am to 6 pm
- OOHW evening hours are 6 pm to 10 pm
- OOHW night hours are Monday to Friday 10 pm to 7 am and Saturday / Sunday / Public holiday 10 pm to 8 am
- A penalty of 5dB(A) is to be added to NMLs when reviewing predictions for 'particularly annoying' activities
- Sleep disturbance (RBL + 15dBA is applicable only during the night time period (as defined above)

6.2.2 Sleep disturbance for residential receivers

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

To assess the likelihood of sleep disturbance, an initial screening level of L_{Amax} or $L_{A1(1min)} \leq L_{A90(15min)}$ + 15 dB(A) is used. In situations where this results in an external screening level of less than 55 dB(A), a minimum screening level of 55 dB(A) is set. Note that this is equivalent to a maximum internal noise level of 45 dB(A) with windows open.

The Noise Policy for Industry (EPA, 2017) (NPI) also requires the potential for sleep disturbance from maximum noise level events during the night time period to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages. As required by the NPI a detailed maximum noise level event assessment should be undertaken when the following exceedances are expected at residential receivers:

- $L_{Aeq(15min)}$: 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- L_{Amax}: 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater

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

- The likely number of events that might occur during the night assessment period
- Whether events exceed an 'awakening reaction' level of 55 dB(A) L_{Amax} or $L_{A1(1min)}$ (internal) that equates to NML of 65 dB(A) (assuming open windows).

All noise levels are external, unless otherwise noted.

A summary of the noise management levels for sleep disturbance at residential receivers is provided in Table 6-3. Refer to Section 7.1 and Section 7.2 for detail on detailed noise assessments.

In accordance with CoA A34(d), the Acoustic Advisor will review all proposed night-time works to determine if sleep disturbance would occur and recommend measures to avoid sleep disturbance or appropriate additional alternative mitigation measures. As detailed in Section 8.2 of the OOHW Protocol mitigation 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 sleep disturbance events, in accordance with CoA E69(c).

6.2.3 NMLs for non-residential sensitive receivers

Table 6-4 sets out the NMLs for noise-sensitive non-residential land uses, including commercial premises, adopted from the ICNG and EIS (Table 10-4). Where a land use has not been identified in this table, a suitable NML can be determined by taking guidance from Australian Standard AS2107. The noise management levels apply only during hours when the non-residential premises are being used.

Table 6-4 NMLs at non-residential sensitive receivers

Non-residential sensitive receiver	Where NML applies	Noise management level ($L_{Aeq(15\ mins)}$)[1]
Classrooms at schools, and other educational institutions	Internal noise level	45 dB(A)[2]
Hospital wards and operating theatres	Internal noise level	45 dB(A)
Places of worship	Internal noise level	45 dB(A)
Childcare centre	External noise level	50 dB(A)[3]
Active recreation areas (e.g. sports field/activities which generate their own noise and are generally less sensitive to external noise)	External noise level	65 dB(A)

Non-residential sensitive receiver	Where NML applies	Noise management level ($L_{Aeq(15\ mins)}$)[1]
Passive recreation areas (e.g. area used for low intensity and low noise producing activities which could be impacted by external noise such as reading or meditation)	External noise level	60 dB(A)
Community centres	Depends on the intended use of the centre[4]	Refer to the 'maximum' internal levels in AS2107 for specific uses[4].
Commercial premises (including offices and retail outlets)	External noise level	70 dB(A)
Industrial premises	External noise level	75 dB(A)
Special noise and/or vibration sensitive (e.g. laboratories, recording studios)	Depends on the intended use	Refer to the 'maximum' internal levels in AS2107 for specific uses.

Note 1: LAeq(15min) is the A-weighted equivalent noise level. It is the summation of noise events and integrated over a period of 15 minutes.

Note 2: dB(A) stands for A-weighted decibel, a unit used to measure noise. Refer to Figure 10-1 for a comparison of dB(A) for various activities.

Note 3: The ICNG does not provide specific noise criteria for childcare centres; this noise management level has been taken from the EIS, Table 10-4. In addition, where a childcare centre is located within an existing commercial building, with no external play areas, they will be identified as a commercial premise, assuming the existing commercial facade would provide enough transmission loss to protect the amenity of the childcare centre (reference EIS, Appendix G, Section 3.4.1.2).

Note 4: Community centres have been assessed to an external noise level of 60 dB(A). Depending on the intended use of the centre, the noise management level may vary.

6.2.4 Additional mitigation measures – airborne noise

Where exceedances of the NMP are expected, additional mitigation measures will be implemented to mitigate residual impacts as outlined in Table 6-5 for the out of hours periods in Figure 6-1.

It should be noted that there may be personal circumstances among sensitive receivers where the below approach to specific additional mitigation measures is not best suited. The Communications Manager has the authority to amend the below approach and offer additional mitigation, considering the personal circumstances that may apply. This additional mitigation may include an offer for an individual briefing or a phone call.

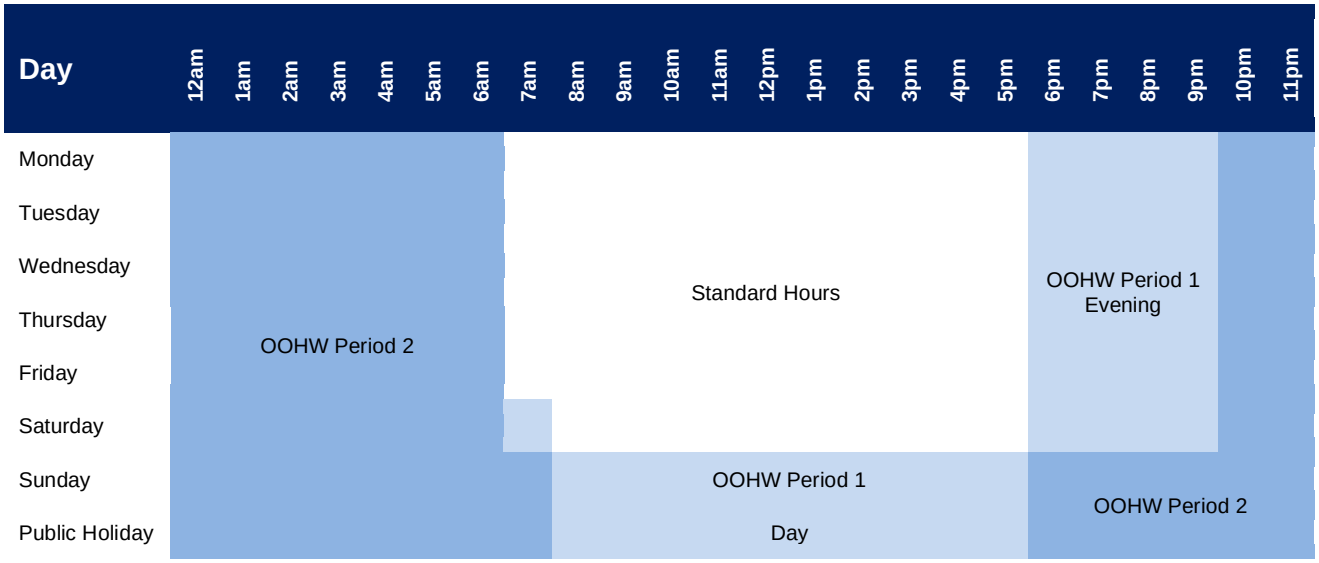

Figure 6-1 Standard construction hours and OOHW periods (Reference: CNVG (RMS 2018) and CoA E66))

Table 6-5 Additional noise mitigation measures – airborne noise (Table C.1, CNVG (RMS 2018))

Perception	dB(A) above RBL	dB(A) above NML	Addition mitigation measures	Mitigation levels
All hours				
75 dBA or greater	-	-	N, V, PC, RO	HA
Standard hours				
Noticeable	5 to 10	0	-	NML
Clearly audible	10 to 20	< 10	-	NML
Moderately intrusive	20 to 30	10 to 20	N, V	NML +10
Highly intrusive	> 30	> 20	N, V	NML +20
Out of hours works 1 (OOHW1)				
Noticeable	5 to 10	< 5	-	NML
Clearly audible	10 to 20	5 to 15	N, R1, DR	NML +5
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR	NML +15
Highly intrusive	> 30	> 25	V, IB, N, PC, R1, DR, SN	NML +25
Out of hours works 2 (OOHW2)				
Noticeable	5 to 10	< 5	N	NML
Clearly audible	10 to 20	5 to 15	V, N, R2, DR	NML +5

Perception	dB(A) above RBL	dB(A) above NML	Addition mitigation measures	Mitigation levels
Moderately intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR	NML +15
Highly intrusive	> 30	> 25	AltA, V, IB, N, PC, SN, R2, DR	NML +25

Notes:

AltA = Alternative Accommodation (refer to OOHW Protocol for further detail), V = Verification, IB = Individual Briefings, N = Notification, PC = Phone Calls, DR = Duration Respite (where feasible), R1 = Respite Period 1, R2 = Response Period 2 (refer to OOHW Protocol for further detail), RO = Respite Offer, SN = Specific Notification, HA = Highly Affected (> 75 dB(A) applies to residential receivers only)

6.2.5 Construction road traffic noise criteria

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

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

The ICNG refers to the NSW Road Noise Policy (RNP) for the assessment of noise from construction traffic on public roads. One of the objectives of the RNP is to apply relevant permissible noise increase criteria to protect sensitive receivers against excessive decreases in amenity as the result of a project. An increase of up to 2 dBA in road traffic noise levels represents a minor impact that is generally considered to be indiscernible to the average person.

Where road traffic noise levels increase by more than 2 dBA as a result of construction traffic, consideration will be given to applying feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity. Consideration will also be given to the actual noise levels associated with construction traffic and whether or not these levels comply with the following road traffic noise criteria in the RNP:

- Existing freeway/arterial/sub-arterial roads: 60 dBA $L_{Aeq(15hour)}$ day and 55 dBA $L_{Aeq(9hour)}$ night
- Existing local road: 55 dBA $L_{Aeq(1hour)}$ day and 50 dBA $L_{Aeq(1hour)}$ night.

6.3 Vibration criteria

The following construction vibration goals are applicable to the critical utilities works:

- For structural damage to heritage structures, the vibration limits set out in the German Standard *DIN 4150-3: Structural Vibration - effects of vibration on structures*
- For damage to other buildings and/or structures (as they are applicable to Australian conditions), the vibration limits set out in the British Standard *BS 7385-1:1990 - Evaluation and measurement for vibration in buildings*
- For human exposure, vibration criteria established using *Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006).

Vibration generating activities will be managed through the establishment of minimum buffer distances to achieve screening levels where practicable. Where vibration levels are predicted to exceed the screening levels, a more detailed assessment of the impacted structure and attended

vibration monitoring will be carried out to ensure vibration levels remain below appropriate limits for that structure.

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

No blasting is currently proposed for the critical utility works.

Further details of each of these references are provided below and specific vibration criteria for the construction identified.

6.3.1 Buildings and structures (non-heritage)

Potential structural damage of buildings by vibration is managed by ensuring vibration impacting the structure does not exceed the limits in the British Standard *BS 7385-1:1990 - Evaluation and measurement for vibration in buildings.* The cosmetic damage levels within this standard are outlined in Table 6-6.

The EIS, Appendix G, Section 3.4.5.2, acknowledges that most construction activities involve intermittent vibration sources in frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range), therefore as recommended the following vibration level (PPV) will be adopted as trigger values:

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

Where predicted or monitored vibration levels exceed these trigger values a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be completed to determine the applicable safe vibration level and approach to construction near the structure.

Table 6-6 Transient Vibration Guide Values for Cosmetic Damage (BS 7385: Part 2: 1993)

<table>
<tr><th rowspan="2">Type of Building</th><th colspan="3">Peak Component Particle Velocity in frequency range of predominant pulse</th></tr>
<tr><th>4 to 15 Hz</th><th>15 to 40 Hz</th><th>40 Hz and above</th></tr>
<tr><td>Reinforced or framed structures.
Industrial and heavy commercial buildings</td><td colspan="3">50 mm/s</td></tr>
<tr><td>Unreinforced or light framed structures.
Residential or light commercial type buildings</td><td>15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz</td><td>20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz</td><td>50 mm/s</td></tr>
</table>

6.3.2 Buildings and structures (heritage)

Vibration limits for heritage items will be considered on a case by case basis, considering whether the building is structurally unsound. The EIS, Appendix G, Section 3.4.5.3 sets a vibration trigger value for heritage items at 2.5mm/s peak component particle velocity (based on the German Standard *DIN 4150-3*). Where vibration levels are predicted or monitored to exceed the trigger value a structural engineering report will be completed on the heritage item, to confirm the structural integrity of the building and if it is 'structurally sound'. If the heritage item is structurally

sound the trigger values from Section 6.3.1 will be adopted. If the building is confirmed as 'structurally unsound' the level of 2.5mm/s peak component particle velocity will be adopted.

In accordance with REMM CNV6 any damage caused to heritage items will be rectified by the Project.

6.3.3 Human comfort goals

The guideline *Assessing Vibration: a technical guideline* (DEC 2006) nominates preferred and maximum vibration values for human comfort for critical areas, residences and other sensitive receptors. The applicable vibration values vary depending on whether vibration sources are continuous, impulsive or intermittent (refer to Table 6-7 for definitions). Preferred and maximum vibration values for continuous and impulsive vibration are outlined in Table 6-8, and for intermittent vibration in Table 6-9.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values, however adverse comment or complaints may be expected if vibration values approach the maximum values.

Activities, particularly for temporary disturbances and infrequent events of short term duration should be designed to meet the preferred values where an area is not already exposed to vibration. Where all feasible and reasonable measures have been applied to control potential ground vibration levels, the maximum values may be used.

Table 6-7 Types of vibration

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

Table 6-8 Preferred and maximum vibration levels for human comfort – continuous and impulsive vibration (Source: Table 2.2, Assessing Vibration; a technical guideline, Department of Environment and Climate Change 2006).

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

Notes:
1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above.

Table 6-9 Preferred and maximum levels for human comfort – intermittent vibration (Source: Table 2.4, Assessing Vibration; a technical guideline, Department of Environment and Climate Change 2006).

Building type	Assessment period[1]	Preferred VDV	Maximum VDV
Intermittent vibration (Vibration Dose Values, VDV, m/s1.75, 1-80Hz)			
Critical working areas (e.g. hospital operating theatres, precision laboratories)	Day- or night-time	0.10	0.20
Residential daytime	Daytime	0.20	0.40
	Night time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day- or night-time	0.40	0.80
Workshops	Day- or night-time	0.80	1.60

Notes:
1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above.

6.3.4 Minimum working distances for vibration intensive plant

The propagation of vibration emitted from a source is site-specific with the level of vibration experienced at a receiver dependent on the vibration energy generated by the source, the main frequencies of vibration, the localised geotechnical conditions and the interaction of structures and features which can dampen vibration. Minimum work distances for typical items of vibration intensive plant and equipment are provided in Table 6-10, based on the EIS Appendix G, Table 4-11.

Minimum working distances for typical items of vibration intensive construction plant are provided in Table 6-10, considering both human comfort and impacts on structures. Appendix F presents worst case safe working distances for typical site establishment and utilities relocation activities associated with the CUT works. These were developed as part of the Construction Noise and Vibration Impact Statement (CNVIS) for the CUT works (refer to Section 7.1).

Where specified construction equipment is used at greater distances from receiver locations than the specified minimum working distance, there is negligible risk of structural damage or impacts on human comfort outside of the construction site. Where the minimum working distances for 'cosmetic' damage nominated in Table 6-10 are unable to be complied with, additional assessment and/or monitoring will be undertaken to determine site specific minimum working distances. Where the minimum working distances for human response are unable to be complied with additional mitigation measures as per Section 6.3.5 will be applied.

Table 6-10 Recommended minimum working distances for vibration intensive equipment (Source: EIS Appendix G, Table 4-11)

Plant item	Rating description	Minimum working distance (m)		
		Cosmetic damage		Human response[3]
		Structurally sound[1] (e.g. Residential and light commercial)	Structurally unsound[2] (e.g. unsound heritage item structure)	
Vibratory roller	< 50 kN (typically 1–2t)	5	11	15-20
	< 100 kN (typically 2–4t)	6	13	20
	< 200 kN (typically 4–6t)	12	15	40
	< 300 kN (typically 7–13t)	15	31	100
	> 300 kN (typically 13–18t)	20	40	100
	> 300 kN (typically > 18t)	25	50	100
Compactor	32t (non-vibratory)	15	30	40
Bulldozer	D10 with ripper	2	10	20
Excavators	<30 tonne (travelling /digging)	10	15	15
Small hydraulic hammer	300 kg – 5 to 12 tonne excavator	2	5	7
Medium hydraulic hammer	900 kg – 12 to 18 tonne excavator	7	15	23
Large hydraulic hammer	1600 kg – 18 to 34 tonne excavator	22	30	73
Vibratory pile driver	Sheet piles	2-20	30	50
Impact piling	Typical driven pile[4]	20	30	110
	338kJ per stroke (23 tonne hammer with 1.5m stroke)	70	140	330

Plant item	Rating description	Minimum working distance (m)		
		Cosmetic damage		Human response[3]
		Structurally sound[1] (e.g. Residential and light commercial)	Structurally unsound[2] (e.g. unsound heritage item structure)	
Pile boring	≤800 mm	2	5	4[5]
Jackhammer	Hand held	1	3	5
Truck traffic	On uneven construction haul roads	5	10	20
Concrete saw	On roads and pavements	1	2	2

Note 1: Criteria referenced from British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2.

Note 2: Criteria referenced from DIN 4150 Structural Damage - Safe Limits for Short-term Building Vibration (including heritage items).

Note 3: Criteria referenced from EPA's Assessing Vibration: a technical guideline (December 2006).

Note 4: Referenced to a 'typical' pile driver (impact) taken from US Department of Transportation Federal Transit Administration Noise and Vibration manual.

Note 5: Criteria referenced from RMS Construction Noise and Vibration Guideline 2016.

Note 6: Road saw safe working distances were not provided in the EIS. Jackhammer offset distances provided in the CNVG have been adopted for road saws at the recommendation of SPA's Acoustician.

6.3.5 Additional Mitigation Measures – Vibration

Where exceedances of the human response minimum working distances are expected, additional mitigation measures will be implemented to mitigate residual impacts as outlined in Table 6-11 for the out of hours periods in Figure 6-1.

Table 6-11 Additional noise mitigation measures – vibration

Perception	Addition mitigation measures
Standard hours	
Human response minimum working distances predicted to be exceeded	N, V, RP
Out of hours works 1 (OOHW1)	
Human response minimum working distances predicted to be exceeded	V, IB, N, RO, PC, RP, SN
Out of hours works 2 (OOHW2)	
Human response minimum working distances predicted to be exceeded	AltA, V, IB, N, PC, SN, RP

Notes:

AltA = Alternative Accommodation (refer to OOHW Protocol for further detail), V = Verification, IB = Individual Briefings, N = Notification, PC = Phone Call, RP = Respite Period (refer to OOHW Protocol for further detail), RO = Respite Offer, SN = Specific Notification

Other additional mitigation measures may include, where possible:

- Selection of less vibration generating plant or equipment
- Saw cutting of rock when hammering rock to provide separation between activity and sensitive receivers.

Refer to Section 8 for all environmental control measures proposed for the CUT works.

7 Construction noise and vibration assessment

To manage potential impacts from noise and vibration during the works, SPA will assess predicted noise impacts associated with the works in accordance with the CVNG through the development of a Construction Noise and Vibration Impact Statement (CNVIS) or using a construction noise estimation tool.

7.1 Construction Noise and Vibration Impact Statement

A Construction Noise and Vibration Impact Statement (CNVIS) will be developed for all activities as detailed in Table 7-1.

CNVISs refine impact predictions presented in the EIS. CNVISs will be prepared by an appropriately qualified and experienced acoustic consultant and, in accordance with CoA E75 will be provided to the Acoustic Advisor and ER prior to the commencement of the activity relating to the CNVIS.

The CNVIS will address:

- Scope of work covered by CNVIS
- Justification for OOHW (where required)
- Nearest noise and vibration sensitive land user(s), based on land use survey
- Construction noise and vibration objectives (outlined in Section 6)
- Construction noise and vibration assessment
- Mitigation options and preferred management measures, including noise barriers and acoustic enclosures as relevant
- Additional mitigation measures as described in Section 6.2.4 and Section 6.3.5
- Noise and vibration monitoring requirements
- Community notification requirements.

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

Table 7-1 Process for assessing construction noise and vibration

Steps	Tasks
1. Determine noise and vibration objectives	For each key construction area: • Identify noise and vibration sensitive receivers • Determine relevant noise and vibration objectives, with reference to Section 6
2. Identify construction stages	For each key construction area: • Identify construction aspects and key activities, including: ◦ Site location ◦ Times of operation ◦ Activities involved

Steps	Tasks
	◦ Plant and equipment (including size/type) • Identify construction works in the vicinity of the project. Liaise with the Utilities Coordination Manager and other construction projects in the vicinity of the works to ensure cumulative noise and vibration impacts are managed, in particular for OOHW.
3. Predict noise and vibration impacts	<u>Airborne construction noise</u> • Determine $L_{Aeq(15\ minute)}$ sound power levels for plant and equipment based on operating scenarios for input to noise model • Establish noise model for construction activity. The noise model should include: ◦ Height and location of sources and receivers ◦ Distance attenuation (incorporating noise reflections, ground absorption) ◦ Effects of noise shielding (topography, buildings, fence, barriers etc.) ◦ Effects of standard noise mitigation measures ◦ Evaluate façade transmission loss of affected receivers to determine internal noise levels • Calculate the $L_{Aeq(15\ minute)}$ noise levels (external and internal) from the proposed construction activities at each receiver and compare these with the construction noise objectives • For night-time activities, calculate the maximum (L_{Amax}) noise levels and compare with $L_{A(1\ min)}$ 65 dB(A) sleep disturbance criterion, applied at the external facade
	<u>Construction vibration</u> • Determine the location of each plant or equipment item in relation to each receiver • Where vibration intensive equipment could potentially be operating in close proximity to receivers, determine whether this is within the minimum working distances (refer to Section 6.3.3). Note that minimum working distances may differ for heritage items • Where plant and equipment may operate within minimum working distances, or for heritage items: ◦ Use vibration levels versus distance prediction curves for each plant item ◦ Determine the vibration likely to occur at each building location ◦ For highly sensitive, equipment, assessment may need to incorporate structural response of building and particular sensitivities of equipment

Steps	Tasks
4. Assess noise and vibration impacts	Where predicted noise and vibration exceeds the objectives identified in Step 1: • Identify key hours of impact for affected sensitive receivers (refer to Section 6.1) • Implement appropriate reasonable/feasible standard mitigation measures (refer to Section 9) • Predict noise and vibration impact at receivers, incorporating nominated mitigation measures, based on the expected noise reduction from mitigation measures • Additional mitigation measures may need to be considered.

7.2 Construction noise estimation tool

A construction noise estimation tool will be developed for use on the Project.

An assessment will be prepared with the tool before works that generate noise impacts commence and will set out the construction noise and vibration prediction, assessment (including detailed sleep disturbance assessment), and mitigation and management measures required for the works. The assessment summary report will address:

- Scope of work covered by CNVIS
- Justification for OOHW (where required)
- Background noise levels
- Noise Management Levels
- Estimated noise levels for each time period at the nearest noise sensitive receivers, based on land use survey
- Sleep disturbance for night time works
- Mitigation options and preferred management measures
- Noise monitoring requirements
- Community notification requirements.

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

8 Environmental control measures

Specific measures and requirements to address contract specifications, CoA and REMM's in relation to impacts from noise and vibration are outlined in Table 8-1. The following mitigation measures have been developed with consideration of SMART (specific, measurable, achievable, relevant and time-based) principles.

Table 8-1 Noise and vibration management and mitigation measures

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
GENERAL NOISE AND VIBRATION IMPACTS						
NV1	Training will be provided to relevant project personnel, including relevant sub-contractors on noise and vibration requirements from this NVMP through inductions, toolboxes or targeted training. Training will cover the following: • Nominated construction hours, restrictions and general requirements for OOHW • Avoiding use of radios or stereos outdoors during standard working hours where residents or Public Schools may be affected and at all times during work outside standard working hours • Avoiding shouting and minimise talking loudly and slamming vehicle doors • Avoiding communicating and signalling using horns	Toolbox talk Induction Noise and vibration awareness training	Prior to construction Construction	Construction Environmental Manager	Best practice CoA C5(c), E66 – E69	Induction records Toolbox talk records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	• Where practical, operate machines at low speed or power and switch off when not used rather than left idling for prolonged periods • Minimising reversing • Avoiding dropping materials from height and avoiding metal to metal contact on material • All site personnel will be responsible for managing noise from their work activities and to work in a manner that will minimise noise emissions • Measures to minimise sleep disturbance impacts from construction vehicles.					
NV2	The location of known heritage items and conservation areas in the vicinity of the Project will be shown on sensitive area plans and their location communicated to all site personnel prior to the commencement of works.	Sensitive area plans	Prior to construction	Construction Environmental Manager Construction Project Manager	Best practice	Sensitive area plans Induction records
NV3	Prior to arriving on site, drivers will be advised of designated vehicle routes, parking locations, acceptable delivery hours specific to the site and other relevant practices (i.e. minimising the use of engine brakes and no extended periods of engine idling). This will be communicated using notifications under contract provisions and communication with companies using heavy vehicles.	Induction	Construction	Supervisor/ Foreman / Site Engineer	Best practice	Vehicle movement plans Traffic control plans Induction records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NV4	Noise generated by construction will not exceed the National Standard for exposure to noise in the occupational environment of an eight-hour (8hr) equivalent continuous A-weighted sound pressure level of LAeq,8h of 85 dB(A) for any employee working at a location near the work site.	Induction	Construction	Construction Manager Foreman	CoA E73	Site inspection and monitoring records
CONSTRUCTION TRAFFIC NOISE						
NV5	Construction vehicle movements will only occur on local roads if approved under CoA E132 to directly access ancillary facilities or the construction boundary.	Relevant traffic noise criteria	Construction	Construction manager	CoA E132 REMM CNV8 (j)	Site inspection records
NV6	Out of hours deliveries will be minimised where possible. Where out of hours deliveries are required, due care will be taken to minimise impacts by no extended periods of engine idling, use of radios instead of shouting, use of non-tonal reversing beepers where possible, avoiding use of chains for lifting or restraining where possible, avoiding local roads where possible, and unloading / loading undertaken during standard hours.	Noise and vibration awareness training	Construction	Construction Manager Foreman Environmental Manager	Best practice REMM CNV8 (j)	Induction records
NV7	Early occupation and later release of road carriageways and construction sites will be considered, where feasible to minimise noise impacts to receivers from night works.	N/A	Construction	Construction Project Manager Construction Manager	CoA E74 (b)	Road Occupancy Licence (ROL)

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
CONSTRUCTION NOISE IMPACT FROM CONCURRENT WORKS						
NV8	Work will be coordinated between project construction sites and / or non-project construction works to avoid cumulative noise impacts.	N/A	Construction	Utilities Coordination Manager Construction Project Manager	REMM CNV1 (i) and CNV10	Meetings with relevant authorities
NV9	Additional at source or near source mitigation will be considered where construction noise levels may result in cumulative construction noise impacts, where programming is not practical to avoid cumulative noise impacts.	N/A	Construction	Construction Project Manager Construction Manager	REMM CNV1 (i) and CNV10	Site inspection records
NV10	Community consultation will be undertaken throughout the project to gauge impacts from construction noise and any unknown impacts from concurrent or consecutive sets of construction works.	N/A	Construction	Construction Project Manager Construction Manager Community Manager	REMM CNV1 (i), CNV8 (d) and CNV10	Community notification
PLANT AND EQUIPMENT						
NV11	Where reasonable and feasible, noise and vibration impacts will be reduced through the selection of less noise intensive equipment and methods.	Noise and vibration awareness training	Construction	Construction Manager Foreman	REMM CNV8 (b)	Site inspection records
NV12	The distance between noisy plant items and nearby noise sensitive receivers will be maximised where feasible, with equipment orientated within the	Noise and vibration	Construction	Construction Manager	Best practice	Site inspection records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	available space to reduce noise. Additionally, the use of alternative construction and demolition techniques will be considered where reasonable and feasible to reduce construction noise and vibration impacts.	awareness training		Foreman	E74(e)	
NV13	Boundary screening including noise barriers will be constructed around construction compounds in accordance with the CNVIS before the commencement of noisy activities to shield sensitive land user(s).	Noise barriers	Construction	Construction manager Construction Project Manager	CoA A20 and E74 (d)	Site inspection records
NV14	Stationary noisy equipment will be enclosed or shielded where reasonably practicable whilst ensuring that the occupational health and safety of workers is maintained. This would apply to plant and equipment such as generators, stationary concrete cutters, stationary vacuum trucks, and stationary jack hammers. Appendix D of AS2436:2010 lists materials suitable for shielding.	Noise and vibration awareness training	Construction	Construction Manager Foreman	CoA E74 REMM CNV8 (i)	Site inspection records
NV15	Plant and equipment will be used and maintained in a proper and efficient manner, in accordance with the manufacturers' specification.	Noise and vibration awareness training	Construction	Construction Manager Foreman	REMM CNV8 (c)	Plant inspection records
NV16	Equipment with non-tonal movement alarms will be used wherever practicable. Non tonal alarms on plant and equipment will be used for out of hours works. Audible alarms to be set to the minimum volume necessary to adequately perform their function.	Noise and vibration awareness training	Construction	Construction Manager Foreman	Best practice	Plant inspection records Site inspection records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NV17	Work sites will be arranged to minimise reversing and the use of movement alarms on vehicles and mobile plant where practical and safe to do so.	Noise and vibration awareness training	Construction	Construction Manager Foreman	Best practice	Site inspection records
NV18	All power-driven work equipment used will have efficient muffler design and be well maintained.	Noise and vibration awareness training	Construction	Construction Manager Foreman	Best practice	Plant inspection records
NV19	Regularly serviced low sound power equipment will be used where reasonably practicable.	Noise and vibration awareness training	Construction	Construction Manager Foreman	CoA E74 (a)	Plant inspection records
CONSTRUCTION HOURS						
NV20	Where works are required near schools, other religious and educational facilities, noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres), the Project will consult with the facility to identify sensitive periods, and will schedule the works to avoid times when attendees are more sensitive to noise, unless other reasonable arrangements with the affected institutions are made, at no cost to the affected institution.	N/A	Construction	Construction Project Manager Construction Manager Construction Environmental Manager	CoA E72	Site inspection records Induction records
NV21	Unless otherwise permitted in accordance with an EPL or CoA E68, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver will only be carried out:	Induction	Construction	Construction Project Manager	CoA E67 CoA E68	Induction records Site inspection records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	• Between 8:00 am and 6:00 pm Monday to Friday • Between 8:00 am and 1:00 pm Saturday • If continuously, then not exceeding three (3) hours with a minimum respite from those activities and works of not less than one (1) hour between each block. Where reasonable and feasible works will be carried out during standard construction hours when near residential receivers.			Construction Manager Construction Environmental Manager	REMM CNV8 (a), (b) and (h)	
NV22	Where works are required outside standard working hours and are not subject to an EPL, the OOHW Protocol will be prepared to identify a process for the consideration, management and approval of that work. The OOHW Protocol will be approved by DPIE before commencement of the relevant out of hours work.	OOHW Protocol OOHW Request Form	Construction	Construction Project Manager Construction Manager Construction Environmental Manager	CoA E69	Site inspection records Induction records OOHW Request Form
NV23	Where ROL restrictions allow, night works will be programmed to carry out noisy activities (e.g. sawcutting, hydraulic hammering / breaking) prior to 11pm.	Noise and vibration awareness training	Construction	Construction Manager Foreman	REMM CNV8 CNVG	Site inspection records
NOISE BARRIERS						
NV24	Noise barriers (such as site hoardings) will be constructed around major ancillary facilities as detailed within the relevant CNVIS (Note: this does not include temporary noise blankets, whose	CNVIS	Prior to construction Construction	Construction Project Manager	Best practice	Site inspection records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	location is not specified in the CNVIS). These will be implemented as early as possible.					
NV25	Structures will be used as noise barriers at compounds where appropriate. These will be implemented as early as possible.	CNVIS Site layout drawings	Construction	Construction Project Manager Construction Environmental Manager	Best practice	Site inspection records
NV26	Site access and egress points will be located as far as feasible and reasonable from noise sensitive receivers.	Site layout drawings	Prior to construction	Construction Manager Foreman Construction Environmental Manager	Best practice	Site inspection records Meeting minutes
NOISE AND VIBRATION MONITORING						
NV27	Noise and vibration monitoring will be carried out in accordance with Section 9.1.	Section 9.1 Appendix F - Noise and Vibration Monitoring Program	Construction	Construction Environmental Manager	CoA C11 to C13; C17 to C20	Monitoring records
NV28	Verification monitoring will be carried out during the initial stages of activities for which a location and activity specific noise and vibration impact assessment has been prepared to confirm that actual noise and vibration levels are consistent with	Section 9.1 Appendix F - Noise and Vibration	Construction	Construction Environmental Manager	Best practice	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	noise and vibration impact predictions and that the management measures that have been implemented are appropriate.	Monitoring Program				
NV29	Attended noise monitoring will be undertaken upon receipt of a complaint, unless monitoring results at or near the receiver for the activity have been collected recently and are within the predicted noise levels. Measured noise levels will be compared to predicted noise levels to confirm that all appropriate mitigation measures have been implemented in accordance with the Construction Noise and Vibration Guideline (Roads and Maritime Services, 2016).	CNVIS Appendix F - Noise and Vibration Monitoring Program	Construction	Construction Manager Construction Environmental Manager	Best practice	Monitoring records
NV30	Periodic compliance noise level spot checks of plant and requirements will be undertaken to ensure the noise performance level predicted is met or whether noise emissions from plant items were higher than predicted. This monitoring will also identify defective silencing requirements on the items of plant.	CNVIS Appendix F - Noise and Vibration Monitoring Program	Construction	Construction Manager Construction Environmental Manager	Best practice	Monitoring records
NV31	If vibration intensive works are required within the minimum working distances, vibration monitoring or attended vibration trials would be undertaken to ensure that levels remain below the cosmetic damage criterion where possible.	CNVIS Appendix F - Noise and Vibration Monitoring Program	Construction	Construction Manager Construction Environmental Manager	Best practice	Monitoring records
NV32	Vibration testing will be conducted during vibration generating activities that have the potential to	CNVIS	Construction	Construction Manager	CoA E79	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	impact on heritage items to identify minimum working distances to prevent cosmetic damage. In the event that the vibration testing and attended monitoring shows that the preferred values for vibration are likely to be exceeded, the construction methodology will be reviewed and, if necessary, additional mitigation measures will be implemented.	Appendix F - Noise and Vibration Monitoring Program		Construction Environmental Manager	REMM CNV6	
NV33	Seek the advice of a heritage specialist on methods and locations for installing equipment to monitor vibration, movement and noise at heritage-listed structures.	Heritage specialist Appendix F - Noise and Vibration Monitoring Program	Construction	Construction Manager Construction Environmental Manager	CoA E80 REMM CNV6	Monitoring records
NV34	The project will offer pre-construction condition surveys on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model or CNVIS or as directed by the Independent Property Impact Assessment Panel. The surveys and subsequent condition survey reports will be prepared by a suitable qualified and experienced person and will be provided to owners of the structure prior to the commencement of potentially impacting works. Where pre-construction surveys have been undertaken in accordance with CoA E107, subsequent post-construction surveys must be undertaken to assess damage to the surface and	Community Communication Strategy	Prior to construction Construction	Construction Project Manager	G36 CoA E75 CoA E107 CoA E108 REMM CNV8(l)	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	sub-surface structures that may have resulted from construction within three months of landowner(s) requests.					
CONSULTATION AND COMPLAINTS MANAGEMENT						
NV35	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage will be notified before works that generates vibration commence in the vicinity of those properties. If the potential exceedance is anticipated 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.	Community Communication Strategy	Pre-construction Construction	Construction Environmental Manager Communications Manager	CoA E76 REMM CNV8	Community notifications
Heritage						
NV36	Before conducting acoustic at-property treatment at any heritage items, SPA will seek the advice of a suitably qualified and experienced built heritage expert to ensure any work does not have an adverse impact on the heritage significance of the item.	Heritage specialist	Construction	Construction Manager Construction Environmental Manager	E81 REMM NAH4	Written advice (memo / report)

9 Compliance Management

9.1 Monitoring

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

9.2 Continual improvement

Monitored noise and vibration levels will be analysed against the predictions made in the relevant CNVIS or using the construction noise estimation tool. This analysis will ensure the Project's performance outcomes are met throughout construction. Where monitored construction noise levels are found to be above modelling predictions or vibration goals are exceeded, or in response to complaints associated with noise and vibration impacts, the following actions will be undertaken:

- Confirm the monitored levels are not being impacted by other noise or vibration sources
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant
- Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment
- Confirm that the modelling reflects the actual activity being undertaken
- Review additional mitigation measures that were applied and revise if necessary
- Implement other (or additional) feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), and utilising alternative construction methodology or a combination of these
- Review work practices to ensure compliance with the ICNG
- Communicate lessons learnt to relevant personnel.

SPA will review the activity or combination of simultaneous activities and where possible, modify the activity to prevent reoccurrence. Lessons learnt will be communicated to relevant personnel in toolbox talks.

Where an increased noise level has been obtained through monitoring, a review of the mitigation measures will be undertaken and appropriate additional mitigation measures will be offered, in accordance with this Plan.

This will form part of the continual improvement processes detailed in Section 3.11 and Section 3.12 of the CEMP.

9.3 Reporting

Reporting requirements and responsibilities are documented in Section 3.9.4 and 3.9.5 of the CEMP.

Construction Monitoring Reports will be prepared on a bi-annual basis (every 6 months) as described in Section 8.2 of the Noise and Vibration Monitoring Program.

Construction Monitoring Reports will be provided to DPIE and relevant regulatory authorities for information, in line with CoA C21. The reports will also be provided to TfNSW, the ER and AA in accordance with CoA C13(d).

Further to this, the Acoustic Advisor will provide a Monthly Noise and Vibration Report detailing the Acoustic Advisor's actions and decisions on matters for which the Acoustic Advisor is responsible, in accordance with CoA A33(h)(v) and included in Section 3.9.4 of the CEMP.

9.4 NVMP update and amendment

The processes described in Section 3.9 to Section 3.12 of the CEMP may result in the need to update or revise this Plan. This will occur as needed.

Any revisions to this Plan will be in accordance with the process outlined in Section 2 and 3.12 of the CEMP.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 3.10.2 of the CEMP.

Appendix A Performance Outcomes

Performance outcomes identified in Table 28-4 of the EIS that are relevant to the management of noise and vibration during the critical utility works are identified in the table below.

Performance outcome	How performance outcome will be addressed	Records	Source
Minimise impacts to local streets from loss of parking, road closures and heavy vehicle movements during construction	Utilise the heavy vehicle routes outlined in the Traffic Management Plan. Implement the measures to minimise impacts resulting from heavy vehicles movements outlined in Section 8 of this NVMP. Undertake training, inspections, auditing and recording in accordance with Section 9.3 and Section 3.9 of the CEMP.	Heavy vehicle routes Complaints register Weekly inspection record	EIS – Chapter 28 (Table 28-4)
Noise and vibration – Amenity			
Include effective management of construction noise and vibration in accordance with relevant guidelines, for example through the use of acoustic sheds	Implement the noise and vibration measures in section 8 which have been developed in accordance with the guidelines in Section 3.1.3. Note: the use of acoustic shed is not applicable to this scope of works. Undertake training, inspections, auditing and recording in accordance with Section 9.3 and Section 3.9 of the CEMP.	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Inspection records Monitoring records Complaints register	EIS – Chapter 28 (Table 28-4)

Performance outcome	How performance outcome will be addressed	Records	Source
Minimise impacts to the local community by: • Controlling noise and vibration at the source • Controlling noise and vibration on the source to receiver transmission path • Controlling noise and vibration at the receiver • Implementing practicable and reasonable measures to minimise the noise and vibration impacts of construction activities on local sensitive receivers	Implement the noise and vibration measures in Section 8. Undertake training, inspections, auditing and recording in accordance with Section 9.3 and Section 3.9 of the CEMP.	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Inspection records Monitoring records Complaints register	EIS – Chapter 28 (Table 28-4)
Noise and vibration – Structural			
Controlling vibration at the source	Implement the noise and vibration measures in Section 8. Undertake training, inspections, auditing and recording in accordance with Section 9.3 and Section 3.9 of the CEMP.	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Inspection records Monitoring records Complaints register	EIS – Chapter 28 (Table 28-4)
Controlling vibration on the source to receiver transmission path	Implement the noise and vibration measures in Section 8. Undertake training, inspections, auditing and recording in accordance with Section 9.3 and Section 3.9 of the CEMP.	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Inspection records Monitoring records	EIS – Chapter 28 (Table 28-4)

Performance outcome	How performance outcome will be addressed	Records	Source
		Complaints register	
Implementing practicable and reasonable measures to minimise vibration impacts of construction activities on structures	Implement the noise and vibration measures in Section 8. Undertake training, inspections, auditing and recording in accordance with Section 9.3 and Section 3.9 of the CEMP.	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Inspection records Monitoring records Complaints register	EIS – Chapter 28 (Table 28-4)

Appendix B Condition of Approval and REMM Compliance Tracking

The Conditions of Approval and Revised Environmental Management Measures detailed below are those that are related specifically to the preparation of this Noise and Vibration Management Sub-plan.

Table App B-1 Minister's Conditions of Approval

CoA No.	Condition Requirements	Document Reference	How Addressed
A20	Boundary screening must be erected between ancillary facilities and are adjacent to sensitive land user(s) for the duration of the ancillary facility is in use unless otherwise agreed with relevant affected residents, business operators or landowners. All boundary screening must minimise visual impacts on adjacent sensitive land user(s).	Section 8	A mitigation measure has been provided in Section 8 to construct boundary screening (including noise barriers) to reduce noise impacts on adjacent sensitive receivers during works.
A29	A suitably qualified and experienced Acoustics Advisor(s) in noise and vibration management, who is independent of the design and construction personnel, must be nominated by the Proponent and engaged for the duration of work (as required by Condition A32) and for no less than six months following completion of construction of the CSSI. The details of the nominated Acoustic Advisor must be submitted to the Planning Secretary for approval no later than one month before commencement of work. (a)	Section 3.3 of the CEMP	A suitably qualified and experienced Acoustic Advisor will be nominated and engaged for the duration of works and for no less than six months following completion of construction. Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3 of the CEMP.
A30	Work must not commence until an Acoustic Advisor has been nominated by the Proponent and approved by the Planning Secretary	Section 3.3 of the CEMP	A suitably qualified and experienced Acoustic Advisor will be nominated and engaged for the duration of works and for no less than six months following

CoA No.	Condition Requirements	Document Reference	How Addressed
			completion of construction. The Acoustic Advisor will be approved by DPIE. Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3 of the CEMP.
A31	The Proponent must cooperate with the Acoustic Advisor by: (a) providing access to noise and vibration monitoring activities as they take place; (b) providing for review of noise and vibration plans, assessments, monitoring reports, data and analyses undertaken; and (c) considering any recommendations to improve practices and demonstrating, to the satisfaction of the Acoustic Advisor, why any recommendation is not adopted.	Section 3.3 of the CEMP	A suitably qualified and experienced Acoustic Advisor will be nominated and engaged for the duration of works and for no less than six months following completion of construction. Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3 of the CEMP.
A32	The Proponent may nominate additional suitably qualified and experienced persons to assist the lead Acoustic Advisor for the Planning Secretary's approval.	Section 3.3 of the CEMP	A suitably qualified and experienced Acoustic Advisor will be nominated and engaged for the duration of works and for no less than six months following completion of construction. Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3 of the CEMP.
A33	Any activities generating noise in excess of 5 dB(A) above the 'Noise affected' Noise Management Levels (NMLs) derived from the Interim Construction Noise Guideline (DECC, 2009) (ICNG) must not commence until an AA, nominated under Condition A29 of this approval, has been approved by the Planning Secretary.	Section 6.2 Section 3.3 of the CEMP	Any activities generating noise above NMLs will not commence until an Acoustic Advisor has been approved by the DPIE, as outlined in Section 6.2.

CoA No.	Condition Requirements	Document Reference	How Addressed
			The Acoustic Advisor was approved by DPIE prior to the commencement of any works. Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3 of the CEMP.
A34	The approved Acoustic Advisor must: (a) receive and respond to communication from the Planning Secretary in relation to the performance of the CSSI in relation to noise and vibration; (b) consider and inform the Planning Secretary on matters specified in the terms of this approval relating to noise and vibration; (c) consider and recommend, to the Proponent, improvements that may be made to avoid or minimise adverse noise and vibration impacts; (d) review all proposed night-time works to determine if sleep disturbance would occur and recommend measures to avoid sleep disturbance or appropriate additional alternative mitigation measures; (e) review all noise and vibration documents required to be prepared under the terms of this approval and, should they be consistent with the terms of this approval, endorse them before submission to the Planning Secretary (if required to be submitted to the Planning Secretary) or before implementation (if not required to be submitted to the Planning Secretary); (f) regularly monitor the implementation of all noise and vibration documents required to be prepared under the terms of this	Section 3.3 of the CEMP	Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3 of the CEMP.

CoA No.	Condition Requirements	Document Reference	How Addressed
	approval to ensure implementation is in accordance with what is stated in the document and the terms of this approval; (g) notify the Planning Secretary of noise and vibration incidents in accordance with Condition A43 and A45 of this approval; (h) in conjunction with the ER, the Acoustic Advisor must: (i) as may be requested by the Planning Secretary or Community Complaints Mediator (required by Condition B12), help plan, attend or undertake audits of noise and vibration management of the CSSI including briefings, and site visits, (ii) in the event that conflict arises between the Proponent and the community in relation to the noise and vibration performance of the CSSI, follow the procedure in the Community Communication Strategy approved under Condition B2 to attempt to resolve the conflict, and if it cannot be resolved, notify the Planning Secretary, (iii) consider relevant minor amendments made to the Ancillary Facility Management Plan, CEMP, relevant sub-plans and noise and vibration monitoring programs that require updating or are of an administrative nature, and are consistent with the terms of this approval and the management plans and monitoring programs approved by the Planning Secretary and, if satisfied such amendment is necessary, endorse the amendment, (this does not include any modifications to the terms of this approval), (iv) review the noise impacts of minor construction ancillary facilities, and		

<table>
<tr><th>CoA No.</th><th>Condition Requirements</th><th>Document Reference</th><th>How Addressed</th></tr>
<tr><td></td><td>(v) prepare and submit to the Planning Secretary and other relevant regulatory agencies, for information, a Monthly Noise and Vibration Report detailing the Acoustic Advisor's actions and decisions on matters for which the Acoustic Advisor was responsible in the preceding month. The Monthly Noise and Vibration Report must be submitted within seven days following the end of each month for the duration of the Acoustic Advisor's engagement for the CSSI, or as otherwise agreed by the Planning Secretary.</td><td></td><td></td></tr>
<tr><td>C4</td><td>The following CEMP Sub-plans must be prepared in consultation with the relevant government agencies identified for each CEMP Sub-plan. Details of all information requested by an agency during consultation must be provided to the Planning Secretary as part of any submission of the relevant CEMP Sub-plan, including copies of all correspondence from those agencies as required by Condition A5
<table>
<tr><th></th><th>Required CEMP Sub-plan</th><th>Relevant government agencies to be consulted for each CEMP Sub-plan</th></tr>
<tr><td>(b)</td><td>Noise and vibration</td><td>NSW Health, relevant council(s)</td></tr>
</table></td><td>This NVMP
Section 4.1
Critical Utilities CEMP Consultation Report.</td><td>This NVMP has been prepared in accordance with this condition and describes how SPA proposes to manage noise and vibration during critical utility works on the project.
Section 4.1 details the relevant government agencies which needs to be consulted during the preparation of the Plan.
The outcomes of the agency consultation are outlined in the Critical Utilities CEMP Consultation Report.</td></tr>
<tr><td>C5</td><td>The CEMP Sub-plans must state how:</td><td></td><td></td></tr>
<tr><td>(a)</td><td>the environmental performance outcomes identified in the documents listed in Condition A1 will be achieved;</td><td>Section 2.2
Appendix A</td><td>This NVMP was prepared in accordance with the environmental performance outcomes identified in the documents listed in CoA A1 and included in Appendix A of this Plan.</td></tr>
</table>

CoA No.	Condition Requirements	Document Reference	How Addressed
(b)	the mitigation measures identified in the documents listed in Condition A1 will be implemented	Through the implementation of this NVMP (refer to Section 8 and Appendix B of this Plan)	The noise and vibration mitigation measures which will be implemented are listed in Section 8 of this Plan and are cross referenced against the REMMs in Appendix B.
(c)	the relevant terms of this approval will be complied with; and	Through the implementation of this NVMP (refer to Appendix B of this Plan)	Details regarding how SPA proposes to comply with the relevant terms of approval are listed in this Appendix B.
(d)	issues requiring management during construction, as identified through ongoing environmental risk analysis, will be managed through SMART principles.	Section 8 of this Plan Section 3.2.1 and Appendix A4 of the CEMP	Noise and vibration issues requiring management have been identified through the EIS and Environmental Risk Assessment Workshop. These issues will be managed through the implementation of this Plan and the measures in Section 8. Mitigation measures identified in Table 8-1 have been developed with consideration of SMART principles. Environmental risk analysis will be ongoing and regularly reviewed in accordance with Section 3.2.1 of the CEMP to ensure effective management of noise and vibration impacts.
C9	Any of the CEMP Sub-plans must be submitted to the Planning Secretary for approval along with, or subsequent to, the submission of	Section 2 of the CEMP	The CEMP Sub-plans will be submitted for approval to DPIE with or subsequent

CoA No.	Condition Requirements	Document Reference	How Addressed
	the CEMP but in any event, no later than one month before construction.		to the final submissions of the CEMP for DPIE approval.
C10	Construction must not commence until the CEMP and all CEMP Sub-plans have been approved, unless otherwise agreed by the Planning Secretary. The CEMP and CEMP Sub-plans, as approved by the Planning Secretary, including any minor amendments approved by the ER must be implemented for the duration of construction. Where construction of the CSSI is staged, construction of a stage must not commence until the CEMP and sub-plans for that stage have been endorsed by the ER and approved by the Planning Secretary.	Section 1.4 of the CEMP Section 2 of the CEMP Section 3.2	Construction will not commence until the CEMP and all Sub-plans have been endorsed by the ER and approved by DPIE. The CEMP and all Sub-plans will be implemented for the duration of construction.
E65	A detailed land use survey must be undertaken to confirm sensitive land user(s) (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration, construction ground-borne noise and operational noise. The survey may be undertaken on a progressive basis but must be undertaken in any one area before the commencement of works which generates construction or operational noise, vibration or ground-borne noise in that area. The results of the survey must be included in the Noise and Vibration CEMP Sub-plan required by Condition C4.	Section 5.1Appendix E Land Use Survey Maps	A detailed land use survey will be undertaken to confirm sensitive land user(s) potentially exposed to construction noise and vibration, and construction ground-borne noise. The results of the survey will be included in Appendix E.
E66	Work must only be undertaken during the following hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; (b) 8:00am to 6:00pm Saturdays; and (c) at no time on Sundays or public holidays.	Section 6.1	Works will only be scheduled and undertaken during the standard construction hours stated in this condition unless permitted in CoA E68 or an EPL. Details regarding the standard construction hours are outlined in Section 6.1.

CoA No.	Condition Requirements	Document Reference	How Addressed
			The nominated construction hours, restrictions and general requirements for any OOHW will be addressed in the project inductions and specific training or toolboxes, as required as stated in Section 8.
E67	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver must only be undertaken: (a) between the hours of 8:00 am to 6:00 pm Monday to Friday; (b) between the hours of 8:00 am to 1:00 pm Saturday; and (c) if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour. For the purposes of this condition, 'continuously' includes any period during which there is less than one hour between ceasing and recommencing any of the work	Section 6.1 Appendix D Out of Hours Work Protocol	Highly noise intensive works that result in an exceedance of the applicable NML at the same receiver will only be scheduled and undertaken at the stated hours, unless otherwise permitted by an EPL or CoA E68, as outlined in Section 6.1 and Appendix D of this NVMP. The nominated construction hours, restrictions and general requirements for any OOHW will be addressed in the project inductions and specific training or toolboxes, as required as stated in Section 8.
E68	Notwithstanding Conditions E66 and E67 work may be undertaken outside the hours specified in any of the following circumstances:		
(a)	Safety and Emergencies, including: (i) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (ii) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm.	Section 6.1 Appendix D Out of Hours Work Protocol	An Out of Hours Work (OOHW) Protocol has been prepared in Appendix D of this Plan to address the circumstances which works may be undertaken outside the hours. SPA will notify the Acoustic Advisor, the ER and the EPA on becoming aware of

CoA No.	Condition Requirements	Document Reference	How Addressed
	On becoming aware of the need for emergency work in accordance with Condition E68(a)(ii), the Proponent must notify the Acoustic Advisor, the ER, the Planning Secretary and the EPA of the reasons for such work. The Proponent must use best endeavours to notify all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work.		the need for emergency works, as outlined in the OOHW Protocol prepared in Appendix D of this Plan.
(b)	Low impact, including: (i) construction that causes LAeq(15 minute) noise levels: • no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, or • no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); or (ii) construction that causes $L_{AFmax(15minute)}$ noise levels nor more than 15 dB(A) above the rating background level at any residence; or (iii) construction that causes: • continuous or impulsive vibration values, measured at the 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 6.1 Appendix D Out of Hours Work Protocol	An Out of Hours Work (OOHW) Protocol has been prepared in Appendix D of this Plan to address the circumstances which works may be undertaken outside the hours.
(c)	By Approval, including:	Section 6.1	An Out of Hours Work (OOHW) Protocol has been prepared in Appendix D of this

CoA No.	Condition Requirements	Document Reference	How Addressed
	(i) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or (ii) works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition E69; or (iii) negotiated agreements with directly affected residents and sensitive land user(s).	Appendix D Out of Hours Work Protocol	Plan to address the circumstances which works may be undertaken outside the hours.
(d)	By Prescribed Activity, including: (i) tunnelling (excluding cut and cover tunnelling and surface works) and tunnel fit out works (excluding surface works) are permitted 24 hours a day, seven days a week; or (ii) delivery of material that is required to be delivered outside of standard construction hours in **Condition E66** to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to/from WHT7 at Berrys Bay which result in a sleep disturbance event for receivers in the proximity of Bay Road and Balls Head Road, Waverton; or (iii) works within an acoustic shed where there is no exceedance of the NMLs; or (iv) trailer suction hopper dredging; or (v) along the Warringah Freeway corridor in accordance with **Condition E88**.	Section 6.1.3 Appendix D Out of Hours Work Protocol	An Out of Hours Work (OOHW) Protocol has been prepared in Appendix D of this Plan to address the circumstances which works may be undertaken outside the hours. Note: CoA E68(d)(i), (ii), (iii) and (iv) are not applicable to the CUT works.
E69	An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of work which is outside the hours defined in **Condition E66**, and that are not subject to an EPL. The Protocol must be approved by the Planning Secretary before commencement of the Out-of-Hours Work. The Protocol must	Section 6.1 Appendix D Out of Hours Work Protocol	An OOHW Protocol has been prepared in Appendix D of this NVMP to identify a process for the consideration, management and approval of works which are outside the standard

CoA No.	Condition Requirements	Document Reference	How Addressed
	be prepared in consultation with the ER, Acoustic Advisor and EPA. The Protocol must provide:		construction hours, and that are not subject to an EPL. The Protocol will be approved by the DPIE before commencing the out of hours works, and will be prepared in consultation with the EPA and the Acoustic Advisor. Out-of-hours-works, not subject to an EPL, will be scheduled, approved and undertaken in accordance with the OOHW Protocol (Appendix D) prepared in accordance with CoA E69.
(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 Acoustic Advisor 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 Acoustic Advisor, and (iii) high risk activities that are approved by the Planning Secretary	Section 7 of the Appendix D Out of Hours Work Protocol	An approval process has been outlined in Section 7 of the OOHW Protocol that considers the risk of activities, proposed mitigation, management and coordination. Figure 4-1 in the OOHW Protocol has also been included to outline the approval process.
(b)	a process for the consideration of out-of-hours work against the relevant NML and vibration criteria;	Section 5 of the Appendix D Out of Hours Work Protocol	A process for the consideration of OOHW against the relevant noise and vibration criteria is provided in Section 5 of the OOHW Protocol.
(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	Sections 4,6 and 8.2 of the Appendix D Out	A process for the identification of mitigation measures for residual impacts, including respite periods is provided in

CoA No.	Condition Requirements	Document Reference	How Addressed
	Condition E83. The measures must take into account the predicted noise levels and the likely frequency and duration of the out-of-hours works that sensitive land user(s) would be exposed to, including the number of noise awakening events;	of Hours Work Protocol	Sections 4, 6 and 8.2 of the OOHW Protocol.
(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	Section 5.4 of the Appendix D Out of Hours Work Protocol	A procedure to coordinate OOHW to ensure appropriate respite is outlined in Section 5.4 of the OOHW Protocol.
(e)	notification arrangements for affected receivers for all approved out-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works. This condition does not apply if the requirements of **Condition E68(b)** are met.	Section 8 of the Appendix D Out of Hours Work Protocol	OOHW community consultation has been included in Section 8 of the OOHW Protocol.
E70	Mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration objectives: (a) construction 'Noise affected' NML established using the *Interim Construction Noise Guideline* (DECC, 2009); (b) vibration criteria established using the *Assessing vibration: a technical guideline* (DEC, 2006) (for human exposure); (c) Australian Standard AS 2187.2 - 2006 "*Explosives - Storage and Use - Use of Explosives*";	Section 6 Section 8	Mitigation measures outlined in Section 8 will be implemented with the aim of achieving the construction NMLs and vibration criteria. The residential receptor NMLs for critical utility works is in Section 6. Any works identified as exceeding the NMLs and/or vibration criteria will be managed in accordance with this Plan.

CoA No.	Condition Requirements	Document Reference	How Addressed
	(d) BS 7385 Part 2-1993 "*Evaluation and measurement for vibration in buildings Part 2" as they are "applicable to Australian conditions*"; and (e) the vibration limits set out in the *German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures* (for structural damage). Any works identified as exceeding the noise management levels and/or vibration criteria must be managed in accordance with the Noise and Vibration CEMP Sub-plan. Note: The ICNG identifies 'particularly annoying' activities that require the addition of 5 dB(A) to the predicted level before comparing to the construction NML.		
E72	Noise generating work in the vicinity of potentially-affected community, religious, educational institutions, noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institutions are made at no cost to the affected institution.	Section 8	A mitigation measure has been provided in Section 8 to avoid sensitive periods when undertaking noise generating works in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration sensitive businesses and critical working areas.
E73	At no time can noise generated by construction exceed the National Standard for exposure to noise in the occupational environment of an eight-hour (8hr) equivalent continuous A-weighted sound pressure level of LAeq,8h of 85 dB(A) for any employee working at a location near the CSSI.	Section 8	Noise generated by construction will not exceed the National Standard for exposure to noise in the occupational environment for any employee working at a location near the project. This has been added as a mitigation measure in Section 8.

CoA No.	Condition Requirements	Document Reference	How Addressed
E74	Industry best practice construction methods must be implemented where reasonably practicable to ensure that noise levels are minimised. Practices must include, but are not limited to:	Section 8	Mitigation measures have been provided in Section 8 which will be implemented during critical utility works to minimise at-source noise levels.
(a)	use of regularly serviced low sound power equipment;	Section 8	A mitigation measure has been provided in Section 8.
(b)	early occupation and later release of road carriageways and construction sites;	Section 8	A mitigation measure has been provided in Section 8.
(c)	scheduling of noisiest works before 11.00 pm Sunday to Thursday and before 12 midnight Friday and Saturday;	Section 5.3 of Appendix D Out of Hours Work Protocol	
(d)	temporary noise barriers (including the arrangement of plant and equipment) around noisy equipment and activities such as rockhammering and concrete cutting; and	Section 8	A mitigation measure has been provided in Section 8.
(e)	use of alternative construction and demolition techniques.	Section 8	A mitigation measure has been provided in Section 8.
E75	Construction Noise and Vibration Impact Statements (CNVIS) must be prepared for any work that may exceed the noise management levels, vibration criteria and/or ground-borne noise levels specified in **Condition E70 and Condition E71** at any residence outside construction hours identified in **Condition E66**, or where receivers will be highly noise affected. The CNVIS must include specific mitigation measures identified through consultation with affected sensitive land user(s) and the mitigation measures must be implemented for the duration of the works. A copy of the CNVIS must be provided to the	Section 7.1	CNVIS(s) will be prepared before works commence that may exceed the NMLs and / or vibration criteria, as detailed in Section 7.1. The CNVIS will include specific mitigation measures identified through consultation with affected sensitive land user(s) which

CoA No.	Condition Requirements	Document Reference	How Addressed
	Acoustic Advisor and ER prior to the commencement of the associated works. The Planning Secretary may request a copy/ies of **CNVIS**.		will be implemented for the duration of the works.
E76	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before work that generates vibration commences in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owners and occupiers are to be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier. These properties must be identified and considered in the Noise and Vibration CEMP Sub-plan required by Condition C4 and the **Community Communication Strategy** required by Condition B1.	CNVIS Section 6.3.4	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage will be notified before works that generate vibration commences in the vicinity of those properties, as detailed in Section 8.
E79	The Proponent must conduct vibration testing during vibration generating activities that have the potential to impact on heritage items to identify minimum working distances to prevent cosmetic damage. In the event that the vibration testing and attended monitoring shows that the preferred values for vibration are likely to be exceeded, the Proponent must review the construction methodology and, if necessary, implement additional mitigation measures.	Appendix F - Noise and Vibration Monitoring Program Heritage Management Procedure	Vibration testing will be conducted during vibration generating activities that have the potential to impact on heritage items, as outlined in the Noise and Vibration Monitoring Program.
E80	Advice from a heritage specialist must be sought on methods and locations for installing equipment used for vibration, movement and noise monitoring at heritage-listed structures.	Section 8 Appendix F - Noise and Vibration Monitoring Program	The advice of a heritage specialist will be used, as detailed in the Noise and Vibration Monitoring Program.

CoA No.	Condition Requirements	Document Reference	How Addressed
		Heritage Management Procedure	
E81	Before conducting at-property treatment at any heritage item identified in the documents listed in Condition A1, the advice of a suitably qualified and experienced built heritage expert must be obtained and implemented to ensure any such work does not have an adverse impact on the heritage significance of the item.	Section 8 Heritage Management Procedure	The advice of a built heritage expert will be used, as detailed in Section 8.
E82	All work undertaken for the delivery of the CSSI, including those undertaken by third parties (such as utility relocations), must be coordinated to ensure respite periods are provided. The Proponent must:	Appendix D Out of Hours Work Protocol	All works, including those undertaken by third parties (such as utility relocations), will be coordinated to ensure respite periods are provided, as identified in Section 5.4 of the OOHW Protocol prepared in Appendix D of this Plan.
(a)	reschedule any work to provide respite to impacted noise sensitive land user(s) so that the respite is achieved in accordance with Condition E83; or	Appendix D Out of Hours Work Protocol	Works will be rescheduled to provide appropriate respite periods to noise sensitive land user(s) as outlined in Section 5.4 of the OOHW Protocol prepared in Appendix D of this Plan.
(b)	consider the provision of alternative respite or mitigation to impacted noise sensitive land user(s); and	Appendix D Out of Hours Work Protocol	Alternative respite periods and mitigation measures for impacted noise sensitive land user(s) will be considered, as identified in Section 5.4 of the OOHW Protocol prepared in Appendix D of this Plan.

CoA No.	Condition Requirements	Document Reference	How Addressed
(c)	provide documentary evidence to the Acoustic Advisor in support of any decision made by the Proponent in relation to respite or mitigation.	Appendix D Out of Hours Work Protocol	Documentary evidence will be provided to the Acoustic Advisor in relation to respite or mitigation, as outlined in Section 5.4 of the OOHW Protocol prepared in Appendix D of this Plan.
	The consideration of respite must also include all other CSSI, SSI and SSD projects which may cause cumulative and/or consecutive impacts at receivers affected by the delivery of the CSSI.	Appendix D Out of Hours Work Protocol	The consideration of respite for the Project will consider other CSSI, SSI and SSD projects that may cause cumulative and/or consecutive impacts at land user(s) as stated in Section 5.4 and Section 8 of the OOHW Protocol prepared in Appendix D of this Plan.
E83	In order to undertake out-of-hours work outside the hours specified under Condition E66, the Proponent must identify appropriate respite periods for the out-of-hours work in consultation with the community at each affected location on a regular basis. This consultation must include (but not be limited to) providing the community with: (a) a progressive schedule for periods no less than three months, of likely out-of-hours work; (b) a description of the potential work, location and duration of the out-of-hours work; (c) the noise characteristics and likely noise levels of the work; and (d) likely mitigation and management measures which aim to achieve the relevant noise management levels under Condition E70 (including the circumstances of when respite or relocation offers will be available and details about how the affected community can access these offers).	Appendix D Out of Hours Work Protocol	Appropriate respite periods will be identified for out of hours works as described in Section 8.2 and 8.3 of the OOHW Protocol prepared in Appendix D of this Plan. The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out of hours works will be provided to the Acoustic Advisor, EPA and the DPIE.

CoA No.	Condition Requirements	Document Reference	How Addressed
	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 Acoustic Advisor, ER, EPA and the Planning Secretary. Note: Respite periods can be any combination of days or hours where out-of-hours work would not be more than 5 dB(A) above the rating background noise level at any residence.		
E88	Out-of-Hours Work along the Warringah Freeway corridor which results in an exceedance of the relevant NML at the same sensitive land user(s) may be undertaken in accordance with the following criteria: (a) two consecutive evenings and/or nights per week; or (b) three non-consecutive evenings and/or nights per week; or (c) 10 evenings and/or nights per month; or (d) except as identified by an EPL; or (e) in accordance with an agreement with a potentially impacted receiver(s) as required by Condition E68(c)(iii) or Condition E83. Note: These parameters may be increased subject to the development of a framework, which is prepared in consultation with the community and EPA and with consideration of the delivery of the NIP.	Section 6.1.3 Appendix D Out of Hours Work Protocol	These OOHW restrictions have been included in Section 6.1.3 of this Plan. An Out of Hours Work (OOHW) Protocol has been prepared in Appendix D of this Plan to address the circumstances which works may be undertaken outside the hours.
E107	The Proponent must offer pre-construction surveys and must undertake and prepare Pre-construction Condition Survey Reports where the offer is accepted, on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model described in Condition E102 and the CNVIS required by Condition E75 or as directed by the Independent	Section 8 Table 8-1	This has been included as management measure NV34 in Table 8-1 of this Plan.

CoA No.	Condition Requirements	Document Reference	How Addressed
	Property Impact Assessment Panel (IPIAP) established under Condition E111. The Pre-construction Condition Survey Reports must be prepared by a suitably qualified and experienced person(s) and must be provided to the owners of the surface and sub-surface structures for review prior to the commencement of potentially impacting works.		
E108	Where pre-construction surveys have been undertaken in accordance with Condition E107, subsequent post-construction surveys must be undertaken to assess damage to the surface and sub-surface structures that may have resulted from construction within three months of landowner(s) requests.	Section 8 Table 8-1	This has been included as management measure NV34 in Table 8-1 of this Plan.

Table App B-2 Revised environmental management measures relevant to this NVMP

Outcome	Ref #	Commitment	Timing	NVMP
Construction noise and vibration impacts	REMM CNV1	A Construction Noise and Vibration Management Plan will be developed for the project. This plan will:	Construction	This Plan
	a)	Identify relevant criteria and management levels in relation to noise and vibration	Construction	Section 6 – Table 6-1
	b)	Identify noise and vibration sensitive receivers and features in the vicinity of the project	Construction	Section 5.1 Appendix E Land Use Survey Maps CNVIS

Outcome	Ref #	Commitment	Timing	NVMP
				Minimum Working Distances
	c)	Include standard and additional mitigation from the Construction Noise and Vibration Guideline (Roads and Maritime, 2016a) and detail how and when these will be applied in the project	Construction	Section 8
	d)	Describe the approach that will be adopted for carrying out location and activity specific constructing noise and vibration impact assessments to assist with designing and selecting of the appropriate mitigation and management measures	Construction	Section 7.1
	e)	Include protocols that will be adopted to manage works required outside standard construction hours	Construction	Appendix D Out of Hours Work Protocol
	f)	Detail the methodology and approach for managing residual construction noise impacts	Construction	Section 6.2
	g)	Detail the process for managing construction vibration, including heritage structures considering all types of vibration generating works, including blasting	Construction	Section 8; Noise and Vibration Monitoring Program; Heritage Management Procedure
	h)	Outline the procedures and approach for noise and vibration monitoring to be carried out to confirm construction noise and vibration levels in relation to noise and vibration management levels	Construction	Noise and Vibration Monitoring Program

Outcome	Ref #	Commitment	Timing	NVMP
	i)	Where feasible and reasonable, detail how construction noise impacts from concurrent or consecutive nearby construction works associated with the project will be managed.	Construction	Section 8
		The Construction Noise and Vibration Management Plan will be implemented for the duration of construction of the project.	Construction	Section 2.1
Construction noise and vibration impacts	REMM CNV2	Detailed Construction Noise and Vibration Impact Statements will be carried out for all construction support sites and major construction works required for the project prior to the commencement of construction. The Statements will consider the proposed site layouts and noise and vibration generating activities that will take place during all major stages of the construction support site, assess predicted noise and vibration levels against the relevant management levels, and incorporate feasible and reasonable mitigation and management measures in accordance with the requirements of the *Interim Construction Noise Guideline* (DECC, 2009) and the *Construction Noise and Vibration Guideline* (Roads and Maritime, 2016a).	Pre-construction	Section 7.1
Construction noise and vibration impacts during out of hours work	REMM CNV3	An out of hours works protocol will be developed for the construction of the project. The protocol will include: a) Details of works required outside standard construction hours, including acceptable justifications for works outside of standard construction hours, what types of works are allowed to take place outside of construction hours, and justifications of why the activities are required outside standard construction hours b) Details of the assessment and approval process (internal and external) for works proposed outside standard construction hours	Construction	Appendix D Out of Hours Work Protocol

Outcome	Ref #	Commitment	Timing	NVMP
		c) Noise and vibration mitigation and management measures that are to be considered and implemented where appropriate to manage potential impacts associated with works outside standard construction hours d) The noise and vibration impact assessment processes that will be followed to identify potentially affected receivers, clarify potential impacts and determine appropriate mitigation and management measures. The protocol will be prepared in consultation with the Department of Planning, Industry and Environment and the NSW Environment Protection Authority, and independently endorsed. The project protocol will be implemented during the duration of the construction of the project.		
Construction noise and vibration impacts	REMM CNV4	Construction noise and vibration impacts will be monitored periodically throughout all stages of the construction support sites to ensure that: a) Impacts are consistent with the noise and vibration levels detailed in the relevant Construction Noise and Vibration Impact Statements b) Noise and vibration impacts are being appropriately managed c) Mitigation measures are effective.	Construction	Noise and Vibration Monitoring Program
Construction noise and vibration impacts	REMM CNV5	Where feasible and reasonable, unless compliance with the relevant traffic noise criteria can be achieved, or alternative arrangements have been agreed with affected receivers, construction vehicle movements will not occur on local roads beyond those required for direct access to construction sites.	Construction	N/A refer to CoA E132
Construction vibration impacts	REMM CNV6	Vibration generating activities will be managed through the establishment of minimum buffer distances to achieve screening levels. Where vibration levels are predicted to exceed the screening levels, a more detailed assessment of the impacted structure and attended vibration	Construction	Section 6.3 Section 8 Noise and Vibration

Outcome	Ref #	Commitment	Timing	NVMP
		monitoring will be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items, the more detailed assessment will specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed. Any damage caused by the project will be rectified.		Monitoring Program
Construction impacts from surface road works	REMM CNV8	Mitigation measures will be implemented for surface road works, local area and utility works, where construction activities are predicted to exceed noise management levels at receivers. Where feasible and reasonable the approaches that will be used include:	Construction	Section 8
	a)	Carrying out works during the daytime period when near residential receivers	Construction	Section 6.1
	b)	Selection of plant and equipment to minimise noise and vibration impacts	Construction	Section 8
	c)	Management of plant and equipment to minimise the generation of noise and vibration impacts	Construction	Section 8
	d)	Community consultation, engagement and notification	Construction	Section 4.2 and 8 Appendix D Out of Hours Work Protocol
	e)	Detailed programming and respite protocols	Construction	Section 6.2.4
	f)	Where out of hours works are required, programming the noisiest activities to occur during the less sensitive time periods	Construction	Section 8

Outcome	Ref #	Commitment	Timing	NVMP
	g)	Out of hours works protocols	Construction	Appendix D Out of Hours Work Protocol
	h)	Limiting timing of noise intensive work	Construction	Section 8
	i)	Use of portable noise barriers around particularly noisy equipment such as concrete saws and rock hammers in cases where it will effectively reduce noise levels at nearby receivers	Construction	Section 8
	j)	Management of construction traffic to minimise movements during the night periods along local roads	Construction	Section 8
	k)	Establishing minimum vibration buffer distances for vibration intensive works	Construction	Section 6.3.4
	l)	Vibration and blasting trials and/or monitoring along with building condition surveys	Construction	Section 6.3.2 and 8
Cumulative construction noise impacts	REMM CNV10	Construction noise from concurrent and consecutive construction works will be managed to minimise cumulative construction noise impacts. Where feasible and reasonable the approaches that will be used include: a) Coordinating work between project construction sites and construction works to avoid cumulative noise impacts b) Consideration of additional at source or near source mitigation where construction noise levels may result in cumulative construction noise impacts, where programming is not practical to avoid cumulative noise impacts c) Community consultation throughout the project to gauge construction key noise impacts and issues and any unknown impacts from concurrent or consecutive sets of constructions works	Construction	Section 8

Outcome	Ref #	Commitment	Timing	NVMP
		d) Incorporating additional noise mitigation and management measures with consideration of cumulative and consecutive construction noise impacts based upon coordination between projects.		
Ongoing non-Aboriginal heritage impacts	NAH4	Should at-property noise treatment be required at a premise that is heritage listed, this will be carried out in a manner to minimise heritage impact, and advice of a heritage conservation architect will be sought prior to undertaking the works. Any treatment will be sympathetic to the heritage values of the item, designed with heritage architect input and be reversible where feasible and reasonable.	Pre-construction	Section 8; Heritage Management Procedure
Construction noise and vibration impact	V6	Hoardings and temporary noise walls will be erected as early as possible within the site establishment phase to provide visual screening.	Construction	Section 8

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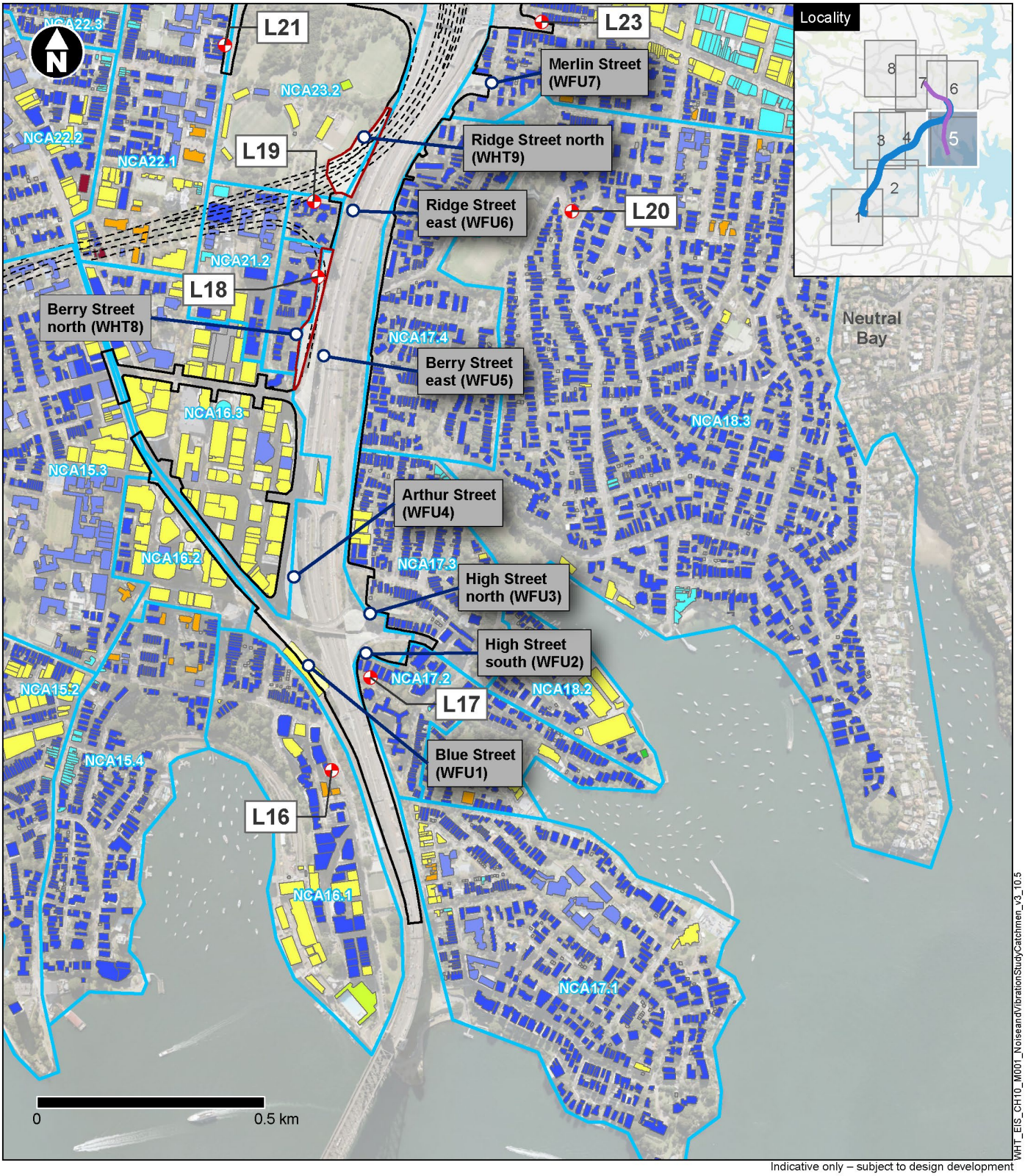
Appendix C Noise Catchment Areas



Legend

Construction features

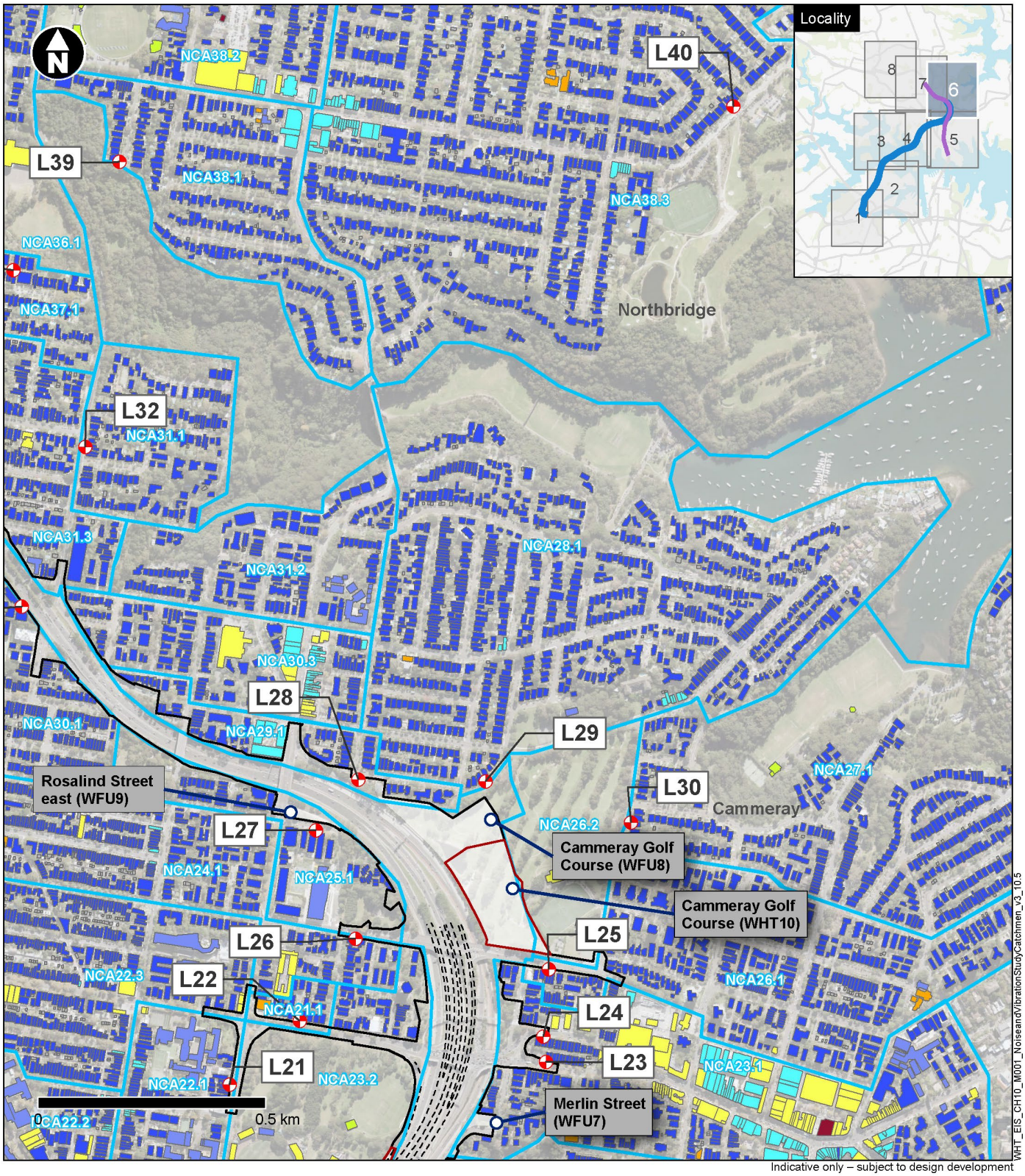
- Construction footprint
- Construction support site
- Tunnel section

Noise assessment features

- Long-term noise monitoring location
- Noise catchment area (NCA)

Receiver type

- Commercial/industrial
- Mixed use
- Non receiver building
- Educational/childcare
- Medical
- Place of worship
- Recreational - active
- Recreational - passive
- Residential



Legend

Construction features

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- Construction support site
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Noise assessment features

- Long-term noise monitoring location
- Noise catchment area (NCA)

Receiver type

- Commercial/industrial
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- Medical
- Place of worship
- Recreational - active
- Recreational - passive
- Residential

Appendix D Out of Hours Work Protocol

Out of Hours Work Protocol

1 Purpose and scope

This Out-of-Hours Works Protocol (the Protocol) for the Stage 1A Early and Enabling Works – Critical utility installation, relocation and protection works (critical utility works) has been prepared in accordance with Condition of Approval (CoA) E68 (c) and E69.

All out-of-hours works undertaken by the Project are intended to be performed subject to a Project Environment Protection Licence (EPL). In the event that OOHW not subject to an EPL are required, this OOHW Protocol defines the process for the assessment and approval for any OOHW non subject to an EPL.

As required by CoA E69, this Out-of-Hours Work Protocol has been prepared in consultation with the Environmental Representative (ER) and the Acoustic Advisor (AA). Ongoing consultation with the NSW Environment Protection Authority (EPA) is occurring concurrently to the review of the Project Environment Protection Licence (EPL). This Protocol will be updated should it be required following consultation with the EPA. This Protocol will be approved by the Department of Planning, Industry and Environment (DPIE) prior to commencement of relevant out of hours works.

This protocol has been developed as part of the Noise and Vibration Management Plan (NVMP) and should be read in conjunction with the NVMP.

2 Construction hours and approach to works

The standard construction hours for the project are, as outlined in CoA E66:

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

In accordance with CoA E68, works may be conducted outside standard construction hours in the following circumstances:

(a) Safety and Emergencies, including:

(i) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or

(ii) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm. On becoming aware of the need for emergency work in accordance with CoA E68(a)(ii), the Proponent (SPA will undertake notification) must notify the Acoustic Advisor, the ER, the Planning Secretary and the EPA of the reasons for such work. The Proponent (SPA will undertake notification) must use best endeavours to notify all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work

(b) Low impact, including:

(i) construction that causes LAeq(15 minute) noise levels:

- no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, or
- no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); or

(ii) construction that causes LAFmax(15 minute) noise levels no more than 15 dB(A) above the rating background level at any residence; or

(iii) construction that causes:

- continuous or impulsive vibration values, measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), or
- intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006).

(c) By Approval, including:

(i) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or

(ii) works which are not subject to an EPL that are approved under an Out-of-Hours Protocol (this Protocol) as required by Condition E69; or

(iii) negotiated agreements with affected residents and sensitive land user(s).

(d) By Prescribed Activity, including:

(i) tunnelling (excluding cut and cover tunnelling and surface works) and tunnel fit out works (excluding surface works) are permitted 24 hours a day, seven days a week; or

(ii) delivery of material that is required to occur outside of standard construction hours in Condition E66 to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to/from WHT7 at Berrys Bay which could result in a sleep disturbance event for receivers in the proximity of Bay Road and Balls Head Road, Waverton; or

(iii) works within an acoustic shed where there is no exceedance of the NMLs; or

(iv) trailer suction hopper dredging; or

(v) along the Warringah Freeway corridor in accordance with Condition E88.

CoA E68(d)(i), (ii), (iii) and (iv) are not applicable to the critical utility works.

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

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

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

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

(d) except as identified by an EPL; or

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

Table 2-1 below summarised the CUT construction activities and their locations that have the potential to trigger the requirement to carry out OOHW.

Table 2-1 Construction activities and locations with the potential to be required to be undertaken as OOHW

Area	Activity	Activities with potential to exceed NML			Reason for OOWH	Timing
		Day	Evening	Night		
Alfred Street North, Neutral Bay	Utility relocations (Power, Communications, Sewer)	-	Utility cutovers	Utility cutovers	Utility authority approvals	Q2 2021 – Q4 2021
Alfred Street North, Neutral Bay	Traffic switch	-	Line removal Line marking Sweeping Barrier install	Line removal Line marking Sweeping Barrier install	Issue of Road Occupancy Licence	Q4 2021
Arthur Street, North Sydney	Traffic switch	-	Line removal Line marking Sweeping Barrier install	Line removal Line marking Sweeping Barrier install	Issue of Road Occupancy Licence	Q2 2021 – Q1 2022
High Street, North Sydney	Communications relocation	-	Utility cutovers	Utility cutovers	Utility authority approvals	Q3 2021 – Q4 2021
Arthur Street, North Sydney	Utility works (Ausgrid, Communications, Water)	-	Pavement sawing Excavation through rock	Pavement sawing Excavation through rock	Issue of Road Occupancy Licence	Q2 2021 – Q1 2022

Ernest Street, Cammeray	Utility relocations (Power, Communications, Sewer)	Pavement sawing Excavation through rock Backfilling	Pavement sawing Excavation through rock Backfilling	Pavement sawing Excavation through rock Backfilling	Issue of Road Occupancy Licence	Q2 2021 – Q4 2021
Warringah Freeway, from Falcon Street to Miller Street	ITS installation	-	Pavement sawing Excavation through rock Backfilling	Pavement sawing Excavation through rock Backfilling	Issue of Road Occupancy Licence	Q3 2021 – Q4 2021
Miller Street off ramp, Cammeray	ITS installation	-	Pavement sawing Excavation through rock Backfilling	Pavement sawing Excavation through rock Backfilling	Issue of Road Occupancy Licence	Q3 2021 – Q4 2021
Mount Street, North Sydney and Sydney Harbour Tunnel approach	Utility relocation (Water)	-	Pavement sawing Excavation through rock Backfilling	Pavement sawing Excavation through rock Backfilling	Issue of Road Occupancy Licence	Q2 2021 – Q4 2021
Arthur Street, North Sydney	Clearing	Clearing	Clearing	Clearing	Issue of Road Occupancy Licence	Q2 2021 – Q3 2021
Alfred Street North, Neutral	Clearing	Clearing	Clearing	Clearing	Issue of Road Occupancy Licence	Q2 2021 – Q3 2021

Ernest Street, Cammeray Bay	Clearing	Clearing	Clearing	Clearing	Issue of Road Occupancy Licence	Q2 2021 – Q3 2021
Cammeray Avenue, Cammeray	Clearing	Clearing	Clearing	Clearing	Issue of Road Occupancy Licence	Q2 2021 – Q3 2021
Rosalind Street, Cammeray	Clearing	Clearing	Clearing	Clearing	Issue of Road Occupancy Licence	Q2 2021 – Q3 2021
Arthur Street, North Sydney	Restoration	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Issue of Road Occupancy Licence	Q1 2022
Alfred Street North, Neutral	Restoration	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Issue of Road Occupancy Licence	Q1 2022
Ernest Street, Cammeray Bay	Restoration	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Issue of Road Occupancy Licence	Q1 2022
Cammeray Avenue, Cammeray	Restoration	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Paving Concrete works (kerbing and footpath)	Issue of Road Occupancy Licence	Q1 2022

Ridge Street, North Sydney	Construction support activities	-	Vehicle movements Material handling Stockpiling	Vehicle movements Material handling Stockpiling	Issue of Road Occupancy Licence for other work areas	Q2 2021 – Q1 2022

3 OOHW Justification

Where works are undertaken outside standard construction hours and exceed the perception classification of Noticeable (refer to Table 6-1) that work must be appropriately justified. In general, OOHW undertaken on public infrastructure projects such as road construction, is necessary to sustain the operational integrity of roads and is considered justified in the ICNG.

Justification for any activities proposed as OOHW must be established to the satisfaction of the Environmental Representative (ER) and the Acoustic Advisor.

4 OOHW Process

Where new OOHW are identified for the critical utilities works the following process (refer to Figure 4-1) would be implemented to assess the works, identify appropriate mitigation and monitoring and seek approval.

- The SPA construction team complete an OOHW Permit, summarising the activities, equipment required, location, duration and justification for works
- The OOHW Permit is submitted to the Environmental Manager (or delegate), who will undertake a noise and vibration assessment for the OOHW (refer to Section 5 of this Protocol). Predicted noise impacts will be assessed against the impact classification in Section 6 of this Protocol and appropriate mitigation measures (including community consultation) will be determined as per Section 6
- Approval of the OOHW Permit will follow the process outlined in Section 7 of this Protocol
- Community consultation and notification will be undertaken in accordance with the Community Communication Strategy (CCS) as outlined in Section 8 of this Protocol
- Monitoring will be undertaken in accordance with Section 9 of this Protocol and the Noise and Vibration Monitoring Program.

In addition to obtaining the OOHW approval, additional approvals and permits such as a Road Occupancy Licence (ROL) and approval from the Traffic Manager must be obtained where required.

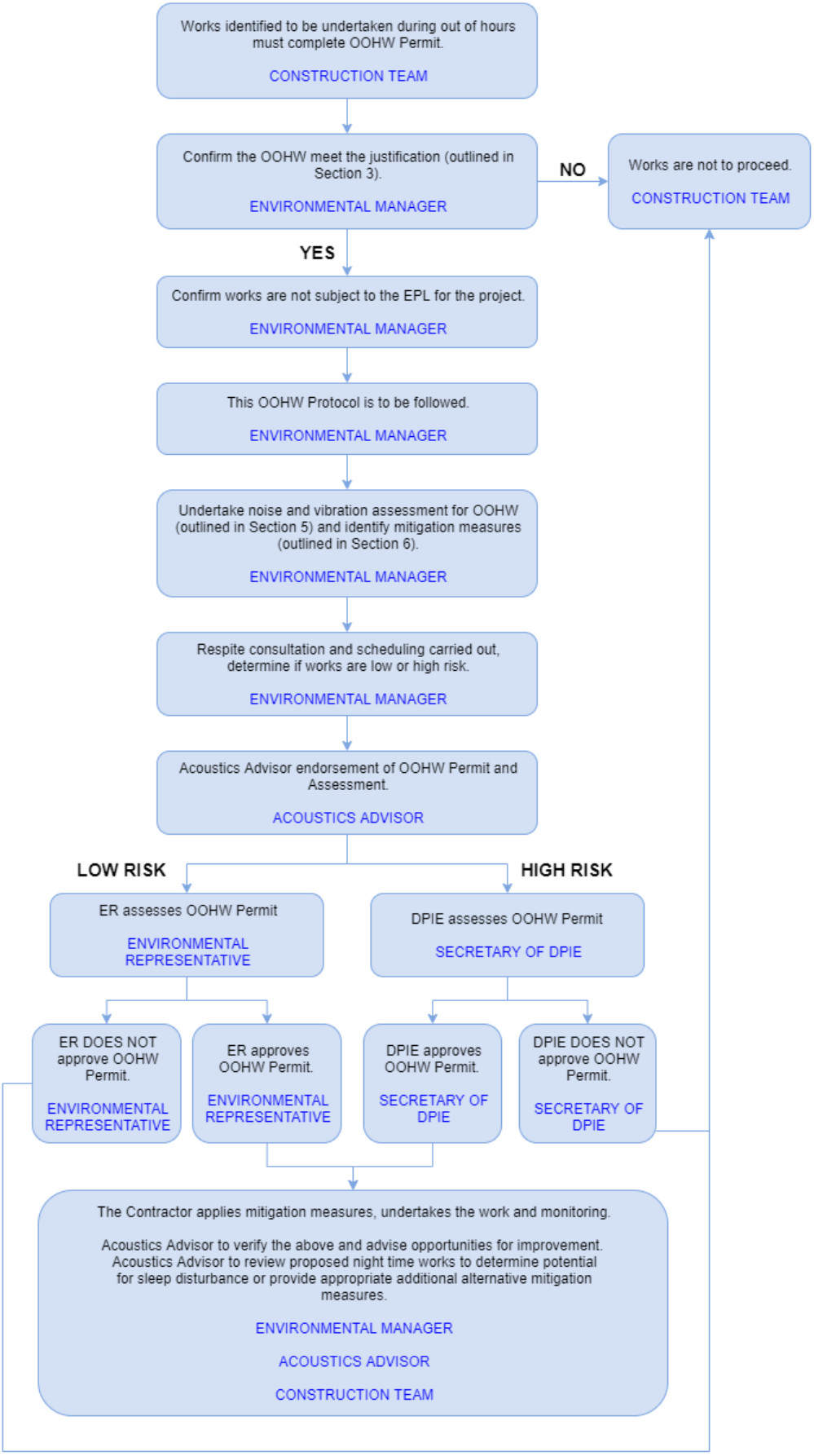


Figure 4-1 OOHW assessment and approval process

5 Noise and Vibration Assessment Process

5.1 Noise

In order to manage potential impacts from noise and vibration during OOHW, SPA will assess predicted noise impacts associated with out hours works in accordance with the CVNG using a construction noise estimation tool or through the development of a Construction Noise and Vibration Impact Statement (CNVIS) (refer to Section 7 of the NVMP) against the relevant NML (refer Section 6.2 in the NVMP).

The assessment will enable the prediction of surface noise impacts, ground-borne noise impacts and vibration impacts on sensitive receivers based on the location and types of construction machinery operating inside a noise catchment area. They will also consider any other OOHW that may be underway during the proposed OOHW, to ensure cumulative noise impacts are minimised at potentially affected sensitive receivers.

The assessment will identify the potentially affected sensitive land user(s), the predicted impacts and the following additional mitigation measures, as described in Table 6-1, to be applied, in addition to those within the ICNG. In accordance with CoA A34(d), the Acoustic Advisor will review all proposed night-time works to determine if sleep disturbance would occur and recommend measures to avoid sleep disturbance or appropriate additional alternative mitigation measures.

The results of these noise assessments along with the selection of reasonable and feasible management measures both from the NVMP, ICNG and CNVG will be considered by the SPA Environmental Manager when determining the approval pathway for the OOHW by the Environmental Representative and / or DPIE. Any OOHW assessments that are sent to DPIE for approval must first be reviewed by the ER. Ongoing monitoring and validation of predictive outputs will be undertaken as detailed in the Noise and Vibration Monitoring Program.

5.2 Vibration

Where vibration intensive activities with the potential to impact upon sensitive receivers or structures are proposed during OOHW, these will also be assessed using the construction noise estimation tool or CNVIS for compliance with safe working distances for:

- Cosmetic and/or structural impacts (including safe working distances)
- Human comfort impacts due to vibration and ground-borne noise
- In accordance with the safe working distances guide (refer to Section 6.3 of the NVMP).

5.3 Highly Noise Intensive Work

In accordance with CoA E67 except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver will only be undertaken:

- Between 08:00am – 06:00pm Monday to Friday
- Between 08:00am – 01:00pm Saturday
- If continuously, then not exceeding three (3) hours, with a minimum cessation of work of not less than one (1) hour.

‘Continuous’ includes any period during which there is less than a 1-hour respite between ceasing and recommencing any of the work. Highly noise intensive works will be conducted during standard construction hours whenever possible.

Where the use of such equipment is proposed out of hours, the equipment will be used prior to 11 pm Sunday to Thursday and before 12 midnight Friday and Saturday, where reasonably practical (CoA E74(c)).

In accordance with CoA E82, SPA will also consider use of alternative respite periods to minimise noise impacts, such as reduced respite periods to complete highly noise intensive works as early in the night as possible. Refer to Section 8.2 for the respite consultation requirements with the community.

The SPA Public Liaison Officer will use the outputs from the assessment to identify a range of appropriate mitigation measures and respite options to be implemented subject to consultation with the community at each affected location.

5.4 Coordination of OOHW

As part of the noise and vibration assessment process, SPA will consider any other OOHW permitted by a Project EPL, or undertaken by third parties (such as utility relocations), other concurrent stages of Western Harbour Tunnel / Warringah Freeway Upgrade and other Critical/State Significant Infrastructure, and State Significant Development that may be underway during the proposed OOHW, to ensure cumulative noise impacts are minimised and appropriate respite is provided at potentially affected sensitive receivers.

To facilitate the coordination of out-of-hours work with other projects, the following procedure will be undertaken:

- Step 1: SPA to identify relevant any relevant third parties in proximity to proposed CUT OOHW
- Step 2: SPA to provide as much advance notice regarding critical utility works to be undertaken out of hours to any relevant third parties
- Step 3: SPA Project Manager and/or Community Manager to communicate with relevant third parties. The frequency of communication is dependent on the nature of OOHW being proposed by both the SPA and any relevant third parties
- Step 4: If out-of-hours works from any relevant third parties are being undertaken in close proximity to proposed SPA OOHW, the proposed OOHW will be reviewed to ensure appropriate respite periods are provided.

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

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

It is noted that other projects / utility providers / etc. may also have their own procedures in place regarding out-of-hours works. This procedure may need to be altered to consider external influences.

6 OOHW Noise and Vibration Control Measures

Following the noise assessment process as described in Section 5 of this Protocol, the most appropriate reasonable and feasible management measures will be determined in accordance with the NVMP, ICNG, and the standard mitigation measures set out in Appendix B of the CNVG.

In addition, the CNVG directs that the Project should consider implementing the additional mitigation measures detailed in Appendix C of the CNVG where feasible and reasonable, and as outlined in Table 6-1 and Table 6-2 below for the out of hours periods in Figure 6-1.

In accordance with the CNVG, the additional mitigation measures outlined in Table 6-1 and Table 6-2 are defined as follows:

- **Notification (N)**: consists of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures.
- **Specific Notification (SN)**: provides additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops.
- **Phone Calls (PC)**: detailing relevant information made to identified/affected stakeholders.
- **Respite Offers (RO)**: to provide residents with respite from ongoing impact. In accordance with CoA E83 note, respite can be any combination of days or hours where out-of-hours works would not be more than 5dBA above the rating background level (Table 6-1, noticeable category).
- **Respite Period 1 (R1):** where out-of-hours construction noise in OOHW Period 1 is generally limited to no more than three consecutive evenings per week.
- **Respite Period 2 (R2)**: where out-of-hours construction noise in OOHW Period 2 is generally limited to two consecutive nights.
- **Duration Respite (DR)**: where it can be strongly justified it may be beneficial to increase the work duration, number of evenings or nights worked through Duration Respite so that the project can be completed more quickly.
- **Alternative Accommodation (AltA)**: may be offered to residents living in close proximity to construction works that are likely to experience highly intrusive noise levels.
- **Verification (V)**: includes the measurement of the background noise level and construction noise to verify that actual noise levels do not exceed predicted noise levels, and that applied mitigation measures are appropriate.

It should be noted that there may be personal circumstances among the sensitive receivers where the approach to specific additional mitigation measures is not best suited. The SPA Public Liaison Officer has the authority to amend the approach and offer additional mitigation considering the personal circumstances that may apply. This will be reviewed by the Acoustic Advisor.

In accordance with CoA A34(d), the Acoustic Advisor may recommend measures to avoid sleep disturbance or appropriate additional alternative mitigation measures.

Where a receiver falls on a noise catchment boundary, the NML applied to that receiver will be the lowest of either noise catchment.

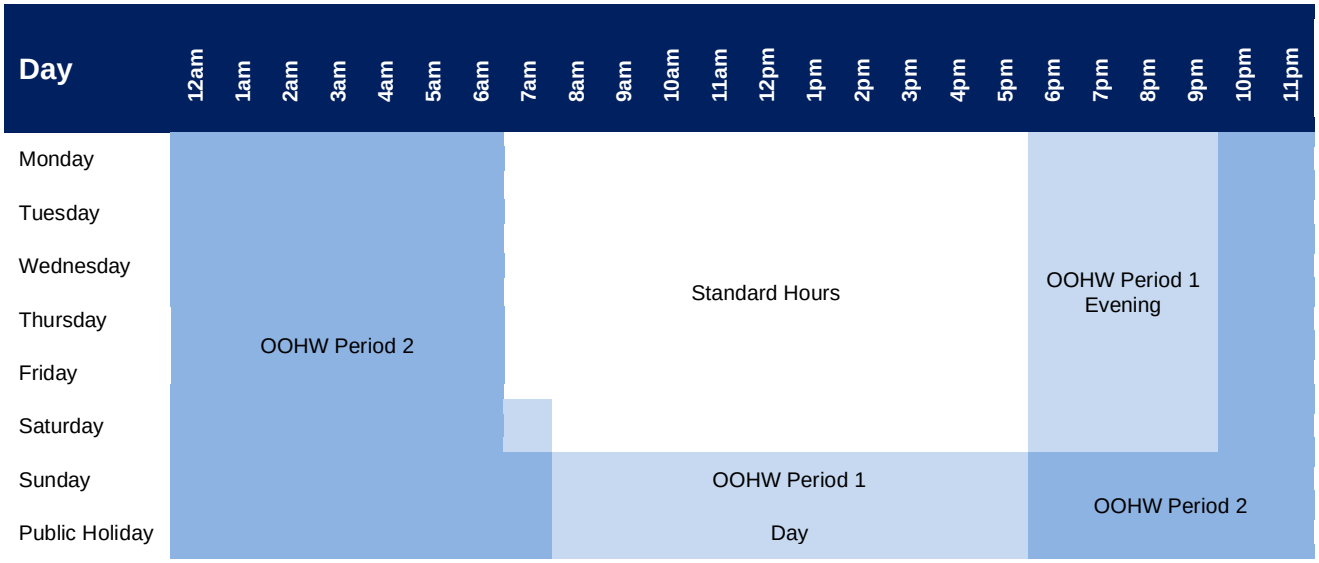


Figure 6-1 Standard construction hours and OOHW periods (Reference: CNVG (RMS 2018) and CoA E63)

Table 6-1 Triggers for additional mitigation measures - airborne noise

Perception	dB(A) above RBL	dB(A) above NML	Addition mitigation measures	Mitigation levels
All hours				
75 dBA or greater	-	-	N, V, PC, RO	HA
Standard hours				
Noticeable	5 to 10	0	-	NML
Clearly audible	10 to 20	< 10	-	NML
Moderately intrusive	20 to 30	10 to 20	N, V	NML +10
Highly intrusive	> 30	> 20	N, V	NML +20
Out of hours works 1 (OOHW1)				
Noticeable	5 to 10	< 5	-	NML
Clearly audible	10 to 20	5 to 15	N, R1, DR	NML +5
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR	NML +15
Highly intrusive	> 30	> 25	V, N, PC, R1, DR, SN	NML +25
Out of hours works 2 (OOHW2)				
Noticeable	5 to 10	< 5	N	NML
Clearly audible	10 to 20	5 to 15	V, N, R2, DR	NML +5

Perception	dB(A) above RBL	dB(A) above NML	Addition mitigation measures	Mitigation levels
Moderately intrusive	20 to 30	15 to 25	V, N, PC, SN, R2, DR	NML +15
Highly intrusive	> 30	> 25	AltA, V, N, PC, SN, R2, DR	NML +25

Notes:

AltA = Alternative Accommodation, V = Verification, N = Notification, PC = Phone Call, DR = Duration Respite (where feasible), R1 = Respite Period 1, R2 = Respite Period 2, RO = Respite Offer, SN = Specific Notification, HA = Highly Affected (> 75 dB(A) applies to residential receivers only)

Table 6-2 Triggers for additional mitigation measures - Vibration

Perception	Addition mitigation measures
Standard hours	
Human response minimum working distances predicted to be exceeded	N, V, RP
Out of hours works 1 (OOHW1)	
Human response minimum working distances predicted to be exceeded	V, N, RO, RP, SN
Out of hours works 2 (OOHW2)	
Human response minimum working distances predicted to be exceeded	AltA, V, N, PC, SN, RP

Notes:

AltA = Alternative Accommodation, V = Verification, N = Notification, PC = Phone Call, RP = Respite Period, RO = Respite Offer, SN = Specific Notification

7 Approval of OOHW not subject to an EPL

7.1 Identification of risk level

In accordance with CoA E69(a)(ii), the Environmental Representative (ER) has the authority to approve low risk OOHW activities in consultation with the Acoustic Advisor. Any high risk OOHW activities must be approved by the Planning Secretary.

Low risk works are defined as:

1. OOHW assessed to meet the perception classification of Noticeable (refer to Table 6-1), **or**
2. OOHW assessed to meet the perception classification of Clearly Audible and above (refer to Table 6-1) at any one residential receiver for a maximum of:
    - Three evenings or nights in a calendar week, with only two consecutive evenings or nights permitted
    - A maximum of 10 evenings or nights in a calendar month, **or**
3. OOHW assessed to meet the perception classification of Clearly Audible and above (refer to Table 6-1) at any one residential receiver and where a substantial majority of affected receivers have agreed in writing to a works program which is greater than that outlined in Item 2 above. In this circumstance the engagement process described in Sections 8.2 and 8.3 must be followed, in accordance with CoA E83.

[Note for Item 2 above: The effect of Item 2facilitates works in two evenings/nights in a row and at least one evening/night off before the third out-of-hours period that week. It is likely that all SPA OOHW will commence in the evening period and continue into the night period. This would count as one OOHW event, not two OOHW events.]

OOHW are considered to be high risk when the duration limitations outlined in the above three scenarios cannot be achieved.

7.2 Approval process

Refer to Figure 4-1 for the approval process for OOHW not subject to an EPL.

In accordance with CoA E69(a)(ii), the Environmental Representative (ER) has the authority to approve low risk OOHW activities in consultation with the Acoustic Advisor. Following the impact assessment, the SPA Environmental Manager will determine if the works are low or high risk and the approval process to be followed. In accordance with CoA E69(a)(i), the ER and Acoustic Advisor will have the opportunity to confirm the proposed out-of-hours works are within the risk level designated by SPA.

For high risk OOHW activities, the OOHW assessment and Permit, will be reviewed by the ER and endorsed by the Acoustic Advisor and issued to the Planning Secretary for review and approval.

Following the process described above, confirmation of the approval or no approval to carry out the works will be provided to the Construction Team by SPA's Environmental Manager utilising the OOHW Permit.

Where works have been approved, any standard and additional mitigation measures that relate to the OOHW will be:

- Implemented prior to works (such as specific conditions that relate to the community)
- Toolboxed with relevant workforce and site personnel before each shift to introduce/reinforce work restrictions, management measures and expected workforce behaviour

- Implemented during works and monitored by SPA's Environmental Manager.

During the delivery of the out-of-hours works, SPA will undertake monitoring to confirm/validate the predictions. Monitoring results are reported in accordance with Section 9.3 of the NVMP. Refer to section 10.1 of this OOHW Protocol for actions to be undertaken if monitoring results are above the modelling predictions.

The Acoustic Advisor will also verify that the above approach has been followed and advise opportunities for improvement in accordance with CoA A34 (c) and (d).

Any complaints received by the project will be managed in accordance with the Community Communication Strategy. All complaints, including any relevant to out-of-hours works, are provided on a weekly basis to the Environmental Representative in accordance with CoA A28(a).

The Environmental Representative, in consultation with the Acoustic Advisor and SPA's Environmental Manager will adjust the terms of the OOHW permit in response to community complaints and/or monitoring results (e.g. proposed works, mitigation measures, monitoring requirements).

Previous OOHW performance will be considered prior to the approval of further OOHW Permits.

8 OOHW Community Engagement

A suite of communication tools and activities will be utilised to provide clear, effective and timely information to the predicted impacted receivers based on the nature of works and the potential impacts. Community engagement will be carried out in accordance with the Community Communication Strategy (CCS) and the section below.

8.1 Community Notification

Where required in the additional mitigation measures outlined in Table 6-1, SPA will notify potentially affected noise sensitive receivers and other affected stakeholders, of works approved outside of standard construction hours not less than 5 calendar days and not more than 14 calendar days before those works are to be carried out.

Where OOHW are proposed over extended periods (e.g. for over 14 days), a monthly notification will be provided in order not to overwhelm the sensitive receivers with constant notification.

It should be noted that there may be personal circumstances among the sensitive receivers where the community notification is not best suited. The SPA Public Liaison Officer has the authority to amend the approach and offer additional mitigation considering the personal circumstances that may apply. This will be monitored by the Acoustic Advisor.

8.2 Respite Consultation

Respite (for example Respite Period 1 and Respite Period 2 identified in Table 6-1 and Table 6-2) generally involves programming the works so they are undertaken in blocks so that any one receiver is not impacted by noise and vibration for continuous periods. In accordance with CoA E69(c) mitigation 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 sleep disturbance events (refer to Section 6.2.2 of the NVMP). Additionally, in accordance with CoA E82, the consideration of respite must also include all other Critical State Significant Infrastructure, State Significant Infrastructure and State Significant Development projects which may cause cumulative and/or consecutive impacts at receivers affected by the delivery of the CSSI.

In accordance with CoA E83, where OOHW is required, SPA will identify appropriate duration respite periods for the OOHW in consultation with the community at each affected location, as identified by the assessment process outlined in Section 5. Based on the noise assessment, duration respite will be considered as a mitigation measure when the trigger levels in Table 6-1 are exceeded. This is identified as ‘DR’ in the table.

This consultation will be conducted in accordance with the CCS and include the provision of the following to affected receivers:

- An indicative three-month construction lookahead for OOHW
- A description of the potential works, location and duration
- The noise characteristics and likely noise levels of the proposed works
- Proposed mitigation and management measures.

The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hours works will be provided to the Acoustic Advisor, EPA and Secretary of DPIE in the form of a Community Respite Consultation Summary Report. These reports will be developed following each respite consultation event required under CoA E83.

In some circumstances (and where reasonable and feasible to do so), duration respite may be used as a mitigation measure, despite the triggers described in Table 6-1. An example is during

daytime works where highly sensitive receivers (e.g. people working from home) may be subject to high levels of noise.

8.3 Community Agreement

In accordance with CoA E68(c)(iii), variation to working hours may occur following negotiated agreements with affected residents and sensitive land user(s). If such negotiated agreements can be made the overall duration of OOHW may be reduced. Negotiated agreements made in accordance with CoA E68(c)(iii) would allow proposed OOWH to occur outside of the provisions of Respite 1 and Respite 2. This provision would allow for an accelerated program of OOHW by permitting additional OOHW shifts per week.

SPA may identify Noticeable OOHW which would provide benefit to the community if completed through an accelerated program. In these instances, SPA may engage with and seek agreement from the noise affected community to conduct the works through this accelerated program.

SPA must engage with and seek agreement in writing from all sensitive receivers which modelling has predicted to be impacted by noise greater than 5dBA above the RBL (this includes receivers that have previously declined to participate in agreements). The agreement must detail:

- The actual works proposed
- Expected impacts in clear, simple English based on noise modelling
- Expected duration of the works
- Any expected benefits for the receivers
- Any other concurrent OOHW that will be occurring
- Any other OOHW that will be occurring on the nights preceding and following the proposed works or, if the proposed work precedes or follows a weekend period, any other OOHW that will be occurring on the weekend.

Community agreements will be undertaken in accordance with the Community Communications Strategy prepared under CoA B1.SPA must keep a record of all attempts made to contact sensitive receivers and requests made to the body corporate; these records must be kept for the duration of the OOHW. Where SPA is not able to contact a sensitive receiver, the receiver will be recorded as having no response.

9 OOHW Noise and Vibration Monitoring

Noise and vibration monitoring of OOHW will be conducted and documented in accordance with Section 6 of this OOHW Protocol and the Noise and Vibration Monitoring Program.

10 OOHW Compliance Management

10.1 Management response

Where monitored noise levels are found to be above modelling predictions or vibration goals are exceeded, the following actions will be undertaken:

- Confirm the monitored levels are not being impacted by other noise or vibration sources
- Implement other feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), and utilising alternative construction methodology or a combination of these
- Review work practices to ensure compliance with the ICNG
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment or vibratory piece of equipment
- Review mitigation measures that were applied and revise if necessary
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant
- Confirm that the modelling reflects the actual activity being undertaken
- Communicate lessons learnt to relevant personnel.

Any previously recorded non-conformances and community complaints relevant to out-of-hours works will be considered prior to the approval of further OOHW Permits. Where noise monitoring indicates that OOHW noise levels are greater or lower than predicted, SPA will consider adjusting the night-time works per week, in line with the mitigation measures in Section 6.

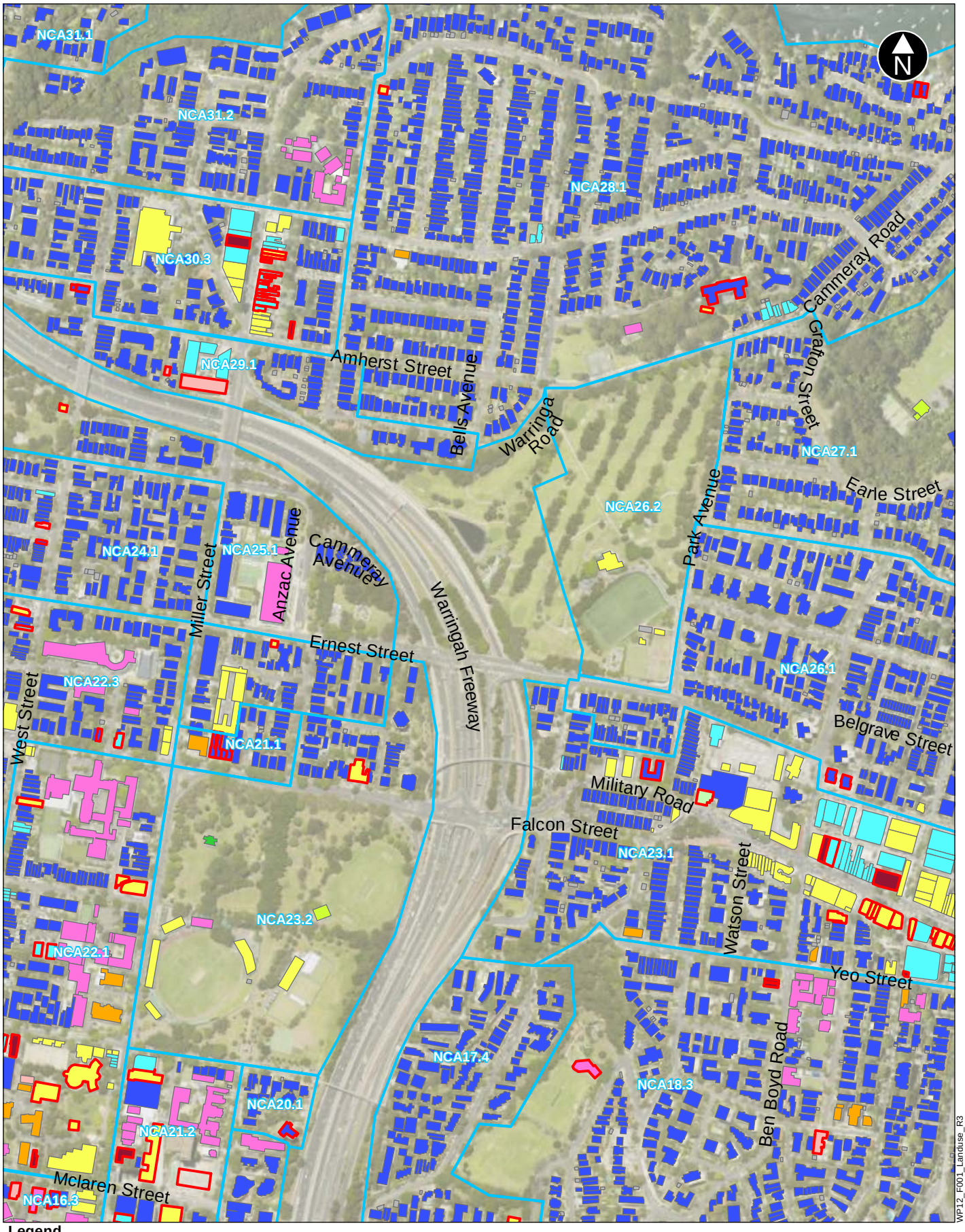
10.2 Reporting

Noise and vibration complaints will be reported in accordance with the CCS.

Construction Monitoring Reports will be prepared and submitted to DPIE and relevant regulatory authorities for information, in line with CoA C21 as described in Section 9.6 of the Noise and Vibration Management Plan.

The Acoustic Advisor provides a Monthly Noise and Vibration Report detailing the Acoustic Advisor's actions and decisions on matters for which the Acoustic Advisor is responsible, in accordance with CoA A34(h)(v) and included in Section 3.9.4 of the CEMP.

Appendix E Land Use Survey Maps



Legend

- Noise catchment area (NCA)
- Landuse updated(2021)

Receiver type

- Commercial/industrial
- Education/Childcare
- Medical / Commercial
- Mixed use
- Non receiver building
- Educational/childcare
- Medical
- Place of worship
- Recreational - active
- Recreational - passive
- Residential

Noise catchment areas and receivers

Legend

Noise catchment area (NCA)

Landuse updated(2021)

Receiver type

- Commercial/industrial
- Education/Childcare
- Mixed use
- Non receiver building
- Educational/childcare
- Medical
- Place of worship
- Recreational - active
- Residential

0 100 200m

Noise catchment areas and receivers

Appendix F Noise and Vibration Monitoring Program

Appendix F

Noise and Vibration Monitoring Program

Western Harbour Tunnel and Warringah Freeway Upgrade

Stage 1A Early and Enabling Works - Critical utility installation, relocation and protection works

April 2021

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Document control

Title	Stage 1A – Early and enabling works - Critical utility installation, relocation and protection works Noise and Vibration Monitoring Program
Document Ref/No.	SPAWP12-JHG-PMM-ENV-0-0001

Document status

Revision	Date	Description	Approval
0	05/02/2021	Prepared for stakeholder consultation	DL
1	23/03/2021	Updated following agency, ER, AA and TfNSW comments	JN
2	30/03/2021	Updated following additional ER and AA comments	JN
3	06/04/2021	Updated following additional AA comments	JN
4	22/04/2021	Updated following DPIE comments	JN

Glossary/ Abbreviations

Abbreviations	Expanded Text
AA	Acoustic Advisor
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline
CNVS	Construction Noise and Vibration Strategy
CNVIS	Construction Noise and Vibration Impact Statement
CoA	Condition of Approval
Critical utility works	Stage 1A Early and enabling works – Critical utility installation, relocation and protection works
CSSI	Critical State Significant Infrastructure
CUT	Stage 1A Early and enabling works – Critical utility installation, relocation and protection works
Daytime, day	The period from 7 am to 6 pm (Monday to Saturday) and 8 am to 6 pm (Sundays and public holidays).
DECC	Department of Energy and Climate Change
DPIE	NSW Department of Planning, Industry and Environment
EIS	Western Harbour Tunnel and Warringah Freeway Upgrade Environmental Impact Statement (January 2020)
ENMM	Environmental Noise Management Manual
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
ER	Environmental Representative
Evening	Refers to the period from 6 pm to 10 pm
Extraneous noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the

Abbreviations	Expanded Text
	application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Heritage item	A place, building, work, relic, archaeological site, tree, movable object or precinct of heritage significance, that is listed under one or more of the following registers: the State Heritage Register under the *Heritage Act 1977* (NSW), a state agency heritage and conservation register under section 170 of the *Heritage Act 1977* (NSW), a Local Environmental Plan under the EP&A Act, the World, National or Commonwealth Heritage lists under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), and an "Aboriginal object" or "Aboriginal place" as defined in section 5 of the *National Parks and Wildlife Act 1974* (NSW)
Highly noise affected	As defined in the Interim Construction Noise Guideline (DECC, 2009)
Highly noise intensive	Works which are defined as annoying under the Interim Construction Noise Guideline (DECC, 2009) including: a. Use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work b. Grinding metal, concrete or masonry c. Rock drilling d. Line drilling e. Vibratory rolling f. Bitumen milling or profiling g. Jackhammering, rock hammering or rock breaking h. Impact piling.
ICNG	Interim Construction Noise Guidelines
$L_{A\ (max)}$	The A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
$L_{Aeq\ (15min)}$	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
NCA	Noise Catchment Area
NCG	Noise Criteria Guideline
Night	The period from 10 pm to 7 am (Monday to Saturday), and 10 pm to 8 am (Sundays and public holidays)
NMG	Noise Mitigation Guideline

Abbreviations	Expanded Text
NML	Noise Management Level
NPI	Noise Policy for Industry, Environment Protection Agency 2017
NVMoP	Noise and Vibration Monitoring Program (the Program, this document)
NVMP	Noise and Vibration Management Sub-plan
OOHW	Out of Hours Work
POEO Act	*Protection of the Environment Operations Act 1997*
PPV	Peak-Particle Velocity
Project, the	Western Harbour Tunnel and Warringah Freeway Upgrade (WHTWFU)
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
REMM	Revised Environmental Management Measure
RMS	Roads and Maritime Services (now Transport for New South Wales)
RTA	Roads and Traffic Authority (now Transport for New South Wales)
RtS	Western Harbour Tunnel and Warringah Freeway Upgrade Response to Submissions (July 2020)
SPA	Sydney Program Alliance
TfNSW	Transport for New South Wales
VDV	Vibration Dose Value

1 Introduction

1.1 Context and Scope

This Noise and Vibration Monitoring Program (NVMoP or Program) forms part of the Construction Environmental Management Plan (CEMP) for the Stage 1A Early and Enabling Works – critical utility installation, relocation and protection works (refer to herein as “the critical utility works’ or ‘CUT’) which will support the delivery program of the Main Works of the Western Harbour Tunnel and Warringah Freeway Upgrade (the Project). Sydney Program Alliance (SPA) has been appointed by Transport for New South Wales (TfNSW) to deliver the CUT works.

This NVMoP has been prepared to address the requirements of the Minister’s Conditions of Approval (CoA), Western Harbour Tunnel and Warringah Freeway Upgrade Environmental Impact Statement (EIS), the revised environmental management measures (REMMs) listed in the Western Harbour Tunnel and Warringah Freeway Upgrade Response to Submissions Report (RtS) and all applicable legislation. It describes how SPA proposes to compare actual performance of critical utility works against the predicted performance.

1.2 Background and project description

The Western Harbour Tunnel and Warringah Freeway Upgrade EIS (January 2020) assessed noise and vibration impacts on sensitive receivers and structures from construction of the Project.

As part of the EIS development, a detailed construction and operational noise and vibration assessment was prepared based on the Concept Design to address the Environmental Assessment Requirements issued by the Department of Planning, Industry and Environment (DPIE). The noise and vibration assessment was included in the EIS, within Chapter 10 and the Noise and Vibration Technical Paper (Appendix G of the EIS).

The project description is outlined in Sections 1.2 of the CEMP.

2 Purpose and objectives

2.1 Purpose

The purpose of this Monitoring Program is to describe how SPA proposes to monitor noise and vibration during the CUT works.

2.2 Objectives

The key objectives of the NVMoP are to identify how the Project will comply with noise and vibration monitoring requirements identified in:

- The EIS prepared for the Project
- The RtS prepared for the Project
- CoA granted to the Project on 21 January 2021
- The Project's Environment Protection Licence (EPL) (insert EPL number)
- All relevant legislation and other requirements described in Section 3.1 of this monitoring program.

To achieve these objectives, SPA will meet the performance outcomes from the EIS, as identified in Appendix A.

3 Environmental requirements

3.1 Relevant legislation

3.1.1 Legislation

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

- *Protection of the Environment Operations Act 1997 (POEO Act)*
- *Protection of the Environment Operations (Noise Control) Regulation 2008.*

All legislation relevant for the Project is included in Appendix A3 of the CEMP.

3.1.2 Guidelines

The main guidelines, specifications and policy documents relevant to this Plan include:

- TfNSW Construction Noise and Vibration Guidelines (CNVG) (RMS 2016)
- TfNSW Noise Criteria Guideline (NCG) RMS 2014
- TfNSW Noise Mitigation Guideline (NMG) RMS 2014
- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009
- NSW Road Noise Policy, Department of Environment, Climate Change and Water 2011
- Noise Policy for Industry (NPI), Environment Protection Authority 2017
- NSW Assessing Vibration – a technical guideline, Department of Environment and Conservation 2006
- Procedure: Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report, RMS 2013
- Environmental Noise Management Manual (ENMM) RTA 2001
- Australian Standard 2659.1 – 1998 Guide to the use of sound measuring equipment – portable sound level meters
- Australian Standard IEC 61672.1 Electroacoustic – Sound Level Meters – Specifications
- Australian Standard 2775 Mechanical Mounting of Accelerometers
- Australian Standard 1055 Acoustics – Description and Measurement of Environmental Noise
- Australian Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
- Australian Standard AS2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites
- British Standard BS 6472-2008, ‘Evaluation of human exposure to vibration in buildings (1-80Hz)
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings'

- German Standard DIN4150-2016 Structural vibration Part 3: Effects of vibration on Structures,
- Construction Noise and Vibration Strategy ST-157/4.1 - 2019 (CNVS), Transport for NSW 2018.

3.2 Minister's Conditions of Approval

The CoA relevant to this Plan are listed Appendix B. A cross reference is also included to indicate where the condition is addressed in this Plan or other project management documents.

3.3 Revised Environmental Management Measures

REMMs relevant to this program are listed Appendix B. This includes reference to required outcomes, the timing of when the commitment applies, relevant documents or sections of the environmental assessment influencing the outcome and implementation.

3.4 Environmental Protection Licence monitoring requirements

SPA holds an EPL (insert EPL number) for CUT works, granted by the NSW Environment Protection Authority (EPA). Noise monitoring requirements from the EPL have been incorporated into this Monitoring Program.

4 Consultation, endorsement and approval of this Program

4.1 Consultation for the development of this Program

This NVMoP has been provided to the NSW Environment Protection Authority (EPA) for consultation in accordance with CoA C11(a). The NVMoP was provided to the EPA for consultation on 8 February 2021 and comments were returned by the EPA on 8 March 2021. The outcomes of the agency consultation have been provided to DPIE in accordance with CoA A5 on 7 April 2021. The CoA A5 consultation summary report demonstrated that the EPA consultation comments were adequately addressed.

4.2 Endorsement and approval

This Monitoring Program must be endorsed by the ER and Acoustic Advisor (AA) prior to lodgement to DPIE for approval. This Monitoring Program must be lodged to DPIE for approval at least one month prior to the commencement of CUT construction works.

5 Baseline monitoring

As part of the development of the EIS, baseline noise monitoring was conducted between June 2017 and November 2017 at a total of 41 locations, with 16 of these monitoring locations being relevant to the critical utility works. The baseline noise monitoring locations were selected to be representative of the appropriate Noise Catchment Areas (NCAs) within and around the project, across a mix of existing land uses including residential, commercial, industrial and open space. NCAs relevant to the critical utility works are identified in Section 6.2.1 of the NVMP. The representative baseline noise monitoring locations are identified in Appendix C.

The RBL is derived based on the measured time periods where the lowest 10th percentile background noise level occurs, representing the 'quietest' period of the day, evening or night assessment period. For further information regarding baseline noise monitoring refer to Section 2.5 of the EIS Appendix G.

The long-term noise monitoring results are included in Table 2-2 of the EIS Appendix G. The results relevant to the critical utility works are included in Table 5-1. The table also identifies the NCAs relevant to the critical utility works that are associated with each monitoring location.

Table 5-1 Long-term noise monitoring results (EIS Appendix G – Table 2-2)

Monitoring location ID (relevant NCAs)	Address	Rating Background Level (RBL)			L_{Aeq} Ambient noise levels		
		Day[1]	Evening[2]	Night[3]	Day[1]	Evening[2]	Night[3]
L15 (NCA 15.2, 15.3, 15.4)	1/16 Munro Street, McMahons Point	42	41	38	52	46	44
L16 (NCA 16.1, 16.2, 16.3)	401/102 Alfred Street, Milsons Point	60	60	50	63	62	58
L17 (NCA 17.1, 17.2, 17.3, 17.4)	6 McDougall Street, Kirribilli	55	54	45	60	58	56
L18 (N/A)	1/191-195 Walker Street, North Sydney	73	71	55	76	75	72
L19 (NCA 19.1, 20.1)	91 Ridge Street, North Sydney	52	52	45	57	57	52
L20 (NCA 18.1, 18.2, 18.3)	14 Montpellier Road, Neutral Bay	54	52	43	59	57	53

Monitoring location ID (relevant NCAs)	Address	Rating Background Level (RBL)			L_{Aeq} Ambient noise levels		
		Day[1]	Evening[2]	Night[3]	Day[1]	Evening[2]	Night[3]
L21 (NCA 22.1, 22.3)	306 Miller Street, North Sydney	52	47	36	65	63	58
L22 (NCA 21.1, 21.2)	1/1 Bardsley Gardens, Crows Nest	53	49	41	68	67	63
L23 (NCA 23.1, 23.2)	288 Falcon Street, Neutral Bay	61	54	44	69	68	65
L24 (N/A)	5 Military Road, Neutral Bay	58	54	44	72	71	67
L25 (NCA 26.1, 26.2)	317 Ernest Street, Cammeray	58	54	41	69	66	62
L26 (NCA 24.1)	225 Ernest Street, Cammeray	56	52	37	68	66	61
L27 (NCA 25.1)	77 Rosalind Street, Cammeray	58	55	43	62	60	57
L28 (NCA 29.1)	53 Bellevue Street, Cammeray	64	63	47	67	67	64
L29 (NCA 28.1)	12 Warringa Road, Cammeray	47	45	37	54	51	48
L30 (NCA 27.1)	57 Park Avenue, Cremorne	49	48	39	59	57	54
L31 (NCA 30.3)	18/22-24 Donnelly Road, Crows Nest	58	56	38	62	61	58
L32 (NCA 31.2)	79 Brook Street, Naremburn	56	49	37	71	69	65

Notes:

1. Day: 7:00am to 6:00pm Monday to Saturday and 8:00am to 6:00pm Sundays and public holidays
2. Evening: 6:00pm to 10:00pm Monday to Sunday and public holidays
3. Night: 10:00pm to 7:00am Monday to Saturday and 10:00pm to 8:00am Sundays and public holidays.

6 Noise and vibration monitoring

6.1 Attended noise monitoring

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

- Monitoring will be carried out at the commencement of activities for which a location and activity specific noise and vibration impact assessment has been prepared to confirm that actual noise and vibration levels are consistent with predictions and that the management measures that have been implemented are appropriate.
- Within the first month of construction and throughout the construction period, monitoring will be undertaken at locations determined in consultation with the AA (refer below for additional detail regarding locations) during the day, evening and night-time periods and will cover the range of activities being undertaken.
- Where a change in methodology, plant or equipment is anticipated to result in an increase in construction noise impact which is greater than that predicted in the noise and vibration assessment
- Where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis)
- As otherwise required by the CNVIS, Construction noise estimation tool or Section 5 of the OOHW Protocol (refer also to Section 6.3 of this program)
- Following the implementation of mitigation measures or noise attenuation as a result of exceedance of predicted noise levels
- Ongoing spot checks for noise intensive plant and equipment will be undertaken throughout construction to ensure compliance with the maximum noise level goals for construction equipment (refer to the CNVIS). Spot checks would be carried out as required on a case-by-case basis, such as in response to a plant/equipment specific noise related complaint and during noise and vibration assessment validation monitoring when it is possible to isolate the noise from one piece of plant or equipment

Noise monitoring undertaken for the critical utility works is summarised in Table 6-1.

Table 6-1 Summary noise monitoring schedule

Type of monitoring	Description / Activity monitored	Timing / Frequency	Parameters to be measured
Attended noise	Activities for which a location and activity specific noise and vibration impact assessment has been prepared	Start of activities	Noise levels predicted by CNVIS or Construction noise estimation tool; management measures are appropriate
Attended noise	Various / range of activities being undertaken	First month of construction, and throughout construction (day, evening and night-time periods)	Noise levels predicted by CNVIS or Construction noise estimation tool; management measures are appropriate

Type of monitoring	Description / Activity monitored	Timing / Frequency	Parameters to be measured
Attended noise	Activity requiring a change in methodology, plant or equipment	Start of activity	Noise levels predicted by CNVIS or Construction noise estimation tool; management measures are appropriate
Attended noise	Activity that resulted in complaint	After complaint	Noise levels predicted by CNVIS or Construction noise estimation tool; management measures are appropriate
Attended noise	As directed by the CNVIS or Construction noise estimation tool	As directed by the CNVIS or Construction noise estimation tool	Noise levels predicted by CNVIS or Construction noise estimation tool; management measures are appropriate
Attended noise	OOHW	At various times during OOHW activities	Noise levels predicted by CNVIS or Construction noise estimation tool; management measures are appropriate
Attended noise	Any activity that resulted in an exceedance of predicted noise levels	After the implementation of mitigation measures or noise attenuation that were required following the exceedance	Noise levels predicted by CNVIS or Construction noise estimation tool; management measures are appropriate
Attended noise – spot checks	Noise intensive plant and equipment	Periodic	Compliance with the maximum noise level goals for construction equipment (refer to the CNVIS)

Representative locations will be identified to verify the noise model / prediction tools described in Section 7 of the NVMP. Monitoring results will be used to verify predictions and refine the model where necessary.

Attended noise monitoring locations will vary and be determined on a case-by-case basis by the CNVIS, the Construction noise estimation tool or where in response to complaints. In accordance with CoA C13(a) all attended noise monitoring locations will be determined in consultation with the Acoustics Advisor. Where possible, monitoring will be undertaken at the most affected noise sensitive receiver/s in proximity to the critical utility works. Noise monitoring locations will consider factors including, but not limited to:

- Location of previous monitoring sites
- Proximity of the receiver to a critical utility works site
- Location and type of mitigation measures
- Location of barrier structures, whether these are items like buildings or topography

- Sensitivity of the receiver to noise
- Expected noise level at the receiver
- Practicality of the measurement site and the ability to obtain valid, useful and representative data
- Background noise levels
- Expected duration of the impact.

These observations will be recorded by the person carrying out the monitoring during the monitoring event. Monitoring will generally be undertaken in publicly accessible locations, unless private access is granted by the owner/resident, and will consider the safety of the personnel undertaking the noise monitoring. In accordance with the ICNG, the amount of noise monitoring will depend on the scale of the construction activities and extent of expected noise impacts. Noise monitoring will cover a representative period of the construction activity.

Due to the scale of the critical utility works, no real-time noise monitoring is proposed. However, the monitoring data obtained during the attended noise monitoring will be available to SPA, TfNSW, ER and AA. The monitoring data will also be available to DPIE and EPA on request.

6.1.1 Parameters to be monitored

All environmental noise monitoring will be taken with the following meter settings:

- Time Constant: Fast (i.e. 125 milliseconds)
- Frequency Weightings: A-weighting
- Sample period: 15 minutes.

Environmental noise monitoring will be recorded over 15-minute sample intervals, excluding periods of extraneous noise until a representative sample has been obtained. A representative sample will be determined by the monitor operator. The minimum range of noise metrics to be stored in the memory for later retrieval include the following A-weighted noise levels: L_{A90}, L_{Aeq}, L_{A10} and $L_{A(max)}$.

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

6.1.2 Calibration, QA and competency

Australian Standard AS 1055 Acoustics - Description and measurement of environmental noise provides a good practice guide for noise measurements.

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

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

Competence demonstrated through professional experience may be supplemented with training delivered by a trained acoustician who is a member of the Australian Acoustical Society, and AA

spot checks of monitoring events to confirm personnel are undertaking the monitoring in a competent manner.

Noise monitoring equipment will be Type 1 instruments as specified in AS/NZS IEC 61672.1:2019 Electroacoustics: sound level meters specifications, calibrated in accordance with manufacturer specifications and / or relevant Australian Standards. The calibration of the monitoring equipment will be checked in the field before the noise measurement period. Records of monitoring equipment calibration (including current calibration certificates) will be maintained by SPA throughout the delivery of critical utility works.

Monitoring records will be retained throughout the delivery of the critical utility works by SPA. Noise monitoring records will include:

- Date and time of measurement
- Name of person undertaking the measurement
- Type, model number and serial number of the noise monitor and portable field calibrator
- The date of the noise monitor's last calibration in a NATA accredited laboratory and the date of the portable field calibrator's last calibration in a NATA accredited laboratory
- Results of field calibration checks
- Time of day, length of measurement and any measurement time intervals
- Monitoring location, including a sketched map of area. Sketched maps may include the following:
    - Monitoring location
    - Noise source being monitored
    - Relevant receiver location
    - North arrow
    - Any other relevant geographic indicators
- Measurement location details and number of measurements at each location
- Weather conditions during measurements. Weather conditions, including wind speed, will be taken from the nearest Bureau of Meteorology weather station at the time of monitoring event. The wind speed at the microphone will be estimated (less than, or more than 5m/sec). Wind speed at the microphone can be estimated by two methods:
    - Using the modified Beaufort Scale; or
    - If the wind noise at the microphone is 10dB(A) less than the noise source being monitored
- Operation and activities of the noise sources under investigation
- Estimated contribution of the Project's activities
- Noise due to other extraneous and environmental sources (e.g. traffic, aircraft, trains, dogs barking, insects).

All outdoor noise measurements will be undertaken with a windscreen over the microphone and measurements of noise will be disregarded (if the measurement is adversely affected by weather) when it is more than a light rain and/or the wind speed is greater than 5 m/s (18 km/h) at the microphone. Rain would be considered light if the sound of the rain is 10dB(A) less than the noise source being monitored.

Extraneous noise events would be excluded from the monitoring event where possible.

Where possible, noise monitoring is to be carried out at least 3.5 m from any reflective surface other than the ground and the preferred microphone/measurement height is 1.2-1.5 m above the ground.

Measurements taken inside buildings should be at least one metre from walls or other reflective surface, and about 1.5 metres from windows, where such instrument siting is possible. Where the monitoring location is within 3.5 metres of a reflecting surface other than the ground, or is not between 1.2 and 1.5 metres above the ground, this will be recorded, the reasons for the variance explained and any effect on the measurements quantified and accounted for in the subsequent analysis.

In the event that calculations are required to support noise measurements, or instead of measurements, this will be justified and the method, inputs and assumptions used in the calculations will be detailed in the relevant monitoring report.

6.2 Short term attended and unattended vibration monitoring

Attended vibration monitoring is to be undertaken as follows:

- At the commencement of operation for each plant or activity on site, which has the potential to generate significant vibration levels, where the vibration screening criteria is likely to be exceeded, as determined by a CNVIS
- At the commencement of vibration generating activities that have the potential to impact on heritage items to confirm/identify the minimum working distances to prevent cosmetic damage
- Where vibration sensitive locations are determined to fall within the 'safe working distances' established for each item of plant, so to refine the indicative minimum working distances
- To determine the effectiveness of vibration mitigation measures
- Where deemed to be relevant to construction works in response to a vibration related complaint
- As otherwise required by the CNVIS or OOHW Protocol.

Vibration monitoring undertaken for the critical utility works is summarised in Table 6-1.

Table 6-2 Summary vibration monitoring schedule

Type of monitoring	Description / Activity monitored	Timing / Frequency	Parameters to be measured
Attended vibration	Each plant or activity on site, which has the potential to generate significant vibration levels, where the vibration screening criteria is likely to be exceeded	Start of activities / operation of plant	Vibration levels predicted by CNVIS or vibration criteria (Section 6.3 of the NVMP); management measures are appropriate
Attended vibration	Vibration generating activities that have the potential to impact on heritage items	Start of activities	Vibration levels predicted by CNVIS or vibration criteria (Section 6.3 of the NVMP); management measures are appropriate

Type of monitoring	Description / Activity monitored	Timing / Frequency	Parameters to be measured
Attended vibration	Vibration generating activities that have the potential to impact on vibration sensitive locations	Start of activities	Vibration criteria (Section 6.3 of the NVMP); management measures are appropriate
Attended vibration	Activity that resulted in complaint	After complaint	Vibration levels predicted by CNVIS or vibration criteria (Section 6.3 of the NVMP); management measures are appropriate
Attended vibration	As directed by the CNVIS or estimation tool	As directed by the CNVIS or estimation tool	Vibration levels predicted by CNVIS or vibration criteria (Section 6.3 of the NVMP); management measures are appropriate
Attended vibration	OOHW	At various times during OOHW activities	Vibration levels predicted by CNVIS or vibration criteria (Section 6.3 of the NVMP); management measures are appropriate

Where possible, monitoring will be undertaken at the most affected noise sensitive receiver/s in proximity to the critical utility works. Noise monitoring locations will consider factors including, but not limited to:

- Location of previous monitoring sites
- Proximity of the receiver to a critical utility works site
- Location and type of mitigation measures
- Location of barrier structures, whether these are items like buildings or topography
- Sensitivity of the receiver to vibration
- Expected vibration levels at the receiver
- Practicality of the measurement site and the ability to obtain valid, useful and representative data
- Expected duration of the impact.

These observations will be recorded by the person carrying out the monitoring during the monitoring event. Monitoring will generally be undertaken in publicly accessible locations, unless private access is granted by the owner/resident, and will consider the safety of the personnel undertaking the vibration monitoring.

Vibration monitoring will be undertaken in accordance with the relevant vibration measurement requirements in the reference standards and documents in Section 3.1.2. In accordance with CoA C13(a) all vibration monitoring locations will be determined in consultation with the Acoustics Advisor.

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

Where property damage is a concern, vibration monitoring results will be assessed and reported against the British Standard BS 7385 Part 2 – 1993 for structurally sound buildings and the German Standard DIN4150-1999 Structural vibration Part 3: Effects of vibration on Structures for structurally unsound structures, as presented in the NVMP.

Vibration monitoring equipment will be mounted directly to the building's foundation at a location on the foundation closest to the vibrating plant. Selected monitoring locations will be solid and rigid to best represent the vibration entering the structure of the building under investigation. The vibration sensor will be mounted to the structure using bees wax or a magnetic mounting plate onto a steel washer, plate or bracket which shall be either fastened or glued to the surface of interest. Any alternative mounting techniques will be determined by an appropriately experienced person in accordance the relevant standards and guidelines and with consideration of avoiding potential damage to the mounting surface. The vibration sensor or transducer shall not be mounted on loose tiles, loose gravel or other resilient surfaces.

Unattended vibration monitors will be left in place on private property, only with permission of the owner or occupier. They will be picked up at a mutually agreed time with the resident.

6.2.1 Parameters to be monitored

The following vibration metrics will be stored in memory and reported:

- Vibration Dose Values (VDVs) – for the assessment of human comfort concerns
- Peak-Particle Velocity (PPV) – for the assessment of cosmetic damage concerns.

All short term attended vibration monitoring will be recorded over a representative sampling interval where the worst-case vibration levels can be captured. Where unattended vibration monitoring is proposed, monitoring will be undertaken continuously whilst the vibrating plant is operational to capture the worst-case vibration levels within the pre-determined 'safe working distance' from the potentially affected building. Typical 'safe working distances' for construction equipment are presented in the CNVIS.

6.2.2 Calibration and QA

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

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

Competence demonstrated through professional experience may be supplemented with training delivered by a trained acoustician who is a member of the Australian Acoustical Society, and AA spot checks of monitoring events to confirm personnel are undertaking the monitoring in a competent manner.

All vibration instruments will be calibrated in accordance with manufacturers' specifications or relevant Australian Standards. Records of monitoring equipment calibration will be maintained by SPA throughout the delivery of the critical utility works.

All monitoring records will be retained throughout the delivery of the critical utility works by SPA. Vibration monitoring records will include:

- Date and time of measurements

- Name of person undertaking the measurements
- Type, model number and serial number of instrumentation
- The date of the vibration monitor's last calibration in a NATA accredited laboratory
- Time of day, length of measurement and measurement time intervals
- Monitoring location, including a sketched map of area. Sketched maps may include the following:
    - Monitoring location
    - Vibration source being monitored
    - Relevant receiver location
    - North arrow
    - Any other relevant geographic indicators
- Measurement location details and number of measurements at each location. Photos should be undertaken, where practical.
- Operation and load conditions of the vibrating plant under investigation
- Possible vibration influences from other sources (e.g. domestic vibrations, other mechanical plant, traffic etc.).

6.3 Out of Hours Work Protocol monitoring

The Out of Hours Work Protocol enables out of hours works for works that are not subject to an EPL under certain circumstances and prescribes requirements that must be complied with to undertake the works.

In accordance with Section 6 of the OOHW Protocol, noise verification monitoring would be undertaken when the impact classification is predicted to be moderately intrusive or highly intrusive (during OOHW period 1) or clearly audible, moderately intrusive or highly intrusive (during OOHW period 2). Vibration verification monitoring would be undertaken when the human response minimum working distances are predicted to be exceeded during OOHW period 1 or period 2.

6.4 Out of Hours EPL monitoring requirements

This section of the monitoring program will be updated once the EPL for the critical utility works is issued.

7 Heritage-listed structures

In accordance with CoA E79, SPA will conduct vibration testing at the commencement of vibration generating activities that have the potential to impact on heritage items to identify minimum working distances to prevent cosmetic damage. Should vibration testing and attended monitoring show that the preferred values for vibration are likely to be exceeded, SPA will follow the process in Section 8.1. Heritage items in the vicinity of the critical utility works are identified in Appendix C and presented in Table 7-1 below.

A CNVIS prepared for the Project will identify where monitoring should be conducted at heritage items.

SPA will seek the advice of the Project's heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage-listed structures as identified in CoA E80.

Table 7-1 Heritage items in the vicinity of the CUT works

Heritage Item / Conservation Area	Listing	Heritage Significance
Cammeray Park (including golf course) at Cammeray	• North Sydney LEP 2013	Local
Cammeray Conservation Area at Cammeray	• North Sydney LEP 2013 • Register of the National Estate	Local
ANZAC Park at Cammeray	• Unlisted	Local
Lavender Bay Conservation Area	• North Sydney LEP 2013 • Register of National Estate	Local
North Sydney Sewer Vent, North Sydney	• State Heritage Register • North Sydney LEP 2013 • Sydney Water Section 170 Heritage and Conservation Register • Register of the National Estate • National Trust of Australia (NSW) Register	State

Heritage Item / Conservation Area	Listing	Heritage Significance
St Leonards Park (including W. Tunks Memorial Fountain, War Memorial, and North Sydney Oval), North Sydney	• State Heritage Register • North Sydney LEP 2013 • Register of the National Estate • National Trust of Australia (NSW) Register	State
Sydney Harbour Bridge, approaches and viaducts (road and rail), Milsons Point/Dawes Point	• National Heritage List • State Heritage Register • North Sydney LEP 2013 • Roads and Maritime Section 170 Heritage and Conservation Register • Register of the National Estate • National Trust of Australia (NSW) Register	National
Walker and Ridge Streets Conservation Area	• North Sydney LEP 2013 • Register of National Estate	Local
Whaling Road Conservation Area	• North Sydney LEP 2013	Local

8 Compliance

8.1 Continual improvement

Monitored noise and vibration levels will be analysed against the predictions made in the relevant CNVIS or using the Construction noise estimation tool. This analysis will ensure the Project's performance outcomes are met throughout construction. This analysis will be undertaken by a person considered competent in the analysis of noise and vibration predictions and monitoring results. The process of demonstration of a competent person has been presented in Section 6.1.2 and Section 6.2.2. Where monitored construction noise levels are found to be above modelling predictions or vibration goals are exceeded, the following actions will be undertaken:

- Confirm the monitored levels are not being impacted by other noise or vibration sources
- Review the implementation of mitigation measures against those specified in the NVMP, CNVIS or Construction noise estimation tool
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant
- Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment
- Confirm that the modelling reflects the actual activity being undertaken
- Review additional mitigation measures that were applied and revise if necessary
- Review noise predictions and update model where required
- Implement other feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), and utilising alternative construction methodology or a combination of these
- Review work practices to ensure compliance with the ICNG
- Communicate lessons learnt to relevant personnel.

SPA will review the activity or combination of simultaneous activities and where possible, modify the activity to prevent reoccurrence. Lessons learnt will be communicated to relevant personnel in toolbox talks.

Where an increased noise or vibration level has been obtained through monitoring, a review of the mitigation measures will be undertaken and additional mitigation measures will be offered to affected receivers, in accordance with the Section 6.2 and Section 6.3 NVMP. This will form part of the continual improvement processes detailed in Section 3.11 and Section 3.12 of the CEMP.

8.2 Reporting

Reporting requirements and responsibilities are documented in Section 3.9.4 of the CEMP.

Construction Monitoring Reports will be prepared on a bi-annual basis (every 6 months) in response to noise and vibration monitoring and will capture detail including:

- The locations and description of monitoring undertaken
- A tabulation of results (e.g. for noise including L_{MAX}, L_{10}, L_{90} and L_{Aeq} noise levels) together with notes identifying the principle sources and operations

- Summary of any measurements exceeding the nominated criteria (refer to Section 6.2 and Section 6.3 in the Noise and Vibration Management Plan), and descriptions of the plant or operations causing these exceedances
- Detail of any corrective actions and confirmation of their successful implementation.

Construction Monitoring Reports will be provided to DPIE and EPA for information, in accordance with CoA C21. The reports will also be provided to TfNSW, the ER and AA in accordance with CoA C13(d). Upon request from the ER/AA, monitoring results will be provided on a more frequent basis to support monthly reports to DPIE.

Further to this, the AA will provide a Monthly Noise and Vibration Report detailing the AA's actions and decisions on matters for which the AA is responsible, in accordance with CoA A33(h)(v) and included in Section 3.9.4 of the CEMP.

8.3 Noise and Vibration Monitoring Program update and amendment

The processes described in Section 3.9 to Section 3.12 of the CEMP may result in the need to update or revise this Monitoring Program. This will occur as needed.

Any revisions to this Monitoring Program will be in accordance with the process outlined in Section 2 and 3.12 of the CEMP.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 3.10.2 of the CEMP.

Appendix A Performance Outcomes

Performance outcomes identified in Table 28-4 of the EIS that are relevant to the management and monitoring of noise and vibration during the critical utility works are identified in the table below.

Performance outcome	How performance outcome will be addressed	Records	Source
Noise and vibration – Amenity			
Include effective management of construction noise and vibration in accordance with relevant guidelines, for example through the use of acoustic sheds	The results of this Monitoring Program will be reviewed to ensure that appropriate noise and vibration mitigation measures identified in Section 6.2 and Section 6.3 of the NVMP are implemented. Note: the use of acoustic shed is not applicable to this scope of works. Undertake training, inspections, auditing and recording in accordance with Section 3.5 of the CEMP.	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Inspection records Construction Monitoring Report Monitoring records Complaints register	EIS – Chapter 28
Minimise impacts to the local community by: • Controlling noise and vibration at the source • Controlling noise and vibration on the source to receiver transmission path • Controlling noise and vibration at the receiver • Implementing practicable and reasonable measures to minimise the noise and vibration impacts of construction activities on local sensitive receivers	The results of this Monitoring Program will be reviewed to ensure that appropriate noise and vibration mitigation measures identified in Section 6.2 and Section 6.3 of the NVMP are implemented. Undertake training, inspections, auditing and recording in accordance with Section 3.5 of the CEMP. Undertaking works (including when and where) as described in community notifications and other communications.	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Inspection records Construction Monitoring Report Monitoring records Complaints register	EIS – Chapter 28
Noise and vibration – Structural			

Performance outcome	How performance outcome will be addressed	Records	Source
Controlling vibration at the source	The results of this Monitoring Program will be reviewed to ensure that appropriate noise and vibration mitigation measures identified in Section 6.2 and Section 6.3 of the NVMP are implemented. Undertake training, inspections, auditing and recording in accordance with Section 3.5 of the CEMP.	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Inspection records Construction Monitoring Report Monitoring records Complaints register	EIS – Chapter 28
Controlling vibration on the source to receiver transmission path	The results of this Monitoring Program will be reviewed to ensure that appropriate noise and vibration mitigation measures identified in Section 6.2 and Section 6.3 of the NVMP are implemented. Undertake training, inspections, auditing and recording in accordance with Section 3.5 of the CEMP.	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Inspection records Construction Monitoring Report Monitoring records Complaints register	EIS – Chapter 28
Implementing practicable and reasonable measures to minimise vibration impacts of construction activities on structures	The results of this Monitoring Program will be reviewed to ensure that appropriate noise and vibration mitigation measures identified in Section 6.2 and Section 6.3 of the NVMP are implemented. Undertake training, inspections, auditing and recording in accordance with Section 3.5 of the CEMP.	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Inspection records Construction Monitoring Report Monitoring records Complaints register	EIS – Chapter 28

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Appendix B Condition of Approval and REMM Compliance Tracking

The Conditions of Approval and Revised Environmental Management Measures detailed below are those that are related specifically to the preparation of this Noise and Vibration Monitoring Program.

Table App B-1 Minister's Conditions of Approval

CoA No.	Condition Requirements	Document Reference	How Addressed
C11	The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each to compare actual performance of construction of the CSSI against the performance predicted in the documents listed in Condition A1 or in the CEMP: (a) Noise and Vibration Monitoring Program: EPA	Section 4.1 Section 6 Appendix A	This Monitoring Program has been prepared in accordance with this condition and describes how SPA proposes to undertake noise and vibration monitoring during critical utility works of the project.
C12	Each Construction Monitoring Program must provide:		
(a)	details of baseline data available;	Section 5	Details of baseline noise and vibration data available are outlined in Section 5.
(b)	details of baseline data to be obtained and when;	Section 5	Baseline noise and vibration data are outlined in Section 5 and has been obtained and is being used to inform this Monitoring Program. No further baseline monitoring is required.
(c)	details of all monitoring of the project to be undertaken;	Section 6	Details of all monitoring of the critical utility works are outlined in Section 6.

CoA No.	Condition Requirements	Document Reference	How Addressed
(d)	the parameters of the project to be monitored;	Sections 6.1.1 and 6.2.1	The parameters of the project to be monitored are outlined in Section 6.1.1 and 6.2.1.
(e)	the frequency of monitoring to be undertaken;	Sections 6.1 and 6.2	The frequency of monitoring to be undertaken is outlined in Section 6.1 and 6.2.
(f)	the location of monitoring;	Sections 6.1 and 6.2	The location of monitoring is outlined in Section 6.1 and 6.2.
(g)	the reporting of monitoring results and analysis results against relevant criteria;	Section 8.2	The reporting of monitoring and analysis results against relevant criteria is outlined in Section 8.2.
(h)	details of the methods that will be used to analyse the monitoring data;	Section 8.1 and 8.2	The analysis of results against modelling predictions or vibration goals is described in Section 8.1 and reporting of monitoring and analysis results against relevant criteria is outlined in Section 8.2.
(i)	procedures to identify and implement additional mitigation measures where the results of the monitoring indicate unacceptable project impacts; and	Section 8.1	The procedures to identify and implement additional mitigation measures where results of noise and vibration monitoring indicate unacceptable project impacts are outlined in Section 8.1.
(j)	a consideration of SMART principles;	Section 6.1, specifically Table 6-1	This Monitoring Program has been developed with consideration of SMART principles. All monitoring will be specific, measurable, achievable, relevant and timebound.

CoA No.	Condition Requirements	Document Reference	How Addressed
		Section 6.2, specifically Table 6-2	
(k)	any consultation to be undertaken in relation to the monitoring programs; and	Section 4.1	Consultation to be undertaken in relation to monitoring is detailed in Section 4.1.
(l)	any specific requirements as required by Conditions C13 to C16.		Refer below to CoA C13. CoA C14 to C16 are not relevant to this Plan.
C13	The Noise and Vibration Monitoring Program must include:		
(a)	noise and vibration monitoring locations determined in consultation with the **AA** to confirm construction noise and vibration levels	Section 6.1 and 6.2	Noise monitoring to satisfy this condition is detailed in Section 6.1 and 6.2. Vibration monitoring to satisfy this condition is detailed in Section 6.2.
(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;	Section 6.1 and Section 6.2	Noise monitoring to satisfy this condition is detailed in Section 6.1 and 6.2
(c)	a protocol for reviewing the implemented management and mitigation measures, based on the monitoring results, to confirm they are consistent with the CEMP Subplan (Condition C4b), and to identify any additional management and mitigation measures that must be implemented; and	Section 8.1	Section 8.1 details the process for continual improvement that will ensure mitigation measures identified in the NVMP are consistent with the results of monitoring results. Monitoring results will also ensure that any additional mitigation measures required are appropriate.
(d)	a process to undertake real time noise and vibration monitoring. The results of the monitoring must be readily available to the construction	Section 8.2	No real-time noise monitoring is proposed for critical utility works.

CoA No.	Condition Requirements	Document Reference	How Addressed
	team, Proponent, ER and Acoustic Advisor. The Planning Secretary and EPA must be provided with access to the results on request		However, the monitoring data obtained during attended noise monitoring will be available to SPA, TfNSW, ER and Acoustic Advisor. DPIE and EPA will also be provided with the monitoring data for information in the form of Construction Monitoring Reports in accordance with CoA C21. The Monitoring Reports will also be submitted for information to TfNSW, ER and AA.
C17	The Construction Monitoring Programs must be developed in consultation with relevant government agencies as identified in Condition C11. Details of all information requested by an agency during consultation must be provided to the Planning Secretary as part of any submission of the relevant Construction Monitoring Programs. including copies of all correspondence from those agencies as required by Condition A5.	Section 4.1 Noise and Vibration Monitoring Program CoA A5 Memo	Section 4.1 details the relevant government agencies which need to be consulted during the preparation of the Construction Monitoring Program. The outcomes of the agency consultation will be provided to DPIE in accordance with CoA A5.
C18	The Construction Monitoring Programs must be endorsed by the ER and then submitted to the Planning Secretary for approval at least one month before the commencement of construction.	Section 4.2 Section 2 of the CEMP	This Monitoring Program will be endorsed by the ER and the Acoustics Advisor prior to submission to the Planning Secretary for approval. It will be submitted to the Planning Secretary for approval no later than one month prior to the commencement of CUT construction works.
C19	Unless otherwise agreed with the Planning Secretary, construction must not commence until all of the relevant Construction Monitoring Programs have been approved by the Planning Secretary, and all	Section 2 of the CEMP	Unless otherwise agreed with the Planning Secretary, construction will not commence until the CEMP and all

CoA No.	Condition Requirements	Document Reference	How Addressed
	relevant baseline data for the specific construction activity has been collected.		relevant Sub-plans have been approved by the Planning Secretary. The CEMP and CEMP Sub-plans will be implemented for the duration of critical utility works.
C20	The Construction Monitoring Programs, as approved by the Planning Secretary including any minor amendments approved by the ER must be implemented for the duration of construction and for any longer period set out in the monitoring program or specified by the Planning Secretary, whichever is the greater.	Section 2	This Monitoring Program will be implemented for the duration of critical utility works.
C21	The results of the Construction Monitoring Programs must be submitted to the Planning Secretary, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program. Note: Where a relevant CEMP Sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP Sub-plan.	Section 8.2	The results of monitoring will be submitted to the DPIE and relevant regulatory authorities for information in the form of a Construction Monitoring Report as outlined in Section 8.2.
A34	The approved AA must: (e) review all noise and vibration documents required to be prepared under the terms of this approval and, should they be consistent with the terms of this approval, endorse them before submission to the Planning Secretary (if required to be submitted to the Planning Secretary) or before implementation (if not required to be submitted to the Planning Secretary	Section 4.2 Section 2 of the CEMP	This Monitoring Program will be endorsed by the ER and the Acoustics Advisor prior to submission to the Planning Secretary for approval. It will be submitted to the Planning Secretary for approval no later than one month prior to the commencement of CUT construction works.

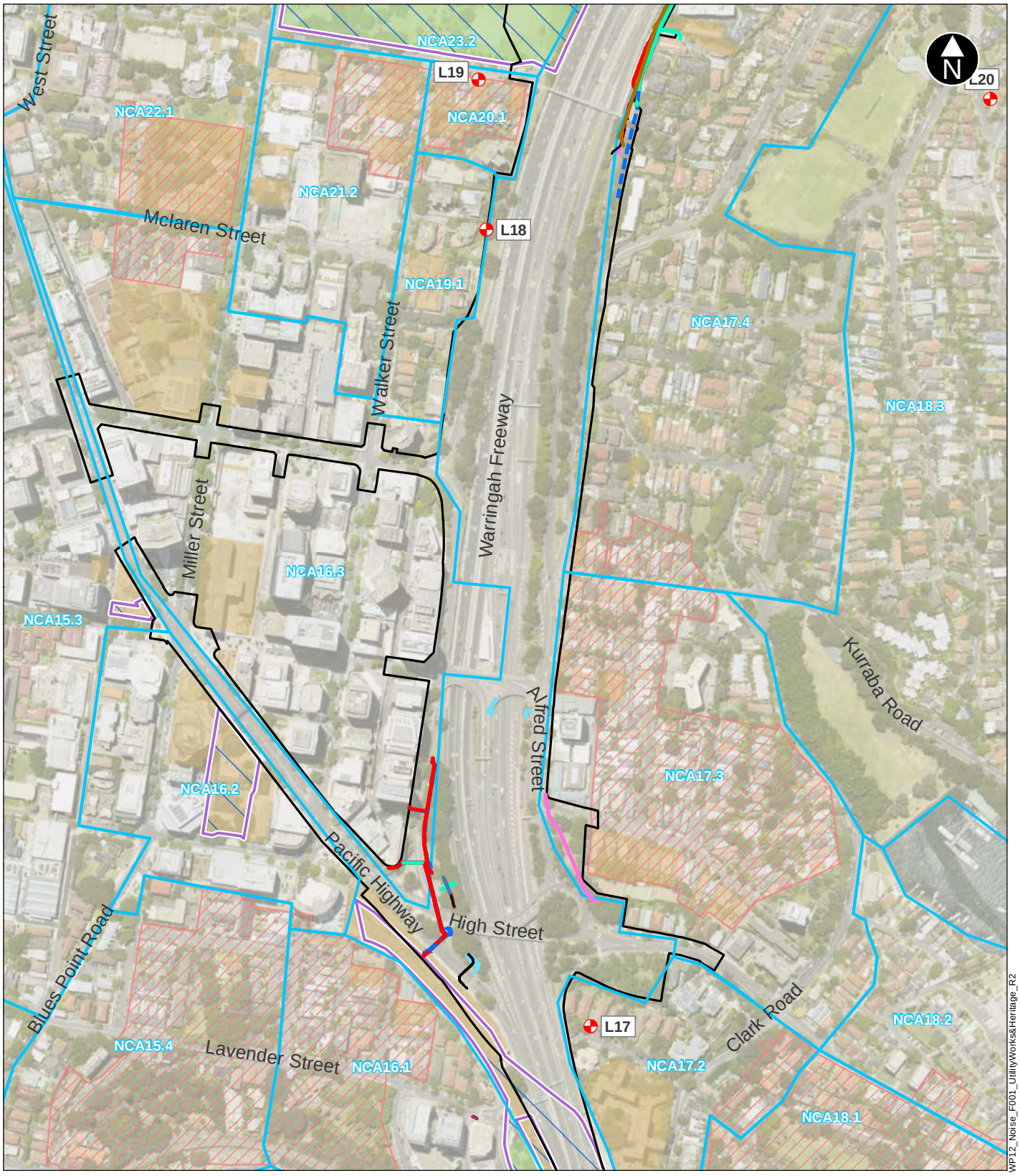
CoA No.	Condition Requirements	Document Reference	How Addressed
E79	The Proponent must conduct vibration testing during vibration generating activities that have the potential to impact on heritage items to identify minimum working distances to prevent cosmetic damage. In the event that the vibration testing and attended monitoring shows that the preferred values for vibration are likely to be exceeded, the Proponent must review the construction methodology and, if necessary, implement additional mitigation measures.	Section 7 Heritage Management Procedure	Vibration testing will be conducted during vibration generating activities that have the potential to impact on heritage items, as stated in Section 7.
E80	Advice from a heritage specialist must be sought on methods and locations for installing equipment used for vibration, movement and noise monitoring at heritage-listed structures.	Section 7 of this Program Section 8 of the Noise and Vibration Management Plan Heritage Management Procedure	The advice of a heritage specialist will be used, as detailed in Section 7.

Table App B-2 Revised environmental management measures relevant to this NVMP

Outcome	Ref #	Commitment	Timing	NVMoP
Construction noise and vibration impacts	REMM CNV4	Construction noise and vibration impacts will be monitored periodically throughout all stages of the construction support sites to ensure that: a) Impacts are consistent with the noise and vibration levels detailed in the relevant Construction Noise and Vibration Impact Statements b) Noise and vibration impacts are being appropriately managed	Construction	This Monitoring Program

Outcome	Ref #	Commitment	Timing	NVMoP
		c) Mitigation measures are effective.		

Appendix C Heritage context



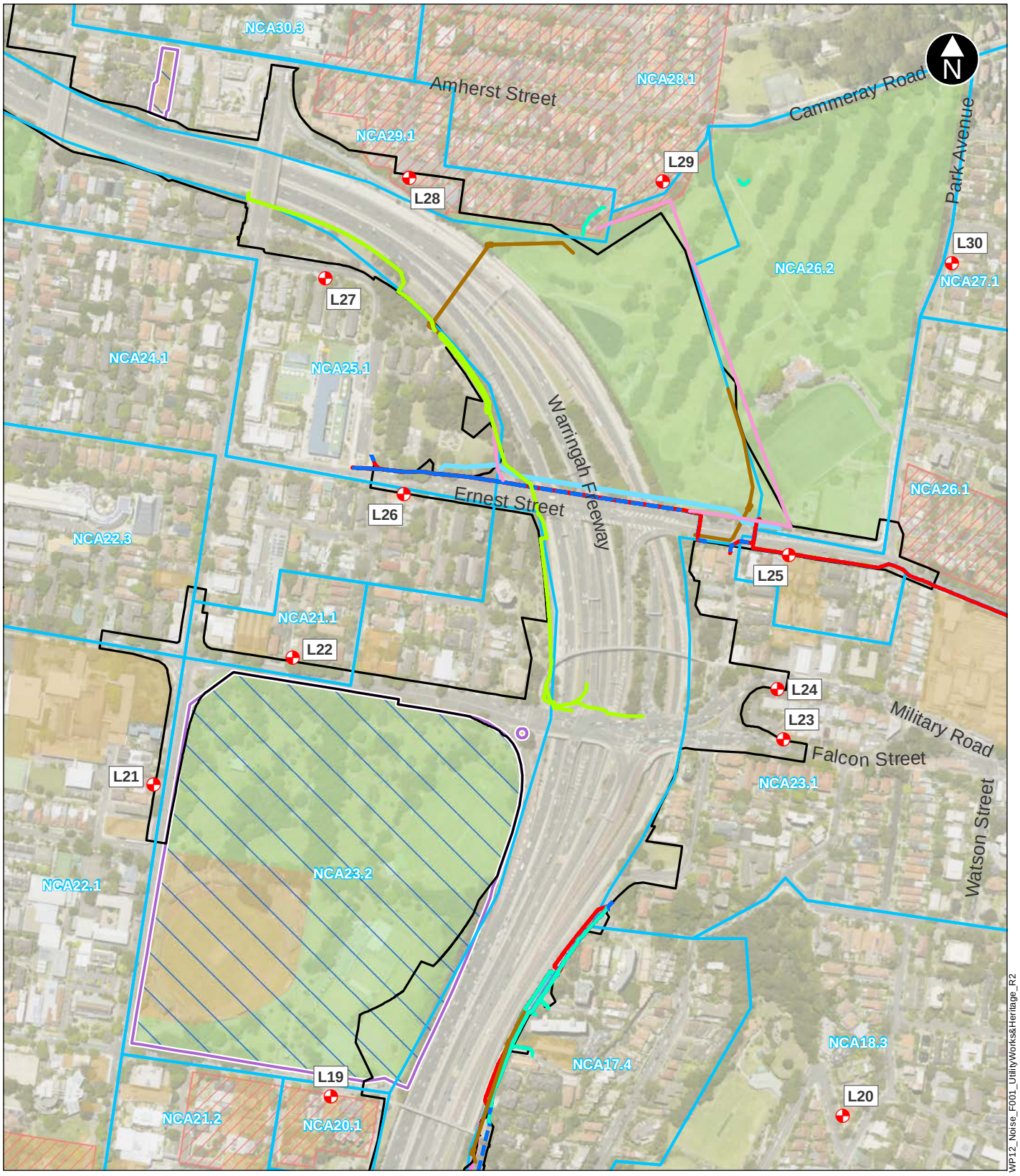
Legend

- Construction footprint
- EIS background noise monitoring locations

Utility works

- Comms
- Electrictiy
- HV
- LV
- Optus
- TPG
- Telstra
- Verizon
- Sewer
- Water
- State Heritage Act
- North Sydney LEP-Conservation Area - General
- North Sydney LEP-Item - General
- North Sydney LEP-Item - Landscape
- State Heritage Register Curilages

Figure title



Legend

- Construction footprint
- EIS background noise monitoring locations

Utility works

- Comms
- Electrictiy
- HV
- LV
- Optus
- TPG
- Telstra
- Uecomm
- Sewer
- Water
- State Heritage Act
- North Sydney LEP-Conservation Area - General
- North Sydney LEP-Item - General
- North Sydney LEP-Item - Landscape
- State Heritage Register Curilages

Figure title

Appendix G Safe working distances for typical vibratory intensive plant

F1: Small Mounted Hammer Vibration Impact at Ridge Street Compound

0 10 20 30 40 m

Scale:1:1000

Basemap: NSW LPI Imagery

Legend

- Compound Boundary
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - DIN 4150 Vibration Sensitive Receiver Setback Distance
- 7m - CNVG Human Comfort Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE:
Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021

F3: Small Mounted Hammer Vibration Impact at Rosalind Street Compound

0 10 20 30 40 m

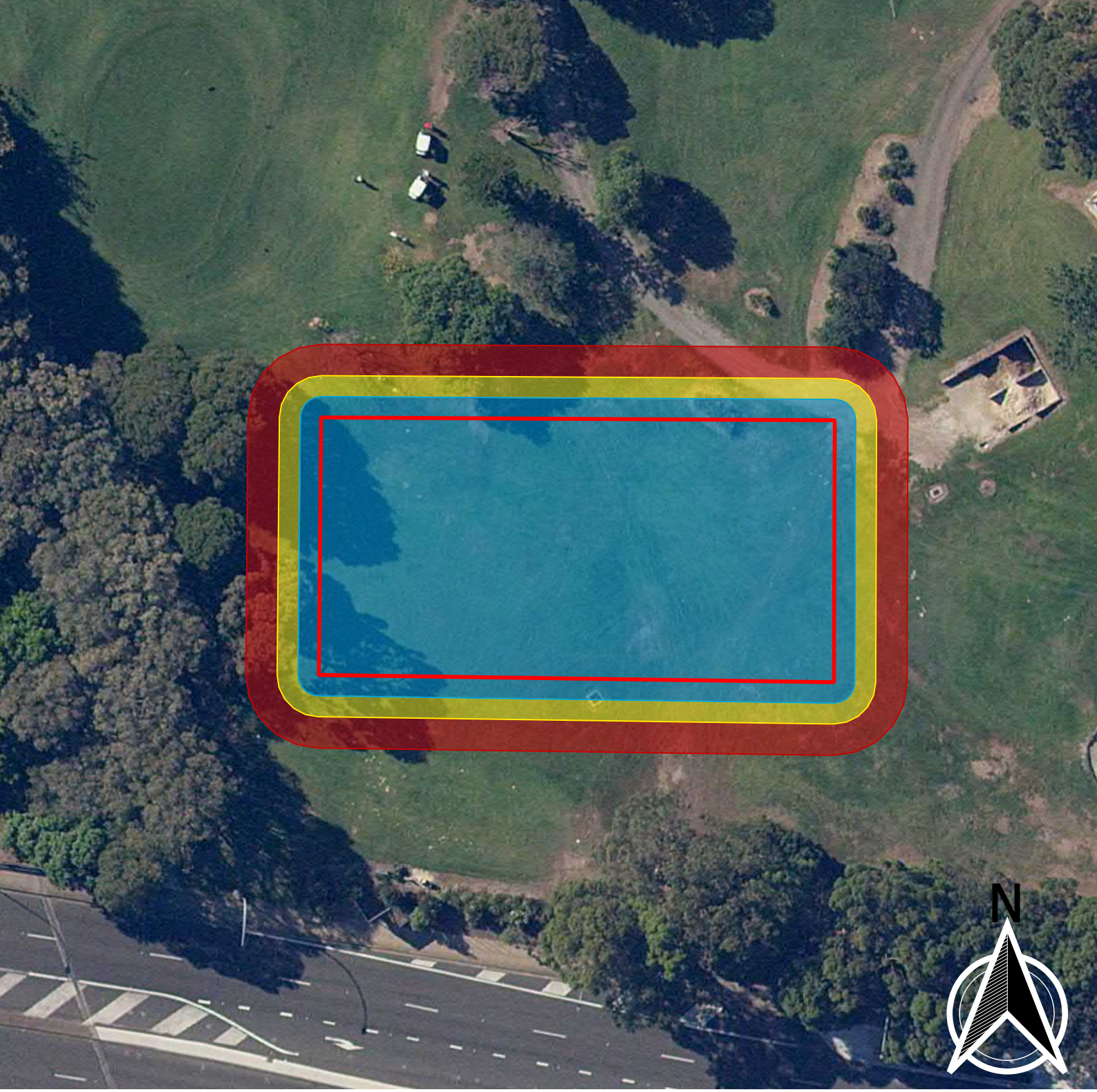
Scale:1:750

Basemap: NSW LPI Imagery

Legend

- Compound Boundary
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - DIN 4150 Vibration Sensitive Receiver Setback Distance
- 7m - CNVG Human Comfort Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE:
Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021



F4: Small Mounted Hammer Vibration Impact at Golf Course Compound

0 5 10 15 20 m

Scale:1:500

Basemap: NSW LPI Imagery

Legend

- Compound Boundary
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - DIN 4150 Vibration Sensitive Receiver Setback Distance
- 7m - CNVG Human Comfort Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021

F5: Small Roller Vibration Impact at Ridge Street Compound

0 10 20 30 40 m

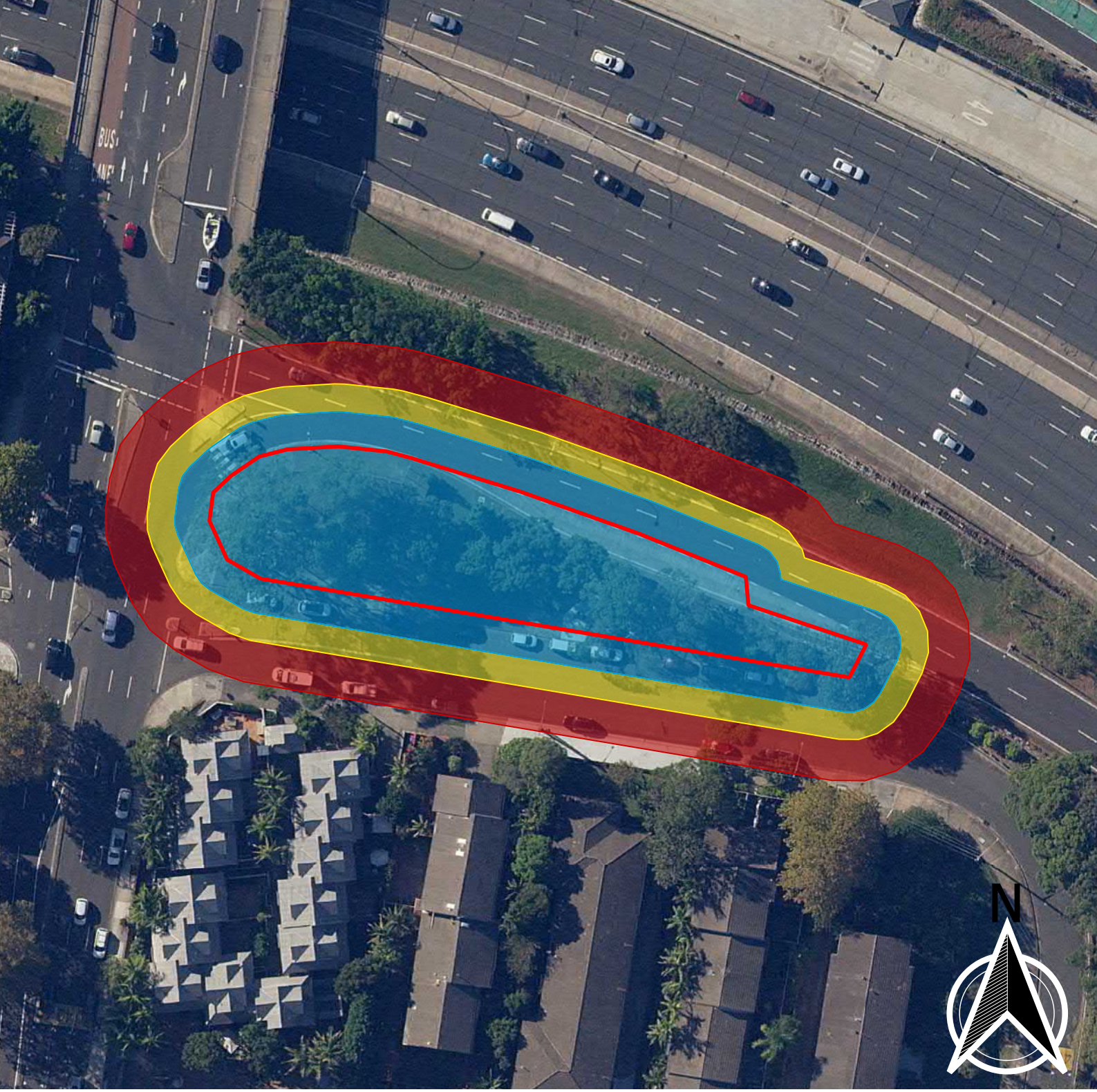
Scale:1:1000

Basemap: NSW LPI Imagery

Legend

- Compound Boundary
- Heritage Item / Area
- 5m - CNVG Cosmetic Damage Setback Distance
- 9m - DIN 4150 Vibration Sensitive Receiver Setback Distance
- 15m - CNVG Human Comfort Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021



F7: Small Roller Vibration Impact at Rosalind Street Compound

0 10 20 30 40 m

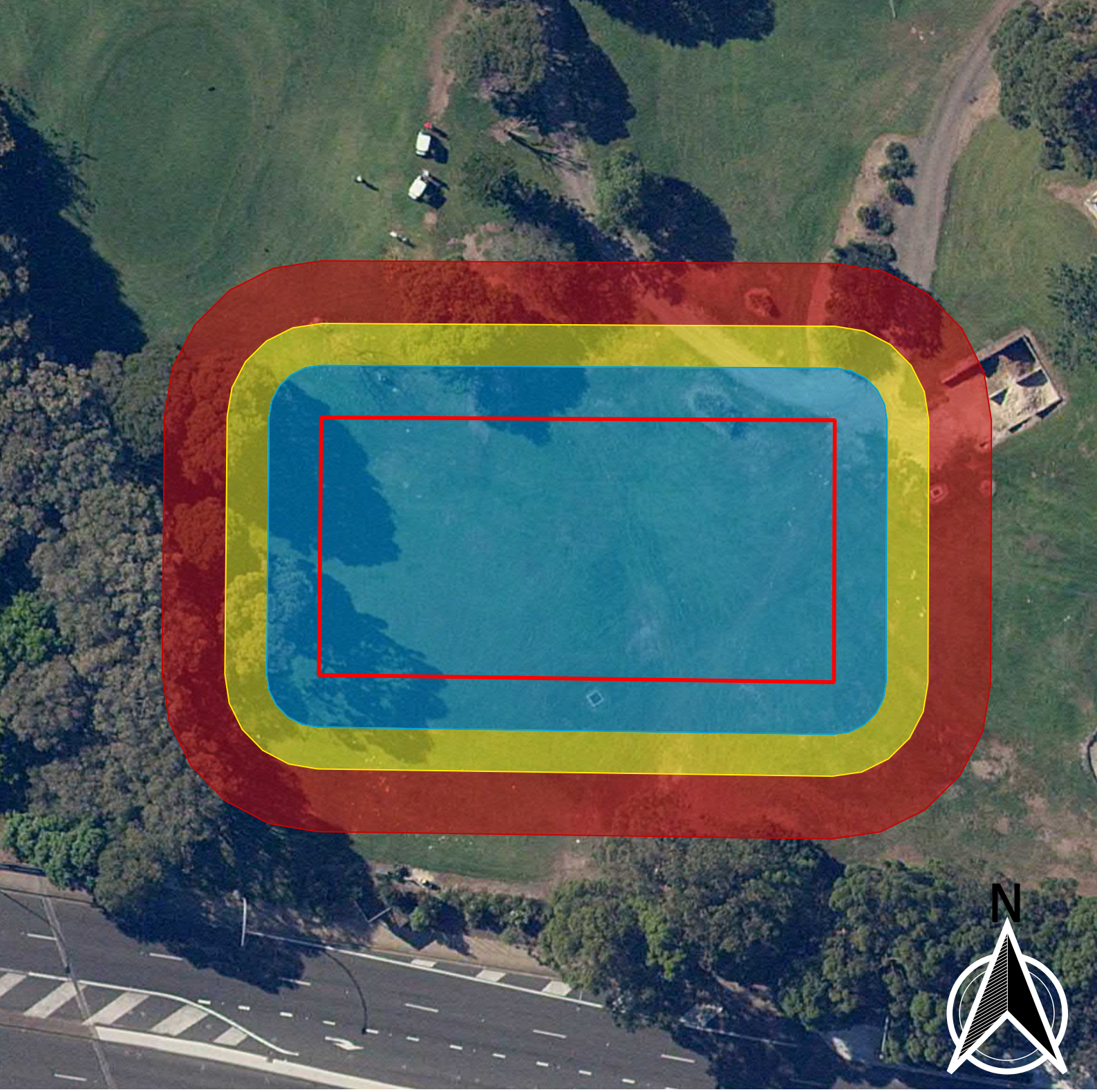
Scale:1:750

Basemap: NSW LPI Imagery

Legend

- Compound Boundary
- Heritage Item / Area
- 5m - CNVG Cosmetic Damage Setback Distance
- 9m - DIN 4150 Vibration Sensitive Receiver Setback Distance
- 15m - CNVG Human Comfort Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021



F8: Small Roller Vibration Impact at Golf Course Compound

0 5 10 15 20 m

Scale:1:500

Basemap: NSW LPI Imagery

Legend

- Compound Boundary
- Heritage Item / Area
- 5m - CNVG Cosmetic Damage Setback Distance
- 9m - DIN 4150 Vibration Sensitive Receiver Setback Distance
- 15m - CNVG Human Comfort Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021

F9: Whacker Packer and Plate Compactor Vibration Impact at Ridge Street Compound

0 10 20 30 40 m

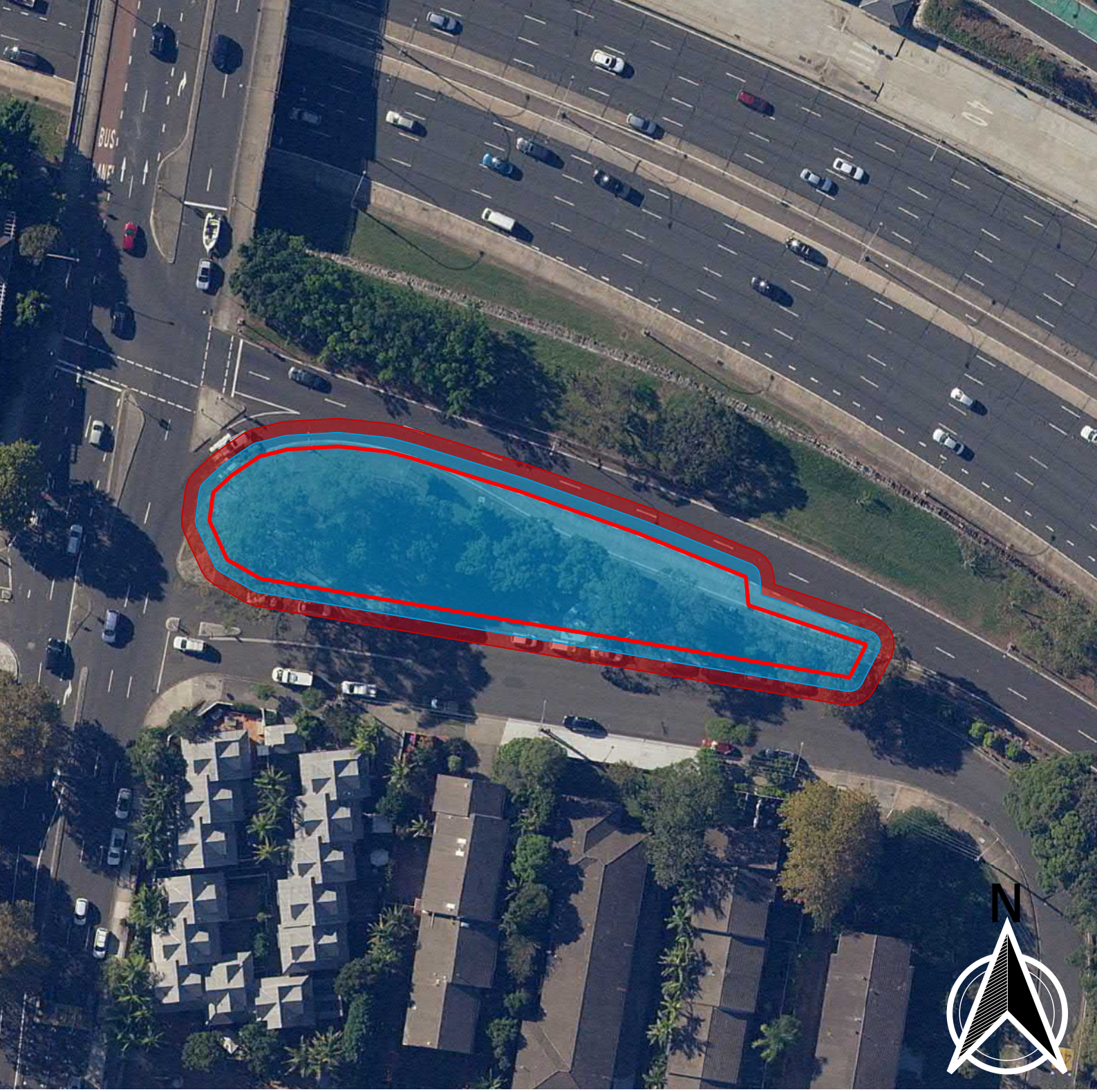
Scale:1:1000

Basemap: NSW LPI Imagery

Legend

- Compound Boundary
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - CNVG Human Comfort and DIN 4150 Sensitive Receivers Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021



F11: Whacker Packer and Plate Compactor Vibration Impact at Rosalind Street Compound

0 10 20 30 40 m

Scale:1:750

Basemap: NSW LPI Imagery

Legend

- Compound Boundary
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - CNVG Human Comfort and DIN 4150 Sensitive Receivers Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE:
Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021

F12: Whacker Packer and Plate Compactor Vibration Impact at Golf Course Compound

0 5 10 15 20 m

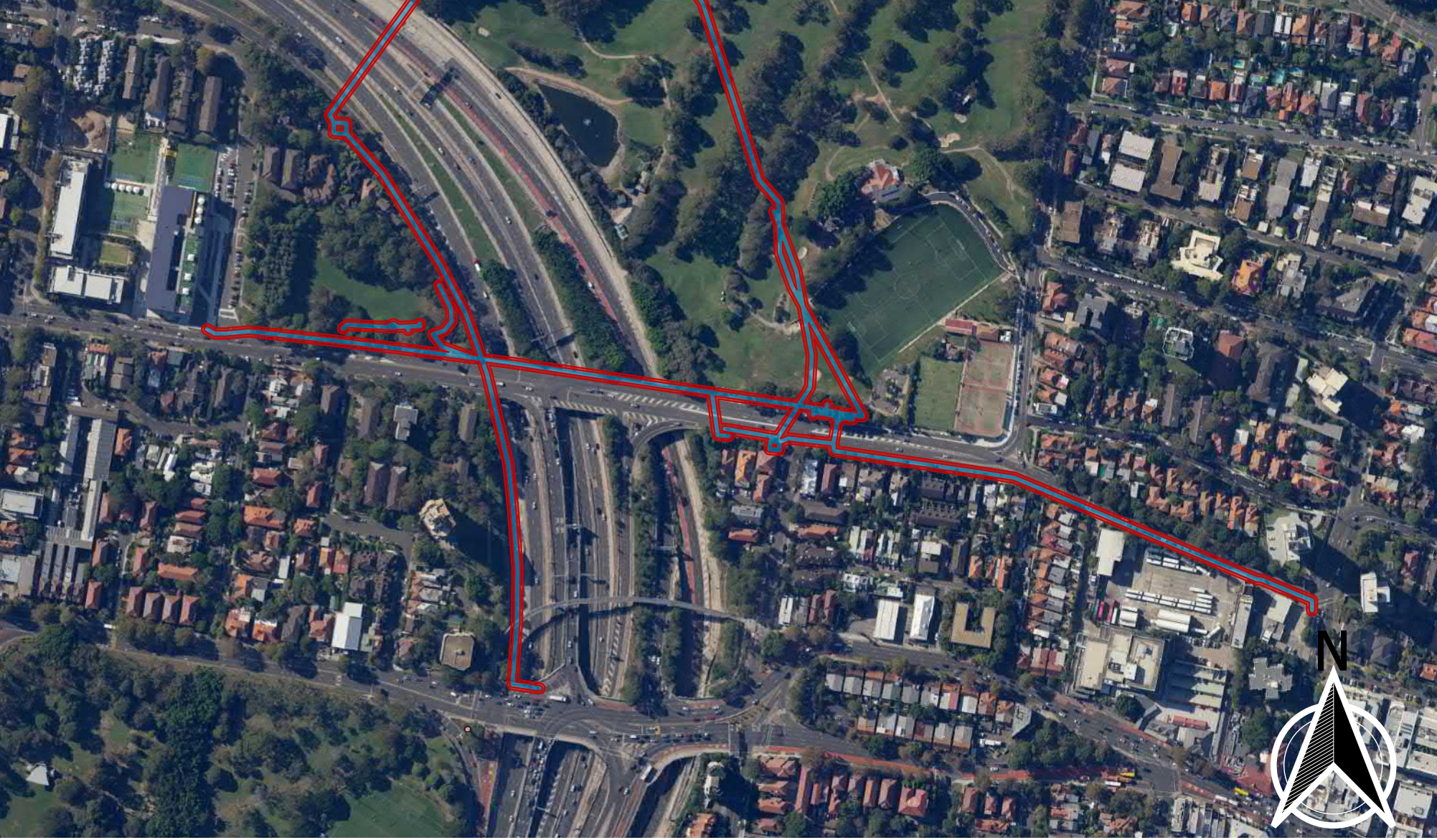
Scale:1:500

Basemap: NSW LPI Imagery

Legend

- Compound Boundary
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - CNVG Human Comfort and DIN 4150 Sensitive Receivers Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021



F13: Borer Vibration Impact at the Cammeray Utilities Installation Locations - South

0 40 80 120 160 m

Legend

- Utilities Works
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - CNVG Human Comfort and DIN 4150 Sensitive Receivers Setback Distance

Scale:1:4000

Basemap: NSW LPI Imagery

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021

F14: Borer Vibration Impact at the Cammeray Utilities Installation Locations - North

0 40 80 120 160 m

Legend

- Utilities Works
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - CNVG Human Comfort and DIN 4150 Sensitive Receivers Setback Distance

Scale:1:4000

Basemap: NSW LPI Imagery

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 04/03/2021

F15: Borer Vibration Impact at the Neutral Bay Utilities Installation Locations

0 25 50 75 100 m

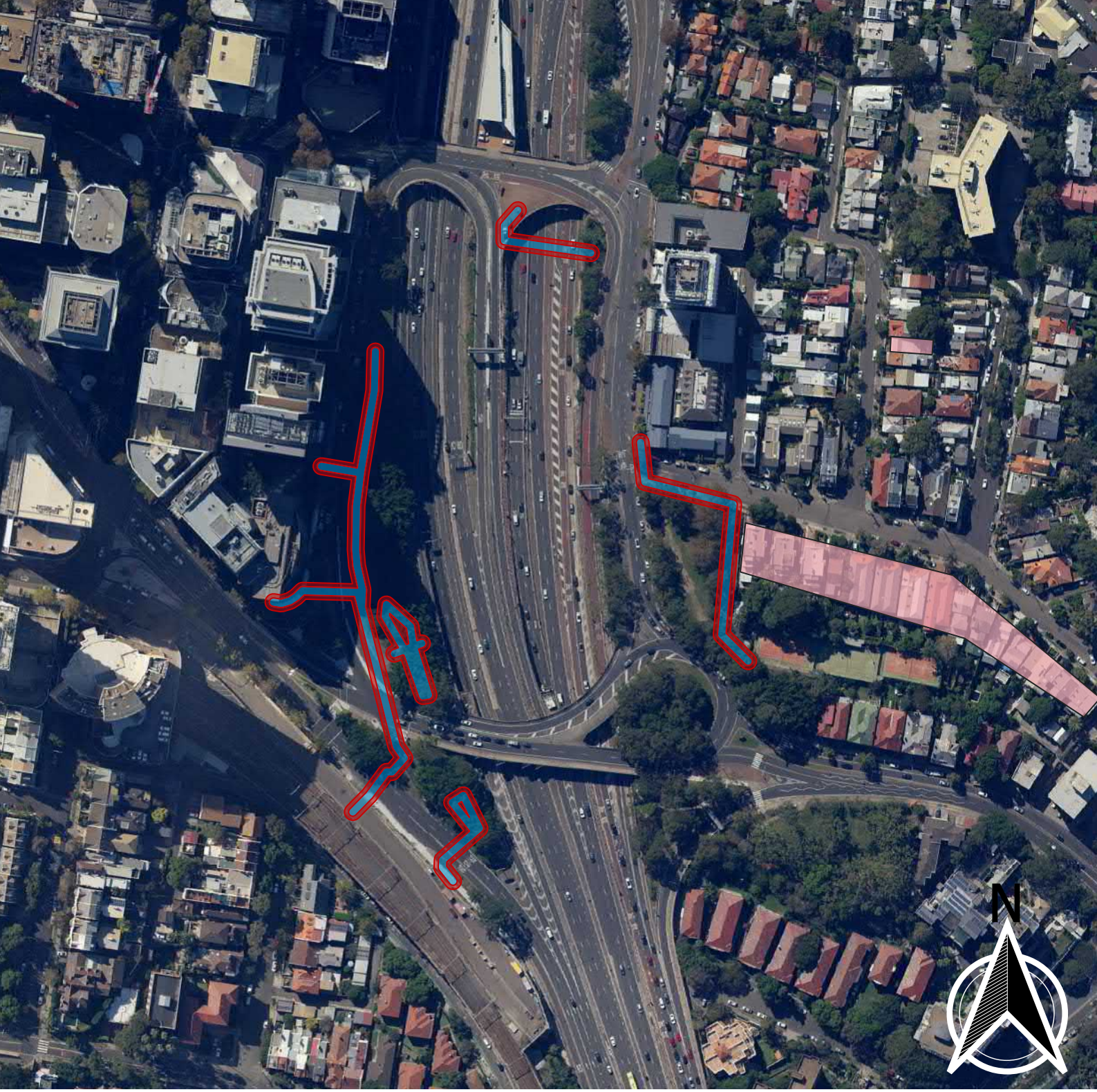
Scale:1:2500

Basemap: NSW LPI Imagery

Legend

- Utilities Works
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - CNVG Human Comfort and DIN 4150 Sensitive Receivers Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021



F16: Borer Vibration Impact at the North Sydney Utilities Installation Locations

0 25 50 75 100 m

Scale:1:2500

Basemap: NSW LPI Imagery

Legend

- Utilities Works
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - CNVG Human Comfort and DIN 4150 Sensitive Receivers Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021

F17: Small Mounted Hammer Vibration Impact at the Cammeray Utilities Installation Locations - South

0 40 80 120 160 m

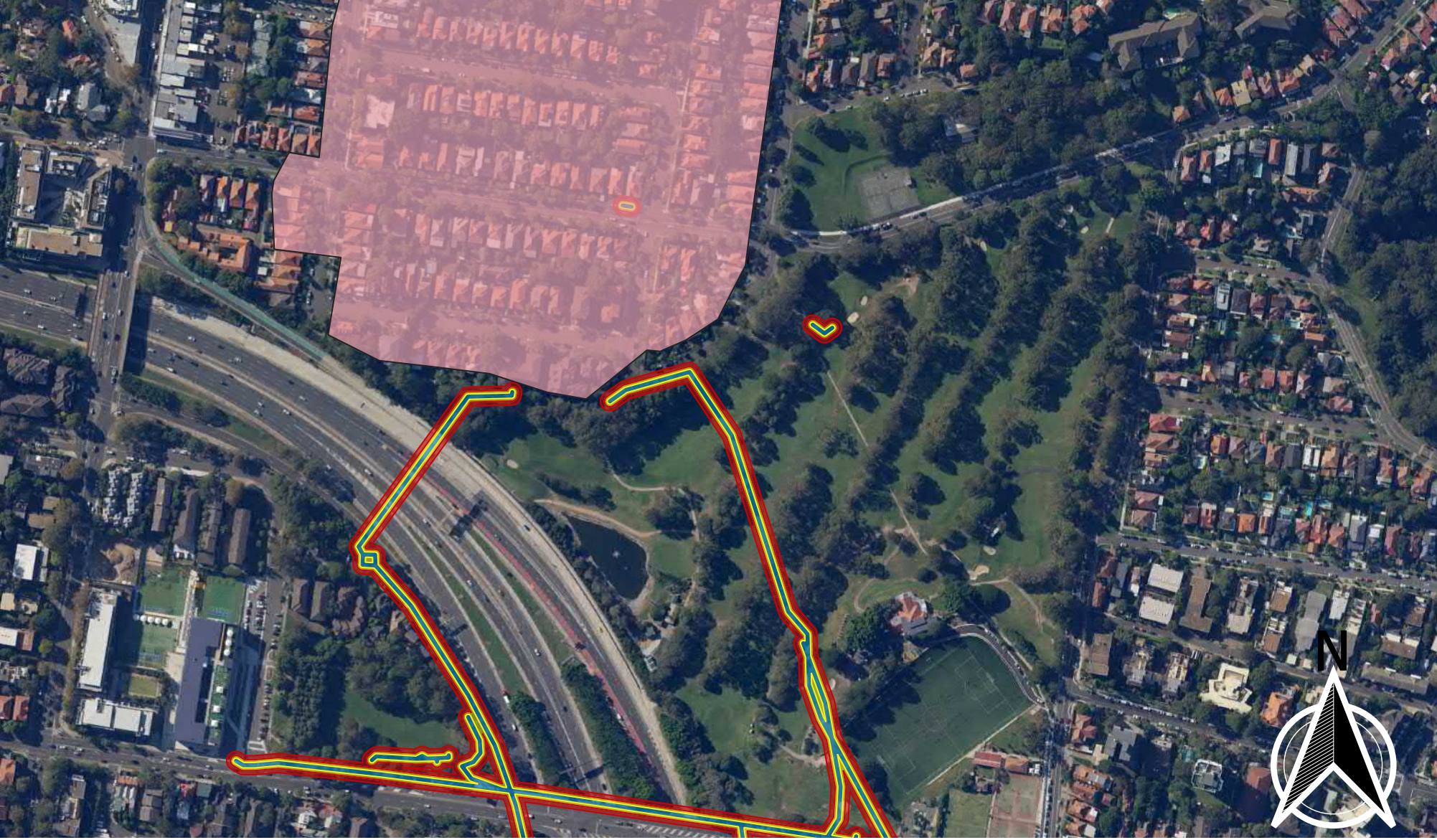
Legend

- Utilities Works
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - DIN 4150 Sensitive Receivers Setback Distance
- 7m - CNVG Human Comfort Setback Distance

Scale:1:4000

Basemap: NSW LPI Imagery

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021



F18: Small Mounted Hammer Vibration Impact at the Cammeray Utilities Installation Locations - North

0 40 80 120 160 m

Legend

- Utilities Works
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - DIN 4150 Sensitive Receivers Setback Distance
- 7m - CNVG Human Comfort Setback Distance

Scale:1:4000

Basemap: NSW LPI Imagery

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 04/03/2021

F19: Small Mounted Hammer Vibration Impact at the Neutral Bay Utilities Installation Locations

0 25 50 75 100 m

Scale:1:2500

Basemap: NSW LPI Imagery

Legend

- Utilities Works
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - DIN 4150 Sensitive Receivers Setback Distance
- 7m - CNVG Human Comfort Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 03/03/2021

F20: Large Mounted Hammer Vibration Impact at the Cammeray Utilities Installation Locations - South

0 40 80 120 160 m

Legend

- Utilities Works
- Heritage Item / Area
- 22m - CNVG Cosmetic Damage Setback Distance
- 40m - DIN 4150 Vibration Sensitive Receivers Setback Distance
- 73m - CNVG Human Comfort Setback Distance

Scale:1:4000

Basemap: NSW LPI Imagery

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 04/03/2021

F21: Large Mounted Hammer Vibration Impact at the Cammeray Utilities Installation Locations - North

0 40 80 120 160 m

Legend

- Compound Boundary
- Heritage Item / Area
- 22m - CNVG Cosmetic Damage Setback Distance
- 40m - DIN 4150 Vibration Sensitive Receivers Setback Distance
- 73m - CNVG Human Comfort Setback Distance

Scale:1:4000

Basemap: NSW LPI Imagery

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 04/03/2021

F22: Large Mounted Hammer Vibration Impact at the Neutral Bay Utilities Installation Locations

0 25 50 75 100 m

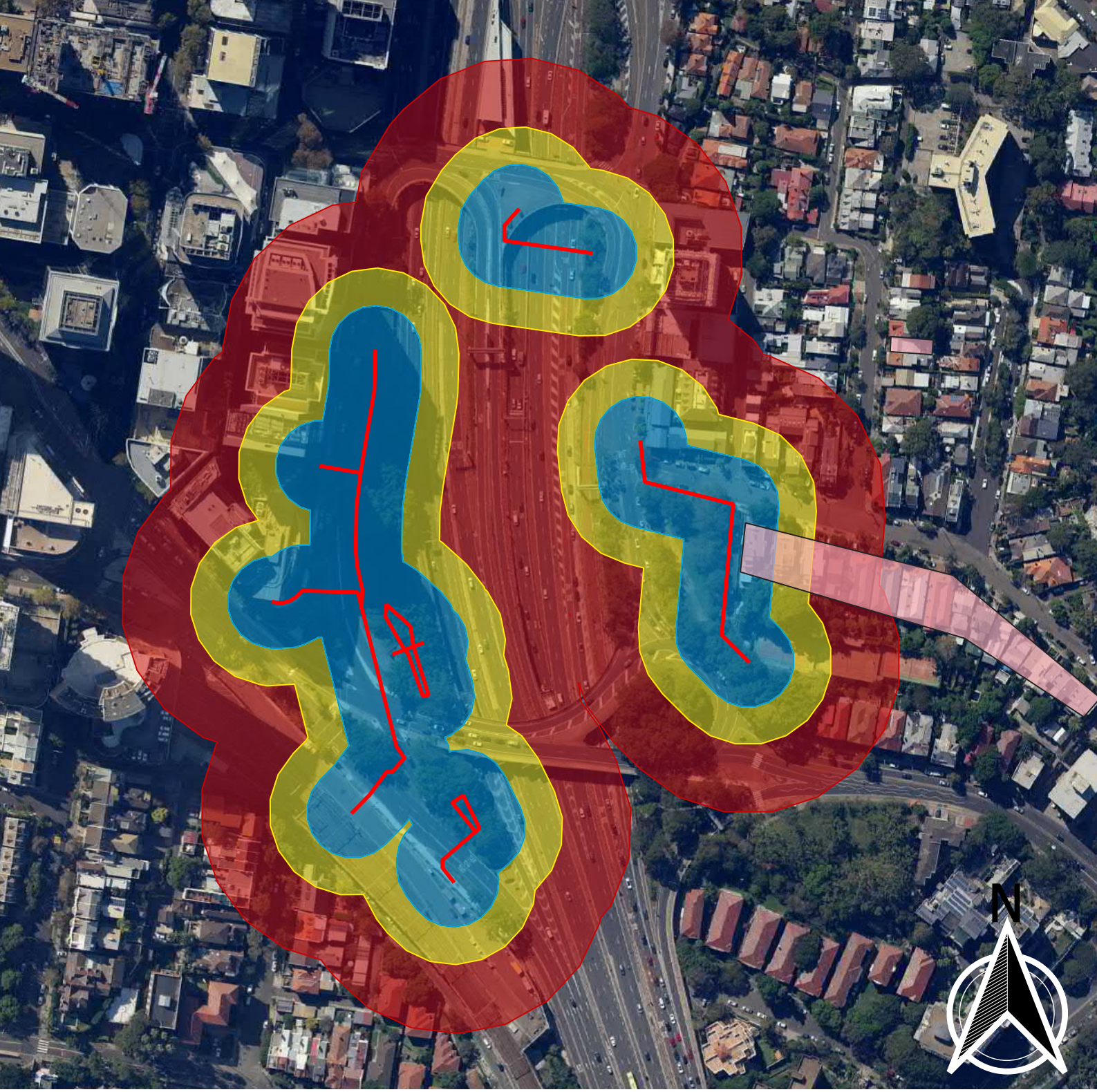
Scale:1:2500

Basemap: NSW LPI Imagery

Legend

- Utilities Works
- Heritage Item / Area
- 22m - CNVG Cosmetic Damage Setback Distance
- 40m - DIN 4150 Vibration Sensitive Receivers Setback Distance
- 73m - CNVG Human Comfort Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 04/03/2021



F23: Large Mounted Hammer Vibration Impact at the North Sydney Utilities Installation Locations

0 25 50 75 100 m

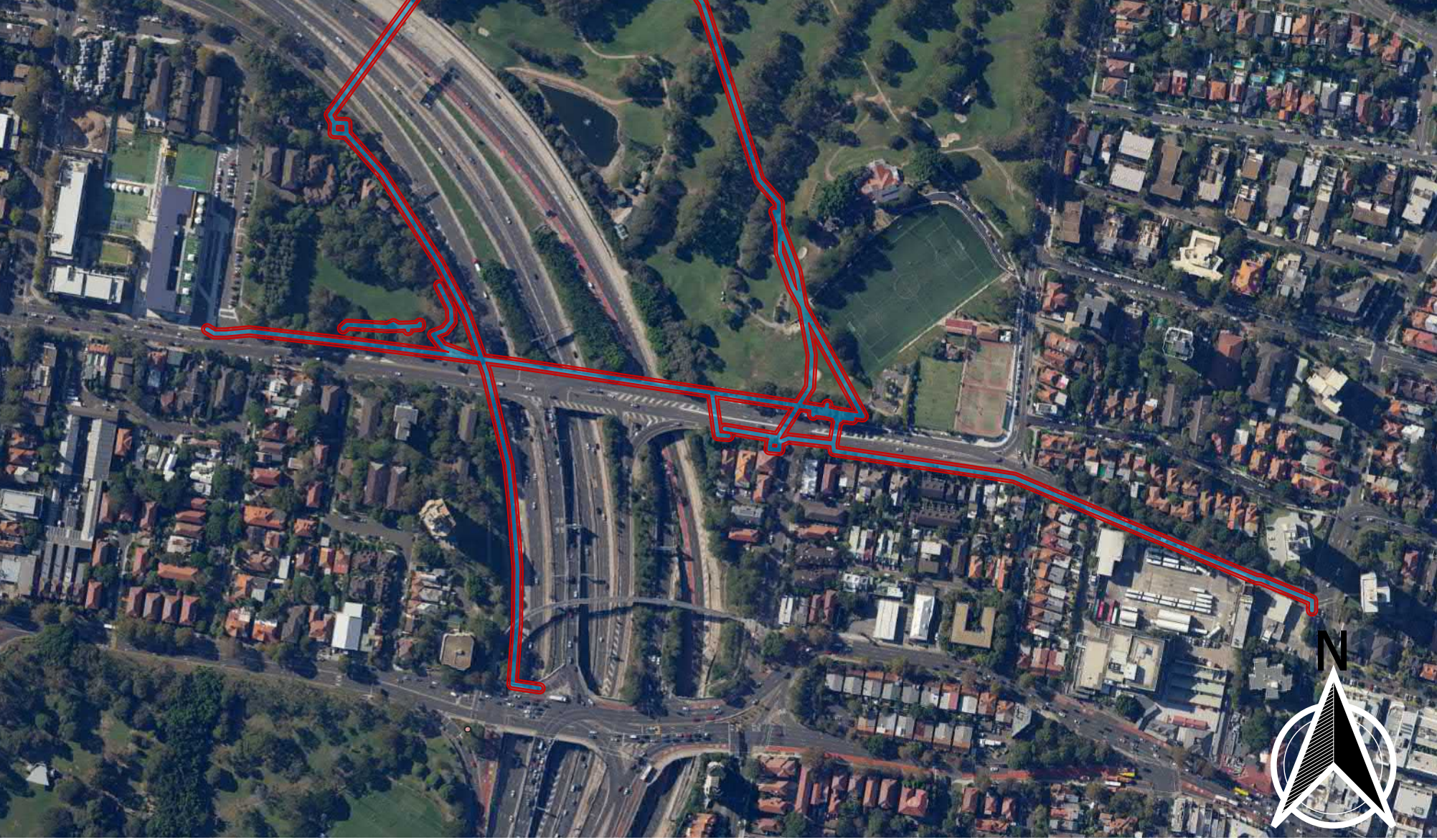
Scale:1:2500

Basemap: NSW LPI Imagery

Legend

- Utilities Works
- Heritage Item / Area
- 22m - CNVG Cosmetic Damage Setback Distance
- 40m - DIN 4150 Vibration Sensitive Receivers Setback Distance
- 73m - CNVG Human Comfort Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 04/03/2021



F24: Whacker Packer and Plate Compactor Vibration Impact at the Cammeray Utilities Installation Locations - South

0 40 80 120 160 m

Legend

- Utilities Works
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - CNVG Human Comfort and DIN 4150 Sensitive Receivers Setback Distance

Scale:1:4000

Basemap: NSW LPI Imagery

NSW ACOUSTICS - GIS PROJECT FILE:
Local_WFU2_Working | Drawn: SB | Check: LS | Date: 04/03/2021

F25: Whacker Packer and Plate Compactor Vibration Impact at the Cammeray Utilities Installation Locations - North

0 40 80 120 160 m

Legend

- Utilities Work
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - CNVG Human Comfort and DIN 4150 Sensitive Receivers Setback Distance

Scale:1:4000

Basemap: NSW LPI Imagery

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 04/03/2021

F26: Whacker Packer and Plate Compactor Vibration Impact at the Neutral Bay Utilities Installation Locations

0 25 50 75 100 m

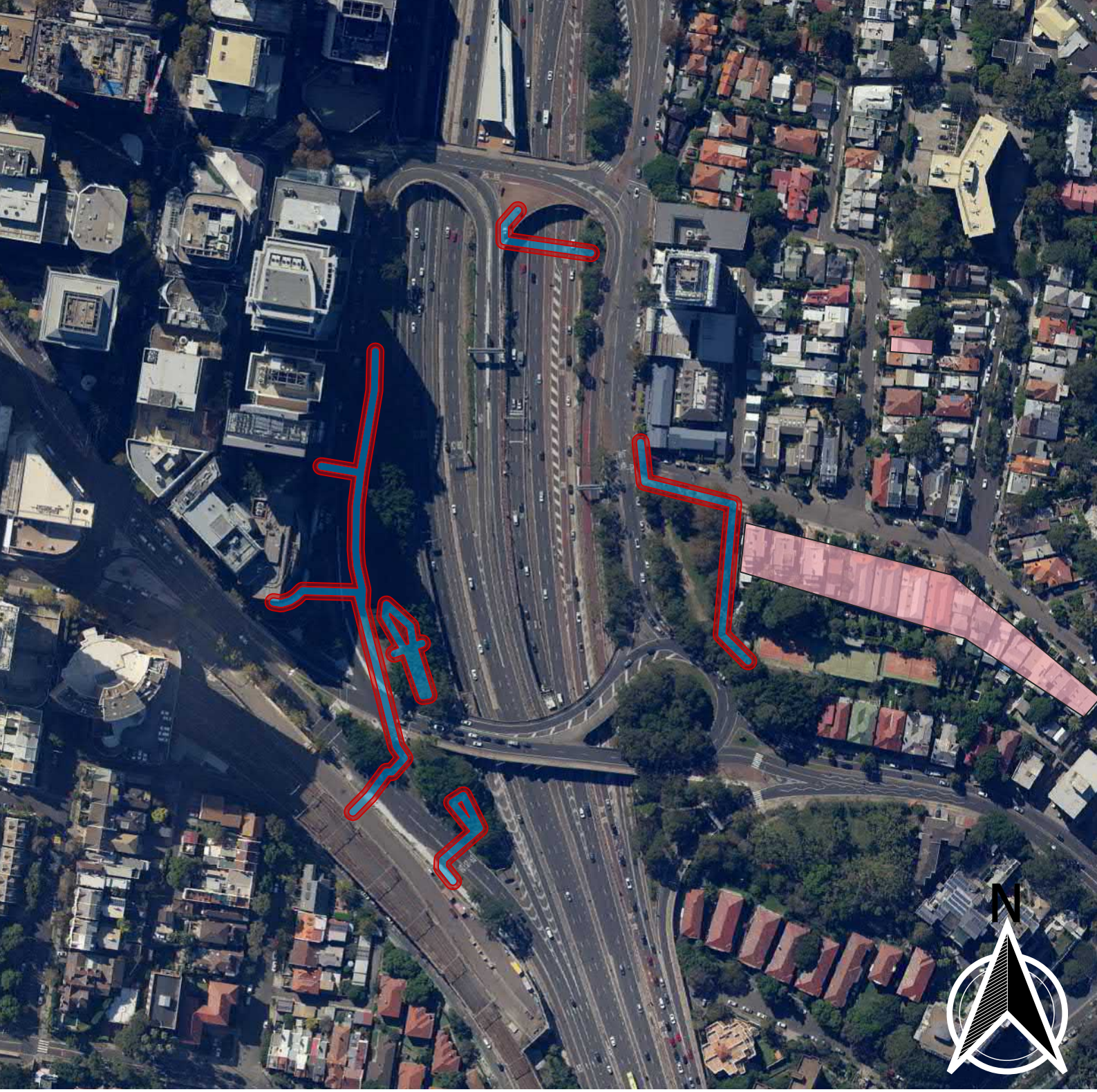
Scale:1:2500

Basemap: NSW LPI Imagery

Legend

- Utilities Works
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - CNVG Human Comfort and DIN 4150 Sensitive Receivers Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 04/03/2021



F27: Whacker Packer and Plate Compactor Vibration Impact at the North Sydney Utilities Installation Locations

0 25 50 75 100 m

Scale:1:2500

Basemap: NSW LPI Imagery

Legend

- Utilities Works
- Heritage Item / Area
- 2m - CNVG Cosmetic Damage Setback Distance
- 4m - CNVG Human Comfort and DIN 4150 Sensitive Receivers Setback Distance

NSW ACOUSTICS - GIS PROJECT FILE: Local_WFU2_Working | Drawn: SB | Check: LS | Date: 04/03/2021