

Sydney Metro City and Southwest – North Corridor Works Construction Noise and Vibration Monitoring Program

Document

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Author

Author Details	Qualifications and Experience
<p>Steven De Luzuriaga ERM Level 15, 309 Kent Street Sydney NSW 2000 T: +61 2 8584 8888 (switchboard) E: steven.deluzuriaga@erm.com W: www.erm.com</p>	<p>Graduate Certificate of Architectural Science (Audio & Acoustics) University of Sydney, Australia. Bachelor of Environmental Science, Southern Cross University, Lismore, Australia Member Australian Acoustical Society (MAAS).</p> <p>Steven has eight years of experience in environmental assessment, with five years of professional experience specialising in noise and vibration environmental impact assessment, monitoring, mitigation and management.</p>
<p>Nathan Lynch ERM Level 15, 309 Kent Street Sydney NSW 2000 T: +61 2 8584 8888 (switchboard) E: nathan.lynch@erm.com W: www.erm.com</p>	<p>Master of Design Science. (Audio & Acoustics) University of Sydney, Australia, 2007. Member Australian Acoustical Society (MAAS).</p> <p>Nathan has over ten years of professional experience specialising in noise, overpressure and vibration environmental impact assessment, monitoring, mitigation and management.</p>

Revisions

Date	Version	Description	Prepared by	Approved by
22/06/2018	V0.1	1 st Draft to LOR	ERM	LOR
14/08/2018	V0.2	Address Sydney Metro, AA, ER Comments	ERM	LOR
27/09/2018	V0.3	Address additional Sydney Metro, AA, ER Comments	ERM	LOR

Terms and definitions

The following general terms, abbreviations and definitions are used in this plan.

Terms	Explanation
A1055	Standards Australia AS1055–1997™ – Description and Measurement of Environmental Noise
AMM	Additional Mitigation Measures
AMMM	Additional Mitigation Measures Matrix
AS2436	Standards Australia AS 2436–2010™ – Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites.
AS61672 or AS1259	Standards Australia AS IEC 61672.1–2004™ – Electro Acoustics - Sound Level Meters Specifications Monitoring or Standards Australia AS1259.2-1990™ – Acoustics – Sound Level Meters – Integrating/Averaging as appropriate to the device.
BS 6472	British Standard (BS 6472–1992) – Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz) dated 1992;
BS 7385	British Standard BS7385: Part 2-1993 - Evaluation and Measurement for Vibration in Buildings — Part 2 – Guide to Damage Levels from Ground-borne Vibration, dated 1993.
CBD	Sydney Central Business District
CNVS (I&S)	Transport for NSW Infrastructure and Services Division (TfNSW I&S) - Construction Noise and Vibration Strategy (I&S CNVS), May 2018;
CNVS (SM)	TfNSW - Sydney Metro Construction Noise and Vibration Strategy (SM CNVS), August 2016 and CNVS Addendum June 2017. (Report No 610.14213-R3).
CNVIS	Construction Noise and Vibration Impact Statement
CNVMP	Construction Noise and Vibration Management Plan
CoA	Conditions of Approval
DIN4150:3	German Institute for Standardisation – DIN 4150 (1999-02) Part 3 – Structural Vibration - Effects of Vibration on Structures.
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPA	NSW Environment Protection Authority
ER	Environmental Representative
ERM	Environmental Resources Management Australia Pty Ltd
HNML	Highly Noise Affected Management Level
ICNG	NSW Department of Environment and Climate Change – NSW Interim Construction Noise Guideline, July 2009.
IEC60942	Standards Australia AS/IEC 60942:2004/IEC 60942:2003 – Australian Standard™ – Electroacoustic – Sound Calibrators.
INP	NSW Environment Protection Authority – NSW Environmental Noise Management – Industrial Noise Policy, January 2000 and relevant application notes.
Laing O’Rourke	Laing O’Rourke Australia Construction Pty Limited
LGA	Local Government Area
LOR	Laing O’Rourke Australia Construction Pty Limited

Terms	Explanation
Minister, the	NSW Minister for Planning
Monitoring Program	Construction Noise and Vibration Monitoring Program
NCA	Noise Catchment Area
NML	Noise Management Level
NSW Vibration Guideline, the	NSW Department of Environment and Conservation – NSW Environmental Noise Management – Assessing Vibration: a Technical Guideline (the NSW Vibration Guideline), February 2006.
OEH	Office of Environment and Heritage
OOHW	Out of Hours Works
POEO Act	Protection of the Environment Operations Act 1997
RNP	NSW Department of Environment, Climate Change and Water – NSW Road Noise Policy, March 2011.
SSI	State Significant Infrastructure
TfNSW	Transport for New South Wales
the project	North Corridor Works Project

The following technical terms, abbreviations and definitions are used in this plan. A glossary of relevant acoustical concepts and terminology is provided in **Appendix A**.

Terms	Explanation
Decibel, dB	The unit used to describe sound levels and noise exposure. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure
dBA	The unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear
LAeq	Equivalent Continuous Sound Level
LAeq, 15minute	Equivalent Continuous Sound Level, over a period of 15 minutes
LA90	Background Noise Level
RBL	Rating Background Level
LW or SWL	Sound Power Level
LP or SPL	Sound Pressure Level
PPV	Peak Particle Velocity (in mm/s)
VDV	Vibration Dose Value (in $m/s^{1.75}$)
mm/s	Millimetres per second
m/s	Metres per second

0. Consolidated Compliance Matrix**Table 1 - Compliance Matrix – CoA**

Item	Requirement	Document Reference
C9	The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each Construction Monitoring Program to compare actual performance of construction of the CSSI against predicted performance. a) Noise and Vibration (EPA and Relevant Councils)	This monitoring program, Section 1.2
C10	Each Construction Monitoring Program must provide:	Section 2.1
	a) details of baseline data available;	Section 2.1
	b) details of baseline data to be obtained and when;	Section 2.1
	c) details of all monitoring of the project to be undertaken;	Section 4
	d) the parameters of the project to be monitored;	Section 4
	e) the frequency of monitoring to be undertaken;	Section 4
	f) the location of monitoring;	Section 4
	g) the reporting of monitoring results;	Section 4.8
	h) procedures to identify and implement additional mitigation measures where results of monitoring are unsatisfactory; and	Section 4.6
i) any consultation to be undertaken in relation to the monitoring programs.	Section 1.2	
C11	The Noise and Vibration Construction Monitoring Program and Blast Construction Monitoring Program must include provision of real time noise and vibration monitoring data. The real time data must be available to the construction team, Proponent, ER and AA in real time. The Department and EPA must be provided with access to the real time monitoring data in real time.	Section 4.1
C12	The Construction Monitoring Programs must be developed in consultation with relevant government agencies as identified in Condition C9 of this approval and must include, to the written satisfaction of the Secretary, information requested by an agency to be included in a Construction Monitoring Programs during such consultation. Details of all information requested by an agency including copies of all correspondence from those agencies must be provided with the relevant Construction Monitoring Program.	Section 1.2
C13	The Construction Monitoring Programs must be endorsed by the ER and then submitted to the Secretary for approval at least one (1) month before commencement of construction or within another timeframe agreed with the Secretary.	Section 1.2
C14	Construction must not commence until the Secretary has approved all of the required Construction Monitoring Programs, and all relevant baseline data for the specific construction activity has been collected.	Section 1.2
C15	The Construction Monitoring Programs, as approved by the 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 Secretary, whichever is the greater.	Section 1.1
C16	The results of the Construction Monitoring Programs must be submitted to the Secretary for information, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.	Section 4.8
C17	Where a relevant CEMP sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP sub-plan.	This monitoring program

Table 2 - Compliance Matrix – MR - minor E

Item	Requirement	Document Reference
2.1	The Contractor must comply with the requirements of the SM ES-ST-204 Sydney Metro Construction Environmental Management Framework (CEMF), as detailed in Annexure A and any other reference Documents identified in Annexure B of the Management Requirement Minor – Environment (MR - minor E).	Section 4.8
2.2	a) The Contractor must provide a monthly report, using the SM ES-FT-421 Sydney Metro City & Southwest Environmental Reporting Template	Section 4.8
2.2	b) Within 5 Business Days each Calendar Quarter Date, a register of ongoing Environmental Compliance Requirements (ECRs) must be submitted to the Environmental Representative for review in accordance with the Contract, which identifies progress and evidence of compliance against each ECR.	Section 4.8
2.2	c) The register of ECRs must classify each ECR as: <ul style="list-style-type: none"> <li data-bbox="357 712 893 741">i. Ongoing or Complete, to indicate their progress; and <li data-bbox="357 741 893 766">ii. Compliant or Non-Compliant, to indicate compliance. 	Section 4.8

Contents

0. Consolidated Compliance Matrix	4
1. Introduction	7
1.1 Purpose and Application.....	7
1.2 Consultation	7
2. Existing Environment	8
2.1 Background Noise Levels.....	8
2.2 Potentially Sensitive Receptors.....	8
3. Management Levels and Criteria	17
3.1 General Construction Noise	17
3.2 Construction Road Traffic Noise	19
3.3 Vibration Management Levels.....	19
3.3.1 Human Comfort (or Annoyance).....	19
3.3.2 Building Damage (Structural/Cosmetic Damage)	21
4. Noise and Vibration Monitoring	24
4.1 General Monitoring Requirements	24
4.1.1 Possessions Schedule.....	26
4.2 Noise Measurement Requirements	27
4.3 Vibration Measurement Requirements	29
4.4 Noise Monitoring in the Community	30
4.5 Vibration Monitoring in the Community	31
4.6 Actions Following Monitoring in the Community	33
4.7 Maximum Noise Levels for Plant and Equipment.....	34
4.8 Noise and Vibration Reporting	35
5. Monitoring Program Review	36
6. References	37
Appendix A – Potentially Sensitive Receptors	38
Appendix B – Noise Monitoring Report Template	39
Appendix C – Vibration Monitoring Report Template	40
Appendix D – Relevant Government Agency Consultation	41

1. Introduction

This monitoring program applies to the construction phase of the Sydney Metro City and Southwest – Northern Corridor Works (NCW) project - Portion 7b. This document provides a monitoring program for noise and vibration relating to the Northern Corridor Works (NCW) project. This monitoring program has been developed based on the predicted construction noise and vibration impacts in the Construction Noise and Vibration Impact Statement (CNVIS).

The NCW project and associated construction works are located in the rail corridor between Chatswood train station and Brand Street in Artarmon, near the Artarmon train station. They are being undertaken as “enabling works” as part of the Sydney Metro City and Southwest project (Sydney Metro).

Detail regarding the NCW scope and potential noise and vibration issues associated with the works/activities are outlined in the overall Construction Environment Management Plan (CEMP) and the Construction Noise and Vibration Management Plan (CNVMP) for the project.

1.1 Purpose and Application

The Northern Corridor Works (NCW) Construction Noise and Vibration Monitoring Program details how Laing O’Rourke Australia Construction Pty Ltd (LOR) and its sub-contractors will monitor noise and vibration impacts during the NCW project, as part of the Sydney Metro City and Southwest project.

A summary table demonstrating the compliance against the requirements of the relevant project approval for the works is documented in Section 0 of this construction noise and vibration monitoring program (here after referred to as the monitoring program). This monitoring program is supported by the CNVMP, which forms a sub-plan to the NCW Construction Environmental Management Plan (CEMP).

In accordance with **CoA – C13** the monitoring program must be endorsed by the ER and then submitted to the Secretary for approval at least one month before commencement of construction or within another timeframe agreed with the Secretary. Construction must not commence until the Secretary has approved all of the required construction monitoring programs, and all relevant baseline data for the specific construction activity has been collected, as stated in **CoA – C14**.

In accordance with **CoA – C15** this monitoring program, as approved by the 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 Secretary, whichever is the greater.

1.2 Consultation

The CoA for the NCW requires that this monitoring program be prepared in consultation with the NSW Environment Protection Authority (EPA) and relevant Councils, in accordance with **CoA – C12**. The NCW project falls into the Willoughby City Council area. A copy of the CNVMP and monitoring program was provided to Willoughby City Council and the EPA for review and comment on 1 August 2018. Willoughby City Council and the EPA reviewed and acknowledged the monitoring program with no comments or edits required, evidence of consultation is provided in **Appendix D** of this monitoring program.

2. Existing Environment

2.1 Background Noise Levels

For the purpose of the CNVMP and CNVIS, surrounding precincts were divided into Noise Catchment Areas (NCAs). These NCAs (adopted for the CNVIS) are shown in **Figure 1**.

The RBLs adopted for the CNVMP and this monitoring program are presented in **Table 2.1** below for the day, evening and night-time periods.

Table 2.1 Rating Background (Noise) Levels

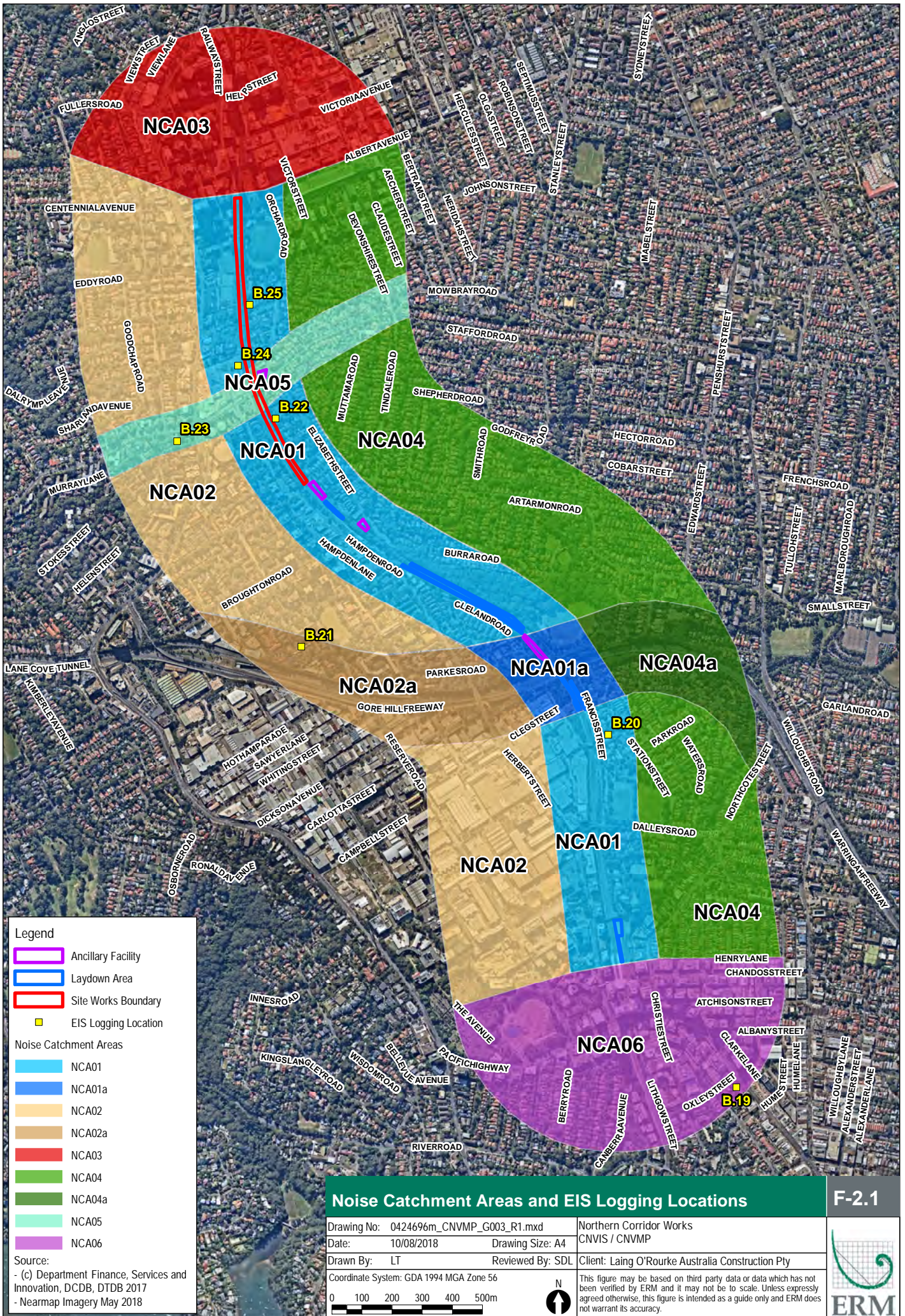
Noise Catchment Area (NCA)	Overall Rating Background Levels (RBL) in dBA		
	Daytime (7am to 6pm)	Evening (6pm to 10pm)	Night-time (10pm to 7am)
NCA01	42	41	35
NCA01a	49	46	41
NCA02	42	41	35
NCA02a	49	46	41
NCA03	46	44	37
NCA04	41	40	34
NCA04a	49	46	41
NCA05	63	60	45
NCA06	45	45	38

Source: CNVIS

2.2 Potentially Sensitive Receptors

ERM identified 530 sensitive receptors in the CNVIS as the closest and/or potentially most affected locations situated within the potential area of influence of the NCW. The full list of sensitive receptors is provided in **Appendix A**.

The NCA and an overview of all sensitive receptor locations are identified in the **Figure 2.1 to Figure 2.8**.



Legend

- Ancillary Facility
- Laydown Area
- Site Works Boundary
- EIS Logging Location

Noise Catchment Areas

- NCA01
- NCA01a
- NCA02
- NCA02a
- NCA03
- NCA04
- NCA04a
- NCA05
- NCA06

Source:
 - (c) Department Finance, Services and Innovation, DCDB, DTDB 2017
 - Nearmap Imagery May 2018

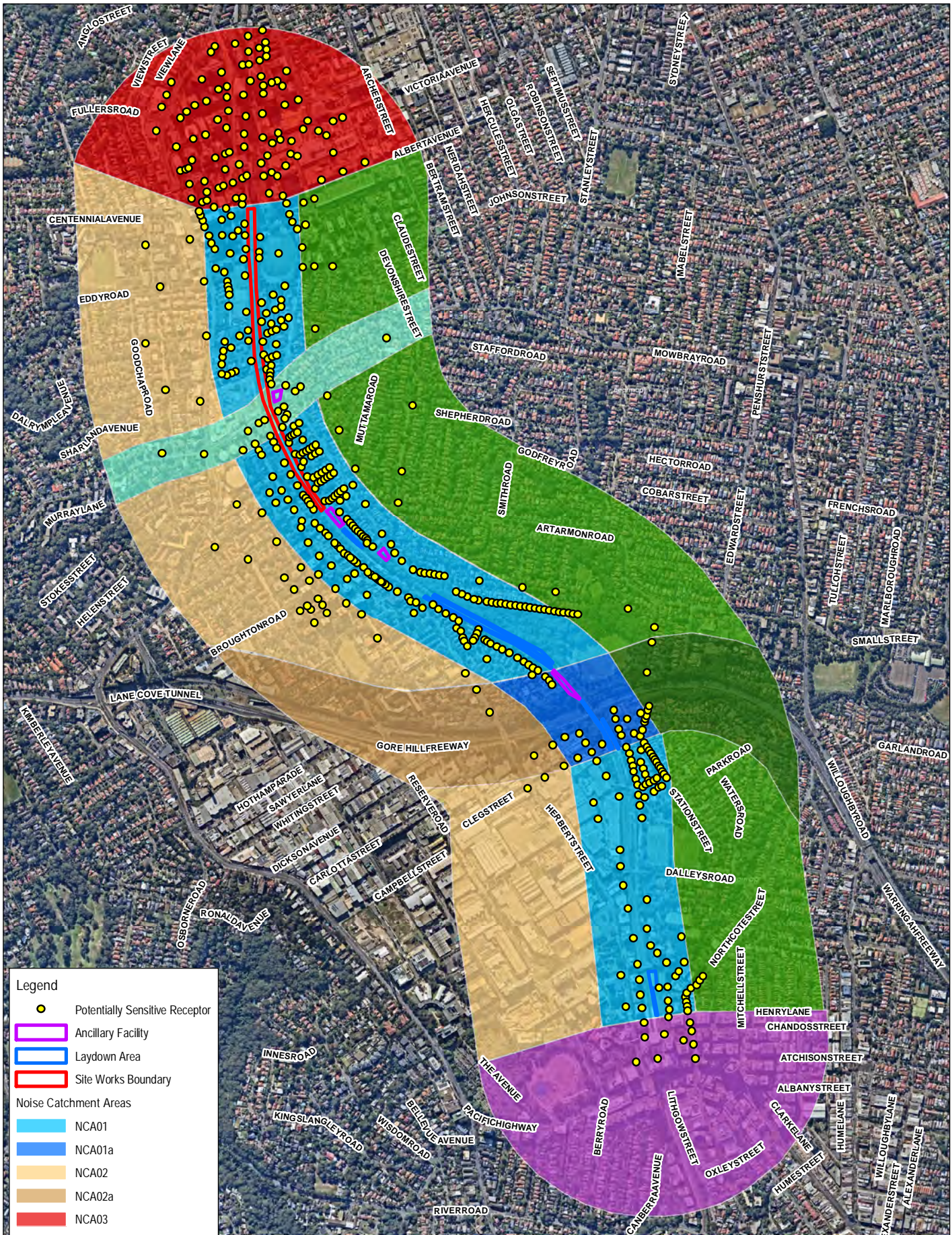
Noise Catchment Areas and EIS Logging Locations

F-2.1

Drawing No: 0424696m_CNVMP_G003_R1.mxd	Northern Corridor Works CNVIS / CNVMP
Date: 10/08/2018	Drawing Size: A4
Drawn By: LT	Reviewed By: SDL
Coordinate System: GDA 1994 MGA Zone 56	Client: Laing O'Rourke Australia Construction Pty

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.





Legend

- Potentially Sensitive Receptor
- Ancillary Facility
- Laydown Area
- Site Works Boundary

Noise Catchment Areas

- NCA01
- NCA01a
- NCA02
- NCA02a
- NCA03
- NCA04
- NCA04a
- NCA05
- NCA06

Source:
 - (c) Department Finance, Services and Innovation, DCDB, DTDB 2017
 - Nearmap Imagery May 2018

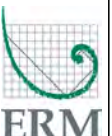
Potentially Sensitive Noise Receptors - Overview Map

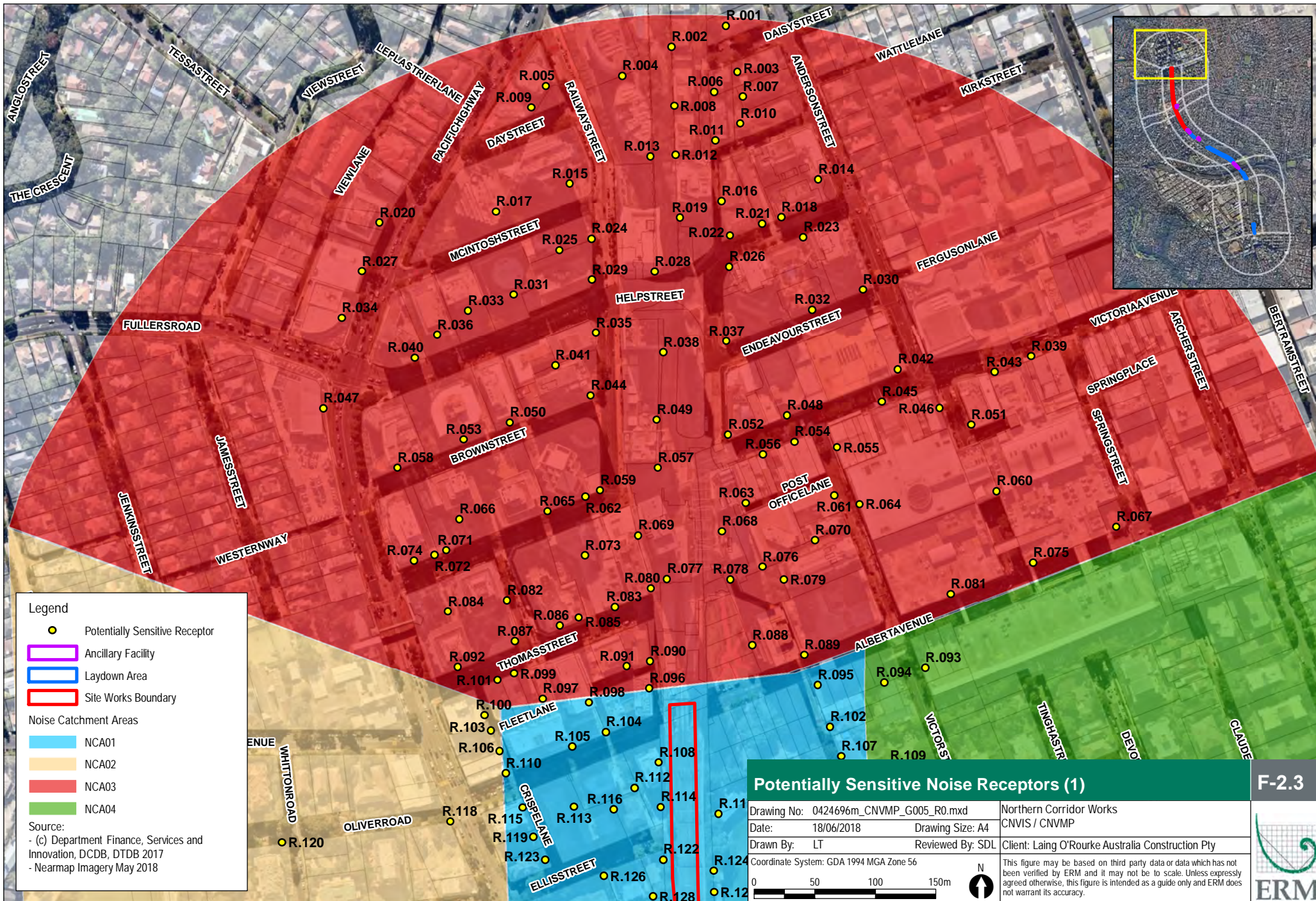
F-2.2

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Drawn By: LT	Reviewed By: SDL
Coordinate System: GDA 1994 MGA Zone 56	
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Client: Laing O'Rourke Australia Construction Pty

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Legend

- Potentially Sensitive Receptor
 - Ancillary Facility
 - Laydown Area
 - Site Works Boundary
- Noise Catchment Areas
- NCA01
 - NCA02
 - NCA03
 - NCA04

Source:
 - (c) Department Finance, Services and Innovation, DCDB, DTDB 2017
 - Nearmap Imagery May 2018

Potentially Sensitive Noise Receptors (1)

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Drawn By: LT	Reviewed By: SDL
Client: Laing O'Rourke Australia Construction Pty	

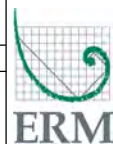
Coordinate System: GDA 1994 MGA Zone 56

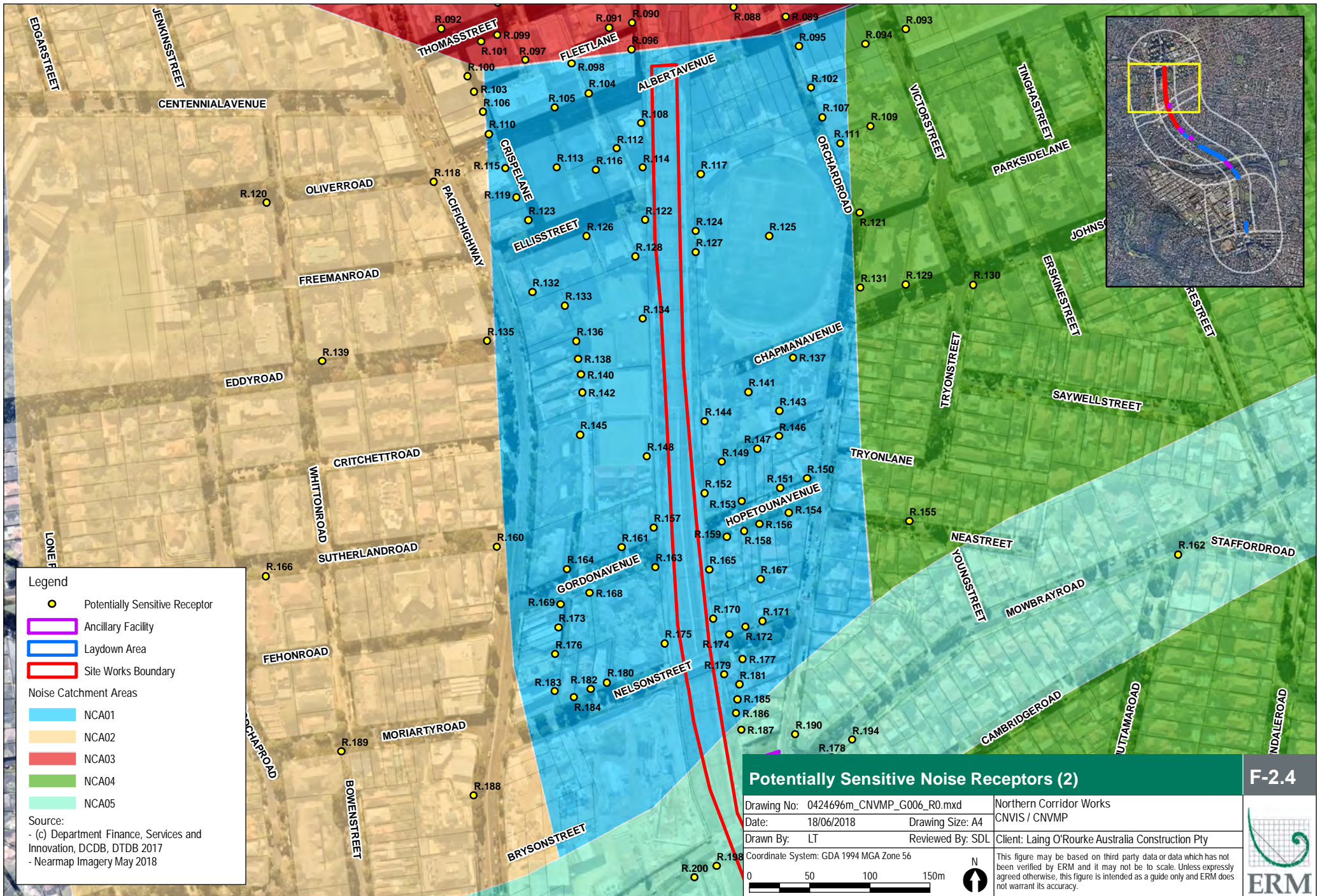
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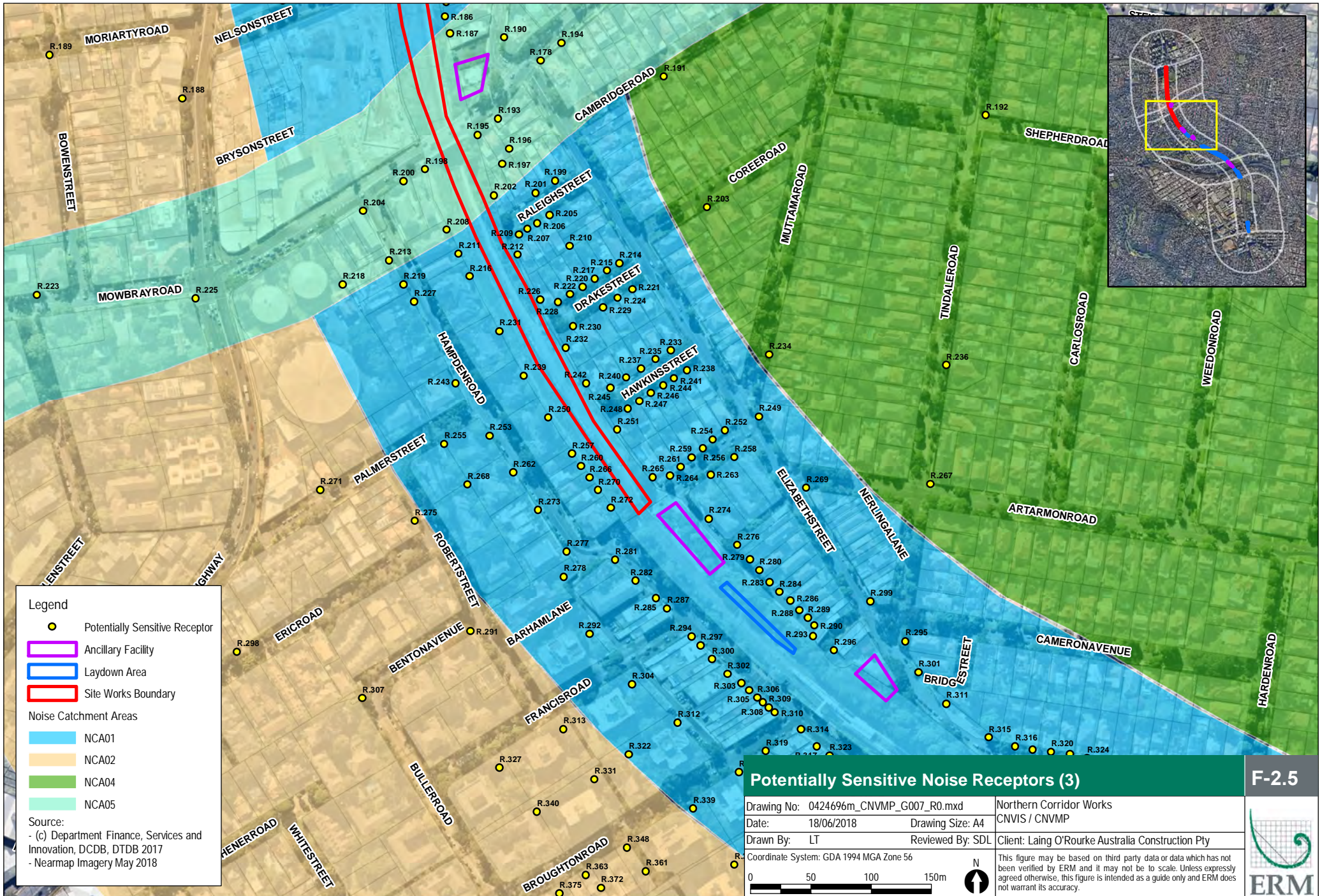
N

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F-2.3







Legend

- Potentially Sensitive Receptor
- Ancillary Facility
- Laydown Area
- Site Works Boundary

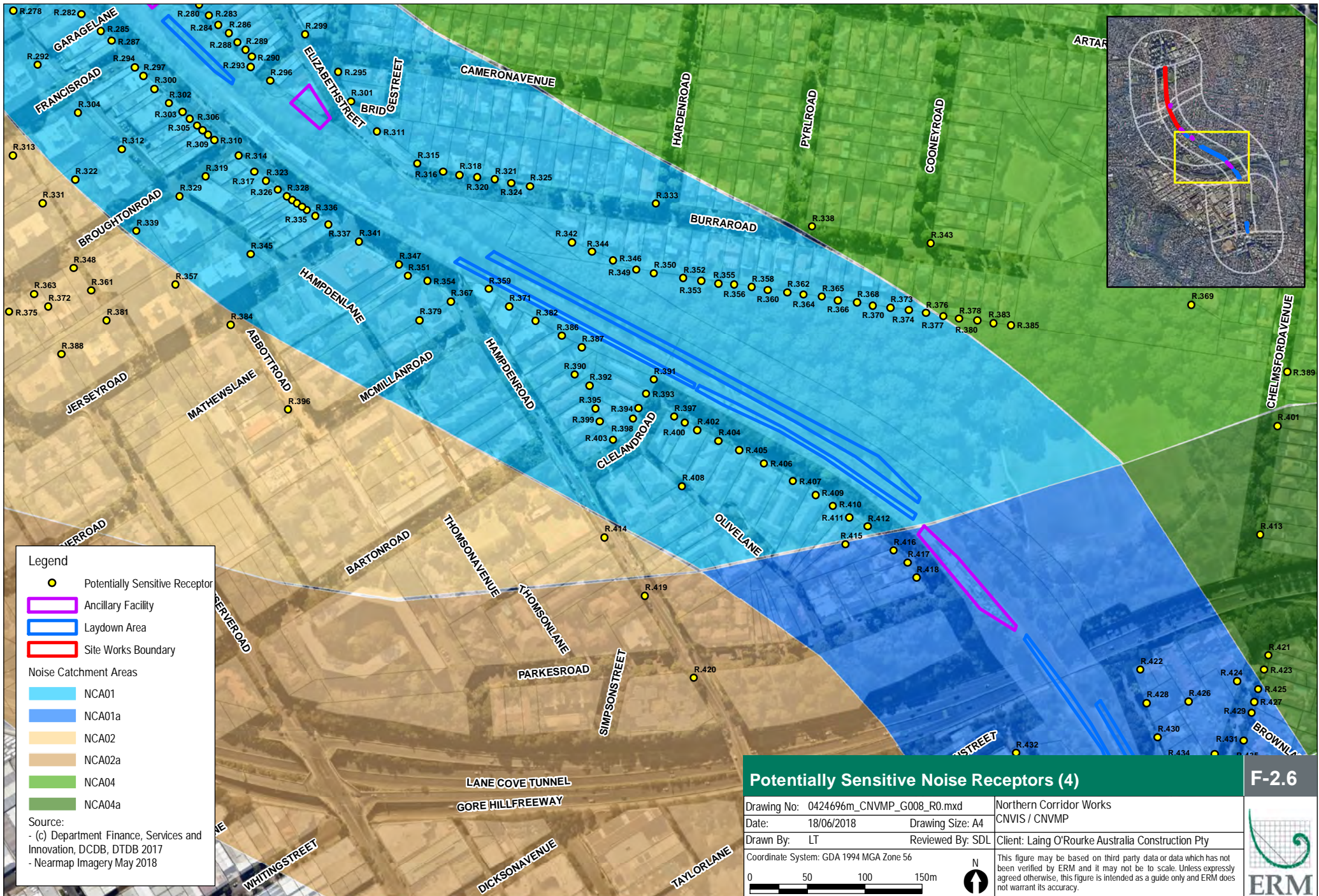
Noise Catchment Areas

- NCA01
- NCA02
- NCA04
- NCA05

Source:

- (c) Department Finance, Services and Innovation, DCDB, DTDB 2017
- Nearmap Imagery May 2018

Potentially Sensitive Noise Receptors (3)		F-2.5
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Date: 18/06/2018	Drawing Size: A4	Client: Laing O'Rourke Australia Construction Pty
Drawn By: LT	Reviewed By: SDL	
Coordinate System: GDA 1994 MGA Zone 56		
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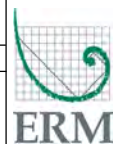
- Legend**
- Potentially Sensitive Receptor
 - Ancillary Facility
 - Laydown Area
 - Site Works Boundary

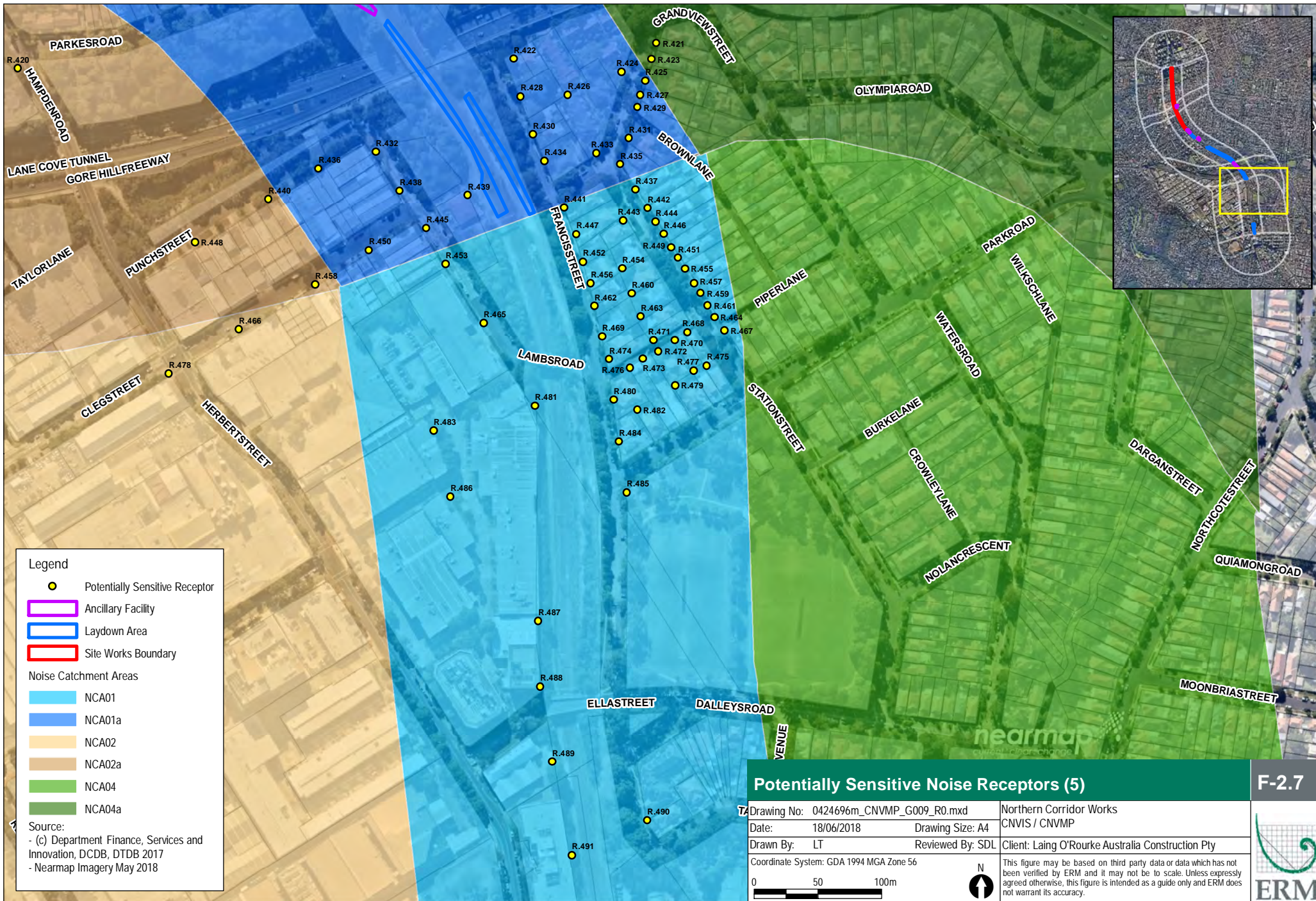
- Noise Catchment Areas**
- NCA01
 - NCA01a
 - NCA02
 - NCA02a
 - NCA04
 - NCA04a

Source:
 - (c) Department Finance, Services and Innovation, DCDB, DTDB 2017
 - Nearmap Imagery May 2018

Potentially Sensitive Noise Receptors (4) F-2.6

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Client: Laing O'Rourke Australia Construction Pty	
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<p>This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.</p>	



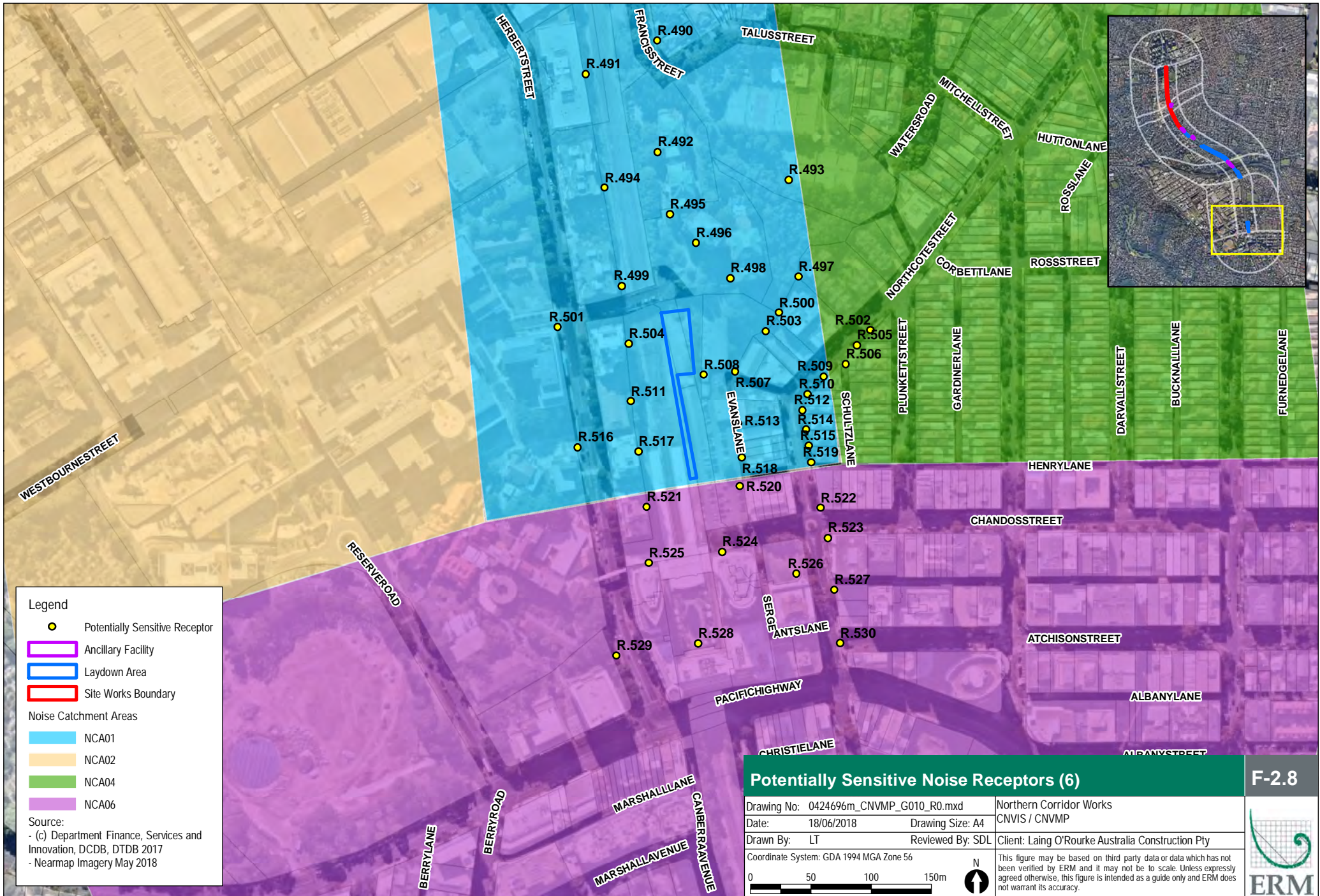


- Legend**
- Potentially Sensitive Receptor
 - Ancillary Facility
 - Laydown Area
 - Site Works Boundary
- Noise Catchment Areas**
- NCA01
 - NCA01a
 - NCA02
 - NCA02a
 - NCA04
 - NCA04a

Source:
 - (c) Department Finance, Services and Innovation, DCDB, DTDB 2017
 - Nearmap Imagery May 2018

Potentially Sensitive Noise Receptors (5) F-2.7

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Coordinate System: GDA 1994 MGA Zone 56	
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.	



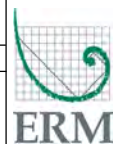
- Legend**
- Potentially Sensitive Receptor
 - ▭ Ancillary Facility
 - ▭ Laydown Area
 - ▭ Site Works Boundary

- Noise Catchment Areas**
- NCA01
 - NCA02
 - NCA04
 - NCA06

Source:
 - (c) Department Finance, Services and Innovation, DCDB, DTDB 2017
 - Nearmap Imagery May 2018

Potentially Sensitive Noise Receptors (6) F-2.8

Drawing No: 0424696m_CNVMP_G010_R0.mxd	Northern Corridor Works
Date: 18/06/2018	CNVIS / CNVMP
Drawn By: LT	Reviewed By: SDL
Client: Laing O'Rourke Australia Construction Pty	
Coordinate System: GDA 1994 MGA Zone 56	
0 50 100 150m	
<small>This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.</small>	



3. Management Levels and Criteria

Based on the ICNG and SM CNVS methodology summarised in the CNVMP the following construction Noise Management Levels (NMLs) and vibration criteria will apply to the NCW project as presented below.

3.1 General Construction Noise

The following general construction NML will apply externally and will be assessed at the most-affected point on or within the receptor property boundary or, if that is more than 30 metres (m) from the receptor, at the most-affected point within 30 m of the receptor.

Table 3.1 Construction Noise Management Levels (Residential Receptors)

Noise Catchment Area (NCA)	Acceptable LAeq, 15 minute Noise Level			
	Standard Construction Hours ¹ (RBL + 10 dBA)	Outside Standard Construction Hours (RBL + 5 dBA)		
		Daytime ²	Evening ³	Night ⁴
NCA01	52	47	46	40
NCA01a	59	54	51	46
NCA02	52	47	46	40
NCA02a	59	54	51	46
NCA03	56	51	49	42
NCA04	51	46	45	39
NCA04a	59	54	51	46
NCA05	73	68	65	50
NCA06	55	50	50	43

Source: CNVIS

1. Standard (daytime): 7:00am to 6:00pm Mondays to Fridays, inclusive and 8:00am to 1:00pm Saturdays;
2. Outside standard (daytime): 1:00pm to 6:00pm Saturdays, and 8:00am to 6:00pm on Sundays or public holidays;
3. Outside standard (evening): 6:00pm to 10pm Monday to Sunday, inclusive; and
4. Outside standard (night time): 10:00pm to 7:00am Monday to Friday and 10:00pm to 8:00am on Saturdays, Sundays and public holidays.

Table 3.2 Construction Noise Management Levels (Other Sensitive Receptors)

Acceptable LAeq, 15 minute Noise Level				
Noise Catchment Area (NCA)	Outside Standard Construction Hours			
	Standard Construction Hours ¹	Daytime ²	Evening ³	Night ⁴
Commercial	70	70	70	70
Industrial	75	75	75	75
Recreational (Active)	65	65	65	65
Place of Worship*	55	55	55	55
Educational*	55	55	55	55
Hospital wards and operating theatres*	55	55	55	55

Source: CNVIS

- Standard (daytime): 7:00am to 6:00pm Mondays to Fridays, inclusive and 8:00am to 1:00pm Saturdays;
- Outside standard (daytime): 1:00pm to 6:00pm Saturdays, and 8:00am to 6:00pm on Sundays or public holidays;
- Outside standard (evening): 6:00pm to 10pm Monday to Sunday, inclusive; and
- Outside standard (night time): 10:00pm to 7:00am Monday to Friday and 10:00pm to 8:00am on Saturdays, Sundays and public holidays.

* External criteria value translated from the internal ICNG management level, assuming windows operable.

Highly Noise Affected Management Level

In accordance with the ICNG, the Highly Noise Affected Management Level (HNML) of 75 dBA will apply to residential (dwelling) receptors during standard construction hours and during the daytime period only. The Highly Noise Affected Management Level does not apply outside the recommended standard hours and does not apply to other sensitive receptors. LOR will consult with all receptors identified to exceed the NMLs in the CNVIS in accordance with **CoA - E33** with the objective of determining appropriate additional mitigation measures in line with the SM CNVS, refer Section 8.2 of the CNVMP.

Table 3.3 Sleep Disturbance Screening Levels

Noise Catchment Area (NCA)	Sleep Disturbance Screening Level (LA1,1minute / LAmax) ¹
NCA01	50
NCA01a	56
NCA02	50
NCA02a	56
NCA03	52
NCA04	49
NCA04a	56
NCA05	60
NCA06	53

Source: CNVIS

- These sleep disturbance screening levels only apply during the night time defined by the INP as the period from 10:00pm to 07:00am (Monday to Saturday) and 10:00pm to 08:00am (Sundays and Public Holidays).

3.2 Construction Road Traffic Noise

An objective of the RNP is to protect sensitive receptors against excessive decreases in amenity as the result of a project by applying apply relevant permissible noise increase criteria. In assessing feasible and reasonable mitigation measures, an increase of up to 2 dBA represents a minor impact that is considered barely perceptible to the average person. Whilst these criteria do not specifically apply to construction/demolition traffic movements, they have been conservatively adopted for the CNVMP and are summarised in **Table 3.4** below.

Table 3.4 Road Traffic Noise Management Levels

Category	Road	Management Level, dBA	
		Daytime ¹	Night time ²
Sub-arterial roads	e.g. Pacific Highway / Mowbray Road	LAeq,1 hour ≤ 60 (external)	LAeq,1 hour ≤ 55 (external)
Local Roads	e.g. Brand St / Drake St / Hopetoun Ave	LAeq,1 hour ≤ 55 (external)	LAeq,1 hour ≤ 50 (external)

Source: SM CNVS, RNP

1. Daytime means between 7:00am and 10:00pm, Monday to Sunday inclusive; and
2. Night time means between 10:00pm to 7:00am, Monday to Sunday inclusive.

The road traffic noise management levels differ from general construction NML and apply 1 m from the property façade. Road traffic impacts are not anticipated such that direct assessment of NCW road traffic noise will not be undertaken unless it becomes necessary (i.e. impacts are identified or complaints are received) during the works. Where impacts are identified or complaints are received the extent of assessment will be determined on a case by case basis.

3.3 Vibration Management Levels

Refer Section 6.3 of the CNVMP which describes how the human comfort structural/cosmetic damage criteria will be evaluated, selected and applied as appropriate to the receptor and potential impacts.

3.3.1 Human Comfort (or Annoyance)

BS 6472-1992 provides guideline values for continuous, transient and intermittent events that are based on a Vibration Dose Value (VDV). The vibration dose value is dependent upon the level and duration of the short term vibration event, as well as the number of events occurring during the daytime or night-time period. The vibration dose values recommended in BS 6472-1992 for which various levels of adverse comment from occupants may be expected are presented in **Table 3.5**.

Based on the NSW Vibration Guideline, Intermittent vibration can be defined as interrupted periods of continuous vibration (e.g. vibratory rolling, heavy truck pass-by's or rock breaking) or continuous periods of impulsive vibration (e.g. impact pile driving). Higher vibration levels are allowed for intermittent vibration compared with continuous vibration on the basis that the higher levels occur over a shorter time period. Hence, for intermittent vibration, human comfort vibration levels are assessed on the basis of the Vibration Dose Value, based on the level and the duration of the vibration events. Given the scenarios and activities outlined in the CNVIS, the vibration generating activities identified for the NCW P7B project will be classified as intermittent vibration.

Table 3.5 Vibration Dose Value Ranges which Might Result in Various Probabilities of Adverse Comment within Residential Buildings

Place and Time	Low Probability of Adverse Comment (m/s ^{1.75})	Adverse Comment Possible (m/s ^{1.75})	Adverse Comment Probable (m/s ^{1.75})
Residential buildings 16 hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hr night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Source: SM CNVS

Note: For offices and workshops, multiplying factors of 2 and 4 respectively would be applied to the above vibration dose value ranges for a 16 hr day.

It is noted however that the direct measurement (or equivalent estimation via calculation) of VDV is often impractical and does not allow for the assessment of impacts whilst works are occurring. VDV provides an indication of impacts after the works have occurred based on the duration, intensity and characteristic frequency of the measured vibration events throughout a work day. To provide greater flexibility and to enable the assessment of potential impact via the PPV parameter (which can be measured and evaluated during works) the following thresholds identified in **Table 3.6** will be applied to assess the probability for adverse comment from residential receptors. These values have been established as per Table C1.1 of the NSW Vibration Guideline and will be applied in combination with the VDV presented in **Table 3.5**.

Table 3.6 Perceptible Vibration Criteria for Exposure to Continuous and Impulsive Vibration

Place	Time	Peak Particle Velocity (mm/s)	
		Preferred	Maximum
Continuous Vibration			
Residences	Daytime	0.28	0.56
	Night-time	0.20	0.40
Offices	Day- or Night-time	0.56	1.1
Workshops	Day- or Night-time	1.1	2.2
Impulsive Vibration			
Residences	Daytime	8.6	17.0
	Night-time	2.8	5.6
Offices	Day- or Night-time	18.0	36.0
Workshops	Day- or Night-time	18.0	36.0

1. Values given for the most critical frequency range >8Hz assuming sinusoidal motion.

Source: Table C1.1 – The NSW Vibration Guideline

3.3.2 Building Damage (Structural/Cosmetic Damage)

The recommended limits (guide value, refer SM CNVS) from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented in **Table 3.6** with each “Line” shown in **Figure 3.1**.

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

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

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

Table 3.6 Building Damage Vibration Management Levels (BS 7385)

Line	Type of Building	Peak Particle Velocity (PPV in mm/s) in the Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz & Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15mm/s at 4 Hz increasing to 20mm/s at 15 Hz	20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above

Source: BS 7385, SM CNVS

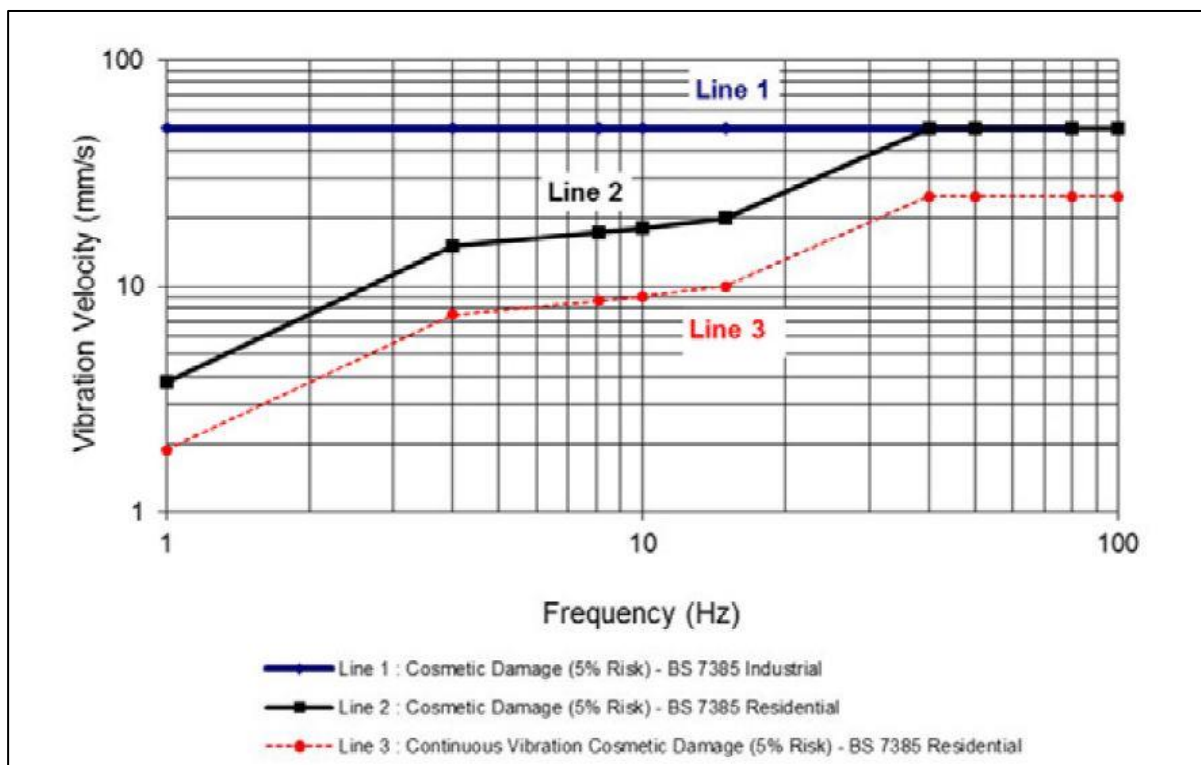


Figure 3.1: Building Damage Vibration Management Levels (BS 7385)

Heritage buildings and structures will also be assessed as per the screening criteria in **Table 3.6** as they should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound.

If a heritage building or structure is found to be structurally unsound (following inspection) a more conservative cosmetic damage criteria of **2.5 mm/s** peak component particle velocity (from DIN 4150) would be considered. The applicable German Standard DIN 4150:3 management levels are tabulated in **Table 3.7** with each "Line" shown in **Figure 3.2**.

Table 3.7 Building Damage Vibration Management Levels (DIN4150:3)

Line	Type of Structure	Guideline Values for Velocity (PPV in mm/s)		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz ¹
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under either of the other classifications and of great intrinsic value	3	3 to 8	8 to 10

Source: SM CNVS, CNVIS

1. At frequencies above 100 Hz, the values given in this column may be used as minimum values; and
2. The 50 Hz values may be applied to assess vibration at the horizontal plane of the highest building floor at all frequencies.
3. As per the SM CNVS, Heritage criteria are provided. It is noted that line one and line two do not apply to this project. These criteria are only to be applied if a heritage building or structure is found to be structurally unsound.

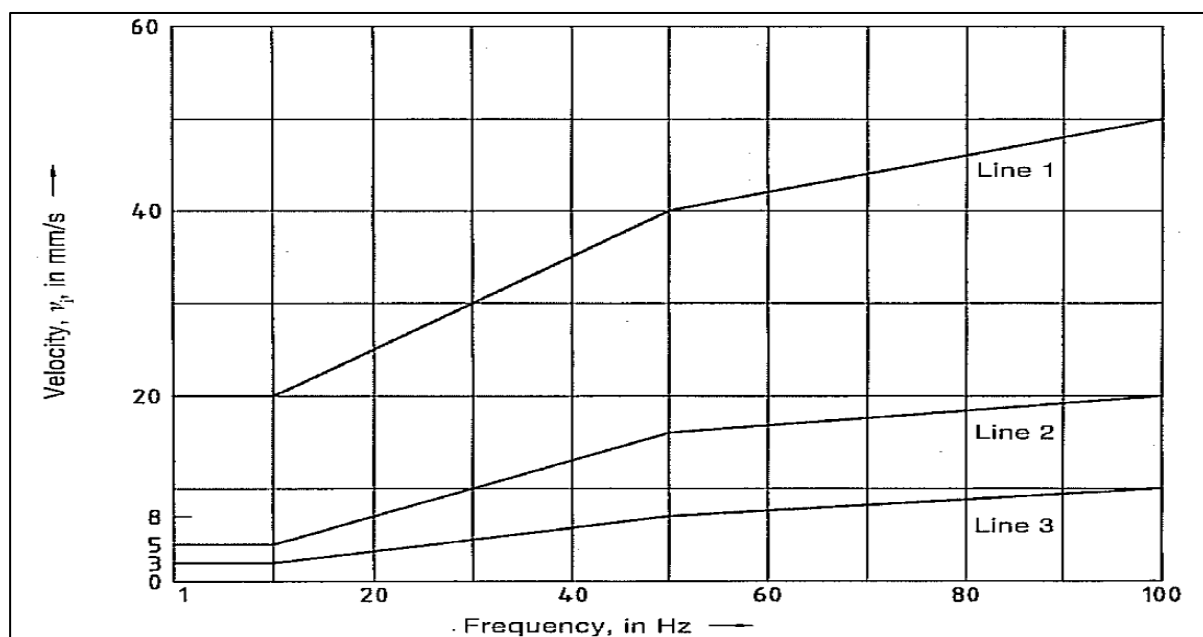


Figure 3.2: Building Damage Vibration Management Levels (DIN4150:3)

4. Noise and Vibration Monitoring

Monitoring for NCW works will be implemented at the commencement of works and at regular intervals throughout the project (i.e. when new construction activities commence) to quantify the airborne noise, ground-borne noise and vibration levels associated with construction activities. Monitoring would also be required in the event of a complaint being received or during OOHW where the AMMM has identified monitoring.

Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals (as is the case for select project works), noise or vibration monitoring may be conducted at the affected receptor(s) or a nominated representative location (typically the nearest receptor where more than one receptor have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goals are being approached so that changes to the configuration of equipment or practices can be made in an effort to reduce noise levels to meet the noise or vibration goal. Additional management measures may also be required.

4.1 General Monitoring Requirements

All construction noise and vibration monitoring will be undertaken in accordance with the construction noise and vibration monitoring guideline, which is included in Appendix A of the SM CNVS. This outlines the minimum requirements for contractors undertaking monitoring on the Sydney Metro Project.

In accordance with the CNVIS, attended measurements will be the focus of all noise monitoring however unattended noise (and vibration) monitoring may be undertaken where specific circumstances warrant. The benefit of attended noise monitoring is that the results can be fed back directly to the project team and actions taken without delay.

Attended monitoring is also preferred for this project as there are a number of non-project related noise sources within the vicinity of the project (e.g. traffic and rail) that will influence the measured data set. Operator attended measurements will allow a site noise contribution to be determined with the exclusion of extraneous influences.

This method of monitoring was proven to be effective during the preliminary works undertaken at the site in 2017, where attended noise monitoring results were fed back directly to the project team and actions were taken on site to manage and mitigate noise impacts.

For vibration it is typical that unattended monitoring is undertaken, however the device may be observed by LOR (or their specialist) during the early stages of certain works to provide feedback of results to the project team, based on which actions can be taken without delay.

Attended monitoring will be conducted during OOHW track possessions, specifically during the night time period where sleep disturbance impacts will be monitored. Data from attended monitoring will be made available to the ER, AA, the Department of Planning and the EPA as required (i.e. if requested). Further detail on noise and vibration requirements are outlined below.

In accordance with **CoA - C11** unattended real-time noise monitoring will be undertaken in conjunction with attended noise monitoring. Vibration monitoring (unattended real-time or attended) may also be undertaken where specific circumstances warrant, such as vibration intensive works occurring within the TfNSW I&S safe working distances. Unattended real-time noise monitoring devices will be installed at locations representative of the nearest and potentially most affect receptors. Details of noise and vibration monitoring in the community are further outlined in **Section 4.4** and **4.5** below.

Unattended noise and/or vibration monitoring devices will be set up for works undertaken for each track possession. They will provide real time web-accessible monitoring with access available to the construction team i.e. LOR, Sydney Metro, AA, ER, DPE and EPA in accordance with **CoA - C11**. The locations of the monitoring devices will be determined in detail closer to implementation of the works which have been identified as requiring unattended noise and/or vibration monitors.

As discussed in the CNVIS monitoring and measurements will be conducted at the potentially most affected receptor(s) from the commencement of construction activities to confirm that the noise and/or vibration levels

in the adjacent community are consistent with the predictions in the CNVIS. Other potentially affected receptors will also be considered as part of the monitoring regime depending on the phase of works.

Based on the scenarios assessed in the CNVIS (which informed the preparation of this CNVMP) the closest and/or potentially most affected noise sensitive receptor locations situated within the potential area of influence of the site are:

- Receptor R.152 – residential dwelling receptor situated near the rail corridor on Hopetoun Avenue.
- Receptor R.179 - residential dwelling receptor situated near the rail corridor on Nelson Street.
- Receptor R.195 - residential dwelling receptor situated near the rail corridor on Mowbray Road.
- Receptor R.209 - residential dwelling receptor situated near the rail corridor on Raleigh Street.
- Receptor R.232 - residential dwelling receptor situated near the rail corridor on Drake Street.
- Receptor R.242 - residential dwelling receptor situated near the rail corridor on Hawkins Street.

These locations were identified in **Figure 2.4**, **Figure 2.5** and **Appendix A**. Noise monitoring will target these locations once works are occurring. The precise monitoring position will be selected on a case-by-case basis and adjusted where necessary to ensure that these locations remain valid, and if not, that alternate monitoring locations are selected. Consideration of this feature will occur prior to works occurring as part of the normal planning and application processes, and then verified during noise monitoring. The same approach will be adopted for any vibration monitoring that becomes necessary during the P7b works.

Unattended real-time noise monitoring devices may be supplemented with operator attended noise monitoring. The benefit of attended noise monitoring is that the results can be fed back directly to the NCW project team and actions taken without delay. For vibration it is typical that unattended monitoring is undertaken, however the device may be observed by LOR (or their specialist) during the early stages of certain works to provide real time feedback of results to the NCW project team, based on which actions can be taken without delay.

All attended measurements will be conducted by appropriately trained personnel in the measurement and assessment of construction noise and vibration. They will be familiar with the requirements of the relevant standards and procedures.

4.1.1 Possessions Schedule

Due to the nature of the project noise and vibration monitoring will be required during weekend rail possessions as well as during non-possession periods. The current possession schedule for the NCW project is outlined below in **Table 4.1**.

Table 4.1 Weekend Possessions

Weekend no.	Dates
Weekend 08	25-26 August 2018
Weekend 14	6-7 October 2018
Weekend 16	20-21 October 2018
Weekend 18	3-4 November 2018
Weekend 20	17-18 November 2018
Weekend 24	15-16 December 2018
Weekend 34	23-24 February 2019
Weekend 40	6-7 April 2019
Weekend 51	22-23 June 2019
Weekend 05	3-4 August 2019
Weekend 15	12-13 October 2019
Weekend 23	7-8 December 2019
Weekend 50	13-14 June 2020
Weekend 09	29-30 August 2020
Weekend 19	7-8 November 2020
Weekend 31	30-31 January 2021
Weekend 38	20-21 March 2021

Source: LOR

1. The above table of scheduled possessions is correct as at 19 June 2018 and is subject to change.
2. Works may not necessarily be continuous during the execution of the project

4.2 Noise Measurement Requirements

The noise measurement procedures employed throughout the monitoring program will be in accordance with the requirements of Australian Standard (AS) 1055:1997 *Acoustics - Description and Measurement of Environmental Noise*.

Attended noise measurements will be conducted by an operator using a hand held Type 1 or Type 2 'integrating-averaging' sound level meter. All measurements will be completed with the sound level meter mounted to a tripod (if possible) and with a windscreen fitted. The preferred measurement height is 1.2 metres (m) to 1.5 m above the ground.

The device will be calibrated prior to and after all measurement rounds, with any change in calibration levels noted. Instantaneous noise levels for all noted noise emission sources (extraneous or otherwise), meteorological conditions (average and maximum wind speeds, temperature, precipitation and cloud cover etc.) shall be recorded during all measurements. The location of monitoring, time of measurement and all relevant measurement parameters (i.e. LAeq, LAmin, LAmx, LA1, LA10 and LA90) will also be recorded.

Unattended noise measurements would be conducted using a Type 1 or Type 2 environmental noise logger. The device will be calibrated prior to and after installation, with any change in calibration levels noted. Measurements will be completed with a windscreen fitted.

Noise monitoring will not be completed within 3.5 m of any reflective structure or wall, if possible. Where it is not possible to measure more than 3.5 m from any reflective structure or wall, a reduction of up to 2.5 dB will be applied to the measured ambient and site noise contribution (LAeq, 15 minute) to account for the likely increase in noise associated with reflective surfaces.

No noise monitoring will be completed during periods where wind speeds exceed 5 m/s at the microphone or during any rain events.

Monitoring will be conducted as per the requirements of the CNVMP and with due regard to AS1055; AS61672, AS1259 (or similar); IEC60942; or the NSW Vibration Guideline as relevant to the monitoring being conducted.

All noise samples shall be recorded using the "fast" time response of the sound level meter.

Site activity records will be maintained during any noise (or vibration) monitoring events.

An example of the correct setup of a sound level meter for attended noise measurements is presented in **Photo 4.1** below. An example of the correct setup of an environmental noise logger for unattended noise monitoring is presented in **Photo 4.2** below.



Photo 4.1: Example Attended Noise Monitoring Setup



Photo 4.2: Example Unattended Noise Monitoring Setup

4.3 Vibration Measurement Requirements

The vibration measurement procedures employed throughout the monitoring program will be in accordance with the requirements of British Standard BS7385: Part 2-1993 (BS 7385) - *Evaluation and Measurement for Vibration in Buildings — Part 2 – Guide to Damage Levels from Ground-borne Vibration*, dated 1993.

Measurement positions will be taken at the base of the building on the side of the building facing the source of vibration, to define the vibration input to the building. Where this is not feasible the measurement will be taken on the ground outside of the building.

The geophone will be mounted to reproduce the vibration in the frequency and magnitude ranges in which vibration response may be expected (i.e. the geophone will be firmly placed with adhesive to a concrete slab or substantially weighted to the ground in order to experience the ground-borne vibration).

Unattended vibration monitoring would be undertaken with due regard to and in accordance with the requirements of the SM CNVS and the NSW vibration guideline using a calibrated vibration logger.

When vibration intensive activities are required e.g. Hydraulic Hammering, the device will be placed (fixed to the structure, or embedded in the ground nearby the structure) at the potentially most affected receptor or structure prior to works commencing.

Where other activities are identified to include risk that levels may exceed structural damage criteria attended vibration monitoring will also be conducted, with measured values to be observed during the first 30 minutes of works to ensure structural damage criteria are not exceeded.

The device will be set to continuously record vibration levels (Peak Particle Velocity (PPV) data in mm/s) at sample intervals (e.g. 5 second, 15 second or 1 minute) appropriate to the activity. Vibration Dose Values (VDV, m/s^2) are reliant on 1) the duration of vibration events and 2) the component frequency (in Hz) associated with the vibration being generated. Hence VDV will be estimated and evaluated regularly during the early stages of the activity and monitoring period. The PPV trigger levels provided in **Table 3.6** will inform the management of vibration e.g. alternate construction methods or respite.

An example of the correct setup of a vibration monitoring device for attended or unattended vibration measurements is presented in **Photo 4.3** below.



Photo 4.3: Example Vibration Monitoring Setup

4.4 Noise Monitoring in the Community

Attended noise measurements will be undertaken at the potentially most affected receptors identified in the CNVIS (dependant on phase of works/scenario) from the commencement of construction activities to confirm that the noise levels in the adjacent community are consistent with the predictions the CNVIS as reproduced in the CNVMP. Other potentially affected receptors will also be considered as part of the monitoring regime depending on the phase of works. Receptor locations are identified in **Figure 2.1 to Figure 2.8**.

The focus for noise monitoring will be for all scenarios in the early stages of work to verify predicted noise levels and confirm that noise levels satisfy the criteria outlined in **Section 3**. Ongoing monitoring and unattended monitoring will be considered on a case by case basis, as detailed in Table 8.1 of the CNVMP.

Monitoring for the NCW project will be required at the commencement of works and at regular intervals throughout the project (i.e. when new construction activities commence) to quantify the airborne noise, ground-borne noise and vibration levels associated with construction activities. Monitoring would also be required in the event of a complaint being received and would be conducted at the most affected receptor in accordance with Appendix A of the SM CNVS.

Hydraulic hammering is the highest vibration generating activity anticipated for the NCW works. While ground-borne noise is not expected from this activity the potential has been considered in accordance with **REMM NV4**. Due to the attention given to the airborne noise for this activity it has been determined that the mitigation and management measures recommended for airborne noise from the hydraulic hammering activity will also be sufficient in managing impacts from potential ground-borne noise.

Community noise monitoring will ensure the $LA_{eq, 15\text{minute}}$ and $LA_{90, 15\text{minute}}$ parameters are recorded as a minimum. The site noise level contribution ($LA_{eq, 15\text{minute}}$) shall be determined in the absence of any influential source not associated with the project works for direct comparison to the relevant criteria. The

L_{max}, L_{Amin}, LA₁ and LA₁₀ parameters will be recorded for each measurement with the LA₁, 1minute parameter measured directly or calculated where possible and if applicable (i.e. for sleep disturbance monitoring).

As stated previously, the community noise measurement sample height will be 1.2 m to 1.5 m above ground level. The duration of each community noise measurement sample will be 15 minutes. All measurements will be completed with the sound level meter mounted to a tripod (if possible) and with a windscreen fitted. The device microphone will be focused on the noise emission centre of the equipment being tested. If community noise monitoring identified that predicted noise levels are being exceeded, LOR will revisit construction practices/sequencing etc. in order to reduce noise levels, minimise impacts and to enable provision of information on noise levels to surrounding and potentially affected residents should this be required (i.e. on request or following a complaint).

Where OOHW is approved and monitoring is determined to be required, attended noise measurements will be conducted at the most affected receptors following the general and community monitoring requirements specified above. Further guidance is provided in the Sydney Metro OOHW Protocol, which included in the CNVMP as Appendix B.

4.5 Vibration Monitoring in the Community

Vibration monitoring will be undertaken at the potentially most affected receptor identified in the CNVIS from the commencement of vibration generating activities (i.e. **R.170, R.174, R.175, R.177 and R179** for SCN10 (Nelson St Bridge) and **R.198 and R.195** for SCN11 and SC12 (Mowbray Rd Bridge) to confirm that the vibration levels at the nearest sensitive receptor are compliant with the criteria outlined the CNVIS and Section 6.3 of the CNVMP. These receptors are presented in **Figure 4.1** below. Attended vibration measurements are also required at the commencement of track tamper activities (SCN04 and SCN05) to confirm that vibration levels satisfy the criteria outlined in **Section 3.3**.

In accordance with **REMM NV3**, where there is potential for exceedances of the criteria, further vibration site law investigations will be undertaken to determine the site-specific safe working distances for the vibration generating activity. Continuous vibration monitoring with audible and visible alarms will be conducted at the nearest sensitive receivers whenever those vibration generating activities need to take place inside the calculated safe-working distances. Additionally noise and/or vibration monitoring may be required at any receptor in response to a complaint which may arise at any stage during the construction works.

If and when site specific safe working distances are established, continuous unattended vibration monitoring will be conducted at the nearest sensitive receptors whenever vibration generating activities need to take place inside the calculated site specific safe-working distances.

At this stage any vibration monitoring will target SCN04, SCN05, SCN10, SCN11 and SCN12 with monitoring of other work phases and activities being considered on a case by case basis, as detailed in the CNVMP.

The TfNSW I&S CNVS defines safe working distances for vibration intensive activities. As was adopted for the CNVIS and outlined in Section 8.1.2 of the CNVMP. These safe work distances will be adopted during the NCW project as a guideline to determine further mitigation. The safe working distances are defined for both cosmetic damage (BS 7385) and human comfort (the NSW Vibration Guideline). **Figure 4.1** below outlines the safe working distance buffer zones identified for SCN10 to SCN12.

The implementation of all noise and vibration mitigation measures will be monitored regularly throughout the works and audited as per the CEMP audit cycle. Where vibration levels are measured and verified to be compliant, no further vibration monitoring may be undertaken, unless for example complaints for human comfort are received.

No heritage items have been identified within close proximity to the NCW project. Impacts to heritage structures are therefore not expected, such that detailed options for any monitoring of heritage structures will be evaluated and implemented on a case-by-case basis and if specific circumstances arise that deem it necessary. Heritage buildings and structures would be assessed as per the screening criteria in Section 6.3 of the CNVMP and they should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound.

In accordance with **CoA – E31**, where monitoring of heritage items becomes necessary LOR must seek the advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage-listed structures.



Legend

- Potentially Sensitive Receptor
- Lots
- Roads
- Rail Line
- 7m Buffer - Hydraulic Hammer
- 23m Buffer - Hydraulic Hammer
- Ancillary Facility
- Laydown Area
- Site Works Boundary
- Work Areas

Source:
 - (c) Department Finance, Services and Innovation, DCDB, DTDB 2017
 - Nearmap Imagery May 2018

Ground-Borne Vibration Safe Working Distances **F-4.1**

Drawing No: 0424696m_CNVMP_G011_R0.mxd	Northern Corridor Works CNVIS / CNVMP	
Date: 18/06/2018	Drawing Size: A4	
Drawn By: LT	Reviewed By: SDL	Client: Laing O'Rourke Australia Construction Pty
Coordinate System: GDA 1994 MGA Zone 56		<small>This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.</small>

4.6 Actions Following Monitoring in the Community

Actions to mitigate or manage noise or vibration emissions will be considered as per the measures described in Section 8 of the CNVMP and the overall monitoring protocol identified in **Figure 4.2** below.

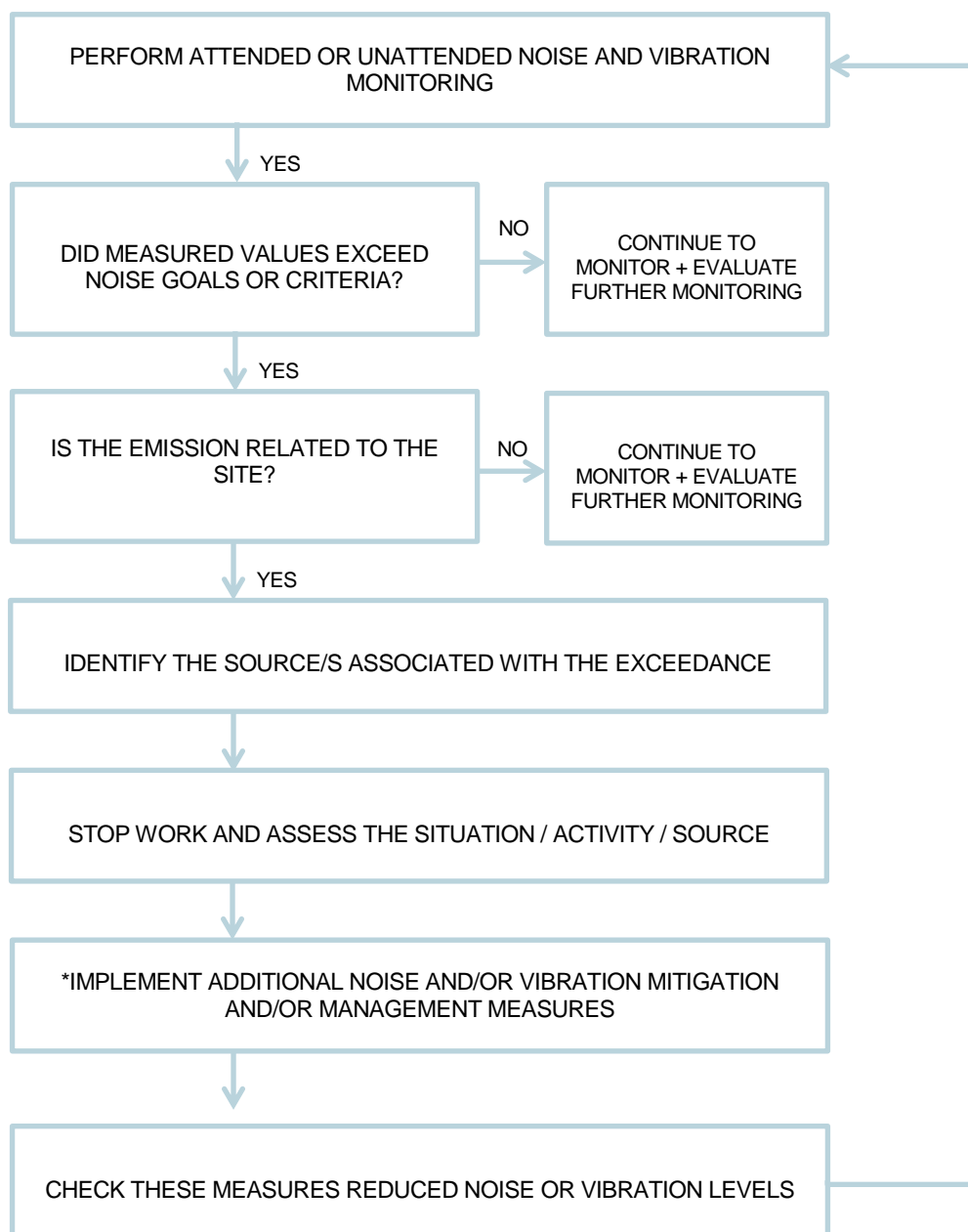


Figure 4.2: Monitoring and Action Protocol

* Noise and/or vibration mitigation and management measures are outlined in Section 8 of the CNVMP. Additional mitigation measures may include additional and/or modified respite schedules, changes to construction methodology, further noise attenuation and alternate accommodation. Consultation with sensitive receptors will be undertaken as the project progresses where sensitive periods can be refined based on the type of activities, expected impacts and the particular circumstances of the receptor at that time. All consultation will be undertaken prior to the start of the relevant portion of works predicted to affect those receptors. Mitigation measures can then be tailored based on the consultation feedback.

4.7 Maximum Noise Levels for Plant and Equipment

All significant noise generating items of plant would have noise audits conducted in accordance with Section 9 of the SM CNVS. Where required, plant and equipment would be measured while operating under typical conditions. If this is not practical, it may be appropriate to conduct a stationary test at high idle. In the case of a sound power level exceeding the values identified in Table 7.2 of the CNVMP the item of plant would either be replaced, or the advice of an acoustic consultant would be sought to provide suitable mitigation measures.

In order to compare the noise levels of plant and equipment with the values in in Table 7.2 of the CNVMP, the following guidelines are recommended in the SM CNVS:

- Measurements of Sound Pressure Level (SPL) at 7 m (with plant or equipment stationary) shall be undertaken using procedures that are consistent with the requirements of Australian Standard AS2012–1990 Acoustics – *Measurement of Airborne Noise Emitted by Earthmoving Machinery and Agricultural Tractors – Stationary Test Condition Part 1: Determination of Compliance with Limits for Exterior Noise*.
- Measurements of Sound Power Level (SWL) shall be determined using procedures that are consistent with the requirements of International Standard ISO9614-2 1996 Acoustics – *Determination of sound power levels of noise sources using sound intensity - Part 2: Measurement by scanning*.
- If measuring the SPL at 7 m of moving plant, compliance measurements would be guided by the requirements of Australian Standard AS2012–1977 *Method for Measurement of Airborne Noise From Agricultural Tractors and Earthmoving Machinery*.

A register of measured sound power levels for each item of plant would be kept for reference where future noise audits are conducted. The register would be reviewed annually in conjunction with this strategy and corresponding revisions made to the Sound Power Levels presented in Table 7.2 of the CNVMP to represent contemporary plant noise emission levels.

4.8 Noise and Vibration Reporting

All noise and vibration monitoring results would be assessed against the nominated goals. Noise and vibration reporting will be included in the monthly environmental reporting (using the Sydney Metro City & Southwest Environmental Reporting Template) as per conditions of the MR-minor E.

The results of construction noise and vibration monitoring must be submitted to the Secretary and relevant regulatory agencies for information in the form of a Construction Monitoring Report every six months, in accordance with **CoA – C16**. In accordance with **CoA – A43(a)** a summary of results and analysis of environmental monitoring will also be included in the Construction Compliance Report which must be prepared and submitted to the Secretary for information every six months.

In accordance with the MR-minor E, within five business days of each Calendar Quarter Date, a register of ongoing Environmental Compliance Requirements (ECRs) must be submitted to the Environmental Representative for review in accordance with the Contract, which identifies progress and evidence of compliance against each ECR. The register of ECRs must classify each ECR as:

- i. Ongoing or Complete, to indicate their progress; and
- ii. Compliant or Non-Compliant, to indicate compliance.

The following will be included in as a minimum (where relevant) in the Construction Monitoring Report:

- The type of monitoring conducted (for example, at a particular project stage or following complaints) and a brief statement of the measurement method;
- The noise/vibration conditions on the consent / licence, or the relevant noise management objectives;
- Descriptions of the nearest affected residences and other sensitive land uses or, in the case of complaints, description of the complainant location and complaint;
- Description of the instrumentation used;
- The results of monitoring at each monitoring location, including a comparison with the consent conditions or relevant noise management objectives;
- Vibration monitoring results summary together with notes describing any vibration intensive activities (if applicable);
- Summary of measurements exceeding the vibration criteria levels and descriptions of the plant or operations causing these exceedances (if available);
- Details of corrective action applicable to vibration criteria exceedances and confirmation of its successful implementation. Where corrective action has not yet been implemented, it may be shown as pending and the status of its implementation will be carried forward to following reports;
- The location of the construction works in relation to the monitoring position. (sketch plan & sections, photos);
- Details of the various construction equipment in use during the measurement period;
- Details as to the likely dominant noise sources;
- Meteorological conditions (i.e. temperature, humidity, cloud cover, and wind speed and direction);
- A clear statement outlining the project's compliance or non-compliance with the conditions or objectives where the monitored level is higher than the conditions or objectives; and
- The reasons for non-compliance will be stated, strategies for minimising noise identified and stated, and the appropriate actions to implement the mitigation and or management strategies.

5. Monitoring Program Review

The monitoring program will be reviewed annually or where circumstances arise during the works that require amends to the program. The type of circumstances that may trigger a review could include, but are not limited to, significant changes in construction procedures, management protocols or environmental requirements; trends in validated noise or vibration complaints are identified; and/or an increase in noise and vibration impacts is identified.

In accordance with **CoA - C15**, minor amendments to the monitoring program will be submitted to the AA and ER for review and endorsement. The Program must be implemented for the duration of the construction and for any longer period set out in the monitoring program or specified by the Secretary. However if major revision is warranted then the Program needs to be endorsed by ER and approved by the Secretary.

Where noise (or vibration) levels are repeatedly identified (e.g. via monitoring) to be above management levels or the predicted values in the CNVIS, a review of this monitoring program in conjunction with a review of the CNVMP will be undertaken as outlined in Section 12.2 of the CNVMP.

As per Section 12.2 of the CNVMP, the following steps will be completed:

- review and identify the cause of any noise (or vibration) exceedances. This will focus on the plant, equipment or machinery in use at the time, or activities undertaken so that any trends can be identified.
- confirm the type and extent of any mitigation or corrective actions implemented during the non-compliant events.
- identify, develop and implement any opportunities for improvement or additional mitigation or management measures that will assist to minimise impacts associated with any trends.
- revise this management plan document, or supplement this plan (e.g. with separate work instructions) to reflect the outcomes of the review.

The revised CNVMP (and Monitoring Program) will be developed to the satisfaction of the Environmental Manager, Sydney Metro Environmental Representative and the Acoustics Advisor, so that the management strategy and management measures continue to assist to minimise impacts at receptors and to ensure that the plan remains an effective instrument for noise management and mitigation. Any review of the CNVMP (and Monitoring Program) will also be undertaken in consultation with relevant government agencies (i.e. Willoughby Council).

The revised CNVMP (and Monitoring Program) will be developed in consultation with the relevant government agencies, endorsed by the ER and submitted to the Secretary, in accordance with **CoA – C3, C5, C6, C7 and C8**. Construction must not commence until the CEMP and associated sub-plan revisions have been approved by the Secretary.

The revised CNVMP (and Monitoring Program) will be referred to the Department of Planning and Environment (DPE) only where amendments are made to address significant changes to project works/schedule and impacts on (or complaints from) the community are verified, or at the request of the Environmental Manager, Environmental Representative or the Acoustics Advisor.

The CNVMP (and Monitoring Program) review will reflect these considerations and upon final approval of the revised CNVMP, the document will be circulated to relevant personnel.

6. References

British Standard (BS 6472–1992) – **Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)** dated 1992.

British Standard BS7385: Part 2-1993 (BS 7385) - **Evaluation and Measurement for Vibration in Buildings — Part 2 – Guide to Damage Levels from Ground-borne Vibration**, dated 1993.

German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150:3) – **Structural Vibration - Effects of Vibration on Structures**, dated 1999.

Laing O'Rourke - Sydney Metro City and Southwest - Northern Corridor Works (K38) Draft **Construction Environmental Management Plan (CEMP)**, dated September 2017.

Laing O'Rourke - Sydney Metro City and Southwest - Northern Corridor Works - Portion 7b - **Construction Noise and Vibration Impact Statement (CNVIS)**, prepared by ERM and dated June 2018.

NSW Department of Environment and Climate Change – **NSW Interim Construction Noise Guideline (ICNG)**, July 2009.

NSW Department of Environment and Conservation – **NSW Environmental Noise Management – Assessing Vibration: a Technical Guideline** (the NSW Vibration Guideline), February 2006.

NSW Department of Environment, Climate Change and Water – **NSW Road Noise Policy (RNP)**, March 2011.

NSW Environment Protection Authority – **NSW Environmental Noise Management – Industrial Noise Policy (INP)**, January 2000 and relevant application notes.

NSW Government – Transport for NSW (TfNSW) - Sydney Metro **Construction Noise and Vibration Strategy (SM CNVS)**, August 2016 and CNVS Addendum June 2017.

NSW Government – Transport for NSW (TfNSW) Infrastructure and Services Division (I&S) - Sydney Metro **Construction Noise and Vibration Strategy (I&S CNVS)**, May 2018.

Standards Australia AS 2436–2010™ (AS2436) – **Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites**.

Standards Australia AS1055–1997™ (AS1055) – **Description and Measurement of Environmental Noise**.

Standards Australia AS IEC 61672.1–2004™ (AS61672) – **Electro Acoustics - Sound Level Meters Specifications Monitoring** or Standards Australia AS1259.2-1990™ (AS1259) – **Acoustics – Sound Level Meters – Integrating/Averaging** as appropriate to the device.

Standards Australia AS/IEC 60942:2004/IEC 60942:2003 (IEC60942) – Australian Standard™ – **Electroacoustic – Sound Calibrators**.

TfNSW - Sydney Metro - Chatswood to Sydenham **Construction Environmental Management Framework (CEMF)** – Appendix B of SPIR, dated August 2016.

TfNSW - Sydney Metro - Chatswood to Sydenham **Environmental Impact Statement (EIS) – Chapter 10: Construction Noise and Vibration**, dated May 2016.

TfNSW - Sydney Metro - Chatswood to Sydenham **Environmental Impact Statement (EIS) – Technical Paper 2 Noise and Vibration**, Prepared by SLR, dated April 2016.

TfNSW - Sydney Metro – Northern Corridor Works **Management Requirement Minor - Environment (MR-minor E)**, dated April 2017.

TfNSW - Sydney Metro - **Chatswood to Sydenham: Staging Report**, dated April 2017.

TfNSW - Sydney Metro - Chatswood to Sydenham **Submissions and Preferred Infrastructure Report (SPIR)**, dated October 2016.

Appendix A – Potentially Sensitive Receptors

Table A.1 Location ID	Description (NCA_Receptor Type)	GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
		Easting	Northing	
R.001	NCA03_Residential	331644.72	6259245.97	102
R.002	NCA03_Residential	331599.74	6259228.51	101
R.003	NCA03_Residential	331654.12	6259207.94	100
R.004	NCA03_Residential	331559.12	6259204.51	101
R.005	NCA03_Commercial	331495.91	6259196.20	104
R.006	NCA03_Residential	331634.95	6259191.33	98
R.007	NCA03_Residential	331658.52	6259187.50	98
R.008	NCA03_Residential	331601.91	6259179.71	99
R.009	NCA03_Commercial	331483.78	6259178.30	104
R.010	NCA03_Residential	331656.70	6259165.07	97
R.011	NCA03_Residential	331636.00	6259151.18	96
R.012	NCA03_Residential	331602.99	6259139.60	99
R.013	NCA03_Residential	331582.34	6259138.14	100
R.014	NCA03_Residential	331720.83	6259119.06	94
R.015	NCA03_Commercial	331515.71	6259115.61	98
R.016	NCA03_Residential	331640.94	6259101.11	94
R.017	NCA03_Commercial	331454.73	6259092.41	100
R.018	NCA03_Residential	331690.32	6259088.03	92
R.019	NCA03_Commercial	331606.85	6259087.61	97
R.020	NCA03_Commercial	331358.49	6259083.51	104
R.021	NCA03_Residential	331674.51	6259082.69	92
R.022	NCA03_Residential	331647.99	6259072.91	92
R.023	NCA03_Residential	331708.52	6259071.40	92
R.024	NCA03_Commercial	331533.54	6259070.19	96
R.025	NCA03_Commercial	331507.14	6259060.67	97
R.026	NCA03_Residential	331647.38	6259047.11	93
R.027	NCA03_Commercial	331343.96	6259043.22	104
R.028	NCA03_Residential	331585.63	6259042.83	100
R.029	NCA03_Commercial	331533.78	6259036.41	97
R.030	NCA03_Commercial	331757.71	6259028.11	90
R.031	NCA03_Commercial	331469.22	6259023.95	99
R.032	NCA03_Commercial	331715.90	6259011.59	92
R.033	NCA03_Commercial	331431.76	6259010.89	101
R.034	NCA03_Commercial	331327.36	6259004.70	106
R.035	NCA03_Commercial	331537.34	6258992.47	98
R.036	NCA03_Commercial	331406.21	6258990.76	103
R.037	NCA03_Commercial	331645.14	6258985.60	96
R.038	NCA03_Commercial	331592.73	6258976.43	100
R.039	NCA03_Commercial	331896.52	6258973.09	88
R.040	NCA03_Commercial	331387.53	6258971.90	104
R.041	NCA03_Commercial	331503.89	6258965.85	101
R.042	NCA03_Commercial	331786.57	6258962.50	90
R.043	NCA03_Commercial	331866.66	6258960.29	88
R.044	NCA03_Commercial	331533.01	6258940.84	101
R.045	NCA03_Commercial	331773.23	6258935.76	92
R.046	NCA03_Commercial	331821.30	6258930.38	90
R.047	NCA03_Commercial	331312.16	6258930.23	108

Table A.1		GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
Location ID	Description (NCA_Receptor Type)	Easting	Northing	
R.048	NCA03_Commercial	331695.13	6258924.53	95
R.049	NCA03_Commercial	331587.35	6258920.72	100
R.050	NCA03_Commercial	331466.04	6258918.36	104
R.051	NCA03_Commercial	331847.09	6258916.54	89
R.052	NCA03_Commercial	331646.40	6258908.67	98
R.053	NCA03_Commercial	331427.99	6258904.46	106
R.054	NCA03_Commercial	331701.28	6258902.45	95
R.055	NCA03_Commercial	331736.56	6258898.00	94
R.056	NCA03_Commercial	331675.29	6258892.18	97
R.057	NCA03_Commercial	331588.30	6258881.16	101
R.058	NCA03_Commercial	331373.52	6258881.01	108
R.059	NCA03_Commercial	331540.75	6258862.45	104
R.060	NCA03_Commercial	331868.10	6258861.83	88
R.061	NCA03_Commercial	331734.25	6258858.25	94
R.062	NCA03_Commercial	331528.50	6258857.31	104
R.063	NCA03_Commercial	331660.80	6258851.98	99
R.064	NCA03_Commercial	331754.98	6258851.07	93
R.065	NCA03_Commercial	331497.52	6258845.22	104
R.066	NCA03_Commercial	331424.53	6258838.85	107
R.067	NCA03_Commercial	331967.16	6258832.36	88
R.068	NCA03_Commercial	331641.32	6258828.65	100
R.069	NCA03_Commercial	331572.06	6258825.33	102
R.070	NCA03_Commercial	331718.19	6258821.53	95
R.071	NCA03_Commercial	331413.76	6258812.87	107
R.072	NCA03_Commercial	331403.75	6258809.18	108
R.073	NCA03_Commercial	331528.33	6258808.82	103
R.074	NCA03_Commercial	331386.85	6258804.38	108
R.075	NCA03_Commercial	331898.30	6258802.73	88
R.076	NCA03_Commercial	331674.98	6258799.42	97
R.077	NCA03_Commercial	331596.01	6258789.40	100
R.078	NCA03_Commercial	331648.51	6258789.04	98
R.079	NCA03_Commercial	331692.47	6258788.90	96
R.080	NCA03_Commercial	331582.63	6258781.57	100
R.081	NCA03_Commercial	331830.23	6258776.77	90
R.082	NCA03_Commercial	331463.81	6258771.73	104
R.083	NCA03_Commercial	331552.91	6258766.25	100
R.084	NCA03_Commercial	331415.20	6258762.38	106
R.085	NCA03_Commercial	331523.10	6258757.30	100
R.086	NCA03_Commercial	331507.60	6258751.00	100
R.087	NCA03_Commercial	331470.12	6258738.04	103
R.088	NCA03_Commercial	331666.32	6258734.68	95
R.089	NCA03_Commercial	331709.50	6258726.57	94
R.090	NCA03_Commercial	331582.06	6258721.42	98
R.091	NCA03_Commercial	331562.57	6258717.42	98
R.092	NCA03_Commercial	331423.17	6258716.70	106
R.093	NCA04_Commercial	331809.33	6258716.20	90
R.094	NCA04_Commercial	331775.54	6258703.98	91

Table A.1 Location ID	Description (NCA_Receptor Type)	GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
		Easting	Northing	
R.095	NCA01_Commercial	331720.48	6258702.01	93
R.096	NCA03_Commercial	331581.25	6258699.32	98
R.097	NCA03_Commercial	331493.27	6258690.44	102
R.098	NCA01_Commercial	331531.60	6258687.45	100
R.099	NCA03_Commercial	331469.67	6258711.33	103
R.100	NCA02_Commercial	331445.17	6258676.95	105
R.101	NCA03_Commercial	331456.13	6258705.92	104
R.102	NCA01_Residential	331730.63	6258667.45	92
R.103	NCA02_Commercial	331450.64	6258664.22	104
R.104	NCA01_Commercial	331545.59	6258662.97	99
R.105	NCA01_Commercial	331517.61	6258650.98	101
R.106	NCA02_Commercial	331457.80	6258647.48	104
R.107	NCA01_Educational	331739.97	6258642.97	92
R.108	NCA01_Residential	331589.30	6258638.02	97
R.109	NCA04_Residential	331780.12	6258635.48	91
R.110	NCA01_Commercial	331462.66	6258629.00	103
R.111	NCA01_Residential	331755.07	6258621.35	92
R.112	NCA01_Residential	331569.19	6258616.97	98
R.113	NCA01_Residential	331519.17	6258601.32	100
R.114	NCA01_Residential	331590.80	6258601.10	96
R.115	NCA01_Residential	331476.71	6258600.56	102
R.116	NCA01_Residential	331551.86	6258599.28	98
R.117	NCA01_Recreational	331638.65	6258595.71	94
R.118	NCA02_Commercial	331417.04	6258589.24	103
R.119	NCA01_Residential	331485.57	6258576.55	101
R.120	NCA02_Residential	331278.01	6258572.03	95
R.121	NCA04_Residential	331770.88	6258563.76	93
R.122	NCA01_Residential	331592.85	6258557.68	96
R.123	NCA01_Residential	331495.48	6258557.64	100
R.124	NCA01_Recreational	331634.66	6258548.49	94
R.125	NCA01_Recreational	331695.82	6258544.37	93
R.126	NCA01_Residential	331543.83	6258544.34	98
R.127	NCA01_Recreational	331634.84	6258530.73	94
R.128	NCA01_Residential	331584.56	6258527.40	96
R.129	NCA04_Residential	331809.21	6258504.14	95
R.130	NCA04_Residential	331865.42	6258503.80	94
R.131	NCA04_Residential	331771.53	6258501.29	94
R.132	NCA01_Residential	331499.02	6258497.55	98
R.133	NCA01_Residential	331525.93	6258486.46	96
R.134	NCA01_Recreational	331590.78	6258475.52	96
R.135	NCA02_Residential	331461.22	6258457.11	96
R.136	NCA01_Residential	331535.48	6258457.02	96
R.137	NCA01_Residential	331715.56	6258443.03	96
R.138	NCA01_Residential	331537.04	6258442.07	96
R.139	NCA02_Residential	331324.35	6258440.28	88
R.140	NCA01_Residential	331539.22	6258429.29	96
R.141	NCA01_Residential	331678.46	6258414.74	97

Table A.1 Location ID	Description (NCA_Receptor Type)	GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
		Easting	Northing	
R.142	NCA01_Residential	331540.46	6258414.33	96
R.143	NCA01_Residential	331704.15	6258398.93	98
R.144	NCA01_Residential	331642.28	6258390.32	97
R.145	NCA01_Residential	331538.59	6258379.12	97
R.146	NCA01_Residential	331703.90	6258377.92	99
R.147	NCA01_Residential	331685.79	6258367.65	99
R.148	NCA01_Commercial	331594.26	6258361.09	97
R.149	NCA01_Residential	331656.33	6258356.57	99
R.150	NCA01_Residential	331727.15	6258342.78	101
R.151	NCA01_Residential	331704.99	6258334.94	101
R.152	NCA01_Residential	331642.28	6258330.50	99
R.153	NCA01_Residential	331673.09	6258323.86	101
R.154	NCA01_Residential	331712.01	6258314.40	102
R.155	NCA04_Residential	331812.10	6258307.23	105
R.156	NCA01_Residential	331687.69	6258304.94	102
R.157	NCA01_Residential	331599.87	6258301.85	99
R.158	NCA01_Residential	331674.98	6258299.26	101
R.159	NCA01_Residential	331660.66	6258294.40	101
R.160	NCA02_Residential	331469.34	6258286.02	100
R.161	NCA01_Residential	331573.16	6258285.57	99
R.162	NCA05_Residential	332035.65	6258279.61	104
R.163	NCA01_Residential	331601.36	6258269.11	100
R.164	NCA01_Residential	331527.58	6258267.33	100
R.165	NCA01_Residential	331645.82	6258267.03	100
R.166	NCA02_Residential	331277.34	6258261.52	104
R.167	NCA01_Residential	331688.66	6258259.21	103
R.168	NCA01_Residential	331546.35	6258247.75	100
R.169	NCA01_Commercial	331522.35	6258238.02	100
R.170	NCA01_Residential	331649.22	6258226.31	101
R.171	NCA01_Residential	331690.13	6258224.30	104
R.172	NCA01_Residential	331676.07	6258219.60	103
R.173	NCA01_Commercial	331520.62	6258218.83	100
R.174	NCA01_Residential	331662.47	6258213.22	103
R.175	NCA01_Residential	331608.98	6258205.77	102
R.176	NCA01_Residential	331517.87	6258196.66	101
R.177	NCA01_Residential	331673.74	6258192.79	104
R.178	NCA05_Mixed Use	331747.75	6258110.89	106
R.179	NCA01_Residential	331658.41	6258179.98	102
R.180	NCA01_Residential	331560.87	6258173.24	101
R.181	NCA01_Residential	331670.89	6258171.66	104
R.182	NCA01_Residential	331547.37	6258167.70	101
R.183	NCA01_Commercial	331517.60	6258165.97	102
R.184	NCA01_Residential	331533.53	6258160.78	102
R.185	NCA01_Residential	331669.46	6258159.38	104
R.186	NCA01_Residential	331668.32	6258147.67	104
R.187	NCA05_Residential	331672.60	6258133.67	104
R.188	NCA02_Mixed Use	331450.25	6258079.47	104

Table A.1 Location ID	Description (NCA_Receptor Type)	GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
		Easting	Northing	
R.189	NCA02_Residential	331340.24	6258115.87	106
R.190	NCA05_Residential	331717.51	6258130.24	106
R.191	NCA04_Residential	331850.00	6258097.81	97
R.192	NCA04_Residential	332117.22	6258065.80	84
R.193	NCA05_Residential	331712.47	6258062.88	106
R.194	NCA05_Residential	331764.81	6258125.64	106
R.195	NCA05_Residential	331695.60	6258049.39	104
R.196	NCA05_Residential	331721.55	6258037.97	106
R.197	NCA05_Residential	331715.84	6258025.26	105
R.198	NCA05_Residential	331652.01	6258020.79	104
R.199	NCA01_Residential	331759.95	6258011.51	104
R.200	NCA05_Residential	331633.73	6258011.15	104
R.201	NCA01_Residential	331743.61	6258001.39	103
R.202	NCA05_Residential	331709.10	6257999.31	101
R.203	NCA04_Residential	331885.98	6257989.24	100
R.204	NCA05_Industrial	331600.49	6257986.22	104
R.205	NCA01_Residential	331755.10	6257983.08	101
R.206	NCA01_Residential	331744.84	6257976.33	100
R.207	NCA01_Residential	331736.92	6257971.52	100
R.208	NCA05_Residential	331669.95	6257970.60	102
R.209	NCA01_Residential	331729.65	6257966.72	99
R.210	NCA01_Residential	331771.85	6257957.37	98
R.211	NCA01_Residential	331679.59	6257950.66	100
R.212	NCA01_Residential	331728.87	6257949.97	96
R.213	NCA05_Industrial	331622.09	6257945.34	102
R.214	NCA01_Residential	331813.16	6257942.85	96
R.215	NCA01_Residential	331802.80	6257936.81	96
R.216	NCA01_Residential	331688.90	6257932.05	97
R.217	NCA01_Residential	331792.60	6257930.07	95
R.218	NCA05_Industrial	331583.54	6257925.40	104
R.219	NCA01_Industrial	331633.73	6257925.40	100
R.220	NCA01_Residential	331782.58	6257923.33	93
R.221	NCA01_Residential	331823.72	6257921.36	94
R.222	NCA01_Residential	331772.21	6257917.11	93
R.223	NCA05_Residential	331329.65	6257916.59	104
R.224	NCA01_Residential	331811.83	6257914.08	93
R.225	NCA05_Place of Worship	331461.40	6257913.94	104
R.226	NCA01_Residential	331747.50	6257912.79	92
R.227	NCA01_Residential	331642.70	6257911.11	98
R.228	NCA01_Residential	331762.36	6257910.71	92
R.229	NCA01_Residential	331799.64	6257906.35	92
R.230	NCA01_Residential	331774.67	6257890.75	90
R.231	NCA01_Residential	331713.49	6257886.51	92
R.232	NCA01_Residential	331768.71	6257872.94	88
R.233	NCA01_Residential	331855.55	6257870.82	90
R.234	NCA04_Residential	331937.37	6257867.19	98
R.235	NCA01_Residential	331843.34	6257863.26	88

Table A.1 Location ID	Description (NCA_Receptor Type)	GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
		Easting	Northing	
R.236	NCA04_Residential	332084.42	6257858.56	93
R.237	NCA01_Residential	331831.13	6257855.70	87
R.238	NCA01_Residential	331869.21	6257854.17	90
R.239	NCA01_Residential	331733.77	6257849.62	88
R.240	NCA01_Residential	331818.91	6257848.14	86
R.241	NCA01_Residential	331858.60	6257847.47	89
R.242	NCA01_Residential	331785.57	6257843.48	86
R.243	NCA01_Residential	331677.26	6257843.31	92
R.244	NCA01_Residential	331849.66	6257841.88	87
R.245	NCA01_Residential	331805.53	6257839.80	85
R.246	NCA01_Residential	331839.23	6257835.18	86
R.247	NCA01_Residential	331829.54	6257828.47	85
R.248	NCA01_Residential	331820.23	6257822.33	84
R.249	NCA01_Residential	331929.02	6257815.80	92
R.250	NCA01_Residential	331754.04	6257815.06	87
R.251	NCA01_Residential	331811.29	6257805.01	84
R.252	NCA01_Residential	331900.82	6257804.42	89
R.253	NCA01_Residential	331705.18	6257799.77	90
R.254	NCA01_Residential	331890.67	6257796.84	88
R.255	NCA01_Residential	331667.63	6257793.12	93
R.256	NCA01_Residential	331882.33	6257789.57	86
R.257	NCA01_Residential	331773.60	6257785.12	86
R.258	NCA01_Residential	331908.40	6257782.19	88
R.259	NCA01_Residential	331873.08	6257781.84	85
R.260	NCA01_Residential	331781.08	6257774.75	85
R.261	NCA01_Residential	331863.68	6257773.95	83
R.262	NCA01_Residential	331725.12	6257769.52	90
R.263	NCA01_Residential	331888.80	6257767.65	84
R.264	NCA01_Residential	331855.20	6257766.98	82
R.265	NCA01_Residential	331840.76	6257765.61	82
R.266	NCA01_Residential	331788.31	6257765.10	85
R.267	NCA04_Residential	332070.98	6257759.91	85
R.268	NCA01_Residential	331686.90	6257759.55	93
R.269	NCA01_Residential	331968.20	6257756.70	88
R.270	NCA01_Residential	331795.55	6257754.97	84
R.271	NCA02_Residential	331564.72	6257755.15	102
R.272	NCA01_Residential	331805.92	6257740.02	83
R.273	NCA01_Residential	331745.73	6257738.28	89
R.274	NCA01_Residential	331887.32	6257731.14	80
R.275	NCA02_Residential	331643.46	6257729.23	95
R.276	NCA01_Residential	331911.07	6257709.17	80
R.277	NCA01_Residential	331769.33	6257703.82	86
R.278	NCA01_Residential	331767.14	6257682.99	85
R.279	NCA01_Residential	331921.46	6257697.60	79
R.280	NCA01_Residential	331929.17	6257688.40	78
R.281	NCA01_Residential	331809.70	6257697.04	82
R.282	NCA01_Residential	331826.49	6257679.79	81

Table A.1		GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
Location ID	Description (NCA_Receptor Type)	Easting	Northing	
R.283	NCA01_Residential	331937.78	6257678.60	78
R.284	NCA01_Residential	331945.80	6257670.29	77
R.285	NCA01_Mixed Use	331843.44	6257665.16	80
R.286	NCA01_Residential	331955.00	6257663.16	76
R.287	NCA01_Mixed Use	331852.75	6257656.52	80
R.288	NCA01_Residential	331962.42	6257655.15	76
R.289	NCA01_Residential	331969.54	6257648.92	76
R.290	NCA01_Residential	331974.88	6257642.68	76
R.291	NCA02_Residential	331689.33	6257637.73	87
R.292	NCA01_Residential	331788.27	6257635.58	83
R.293	NCA01_Residential	331973.99	6257633.78	76
R.294	NCA01_Mixed Use	331872.97	6257633.59	80
R.295	NCA01_Residential	332050.43	6257629.51	74
R.296	NCA01_Commercial	331991.11	6257621.80	76
R.297	NCA01_Mixed Use	331880.56	6257626.12	80
R.298	NCA02_Residential	331495.82	6257620.65	101
R.299	NCA01_Commercial	332021.48	6257662.43	76
R.300	NCA01_Mixed Use	331889.94	6257614.72	81
R.301	NCA01_Residential	332061.32	6257603.73	74
R.302	NCA01_Mixed Use	331902.86	6257602.22	82
R.303	NCA01_Mixed Use	331914.39	6257594.69	82
R.304	NCA01_Residential	331823.39	6257593.85	87
R.305	NCA01_Mixed Use	331920.83	6257588.71	82
R.306	NCA01_Mixed Use	331927.49	6257582.72	82
R.307	NCA02_Residential	331599.77	6257582.25	96
R.308	NCA01_Mixed Use	331932.10	6257578.85	82
R.309	NCA01_Mixed Use	331937.04	6257574.68	82
R.310	NCA01_Mixed Use	331942.24	6257570.30	82
R.311	NCA01_Residential	332084.32	6257577.55	73
R.312	NCA01_Residential	331861.60	6257562.08	90
R.313	NCA02_Residential	331766.52	6257556.62	94
R.314	NCA01_Commercial	331963.61	6257556.66	82
R.315	NCA01_Residential	332119.38	6257549.65	72
R.316	NCA01_Residential	332141.65	6257542.49	70
R.317	NCA01_Mixed Use	331977.10	6257542.40	83
R.318	NCA01_Residential	332156.02	6257539.63	69
R.319	NCA01_Commercial	331934.69	6257538.47	85
R.320	NCA01_Residential	332171.51	6257537.75	69
R.321	NCA01_Residential	332187.01	6257535.87	68
R.322	NCA01_Residential	331820.98	6257535.53	94
R.323	NCA01_Mixed Use	331987.46	6257534.44	84
R.324	NCA01_Residential	332201.10	6257532.58	68
R.325	NCA01_Residential	332217.54	6257529.77	68
R.326	NCA01_Mixed Use	331997.86	6257526.70	83
R.327	NCA02_Residential	331713.60	6257524.67	95
R.328	NCA01_Mixed Use	332005.72	6257521.11	83
R.329	NCA01_Residential	331912.15	6257520.91	90

Table A.1 Location ID	Description (NCA_Receptor Type)	GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
		Easting	Northing	
R.330	NCA01_Mixed Use	332010.22	6257517.91	82
R.331	NCA02_Residential	331792.43	6257515.02	98
R.332	NCA01_Mixed Use	332014.46	6257514.89	82
R.333	NCA01_Residential	332327.30	6257514.52	72
R.334	NCA01_Mixed Use	332018.68	6257511.91	82
R.335	NCA01_Mixed Use	332022.86	6257508.95	82
R.336	NCA01_Mixed Use	332030.62	6257503.87	82
R.337	NCA01_Mixed Use	332041.98	6257496.69	81
R.338	NCA04_Residential	332463.49	6257494.60	76
R.339	NCA01_Residential	331874.49	6257490.79	94
R.340	NCA02_Residential	331744.57	6257488.08	98
R.341	NCA01_Mixed Use	332068.64	6257481.77	80
R.342	NCA01_Residential	332254.17	6257480.92	68
R.343	NCA04_Residential	332567.19	6257480.15	73
R.344	NCA01_Residential	332271.50	6257472.69	66
R.345	NCA01_Residential	331973.90	6257470.46	90
R.346	NCA01_Residential	332290.19	6257465.21	66
R.347	NCA01_Residential	332103.42	6257461.87	81
R.348	NCA02_Residential	331819.52	6257458.41	98
R.349	NCA01_Residential	332310.37	6257456.98	66
R.350	NCA01_Residential	332325.55	6257453.72	66
R.351	NCA01_Residential	332111.33	6257451.73	81
R.352	NCA01_Residential	332351.35	6257449.81	64
R.353	NCA01_Residential	332366.98	6257447.47	67
R.354	NCA01_Residential	332128.12	6257447.43	80
R.355	NCA01_Residential	332381.83	6257445.12	68
R.356	NCA01_Residential	332395.61	6257444.27	68
R.357	NCA02_Residential	331908.38	6257444.10	93
R.358	NCA01_Residential	332410.94	6257442.03	68
R.359	NCA01_Place of Worship	332181.59	6257440.19	78
R.360	NCA01_Residential	332424.77	6257439.41	68
R.361	NCA02_Residential	331834.96	6257438.83	97
R.362	NCA01_Residential	332441.97	6257437.17	68
R.363	NCA02_Residential	331785.26	6257435.82	100
R.364	NCA01_Residential	332456.17	6257435.30	68
R.365	NCA01_Residential	332472.25	6257433.43	68
R.366	NCA01_Residential	332486.08	6257430.44	68
R.367	NCA01_Residential	332148.66	6257429.46	80
R.368	NCA01_Residential	332502.90	6257428.57	68
R.369	NCA04_Residential	332794.43	6257426.48	69
R.370	NCA01_Residential	332516.73	6257425.96	68
R.371	NCA01_Residential	332199.23	6257425.17	78
R.372	NCA02_Residential	331797.68	6257424.90	99
R.373	NCA01_Residential	332532.06	6257424.09	69
R.374	NCA01_Residential	332547.76	6257421.84	69
R.375	NCA02_Residential	331763.42	6257420.38	100
R.376	NCA01_Residential	332562.72	6257419.23	69

Table A.1 Location ID	Description (NCA_Receptor Type)	GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
		Easting	Northing	
R.377	NCA04_Residential	332578.04	6257416.61	69
R.378	NCA04_Residential	332591.50	6257414.37	69
R.379	NCA01_Residential	332121.07	6257413.10	84
R.380	NCA04_Residential	332607.58	6257412.87	69
R.381	NCA02_Residential	331848.51	6257412.85	95
R.382	NCA01_Residential	332222.53	6257412.53	76
R.383	NCA04_Residential	332621.78	6257410.63	68
R.384	NCA02_Residential	331956.56	6257409.21	91
R.385	NCA04_Residential	332637.11	6257408.76	68
R.386	NCA01_Residential	332245.22	6257399.35	74
R.387	NCA01_Residential	332262.63	6257389.35	74
R.388	NCA02_Residential	331808.98	6257383.48	94
R.389	NCA04_Residential	332877.83	6257368.05	78
R.390	NCA01_Residential	332256.50	6257365.82	76
R.391	NCA01_Residential	332325.49	6257361.31	76
R.392	NCA01_Residential	332269.40	6257356.15	77
R.393	NCA01_Residential	332319.05	6257349.06	77
R.394	NCA01_Residential	332312.28	6257336.48	77
R.395	NCA01_Residential	332274.88	6257336.16	78
R.396	NCA02_Educational	332006.82	6257335.40	90
R.397	NCA01_Residential	332343.40	6257329.13	77
R.398	NCA01_Residential	332307.44	6257327.13	78
R.399	NCA01_Residential	332278.43	6257324.88	80
R.400	NCA01_Residential	332352.50	6257323.63	78
R.401	NCA04a_Residential	332869.44	6257321.05	71
R.402	NCA01_Residential	332363.50	6257317.49	78
R.403	NCA01_Residential	332290.03	6257308.76	81
R.404	NCA01_Residential	332381.69	6257307.76	78
R.405	NCA01_Residential	332400.09	6257299.94	78
R.406	NCA01_Residential	332421.74	6257288.32	78
R.407	NCA01_Residential	332447.03	6257272.97	78
R.408	NCA01_Residential	332350.02	6257268.42	82
R.409	NCA01_Residential	332466.70	6257260.72	78
R.410	NCA01_Residential	332481.85	6257251.05	78
R.411	NCA01_Residential	332496.03	6257241.38	76
R.412	NCA01_Residential	332512.15	6257233.32	74
R.413	NCA04a_Residential	332854.50	6257226.19	56
R.414	NCA02_Residential	332282.48	6257223.95	86
R.415	NCA01a_Residential	332492.81	6257217.85	74
R.416	NCA01a_Residential	332534.72	6257212.37	72
R.417	NCA01a_Residential	332546.97	6257201.73	70
R.418	NCA01a_Residential	332554.71	6257188.83	69
R.419	NCA02a_Residential	332317.97	6257172.83	79
R.420	NCA02a_Residential	332360.64	6257101.41	71
R.421	NCA04a_Residential	332861.55	6257120.95	54
R.422	NCA01a_Residential	332749.73	6257108.72	57
R.423	NCA04a_Residential	332857.74	6257108.41	55

Table A.1 Location ID	Description (NCA_Receptor Type)	GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
		Easting	Northing	
R.424	NCA01a_Residential	332834.29	6257098.59	57
R.425	NCA01a_Residential	332852.83	6257091.50	57
R.426	NCA01a_Residential	332791.94	6257080.69	60
R.427	NCA01a_Residential	332849.01	6257080.60	58
R.428	NCA01a_Residential	332755.11	6257079.43	60
R.429	NCA01a_Residential	332846.83	6257070.78	59
R.430	NCA01a_Residential	332764.67	6257049.55	63
R.431	NCA01a_Residential	332839.97	6257046.67	62
R.432	NCA01a_Commercial	332641.39	6257035.93	61
R.433	NCA01a_Residential	332814.55	6257034.88	64
R.434	NCA01a_Residential	332773.64	6257028.62	64
R.435	NCA01a_Residential	332833.35	6257026.07	65
R.436	NCA01a_Commercial	332596.30	6257022.67	61
R.437	NCA01_Residential	332845.31	6257006.22	66
R.438	NCA01a_Commercial	332660.31	6257005.41	67
R.439	NCA01a_Industrial	332713.51	6257001.99	70
R.440	NCA02a_Commercial	332557.32	6256998.79	63
R.441	NCA01_Residential	332789.18	6256992.16	68
R.442	NCA01_Residential	332854.72	6256991.72	67
R.443	NCA01_Residential	332835.43	6256982.12	69
R.444	NCA01_Residential	332860.83	6256981.29	68
R.445	NCA01a_Commercial	332681.05	6256975.86	70
R.446	NCA01_Residential	332867.44	6256971.63	69
R.447	NCA01_Residential	332798.75	6256971.24	70
R.448	NCA02a_Commercial	332499.53	6256965.11	68
R.449	NCA01_Residential	332873.04	6256960.94	70
R.450	NCA01a_Commercial	332636.00	6256958.62	67
R.451	NCA01_Residential	332878.64	6256952.80	70
R.452	NCA01_Residential	332804.13	6256949.72	71
R.453	NCA01_Commercial	332696.26	6256948.10	73
R.454	NCA01_Residential	332834.85	6256944.43	72
R.455	NCA01_Residential	332883.98	6256944.15	71
R.456	NCA01_Residential	332810.10	6256932.98	73
R.457	NCA01_Residential	332891.10	6256932.96	72
R.458	NCA02a_Commercial	332593.73	6256931.89	69
R.459	NCA01_Residential	332896.44	6256925.07	73
R.460	NCA01_Residential	332842.39	6256924.72	74
R.461	NCA01_Residential	332901.78	6256915.41	74
R.462	NCA01_Residential	332813.09	6256915.05	75
R.463	NCA01_Residential	332849.34	6256906.74	75
R.464	NCA01_Residential	332907.13	6256906.25	75
R.465	NCA01_Commercial	332726.00	6256901.83	77
R.466	NCA02_Commercial	332533.98	6256896.72	74
R.467	NCA01_Residential	332914.99	6256895.73	75
R.468	NCA01_Residential	332886.09	6256894.37	76
R.469	NCA01_Residential	332819.07	6256891.14	77
R.470	NCA01_Residential	332875.97	6256888.22	77

Table A.1		GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
Location ID	Description (NCA_Receptor Type)	Easting	Northing	
R.471	NCA01_Residential	332859.20	6256888.19	77
R.472	NCA01_Residential	332863.31	6256879.55	77
R.473	NCA01_Residential	332850.83	6256873.53	78
R.474	NCA01_Residential	332824.45	6256873.21	78
R.475	NCA01_Residential	332901.27	6256868.34	77
R.476	NCA01_Residential	332840.97	6256866.59	78
R.477	NCA01_Residential	332890.79	6256864.36	78
R.478	NCA02_Commercial	332479.05	6256862.13	74
R.479	NCA01_Residential	332876.33	6256852.80	79
R.480	NCA01_Residential	332828.04	6256841.52	80
R.481	NCA01_Commercial	332766.27	6256836.79	79
R.482	NCA01_Residential	332846.68	6256833.64	80
R.483	NCA01_Commercial	332686.81	6256817.30	78
R.484	NCA01_Residential	332832.22	6256808.65	81
R.485	NCA01_Recreational	332838.37	6256768.92	83
R.486	NCA01_Commercial	332700.05	6256765.43	78
R.487	NCA01_Commercial	332768.86	6256668.04	76
R.488	NCA01_Commercial	332770.44	6256616.69	77
R.489	NCA01_Commercial	332779.86	6256557.67	77
R.490	NCA01_Residential	332854.36	6256511.84	76
R.491	NCA01_Commercial	332795.39	6256484.37	76
R.492	NCA01_Residential	332854.72	6256419.66	74
R.493	NCA01_Recreational	332963.49	6256396.54	68
R.494	NCA01_Residential	332810.92	6256389.94	78
R.495	NCA01_Residential	332864.92	6256367.99	76
R.496	NCA01_Residential	332886.67	6256344.20	75
R.497	NCA01_Residential	332971.65	6256316.33	66
R.498	NCA01_Residential	332915.23	6256314.97	74
R.499	NCA01_Residential	332825.21	6256308.57	78
R.500	NCA01_Residential	332955.33	6256286.41	66
R.501	NCA01_Hospital	332771.97	6256274.48	83
R.502	NCA04_Residential	333031.43	6256271.73	74
R.503	NCA01_Commercial	332944.56	6256270.95	67
R.504	NCA01_Residential	332830.80	6256260.73	78
R.505	NCA04_Residential	333020.10	6256259.33	74
R.506	NCA04_Residential	333010.89	6256243.76	76
R.507	NCA01_Commercial	332919.25	6256237.74	68
R.508	NCA01_Commercial	332893.07	6256234.91	74
R.509	NCA01_Residential	332992.79	6256233.42	74
R.510	NCA01_Residential	332979.08	6256218.72	74
R.511	NCA01_Residential	332832.67	6256212.90	78
R.512	NCA01_Residential	332975.04	6256205.67	75
R.513	NCA01_Commercial	332921.68	6256194.36	71
R.514	NCA01_Residential	332978.21	6256189.47	76
R.515	NCA01_Residential	332980.07	6256176.05	77
R.516	NCA01_Hospital	332788.60	6256174.71	81
R.517	NCA01_Residential	332838.88	6256171.28	77

Table A.1	Description (NCA_Receptor Type)	GPS Co-ordinates (Zone 56H)		Ground Height (AHD) m
Location ID		Easting	Northing	
R.518	NCA01_Commercial	332924.58	6256166.33	73
R.519	NCA01_Residential	332982.31	6256162.26	78
R.520	NCA06_Commercial	332923.01	6256142.60	75
R.521	NCA06_Residential	332845.71	6256125.31	74
R.522	NCA06_Commercial	332990.11	6256124.44	79
R.523	NCA06_Commercial	332996.04	6256099.56	80
R.524	NCA06_Residential	332908.45	6256088.03	76
R.525	NCA06_Residential	332847.57	6256078.71	74
R.526	NCA06_Commercial	332969.99	6256069.92	80
R.527	NCA06_Commercial	333001.38	6256056.61	82
R.528	NCA06_Commercial	332888.38	6256012.19	76
R.529	NCA06_Commercial	332820.53	6256002.03	76
R.530	NCA06_Commercial	333006.16	6256012.39	84

1. All GPS coordinates are in UTM, Zone 56H

2. Australian Height Datum in metres (m).

Appendix B – Noise Monitoring Report Template

Sydney Metro City and Southwest – Northern Corridor Works
Technical Report - Noise Monitoring – [DESCRIPTION]**Project**

Title	Technical Report – Noise Monitoring
Client	Sydney Metro City and Southwest
Document Reference No.	LOR-NCW-Noise Monitoring_template.docx
Laing O'Rourke Project No.	K38

Document

Date	14 August 2018
Monitoring Period	[DAY], [DAY] [MONTH] to [DAY], [DAY] [MONTH]
Prepared by:	[NAME]
Reviewed by:	[NAME]

Revisions

Date	Version	Description
DD/MM/YY	V.0X	Technical Report - Noise Monitoring – [XXX]

1. OVERVIEW

[PROVIDE OVERVIEW OF PROJECT, ACTIVITIES AND MONITORING]

A summary of the works and any complaints is provided in **Section 2**, with a summary of the resultant noise levels (and any recommendations) provided in **Section 3**. The noise monitoring methodology is documented in **Appendix A**, with the detailed noise data set provided in **Appendix B**.

[INSERT OTHER RELEVANT INFORMATION]

2. SUMMARY OF [XXX] WORKS [EXAMPLE ONLY]

[PROVIDE OVERVIEW OF WORKS, ACTIVITIES AND EQUIPMENT]

The plant and equipment listed for use in OOHWAF- [XXX] are reproduced below, and generally aligned with that observed to be in use on site during the works:

- 1 x Lighting towers (battery powered).
- 2 x Blowtorch and welding equipment.
- 3 x Multi Cranes
- 4 x Vehicle light commercial
- General hand tools (multiple, various types).

Further detail of the [XXX] work, specified management measures and other mitigation is provided in OOHWAF- [XXX], which also noted that given the mid-week nights track possession and safe access to the rail corridor and [XXX] Road Bridge, other works were being undertaken by other stakeholders. These works were observed and were noted to generate similar impacts to that of the works conducted by LOR.

[INSERT OTHER RELEVANT INFORMATION]

2.1 Summary of Complaints

[PROVIDE SUMMARY OF COMPLAINTS, IF ANY]

3. MONITORING SUMMARY ([XXX] WORKS)

Table 1 presents a summary of the highest measured site noise levels. The full noise data set presenting the measured overall and site Leq, 15minute noise level contributions in dBA is provided in **Appendix B** of this technical report.

[INSERT OTHER RELEVANT INFORMATION]

EXAMPLE TEST PROVIDED IN TABLE 1

TABLE 1 – NOISE MONITORING SUMMARY

ID	Item	Results	Discussion																																						
1	Operator Attended Noise Monitoring	<p>A qualified and suitably experienced operator visited community areas surrounding the [XXX] works from DD-MONTH-YY to DD-MONTH-YY and completed operator attended noise measurements at a total of [XXX] publically accessible locations adjacent to the rail corridor; refer Figure A1.X to A1.X of Appendix A. A total of [XXX] noise measurements (each of 15 minutes duration) were conducted. The closest receptors were targeted for monitoring, with actual measurement locations selected based on the position of site works and the potentially most affected receptors.</p> <p>Overall noise levels (L_{max}, L_{min}, L_{eq}, L_1, L_{10} and L_{90} in dBA) were measured at all locations; refer Appendix B. Based on the measured overall values and observations made during each operator attended noise measurement a site $L_{eq, 15\text{minute}}$ noise level contribution (in dBA) was determined in the absence of any influential source not associated with the project. The five highest values (and comparison to the noise management levels (NML) identified in the CNVIS) are presented below in Table 1.1.</p> <p>[INSERT OTHER RELEVANT INFORMATION]</p> <p>Table 1.1 – Site Noise Level Assessment</p> <table border="1"> <thead> <tr> <th colspan="3">Measurement Details</th> <th rowspan="2">Construction Activity at the Time of Measurement</th> <th colspan="3">NML vs. Measured Assessment ($L_{eq, 15\text{ minute}}$ in dBA)</th> </tr> <tr> <th>Location</th> <th>Date</th> <th>Start Time (24 Hr)</th> <th>Noise Management Level (NML)</th> <th>Measured Site Noise Level Contribution</th> <th>Comparison Δ (Meas. – NML)</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td rowspan="4">[XXX]</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>1. All noise levels are expressed in dB(A) re 2×10^{-5} Pa.</p> <p>2. Measured site noise levels include consideration of INP penalties for offensive noise characteristics.</p>	Measurement Details			Construction Activity at the Time of Measurement	NML vs. Measured Assessment ($L_{eq, 15\text{ minute}}$ in dBA)			Location	Date	Start Time (24 Hr)	Noise Management Level (NML)	Measured Site Noise Level Contribution	Comparison Δ (Meas. – NML)				[XXX]																						<p>The existing noise environment at the majority of community locations near to the [XXX] works was generally dominated by non-project related road traffic on public roads. The highest road traffic noise emissions were associated with the [XXX] Highway, [XXX] Street, [XXX] Avenue and [XXX] Road. Other non-project related emissions included those generated by residences near the measurement position, animals (birds and insects, domestic animals), wind-blown vegetation and aircraft passing overhead.</p> <p>Site noise level contributions ($L_{eq, 15\text{ minute}}$) were XX-XX dBA on DD-MONTH-YY and [XXX]-[XXX] dBA on DD-MONTH-YY depending on the type of construction activity and the duration of noise events that occurred within the sample period.</p> <p>On average¹ site noise level contributions for the [XXX] works were [XXX] dBA above the NML, which is to be expected for the type activities being undertaken. A comparison of site noise levels to the predicted values presented in OOHWAF-[XXX] is provided Appendix B of this report. It indicates that on average¹, actual emissions associated with [XXX] works were [XXX] dBA above the predicted values in OOHWAF-[XXX]. It should be noted that the difference in noise levels is primarily related to the implementation of INP penalties for offensive noise characteristics. It is therefore apparent that these INP penalties need to be considered during the OOHW applications and incorporated into predicted noise impacts.</p> <p>While some noise from construction sites is inevitable, the aim of the CNVMP (and other relevant documents presented in the reference section of this report) is to protect the majority of residences and other sensitive land uses from noise pollution most of the time. It focuses on minimising construction noise impacts, rather than only on achieving numeric noise levels. Accordingly, specific recommendations suitable to the [XXX] work and the magnitude and extend of impacts observed is provided in Section 3.1 of this report.</p>
Measurement Details			Construction Activity at the Time of Measurement	NML vs. Measured Assessment ($L_{eq, 15\text{ minute}}$ in dBA)																																					
Location	Date	Start Time (24 Hr)		Noise Management Level (NML)	Measured Site Noise Level Contribution	Comparison Δ (Meas. – NML)																																			
			[XXX]																																						
1. The logarithmic average of all measured site noise level contributions was calculated.																																									

3.1 Recommendations

Based on the results and findings of the noise monitoring, it is recommended that:

- [XXX]
- [XXX]
- [XXX]
- [XXX]

3.1.1 Closing

[INSERT CLOSING STATEMENTS]

REFERENCES

[INSERT CNVIS REFERENCE]

[INSERT CNVMP REFERENCE]

NSW Environment Protection Authority – NSW Environmental Noise Management – **Industrial Noise Policy (INP)**, January 2000 and relevant application notes

NSW Department of Environment and Climate Change – **NSW Interim Construction Noise Guideline (ICNG)**, July 2009

NSW Government – Sydney Metro **Construction Noise and Vibration Strategy (CNVS)**, August 2017

Standards Australia AS1055–1997™ (AS1055) – **Description and Measurement of Environmental Noise**, Parts 1, 2 and 3

Standards Australia AS IEC 61672.1–2004™ (AS61672) – Electro Acoustics - Sound Level Meters Specifications Monitoring or Standards Australia AS1259.2-1990™ (AS1259) – **Acoustics – Sound Level Meters – Integrating Averaging**

Standards Australia AS/IEC 60942:2004/IEC 60942:2003 (IEC60942) – Australian Standard™ – **Electroacoustics – Sound Calibrators**

APPENDIX A – NOISE MONITORING METHODOLOGY

A summary of the noise monitoring methodology is provided below. The monitoring was conducted with due regard to an in accordance with the CNVMP and other relevant policy, guidelines and standards as listed in the reference section of this report; and as per the construction noise and vibration monitoring program established for [XXX].

1. Overview

[PROVIDE AN OVERVIEW OF THE MONITORING]

1.1 Monitoring Locations

Figure A1.1 to A1.3 identify the monitoring locations referenced in this report and other items of importance e.g. nearby roads. Each monitoring location is described in **Table A1**.

Table A1 – Noise Monitoring Locations

ID	Description	GPS Co-ordinates (Zone 56H)		Ground Height (AHD), metres
		Easting	Northing	

1. AHD = Australian Height Datum not determined during this monitoring event.

2. Technical Requirements

All construction noise monitoring was undertaken in accordance with the “construction noise and vibration monitoring guideline” that is included in Appendix A of the Construction Noise and Vibration Strategy (CNVS) and outlines the minimum requirements for contractors undertaking monitoring on the Sydney Metro Project.

[INSERT OTHER RELEVANT INFORMATION]

2.1 Noise Monitoring Equipment

All noise measurements were conducted by suitably experienced and qualified personnel with due regard to, and in accordance with, the relevant local and international standards for environmental monitoring.

The noise measurement instrumentation used to conduct the monitoring complied with the requirements of AS 61672.1 and AS/IEC 60942. Each noise device had current National Association of Testing Authorities, Australia (NATA) calibration certificates, with certification at intervals not exceeding two years at the time of use.

The equipment used for this assessment was as follows:

- 1 x [EXAMPLE]; and
- 1 x [EXAMPLE].

Noise instrument calibration was checked prior to monitoring and again at the conclusion with no difference noted between the two measurements. All data handling and analysis has been completed by a suitably experienced person, and subsequently reviewed by a qualified and experienced acoustician.

2.2 Other requirements

All attended measurements were conducted by appropriately trained personnel in the measurement and assessment of construction noise and vibration. They are familiar with the requirements of the relevant standards and procedures.

The noise measurement procedures employed throughout the monitoring were established in accordance with the requirements of Australian Standard (AS) 1055:1997 *Acoustics - Description and Measurement of Environmental Noise*.

Attended noise measurements were conducted by an operator using a hand held Type 1 'integrating-averaging' sound level meter. All measurements were completed with the sound level meter mounted to a tripod and with a windscreen fitted, at a height of 1.2 to 1.5 metres above the ground.

Instantaneous noise levels for all noted noise emission sources (extraneous or otherwise), meteorological conditions (average and maximum wind speeds, temperature, precipitation and cloud cover etc.) were recorded during all measurements. Relevant measurement parameters i.e. L_{eq} , L_{min} , L_{max} , L_1 , L_{10} and L_{90} were recorded in dBA. All noise samples were recorded using the "fast" time response of the sound level meter.

Noise monitoring was not completed within 3.5 metres of any reflective structure or wall, unless behind a barrier. A reduction of up to 2.5 dB was not applied to the measured ambient or site noise contribution (L_{eq} , 15 minute in dBA) as the barrier was reducing noise emissions from site and in general did not increase noise due to the reflective properties of the surface.

Noise monitoring was not completed during periods where wind speeds exceeded 5 m/s at the microphone. Noise monitoring was conducted during rain events however the rain was very light and had no effect on the measured data.

The general setup of the sound level meter for attended noise measurements was as per **Photo 4.1** of the construction noise and vibration monitoring program established for [XXX], as reproduced below.

[INSERT OTHER RELEVANT INFORMATION]



Photo 4.1: Example Attended Noise Monitoring Setup

[INSERT OTHER RELEVANT INFORMATION]

Figure A1.X - Monitoring Locations

[INSERT FIGURES]

Appendix B – Recorded Noise Data Set

[INSERT DATA]

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Appendix C – Vibration Monitoring Report Template

Sydney Metro City and Southwest – Northern Corridor Works Technical Report - Vibration Monitoring – [DESCRIPTION]

Project

Title	Technical Report – Vibration Monitoring
Client	Sydney Metro City and Southwest
Document Reference No.	NCW-LOR-Vibration Monitoring_template.docx
Laing O'Rourke Contract No.	K38

Document

Date	14 August 2018
Monitoring Period	[DAY], [DAY] [MONTH] to [DAY], [DAY] [MONTH]
Prepared by:	[NAME]
Reviewed by:	[NAME]

Revisions

Date	Version	Description
DD/MM/YY	V.0X	Technical Report - Vibration Monitoring – [XXX]

1. OVERVIEW

[PROVIDE OVERVIEW OF PROJECT, ACTIVITIES AND MONITORING]

A summary of the works and any complaints is provided in **Section 2**, with a summary of the resultant vibration levels (and any recommendations) provided in **Section 3**. The vibration monitoring methodology is documented in **Appendix A**, with the detailed vibration data set provided in **Appendix B**.

[INSERT OTHER RELEVANT INFORMATION]

2. SUMMARY OF [XXX] WORKS [EXAMPLE ONLY]

[PROVIDE OVERVIEW OF WORKS, ACTIVITIES AND EQUIPMENT]

The plant and equipment listed for use in OOHWAF- [XXX] are reproduced below, and generally aligned with that observed to be in use on site during the works:

- 1 x Lighting towers (battery powered).
- 2 x Blowtorch and welding equipment.
- 3 x Multi Cranes
- 4 x Vehicle light commercial
- General hand tools (multiple, various types).

Further detail of the [XXX] work, specified management measures and other mitigation is provided in OOHWAF- [XXX], which also noted that given the mid-week nights track possession and safe access to the rail corridor and [XXX] Road Bridge, other works were being undertaken by other stakeholders. These works were observed and were noted to generate similar impacts to that of the works conducted by LOR.

[INSERT OTHER RELEVANT INFORMATION]

2.1 Summary of Complaints

[PROVIDE SUMMARY OF COMPLAINTS, IF ANY]

3. MONITORING SUMMARY (XXX WORKS)

Table 1 presents a summary of the measured vibration levels. **Appendix A** presents the vibration monitoring methodology. The full vibration data set (measured PPV over time, all relevant data captured during the monitoring period) is provided in **Annex B**.

[INSERT OTHER RELEVANT INFORMATION]

EXAMPLE TEST PROVIDED IN TABLE 1

TABLE 1 – VIBRATION MONITORING SUMMARY

ID	Item	Results	Discussion																																														
1	Vibration Monitoring	<p>XXX visited the areas surrounding XXX site on [DATE] and completed operator attended vibration measurements at [LOCATION]. Refer Figure A1 of Appendix A.</p> <p>Vibration levels in Peak Particle Velocity (PPV, mm/s and Frequency, Hz) were measured. All samples were one minute in duration. The [INSERT] highest vibration levels captured at each location and comparison to the vibration guideline values identified in the CNVMP are presented in Table 1.1, Table 1.2 and Table 1.3.</p>	<p>Vibration events associated with general construction activities and the piling works continue to be mostly imperceptible. Other vibration events associated with the general acoustics environment also remain imperceptible.</p> <p>The measured dataset was dominated by ambient vibration events not associated with the project. A summary of known vibration event data (frequency, Hz) for vibratory piling, impact piling or general construction includes:</p> <ul style="list-style-type: none"> • Vibratory piling typically generates vibration event data in the frequency range of 15 to 25 Hz • Impact piling typically generates vibration event data in the frequency range of 40 to 60 Hz • General construction typically generates vibration event data in the frequency range of 40 to 90 Hz <p>The highest measured vibration levels were: [INSERT] mm/s at [INSERT] Hz at [INSERT] and [INSERT] mm/s at [INSERT] Hz at [INSERT].</p>																																														
		<p>Table 1.1 Site Vibration Level Assessment (Structural Damage)</p> <table border="1" data-bbox="400 635 1612 1136"> <thead> <tr> <th colspan="3">Measurement Details</th> <th colspan="4">Compliance Assessment (Peak Particle Velocity (PPV), mm/s)</th> </tr> <tr> <th rowspan="2">Location</th> <th rowspan="2">Start time (24 hour)¹</th> <th rowspan="2">Construction Activity at the Time of Measurement</th> <th rowspan="2">Limiting Vibration Limit/Criteria¹</th> <th colspan="3">Site Vibration Event</th> </tr> <tr> <th>PPV, mm/s</th> <th>Frequency, Hz</th> <th>Comparison to Criteria</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td rowspan="6">[XXX]</td> <td rowspan="6">15mm/s at 4 Hz increasing to 20mm/s at 15 Hz then 20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above</td> <td></td> <td></td> <td>Comply</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>Comply</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>Comply</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>Comply</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>Comply</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>Comply</td> </tr> </tbody> </table> <p>1. Sample recorded on [DATE]: works (piling) in progress.</p>		Measurement Details			Compliance Assessment (Peak Particle Velocity (PPV), mm/s)				Location	Start time (24 hour) ¹	Construction Activity at the Time of Measurement	Limiting Vibration Limit/Criteria ¹	Site Vibration Event			PPV, mm/s	Frequency, Hz	Comparison to Criteria			[XXX]	15mm/s at 4 Hz increasing to 20mm/s at 15 Hz then 20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above			Comply					Comply					Comply					Comply					Comply		
Measurement Details			Compliance Assessment (Peak Particle Velocity (PPV), mm/s)																																														
Location	Start time (24 hour) ¹	Construction Activity at the Time of Measurement	Limiting Vibration Limit/Criteria ¹	Site Vibration Event																																													
				PPV, mm/s	Frequency, Hz	Comparison to Criteria																																											
		[XXX]	15mm/s at 4 Hz increasing to 20mm/s at 15 Hz then 20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above			Comply																																											
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						Comply																																											

ID	Item	Results	Discussion																																																	
		<p>Table 1.2 Site Vibration Level Assessment (Human Comfort)</p> <table border="1"> <thead> <tr> <th colspan="3">Measurement Details</th> <th colspan="5">Compliance Assessment (Peak Particle Velocity (PPV), mm/s)</th> </tr> <tr> <th rowspan="2">Location</th> <th rowspan="2">Vibration Type</th> <th rowspan="2">Start time (24 hour)¹</th> <th rowspan="2">Construction Activity at the Time of Measurement</th> <th colspan="4">Site Vibration Event</th> </tr> <tr> <th>Criteria¹</th> <th>PPV, mm/s</th> <th>Frequency, Hz</th> <th>Comparison to Criteria</th> </tr> </thead> <tbody> <tr> <td></td> <td>Continuous</td> <td>12:00</td> <td rowspan="4">Piling works</td> <td>0.56</td> <td></td> <td></td> <td>Comply</td> </tr> <tr> <td></td> <td>Impulsive</td> <td>03:00</td> <td>0.40</td> <td></td> <td></td> <td>Comply</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Comply</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Comply</td> </tr> </tbody> </table> <p>1. Criteria given for the most critical frequency range >8Hz assuming sinusoidal motion.</p>	Measurement Details			Compliance Assessment (Peak Particle Velocity (PPV), mm/s)					Location	Vibration Type	Start time (24 hour) ¹	Construction Activity at the Time of Measurement	Site Vibration Event				Criteria ¹	PPV, mm/s	Frequency, Hz	Comparison to Criteria		Continuous	12:00	Piling works	0.56			Comply		Impulsive	03:00	0.40			Comply							Comply							Comply	
Measurement Details			Compliance Assessment (Peak Particle Velocity (PPV), mm/s)																																																	
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	Impulsive	03:00		0.40			Comply																																													
							Comply																																													
							Comply																																													
		<p>Table 1.3 VDV Assessment (Human Comfort)</p> <table border="1"> <thead> <tr> <th colspan="2">Measurement Details</th> <th rowspan="2">Construction Activity at the Time of Measurement</th> <th colspan="3">Compliance Assessment (Vibration Dose Values (VDV), m/s^{1.75})</th> </tr> <tr> <th>Location</th> <th>Compound Period (24 hour)</th> <th>Limiting Vibration Limit/Criteria¹</th> <th>Calculated VDV</th> <th>Comparison to Criteria</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td rowspan="2">Piling works</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>1. Maximum acceptable VDV (Offices) for intermittent vibration (m/s^{1.75}) identified in the CNVMP.</p>	Measurement Details		Construction Activity at the Time of Measurement	Compliance Assessment (Vibration Dose Values (VDV), m/s ^{1.75})			Location	Compound Period (24 hour)	Limiting Vibration Limit/Criteria ¹	Calculated VDV	Comparison to Criteria			Piling works																																				
Measurement Details		Construction Activity at the Time of Measurement	Compliance Assessment (Vibration Dose Values (VDV), m/s ^{1.75})																																																	
Location	Compound Period (24 hour)		Limiting Vibration Limit/Criteria ¹	Calculated VDV	Comparison to Criteria																																															
		Piling works																																																		

3.1 Recommendations

Based on the results and findings of the noise monitoring, it is recommended that:

- [XXX]
- [XXX]
- [XXX]
- [XXX]

3.1.1 Closing

[INSERT CLOSING STATEMENTS]

References

British Standard (BS 6472–1992) – **Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)** dated 1992

British Standard BS7385: Part 2-1993 (BS 7385) - **Evaluation and Measurement for Vibration in Buildings — Part 2 – Guide to Damage Levels from Ground-borne Vibration**, dated 1993

German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150:3) – **Structural Vibration - Effects of Vibration on Structures**, dated 1999

[INSERT CNVIS REFERENCE]

[INSERT CNVMP REFERENCE]

NSW Government – Sydney Metro **Construction Noise and Vibration Strategy (CNVS)**, August 2017

NSW Department of Environment and Conservation – **NSW Environmental Noise Management – Assessing Vibration: a Technical Guideline** (the NSW Vibration Guideline), February 2006

APPENDIX A – VIBRATION MONITORING METHODOLOGY**[UPDATE SECTION ACCORDINGLY TO REFLECT APPROACH]****1. Monitoring Overview****1.1 Vibration Monitoring**

[A brief overview of the monitoring methodology, inputs and any assumptions]

- [INSERT]
- [INSERT]

1.2 Monitoring Locations

Figure A1 identifies the key work areas and all monitoring locations referenced in this report and other items of importance to this. Each monitoring location is described in **Table A1**.

Table A1 Site Noise Level Assessment

ID	Description	GPS Co-ordinates (Zone 56H)		Ground Height (AHD), m
		Easting	Northing	

1. AHD = Australian Height Datum

1.3 Noise Monitoring Equipment

All vibration measurements were conducted by suitably experienced and qualified XXX personnel with due regard to, and in accordance with, the relevant local and international standards for environmental monitoring.

Vibration equipment was calibrated and checked to the manufacturer's specification, with certification at intervals not exceeding one year at the time of use.

The equipment used for this assessment was as follows:

- 1 x XXX Vibration Monitor.

All data handling and analysis has been completed by qualified and experienced acoustician.

Figure A1.X - Monitoring Locations

[INSERT FIGURE]

Appendix B – Recorded Vibration Data Set

[INSERT DATA]

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Appendix D – Relevant Government Agency Consultation

Sydney Metro City & Southwest Stakeholder Comment Tracker



Document: NCW Portion 7b - Construction Noise and Vibration Management Plan
 Version: 1
 Date of review: 10/08/2018

RESPONSE STATUS
 O Open
 C Closed

Item No	Contract	Contractor	Doc Rev	Item Description, Page, Para, Drg ref	Stakeholder	Reviewer	Date	Requirement Ref (COA or REMM)	Stakeholder comment	T/NSW/Contractor Response	Date	Response Status (date)
1	NCW	LOR	V1	All	WCC	MH	10-Aug-2018	C11	<p>Dear Christopher,</p> <p>I refer to your request to Council for comments for the Sydney Metro City and Southwest – North Corridor Works documents “Construction Noise and Vibration Management Plan (CNVMP)” and Construction Noise and Vibration Monitoring Program”</p> <p>I have reviewed documentation. Please be advised that Council does not have appropriately accredited personnel in this field to fully review all aspects of the documentation however I have, as the most appropriate officer within Council regarding noise issues, reviewed the attached documentation which is noted. The documentation provided appears comprehensively prepared by a qualified acoustic engineer and I am satisfied the Management Plan and Monitoring Program comply with the relevant standards.</p> <p>If you have any further queries please contact me.</p> <p>Mark Hayward - Compliance Team Leader WILLOUGHBY CITY COUNCIL</p>	Noted and thanks	13-Aug-2018	C
2	NCW	LOR	V1	All	WCC	MH	10-Aug-2018	C11	<p>Hi Chris,</p> <p>I refer to the Sydney Metro City and Southwest – Northern Corridor Works – Construction Noise and Vibration Management Plan (Document Reference No. MNNSCW - Portion 7b - CNVMP_V0.2.docx) forwarded to EPA via email on 31 July 2018. I apologise for the delay in responding.</p> <p>Thank you for forwarding the CNVMP for our records. The EPA encourages the development of such plans to ensure that proponents have determined how they will meet their statutory obligations and designated environmental objectives. However, it is not EPA policy to approve or endorse these documents. The EPA's role is to set environmental objectives/requirements for environmental management, rather than being directly involved in the development of strategies to achieve those objectives/requirements.</p> <p>You may however wish to submit the CNVMP, or parts thereof, as supporting information for your future Environment Protection Licence (EPL) application. Information in the CNVMP would be a relevant consideration for EPA in exercising its functions under Section 45 of the Protection of the Environment Operations Act 1997.</p> <p>Any required application to EPA to issue a licence for scheduled development work or a licenced activity should be made in a timely manner to allow for processing of the application. The Act provides that a licence application is deemed to have been refused after 60 days.</p> <p>Thank you for your email and please do not hesitate to contact me should you wish to discuss.</p> <p>Best regards</p> <p>Gordon</p> <p>Gordon Downey Senior Operations Officer - Metropolitan Infrastructure Metro, NSW Environment Protection Authority</p>	Noted and thanks	13-Aug-2018	C

From: Gordon Downey <Gordon.Downey@epa.nsw.gov.au>
Sent: Friday, 10 August 2018 3:05 PM
To: Standing, Christopher; Claire Miles
Subject: RE: REQUEST FOR RVEIEW: Sydney Metro City & Southwest // Northern Corridor Works - Construction Noise and Vibration Management Plan

Hi Chris,

I refer to the Sydney Metro City and Southwest – Northern Corridor Works – Construction Noise and Vibration Management Plan (Document Reference No. MNNSCW - Portion 7b - CNVMP_V0.2.docx) forwarded to EPA via email on 31 July 2018. I apologise for the delay in responding.

Thank you for forwarding the CNVMP for our records. The EPA encourages the development of such plans to ensure that proponents have determined how they will meet their statutory obligations and designated environmental objectives. However, it is not EPA policy to approve or endorse these documents. The EPA's role is to set environmental objectives/requirements for environmental management, rather than being directly involved in the development of strategies to achieve those objectives/requirements.

You may however wish to submit the CNVMP, or parts thereof, as supporting information for your future Environment Protection Licence (EPL) application. Information in the CNVMP would be a relevant consideration for EPA in exercising its functions under Section 45 of the Protection of the Environment Operations Act 1997.

Any required application to EPA to issue a licence for scheduled development work or a licenced activity should be made in a timely manner to allow for processing of the application. The Act provides that a licence application is deemed to have been refused after 60 days.

Thank you for your email and please do not hesitate to contact me should you wish to discuss.

Best regards

Gordon

Gordon Downey

Senior Operations Officer - Metropolitan Infrastructure

Metro, NSW Environment Protection Authority

+61 2 9995 5783

gordon.downey@epa.nsw.gov.au www.epa.nsw.gov.au [@EPA_NSW](https://twitter.com/EPA_NSW)

Report pollution and environmental incidents 131 555 (NSW only) or +61 2 9995 5555



From: Standing, Christopher [mailto:cstanding@laingorourke.com.au]
Sent: Friday, 10 August 2018 2:56 PM
To: Claire Miles <Claire.Miles@epa.nsw.gov.au>
Cc: Gordon Downey <Gordon.Downey@epa.nsw.gov.au>
Subject: RE: REQUEST FOR RVEIEW: Sydney Metro City & Southwest // Northern Corridor Works - Construction Noise and Vibration Management Plan

Dear Claire,

In reference to the request below for review of the Construction Noise & Vibration Management Plan for the Sydney Metro City & Southwest Northern Corridor Works – Portion 7b and its monitoring program.

Would you be able to please provide your comments today.

Thanks and regards,
Chris

Chris Standing
Environment and Sustainability Manager

Laing O'Rourke Australia
Level 8, 100 Christie Street
St Leonards NSW 2065
www.laingorourke.com.au

mobile: +61 431 338 578

From: Standing, Christopher
Sent: Thursday, 2 August 2018 6:29 AM
To: 'Claire Miles' <Claire.Miles@epa.nsw.gov.au>
Cc: Gordon Downey <Gordon.Downey@epa.nsw.gov.au>
Subject: RE: REQUEST FOR RVEIEW: Sydney Metro City & Southwest // Northern Corridor Works - Construction Noise and Vibration Management Plan

Morning Claire,

Thank you for the email.
Regards,
Chris

Chris Standing
Environment and Sustainability Manager

Laing O'Rourke Australia
Level 8, 100 Christie Street
St Leonards NSW 2065
www.laingorourke.com.au

mobile: +61 431 338 578

From: Claire Miles <Claire.Miles@epa.nsw.gov.au>
Sent: Wednesday, 1 August 2018 4:36 PM
To: Standing, Christopher <cstanding@laingorourke.com.au>
Cc: Gordon Downey <Gordon.Downey@epa.nsw.gov.au>
Subject: RE: REQUEST FOR RVEIEW: Sydney Metro City & Southwest // Northern Corridor Works - Construction Noise and Vibration Management Plan

Hello Christopher.

The EPA has received the documents and will respond shortly.

Regards,

Claire Miles

Unit Head - Metropolitan Infrastructure
Metro, NSW Environment Protection Authority
Ph: 02 9995 5167 Mob: 0436 682 226



From: Standing, Christopher [<mailto:cstanding@laingorourke.com.au>]

Sent: Wednesday, 1 August 2018 4:33 PM

To: Claire Miles <Claire.Miles@epa.nsw.gov.au>

Subject: RE: REQUEST FOR RVEIEW: Sydney Metro City & Southwest // Northern Corridor Works - Construction Noise and Vibration Management Plan

Dear Claire,

In addition to the Construction Noise & Vibration Management Plan for the NCW – Portion 7b package component of the project, please also find attached the Noise and Vibration Monitoring program.

If you could also please provide your comments on the program as required by C11 of project approval SSI 15_7400

Thank you for your help and understanding and please do not hesitate in contacting me if required to discuss.

Regards,
Chris

Chris Standing
Environment and Sustainability Manager

Laing O'Rourke Australia
Level 8, 100 Christie Street
St Leonards NSW 2065
www.laingorourke.com.au

mobile: +61 431 338 578

From: Standing, Christopher

Sent: Tuesday, 31 July 2018 7:13 AM

To: 'Claire Miles' <Claire.Miles@epa.nsw.gov.au>

Subject: REQUEST FOR RVEIEW: Sydney Metro City & Southwest // Northern Corridor Works - Construction Noise and Vibration Management Plan

Importance: High

Dear Claire,

Laing O'Rourke has been engaged by Sydney Metro Delivery Office for the Northern Corridor Works (NCW) as part of the approved Sydney Metro City and Southwest project.

Please see attached Laing O'Rourke's Construction Noise & Vibration Management Plan for the NCW – Portion 7b package component of the project which has been developed for the City and Southwest project as per the planning approval requirement condition C9 of project approval SSI 15_7400. This condition also requires the project to develop Construction Monitoring Programs in consultation with the EPA.

A copy of the planning approval conditions for the project can be found [here](#).

As such, Laing O'Rourke would like to formally submit the attached documents for comment. The earliest EPA response would be very much appreciated however the project team need comments back by no later than Friday August 10th 2018.

Thank you for your help and understanding and please do not hesitate in contacting me if required to discuss.

Yours sincerely,
Chris

Chris Standing
Environment and Sustainability Manager

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PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL

From: Hayward, Mark <mark.hayward@willoughby.nsw.gov.au>
Sent: Friday, 10 August 2018 4:24 PM
To: Standing, Christopher
Subject: RE: REQUEST FOR RVEIEW: Sydney Metro City & Southwest // Northern Corridor Works - Construction Noise and Vibration Management Plan

Dear Christopher,

I refer to your request to Council for comments for the Sydney Metro City and Southwest – North Corridor Works documents “Construction Noise and Vibration Management Plan (CNVMP)” and Construction Noise and Vibration Monitoring Program”

I have reviewed documentation. Please be advised that Council does not have appropriately accredited personnel in this field to fully review all aspects of the documentation however I have, as the most appropriate officer within Council regarding noise issues, reviewed the attached documentation which is noted. The documentation provided appears comprehensively prepared by a qualified acoustic engineer and I am satisfied the Management Plan and Monitoring Program comply with the relevant standards.

If you have any further queries please contact me.

Mark Hayward - Compliance Team Leader

WILLOUGHBY CITY COUNCIL

PO Box 57 Chatswood NSW 2057

P +61 2 9777 7991

E mark.hayward@willoughby.nsw.gov.au

willoughby.nsw.gov.au | visitchatswood.com.au | theconcourse.com.au



From: Standing, Christopher [mailto:cstanding@laingorourke.com.au]
Sent: Friday, 10 August 2018 2:56 PM
To: Hayward, Mark
Subject: RE: REQUEST FOR RVEIEW: Sydney Metro City & Southwest // Northern Corridor Works - Construction Noise and Vibration Management Plan

Dear Mark,

In reference to the request below for review of the Construction Noise & Vibration Management Plan for the Sydney Metro City & Southwest Northern Corridor Works – Portion 7b and its monitoring program.

Would you be able to please provide your comments today.

Thanks and regards,
Chris

Chris Standing
Environment and Sustainability Manager

Laing O'Rourke Australia

Level 8, 100 Christie Street
St Leonards NSW 2065
www.laingorourke.com.au

mobile: +61 431 338 578

From: Standing, Christopher

Sent: Wednesday, 1 August 2018 4:33 PM

To: 'mark.hayward@willoughby.nsw.gov.au' <mark.hayward@willoughby.nsw.gov.au>

Subject: RE: REQUEST FOR RVEIEW: Sydney Metro City & Southwest // Northern Corridor Works - Construction Noise and Vibration Management Plan

Dear Mark,

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Thank you for your help and understanding and please do not hesitate in contacting me if required to discuss.

Regards,
Chris

Chris Standing

Environment and Sustainability Manager

Laing O'Rourke Australia

Level 8, 100 Christie Street
St Leonards NSW 2065
www.laingorourke.com.au

mobile: +61 431 338 578

From: Standing, Christopher

Sent: Tuesday, 31 July 2018 7:18 AM

To: 'mark.hayward@willoughby.nsw.gov.au' <mark.hayward@willoughby.nsw.gov.au>

Subject: REQUEST FOR RVEIEW: Sydney Metro City & Southwest // Northern Corridor Works - Construction Noise and Vibration Management Plan

Importance: High

Dear Mark,

Laing O'Rourke has been engaged by Sydney Metro Delivery Office for the Northern Corridor Works (NCW) as part of the approved Sydney Metro City and Southwest project.

Please see attached Laing O'Rourke's Construction Noise & Vibration Management Plan for the NCW – Portion 7b package component of the project which has been developed for the City and Southwest project as per the planning approval requirement condition C9 of project approval SSI 15_7400. This condition also requires the project to develop Construction Monitoring Programs in consultation with the EPA.

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Thank you for your help and understanding and please do not hesitate in contacting me if required to discuss.

Yours sincerely,
Chris

Chris Standing
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