RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

SYDNEY METRO EASTERN TUNNELLING PACKAGE

Detailed Noise and Vibration Impact Statement - Pyrmont Station

5 March 2024

John Holland CPB Contractors Ghella Joint Venture

TM372-02-1-02F01 SMW-ETP_DNVIS-PYR (rev04)

40 YEARS 1982-2022 ACOUSTIC ENGINEERING EXCELLENCE

Sydney Melbourne Brisbane Gold Coast Kuwait Singapore
Renzo Tonin & Associates ABN 29 117 462 861
Level 1/418A Elizabeth St SURRY HILLS NSW 2010 | PO Box 877 STRAWBERRY HILLS NSW 2012
P (02) 8218 0500 F (02) 8218 0501 sydney@renzotonin.com.au www.renzotonin.com.au

Document details

Detail	Reference
Doc reference:	TM372-02-1-02F01 SMW-ETP_DNVIS-PYR (rev04)
Prepared for:	John Holland CPB Contractors Ghella Joint Venture
Address:	Level 6, 60 Union Street Pyrmont NSW 2009
Attention:	[redacted]

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
20.03.2023	Initial issue to Sydney Metro	-	A	[redacted]	-	[redacted]
05.04.2023	Respond to Sydney Metro, ER and AA comments	-	B	[redacted]	-	[redacted]
13.04.2023	Minor edits	-	C	T[redacted]	-	[redacted]
13.09.2023	Updated to include shaft excavation, tunnelling and decommissioning	C.2	C.3	[redacted]	-	[redacted]
19.10.2023	Respond to Sydney Metro, ER and AA comments	C.4	02	[redacted]	-	[redacted]
31.10.2023	Respond to AA comments	-	03	[redacted]	-	[redacted]
05.03.2024	Replace Tower Crane (electric) with Tower Crane (diesel) and update	3.1	04	[redacted]n	-	[redacted]

[redacted] (rev04).docx

Important Disclaimers:

The work presented in this document was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian/New Zealand Standard AS/NZS ISO 9001.

This document is issued subject to review and authorisation by the suitably qualified and experienced person named in the last column above. If no name appears, this document shall be considered as preliminary or draft only and no reliance shall be placed upon it other than for information to be verified later.

This document is prepared for the particular requirements of our Client referred to above in the 'Document details' which are based on a specific brief with limitations as agreed to with the Client. It is not intended for and should not be relied upon by a third party and no responsibility is undertaken to any third party without prior consent provided by Renzo Tonin & Associates. The information herein should not be reproduced, presented or reviewed except in full. Prior to passing on to a third party, the Client is to fully inform the third party of the specific brief and limitations associated with the commission.

In preparing this report, we have relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, we have not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

We have derived data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination and re-evaluation of the data, findings, observations and conclusions expressed in this report.

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

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

External cladding disclaimer: No claims are made and no liability is accepted in respect of any external wall and/or roof systems (eg facade / cladding materials, insulation etc) that are: (a) not compliant with or do not conform to any relevant non-acoustic legislation, regulation, standard, instructions or Building Codes; or (b) installed, applied, specified or utilised in such a manner that is not compliant with or does not conform to any relevant non-acoustic legislation, regulation, standard, instructions or Building Codes.

Contents

List of tables

List of figures

1 Introduction

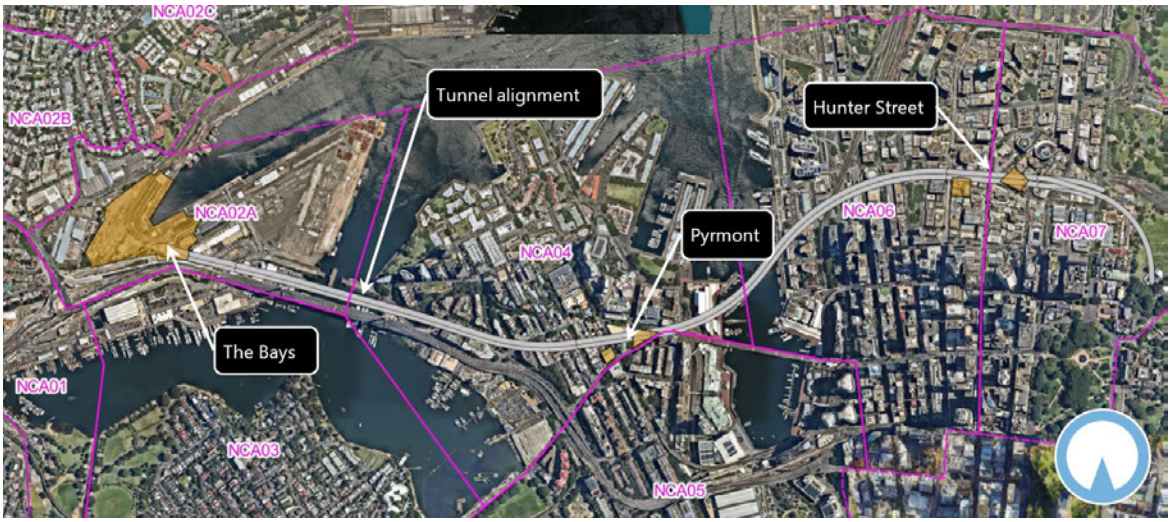
1.1 Purpose and application

This Detailed Noise and Vibration Impact Statement (DNVIS) has been prepared on behalf of John Holland CPB Ghella Joint Venture (JCG) in accordance with the Sydney Metro Construction Noise and Vibration Standard (CNVS)[1] for the construction of the Sydney Metro West – Eastern Tunnelling Package (ETP) Works. This DNVIS has been prepared to satisfy Planning Approval (SSI 19238057) Condition D29.

1.2 Overview

Sydney Metro West ETP is Stage 2 of the Sydney Metro West a new 24-kilometre metro line that will connect Greater Parramatta with the Sydney CBD via stations at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock, The Bays, Pyrmont and Hunter Street (Sydney CBD). The Project includes all major civil construction work including station excavation (at the Pyrmont Station and Hunter Street Station (Sydney CBD) construction sites) and tunnelling between The Bays and Sydney CBD. An overview of the construction work locations for Sydney Metro West ETP is presented in Figure 1.1.

Figure 1.1: Overview of Sydney Metro West ETP construction work between The Bays and Sydney CBD



The aim of this assessment is to minimise the impact of construction noise and vibration on sensitive receivers and demonstrate compliance with relevant Conditions of Approval, the CSSI Stage 2 Environmental Impact Statement (EIS)[4], the Revised Environmental Mitigation Measures (REMMs) included in the Submissions Report [5] and the Construction Noise and Vibration Management Plan (CNVMP) (SMWSTETP-JCG-SWD-SW000-EN-PLN-002019).

1.3 Detailed Noise and Vibration Impact Statement

This DNVIS provide a quantitative noise and vibration assessment of activities and/ or locations where construction work will occur. They clarify details provided in the EIS Noise and Vibration technical Paper [4], updated to include the more detailed information available at the detailed design and construction planning stage of the Project. This DNVIS is structured to meet the requirements of Condition of Approval D29 and the CNVS, including specific mitigation measures to be implemented for the duration of the assessed works, identified through consultation with affected sensitive land user(s).

This DNVIS provides a noise and vibration assessment of the ETP Pyrmont Station surface worksites that are required to be completed within and outside of standard construction hours. Note that this DNVIS excludes the tunnelling works associated with Pyrmont station and the crossover cavern. Tunnelling works are assessed in a separate DNVIS (ref: TM372-02-1-04F01 SMW-ETP_DNVIS-TUN).

The works covered by this DNVIS will be undertaken in accordance with the CEMP (incorporating the CNVMP).

1.4 Quality assurance

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Construction works and hours

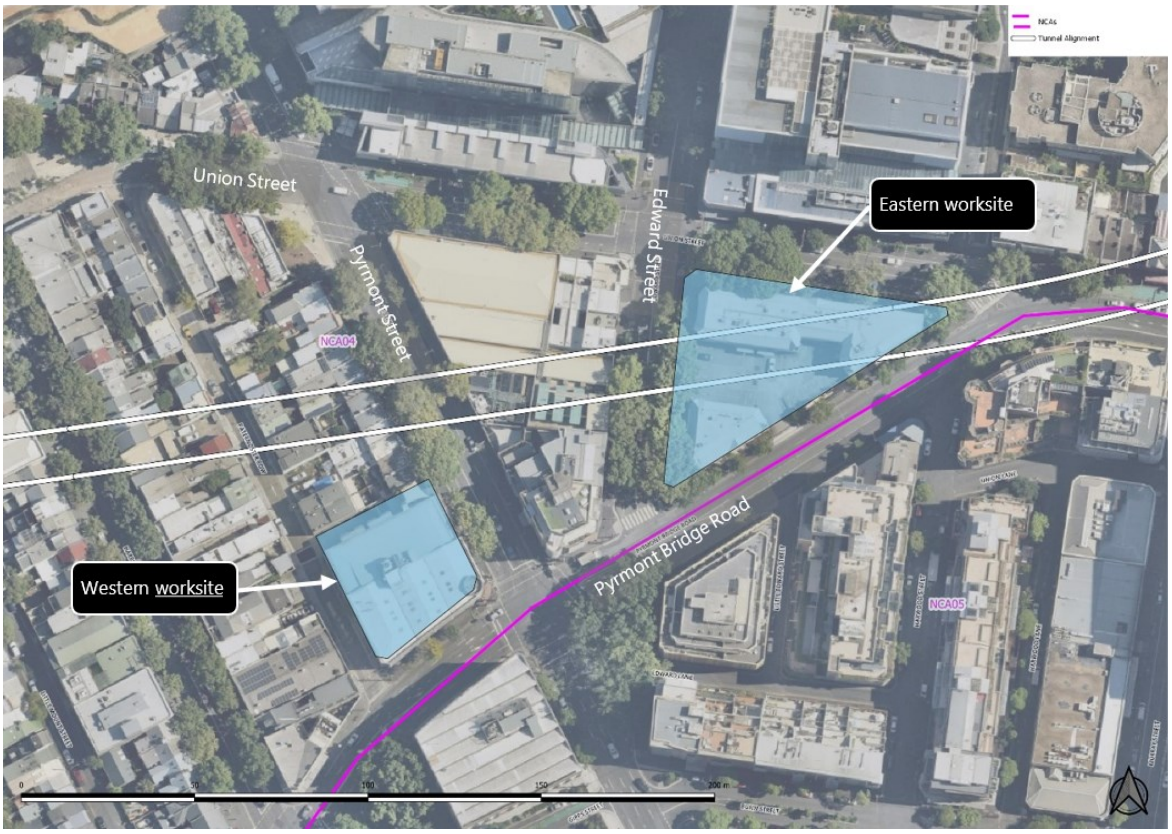
2.1 Construction works addressed in this DNVIS

2.1.1 Location of worksite

The Pyrmont Station worksite includes a western worksite and an eastern worksite.

The western worksite is located between Paternoster Row and Pyrmont Street, immediately north of Pyrmont Bridge Road. The eastern worksite is located between Edward Street, Union Street and Pyrmont Bridge Road. The construction worksite location and layout are shown in Figure 2.1 below.

Figure 2.1: Pyrmont Station worksite



2.1.2 Construction works

The Pyrmont ETP Works at the eastern and western worksites will be delivered through sub-stages 1 to 4, outlined below and shown on an indicative construction timeline in APPENDIX C Table C1-3:

- Stage 1: Site Establishment: Hoardings; demolition; preliminary earthworks
- Stage 2:
  - Acoustic Shed construction;

  - Shaft excavation: Temporary Shaft, to allow access to mined tunnelling work area. The temporary shaft will be excavated concurrent with the acoustic shed construction. Platforms forming the shed floor will be in place at the time of excavation, forming a partial enclosure over the temporary shaft;

- Stage 3 (with acoustic shed):
  - Shaft excavation: Permanent Shaft(s);
  - Mined tunnelling and associated activities for station cavern and adits;
- Stage 4: Demobilisation.

The works are proposed to be undertaken during standard construction hours and outside standard construction hours, where this is necessary and the out of hours works (OOHW) are justified (see Section 2.2.1). The works are summarised in Table 2.1.

Table 2.1: Summary of construction works under this DNVIS

Activity/ work area	Aspect	Construction hours	Indicative timing of activity
Western worksite			
Site Establishment	B-class hoarding erection and site offices	Standard hours + OOHW (D/E/N)*	4 weeks
	Demolition	Standard hours (D)	20 weeks
	B-class hoarding dismantle and A-class hoarding erection	Standard hours + OOHW (D/E/N)*	5 weeks
	Preliminary earthworks and piling pad	Standard hours (D)	2 weeks
Acoustic shed construction	Piling and capping beams	Standard hours + OOHW (D/E/N)*	8 weeks
	Platform and acoustic shed	Standard hours + OOHW (D/E/N)*	18 weeks
Permanent shaft excavation (with shed)	Shaft excavation	Standard hours (D)	20 weeks
	Spoil haulage	Standard hours + OOHW (D/E)	20 weeks
	Support works	Standard hours + OOHW (D/E)	20 weeks
	Base slab	Standard hours + OOHW (D/E)	6 weeks
Mined tunnelling and associated activities	Tunnelling and associated activities of rockbolting, shotcreting, mucking out	Standard hours + OOHW (D/E/N)	6 months
	Spoil haulage; delivery of material to directly support tunnelling activities	Standard hours + OOHW (D/E)	
	Tunnel Lining (concreting), including delivery of concrete	Standard hours + OOHW (D/E/N)	
Demobilisation	Platform and acoustic shed removal	Standard hours	8 weeks
Eastern worksite			
Site Establishment	B-class hoarding erection and site offices	Standard hours + OOHW (D/E/N)*	6 weeks
	Demolition	Standard hours (D)	12 weeks
	B-class hoarding dismantle and A-class hoarding erection	Standard hours + OOHW (D/E/N)*	10 weeks
	Preliminary earthworks and piling pad	Standard hours (D)	4 weeks

Activity/ work area	Aspect	Construction hours	Indicative timing of activity
Acoustic shed construction	Piling and capping beams	Standard hours (D)	14 weeks
	Platform and acoustic shed	Standard hours (D)	21 weeks
Temporary shaft excavation (without shed)	Shaft excavation (and spoil handling)	Standard hours (D)	12 weeks
	Ground support works (concreting)	Standard hours (D)	12 weeks
Permanent shaft excavation (with shed)	Shaft excavation	Standard hours (D)	19 months
	Spoil haulage	Standard hours + OOHW (D/E)	19 months
	Ground support works	Standard hours + OOHW (D/E)	19 months
	Base slab	Standard hours + OOHW (D/E)	12 weeks
Mined tunnelling and associated activities	Tunnelling and associated activities of rockbolting, shotcreting, mucking out	Standard hours + OOHW (D/E/N)	19 months
	Spoil haulage; delivery of material to directly support tunnelling activities	Standard hours + OOHW (D/E)	19 months
	Tunnel Lining (concreting), including delivery of concrete	Standard hours + OOHW (D/E/N)	15 months
Demobilisation	Platform and acoustic shed removal	Standard hours	8 weeks

Notes: 'OOHW' means Out of Hours works, or work outside the standard construction hours (see Section 2.2)

'OOHW(D)' is the OOH 'Day' period,; 8am to 6pm Sunday

'OOHW(E)' is the 'Evening' period, 6pm to 10pm Monday to Sunday

'OOHW(N) is the OOH 'Night' period, 10pm to 7am Sunday/Monday to Thursday/ Friday; 10pm to 8am Friday/Saturday and Saturday/ Sunday

* Works mostly completed during standard construction hours. Limited OOHW required as outlined in Section 2.2.1.

A detailed summary of the construction activities assessed in this report is presented in Section 5.1 and in Table C.1 of APPENDIX C.

2.1.3 Construction traffic

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

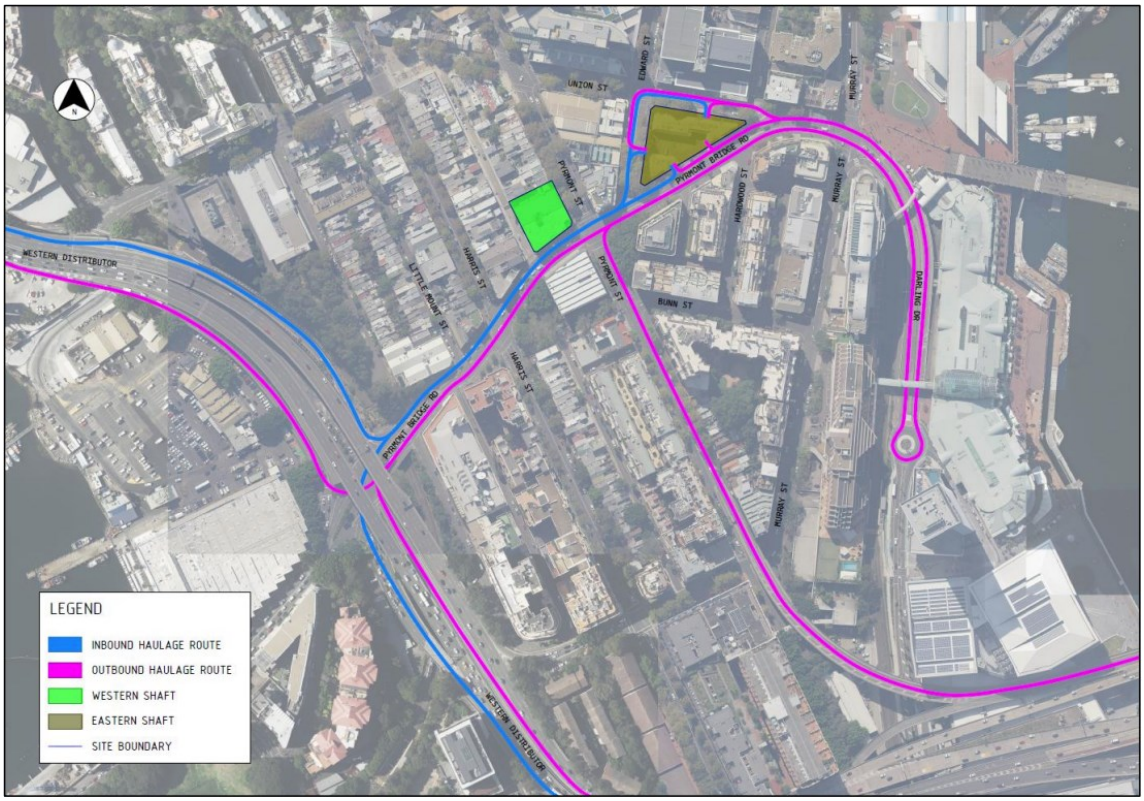
Construction traffic will use the approved primary heavy vehicle routes, as described in the Construction Traffic Management Plan, Pyrmont West – Stage 2: Site Establishment, Excavation and Tunnelling (ref: SMWSTETP-JCG-PYR-SN150-TF-PLN-002034) and the Construction Traffic Management Plan, Pyrmont East – Stage 2: Site Establishment & Excavation (ref: SMWSTETP-JCG-PYR-SN150-TF-PLN-002272.

The proposed primary truck routes are shown in Figure 2.2 and Figure 2.3. Vehicle access points also shown in Figures C1-1-1, C1-1-2, C1-2-1 and C1-2-2 in APPENDIX C.

Figure 2.2:Additional approved heavy vehicle haulage route for Pyrmont West

Source: Construction Traffic Management Plan, Pyrmont West – Stage 2: Site Establishment, Excavation and Tunnelling (ref: SMWSTETP-JCG-PYR-SN150-TF-PLN-002034)

Figure 2.3:Approved construction haulage route for Pyrmont East



Source: Construction Traffic Management Plan, Pyrmont East – Stage 2: Site Establishment & Excavation (ref: SMWSTETP-JCG-PYR-SN150-TF-PLN-002272)

These roads are arterial and sub-arterial roads with typically moderate to high traffic volume, including heavy vehicles. The worksite will generate additional traffic movements in the form of:

- Light vehicle movements generated by construction personnel travelling to and from work
- Heavy vehicle movements generated by:
  - Delivery vehicles bringing raw materials, plant, and equipment to the site (typically standard hours, except for oversized deliveries)
  - Concrete trucks bringing concrete to the site (typically standard hours, with OOHW deliveries up to 10:00 pm required during mined tunnelling and the permanent shaft base slab construction)
  - Spoil trucks removing spoil from the site (typically standard hours. There will be some spoil handing within the acoustic shed during shaft excavation and mined tunnelling up to 10pm).

Construction traffic noise, related to the public road network, is addressed in Section 8.

2.2 Construction Hours

Construction hours for the Project are outlined in Conditions of Approval D21, D22 and D23. Table 2.2 below consolidates the information provided in these Conditions regarding construction working hours for the Project.

Table 2.2: Working hours for construction worksites

CoA	Construction Activity[9]	Monday to Friday	Saturday	Sunday / Public holiday
D21	Standard construction	07:00 to 1800	08:00 to 18:00	No work[1]
D22	Highly noise intensive works[2]	08:00 to 18:00 (plus respite[2])	08:00 to 13:00 (plus respite[2])	No work[1]
D23(a)	Safety and emergency work	18:00 to 07:00	18:00 to 08:00	08:00 to 0:700
D23(b)	Low noise impact work[3]	18:00 to 07:00	18:00 to 08:00	08:00 to 07:00
D23(c)	Works approved under an EPL or Out-of-Hours Work Protocol or through negotiated agreement with directly affected residents and sensitive land user(s)	18:00 to 07:00	18:00 to 08:00	08:00 to 07:00
D23(d)	Prescribed activity: ▪ Tunnelling (and associated activities of rockbolting, shotcreting and mucking out, but excluding cut and cover tunnelling and surface works)[4] ▪ Delivery of material to directly support tunnelling activities[5] ▪ Haulage of spoil[6] ▪ Work within an acoustic shed or enclosure[7].	24 hours	24 hours	24 hours
D39	Rock breaking and other particularly highly noise intensive activities for station shaft or cut and cover stations at Hunter Street Sydney CBD[8]	07:00 to 20:00[8]	07:00 to 20:00[8]	07:00 to 20:00[8]

CoA	Construction Activity[9]	Monday to Friday	Saturday	Sunday / Public holiday
D39 and D40	Rock breaking and other particularly highly noise intensive activities for station shaft or cut and cover stations at Pyrmont[8]	07:00 to 18:00[8]	08:00 to 18:00[8]	No work[1]

Notes:

1. No work unless permitted and approved.
2. Minimum respite from highly noise intensive works of not less than one (1) hour between each continuous block of works not exceeding three (3) hours.
3. Construction that causes $L_{Aeq(15\ minute)}$ noise levels no more than 5dB(A) above the Rating Background Level (RBL) at any residence; and/or no more than the 'noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s). Construction that causes continuous/impulsive/intermittent vibration values at the most affected residence, no more than the preferred values for human exposure to vibration, specified in Table 2.2 and Table 2.4 of the AVTG.
4. Tunnelling does not include station box excavation and the requirements of Condition D26 apply .
5. Except between the hours 10:00 pm and 7:00 am to / from the Pyrmont construction site which could result in a sleep disturbance event [as defined in the CoA and presented in Table 4.1] for receivers in the proximity of Pyrmont Street, Edward Street, Union Street, Paternoster Row and Pyrmont Bridge Road
6. Except between the hours of 10:00 pm and 7:00 am to / from the Pyrmont construction site
7. Where there is no exceedance of noise levels under Low Noise Impact Work circumstances identified in D23(b), unless otherwise agreed by the Planning Secretary
8. Respite provided by ensuring noise levels are less than $L_{Aeq(15\ minute)}$ 60 dB(A) for at least 6.5 hours between 7am and 8pm, of which at least 3.25 hours must be below $L_{Aeq(15\ minute)}$ 55 dB(A). Noise equal to or above $L_{Aeq(15\ minute)}$ 60 dB(A) is allowed for the remaining 6.5 hours between 7am and 8pm.

2.2.1 Justification for OOHW

Stage 1 and 2: Site establishment and acoustic shed construction

Site establishment, including demolition, hoarding construction and preliminary earthworks; and acoustic shed construction will mostly be completed during standard construction hours. Some of the works associated with demolition, hoarding construction and acoustic shed construction (including piling and capping beams) will most likely need a Road Occupancy Licence (ROL) for the closure of one or more lanes on the roads the works are within or adjacent to, including Pyrmont Bridge Road, Pyrmont Street, Union Street and Edward Street to allow the works to be completed without high risk to construction personnel or public safety.

Utilisation of a temporary lane closure between 10am and 3pm daily to complete above works has been considered, however traffic interfaces and frequency of works raised safety concerns for personnel. A ROL is not likely to be issued during the hours specified in the Condition D21 (Table 2.2). Therefore, works may need to be undertaken outside of standard construction hours, as per Condition D23(a), (b) and (c). Forecast number of nights of work are detailed in Table C2 of APPENDIX C.

Out-of-hours work under CoA D23(c) would be undertaken through the Sydney Metro West Out of Hours Works Protocol [3] (OOHW Protocol) prepared for the project or under the Environment Protection Licence (EPL) number 21784 for works subject to an EPL.

Stage 3: Mined tunnelling and associated activities for station cavern and adits (including tunnel lining)

Tunnelling and associated activities of rockbolting, shotcreting and mucking out for the cavern and adits (but excluding cut and cover tunnelling and surface works) at the eastern and western shaft sites are a prescribed activity permitted 24 hours a day under condition D23(d).

There are several large concrete pours associated with the base slab for the Pyrmont East and West shaft, and for the caverns, including the tunnel crown pour and tunnel invert. The works would be completed under condition D23(d)(ii) and D23(d)(iv). Condition D23(ii) allows delivery of material outside standard hours, except between the hours 10:00 pm and 7:00 am to / from the Pyrmont construction site which could result in a sleep disturbance event for receivers in the proximity of Pyrmont Street, Edward Street, Union Street, Paternoster Row and Pyrmont Bridge Road. A sleep disturbance event is defined in Table 4.1

JCG require extended hours of concrete deliveries at the Pyrmont sites due to formwork design limitations with respect to the rate of rise. The rate of rise, the speed in which you can place concrete into a formwork system, is governed by the Australian Standards (AS3610 Section 4.4) and is calculated using several variables including vertical height of formwork, concrete temperature, density of concrete etc. Due to the height of some tunnel profiles at Pyrmont, JCG will require extended hours to be able to comply with this Australian Standards and maintain a continuous concrete pour to ensure the structure performs as required by the permanent lining design, limiting construction joints within the arched profiles.

The pours are generally planned to be completed within 10 to 15 hours, between 7 am and 10 pm. On limited occasions there will be a need to commence the pour from 5am, or extend the pour beyond 10 pm to ensure its completion in a single pour. These will be limited to the east worksite only, to limit the likelihood of sleep disturbance impact to residential receivers.

Details of the large concrete pours and likely OOHW requirements are summarised in Table 2.3.

Table 2.3: Large concrete pour out-of-hours work requirements

Concrete pour location	Overall duration	Frequency	Working hours*	Construction hours
Crossover & Station Cavern Inverts	Aug to Dec 2024 (19 weeks)	24 pours in 19 weeks = 1-3 pours/week	12no. x 16 hours pour	Standard hours + OOHW (D/E/N)
			9no. x 17 hours pour	Standard hours + OOHW (D/E/N)
			2no. x 23 hours pour	Standard hours + OOHW (D/E/N)
			1no. x 25 hour pour	Standard hours + OOHW (D/E/N)
Crossover Cavern Crown Lining**	Mar to May 2025 (6 weeks)	12 pours in 6 weeks = 2 pours/week	12no. x 13 hours pour	Standard hours + OOHW (D/E)
Station Cavern Crown Lining**	May to Aug 2025 (13 weeks)	12 pours in 13 weeks = 1-2 pours/week	9no. x 12 hour pours	Standard hours + OOHW (D/E)
			2no. x 15 hour pours	Standard hours + OOHW (D/E)
			1no. x 18 hour pours	Standard hours + OOHW (D/E/N)

Note: * Standard construction hours = 11 hours (7am to 6pm)

** Crown lining pours will often run longer that the theoretical duration due to using a concrete fibre mix which can result in line blockages, as well as pressure pouring vertically overhead.

Concrete lining of the crossover and station caverns will require up to 24 pours, completed by 1 to 3 concrete pours per week over 19 weeks. The planned working hours of each pour is more than 15 hours, which will mean extension into the night time period (10:00 pm to 7:00 pm). It is anticipated that the majority of these pours will be completed by 10pm. There are three (3) pours that are anticipated to run over 20+ hours and will require night time concrete delivery to the east worksite.

The Crossover Cavern Crown Lining will require up to 12 pours, completed by 2 concrete pours per week over 6 weeks. All pours are planned to be completed during the day and evening period only.

The Station Cavern Crown Lining will require up to 12 pours, completed by 1-2 concrete pours per week over 13 weeks. All pours are planned. It is anticipated that 11 pours will be completed by 10pm. One (1) pour is planned to be completed over more than 15 hours and will therefore likely require night time concrete delivery to the east worksite.

Assessment of potential sleep disturbance impact is included in Section 5.2.3.

All reasonable and feasible mitigation and management measures will be implemented to reduce noise from the works to within NMLs. The requirements of the Conditions of Approval will be met.

2.2.2 Assessment periods

The standard hours and out of hours work (OOHW) periods for construction works are depicted in Table 2.4. The OOHW periods are further defined as OOHW Period 1 and 2, based on the CNVS [1].

Construction traffic is assessed over a fifteen-hour day period, between 7am and 10pm (typically standard hours plus OOHW Period 1) and a nine-hour night period, between 10pm and 7am (typically OOHW Period 2). This is consistent with the NSW Road Noise Policy [8] and the CNVS [1].

Table 2.4: Assessment periods

Day/ Time	12am – 1am	1am – 2am	2am – 3am	3am – 4am	4am – 5am	5am – 6am	6am – 7am	7am – 8am	8am – 9am	9am – 10am	10am – 11am	11am – 12pm	12pm – 1pm	1pm – 2pm	2pm – 3pm	3pm – 4pm	4pm – 5pm	5pm – 6pm	6pm – 7pm	7pm – 8pm	8pm – 9pm	9pm – 10pm	10pm – 11pm	11pm – 12am
Monday to Friday									Standard construction Hours										OOHW Period 1					
Saturday																								
Sunday or Public Holiday	OOHW Period 2								OOHW Period 1										OOHW Period 2					

3 Existing environment

3.1 Land use survey

To assess and manage construction noise and vibration impact, a Land Use Survey has been undertaken to satisfy Condition D20. The Land Use Survey identifies existing land use and development along the Project alignment, including a mix of residential, commercial and industrial uses; along with other noise and vibration-sensitive businesses, such as Hotels, medical or dental surgeries and childcare facilities. At Pyrmont Station there are residential receivers surrounding the two worksites.

Heritage receivers have been identified in the EIS [4] and in the land use survey.

The Land Use Survey is maintained in a Geographic Information System (GIS) established for the Project and was used in the preparation of this DNVIS. The land use at the time of issue of this DNVIS is identified on an aerial photograph in Figure 3.1 (and in APPENDIX B). The land use revision date is shown in the top left corner of the drawing.

3.2 Noise Catchment Areas

Further to the Land Use Survey, residential areas have been divided into Noise Catchment Areas (NCAs) based on those established in the Environmental Impact Statement (EIS) [4] for the project. NCAs group individual sensitive receivers by common traits, such as existing noise environment and location in relation to the ETP works. NCAs relevant to the Pyrmont Station worksite are identified in Figure 3.1.

3.3 Baseline noise monitoring

As part of the EIS process, baseline noise monitoring was conducted in Pyrmont in 2019 and 2021. The ambient noise monitoring locations were selected with reference to the procedures outlined in the Noise Policy for Industry (NPfI, EPA 2017)[7]. Noise monitoring was used to determine appropriate RBLs and ambient noise levels (L_{Aeq}) for each NCA. Noise monitoring was used to establish the Rating Background Level (RBL). The RBL represents the average minimum background sound level for each measurement period, averaged over the measurement days. The RBLs and average ambient noise levels for the day, evening and night assessment periods are summarised in Table 3.1 and in Table B.1 in APPENDIX B.

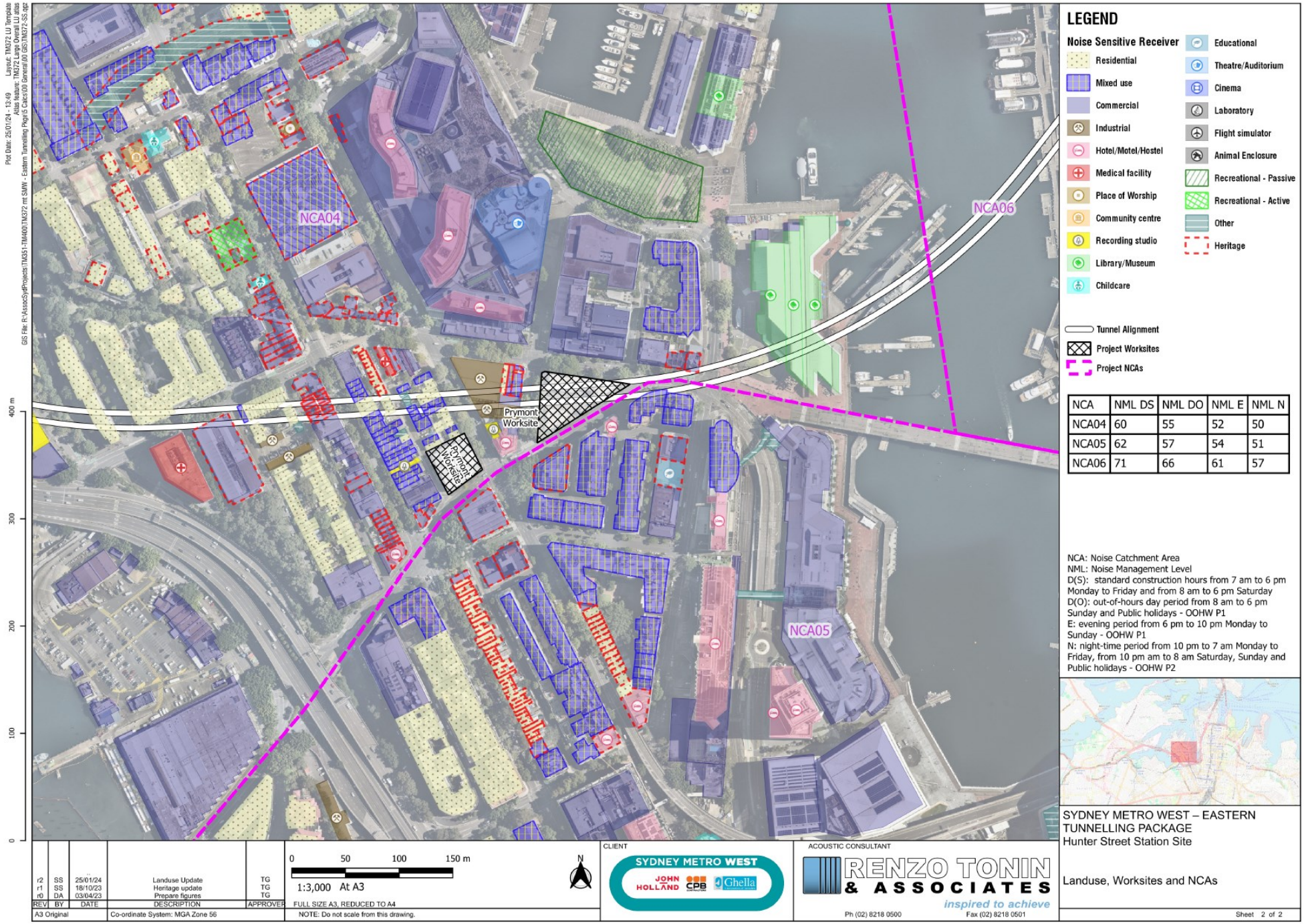
Table 3.1: Summary of baseline noise monitoring data from EIS

Construction work area	Monitor ID	Rating Background Noise (RBL)[1]			Ambient Noise Level ($L_{Aeq(15min)}$)[1]			Representative NCA
		Day[2]	Eve[2]	Ngt[2]	Day[2]	Eve[2]	Ngt[2]	
Pyrmont Station	B.04	50	47	45	56	50	47	NCA04
	B.05	52	49	46	61	59	56	NCA05

Notes: 1. RBL and LAeq noise levels determined with reference to NPfI procedures

2. Day is 7.00am to 6.00pm; Eve (evening) is 6.00pm to 10.00pm; Ngt (night) is 10.00pm to 7.00am

Figure 3.1: Noise Catchment Areas appliable to the Pyrmont Station worksite



NCA	NML DS	NML DO	NML E	NML N
NCA04	60	55	52	50
NCA05	62	57	54	51
NCA06	71	66	61	57

REV	BY	DATE	DESCRIPTION	APPROVER
r2	SS	25/01/24	Landuse Update	TG
r1	SS	18/10/23	Heritage update	TG
r0	DA	03/04/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

4 Construction noise and vibration objectives

Construction noise and vibration objectives are detailed in the CNVS Section 2 and the CNVMP. A summary of the objectives as applicable to the Pyrmont Station worksite is provided in Table 4.1.

Table 4.1: Summary of construction noise and vibration objectives

Impact	Relevant guideline	Construction noise/ vibration objective
Airborne noise	NSW Interim Construction Noise Guideline (ICNG) [6] CNVS [1]	Construction noise management levels (NMLs) for residential receivers are based on long-term noise logging conducted on behalf of Sydney Metro to quantify ambient noise levels for the EIS [3]. During standard construction hours, a highly affected noise objective of $L_{Aeq(15min)}$ 75dB(A) applies at all residential receivers. The NMLs for 'other' sensitive receivers are from the ICNG, as reported in Section 2.2 of the CNVS. Receivers are considered 'noise affected' where construction noise levels are greater than the noise management levels identified in Table B.1 of APPENDIX B. Where construction activities are tonal or impulsive in nature and are described in the ICNG as being particularly annoying, a +5dB(A) correction must be added to the activity noise. construction related activities that could exceed the NMLs shall be identified and managed in accordance with the noise and mitigation and management measures set out in Section 9.
Sleep disturbance	Noise Policy for Industry (EPA 2017) [7] CNVS [1] CoA Definitions	Initial screening level/ CoA defined sleep disturbance event • L_{AFmax} ≤ 52 dB(A) or RBL + 15 dB (whichever is greater); and/ or • $L_{Aeq,15min}$ ≤ 40 dB(A) or RBL + 5 dB (whichever is greater). Under the NPfI, where noise events are found to exceed the initial screening level, further analysis will be made to identify: • the likely number of events that might occur during the night assessment period, and • Whether events exceed an 'awakening reaction' level of 55 dB(A) L_{AFmax} (internal) that equates to NML of 65 dB(A) externally (assuming open windows).
Ground-borne noise	NSW Interim Construction Noise Guideline (ICNG) [6] CNVS [1]	Receivers are considered 'ground-borne noise affected' where construction noise levels are greater than the noise management levels identified in Table B.2 of APPENDIX B.
Construction traffic	ICNG refers to the NSW Road Noise Policy (RNP) [8] CNVS [1]	Construction traffic impact initial screening test: • Traffic noise levels increase ≤ 2 dB(A) because of construction traffic Where traffic noise levels increase by more than 2 dB(A): • Freeway/arterial/sub-arterial road - 60 dB $L_{Aeq(15hour)}$ day and 55 dB $L_{Aeq(9hour)}$ night • Existing local road - 5 dB $L_{Aeq(1hour)}$ day and 50 dB $L_{Aeq(1hour)}$ night

Impact	Relevant guideline	Construction noise/ vibration objective
Vibration – disturbance to building occupants	NSW 'Environmental Noise Management Assessing Vibration: A Technical Guideline' (AVTG) [9] CNVS [1]	To assess the potential for vibration impact on human comfort, an initial screening test will be done based on peak velocity units, as this metric is also used for the cosmetic damage vibration assessment. The initial screening test values are: • Critical areas - 0.28 mm/s (day or night) • Residential buildings - 0.56 mm/s (15h day); 0.40 mm/s (9h night) • Offices, schools, educational institutions and places of worship - 1.10 mm/s (day or night) • Workshops - 2.20 mm/s (day or night). If the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (i.e. eVDV) will be determined based on the level and duration of the vibration event causing exceedance as detailed in Section 2.3.1 of the CNVS and Section 2.4 of the AVTG.
Vibration – structural damage to buildings	British Standard BS 7385-2:1993 'Evaluation and measurement for vibration in buildings' [13] German Standard DIN 4150-3: 2016-12, Structural vibration - Effects of vibration on structures [14] CNVS [1]	A conservative vibration damage screening level (peak component particle velocity) per receiver type is detailed in Section 2.4 of the CNVS and outlined below: • Reinforced or framed structures: 25.0 mm/s • Unreinforced or light framed structures: 7.5 mm/s. Heritage buildings and structures found to be structurally unsound (following inspection) would adopt a more conservative vibration damage screening level (peak component particle velocity): • Heritage structures (structurally unsound): 2.5 mm/s (initial screening level). Where the predicted and/or measured vibration is greater than shown above, a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure will be completed to determine the applicable vibration limit.
Sensitive scientific and medical equipment	ASHRAE Applications Handbook (SI) [15] and AS 2834 Computer Accommodation [16]	Where vibration sensitive equipment is potentially affected by construction works, vibration limits for the operation of the equipment will be taken from manufacturer's data or provided by the equipment owner. Where this is not available, the following generic Vibration Criterion (VC) curves apply: • Computer Areas 0.7 mm/s, rms* 1.0 mm/s, peak • Medical 0.1 mm/s, rms* 0.14 mm/s, peak • Vibration criterion curve VC-A 0.05 mm/s, rms* 0.07 mm/s, peak • Vibration criterion curve VC-B 0.025 mm/s, rms* 0.03 mm/s, peak * Measured in one-third octave bands over the frequency range 8 to 100 Hz

5 Construction airborne noise impacts

5.1 Noise prediction methodology

Assessment of airborne noise impacts from the construction works were determined by predicting noise levels using a Cadna-A computer noise model developed for this project. The Cadna-A noise model incorporates ground elevation contours, building heights, the built environment, and atmospheric conditions to predict the contribution of each noise source at identified sensitive receiver locations and allows for the prediction of the total noise from a worksite for the various construction stages.

Key details regarding the construction work locations, the likely plant and equipment, and hours of operation were informed by the Design and Construction Teams.

A summary of the noise model input parameters is detailed in Table 5.1.

Table 5.1: Summary of noise modelling parameters

Parameters	Inputs
Calculation method	ISO 9613-2:1996 implementing quality standard ISO 17534-1:2015
Location of noise sources	0.5m to 2m above the ground depending on the equipment or plant in use
Height of receivers	1.5m above ground level to represent 1.5m above ground floor level Additional 3m height for every additional floor assessed (i.e. 4.5m above ground for first floor, 7.5m for second floor etc.)
Ground topography	1m digital ground contours
Sound power levels of plant and equipment	Detailed in Table C.1 in APPENDIX C. Activity timing, number of plant and hours of operation also in Table C1.
Ground absorption	0.5
Noise barriers and screening	Noise barriers are being installed as part of these works and are therefore not included in the noise predictions. Existing buildings providing shielding to receivers has been included in the noise model.
Acoustic sheds/ enclosures	Not considered in the assessment as they are being built.
Noise source corrections	Noise source penalty corrections have been applied in accordance with Section 4.5 of the NSW Interim Construction Noise Guideline (INCG).

The noise predictions in this report represent a realistic worst-case scenario when construction occurs at a works location close to residences and other sensitive receivers. At each receiver, noise levels will vary during the construction period based on:

- the position of equipment within the worksite and distance to the receiver;
- the construction activities being undertaken;
- the noise levels of plant items and equipment
- temporary noise barriers/ construction hoarding/ acoustic sheds or enclosures.

Predicted noise levels presented in APPENDIX D are the maximum noise levels for each building. Actual noise levels will often be less than the predicted levels presented in this report.

5.2 Predicted noise levels

Noise impacts during construction works have been predicted and compared to the noise management levels (NMLs). A receiver is considered construction noise affected when the predicted construction noise level is above the NML. Table 5.3 and Table 5.4 present a summary of the number of residential receivers and 'other sensitive receivers (respectively) likely to be noise affected by the proposed activities. The tables are colour coded to indicate how much the predicted noise level is above the NML and the corresponding perceived noise impact, based on the CNVS, as noted in Table 5.2.

Table 5.2: Key to the predicted construction noise results tables

Assessment	Time of day	Key			
$L_{Aeq(15min)}$	Standard hours[1] or Outside standard hours	0-10 dB(A) above NML (green) Noticeable to clearly audible	11-20 dB(A) above NML (yellow) Clearly audible to moderately intrusive	21-30 dB(A) above NML (orange) Moderately intrusive to highly intrusive	>30 dB(A) above NML (purple) Highly intrusive .
Sleep disturbance	Night only	$L_{Aeq,15min}$ above 40 dB(A) or RBL plus 5 dB, whichever is the greater (yellow)		L_{Amax} above 52 dB(A) or RBL plus 15 dB, whichever is the greater (purple)	

Notes: 1. Highly noise affected (HNA) which is greater than 75dB(A) during standard construction hours is shown with **Bold** text and applies to residential receiver buildings only.

Table 5.3 summarises the number of construction noise affected residential receivers (i.e. receivers where predicted L_{Aeq} noise levels construction works are above the NML) and the likely perceived noise impact. Table 5.4 presents the number of construction noise affected other sensitive receivers. Detailed predicted L_{Aeq} noise levels for all receivers in each NCA are presented in Table D.1 of APPENDIX D.

The impacts presented below and in Table D.1 are the maximum predicted noise levels for each activity based on the plant and equipment operating in the closest location relative to the receiver, for the Pyrmont West and Pyrmont East worksites. The cumulative impact from both construction sites operating concurrently is unlikely to add more than 2 dB(A) to the overall airborne construction noise level. To allow for changes to the construction program, cumulative impacts from the worksites can be reviewed in the Appendix D spreadsheet on a case-by-case basis, based on the activities likely to be occurring concurrently.

Table 5.3: Number of receiver buildings over the airborne noise management level (all NCAs) – residential receivers

Worksite	Construction activity	Assessment reference[1]	Highly noise affected[2, 3]	Day (standard hours)[2]				Day (outside standard hours)[2]				Evening[2]				Night[2]				Sleep disturbance[2]	
			L_{Aeq}	L_{Aeq}				L_{Aeq}				L_{Aeq}				L_{Aeq}				L_{Aeq}	L_{Amax}
			> 75 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	> 40 or RBL+5 dB(A)	> 52 or RBL+15 dB(A)
Pyrmont West	Class-B hoarding erection	PW-SE(B)	7	15	5	0	0	17	7	3	0	21	12	3	1	27	18	3	1	49	58
	Demolition - above hoarding	PW-DE(AH)	28	84	22	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Demolition - below hoarding	PW-DE(BH)	25	53	11	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Dismantle Class-B; erect Class-A hoarding	PW-SE(A)	26	41	9	0	0	71	18	15	4	100	23	18	6	102	49	16	9	176	209
	Preliminary earthworks and piling pad	PW-PE	25	51	2	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Piling and capping beams	PW-PC	18	27	7	0	0	20	12	3	0	22	18	3	2	12	17	5	2	53	68
	Platform and acoustic shed erection	PW-PAS	4	18	2	0	0	13	10	3	1	10	14	4	1	7	18	5	1	31	53
Pyrmont East	Class-B hoarding erection[3]	PE-SE(B)	0	6	2	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Demolition - above hoarding[3]	PE-DE(AH)	10	39	2	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Demolition - below hoarding[3]	PE-DE(BH)	8	32	3	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Dismantle Class-B; erect Class-A hoarding[3]	PE-SE(A)	8	10	4	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Preliminary earthworks and piling pad	PE-PE	6	23	5	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Piling and capping beams	PE-PC	5	6	3	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Platform and acoustic shed erection	PE-PAS	0	32	1	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	4[5]	2[5]	0	0	6[5]	0
	Temporary shaft excavation at surface[3]	PE-SE(S)	7	43	4	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	3[5]	0	0	0	3[5]	0
	Temporary shaft excavation at 5m depth[3]	PE-SE(5m)	5	34	4	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	3[5]	0	0	0	3[5]	0
	Temporary shaft excavation at 10m depth[3]	PE-SE(10m)	5	34	4	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	3[5]	0	0	0	3[5]	0
	Temporary shaft support works at surface level[3]	PE-GS(S)	4	8	0	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Temporary shaft support works at 5m depth[3]	PE-GS(5m)	2	8	2	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Temporary shaft support works at 10m depth[3]	PE-GS(10m)	2	8	2	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]

Worksite	Construction activity	Assessment reference[1]	Highly noise affected[2, 3]	Day (standard hours)[2]				Day (outside standard hours)[2]				Evening[2]				Night[2]				Sleep disturbance[2]	
			L_{Aeq}	L_{Aeq}				L_{Aeq}				L_{Aeq}				L_{Aeq}				L_{Aeq}	L_{Amax}
			> 75 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	> 40 or RBL+5 dB(A)	> 52 or RBL+15 dB(A)
Site wide	Permanent shaft excavation and support works with shed	SW-SE	0	4	0	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
(Pyrmont West and Pyrmont East, with shed)	Permanent shaft excavation (Option A) and support works	SW-SE-A	0	5	0	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Permanent shaft temporary ground support works	SW-GS(S)	0	0	0	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Permanent shaft base slab	SW-BS	0	0	0	0	0	0	0	0	0	1	0	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Mined tunnelling and associated activities of rockbolting, shotcreting and mucking out; spoil haulage; delivery of material to directly support tunnelling activities	SW-MTS	0	1	0	0	0	5	0	0	0	10	0	0	0	8	0	0	0	8	8
	Mined tunnel lining, including delivery of concrete	SW-MTL	0	0	0	0	0	0	0	0	0	1	0	0	0	4	0	0	0	4	4
Pyrmont West	Acoustic shed decommissioning	PW-ASD	3	15	4	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
Pyrmont East	Acoustic shed decommissioning	PE-ASD	0	5	0	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]

Note: Construction noise level cells are shaded based upon the predicted worst case NML exceedance in accordance with the key presented in Table 5.2

1. For detail, refer to Table C1 in APPENDIX C

2. Highly noise affected applies to residential receivers, as per the ICNG.

3. Assumes acoustic shed is not yet completed (i.e. no shed) for this activity. The acoustic shed is being constructed during the temporary shaft excavation. Conservative approach of 'no shed' applied here. Shaft excavation inside the acoustic shed is assessed in the site wide construction activities.

4. No work is proposed outside standard construction hours for this work activity.

5. Generator startup at 5:30 am to allow for site personnel the opportunity to use toilets and change rooms. Generator will be removed from site once mains power has been established.

Grey text indicates works completed at time of DNVIS issue.

Table 5.4: Number of other sensitive receivers over the airborne noise management levels (all NCAs)

Stage	Construction activity	Assessment reference	Commercial[1]				Childcare[1]				Educational[1]				Recreational[1]				Places of worship[1]				Hotel/Motel/ Hostel[1]				Other[1]			
			1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)
Pyrmont West	Class-B hoarding erection	PW-SE(B)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0
	Demolition - above hoarding[3]	PW-DE(AH)	16	2	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	3	1	0	2	1	0	0
	Demolition - below hoarding[3]	PW-DE(BH)	5	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	1	0	2	0	0	0
	Dismantle Class-B; erect Class-A hoarding	PW-SE(A)	4	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	1	0	1	0	0	0
	Preliminary earthworks and piling pad[3]	PW-PE	5	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	1	0	0	0	2	0
	Piling and capping beams	PW-PC	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0
	Platform and acoustic shed erection	PW-PAS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0
Pyrmont East	Class-B hoarding erection	PE-SE(B)	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	2	0	0	0
	Demolition - above hoarding	PE-DE(AH)	6	6	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	2	2	0	2	0	2	0
	Demolition - below hoarding	PE-DE(BH)	4	6	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	2	2	0	1	1	1	0
	Dismantle Class-B; erect Class-A hoarding	PE-SE(A)	7		0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	1	2	0	1	2	0	0
	Preliminary earthworks and piling pad	PE-PE	5	6	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	1	2	0	1	1	0	0
	Piling and capping beams	PE-PC	3	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2	1	0	2	0	0	0
	Platform and acoustic shed erection	PE-PAS	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0
	Temporary shaft excavation at surface level[3]	PE-SE(S)	7	5	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	1	2	0	1	1	0	0
	Temporary shaft excavation at 5m depth[3]	PE-SE(5m)	7	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	1	1	0	0
	Temporary shaft excavation at 10m depth[3]	PE-SE(10m)	8	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	1	1	0	0
	Temporary shaft support works at surface level[3]	PE-GS(S)	3	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	2	0	0	0
	Temporary shaft support works at 5m depth[3]	PE-GS(5m)	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	1	0	0	0
	Temporary shaft support works at 10m depth[3]	PE-GS(10m)	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	1	0	0	0

Stage	Construction activity	Assessment reference	Commercial[1]				Childcare[1]				Educational[1]				Recreational[1]				Places of worship[1]				Hotel/Motel/ Hostel[1]				Other[1]			
			1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)
Site wide (Pyrmont West and Pyrmont East, with shed)	Shaft excavation and support works	SW-SE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0
	Permanent shaft excavation (Option A) and support works	SW-SE-A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0
	Permanent shaft temporary ground support works	SW-GS(S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	Permanent shaft base slab	SW-BS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	Mined tunnelling and associated activities of rockbolting, shotcreting and mucking out; spoil haulage; delivery of material to directly support tunnelling activities	SW-MTS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
	Mined tunnel lining, including delivery of concrete	SW-MTL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Pyrmont West	Acoustic shed decommissioning	PW-ASD	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0
Pyrmont East	Acoustic shed decommissioning	PE-ASD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0

Note: Highly noise affected does not apply to OSRs, as per the ICNG.

1. Commercial, recreational and other sensitive receivers have been assessed against the respective NMLs (see Table B1 in APPENDIX B), and exceedances have been presented in the count table. 'Other' includes industrial receivers, television or recording studios. For more detail on specific impacts to receivers refer to Appendix D (Table D.1)

2. Impacts only applicable when facility is in use.

3. Assumes acoustic shed is not yet completed (i.e. no shed) for this activity. The acoustic shed is being constructed during the temporary shaft excavation. Conservative approach of 'no shed' applied here. Shaft excavation inside the acoustic shed is assessed in the last line item of this table.

Grey text indicates works completed at time of DNVIS issue.

5.2.1 Standard construction hours

The results summarised in Table 5.3 and Table 5.4 show that residential and other sensitive receivers are expected to be construction noise affected by all the works at Pyrmont West and Pyrmont East during standard construction hours. Residential receivers close to the worksites may be highly noise affected (i.e exposed to construction noise above $L_{Aeq(15min)}$ 75 dB(A)).

Mitigation and management measures to reduce construction noise levels towards the standard construction hours NML are summarised in Section 9.

Review of the predicted noise levels indicates that there are receivers close to the worksites likely to experience internal noise levels greater than $L_{Aeq(15\ minute)}$ 60 dB(A) inclusive of a 5 dB penalty during the rock breaking or other highly noise intensive activity during the construction works at Pyrmont West and East, mostly when high noise generating works are located close to the receiver. This includes excavation of the temporary shaft at Pyrmont East, prior to the completion of the acoustic shed. JCG JV will consult with identified receivers where internal noise levels are above $L_{Aeq(15\ minute)}$ 60 dB(A) with the objective of determining appropriate hours of respite. Consultation requirements are summarised in Section 9.1 and 9.2.

Once the acoustic sheds are constructed, airborne noise impacts from the excavation of the shafts at Pyrmont East and Pyrmont West are below internal $L_{Aeq(15\ minute)}$ 60 dB(A) at all receivers.

5.2.2 Out of hours work

The results summarised in Table 5.3 and Table 5.4 show that there will be construction noise affected residential receivers where works are undertaken outside standard construction hours. During Stage 1 and 2 works (i.e. demolition and temporary shaft excavation), out-of-hours works will only occur where the works require ROL, as outlined in Section 2.2.1. This includes Class-B hoarding installation and dismantling; Class-A hoarding installation, piling and capping beam works; and platform and acoustic shed erection, where these works bound the site on Pyrmont Bridge Road and Pyrmont Street. Several other sensitive receivers, including hotels, should they be occupied, are expected to be construction noise affected by the out-of-hours construction works.

At Pyrmont East a generator has been installed on site to provide power during the platform and acoustic shed erection, until mains power is available. The generator is required from 5.30am to allow for site personnel the opportunity to use toilets and change rooms prior to shift commencement. The generator is located between site buildings that provide shielding to the nearest residential receivers with the exhaust oriented to the north (away from sensitive receivers). Additional noise blankets will be installed on sides not shielded by the site buildings. Noise monitoring will be undertaken at the nearest receiver on Edward Street to confirm actual noise levels from the generator operating (see Section 9.6.1). Where noise levels do not meet the NML, additional noise blankets will be installed, where feasible and reasonable, to mitigate noise levels further.. Note that the platform and acoustic shed will provide additional shielding as it is constructed.

Once the acoustic sheds are constructed, out of hours works will be undertaken where the works satisfy the requirements of Condition D23(d). Key activities that will be undertaken outside standard construction hours are identified in Table C1-1 and Table C1-2 in APPENDIX C and include:

- Base slabs construction (large concrete pour) up to 10:00 pm;
- Mined tunnel excavation and associated activities of rockbolting, shotcreting and mucking out 24 hours per day, with spoil haulage and delivery of materials to support tunnelling up to 10:00 pm. Some concrete trucks may be required after 10:00 pm, subject to the suitability of using long-life mix shotcrete for ground support works between 10:00 pm and 7:00 am;
- Tunnel lining (permanent concrete works) during the evening period, with some concrete pours extending into the night period (10:00 pm to 7:00 am) as noted in Section 2.2.1.

Predicted impacts at residential receivers are within 5 dB(A) of the evening NML and within 3 dB(A) of the night NML at all residential receivers, with the exception of the two residential properties directly north of the Pyrmont West worksite. Mitigation and management measures to reduce construction noise levels to the out-of-hours hours NML are summarised in Section 9.

5.2.3 Sleep disturbance

The results summarised in Table 5.3 show that there are residential receivers expected to experience construction noise levels above the sleep disturbance criteria by the works undertaken at Pyrmont during the night period due to the close proximity of residential receivers to the work site.

Stage 1 and 2: Site establishment and acoustic shed construction

The installation and dismantling of the hoardings (Class-A and Class-B), piling works and acoustic shed construction require high noise impact plant, such as the use of a circular saw. This results in many receivers exceeding the sleep disturbance screening level. Where feasible all circular saw operation should be completed before 10pm and if required after 10pm no circular sawing after 12am.

Stage 3: Mined tunnelling and associated activities for station cavern and adits

Once the acoustic sheds are constructed, out of hours works will be undertaken where the works satisfy the requirements of Condition D23(d). Key activities that will be undertaken during the night period (between 10:00pm and 7:00am) are identified in Table C1-1 and Table C1-2 in APPENDIX C and include:

- Mined tunnel excavation and support 24 hours per day, excluding heavy vehicle movements for spoil handling and concrete delivery; and
- Large concrete pours during base slab construction and permanent tunnel lining that require completion in a single pour are planned for completion by 10:00pm. Some contingency is required for limited occasions where there may be a need to commence delivery of concrete to the Pyrmont East worksite from 6am, or extend deliveries beyond 10 pm to ensure , due to unforeseen circumstances.

- Four large concrete pours that are planned to be completed over 20+ hours and will require concrete deliveries between 10:00 pm and 7:00 am.

The assessment found that during night time mined tunnel excavation and support works as a worst case, up to nine (9) residential receivers may be exposed to noise levels above the sleep disturbance screening level. The two worst affected receivers will be unoccupied during the construction period. The remainder are within 1 to 3 dB(A) of the sleep disturbance screening level The most likely cause are heavy clangs and bangs at the bottom of the shaft or in the shed during the night period. Careful management of activities such as the loading and unloading of the kibble during the night period will reduce the risk of sleep disturbance events occurring.

Mitigation and management measures to reduce construction noise levels to the sleep disturbance screening level are summarised in Section 9.

Stage 3: Tunnel lining support (deliveries to site)

Predicted noise levels from truck entry off Edward Street into the Pyrmont East acoustic shed potentially exceed the CoA defined L_{AFmax} sleep disturbance event level (i.e. $L_{AFmax} \leq 52$ dB(A) or RBL + 15 dB, whichever is greater) at two residential receivers on Edward Street. Truck egress from the acoustic shed onto Pyrmont Bridge Road may trigger a noise event above the CoA defined L_{AFmax} sleep disturbance event at three residential receiver buildings. The risk of this occurring would be managed through the truck management system (see Section 9) and limiting concrete delivery to the Pyrmont East shaft to the day and evening period (7:00 am to 10:00 pm), where practicable.

Prior to any night time deliveries to Pyrmont East, noise monitoring of concrete trucks accessing the Pyrmont East acoustic shed to verify L_{Amax} noise levels would be undertaken during the day or evening period. Where measurements confirm that the L_{Amax} noise level is below the CoA sleep disturbance event level, concrete trucks would be permitted.

6 Ground-borne noise impacts

6.1 Ground-borne noise prediction methodology

Assessment of ground-borne noise impacts from the construction works were determined by predicting noise levels using a 3-dimensional model of the west shaft and east shaft was developed. The model incorporates the ground-borne noise levels versus distance prediction curve algorithms for each plant item, developed from measurement data obtained from various Sydney projects.

Key details regarding the construction work methodology, the likely plant and equipment, and hours of operation were informed by the Design and Construction Teams.

The ground-borne noise predictions in this report represent a realistic worst-case scenario when excavation occurs at the closest location to residences and other sensitive receivers. At each receiver, noise levels will vary during the construction period based on:

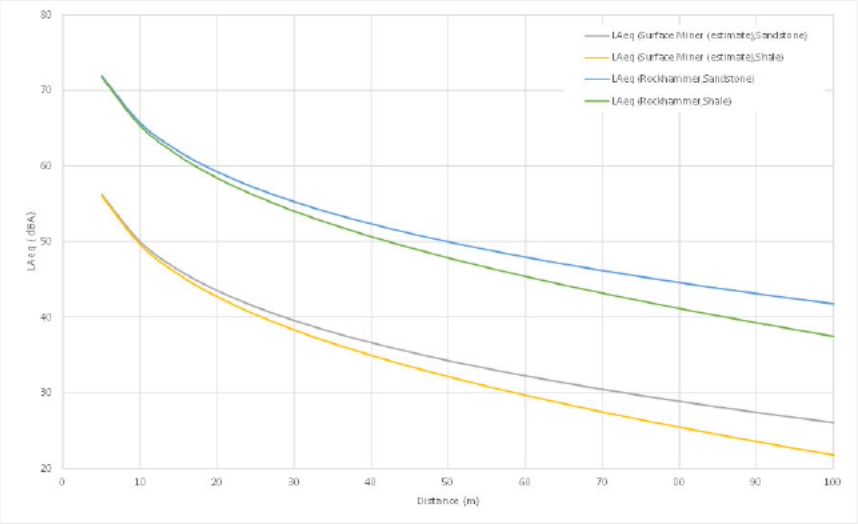
- the position of equipment within the shaft and distance to the receiver;
- the excavation activity being undertaken/ plant items and equipment in use;
- construction methodology.

Predicted noise levels presented in APPENDIX D are the maximum noise levels for each building. Actual noise levels will often be less than the predicted levels presented in this report.

A summary of the noise model input parameters is detailed in Table 6.1.

Table 6.1: Summary of noise modelling parameters

Parameters	Inputs
Calculation method	Empirical model using ground-borne noise levels versus distance prediction curve algorithms. Distances between the excavation works and nearby buildings was calculated as the 3-dimensional slant distance from the closest edge of the buildings to: - Temporary shaft excavation depth - Permanent shaft excavation depth.
Location of ground-borne noise sources	3D shaft information was provided by JCG: - Shaft based on site layout (ref: SMWSTETP-JCG-PYR-SN150-CV-DRG-045102) with details of shaft depth provided. - Assumed shaft depth of 5 m below surface when acoustic shed complete.
Height of receivers	Ground-borne noise levels are calculated on the ground floor level of within each building. Assumed 2 dB loss for every additional floor assessed.
Ground topography	1m digital ground contours

Parameters	Inputs
Ground-borne noise sources:	Algorithms based on measurement data obtained from Sydney Metro City & South-West (TSE), Sydney Metro North-West (NWRL), WestConnex Rozelle Interchange (WCX3B), WestConnex M8 (M5N), WestConnex M4East (M4E), Cross City Tunnel (CCT), Lane Cove Tunnel (LCT), Epping to Chatswood Rail Link (ECRL). See Figure 6.1. Shaft excavation method, number of plant and hours of operation detailed in Table C.1 in APPENDIX C. A 5 dB(A) penalty has been applied for rockhammer excavation works due to the annoying characteristic.
Ground-borne noise sources:	**Figure 6.1: Indicative ground-borne noise levels from shaft excavation**  Source: GBN from Sydney tunnel projects, including SM-C&SW, WCX3B, M8, M4E and SM-NW
Engineering margin	The ground-borne noise predictions are based on typical geology for the area, comprising Sydney sandstone with a varying depth of shale above. However due to localised geological anomalies, foundation-to-footing interaction and the large range and variety of structures that exist (e.g. construction type, dimensions, materials, quality of construction, footing conditions etc) actual GBN levels may vary significantly to what has been predicted herein. The GBN empirical algorithms are derived from the 95th percentile of the measured GBN data. **Verification measurements shall be undertaken at the first opportunity to check and verify the models.**

6.2 Predicted ground-borne noise levels

Ground-borne noise impacts during construction works have been predicted and compared to the noise management levels (NMLs). A receiver is considered construction noise affected when the predicted construction noise level is above the NML. Table 6.3 and Table 6.4 present a summary of the number of residential receivers and 'other sensitive receivers (respectively) likely to be noise affected by the proposed activities. The tables are colour coded to indicate how much the predicted noise level is above the NML and the corresponding perceived noise impact, based on the CNVS, as noted in Table 6.2.

Figures showing ground-borne noise impacts during shaft excavation are provided in APPENDIX E. TO satisfy Condition D38, recovers where predicted GBN levels are more than $L_{eq(15min)}$ 60 dB(A) are summarised in APPENDIX E.3.

Table 6.2: Key to the predicted construction ground-noise results tables

Assessment	Time of day	Key		
$L_{Aeq(15min)}$	Standard hours[1] or Outside standard hours	0-10 dB(A) above NML (green)	11-20 dB(A) above NML (yellow)	>20 dB(A) above NML (orange)

Table 6.3 summarises the number of construction noise affected residential receivers (i.e. receivers where predicted L_{Aeq} noise levels construction works are above the NML) and the likely perceived noise impact. Table 6.4 presents the number of construction noise affected other sensitive receivers. Detailed predicted L_{Aeq} noise levels for all receivers in each NCA are presented in APPENDIX E.

Table 6.3: Number of residential receiver buildings over the GBN management level (all NCAs)

Work site	Construction activity	Day (standard hours)			Day (outside standard hours)			Evening			Night		
		L_{Aeq}			L_{Aeq}			L_{Aeq}			L_{Aeq}		
		1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)
Pyrmont West	Permanent shaft – Rockhammer excavation – 5 m deep	15	7	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Permanent shaft – Rockhammer excavation – 10 m deep	18	4	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Permanent shaft – Rockhammer excavation – 20 m deep	20	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Permanent shaft – Rockhammer excavation – 30 m deep	13	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
Pyrmont East	Temporary shaft – Rockhammer excavation – 5 m deep	7	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Temporary shaft – Rockhammer excavation – 10 m deep	7	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Temporary shaft – Rockhammer excavation – 20 m deep	5	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Temporary shaft – Rockhammer excavation – 30 m deep	0	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Permanent shaft – Surface Miner excavation – 5 m deep	0	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Permanent shaft – Surface Miner excavation – 10 m deep	0	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Permanent shaft – Surface Miner excavation – 20 m deep	0	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Permanent shaft – Surface Miner excavation – 30 m deep	0	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]

Note: 1. No shaft excavation works are proposed outside standard construction hours. Mined tunnel excavation has not been assessed in this issue of the DNVS.

2. Construction noise level cells are shaded based upon the predicted worst case NML exceedance in accordance with the key presented in Table 6.2.

Table 6.4: Number of other sensitive receivers over the noise management levels (all NCAs)

	Construction activity	Commercial			Childcare			Educational			Places of worship			Hotel/Motel/ Hostel			Recording Studio		
		L_{Aeq}			L_{Aeq}			L_{Aeq}			L_{Aeq}			L_{Aeq}			L_{Aeq}		
		1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)
Pyrmont West	Temporary shaft – Rockhammer excavation – 5 m deep	4	1		0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
	Temporary shaft – Rockhammer excavation – 10 m deep	5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
	Temporary shaft – Rockhammer excavation – 20 m deep	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
	West temporary shaft – Rockhammer excavation – 30 m deep	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Pyrmont East	Temporary shaft – Rockhammer excavation – 5 m deep	4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	1
	Temporary shaft – Rockhammer excavation – 10 m deep	4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	1
	Temporary shaft – Rockhammer excavation – 20 m deep	4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	1
	Temporary shaft – Rockhammer excavation – 30 m deep	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
	Temporary shaft – Surface Miner excavation – 5 m deep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Temporary shaft – Surface Miner excavation – 10 m deep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Temporary shaft – Surface Miner excavation – 20 m deep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Temporary shaft – Surface Miner excavation – 30 m deep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

Note: 1. Commercial, industrial and other sensitive receivers have been assessed against the respective NMLs, and exceedances have been presented in the count table.

2. Impacts only applicable when facility is in use.

6.2.1 Standard construction hours

The results summarised in Table 6.3 and Table 6.4 show that nearby residential receivers are likely to be ground-borne noise affected by temporary shaft excavation works (without and with the acoustic shed

installed) at the Pyrmont West and Pyrmont East worksites during standard construction hours. The impacts progressively reduce as the shaft deepens.

During the excavation of the Pyrmont West shaft there are up to six (6) residential receivers to the north of the Pyrmont West worksite where predicted ground-borne noise levels are above $L_{eq(15min)}$ 60 dB(A). Consultation will be required to manage respite periods in accordance with CoA D38 and D39, as outlined in Section 9.1.2. There are two (2) recording studios opposite the Pyrmont West worksite that are predicted to be ground-borne noise affected by the temporary shaft excavation, but predicted levels are less than $L_{eq(15min)}$ 60 dB(A)). There is one (1) commercial receiver where predicted noise levels may exceed $L_{eq(15min)}$ 60 dB(A)) during early excavation (depth approx. 5 m below surface).

An alternative excavation methodol”gy t’ use surface miners was considered for Pyrmont West to potentially reduce ground-borne noise impact, however this was not feasible as the site is too small for the plant to operate effectively.

During the rockhammer excavation of the Pyrmont East shaft predicted ground-borne noise levels at all receivers surrounding the Pyrmont East worksite are less than $L_{eq(15min)}$ 60 dB(A). Consultation will be undertaken to understand sensitive time periods and coordinate respite, as outlined in Section 9.2. The use of surface miners have also been considered for the excavation works at Pyrmont East and as the site is larger, there is potential for this method to be used to reduce ground-borne noise impacts. Predicted ground-borne noise levels at all receivers, except the recording studios, are below the ground-borne NML during the day period.

Note that predictions are based on the worst-case scenario when excavation is occurring at the closest location to the receiver and are to ground floor level. Ground borne noise levels to level two and above will be less than the levels predicted in this report. Verification monitoring is recommended to confirm predicted levels at the nearest receivers as discussed in Section 9.6.2.

Impacts from ground-borne noise can be managed on the worksites by excavating in different areas of the site over the excavation period, providing respite to the nearest receivers. Appendix E.4 and E.5 present ground-borne noise ‘heat’ maps. The shaft area is divided into a 5 m by 5 m grid. Each grid presents the predicted ground-borne noise level from the worst affected receiver at the excavation depth. Works on site will be managed to ensure the respite requirements of Condition D39 and D40 are maintained at each excavation depth.

6.2.2 Out of hours work

Shaft excavation works that would generate ground-borne noise impacts are not scheduled during OOHW periods, as shown in Table C1 in APPENDIX C.

7 Construction vibration impacts

7.1 Vibration assessment methodology

7.1.1 Vibration intensive activities

From the plant and equipment listed in APPENDIX C, the site establishment activities with dominant vibration generating plant and equipment include:

Table 7.1: Pyrmont Station vibration intensive activities and plant items

Activity/ work area	Aspect	Vibration intensive plant
Western worksite		
Site Establishment	Hoarding erection and site offices	Nil
	Demolition	Excavator 13T (Hammer); Excavator 49T (Hammer)
	Preliminary earthworks and piling pad	Excavator 35T (Hammer); Vibratory Roller 16T (Smoothdrum; Padfoot)
Acoustic shed construction	Piling and capping beams	Piling Rig (Bauer BG36); Jackhammer
	Platform and acoustic shed	Nil
Permanent shaft excavation (with shed)	Shaft excavation and spoil haulage	Excavator 35T (Hammer; Saw attachment; Cutter attachment)
	Ground support works	Drill Rig (percussive)
	Permanent shaft base slab	Nil
Mined tunnelling and associated activities	Tunnelling and associated activities of rockbolting, shotcreting and mucking out; spoil haulage; delivery of material to directly support tunnelling activities	Nil on surface; tunnelling assessed in Tunnelling DNVIS
	Tunnel lining (concreting), including delivery of concrete	Nil
Demobilisation	Platform and acoustic shed (west) removal	Nil
Eastern worksite		
Site Establishment	Hoarding erection and site offices	Nil
	Demolition	Excavator 49T (Hammer)
	Preliminary earthworks and piling pad	Excavator 35T (Hammer); Vibratory Roller 16T (Smoothdrum; Padfoot)
Acoustic shed construction	Piling and capping beams	Piling Rig (Bauer BG36); Jackhammer
	Platform and acoustic shed	Nil
Temporary shaft excavation/ Permanent shaft excavation	Shaft excavation and spoil haulage	Excavator 35T (Hammer; Saw attachment; Cutter attachment; surface miner)
	Ground support works	Drill Rig (percussive)
	Permanent shaft base slab	Nil

Activity/ work area	Aspect	Vibration intensive plant
Mined tunnellingand associated activities	Tunnelling and associated activities of rockbolting, shotcreting and mucking out; spoil haulage; delivery of material to directly support tunnelling activities	Nil on surface; tunnelling assessed in Tunnelling DNVIS
	Tunnel lining (concreting), including delivery of concrete	Nil
Demobilisation	Platform and acoustic shed (east) removal	Nil

Potential vibration generated to receivers is dependent on separation distances, the intervening soil and rock strata, dominant frequencies of vibration, and the receiver structure. The recommended minimum working distances for vibration intensive plant in Table 7.2 are taken from a database of vibration levels measured at various sites or obtained from other sources (e.g. BS5228-2:2009). They are not specific to the Project works as final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver.

Potential impacts are identified by determining the buildings/ structures likely to be within the recommended minimum working distances, taking into consideration the vibration intensive plant in use, location of works and distance to nearest affected receiver buildings/ structures.

7.1.2 Minimum working distances for vibration intensive plant

Site specific minimum working distances for vibration significant plant items must be measured on site where plant and equipment is likely to operate close to or within the recommended minimum working distances for cosmetic damage (Table 7.2).

Table 7.2: Recommended minimum working distances (m) for managing vibration impact based on screening criteria

Vibration sensitive receiver	Minimum working distances for vibration intensive plant, m										
	Jackhammer	Excavator 35t (Saw)	Excavator 35t (Cutter)	Drill Rig (percussive)	Surface Miner	Piling Rig (Bauer BG36)	Excavator 13t (Hammer)	Excavator 35t (Hammer)	Excavator 49t (Hammer)	Roller <16t Smooth (vibratory mode)	Roller <16t Padfoot (vibratory mode)
Structural damage to buildings											
Reinforced or frame structures (Line 1)[1]	5	5	5	5	5	5	5	5	5	5	5
Unreinforced or light framed structures[1, 2]	5	5	5	5	5	5	5	5	10	5	10
Structurally unsound heritage structures[1, 2]	5	5	5	5	5	5	10	15	20	15	20
Disturbance to building occupants											
Critical areas[4,7]	25	40	40	20	30	20	30	40	65	105	120

Vibration sensitive receiver	Minimum working distances for vibration intensive plant, m										
	Jackhammer	Excavator 35t (Saw)	Excavator 35t (Cutter)	Drill Rig (percussive)	Surface Miner	Piling Rig (Bauer BG36)	Excavator 13t (Hammer)	Excavator 35t (Hammer)	Excavator 49t (Hammer)	Roller <16t Smooth (vibratory mode)	Roller <16t Padfoot (vibratory mode)
Residences – Day	15	25	25	10	15	15	20	25	45	55	70
Residences – Night	-	-	-	-	-	-	-	-	-	-	-
Offices[6,7]	10	15	15	5	5	10	15	20	30	30	40
Workshops[7]	5	10	10	5	5	10	10	15	20	15	25

Notes: 1. Initial screening test criteria reduced by 50% due to potential dynamic magnification in accordance with BS7385.

2. In accordance with CNVMP, a site inspection should determine whether a heritage structure is structurally unsound.

3. Minimum working distances are in 5m increments only to account for the intrinsic uncertainty of this screening method. Jackhammers/ plate compactors are likely to have minimum working distances smaller than 5 m.

4. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.

5. Daytime is 7 am to 10 pm; Night-time is 10 pm to 7am.

6. Examples include offices, schools, educational institutions, and place of worship.

7. Applicable when in use.

7.2 Vibration assessment

The numbers of buildings which are close to or within the minimum working distances for vibration impact are shown in Table 7.3. More detailed results are presented in APPENDIX F. The figures in APPENDIX F identify the minimum working distances for vibration over aerial photographs that also show the work areas and the land uses.

Table 7.3: Number of buildings within minimum working distances for vibration impact

	Number of buildings within minimum working distances									
	Jackhammer	Excavator 35t (Saw/ Cutter)	Drill Rig (percussive)	Surface Miner	Piling Rig (Bauer BG36)	Excavator 13T (Hammer)	Excavator 35T (Hammer)	Excavator 49T (Hammer)	Roller <16T Smooth (vibratory mode)	Roller <16T Padfoot (vibratory mode)
Pyrmont West										
Structural damage to buildings										
Reinforced or frame structures (Line 1)[1]	0	0	0	0	0	0	0	0	0	0
Unreinforced or light framed structures[1, 2]	2	2	2	2	2	2	2	7	2	8
Structurally unsound heritage structures[1, 2]	0	0	0	0	0	0	0	0	0	0
Disturbance to building occupants										
Critical areas[2,7]	0	0	0	0	0	0	0	0	0	0
Residences – Day	11	19	4	15	11	15	18	28	31	44

	Number of buildings within minimum working distances									
	Jackhammer	Excavator 35t (Saw/ Cutter)	Drill Rig (percussive)	Surface Miner	Piling Rig (Bauer BG36)	Excavator 13T (Hammer)	Excavator 35T (Hammer)	Excavator 49T (Hammer)	Roller <16T Smooth (vibratory mode)	Roller <16T Padfoot (vibratory mode)
Residences – Night	-	-	-	-	-	-	-	-	-	-
Offices[4,7]	0	0	0	0	0	0	0	0	0	0
Workshops[7]	0	0	0	0	0	0	0	0	0	0
Pyrmont East										
Structural damage to buildings										
Reinforced or frame structures (Line 1)[1]	0	0	0	0	0	0	0	0	0	0
Unreinforced or light framed structures[1, 2]	0	0	0	0	0	0	0	0	0	0
Structurally unsound heritage structures[1, 2]	0	0	0	0	0	0	0	1	0	1
Disturbance to building occupants										
Critical areas[2,7]	0	0	0	0	0	0	0	0	0	0
Residences – Day	0	4	0	0	0	2	4	5	8	11
Residences – Night	-	-	-	-	-	-	-	-	-	-
Offices[4,7]	0	0	0	0	0	0	0	1	1	1
Workshops[7]	0	0	0	0	0	0	0	0	0	0

Notes: 1. Site inspection should determine structural conditions of all potentially vibration affected buildings

2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.

3. Daytime is 7 am to 10 pm; Night-time is 10 pm to 7am.

4. Examples include offices, schools, educational institutions, and place of worship.

5. Applicable when in use.

7.2.1 Structural damage

During vibration intensive works at the Pyrmont West worksite, there are two (2) residential buildings adjacent to the west shaft (127 Pyrmont Street and 28 Paternoster Row) that will be within the minimum working distance for all vibration intensive plant, depending on the specific location the plant is operating on the worksite. When higher vibration generating plant operates, including the excavator 49T with hammer and the vibratory roller 16T (padfoot, vibratory mode), four additional residential properties (125 Pyrmont Street, 26 Paternoster Row, and 206 and 212 Harris Street) are identified within the minimum working distance.

There are no structures identified at risk of cosmetic damage from vibration intensive works at the Pyrmont East worksite. There is one heritage building within the minimum working distance for 'unsound' heritage structures when higher vibration generating plant operates on the eastern site.

Where plant is required to operate within minimum working distances, works will be paused and the construction methodology will be revised to ensure the vibration intensive plant only operates outside

the minimum working distance. Alternatively, vibration monitoring is recommended to determine site specific minimum working distances to verify that vibration levels achieve compliance with the structural damage objectives as outlined in Section 4.

Where plant is required to operate within minimum working distances, vibration monitoring is recommended to determine site specific minimum working distances and/or verify that vibration levels achieve compliance with the structural damage objectives, as outlined in Section 9.6.3.

If the monitoring above identifies that vibration is likely to exceed the structural damage objectives, a different construction method with lower source vibration levels should be considered.

7.2.2 Heritage structures at Pyrmont

The following heritage structures are identified within the recommended minimum working distance for the conservative screening limit for cosmetic damage for 'structurally unsound' structures:

- 35 Union Street, Pyrmont, here the excavator 49T with hammer and the vibratory roller 16T (padfoot, vibratory mode) operates within 10 metres of the structure.

A structural condition survey has been completed for this building and confirmed it is not 'unsound'.

7.2.3 Human annoyance

The assessing vibration guideline [7] notes that inside dwellings, adverse comments often arise when occupants can perceive (feel) vibration, particularly when the vibration arises from a source located outside their home (or outside their control) and assume that the vibration has the potential to damage their building or contents.

However, it is noted that vibration levels required to cause minor cosmetic damage are typically 10 x higher than levels that will cause disturbance to building occupants. Many building occupants assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures.

At properties near the worksite, it is possible that the nearest receivers will be able to feel vibration levels when vibration-generating equipment is being utilised. Properties where vibration levels may be above the vibration disturbance goals in Table 4.1 and there is a probability of adverse comment are shown in Table 7.3. It is important to note that human comfort levels are much lower than vibration levels likely to result in property damage and people therefore may be disturbed by vibration with no potential to result in property damage. More detailed results are presented in APPENDIX E.

As can be noted from the table above, there are properties that may be exposed to vibration above the screening limit for human annoyance. The above assessment is based on vibration-generating equipment being operating constantly at the closest location to nearby receivers. When vibration-

generating equipment operates further from the closest point, the predicted vibration levels will reduce along with the probability of adverse comment.

Attended vibration measurements are proposed to be carried out in accordance with the CNVMP Appendix A and in response to vibration complaints. If measurement results indicate events above the vibration objectives for human annoyance, vibration control and management measures will be provided to reduce vibration impact (see Section 9).

After applying all feasible and reasonable vibration mitigation measures, if vibration monitoring still identifies that measured vibration levels are above the relevant vibration criteria for human annoyance, appropriate additional management measures should be considered (see Section 9).

7.2.4 Sensitive scientific and medical equipment (SME)

Receivers with potentially sensitive scientific and medical equipment (SME) have been identified near the Pyrmont Station worksites and are summarised in Table 7.4

Table 7.4: Shortest distance between construction works and sensitive SME receivers

Worksite	Sensitive SME receiver	Distance to closest excavation face
Pyrmont West Shaft	Pyrmont Data Centre, 13A-29 Union Street, Pyrmont NSW	23 m (ground floor)
Pyrmont East Shaft	Pyrmont Data Centre, 13A-29 Union Street, Pyrmont NSW	20 m (ground floor)

The P.P.V. vibration levels vibration intensive plant is likely to generate on sensitive SME receivers has been predicted, based on a database of vibration levels measured at various sites or obtained from other sources (e.g. BS5228-2:2009). The predicted vibration levels are presented in Table 7.5 and compared against the generic Vibration Criterion (VC) curve screening level (refer to Table 4.1).

Bold text indicates the predicted vibration is above the initial screening threshold limit.

Table 7.5: Predicted vibration from construction works at sensitive SME receivers

Worksite	Sensitive SME receiver	Applicable VC-curve - screening limit PPV	Vibration intensive plant	Distance to closest excavation face	Predicted P.P.V. vibration, mm/s
Pyrmont West Shaft	Pyrmont Data Centre (ground floor)	Computer Areas 1.0 mm/s	Vibratory Roller 16 – High vibration	23 m at 5 m depth	2
				25 m at 10 m depth	2
				30 m at 20 m depth	2
				38 m at 30 m depth	1
			Excavator 45t (Hammer)	23 m at 5 m depth	1
				25 m at 10 m depth	1
				30 m at 20 m depth	1
				38 m at 30 m depth	1
			Excavator 35t (Hammer)	23 m at 5 m depth	1
				25 m at 10 m depth	1
				30 m at 20 m depth	1

Worksite	Sensitive SME receiver	Applicable VC-curve - screening limit PPV	Vibration intensive plant	Distance to closest excavation face	Predicted P.P.V. vibration, mm/s
				38 m at 30 m depth	1
Pyrmont East Shaft	Pyrmont Data Centre (ground floor)	Computer Areas 1.0 mm/s	Vibratory Roller 16 – High vibration	20 m at 5 m depth	**2**
				25 m at 10 m depth	**2**
				30 m at 20 m depth	**2**
				38 m at 30 m depth	1
			Excavator 45t (Hammer)	20 m at 5 m depth	**2**
				25 m at 10 m depth	**2**
				30 m at 20 m depth	1
				38 m at 30 m depth	1
			Excavator 35t(Hammer)	23 m at 5 m depth	1
				25 m at 10 m depth	1
				30 m at 20 m depth	1
				38 m at 30 m depth	1

The results presented in Table 7.5 indicate that vibration from rockhammer excavation of the Pyrmont East shaft and Pyrmont West shaft are likely to be below vibration limits for sensitive SME receivers, with the exception of the 45 tonne excavator with hammer at the closest location at Pyrmont East shaft to the Pyrmont Data Centre.

Vibratory rolling works should maintain a minimum working distance of 40 metres from the Pyrmont Data Centre unless non-vibratory mode can be used. The 45 tonne excavator with hammer should maintain a minimum working distance of 30 metres from the Pyrmont Data Centre until the shaft is at least 20 metres deep, after which excavation at any location within the shaft footprint is predicted to be below the vibration limit for computer areas.

Vibration monitoring is recommended at the data centre during vibratory rolling works and for excavation works, until the shaft is at least 20 metres deep to verify that vibration levels achieve compliance with the SME objectives, as outlined in Section 9.6.3.

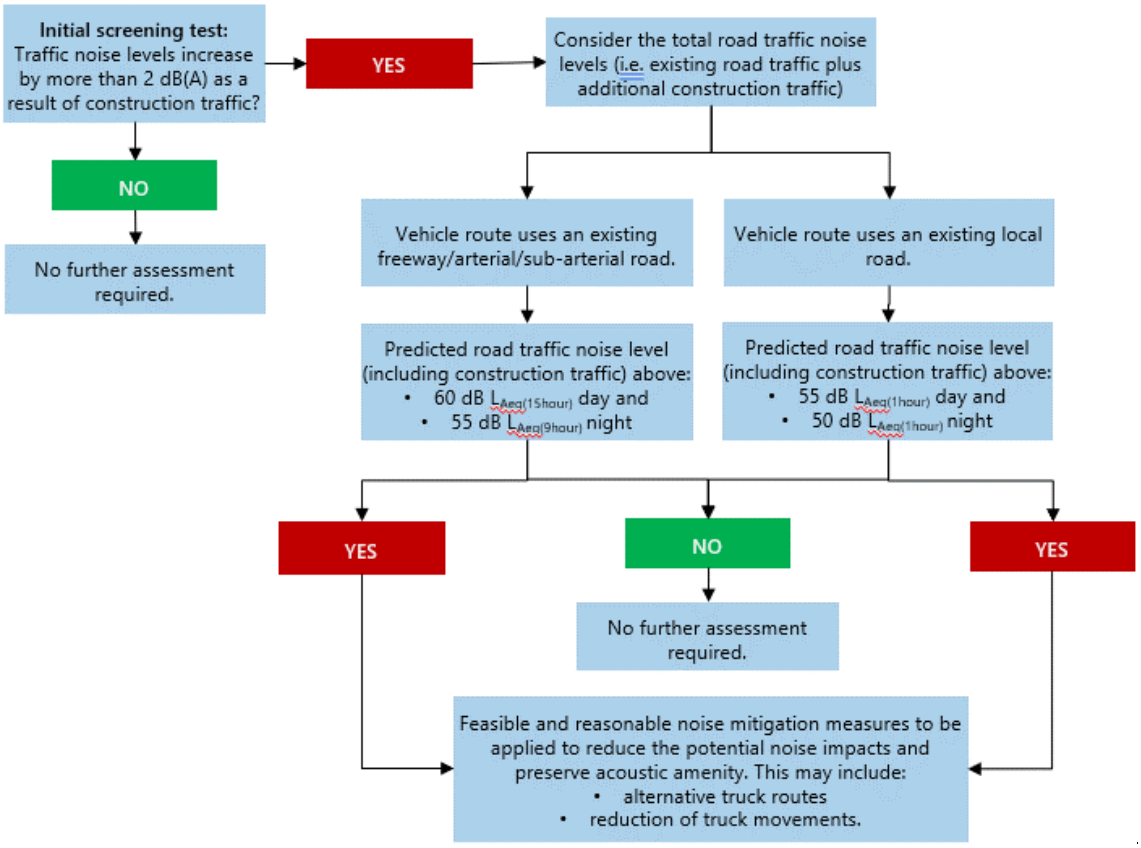
If the monitoring above identifies that vibration is likely to exceed the SME objectives, a different construction method with lower source vibration levels would be considered.

8 Construction traffic noise assessment

8.1 Traffic noise assessment methodology

Construction related traffic has the potential to temporarily increase road traffic noise levels at receivers which are adjacent to construction haulage routes. The construction road traffic noise assessment procedure is outlined in Figure 8.1.

Figure 8.1: Construction Road Traffic Noise assessment procedure



The potential impact of construction road traffic noise to nearby residential receivers has been estimated using the United Kingdom Department of Environment's 'Calculation of Road Traffic Noise' (1988) method. The method uses the average 1-hour traffic volume for the 'assessment period' (i.e. day or night) to predict the $L_{10,\ 1hour}$ noise levels. A correction of -3dB(A) is applied to obtain the $L_{eq,\ 1\ hour}$ noise levels which equate to the L_{Aeq} noise levels for the 'assessment period'.

Details of projected heavy vehicle movements associated with the construction works were provided by JCG (See Table C.1 in APPENDIX C) and are summarised in Table 8.1below.

Table 8.1: Construction generated traffic (refer to Table C.1)

Worksite	Activity/ Work Area	Day (7am to 10pm)		Night (10pm to 7am)	
		Heavy vehicles	Light vehicles	Heavy vehicles	Light vehicles
West	Site establishment and demolition	110	240	-	60
	Acoustic shed construction	95	240	4	60
	Permanent Shaft excavation	150	240	-	60
	Mined tunnel support (surface)	165	240	-	60
East	Site establishment and demolition	90	240	-	20
	Acoustic shed construction	60	240	4	20
	Temporary Shaft excavation	110	240	-	20
	Permanent Shaft excavation	150	240	-	60
	Mined tunnel support (surface)	165	240	-	60

As the proposed heavy vehicle routes have not substantially changed from the traffic routes assessed in the EIS Technical Paper 2: Noise and vibration [4], the assessment is based on the impacts presented in the EIS. Additionally, construction traffic generated during the construction stages assessed in this DNVIS will be during standard construction hours. There is no expectation for heavy vehicles after 10 pm, except for oversized deliveries or where OOHW is triggered by an ROL.

8.2 Predicted construction traffic noise

The EIS and Submissions Report summarises the predicted construction traffic noise levels during day and night periods. The predicted change in traffic noise levels from additional construction vehicles (including heavy vehicles) accessing the Pyrmont Station worksites was less than 2 dB(A). The heavy vehicle routes are consistent with the proposed routes assessed in the EIS and Submissions Report.

Construction traffic noise impacts will be managed by generally limiting heavy vehicle movements to standard construction hours. Outside standard construction hours, heavy vehicles would be limited before 10 pm as much as practical, especially where traffic conditions inhibit the use of the primary egress route (see Section 2.1.3). Heavy vehicles during the evening period (6:00 pm to 10:00 pm) are likely to be less than 10 per hour.

There may be limited heavy vehicle movement after 10 pm when OOHW is triggered by ROL or similar (e.g. oversized deliveries during acoustic shed construction). On this basis it is anticipated that construction generated traffic impacts will be consistent with the EIS predicted road traffic noise levels, that is less than 2dB(A) increase on all proposed heavy vehicle routes.

There will be a need for concrete (shotcrete) to be used on site between 10 pm and 7 am during the mined tunnelling stage, to provide temporary ground support for the tunnelling excavation. To eliminate the need to have concrete deliveries after 10 pm, the use of a long-life mix shotcrete will be trialled. The mix will be delivered to site prior to 10 pm and should be suitable for use during the 9 hour night period. If this proposed methodology was unsuccessful, shotcrete trucks would be limited to the Pyrmont East site, with up to 2 trucks per night period. The truck management system described in

Table 9.1 would be used to ensure the concrete truck is directed into the acoustics shed with minimal delay and limited opening of the acoustic shed door. Trucks would exit directly onto Pyrmont Bridge Road. This would minimise the likelihood of a noise event occurring that would trigger sleep disturbance.

There are several large concrete pours associated with the base slab for the Pyrmont East and West shaft, and for the caverns. These pours will extend up to 10:00 pm although several pours will need to commence prior to 7am and/or extend beyond 10 pm to ensure completion in a single pour, as described in Section 2.1.2 and Section 5.2. On limited occasions there. This is likely to occur on less than 12 occasions over the duration of the Project. Any pours during the night period would be within the Pyrmont East site. The truck management system described in Table 9.1 would be used to ensure the concrete truck is directed into the acoustics shed with minimal delay and limited opening of the acoustic shed door. Trucks would exit directly onto Pyrmont Bridge Road. This would minimise the likelihood of a noise event occurring that would trigger sleep disturbance (refer to Section 5.2.3 for further discussion on managing potential sleep disturbance events at night).

9 Mitigation and management measures

9.1 High noise impact activities

9.1.1 Standard respite periods (CoA D22 and EPL)

Highly noise intensive works are defined in the Conditions of approval as works which are defined as annoying under the ICNG, including:

a) use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work;

b) grinding metal, concrete or masonry;

c) rock drilling;

d) line drilling;

e) vibratory rolling;

f) bitumen milling or profiling;

g) jackhammering, rock hammering or rock breaking;

h) rail tamping and regulating; and

i) impact piling.

EPL 21784 defines *high noise impact activities and works as jack hammering, rock breaking or hammering, pile driving, vibratory rolling, cutting of pavement, concrete or steel or other work occurring on the surface that generates noise with impulsive, intermittent, tonal or low frequency characteristics*. Consistent with the NSW Noise Policy for Industry [7] Fact Sheet C, the occurrence of intermittent, tonal or low frequency characteristics is assessed at the receiver location.

Activities during site establishment, acoustic shed construction and shaft excavation works include the use of the above items. Where Condition D38 and D39 do not apply and verification monitoring finds highly noise intensive works exceed the applicable NML, respite from will be provided by limiting activities as follows to satisfy CoA D22 and the EPL Condition L5.2:

- Between the hours of 8:00am to 6:00pm Monday to Friday
- Between the hours of 8:00am to 1:00pm Saturday, and
- In continuous blocks not exceeding three hours each with a minimum respite from those activities or works of not less than one hour.

For the purposes of this requirement 'continuous' includes any period during which there is less than one-hour respite between ceasing and recommencing any of the work that is subject to this requirement.

9.1.2 Conditional respite periods (CoA D38, D39 and D40)

Under CoA D38 JCG JV must identify all receivers at Pyrmont likely to experience internal noise levels greater than $L_{eq(15\ minute)}$ 60 dB(A) inclusive of a 5 dB penalty, if rock breaking or any other highly noise intensive activity likely to result in regenerated (ground-borne) noise or a perceptible level of vibration is planned (including works associated with utility adjustments), between 7am and 8pm. Table D.1 in APPENDIX D identifies receivers where predicted internal airborne noise levels are above 60 dB(A), taking into consideration the estimated facade attenuation of the buildings. Table E.3 in APPENDIX E identifies receivers where predicted internal ground-borne noise levels are above 60 dB(A).

JCG JV will consult with the receivers identified above with the objective of determining appropriate hours of respite so that construction noise (including ground-borne noise) from rock breaking or any other highly noise intensive activity, does not exceed internal noise levels of:

a) $L_{eq(15\ minute)}$ 60 dB(A) inclusive of a 5 dB penalty if rock breaking or any other highly noise intensive activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am – 8pm for more than 50 percent of the time; and

b) $L_{eq(15\ minute)}$ 55 dB(A) inclusive of a 5 dB penalty if rock breaking or any other highly noise intensive activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am – 8pm for more than 25 percent of the time,

unless an agreement is reached with those receivers. This does not apply to noise associated with the cutting surface of a TBM as it passes under receivers.

Following consultation, the Pyrmont Station worksites construction respite program will be developed and included in this APPENDIX G of this DNVIS.

9.2 Consultation with affected receivers

CoA D29 and D30 require consultation with noise and/ or vibration affected sensitive land users to assist in determining site-specific mitigation measures.

JCG has commenced consultation and will continue to consult with potentially affected stakeholders including Councils, business and residential receivers. The consultation is focused on specific mitigation and management measures applicable to the works at the Pyrmont Station worksites. These measures may include managing noise impact and appropriate respite periods for out-of-hours works; scheduling high noise impact works around sensitive periods where feasible and reasonable; alternative methods of compaction to reduce vibration, substitution of plant and equipment to ones with a lower sound power level, offers of movie or dinner vouchers; alternative accommodation offers. Consultation is also being undertaken to understand stakeholders' noise and vibration expectations and preferences for timing of high impact noise respite. This is consistent with requirements in CoA Conditions D37, D38 and D39.

Details of completed consultation is recorded in the Sydney Metro Stakeholder Management System, Consultation Manager. A summary of the consultation program is provided below:

- Consultation with relevant community members on construction works, including site establishment, demolition, acoustic shed construction and temporary shaft excavation works.
- A Project wide community information session to discuss site establishment, utility and early shaft excavation works. These sessions will occur every quarter as the Project continues.
- Residents and businesses within the 50m of the west and east worksite shafts and the station cavern tunnel alignment will receive the following:
  - Advise of likelihood of ground-borne noise being audible during shaft excavation
  - Property condition survey offer letter,
  - Where applicable, subsurface acquisition notification which includes an information pack on tunnel excavation activities,
  - Notification of the online Tunnel Tool available through the Project website,
  - Community updates as shaft and tunnel excavation progresses and the expected noise and vibration impacts,
  - Where requested, specific meetings with stakeholders
  - Residents nominated in Table D.1 and Table E.3 (i.e. exposed to internal airborne noise (ABN) or GBN more than 60 dB(A) during shaft excavation) will be consulted regarding appropriate respite periods for highly noise intensive works. Evidence of consultation is documented in APPENDIX G.1. The outcomes of the consultation will determine the noise respite program, included in APPENDIX G.2.
  - Consultation with noise affected receivers identified in APPENDIX D to ensure additional management measures are provided (if required, refer to Section 9.4).
  - Consultation with potentially noise and/ or vibration affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) to satisfy CoA D27 and ensure events resulting in noise levels above the NMLs are not timetabled within sensitive periods, or make alternative arrangements where this cannot be avoided.
  - Consultation with community that are construction noise and/or vibration affected on a regular basis on respite during out-of-hours work. To satisfy CoA D37, this consultation will include:
    - a progressive schedule for periods no less than three (3) months of likely out-of-hours work;
    - a description of the potential work, location and duration of the out-of-hours work;
    - the noise characteristics and likely noise levels of the work; and

  - likely mitigation and management measures which aim to achieve the relevant NMLs under CoA D26, including the circumstances of when respite or relocation offers will be available and details about how the affected community can access these offers (see Section 9.4 and 9.3).

- Consultation with the owners of properties identified as at risk of exceeding the screening criteria for cosmetic damage, to satisfy Condition D31, and identified in APPENDIX E and in Table E.1 will receive the following:
  - Property condition survey offer letter,
  - Community updates as shaft excavation progresses and the expected vibration impacts,
  - Where requested, specific meetings with stakeholders.

Evidence of the receiver specific consultation program and site-specific mitigation and management measures that have been adopted to date to reduce impacts to receivers is included in APPENDIX G. Consultation will continue and mitigation measures implemented as applicable to the stage of work. APPENDIX G will be updated progressively to reflect consultation completed prior to the next stage of work at Pyrmont. The ongoing consultation record will be entered into the Sydney Metro Consultation Manager system and included in future updates of this DNVIS.

9.3 Noise and vibration control and management measures

Noise and vibration control and management measures to reduce potential noise impacts will be implemented during the construction works, where reasonable and feasible. In accordance with the ICNG and consistent with the CNVS, feasible noise mitigation measures are those work practices or measures to reduce noise that are capable of being put into practice or of being engineered and are practical to build given project constraints such as safety and maintenance requirements. Reasonable noise mitigation measures are those feasible noise mitigation measures that are considered reasonable in the circumstances, based on a judgement that the overall noise benefits outweigh the overall adverse social economic and environmental effects, including the cost of implementing the measure. To make such a judgement, consideration is to be given to noise level impacts, duration of impacts, noise mitigation benefits, cost effectiveness of noise mitigation and community views.

Table 9.1 outlines the noise and vibration control measures that will be implemented on site during the construction works, where feasible and reasonable.

Table 9.1 Site noise control measures

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
At source control measures							
Site planning and layout	Locate noise-generating activities away from sensitive receivers, where practicable. Plan traffic flow, parking, loading/unloading, and other vehicle movements to keep vehicles away from sensitive receivers where possible and to minimise reversing movements.	The site has been designed and constructed to include this (see Figure C1).	Yes	- Potential benefit of 5-10 dB(A). - Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic and environmental effects.	Yes	Yes	Fixed noise sources such as the water treatment plant is located away from more sensitive receivers. Traffic flow is one-directional. Once constructed, loading and unloading of heavy vehicles on site will take place within the acoustic sheds.
Noise control kits	Plant that is brought to site for works should meet the sound power limits identified in Table C1 of this assessment. Where plant are above limits then the plant may require installation of 'noise control kits' to comply with the noise limits in this assessment. Such 'noise control kits' comprise: • high performance 'residential-grade' exhaust mufflers, • additional engine cowling / enclosure lined inside with sound absorbent industrial-grade foam, and • air intake and discharge silencers / louvres.	This measure could be feasibly implemented. Subject to availability for each equipment item.	Yes	- Potential benefit of 5-10 dB(A). - Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic and environmental effects. - Deemed to be cost effective. - Outweighs the identified social, economic and environmental effects.	Yes	Yes, subject to noise testing on site	The need to fit 'noise control kits' onto the identified plant, will be confirmed once each plant item is tested prior to its regular use on site, or alternative the plant will be swapped for lower noise plant. (see Table C2)
Limit equipment in use	Only the equipment necessary during each stage of the works will be used.	This measure could be feasibly implemented.	Yes	- Routine measure for project team. - Sufficient noise reduction could be achieved at enough receivers. - Cost effective.	Yes	Yes	Excess equipment will be avoided where it is not needed for the works and where it is reasonable to do without it. (see Table C1 for specific limitations)
Timing of equipment in use	Where practicable, activities and plant will be scheduled/limited as outlined in Table C1 and C2 (APPENDIX C) of this assessment For example, for OOHW - During acoustic shed construction under ROL, limit all high noise activities (jackhammer, power tools etc) to standard hours, where practicable or to before midnight where the works cannot be undertaken during standard hours.	This measure is not feasible for all works as there is limited time for works to be completed under ROL (or similar).	Not for all works	- Sufficient noise reduction could be achieved at enough receivers and cost effective etc, - Note that some of the OOHW are unavoidable due to the high risk to construction personnel or public safety triggering ROL.	Not for all works	Not for all works	Where practicable, the timing of works will be managed to reduce noise levels during more sensitive periods (i.e. after 10pm and after 12am; and not before 7am). Noisy plant that supports OOHW, but does not require OOH operation (e.g. jackhammer) will be limited to standard hours use only within the worksite or off site, where practicable), providing a 5-15 dB reduction in noise levels.
Limit activity duration	Any equipment not in use for extended periods shall be switched off. For example, heavy vehicles will switch engines off when not in use, tower crane will be switched off when not in use.	This measure could be feasibly implemented.	Yes	- Routine measure for project team. Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic, and environmental effects.	Yes	Yes	Equipment that is not directly needed for works at a given time will be switched off.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Equipment selection	Use quieter and less noise/vibration emitting construction methods where feasible and reasonable, for example use rock saw to separate shaft excavation area from existing ground where practicable, to provide a reduction in GBN and vibration; vibratory rollers can, where practicable, be operated with the vibratory mode switched off to reduce vibration impact.). Concrete shears/ pulveriser attachments to be used as the primary demolition method for concrete walls and suspended concrete slabs instead of rockhammers, to reduce potential noise and vibration impacts. Surface miners are being considered to replace rockhammers in the East shaft. Rockhammers would still be required, but there would be a reduction in total rockhammer time. There is insufficient space in the west shaft for this. Electric tower crane was considered as an alternative to a diesel tower crane at Pyrmont East.	This measure could be feasibly implemented. To be determined on a case-by-case basis.	Yes	- Sufficient noise or vibration reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic, and environmental effects. An electric tower crane with sufficient load capacity was not available in Sydney to meet the Project timing. Also, the required electrical works onsite including the commissioning of the onsite sub-station has not been completed to provide power to an electric tower crane. It is noted that the tower crane is only required until the gantry crane in the acoustic shed is installed (approx. 6 months) and will only be in use during standard construction hours.	Yes	Yes	Project team shall review plant and equipment on a case-by-case basis and find opportunities to use items with lower noise/vibration impacts. The use of concrete shears/ pulveriser attachments as the primary demolition method for concrete walls and suspended concrete slabs has been detailed in the Particular Specification by Sydney Metro (Ref: SM-W-ETP-PS-482) and has been included in the demolition contract and associated documentation. Surface miners may replace some of the rockhammers in the East shaft. Review found it was found not reasonable to replace the diesel tower crane with an electric tower crane.
Alternative construction methods to reduce vibration	Alternative, less vibration generating construction methods will be reviewed where vibration significant works found to be within the site-specific minimum working distance of a structure, as determined by site vibration monitoring. For example, the use of rocksaw cutting or surface miners instead of rockbreaking to excavate the shaft.	This measure could be feasibly implemented. To be determined on a case-by-case basis.	Yes	- Sufficient vibration reduction could be achieved at identified structure to reduce the risk of structural damage from vibration significant works.	Yes	Yes	The use of alternative methods to reduce vibration transmission will be considered where site specific vibration assessments indicate that minimum working distances for cosmetic damage cannot be met.
Managing shaft excavation location to provide respite	The location of excavation works on site will be managed to ensure the respite requirements of Condition D39 and D40 are maintained at each excavation depth, taking guidance from the ground-borne noise 'heat' maps present in Appendix E.4 and E.5.	This measure could be feasibly implemented.	Yes	- Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic, and environmental effects.	Yes	Yes	The location of excavation works on site will be managed to ensure the respite requirements of Condition D39 and D40 are met. See Section 9.1.2.
Truck movements	Where practicable, avoid the use of park air brakes at night. Set up relevant traffic management measures to minimise the use of air brakes when leaving site. Air brake silencers are to be correctly installed and fully operational for any heavy vehicles (as per CNVMP). Minimise unnecessary acceleration on site and avoid vigorous slamming of truck doors.	This measure could be feasibly implemented, subject to trial of long-life shotcrete mix on site.	Yes	- Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic, and environmental effects.	Yes	Yes	Drivers will be reminded to drive responsibly on-site, especially when accessing and departing the site. Limits on truck numbers, namely for OOHW period, are identified in Table C1 and Table C2. See also truck management system below.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Limit truck movements at night	Truck movements at night will be limited as much as practicable, to reduce the risk of potential sleep disturbance at residences surrounding the worksites. Long-life shotcrete mix will be used for temporary ground support after 10:00 pm. Concrete trucks will deliver the last load of shotcrete prior to 10:00 pm. On limited occasions when concrete trucks are required during the night period, this would be at the Pyrmont East site only, with managed access (see truck management system) via Edward Street and egress via Pyrmont Bridge Road, subject to verification noise monitoring.	This measure could be feasibly implemented, subject to trial of long-life shotcrete mix on site.	Yes	- Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic, and environmental effects.	Yes	Yes	All drivers will be instructed to deliver to site prior to 10:00 pm. Access to and from site will be controlled via the truck management system (see below). Noise monitoring of truck entry to and exit from site would be undertaken to verify noise levels meet the sleep disturbance event levels.
Non-tonal reversing alarms and other audible alarms	Alternative reverse or other audible alarms, such as 'quackers' will be installed on all vehicles, mobile plant and fixed plant regularly used on site and on all vehicles & plant required for OOHW. For example, avoid tonal alarms on plant items such as gantry cranes, EWPs etc. Consider limiting the volume of other audible alarms on plant/ equipment, while maintaining safe working.	This measure could be feasibly implemented.	Yes	- Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic, and environmental effects.	Yes	Yes	Project team will mandate use of non-tonal reversing alarms on equipment.
Building condition surveys	**Undertake building dilapidation surveys on all buildings located within the minimum working distances established for cosmetic damage prior to commencement of activities with the potential to cause property damage (see Section 7.2.1 and** Table F.).	This measure could be feasibly implemented.	Yes	Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	Buildings identified within the MWD for cosmetic damage will undergo building condition survey, to reduce the risk of cosmetic damage.
Path mitigation measures							
Steel decking/ platforms as partial acoustic enclosure at Pyrmont East	Steel decking/ platforms forming the shed floor will be installed to form a partial enclosure over the temporary shaft during temporary shaft excavation	The site has been designed and constructed to include this.	Yes	- Potential benefit of 5-10 dB(A). - Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic, and environmental effects.	Yes	Yes	Steel decking/ platforms to be installed as early as practicable during construction to mitigate noise during the excavation of the temporary shaft at Pyrmont East.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Acoustic shed	Acoustic sheds with sound insulation/absorption specifications designed by Renzo Tonin & Associates will be utilised on the site.	The site has been designed and constructed to include this.	Yes	- Potential benefit of at least 20 dB(A). - Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic, and environmental effects.	Yes	Yes	Acoustic shed to be constructed as early as practicable during the construction to mitigate noise during the excavation of the shaft. Note: Shed design details to be provided in APPENDIX C.
Noise barriers or temporary noise screens	Erection of noise barriers around the perimeter of the site to shield sensitive receivers from noisy activities. Prior to completion of construction hoarding, or where there are gaps due to construction methodology e.g construction of acoustic shed) utilise temporary noise screens (e.g. Echo-barrier, FlexShield or similar) to provide noise screening until the hoarding or acoustic shed is complete. For OOHW outside the site boundary, a temporary screen should be located around work areas as close as possible to the plant to ensure adequate shielding of the plant to receivers. Temporary screens will be placed around the diesel generator required to power the site until mains power has been connected to the site.	This measure is generally feasible, provided there is sufficient space to complete the works.	Yes, where there is sufficient space	- Potential benefit of 5-10 dB(A). - Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Safety can be compromised if the workspace is too small or adjacent to busy road	Yes, where safe to do so	Yes, as noted	Construction hoarding combined with acoustic sheds will be utilised as noise barriers around the perimeter of the site (see Table C3). In the absence of construction hoarding or acoustic sheds, temporary noise screens will be utilised on OOHW wherever is safe and practicable to do so. For the diesel generator, temporary noise screens will be used where site buildings do not shield the generator from sensitive receivers.
Enclosures	Temporary enclosures containing key stationary noise-generating activities and/or items such as generators. The enclosure may be incorporated into the plant design (e.g. generator housing) or built on site, such as an 'acoustic tent', i.e. a structure hung with temporary noise screens (e.g. Echo-barrier, FlexShield or similar).	This measure could be feasibly implemented. Limitations as per temporary noise screens above.	Yes	- Potential benefit of 10-20 dB(A). - Sufficient noise reduction could be achieved at enough receivers. - Could be cost effective, where this is incorporated into the plant design (e.g. generator housing)	Yes, where safe to do so	Yes, as noted	Temporary enclosures will be utilised on OOHW wherever is safe and practicable to do so.
Saw cutting to disconnect the shaft and the neighbouring sensitive receivers.	During excavation of shaft, use rock saw to cut and disconnect the shaft from the remaining natural ground beneath sensitive receivers. Gap will increase the GBN and vibration transmission path and reduce GBN vibration to receivers.	This measure could be feasibly implemented.	Yes	- Potential benefit of 3-10 dB(A). - Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic and environmental effects.	Yes	Yes	Rock saw cutting around excavation area to increase the GBN and vibration transmission path and reduce GBN vibration impacts to receivers.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
At-receiver							
At-property treatments	Design and installation of architectural treatments to sensitive receiver buildings to reduce internal noise levels to key rooms.	This measure could be feasibly implemented.	Yes	- Provides reduction for airborne noise only. Airborne noise from worksites will be mitigated by the construction of an acoustic shed and construction hoardings as noise barriers. - Does not mitigate GBN or vibration - Short term highly noise intrusive works or OOHW will be managed - Not cost effective.	No	No	The existing on-site mitigation is considered sufficient to manage noise impacts from this worksite.
Relocation of receivers during high impact works	Long term relocation of the occupants of identified properties (see APPENDIX G) to be considered for highly GBN and vibration affected receivers adjacent to the western shaft.	This measure could be feasibly implemented.	Yes	- Suitable management approach for most impacted receivers. - Deemed to be cost effective. - Outweighs the identified social, economic and environmental effects.	Yes	Yes	Relocation of the occupants of identified properties identified as highly noise and vibration affected during excavation of western shaft. Relocation will reduce highly impacted receivers.
Noise management measures							
Site inductions & Toolbox Talks	All employees, contractors and subcontractors will receive a Project induction. The environmental component may be covered in toolboxes and should include (but is not limited to): • location of nearest sensitive receivers • relevant project specific and standard noise and vibration mitigation measures; • permitted hours of work; • OOHW Procedure and Form • construction employee parking areas.	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Inductions and toolbox talks will continue to be conducted for the project.
Community consultation - disseminating information	Provide information to community of construction activity and potential impacts (see Section 9.2).	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Updates will be distributed regularly for the duration of the project.
Community consultation - active communication with nearby sensitive receivers	Seek feedback from community to identify more sensitive times of the day, or particularly sensitive days (see Section 9.2). An example is identifying when student exams (such as Higher School Certificate exams, end of semester exams) will take place.	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Project team shall proactively contact nearby sensitive receivers, particularly those which may have special requirements (e.g. recording studios).
Behavioural practices	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Project team shall monitor site behaviour and advise supervisors if issues arise or additional behavioural practices are needed.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Noise monitoring	Noise monitoring to be conducted at key locations to quantify noise impacts at sensitive receivers.	This measure could be feasibly implemented.	Yes	Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	Noise monitoring shall be carried out as detailed in this assessment.
Update DNVIS	Regular updates of the DNVIS to account for changes in noise and vibration management strategies.	This measure could be feasibly implemented.	Yes	Can be reasonably undertaken by project team where required.	Yes	Yes	Updates to the DNVIS will be carried out where required and will be reviewed regularly.
Provision of respite evenings and nights	Where OOHW are required under CoA D23(c), such as works under ROL, respite evenings and nights will be provided in accordance with the CNVS. Where after all reasonable and feasible noise mitigation measures have been implemented there are still receivers noise affected during the OOHW period, works will be programmed to ensure that works and activities do not result in noise levels exceeding NMLs at the same noise sensitive receivers on more than: • 2 consecutive evenings and/or nights at any time; and • 3 evenings and/or nights per week; and • 10 evenings and/or nights per month. Furthermore, high noise impact works will be completed before 12:00 am (midnight) where reasonable and feasible.	This measure could be feasibly implemented and updated to reflect EPL conditions, if required.	Yes	Works would be able to be undertaken at night, with respite achieved at enough receivers on nights where works are not undertaken. Deemed to be cost effective. Outweighs the identified social, economic, and environmental effects.	Yes	Yes	Works will be planned to minimise consecutive nights of works affecting the same sensitive receiver.
Respite coordination	Consult with proponents of other construction works in the vicinity of the worksite and take reasonable steps to coordinate works to minimise cumulative impacts of noise and vibration and maximise respite for affected sensitive receivers (e.g. aligning respite evenings).	This measure could be feasibly implemented, if required.	Yes	Sufficient noise reduction could be achieved at enough receivers. Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	Respite coordination shall be conducted with neighbouring projects.
Implement additional management measures	Identify and implement additional management measures outlined in this assessment.	This measure could be feasibly implemented.	Yes	Consistency with CNVS	Yes	Yes	Additional management measures to be identified on a case-by-case basis and with consideration of the standard mitigation and management measures outlined in this report.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Truck management system	Truck access to the Pyrmont West and East site will be managed through the use of the The Bays worksite for truck staging between 5 am and 10 pm. This will reduce the likelihood of queuing outside the Pyrmont worksites. Trucks arriving at the site will be managed by radio contact with the worksite to ensure smooth access into the acoustic shed, limiting the time the acoustic shed door is open during shaft excavation and during the OOHW period.	This measure could be feasibly implemented	Yes	- Suitable management approach for limiting impacts of truck movements to/ from site. - Deemed to be cost effective. - Outweighs the identified social, economic and environmental effects.	Yes	Yes	Project team will ensure truck management system is implemented to reduce impacts from trucks accessing and egressing site, especially during the OOHW period.
Encourage good heavy vehicle driver behaviour	The JCG Heavy Vehicle Code of Conduct also includes several measures, including limiting of compression braking, which will ensure that noise impacts of heavy vehicle traffic on surrounding streets are minimised.	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	The JCG Heavy Vehicle Code of Conduct will be implemented through toolbox talks and as part of the truck management system.

9.4 Additional management measures

Section 5 of the CNVS directs that in instances where, after the application of all reasonable and feasible mitigation and management measures (refer to Section 9.3), the $L_{Aeq(15minute)}$ airborne construction noise and/ or $L_{Aeq(15minute)}$ ground-borne noise levels are still predicted to exceed the relevant NMLs, or if vibration monitoring at representative locations still exceeds relevant vibration objectives for human annoyance, additional management measures can be applied to further limit the risk of annoyance from construction noise and vibration. The CNVS suggests the Project should consider implementing additional management measures such as:

- **Alternative accommodation** (**AA**) options may be provided for residents living close to construction works that are likely to incur unreasonably high impacts over an extended period of time (more than 2 consecutive days). Alternative accommodation will be determined on a case-by-case basis.
- **Monitoring** (**M**) of noise or vibration may be conducted at the affected receiver(s) or a nominated representative location where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration objectives. Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
- **Individual briefings** (**IB**) are used to inform stakeholders about the impacts of high noise activities and mitigation and management measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
- **Letter box drops** (**LB**) in the form of a newsletter produced and distributed to the local community via letterbox drop or email via the project mailing list. The newsletter will provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage, inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community.
- **Project specific respite offers** (**RO**) provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
- **Phone calls and emails** (**PC**) detailing relevant information about construction works would be made to identified noise or vibration affected stakeholders within 7 days of proposed work to provide tailored advice and the opportunity for stakeholders to provide comments on the proposed work and specific needs etc.
- **Specific notifications** (**SN**) would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the

noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

In addition, all potentially impacted receivers will be kept informed of the nature of works to be carried out, the expected noise levels and duration, as well as be given appropriate enquiries and complaints contact details (see Section 9.6.4).

9.4.1 Additional airborne noise management measures

The steps to be carried out to determine the additional airborne noise management measures to be implemented are identified in Figure 9.1.

Figure 9.1: Additional airborne noise management measures

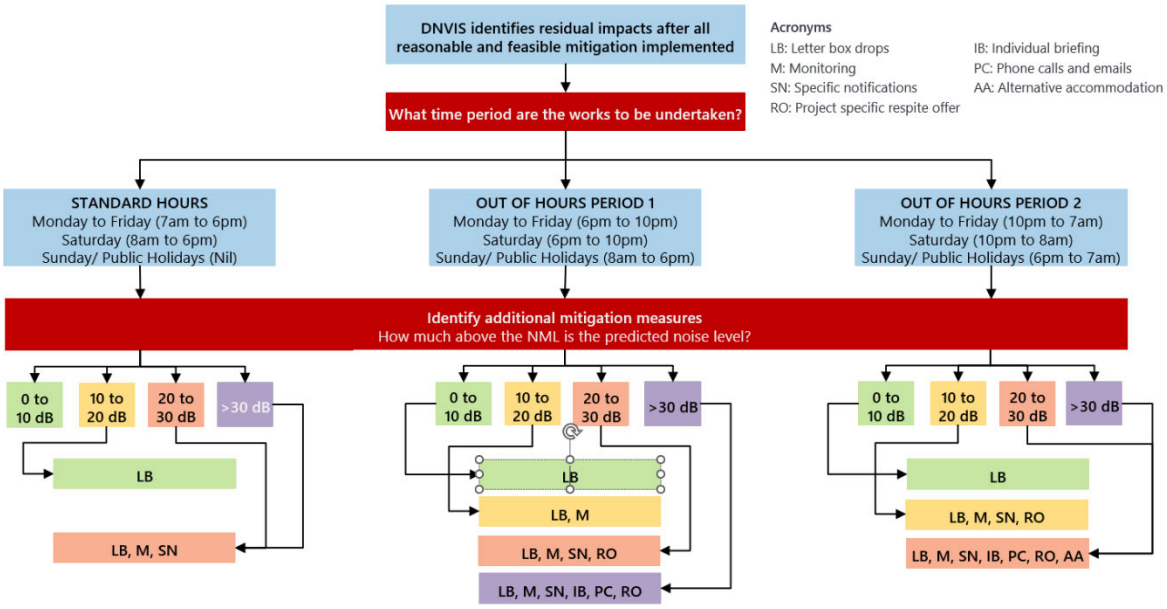


Figure 9.1 presents a summary of the additional management measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, construction noise levels are still above the NMLs.

Prior to the commencement of works, receivers identified in APPENDIX D.3 will be notified to advise that noise from the works may at times be audible. Additional airborne noise management measures will be implemented as per Table D.3. Additional airborne noise management measures

9.4.2 Additional ground-borne noise management measures

The steps to be carried out to determine the additional ground-borne noise management measures to be implemented are identified in Figure 9.2.

Figure 9.2: Additional ground-borne noise management measures

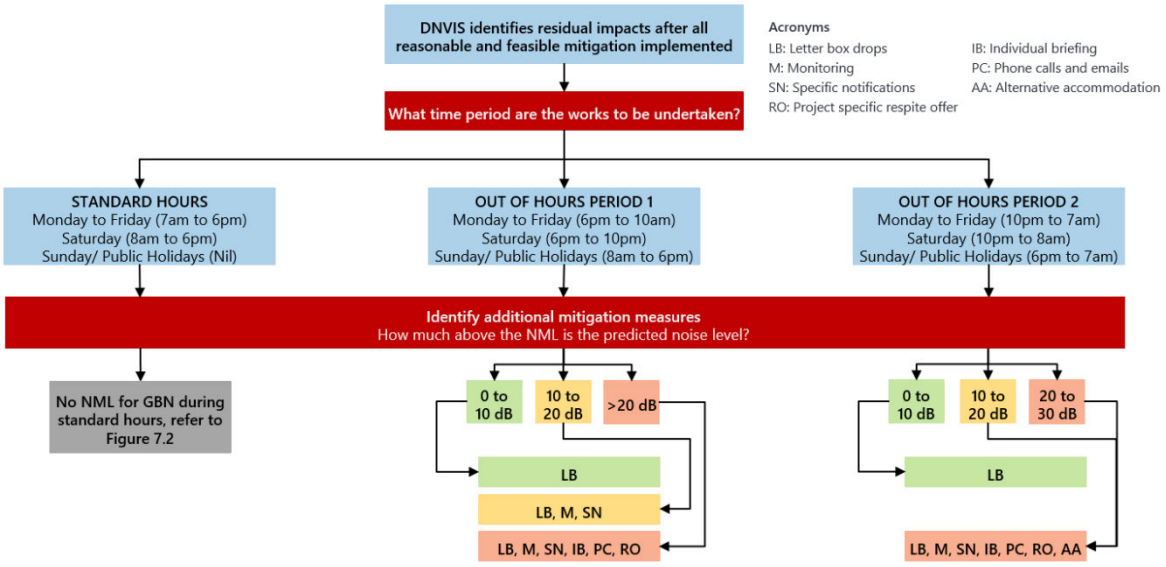


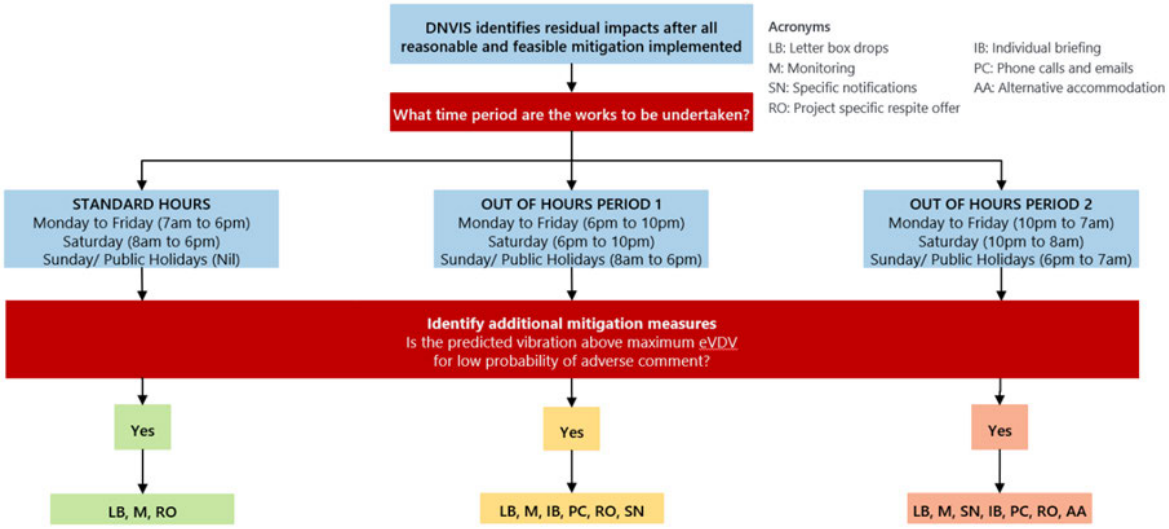
Figure 9.2 presents a summary of the additional ground-borne noise management measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, ground-borne noise levels are still above the NMLs.

Prior to the commencement of works, receivers identified in APPENDIX E will be notified to advise that ground-borne noise from the works may at times be audible.

9.4.3 Additional vibration management measures

If vibration monitoring at representative locations still exceeds relevant vibration objectives for human annoyance, the appropriate additional management measures [1], presented in Figure 9.3, should be provided.

Figure 9.3: Additional vibration management measures



9.5 Managing site specific activities and cumulative noise impacts

9.5.1 Construction noise and vibration management tool (Gatewave)

This DNVIS has established the overall impacts associated with the proposed works. A 3D construction noise and vibration management tool (Gatewave, www.gatewave.com.au) is being developed specifically for the ETP Works to allow specific work areas and activities to be assessed as construction works progress. It also allows cumulative noise impact from other aspects of the Project or, where relevant noise from other construction projects, to be assessed and managed in accordance with relevant conditions of approval.

Gatewave will be used regularly to plan, assess and manage works progressively.

Gatewave incorporates ground elevation contours, building heights, the built environment and atmospheric conditions to predict construction noise in accordance with the International Standard ISO 9613-2:1996 implementing quality standard ISO 17534-1:2015. All sensitive receivers identified by the land use survey are integrated into the Gatewave tool.

9.5.2 Managing duration of impact and cumulative noise impacts (Gatewave)

The extent of mitigation and management required to manage potential GBN impacts at the nearest noise sensitive receivers is determined by not only considering the level of noise impact, but also the duration that receivers are likely to be exposed to noise levels above the relevant GNMLs.

The duration of potential GBN impacts depends on potentially concurrent and non-concurrent excavation works and the excavation advance rate. Due to the dynamic nature of the tunnel excavation, excavation programs often change and therefore it is not possible to determine in this DNVIS an overall duration of GBN impacts at each receiver. However, in order to properly address and assess the potential variability in excavation staging, a construction noise and vibration management tool (Gatewave) is being developed in conjunction with JCG to assist in the prediction of GBN&V impacts and the identification of appropriate mitigation and management measures. The predicted values are compared against the relevant ground-borne noise and vibration criteria and are used to select the specific management measures to be applied to individual properties during construction.

GBN affected receivers will be notified prior to commencement of shaft and tunnel excavation activities.

9.6 Real-time and attended noise monitoring

To provide real time noise monitoring data to assess and confirm whether noise emission from site is within the predicted noise levels identified in this DNVIS and to satisfy condition C16(c), long-term, unattended noise monitoring will occur at fixed locations at the Pyrmont Station East and West worksites.

Noise and vibration monitoring should follow the procedures outlined in the Noise and Vibration Monitoring Program required by condition C14 and the CNVS. Note that monitoring at all properties may be undertaken from the property boundary to limit any inconvenience to property owners. Monitoring should be undertaken at a minimum of two of the most affected locations nominated in Table 9.2.

9.6.1 Airborne noise

Attended noise monitoring is to be undertaken to verify that noise levels resulting from construction works are in accordance with the levels predicted in this report, subject to obtaining the property owner/occupier's consent to access the property (where required). Noise monitoring will be completed in publicly accessible areas on or near the nominated receivers, typically at ground floor level. Where, following community consultation, specific sensitive receivers are identified for additional monitoring, access to the property will be sought through the Stakeholder and Community Relations team.

Real-time vibration monitoring in accordance with CoA C16(c) is proposed for the nominated locations in Table 9.2 and will commence prior to the start of the temporary shaft excavation works.

Table 9.2: Nominated verification monitoring locations

Type of monitoring	NCA/ Receiver type	Nominated receiver address
Fixed, real-time*	OSR (SME)	PYRMONT DATA CENTRE, 13A-29 UNION STREET, PYRMONT
Fixed, real-time	NCA04	PYR-W - 28 PATERNOSTER ROW PYRMONT
Fixed, real-time	NCA04	PYR-E - 67 EDWARD STREET PYRMONT
Attended	NCA04	127 PYRMONT STREET PYRMONT
Attended	NCA04	125 PYRMONT STREET PYRMONT
Attended	NCA04	28 PATERNOSTER ROW PYRMONT
Attended	NCA04	194 HARRIS STREET PYRMONT
Attended	NCA04	53 PATERNOSTER ROW PYRMONT/ 206 HARRIS STREET PYRMONT
Attended	NCA04	63 EDWARD STREET PYRMONT
Attended	NCA04	65-67 EDWARD STREET PYRMONT
Attended	NCA05	17-21 PYRMONT BRIDGE ROAD, PYRMONT
Attended	OSR (STUDIO)	198 HARRIS STREET PYRMONT
Attended	OSR (STUDIO)	102 PYRMONT STREET PYRMONT
Attended	OSR (HOTEL)	SEBEL HOTEL, 104 PYRMONT STREET PYRMONT
Attended	OSR (COMMERCIAL)	60 UNION STREET, PYRMONT

Note: * To be confirmed subject to suitability of location and agreement from property owner.

APPENDIX D.3 identifies the activities where monitoring should be carried out for each NCA and additional locations, should any of the above monitoring locations be unsuitable.

9.6.2 Ground-borne noise

Attended or unattended noise monitoring is to be undertaken to validate the GBN model and to verify

that GBN resulting from excavation works are in accordance with the levels predicted in this DNVIS and any EPL Conditions.

Noise (and vibration) monitoring would be conducted during shaft (and tunnelling) excavation works at the first available locations identified in Table 9.3. These monitoring locations are considered the most suitable locations relative to the shaft to collect a representative sample of measurements required to validate the noise model.

Once a representative sample of measurements has been completed and the model has been validated, no further monitoring is required for model validation. However, additional monitoring would be conducted in response to noise complaints or community consultation. Where, following community consultation, specific sensitive receivers are identified for additional monitoring, access to the property will be sought through the Stakeholder and Community Relations team.

Table 9.3: Nominated verification ground-borne noise monitoring locations

Activity	NCA/ Receiver type	Address	Nominated location
- West shaft excavation - Mined tunnelling support	NCA04	127 PYRMONT STREET PYRMONT	Internal, within ground floor rooms situated away from Pyrmont Bridge Road
	NCA04	125 PYRMONT STREET PYRMONT	Internal, within ground floor rooms situated away from Pyrmont Bridge Road
	NCA04	28 PATERNOSTER ROW PYRMONT	Internal, within ground floor rooms situated away from Pyrmont Bridge Road
	NCA04	26 PATERNOSTER ROW PYRMONT	Internal, within ground floor rooms situated away from Pyrmont Bridge Road
	NCA04	53 PATERNOSTER ROW PYRMONT	Internal, within ground floor rooms situated away from Pyrmont Bridge Road
	OSR (HOTEL)	SEBEL HOTEL, 104 PYRMONT STREET PYRMONT	Within lowest floor level with hotel suites (with sleeping areas)
	OSR (STUDIO)	102 PYRMONT STREET PYRMONT	Within lowest floor level studio facing worksite
	OSR (STUDIO)	198 HARRIS STREET PYRMONT	Within lowest floor level studio facing worksite
- East shaft excavation - Mined tunnelling support	NCA04	63 EDWARD STREET PYRMONT	Internal, within first floor rooms situated away from Pyrmont Bridge Road
	NCA04	65-67 EDWARD STREET PYRMONT	Internal, within first floor rooms situated away from Pyrmont Bridge Road
	OSR (HOTEL)	SEBEL HOTEL, 104 PYRMONT STREET PYRMONT	Within lowest floor level with hotel suites (with sleeping areas)
	OSR COMMERCIAL	60 UNION STREET, PYRMONT	Internal, within ground floor rooms facing Pyrmont Bridge West site

Subject to obtaining the property owner/occupier's consent to access the property, ground-borne noise measurements would be undertaken in rooms that are the most shielded from existing ambient noise to allow a higher signal to noise ratio to be obtained.

In addition, vibration monitoring at the receivers identified in the table above should be considered to provide assurance to the residents that vibration levels are not potentially causing any cosmetic

damages to the buildings (see Section 9.6.3).

9.6.3 Vibration monitoring

Attended vibration monitoring is to be undertaken to determine and verify site specific minimum working distances for cosmetic damage and human annoyance. Attended vibration monitoring will be undertaken during works at the locations identified in Table 9.4 whenever vibration significant plant items are operating within the recommended minimum working distances in Table 7.2.

Real-time vibration monitoring in accordance with CoA C16(c) is proposed for the nominated locations in Table 9.4 and will commence prior to the start of the temporary shaft excavation works.

Table 9.4: Attended and unattended vibration monitoring - nominated representative locations

Type of monitoring	NCA/ Receiver type	Address	Vibration monitoring for:	
			Cosmetic damage[1]	Human annoyance[2]
Fixed, real-time*	NCA04	PYR-W - 28 PATERNOSTER ROW PYRMONT	√	√
Fixed, real-time*	NCA04	PYR-E - 67 EDWARD STREET PYRMONT	√	√
Fixed, real-time*	OSR (SME)	PYRMONT DATA CENTRE, 13A-29 UNION STREET, PYRMONT		√[4]
Attended	NCA04	127 PYRMONT STREET, PYRMONT	√	√
Attended	NCA04	127 PYRMONT STREET, PYRMONT	√	√
Attended	NCA04	125 PYRMONT STREET, PYRMONT	√	√
Attended	NCA04	28 PATERNOSTER ROW, PYRMONT	√	√
Attended	NCA04	26 PATERNOSTER ROW, PYRMONT	√	√
Attended	NCA04	212 HARRIS STREET PYRMONT	√	√
Attended	NCA04	210 HARRIS STREET PYRMONT	√	√
Attended	NCA04	212 HARRIS STREET PYRMONT	√	√
Attended	NCA04 (HERITAGE)	63 EDWARD STREET, PYRMONT/ 35 UNION STREET, PYRMONT	√[3]	√
Attended	OSR (STUDIO)	198 HARRIS STREET PYRMONT	√	√
Attended	OSR (STUDIO)	102 PYRMONT STREET PYRMONT	-	√
Attended	OSR (HOTEL)	SEBEL HOTEL, 104 PYRMONT STREET PYRMONT	-	√
Attended	OSR (COMMERCIAL)	206 HARRIS STREET PYRMONT	√	√
Attended	OSR (COMMERCIAL)	60 UNION STREET PYRMONT	-	√

Note: * Project duration subject to suitability of location and agreement from property owner.

1. Properties identified as potentially within recommended MWD for cosmetic damage, based on Table 7.2. Vibration monitoring is recommended to determine site specific minimum working distances and/or verify that vibration levels achieve compliance with the structural damage objectives, as outlined in Section 9.6.3
2. Monitoring is required in the event of complaint in relation to vibration
3. Subject to building condition report, as noted in Section 7.2.2
4. Building housing sensitive scientific and medical equipment, as noted in Section 7.2.4

9.6.4 Complaints handling

Noise and/ or vibration complaints received and responded to will be managed in accordance with the JCG Community Communication Strategy prepared under Condition D52 and the Overarching Community Communications Strategy.

All noise and vibration related complaints received and responded to will be managed in accordance with the CEMP, the JCG Community Communication Strategy prepared under Condition D52 and the Overarching Community Communications Strategy. Each complaint shall be investigated and where noise and/or vibration levels are established as exceeding the set limits, appropriate amelioration measures shall be put in place to mitigate future occurrences. Management measures may include modification of construction methods such as using smaller equipment and establishment of minimum working distances as mentioned above and/or use of additional temporary screening.

Sydney Metro operate a 24-hour construction complaints line. Enquiries/ complaints may also be received through the project email mailbox (sydneymetrowest@transport.nsw.gov.au) or through the complaints hotline (1800 612 173).

10 Impact classification

The CNVS requires that on completion of a DNVIS, the subjective classification of the noise (and vibration) impact is to be evaluated and documented as:

- Low Impact
- Moderate Impact
- High Impact.

The classifications are to be determined on a case-by-case basis with consideration of the items addressed in the table below and the requirements of SSI 19238057 Condition D23 (b) which defines Low impact.

Table 10.1: Impact classification for the works – Pyrmont Station *(Stage 1 demolition and Stage 2 excavation)*

No.	Impact item description	Analysis	Classification
1	The location of the works in relation to noise sensitive receivers (NSRs) with consideration of noise attenuation features such as noise barriers including topographical features (earth-mounds), buildings, dividing fences etc (distance of works from sensitive receiver(s)).	Majority of the NSRs close to the Pyrmont Station worksites are mixed use residential and commercial receivers.	Moderate to High
2	The type and sensitivity of the NSRs: - Low Impact: e.g. Commercial buildings/ Scattered Residential (low density) - Moderate Impact: e.g. Standard residential (typical density) - High Impact: e.g. Residential home for the elderly/high density unit blocks/ persistent complainers/ residents deemed to have "construction noise fatigue".	Two recording studios, one hotel and residential receivers located close to the Pyrmont Station worksites.	Moderate to High
3	Land use zoning and planning amenity objectives for the area.	Commercial and mixed land use	Low to moderate
4	Construction and architectural design of impacted building, particularly the presence of any existing noise mitigation including that provided under a Noise Abatement Program or required by the ISEPP, Council DCP or other planning instrument.	At the Pyrmont Station worksites there is a mix of commercial, hotel and multi-storey residential and mixed-use residential receivers with additional façade attenuation. Single occupancy residential or older multi-storey residential are assumed to be standard construction with no extra noise mitigation.	Low to moderate
5	Existing ambient levels.	Moderate existing ambient noise levels during daytime ($L_{Aeq(15min)}$ 56 dB(A)); evening ($L_{Aeq(15min)}$ 50 dB(A)); and night ($L_{Aeq(15min)}$ 47 dB(A)) at Pyrmont.	Low
6	The extent of noise exceedance above Noise Management Level.	Mitigation measures including construction hoarding, acoustic sheds and temporary noise barriers will be implemented to reduce airborne noise from the works, where reasonable and feasible. Impacts at Pyrmont are moderate to high due to proximity of residential receivers to the works. Once the acoustic shed construction is complete, impacts are significantly reduced to low to moderate. Works will be programmed to ensure respite periods for receivers, as required by the CNVS and the Conditions of Approval.	Moderate

No.	Impact item description	Analysis	Classification
7	The likelihood for potential sleep disturbance (as described in the NPfI).	Residential receivers near the work zone may experience construction noise levels above the sleep disturbance criteria at Pyrmont, however OOHW are limited during the stages assessed in this DNVIS. Truck movements to and from site are limited between 10pm and 7am to reduce the potential for sleep disturbance.	Low to Moderate
8	The type of and intensity of noise emitted from works (i.e. tonal or impulsive): - Lower Impact: No high noise and/or vibration intensive activities - Moderate Impact: Short/intermittent high noise and/or vibration intensive activities - High Impact: Prolonged high noise and/or vibration intensive activities.	The proposed works consist of 'typical impact', with high noise and/or vibration intensive activities such as rock sawing or rock hammering. All reasonable and feasible measures will be applied to minimise noise and vibration impacts. Respite periods will be provided for highly noise intensive works following consultation with nominated receivers in Table E.3. For OOHW under Condition D23(c), high noise activities will be completed before midnight, where reasonable and feasible. All works are typically short term, as noted in Table 2.1.	Low to Moderate
9	The duration of any OOHW required.	Most OOHW works during the stages assessed in this DNVIS will be undertaken in less than 6 shifts.	Moderate
10	The time frames for any OOHW: - Lower Impact: 6.00 pm till 10.00 pm weekdays 1.00 pm till 10.00pm Saturdays 8.00 am till 6.00 pm Sundays or Public Holidays. - Moderate Impact: 10.00 pm to 7.00 am Weekday Nights 10.00 pm to 8.00 am Saturdays. - High Impact: 6.00 pm to 7.00 am Sundays and Public Holidays.	Some assessed works are required to be OOHW due to the requirement for road closures. Where reasonable and feasible works would be limited to 10pm, although road closures in Pyrmont may not commence until after 9pm. High noise works will be completed before midnight, where reasonable and feasible to reduce the likelihood of sleep disturbance.	Moderate
11	As a result of noise classification and/or the noise level exceedances at sensitive receivers provided by the DNVIS report, appropriate reasonable and feasible noise mitigation is to be adopted and implemented. For sites where works are predicted to significantly exceed noise goals and impact on receivers for a significant period of time, additional reasonable and feasible noise mitigation measures such as those outlined in Section 5 of the CNVS would be considered if practical to reduce the noise levels and impact on sensitive receivers.	Mitigation measures outlined in Section 9 will be implemented to manage and reduce impacts from the works.	Low

Review of the overall noise impact of the Pyrmont Station (Stage 1 demolition and Stage 2 excavation) works is considered **moderate**. Some of the works outside standard construction hours were found to, at times, exceed the NMLs. This impact will be managed through the mitigation and management measures outlined in Section 9, including suitable community notification regarding potential impacts from the works. Mitigation measures will be implemented to reduce noise levels with the aim of achieving the NMLs and limit the overall noise impact to **low**. Where this is not feasible or reasonable, residual impacts will be managed as outlined in Section 9.4.

Properties at risk of vibration impact have been identified through the conservative screening process set out in the CNVS [1]. Vibration significant works will be managed in accordance with Section 9. The overall vibration impact of the Pyrmont Station (Stage 1 demolition and Stage 2 excavation) is considered **low to moderate**.

11 Conclusion

In conclusion, construction works associated with the Pyrmont Station *(Stage 1 demolition and Stage 2 excavation)* have been described in this DNVIS to identify potential environmental risks associated with construction noise and vibration. Construction noise and vibration objectives have been established consistent with the conditions of approval for the Project and the EIS.

Construction airborne noise

During Stage 1 and 2 works (i.e. demolition works and Pyrmont East temporary shaft excavation) the predicted noise levels indicate the nearest sensitive receivers will be construction noise affected during standard construction hours. The nearest receivers are likely to be highly noise affected receivers during the temporary shaft excavation at the eastern worksite. Construction of an acoustic shed over the shaft excavation area will significantly reduce airborne noise impacts from the longer duration shaft excavation works.

During Stage 1 and 2 works (i.e. demolition and temporary shaft excavation), out-of-hours works will only occur where the works require ROL or as otherwise approved in the planning approval or EPL, as outlined in Section 2.2.1. This hoarding installation and dismantling, piling and capping beam works, and acoustic shed construction, where these works bound the site on Pyrmont Bridge Road and Pyrmont Street. Several other sensitive receivers, including hotels, should they be occupied, are expected to be construction noise affected by the out-of-hours construction works.

Permanent shaft excavation works will be undertaken within an acoustic shed, which will significantly reduce airborne noise impacts during the standard hours work period. Airborne noise impacts from the excavation of the shafts at Pyrmont East and Pyrmont West are below internal $L_{Aeq(15\ minute)}$ 60 dB(A) at all receivers. Out of hours works will be undertaken where the works satisfy the requirements of Condition D23(d).

Tunnelling and associated activities of rockbolting, shotcreting and mucking out; delivery of material to directly support tunnelling activities; and spoil haulage will be undertaken 24 hours per day, with spoil handling up to 10:00 pm within the acoustic sheds at Pyrmont West and Pyrmont East. Residual impacts will be mitigated and managed with the aim of meeting the NMLs.

Noise mitigation and management measures, including noise monitoring requirements, have been presented in Section 9 to aid in providing additional noise reduction benefits where noise levels are above the NMLs.

Construction ground-borne noise

Ground-borne noise is likely to be more perceptible once the airborne construction noise is mitigated through the construction of the acoustic sheds of the eastern and western shafts. Some noise sensitive receivers have building façades designed to mitigate airborne noise (such as traffic noise), including the hotels, recording studios and commercial premises. For occupants of these buildings, ground-borne noise may be more noticeable as the airborne construction noise will be reduced by the façade.

During the excavation of the Pyrmont West shaft there are up to six (6) residential receivers to the north of the Pyrmont West worksite where predicted ground-borne noise levels are above $L_{eq(15min)}$ 60 dB(A). Consultation is being undertaken to manage respite periods in accordance with CoA D38 and D39. During the rockhammer excavation of the Pyrmont East shaft predicted ground-borne noise levels at all receivers surrounding the Pyrmont East worksite are less than $L_{eq(15min)}$ 60 dB(A).

Management measures, including alternative construction methodology, construction staging and consultation with impacted receivers, as outlined in Section 9 will be implemented to reduce ground-borne noise levels from the works.

Construction vibration

Several buildings/structures have been identified as within recommended minimum working distances for cosmetic damage during the works, depending on the vibration intensive plant in use. Site specific minimum working distances will be determined and (if required) alternative construction methodology implemented, where reasonable and feasible, to reduce the risk of cosmetic damage occurring.

A conservative screening test found that vibration impacts from construction activities, namely shaft excavation works, are likely to be perceptible and may cause human annoyance.

Vibration mitigation and management measures, including vibration monitoring requirements, have been presented in Section 9 to reduce the risk of damage to buildings near the worksites and to manage annoyance from construction vibration.

Construction traffic

The predicted noise impacts are assessed as low and generally within the minimum requirements in the CNVS.

Impact classification

The overall noise and vibration impact of the Pyrmont Station works is considered **moderate**.

Careful management of noise and vibration generating activities will reduce the impact of the works.

References

[1] Sydney Metro Construction Noise and Vibration Standard Version 4.3 (SM-20-00098866) – 4 November 2020

[2] Transport for NSW Construction Noise and Vibration Strategy (ref: ST-157/4.1) April 2019

[3] Sydney Metro West Out-of-hours Work Protocol (in progress)

[4] SLR Consulting Australia Pty Ltd 2021 Sydney Metro West - Major civil construction between The Bays and Sydney CBD - Technical Paper 2: Noise and Vibration October 2020

[5] Sydney Metro 2022 Sydney Metro West – Submissions Report - Major civil construction between The Bays and Sydney CBD

[6] Department of Environment and Climate Change 2009 NSW Interim Construction Noise Guideline (ICNG)

[7] Environment Protection Authority 2017 NSW Noise Policy for Industry (NPfI)

[8] Department of Environment, Climate Change and Water 2011 NSW Road Noise Policy (RNP)

[9] Department of Environment Conservation NSW 2006 Assessing Vibration; a technical guideline

[10] Environment Protection Authority 2000 NSW Industrial Noise Policy (INP)

[11] British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)

[12] Australian Standard AS 2187.2-2006 Explosives - Storage and Use - Use of Explosives

[13] British Standard BS 7385 Part2-1993, Evaluation and measurements for vibration in buildings Part 2

[14] German Standard DIN 4150-3: 2016-12, Structural vibration - Effects of vibration on structures, December 2016

[15] ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control, pp47.39-47.40

[16] Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration, p16

[17] Australian Standard AS/NZS 2107:2000 *Acoustics - Recommended design sound levels and reverberation times for building interiors*

APPENDIX A Glossary of terminology

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

ABN	Airborne Noise
Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline (DEC 2006)
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
CEMP	Construction Environmental Management Plan
CNVS	Construction Noise and Vibration Standard (Sydney Metro 2021)
CoA	Condition of Approval (SSI 19238057)
Condition	Condition of Approval (SSI 19238057)
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
DEC	Department of Environment and Conservation (now EPA)

DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
DNVIS	Detailed Noise and Vibration Impact Statement
DP&E	NSW Department of Planning and Environment
ECRTN	Environmental Criteria for Road Traffic Noise (EPA 1999)
EIS	Environmental Impacts Statement
EPA	NSW Environment Protection Authority
ETP	Sydney Metro West – Eastern Tunnelling Package
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
GBN	Ground-borne noise
GNML	Ground-borne Noise Management Level
GIS	Geographic Information System
ICNG	Interim Construction Noise Guideline (DECC, 2009)
INP	NSW Industrial Noise Policy (EPA, 2000)
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
JCG	John Holland CPB Contractors Ghella Joint Venture
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
MWD	Minimum Working Distance
NCA	Noise Catchment Area
NML	Noise management level
NPfI	Noise Policy for Industry
NSR	Noise Sensitive Receiver
OEH	Office of Environment and Heritage
OOHW	Out-of-Hours Works – work completed outside of standard construction hours

OSR	Other Sensitive Receiver
PPV	Peak Particle Velocity
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
REMM	Revised Environmental Mitigation Measure
RNP	NSW Road Noise Policy (DECCW 2011)
ROL	Road Occupancy Licence
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level (SPL)	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level (SWP)	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
SSI	State Significant Infrastructure
Standard construction hours	Hours during which construction work is permitted by the conditions of approval and the EPL.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Sensitive receivers and noise management levels

B.1 NCAs and sensitive receiver identification

LEGEND

Noise Sensitive Receiver

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library/Museum
- Childcare
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Flight simulator
- Animal Enclosure
- Recreational - Passive
- Recreational - Active
- Other
- Heritage

- Tunnel Alignment
- Project Worksites
- Project NCAs

NCA	NML DS	NML DO	NML E	NML N
NCA04	60	55	52	50
NCA05	62	57	54	51
NCA06	71	66	61	57

NCA: Noise Catchment Area
NML: Noise Management Level
D(S): standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday
D(O): out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1
E: evening period from 6 pm to 10 pm Monday to Sunday - OOHW P1
N: night-time period from 10 pm to 7 am Monday to Friday, from 10 pm am to 8 am Saturday, Sunday and Public holidays - OOHW P2

REV	BY	DATE	DESCRIPTION	APPROVED
r2	SS	25/01/24	Landuse Update	TG
r1	SS	18/10/23	Heritage update	TG
r0	DA	03/04/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 m

1:3,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

CLIENT

SYDNEY METRO WEST

JOHN HOLLAND CPB Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES

inspired to achieve

Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST – EASTERN TUNNELLING PACKAGE
Hunter Street Station Site

Landuse, Worksites and NCAs

Sheet 2 of 2

B.2 NCAs and noise management levels

Table B1: Noise Sensitive Receivers and Construction Noise Management Levels (airborne noise) **PYRMONT STATION**

NCA	Receiver Type	Reference RBL	Existing Noise Levels, dB(A)						Airborne NMLs based on ICNG (external)					Sleep Dist. L_{Amax}		Comments
			RBL Day	RBL Evening	RBL Night	LAeq_D	LAeq_E	LAeq_N	NMLD(S)	NMLD(O)	NMLE	NMLN	NMLMS	$L_{Aeq(15min)}$	L_{AFmax}	
Residential receivers																Nearest worksite
NCA04	Predominantly Residential	B.04	50	47	45	56	50	47	60	55	52	50	53	50	60	Pyrmont
NCA05	Predominantly Residential	B.05	52	49	46	61	59	56	62	57	54	51	54	51	61	Pyrmont
ICNG 'Other sensitive' receivers (NML applicable when in use)																
Classrooms at schools and other educational institutions									55	55	55	55	55	-	-	Source: ICNG, assuming a conservative façade loss of 10 dB(A)
Hospital wards and operating theatres									65	65	65	65	65	-	-	Source: ICNG, assuming a conservative façade loss of 20 dB(A)
Places of worship									55	55	55	55	55	-	-	Source: ICNG, assuming a conservative façade loss of 10 dB(A)
Passive recreation areas (e.g. area used for reading, meditation)									60	60	60	60	60	-	-	Source: ICNG
Active recreation areas (e.g. sports fields)									65	65	65	65	65	-	-	Source: ICNG
Commercial premises (including offices and retail outlets)									70	70	70	70	70	-	-	Source: ICNG
Industrial premises									75	75	75	75	75	-	-	Source: ICNG
Non-ICNG 'Other sensitive' receivers (GBNML applicable when in use)																
Hotel - daytime and evening									70	70	70	70	70	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum', assuming 20 dB(A) facade loss
Hotel - night-time									60	60	60	60	60	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum', assuming 20 dB(A) facade loss
Café/ Bar/ Restaurant									60	60	60	60	60	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum', assuming 10 dB(A) facade loss
Childcare centre (indoor sleeping areas)									55	55	55	55	55	-	-	Source: CNVS Section 2.2.1, assuming a conservative façade loss of 10 dB(A)
Childcare centre (play areas)									65	65	65	65	65	-	-	Source: CNVS Section 2.2.1
Public Building									60	60	60	60	60	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum', assuming 10 dB(A) facade loss
Studio building (music recording studio)									45	45	45	45	45	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum', assuming 20 dB(A) facade loss
Studio building (film or television studio)									50	50	50	50	50	-	-	Source: AS2107 'maximum', assuming 20 dB(A) facade loss
Theatre/ Auditorium									50	50	50	50	50	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum', assuming 20 dB(A) facade loss

Notes: D(S): standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday
D(O): out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1
E: evening period from 6 pm to 10 pm Monday to Sunday - OOHW P1
N: night-time period from 10 pm to 7 am Monday to Friday, from 10 pm am to 8 am Saturday, Sunday and Public holidays - OOHW P2
MS: Morning shoulder from 05:00 to 07:00 Monday to Friday, and from 06:00 to 08:00 Saturday, Sunday and Public holidays - OOHW P2

Table B2: Noise Sensitive Receivers and Construction Noise Management Levels (groundborne noise) **PYRMONT STATION**

NCA	Receiver Type	Groundborne NMLs based on ICNG (internal) NMLDS	NMLDO	NMLE	NMLN	MS			Comments
Residential receivers									
All	All residential receivers	(50)*	(50)*	40	35				Source: ICNG
		**Human comfort vibration limit applies during the day. 50 dB(A) used as screening guideline.*							
ICNG 'Other sensitive' receivers (NML applicable when in use)									
Classrooms at schools and other educational institutions		45	45	45	45	45	-	-	Source: ICNG
Hospital wards and operating theatres		45	45	45	45	45	-	-	Source: ICNG
Places of worship		45	45	45	45	45	-	-	Source: ICNG
Commercial premises (including offices and retail outlets)		50	50	50	50	50	-	-	Source: ICNG, assuming a conservative façade loss of 20 dB(A)
Industrial premises		55	55	55	55	55	-	-	Source: ICNG, assuming a conservative façade loss of 20 dB(A)
Non-ICNG 'Other sensitive' receivers (GBNML applicable when in use)									
Hotel - daytime and evening (non-sleeping areas)		50	50	50	50	50	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Hotel - night-time (sleeping areas)		40	40	40	40	40	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Café/ Bar/ Restaurant		50	50	50	50	50	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Childcare centre (indoor sleeping areas)		45	45	45	45	45	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Childcare centre (play areas)		55	55	55	55	55	-	-	Source: CNVS Section 2.2.1, assuming a conservative façade loss of 10 dB(A)
Public Building		50	50	50	50	50	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Studio building (music recording studio)		25	25	25	25	25	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Studio building (film or television studio)		30	30	30	30	30	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Theatre/ Auditorium		30	30	30	30	30	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'

Notes: D(S): standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday
D(O): out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1
E: evening period from 6 pm to 10 pm Monday to Sunday - OOHW P1
N: night period from 22:00 to 07:00 Monday to Friday, and from 22:00 to 08:00 Saturday, Sunday and Public holidays - OOHW P2
MS: Morning shoulder from 05:00 to 07:00 Monday to Friday, and from 06:00 to 08:00 Saturday, Sunday and Public holidays - OOHW P2

APPENDIX C Construction timetable/ activities/ management

C.1 Construction timetable/activities/equipment

Table C1-1: Construction timetable/ activities/ equipment **PYRMONT STATION - WEST WOKSITE**

Activity/ Work Area	Aspect	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity		Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
			7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	Duration	L_{Aeq}	Penalty	L_{Amax}			
WEST WORKSITE													
Compound	Deliveries; Maintenance; Office areas; Storage areas; Car parking	Delivery truck	4 per hour	-	-	Aug-23	100 weeks	106	-	111	-	-	
		Light vehicle	180 in/ out	60 in/ out	60 in/ out	Aug-23	100 weeks	89	-	100	-	-	
		Compressor	1	-	-	Aug-23	100 weeks	102	-	103	-	-	
		Workshop Hand Tools	1	-	-	Aug-23	100 weeks	105	-	118	-	-	
		Franna Crane	1	-	-	Aug-23	100 weeks	98	-	102	-	-	
		Water cart/ Street Sweeper	1	-	-	Aug-23	100 weeks	107	-	111	-	-	
	Shaft and tunnel ventilation	Ventilation fan with silencer - Cavern	1	1	1	Jan-24	65 weeks	76	-	79	-	-	Fan mounted within cavern; Assumed Lw fan air intake (see Table C4b)
Stage 1: Site establishment and demolition	B-Class Hoarding/ Scaffold construction and dismantle	Forklift	2	2	2	Apr-23		99	-	103	-	-	B-class hoarding installed prior to demolition
		EWP / Scissor Lift	2	2	2	Install	4 weeks	95	-	98	-	-	Install from April 2023
		Circular Saw (petrol)	3	3	3	Dismantle	3 weeks	115	5	120	HN	-	Dismantle when demolition complete, August 2023
	Assessment ref: **PW-SE(B)**	Impact Driver	2	2	2			106	-	109	-	-	OOHW required where ROL prohibits lane closure during standard construction hours
		Rattle Gun	3	3	3			90	-	105	-	-	
		Hiab Truck	2	2	2			95	-	98	-	-	
	Demolition	Truck (spoil haulage)	5 p.h	-	-	May-23	20 weeks	106	-	111	-	-	(Rigid Body, 10 Wheeler)
		Dust Suppression Fan	2	-	-	May-23	20 weeks	99	-	102	-	-	
	Assessment ref: **PW-DE(AH)**	Skid Steer 3T	3	-	-	May-23	8 Weeks	102	-	107	-	-	
	[Demolition above hoarding]	Excavator 5T (Bucket, Grabs)	3	-	-	May-23	8 Weeks	101	-	114	-	-	
		Excavator 13T (Bucket, Grabs and Shears)	1	-	-	May-23	12 weeks	103	-	108	-	-	
	Assessment ref: **PW-DE(BH)**	Excavator 13T (Hammer)	1	-	-	May-23	4 Weeks	118	5	123	HN	X	
	[Demolition below hoarding]	Oxy Acetylene	2	-	-	May-23	20 weeks	96	-	107	-	-	
		Mobile Crane 40T	-	1	-	May-23	2 weeks	104	-	108	-	-	OOHW required where ROL prohibits lane closure during standard construction hours
		EWP / Scissor Lift	2	-	-	May-23	4 Weeks	95	-	98	-	-	
		Dust Suppression Fan	2	-	-	Jul-23	8 Weeks	99	-	102	-	-	
		Excavator 49T (Bucket, Grabs and Shears)	1	-	-	Jul-23	8 Weeks	106	-	111	-	-	
		Excavator 49T (Hammer)	0.5	-	-	Jul-23	6 Weeks	118	5	126	HN	X	
	A-Class Hoarding construction (and dismantle B-Class hoarding)	Forklift	2	2	2	Nov-23	2 weeks	99	-	103	-	-	A-class hoarding installed post demolition
		EWP / Scissor Lift	2	2	2	Nov-23	2 weeks	95	-	98	-	-	Install from August 2023
		Circular Saw (petrol)	3	3	3	Nov-23	2 weeks	115	5	120	HN	-	OOHW required where ROL prohibits lane closure during standard construction hours
	Assessment ref: **PW-SE(A)**	Impact Driver	2	2	2	Nov-23	2 weeks	106	-	109	-	-	
		Rattle Gun	3	3	3	Nov-23	2 weeks	90	-	105	-	-	
		Hiab Truck	2	2	2	Nov-23	2 weeks	95	-	98	-	-	
	Prelim Earthworks and Piling Pad Construction	Excavator 35t (Hammer)	2	-	-	Nov-23	2weeks	118	5	126	HN	X	Levelling site and piling pad; stripping and loading of subgrade
		Excavator 30t (Bucket)	2	-	-	Nov-23	2weeks	103	-	108	-	-	Spread and place fill for piling pad
		Vibratory Roller 16t (Smoothdrum)	2	-	-	Nov-23	2weeks	108	5	113	HN	X	
	Assessment ref: **PW-PE**	Vibratory Roller 16t (Padfoot)	2	-	-	Nov-23	2weeks	108	5	113	HN	X	
		Truck (spoil haulage)	2 p.h.	-	-	Nov-23	2weeks	106	-	111	-	-	Import / export material
		Moxy 20T	2	-	-	Nov-23	2weeks	109	-	119	-	-	Cart to/from stockpile
Stage 2: Acoustic shed construction	Piling and capping beams for acoustic shed footings and initial shoring	Piling Rig (Bauer BG36)	1	-	-	Dec-23	1 week	107	-	116	-	X	
		Excavator 20t	1	1	1	Dec-23	8 weeks	103	-	108	-	-	Capping beam on Pyrmont Bridge Road and Pyrmont Street will require OOHW due to ROL
		Shotcrete rig	1	1	1	Dec-23	8 weeks	104	-	107	-	-	-Mobilisation (rig/crane delivery), Piling activities, and Demobilisation
		Concrete pump	1	1	1	Dec-23	8 weeks	103	-	107	-	-	- See Table C2 for management details
	Assessment ref: **PW-PC**	Concrete agitator	4	4	4	Dec-23	8 weeks	108	-	111	-	-	
		Compressor	2	2	2	Dec-23	6 weeks	102	-	103	-	-	
		Crawler Crane 100t	1	-	-	Dec-23	6 weeks	104	-	108	-	-	
		Delivery truck	1	-	-	Dec-23	6 weeks	106	-	111	-	-	
		Power hand tools	1	-	-	Dec-23	6 weeks	108	-	118	-	-	
		Jackhammer	1	-	-	Dec-23	6 weeks	111	5	121	HN	X	
	Platform and acoustic shed (west) construction	Mobile Crane 100t	1	1	1	Feb-24	18 weeks	104	-	108	-	-	
		Franna Crane	1	1	1	Feb-24	18 weeks	98	-	102	-	-	
	Assessment ref: **PW-PAS**	Delivery Trucks	4 p.h.	4 p.h.	4 p.h.*	Feb-24	18 weeks	106	-	111	-	-	Oversized deliveries OOH
		EWP	-	-	-	Feb-24	18 weeks	95	-	98	-	-	

Table C1-1: Construction timetable/ activities/ equipment **PYRMONT STATION - WEST WOKSITE**

Activity/ Work Area	Aspect	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity		Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
			7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	Duration	L_{Aeq}	Penalty	L_{Amax}			
Stage 3: Permanent Shaft Excavation	Shaft excavation Assessment ref: **PW-SE(S)**; **PW-SE(5m)**; **PW-SE(10m)** [Shaft excavation at surface; 5m deep; and 10m deep, inc spoil handling, acoustic shed incomplete] **SW-SE** [Site wide shaft excavation in acoustic shed.]	Power hand tools	1	1	-	May-24	20 weeks	108	-	118	-	-	*Permanent Shaft excavation happening concurrently with Mined Tunnel excavation and lining.*
		Generator	1	-	-	May-24	20 weeks	94	-	95	-	-	*Shed installation complete*
		Water pump (diaphragm pump)	1	1	-	May-24	20 weeks	106	-	109	-	-	
		Excavator 35T (rockhammer)	5	-	-	May-24	20 weeks	118	5	126	HN	X	BASE CASE: 5x excavator with rockhammers;
		Excavator with saw attachment	1	-	-	May-24	20 weeks	121	5	129	HN	X	2x excavator with saw attachment;
		Excavator with cutter attachment	-	-	-	May-24	20 weeks	121	5	129	HN	X	1x excavator with cutter
		Surface Miner (optional)	*2*	-	-	May-24	20 weeks	120	-	125	-	X	*OPTION A: 2 x surface miners and 2 x excavators with rockhammers*
		Excavator 30T with bucket	-	1	-	May-24	20 weeks	103	-	108	-	-	
		EWP - 56ft diesel telescopic boom	1	1	-	May-24	20 weeks	95	-	98	-	-	
		Site Forklift	1	-	-	May-24	20 weeks	99	-	103	-	-	
		Compressor	1	-	-	May-24	20 weeks	102	-	103	-	-	
		Dust Scrubber with silencer	2	2	2	May-24	20 weeks	104	-	107	-	-	Located at bottom of shaft
	Spoil Handling	Truck (spoil haulage)	4-6 p.h	4 p.h	-	May-24	20 weeks	106	-	111	-	-	Evening - spoil truck NOT concurrent with concrete/ shotcrete delivery for ground support
		Gantry Crane	1	1	-	May-24	20 weeks	106	-	110	-	-	
		Kibble (bottom dumping)	1	1	-	May-24	20 weeks	103	-	108	-	-	Inside shed, loading spoil truck
	Temporary ground support works Assessment ref: **PW-GS(S)**; **PW-GS(5m)**; **PW-GS(10m)** [Ground support at surface; 10m deep; + spoil handling]	Drill Rig (percurssion)	1	1	-	May-24	20 weeks	114	-	118	HN	X	
		Power hand tools	4 p.h.	4 p.h.	-	May-24	20 weeks	108	-	118	-	-	
		Concrete truck	4 p.h.	4 p.h.	-	May-24	20 weeks	108	-	111	-	-	Evening - concrete/ shotcrete delivery for ground support NOT concurrent with spoil truck
		Concrete pump	1	1	-	May-24	20 weeks	103	-	107	-	-	
		Shotcrete rig	1	2	-	May-24	20 weeks	104	-	107	-	-	
		Welding equipment	1	1	-	May-24	20 weeks	96	-	107	-	-	
	Base Slab - temporary/ permanent (concreting)	Power hand tools	4	4	-	Temporary		108	-	118	-	-	6-10pm only if we can't finish the concrete pour in time
		Concrete truck	4 p.h.	4 p.h.	-	Sep-24	2 weeks	108	-	111	-	-	6-10pm only if we can't finish the concrete pour in time
		Concrete pump	1	1	-	Permanent		103	-	107	-	-	6-10pm only if we can't finish the concrete pour in time
		Welding equipment	1	1	-	Nov-25	4 Weeks	96	-	107	-	-	6-10pm only if we can't finish the concrete pour in time
Stage 3: Mined tunnelling and associated activities (Adits)	Adit excavation & support Assessment ref: **SW-MTS** [Site wide (East & West sites, with shed) tunnelling and associated activities of rockbolting, shotcreting and mucking out; spoil haulage; delivery of material to directly support tunnelling activities]	Road Header 1,000V Electric	1	1	1	Aug-24	6 months	104	-	108	-	-	Adits
		Bolting rig Robodrill 525	1	1	1		6 months	106	-	116	-	X	Adits
		Shotcrete rig (Potenza)	1	1	1		6 months	104	-	107	-	-	Adits
		Concrete site agitator	2	2	2		6 months	108	-	111	-	-	Shaft / Adits
		Concrete road agitator	2 p.h	2 p.h	2 p.h (TBC)		6 months	108	-	111	-	-	Inside shed
		Skid steer	1	1	1		6 months	109	-	113	-	X	Adits
		Excavator 8t w hammer	1	-	-		6 months	118	5	123	HN	X	Adits
		Excavator 25t w bucket	1	1	0		6 months	103	-	108	-	-	Adits
		FE Loader (CAT980)	1	1	1		6 months	110	-	115	-	-	Bottom of shaft, loading spoil bin
		Dust Scrubber with silencer	1	1	1		6 months	104	-	107	-	-	Located underground
	Spoil Haualage/ mucking out Assessment ref: **SW-MTS**	Dump truck (Moxy CAT 725)	1	1	1	Aug-24	6 months	109	-	119	-	-	Adit / temp shaft
		Gantry Crane	1	1	1		6 months	106	-	110	-	-	Inside shed
		Excavator 30T with bucket	1	1	1		6 months	103	-	108	-	-	Bottom of shaft, loading kibble
		Kibble (bottom dumping)	1	1	-		6 months	103	-	108	-	-	Inside shed, loading spoil truck
		Truck (spoil haulage)	7-9 p.h.	7-9 p.h.	-		6 months	102	-	111	-	-	Inside shed
	Tunnel Lining (concreting) Assessment ref: **SW-MTL** [Site wide (East & West sites, with shed) Tunnel Lining (concreting) , including delivery of concrete	Concrete pump	2	2	-	Feb-25	10 months	103	-	107	-	-	Adit - form pumps
		Compressor	1	1	-		10 months	102	-	103	-	-	On form for vibrators
		Genset	1	1	-		10 months	94	-	95	-	-	2 / 3 days usage for form power
		Pneumatic vibrator	40	40	-		10 months	97	-	100	-	-	During crown concrete pours - every 2-3 days, significantly less during invert and kicker works
		Concrete road agitator	5 p.h	5 p.h	-		10 months	108	-	111	-	-	Inside shed during concrete pours - every 2-3 days
		Concrete site agitator	5	5	-		10 months	108	-	111	-	-	Adits
		Telehandler	1	1	-		10 months	98	-	102	-	-	Adits
Stage 4: Acoustic shed decomissioning	Platform and acoustic shed (west) removal Assessment ref: **PE-ASD**	Mobile Crane 150T	1	-	-	Nov-25	8 weeks	104	-	108	-	-	
		Franna Crane	2	-	-	Nov-25	8 weeks	98	-	102	-	-	
		Delivery Trucks	4 p.h.	-	-	Nov-25	8 weeks	106	-	111	-	-	
		Excavator 25t w bucket	2	-	-	Nov-25	8 weeks	103	-	108	-	-	
		Excavator 45t w bucket	1	-	-	Nov-25	8 weeks	106	-	111	-	-	
		Impact wrench	4	-	-	Nov-25	8 weeks	107	-	118	-	-	
		Handtool - grinder	4	-	-	Nov-25	8 weeks	108	-	118	-	-	
		Hand tools	4	-	-	Nov-25	8 weeks	105	-	118	-	-	
		Welding equipment	2	-	-	Nov-25	8 weeks	96	-	107	-	-	
		EWP	2	-	-	Nov-25	8 weeks	95	-	98	-	-	

Figure C1-1-1: Site Layout and Hoardings (Stage 1)

PYRMONT STATION - WEST WOKSITE

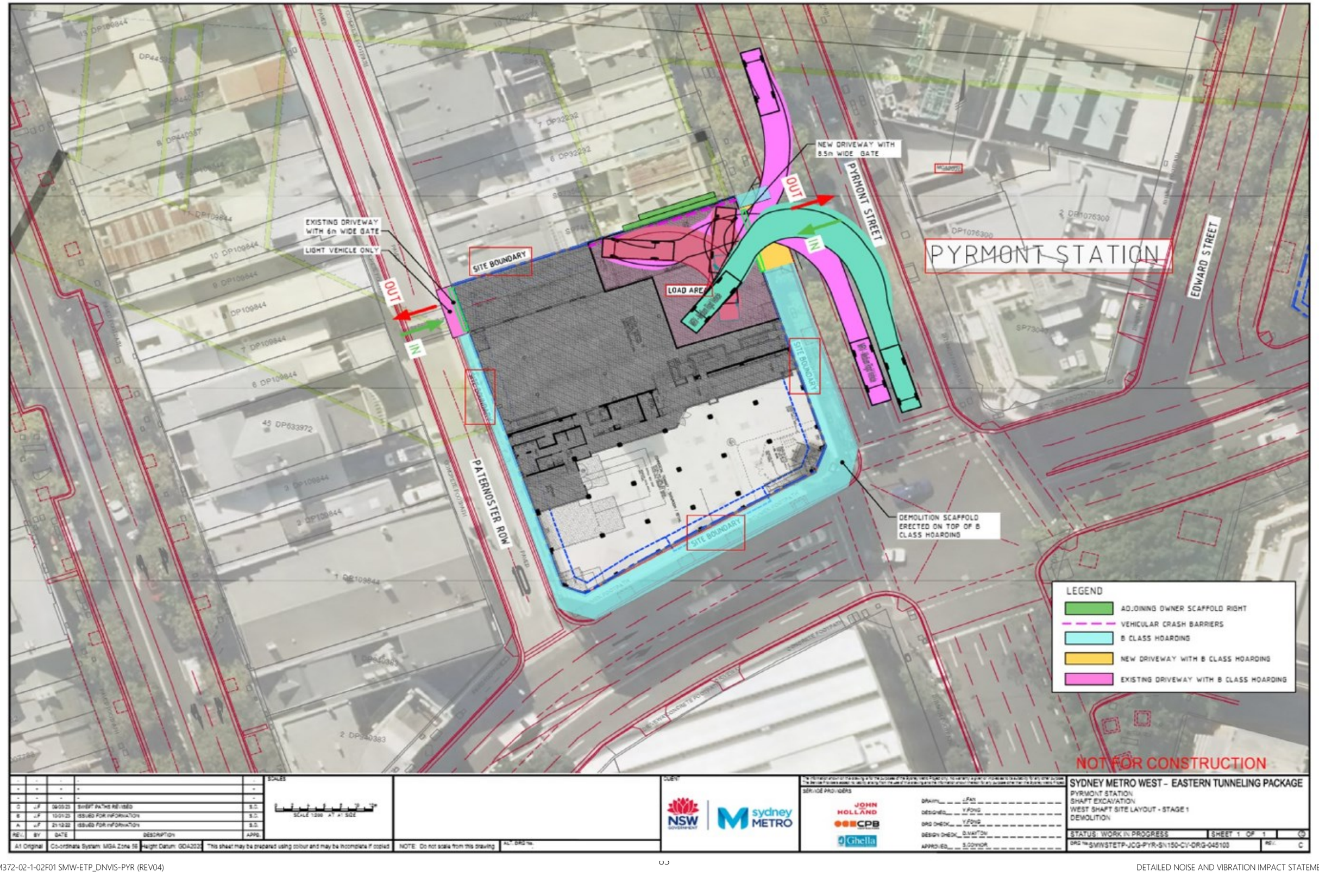
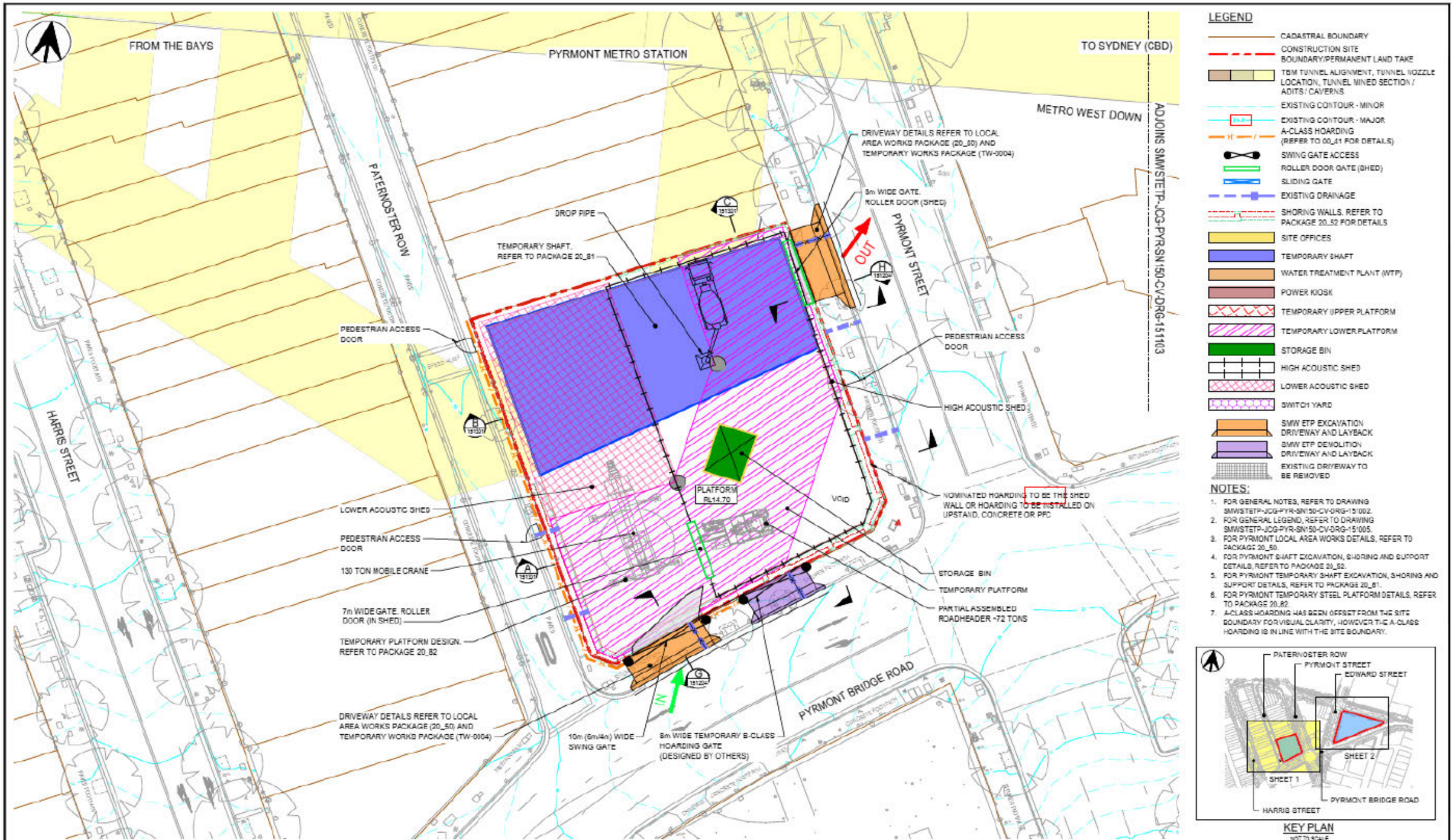


Figure C1-1-2: Site Layout and Hoardings (Stage 2)

PYRMONT STATION - WEST WOKSITE



WESTERN PYRMONT STATION SHAFT

APPROVED FOR CONSTRUCTION

ID	R.TAG	T.DATE	APPROVED FOR CONSTRUCTION	FBAN
REV.	BY	DATE	DESCRIPTION	APPD.

SCALES

IC CERTIFICATE: SMWSTETP-SKB-PYR-DN-CER-000001-[A]

SERVICE PROVIDERS: JOHN HOLLAND · CPB CONTRACTORS · Ghella

DRAWN	COLIN BIBLE
DESIGNED	ISAAC ATHFIELD
DRG CHECK	ROHVEL TADAGINA
DESIGN CHECK	ANDREW KIN
APPROVED	FRANK SHING

SYDNEY METRO WEST - EASTERN TUNNELLING PACKAGE
PYRMONT STATION
20_51 CIVIL WORKS
DETAIL GENERAL ARRANGEMENT PLAN

STATUS: AFC | SHEET 1 OF 2 | DRG No. SMWSTETP-JCG-PYR-SN150-CV-DRG-151102 | REV. 00

A1 Original | Co-ordinate System: GDA 2020 | Height Datum: A.H.D | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing | ALT. DRG No.

Table C1-2: Construction timetable/ activities/ equipment **PYRMONT STATION - EAST WORKSITE**

Activity/ Work Area	Aspect	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity		Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
			7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	Duration	L_{Aeq}	Penalty	L_{Amax}			
EAST WORKSITE													
Compound	Deliveries; Maintenance; Office areas; Storage areas; Car parking	Delivery truck	4 per hour	-	-	Aug-23	120 weeks	106	-	111	-	-	
		Light vehicle	30 in/ out	20 in/ out	20 in/ out	Aug-23	120 weeks	89	-	100	-	-	
		Water Treatment Plant pump	2	2	2	Aug-23	120 weeks	99	-	101	-	-	See Table C5
		Compressor	2	-	-	Aug-23	120 weeks	102	-	103	-	-	
		Workshop Hand Tools	1	-	-	Aug-23	120 weeks	105	-	118	-	-	
		Franna Crane	1	-	-	Aug-23	120 weeks	98	-	102	-	-	
		Water cart/ Street Sweeper	1	-	-	Aug-23	120 weeks	107	-	111	-	-	
	Shaft and tunnel ventilation	Ventilation fan with silencer - Cavern	2	2	2	Jan-24	65 weeks	105	-	108	-	-	Fan mounted within cavern; Assumed Lw fan air intake (see Table C4b)
		Ventilation fan with silencer - TBM	2	2	2	Oct-24	16 weeks	101	-	104	-	-	Fan mounted within tunnel; Assumed Lw fan air intake (see Table C4b)
Stage 1: Site establishment and demolition	B-Class Hoarding/ Scaffold construction and dismantle	Forklift	2	-	-	May-23		99	-	103	-	-	B-class hoarding installed prior to demolition
		EWP / Scissor Lift	2	-	-	Install	6 weeks	95	-	98	-	-	Install from May 2023
		Circular Saw (petrol)	3	-	-	Dismantle	4 weeks	115	5	120	HN	-	Dismantle when demolition complete, July 2023
	Assessment ref: **PE-SE(B)**	Impact Driver	2	-	-			106	-	109	-	-	
		Rattle Gun	3	-	-			90	-	105	-	-	
		Hiab Truck	2	-	-			95	-	98	-	-	
	Demolition	Truck (spoil haulage)	4 p.h.	-	-	Jun-23	12 weeks	106	-	111	-	-	(Rigid Body, 10 Wheeler)
		Skid Steer 3T	2	-	-	Jun-23	12 weeks	102	-	107	-	-	
	Assessment ref: **PE-DE(AH)**	Excavator 5T (Bucket, Grabs)	2	-	-	Jun-23	12 weeks	101	-	114	-	-	
	[Demolition above hoarding]	EWP / Scissor Lift	2	-	-	Jun-23	12 weeks	95	-	98	-	-	
		Excavator 49T (Bucket, Grabs and Shears)	1	-	-	Jun-23	12 weeks	106	-	111	-	-	
	Assessment ref: **PE-DE(BH)**	Excavator 49T (Hammer)	0.5	-	-	Jun-23	6 weeks	118	5	126	HN	X	
	[Demolition below hoarding]	Dust Suppression Fan	2	-	-	Jun-23	12 weeks	99	-	102	-	-	
		Oxy Acetylene	2	-	-	Jun-23	1 week	96	-	107	-	-	
	A-Class Hoarding construction	Forklift	2	-	-	Aug-23		99	-	103	-	-	A-class hoarding installed post demolition
		EWP / Scissor Lift	2	-	-	Install	6 weeks	95	-	98	-	-	Install from July 2023
	Assessment ref: **PE-SE(A)**	Circular Saw (petrol)	3	-	-			115	5	120	HN	-	
		Impact Driver	2	-	-			106	-	109	-	-	
		Rattle Gun	3	-	-			90	-	105	-	-	
		Hiab Truck	2	-	-			95	-	98	-	-	
	Prelim Earthworks and Piling Pad Construction	Excavator 35T with hammer	2	-	-	Sep-23	4 weeks	118	5	126	HN	X	Levelling site and piling pad; stripping and loading of subgrade
		Excavator 30T with bucket	2	-	-	Sep-23	4 weeks	103	-	108	-	-	Spread and place fill for piling pad
		Vibratory Roller 16T (Smoothdrum)	2	-	-	Sep-23	4 weeks	108	5	113	HN	X	
	Assessment ref: **PE-PE**	Vibratory Roller 16T (Padfoot)	2	-	-	Sep-23	4 weeks	108	5	113	HN	X	
		Truck (spoil haulage)	2 p.h.	-	-	Sep-23	4 weeks	106	-	111	-	-	Import / export material
		Moxy 20T	2	-	-	Sep-23	4 weeks	109	-	119	-	-	Cart to/from stockpile
Stage 2: Acoustic shed construction	Piling and capping beams	Piling Rig (Bauer BG36)	1	-	-	Sep-23	14 weeks	107	-	116	-	X	Assumes piling in series (temp east, then permanent west, then permanent east)
		Excavator 20T	1	-	-	Sep-23	14 weeks	103	-	108	-	-	Also includes 4 king piles at Pyrmont East.
	Assessment ref: **PE-PC**	Shotcrete rig	1	-	-	Sep-23	14 weeks	104	-	107	-	-	
		Concrete pump	1	-	-	Sep-23	14 weeks	103	-	107	-	-	
		Concrete truck	4 p.h.	-	-	Sep-23	14 weeks	108	-	111	-	-	
		Compressor	2	-	-	Sep-23	14 weeks	102	-	103	-	-	
		Crawler Crane 100t	1	-	-	Sep-23	14 weeks	104	-	108	-	-	
		Delivery truck	1	-	-	Sep-23	14 weeks	106	-	111	-	-	
		Power hand tools	1	-	-	Sep-23	14 weeks	108	-	118	-	-	
		Jackhammer	1	-	-	Sep-23	14 weeks	111	5	121	HN	X	
	Platform and acoustic shed (east) construction	Mobile Crane 150T	1	1	1	Nov-23	20 weeks	104	-	108	-	-	Shed erection and temporary shaft happening concurrently
		Franna Crane	2	2	2	Nov-23	20 weeks	98	-	102	-	-	
	* includes Tower Crane construction and dismantle	Delivery Trucks	4 p.h.	4 p.h.	1	Nov-23	20 weeks	106	-	111	-	-	Oversize deliveries will be required during nightshift.
		Impact wrench	4	-	-	Nov-23	20 weeks	107	-	118	-	-	
	Assessment ref: **PE-PAS**	Hand tools	4	-	-	Nov-23	20 weeks	105	-	118	-	-	
		EWP	2	-	-	Nov-23	20 weeks	95	-	98	-	-	
		Generator (1500 RPM; 1200 kW)	1	-	1*	Jan-24	12 weeks	110	-	110	-	-	* Generator located in temporary site office area, startup at 5:30 am
		Tower Crane (diesel)	1	-	-	Sep-23	14 weeks	114	-	119	-	-	Crane to be switched off when not in use.
Stage 2: Temporary Shaft Excavation	Shaft excavation	Power hand tools	1	-	-	Jan-24	12 weeks	108	-	118	-	-	Shed construction and temporary shaft happening concurrently
	Assessment ref: **PE-SE(S)**; **PE-SE(5m)**; **PE-SE(10m)**	Generator	1	-	-	Jan-24	12 weeks	94	-	95	-	-	Generator located near tower crane
		Water pump (diaphragm pump)	1	-	-	Jan-24	12 weeks	106	-	109	-	-	
	[Shaft excavation at surface; 5m deep; and 10m deep, inc spoil handling]	Excavator 35T (rockhammer)	3	-	-	Jan-24	12 weeks	118	5	126	HN	X	
		Excavator with saw attachment	1	-	-	Jan-24	12 weeks	121	5	129	HN	X	
		Excavator with cutter attachment	-	-	-	Jan-24	12 weeks	121	5	129	HN	X	
		Site Forklift	1	-	-	Jan-24	12 weeks	99	-	103	-	-	
		Generator	-	-	-	Jan-24	12 weeks	94	-	95	-	-	
		Tower Crane (diesel)	1	-	-	Jan-24	12 weeks	114	-	119	-	-	
		Generator (1500 RPM; 1200 kW)	1	-	1*	Jan-24	12 weeks	110	-	110	-	-	* Generator located in temporary site office area, startup at 5:30 am
		Compressor	1	-	-	Jan-24	12 weeks	102	-	103	-	-	
	Spoil Handling	Truck (spoil haulage)	4-6 p.h	-	-	Jan-24	12 weeks	106	-	111	-	-	
		Excavator 30T with bucket	1	-		Jan-24	12 weeks	103	-	108	-	-	
		Mobile Crane 100T	1	-	-	Jan-24	12 weeks	104	-	108	-	-	

Table C1-2: Construction timetable/ activities/ equipment **PYRMONT STATION - EAST WORKSITE**

Activity/ Work Area	Aspect	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity		Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
			7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	Duration	L_{Aeq}	Penalty	L_{Amax}			
	Temporary ground support works	Drill Rig (percurssion)	1	-	-	Jan-24	12 weeks	108	-	118	-	-	
	Assessment ref: **PE-GS(S)**;	Power hand tools	4	-	-	Jan-24	12 weeks	108	-	118	-	-	
	PE-GS(5m); **PE-GS(10m)**	Concrete truck	4 p.h.	-	-	Jan-24	12 weeks	108	-	111	-	-	6-10pm only if we can't finish the concrete pour in time
	[Ground support at surface; 5m	Concrete pump	1	-	-	Jan-24	12 weeks	103	-	107	-	-	6-10pm only if we can't finish the concrete pour in time
	deep; and 10m deep]	Shotcrete rig	1	-	-	Jan-24	12 weeks	104	-	107	-	-	6-10pm only if we can't finish the concrete pour in time
		Welding equipment	1	-	-	Jan-24	12 weeks	96	-	107	-	-	6-10pm only if we can't finish the concrete pour in time
Stage 3:	Shaft excavation	Power hand tools	1	-	-	Apr-24	19 months	108	-	118	-	-	*Permanent Shaft excavation happening concurrently with Mined Tunnel excavation and lining.*
Permanent Shaft	Assessment ref: **SW-SE** [Site wide	Generator	1	-	-	Jan-24	19 months	94	-	95	-	-	*Shed installation complete*
Excavation	shaft excavation in acoustic shed	Water pump (diaphragm pump)	1	1	1	Jan-24	19 months	106	-	109	-	-	
	(base case).]	Excavator 35T (rockhammer)	5	-	-	Jan-24	19 months	118	5	126	HN	X	BASE CASE: 5x excavator with rockhammers; 2x excavator with saw attachment; 1x excavator with cutter
	SW-SE-A [Site wide shaft excavation	Excavator with saw attachment	2	-	-	Jan-24	19 months	121	5	129	HN	X	BASE CASE: 5x excavator with rockhammers; 2x excavator with saw attachment; 1x excavator with cutter
	in acoustic shed (Option A).]	Excavator with cutter attachment	1	-	-	Jan-24	19 months	121	5	129	HN	X	BASE CASE: 5x excavator with rockhammers; 2x excavator with saw attachment; 1x excavator with cutter
		Surface Miner (optional)	*2*	-	-	*Jan-24*	*19 months*	*120*	-	*125*	-	*X*	*OPTION A: 2 x surface miners and 3 x excavators with rockhammers*
		Excavator 30T with bucket	3	1	-	Jan-24	19 months	103	-	108	-	-	Inside shed (bottom of shaft), moving spoil/ loading kibble
		EWP - 56ft diesel telescopic boom	1	-	-	Jan-24	19 months	95	-	98	-	-	
		Site Forklift	1	-	-	Jan-24	19 months	99	-	103	-	-	
		Compressor	1	1	-	Jan-24	19 months	102	-	103	-	-	
		Dust Scrubber with silencer	2	2	-	Jan-24	19 months	104	-	107	-	-	Located at bottom of shaft
	Spoil Handling	Bogie (spoil haulage)	4-6 p.h	4 p.h	-	Jan-24	19 months	106	-	111	-	-	Evening - spoil truck NOT concurrent with concrete/ shotcrete delivery for ground support
		Gantry Crane	1	1	-	Jan-24	19 months	106	-	110	-	-	
		Kibble (bottom dumping)	1	1	-	Jan-24	19 months	103	-	108	-	-	Inside shed, loading spoil truck
	Temporary ground support works	Drill Rig (percurssion)	1	1	-	Oct-23	19 months	108	-	118	-	-	
	Assessment ref: **SW-GS(S)**;	Power hand tools	4	4	-	Oct-23	19 months	108	-	118	-	-	
	SW-GS(5m); **SW-GS(10m)**	Concrete truck	4 p.h.	4 p.h.	-	Oct-23	19 months	108	-	111	-	-	Evening - concrete/ shotcrete delivery for ground support NOT concurrent with spoil truck
	[Ground support at surface; 10m	Concrete pump	1	1	-	Oct-23	19 months	103	-	107	-	-	
	deep; + spoil handling]	Shotcrete rig	1	1	-	Oct-23	19 months	104	-	107	-	-	
		Welding equipment	1	1	-	Oct-23	19 months	96	-	107	-	-	
	Base Slab (concreting)	Power hand tools	4 p.h.	4 p.h.	-	Jan-24	12 weeks	108	-	118	-	-	6-10pm only if we can't finish the concrete pour in time
	Assessment ref: **SW-BS** [Site wide	Concrete truck	4 p.h.	4 p.h.	-	Jan-24	12 weeks	108	-	111	-	-	6-10pm only if we can't finish the concrete pour in time
	in acoustic shed]	Concrete pump	1	1	-	Jan-24	12 weeks	103	-	107	-	-	6-10pm only if we can't finish the concrete pour in time
		Welding equipment	1	1	-	Jan-24	12 weeks	96	-	107	-	-	6-10pm only if we can't finish the concrete pour in time
Stage 3:	Cavern excavation & support	Road Header 1,000V Electric	2	2	2	Apr-24	19 months	104	-	108	-	-	
Mined tunnelling and	Assessment ref: **SW-MTS**	Bolting rig Robodrill 525	1	1	1	Apr-24	19 months	106	-	116	-	X	Adits
associated activities	[Site wide (East & West sites, with shed)	Shotcrete rig (Potenza)	1	1	1	Apr-24	19 months	104	-	107	-	-	Adits
(Caverns)	tunnelling and associated activities of	Concrete site agitator	2	2	2	Apr-24	19 months	108	-	111	-	-	Adits
	rockbolting, shotcreting and mucking	Concrete road agitator	2 p.h	2 p.h	2 p.h	Apr-24	19 months	108	-	111	-	-	Shaft / Adits
	out; spoil haulage; delivery of material	Skid steer	1	1	1	Apr-24	19 months	109	-	113	-	-	Inside shed
	to directly support tunnelling activities]	Excavator 25t w hammer	1	-	-	Apr-24	19 months	118	5	126	HN	X	Adits
		Excavator 8t w hammer	1	-	-	Apr-24	19 months	118	5	123	HN	X	Adits
		FE Loader (CAT980)	1	1	-	Apr-24	19 months	110	-	115	-	-	Inside shed (lower deck), loading spoil truck
		Dust Scrubber with silencer	2	2	2	Apr-24	19 months	104	-	107	-	-	Located underground near excavation face
	Spoil Haualage/ mucking out	Dump truck (Moxy CAT 725)	3	3	3	Apr-24	19 months	109	-	119	-	-	Inside shed - to be acoustically treated
	Assessment ref: **SW-MTS**	Excavator 25t w bucket	1	1	1	Apr-24	19 months	103	-	108	-	-	Cavern / temp shaft
		Excavator 8t w bucket	1	1	1	Apr-24	19 months	103	-	108	-	-	Cavern
		Excavator 30T with bucket	1	1	1	Apr-24	19 months	103	-	108	-	-	Cavern
		Gantry Crane	2	2	2	Apr-24	19 months	106	-	110	-	-	Inside shed at bottom of shaft
		FE Loader (CAT980)	1	1	-	Apr-24	19 months	110	-	115	-	-	Inside shed (lower deck), loading spoil truck
		Truck (spoil haulage)	8-9 p.h.	8-9 p.h.	-	Apr-24	19 months	106	-	111	-	-	Inside shed
	Tunnel Lining (concreting)	Concrete pump	2	2	2	Oct-24	15 months	103	-	107	-	-	Inside shed
	Assessment ref: **SW-MTL**	Compressor	1	1	1	Oct-24	15 months	102	-	103	-	-	Adit - form pumps
	[Site wide (East & West sites, with shed)	Genset	1	1	1	Oct-24	15 months	94	-	95	-	-	2 / 3 days usage for form power
	Tunnel Lining (concreting) , including	pneumatic vibrator	40	40	40	Oct-24	15 months	97	-	100	-	-	On form for vibrators in cavern
	delivery of concrete	Concrete road agitator	6 p.h	6 p.h*	6 p.h*	Oct-24	15 months	105	-	111	-	-	During crown concrete pours - every 2-3 days, significantly less during invert and kicker works
		Concrete site agitator	5	5*	5*	Oct-24	15 months	108	-	111	-	-	Inside shed during concrete pours - every 2-3 days
		Telehandler	1	1	1	Oct-24	15 months	98	-	102	-	-	
Stage 4:	Platform and acoustic shed (east)	Mobile Crane 150T	1	-	-	Nov-25	8 weeks	104	-	108	-	-	
Acoustic shed	removal	Franna Crane	2	-	-	Nov-25	8 weeks	98	-	102	-	-	
decomissioning	Assessment ref: **PE-ASD**	Delivery Trucks	4 p.h.	-	-	Nov-25	8 weeks	106	-	111	-	-	
		Excavator 25t w bucket	2	-	-	Nov-25	8 weeks	103	-	108	-	-	
		Excavator 45t w bucket	1	-	-	Nov-25	8 weeks	106	-	111	-	-	
		Impact wrench	4	-	-	Nov-25	8 weeks	107	-	118	-	-	
		Handtool - grinder	4	-	-	Nov-25	8 weeks	108	-	118	-	-	
		Hand tools	4	-	-	Nov-25	8 weeks	105	-	118	-	-	
		Welding equipment	2	-	-	Nov-25	8 weeks	96	-	107	-	-	
		EWP	2	-	-	Nov-25	8 weeks	95	-	98	-	-	

Figure C1-2-1: Site Layout and Hoardings (Stage 1)

PYRMONT STATION - EAST WORKSITE

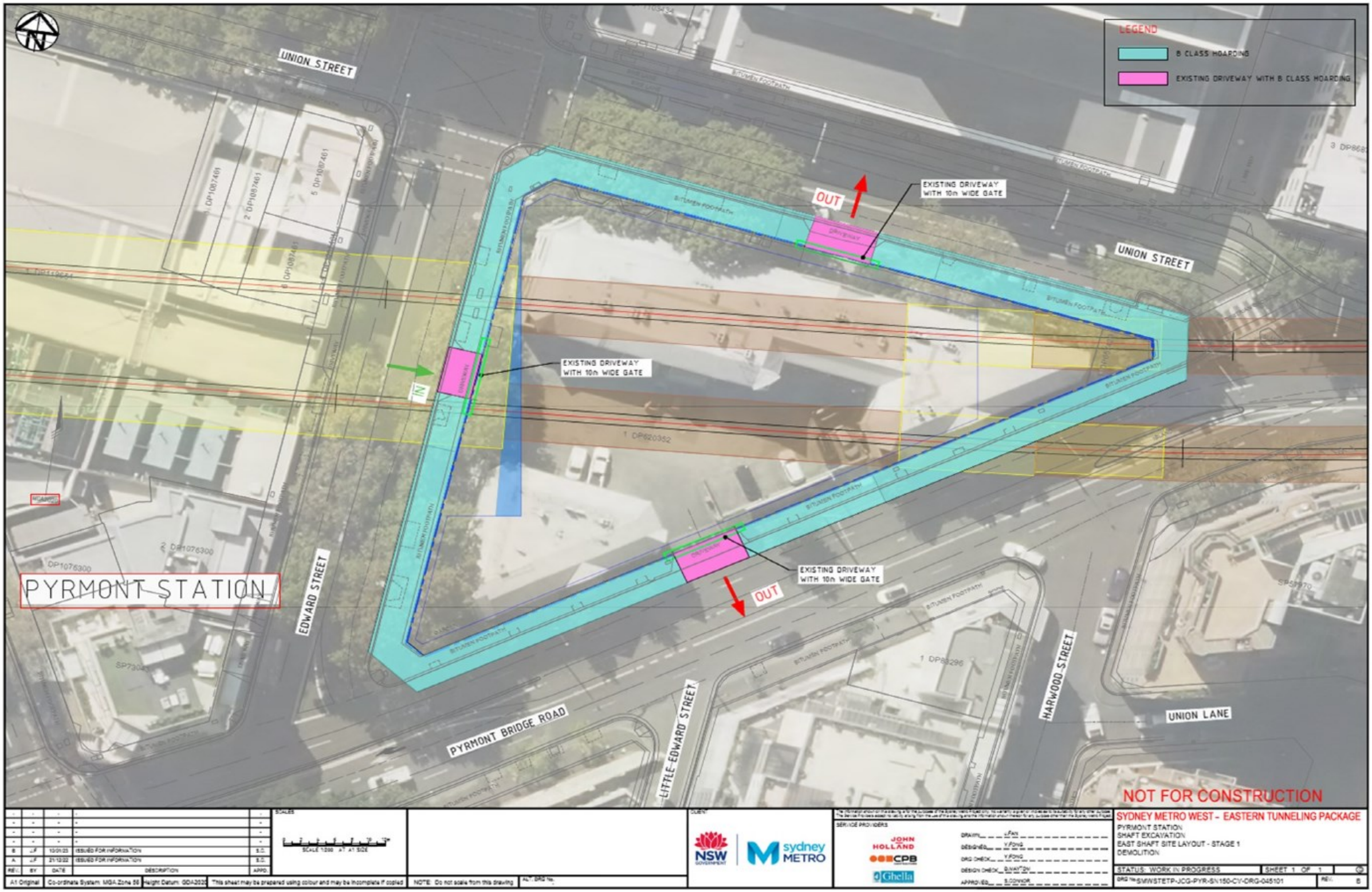


Figure C1-2-2: Site Layout and Hoardings (Stage 2)

PYRMONT STATION - EAST WORKSITE

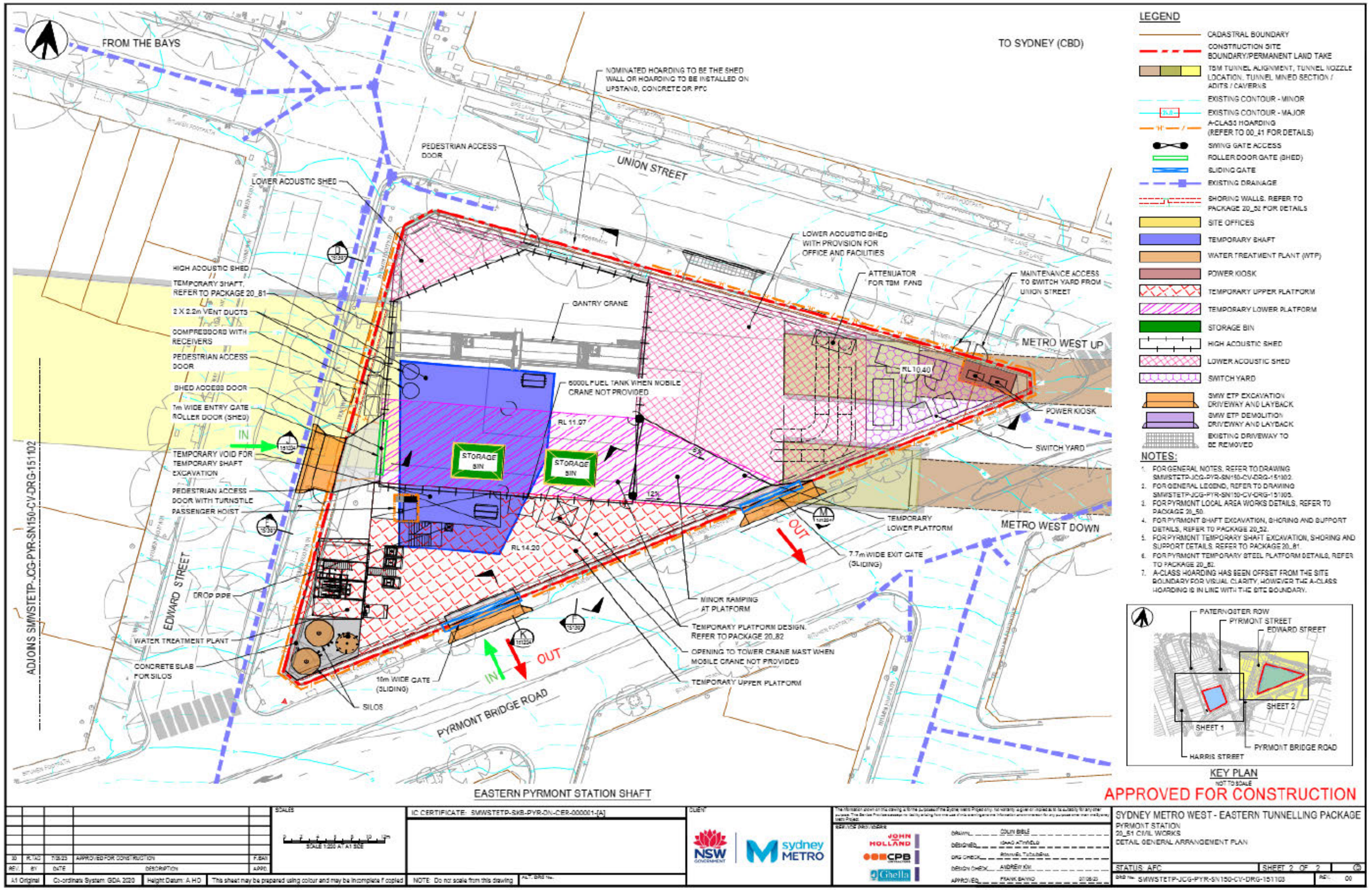


Table C1-3: Construction timetable (indicative)

Activity/ Work Area	Aspect	2023				2024																		2025											
		April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December
WEST WORKSITE																																			
Compound	Deliveries; Maintenance; Office areas; Storage areas; Car parking																																		
	Shaft and tunnel ventilation																																		
Stage 1: Site establishment	B-Class Hoarding/ Scaffold																																		
	Demolition																																		
	A-Class Hoarding construction																																		
	Prelim Earthworks and Piling Pad Construction																																		
Stage 2: Acoustic shed construction	Piling and capping beams																																		
	Platform and acoustic shed (west) construction																																		
Stage 3: Permanent Shaft Excavation	Shaft excavation																																		
	Spoil Handling																																		
	Temporary base slab																																		
	Base Slab (permanent)																																		
Stage 3: Mined tunnel tunnelling and associated activities (Adits)	Tunnelling excavation and associated activities																																		
	Spoil Haulage and mucking out																																		
	Tunnel Lining (concreting) , including delivery of concrete																																		
Stage 4: Acoustic shed decommisioning	Removal of acoustic shed																																		
EAST WORKSITE																																			
Compound	Deliveries; Maintenance; Office areas; Storage areas; Car parking																																		
	Shaft and tunnel ventilation																																		
Stage 1: Site establishment	B-Class Hoarding/ Scaffold																																		
	Demolition																																		
	A-Class Hoarding construction																																		
	Prelim Earthworks and Piling Pad Construction																																		
Stage 2: Acoustic shed construction	Piling and capping beams																																		
	Platform construction (east)																																		
	Acoustic shed construction (east)																																		
Stage 2: Temporary Shaft Excavation	Shaft excavation																																		
	Spoil Handling																																		
	Support works																																		
Stage 3: Mined tunnel tunnelling and associated activities (Station Cavern)	Tunnelling excavation and associated activities																																		
	Spoil Haulage and mucking out																																		
	Tunnel Lining (concreting) , including delivery of concrete																																		
Stage 3: Permanent Shaft Excavation (within acoustic shed)	Shaft excavation and temporary ground support works																																		
	Spoil Handling																																		
	Base Slab																																		
Stage 4: Acoustic shed decommisioning	Removal of acoustic shed																																		

C.2 Construction mitigation and management measures

Table C2: Construction Noise Management Schedule **PYRMONT STATION**

Area to be Managed			Specific Mitigation/ Management Measure	Details
1	**Acoustic shed construction (PW-PAS; PE-PAS)**			
1.1	Work during Standard Construction Hours	DAY:	Standard hours activities	See Table C6
			Noise control kits (including mufflers, attenuators, shrouding of tower crane engine) was reviewed and found to be not feasible post installation of crane.	
			Tower Crane to be switched off when not in use.	
1.2	Work outside Standard Construction Hours	D(O)/EVE/ NGT:	Works adjacent to Pyrmont Bridge Road and Pyrmont Street will require OOHW due to Road Occupancy License (ROL) limiting road access to OOHW period	
			- Piling and capping beams works limited to:	Plant/ equipment limited as noted in Table C1-1
			Mobilisation (rig/crane delivery) – 2 nights	
			Piling activities – 1 night per week for 2 weeks	
			Demobilisation – 2 nights	
			- Formwork, reinforcement and concrete pour works limited to:	
			Concrete deliveries (overrun contingency) – 1 night per week for 2 months	Plant/ equipment limited as noted in Table C1-1 and C1-2
			- Platform/Shed construction works limited to:	
			Oversized deliveries – 1 night per week for 4 months	Plant/ equipment limited as noted in Table C1-1 and C1-2
1.3	Temporary noise barriers	D(O)/EVE/ NGT:	Temporary noise screen located around work areas as close as possible to the plant, where practicable and safe.	
			Site buildings and temporary noise screen located around generator to shield nearest affected receivers. Generator exhaust to be oriented away from sensitive receivers.	
1.4	Residual impacts	D(O)/EVE/ NGT:	Additional Mitigation Measures for OOH noise affected receivers to WEST worksite on PYRMONT STREET and PATERNOSTER ROW	See Appendix D, Table D3-1
			Additional Mitigation Measures for OOH noise affected to EAST worksite on PYRMONT BRIDGE ROAD and EDWARD STREET	See Appendix D, Table D3-1
2	**Permanent shaft excavation**			
2.1	Work during Standard Construction Hours	DAY:	Standard hours activities	see Table C1 for details
2.2	Work outside Standard Construction Hours	D(O)/EVE/ NGT:	OOHW activities limited as noted below and in Table C1	see Table C1 for details
2.3	Acoustic enclosures/sheds			
	Acoustic shed and cover over WEST shaft	D(O)/EVE:	Acoustic shed to allow OOHW concrete delivery, ground-support/ temporary lining of shaft	see Table C4 for details
		D(O)/EVE/ NGT:	**Rapid roller door** on the **southern and eastern side** of the shed to be closed in the evening and at night.	see Table C4 for details
	Acoustic shed and cover over EAST shaft	D(O)/EVE:	Acoustic shed to allow OOHW concrete delivery, ground-support/ temporary lining of shaft	see Table C4 for details
		D(O)/EVE/ NGT:	**Rapid roller door** on the **eastern and western side** of the shed to be closed in the evening and at night.	see Table C4 for details
2.4	Truck restrictions during the OOHW period			
			Avoid the use of park air brakes outside the sheds at night. Set up relevant traffic management measures to minimise the use of air brakes when leaving the site.	
			Air brake silencers are to be correctly installed and fully operational for any heavy vehicles (as per CNVMP). Minimise unnecessary acceleration on site.	
	Deliveries (concrete)	D(O)/EVE:	≤ 4 per hour (concrete trucks afor ground support/ temporary lining following shaft excavation)	see Table C1 for details
	SPOIL trucks on site	D(O)/EVE	≤ 4 per hour	see Table C1 for details
		NIGHT:	No spoil trucks after 6pm	
2.5	Ventilation Fans	D(O)/EVE/ NGT:	2 x TBM Ventilation fans with silencer located underground within tunnel and ducted to surface air intake plenum located on eastern side of Pyrmont East site (intake facing north).	see Table C4b for performance requirements
			2 x Cavern Ventilation fans with silencer located underground within cavern and ducted to surface. Air intake located on south wall of Pyrmont West Low Shed.	see Table C4b for performance requirements
			1 x Cavern Ventilation fan with silencer located underground within ventilation plenum and ducted to surface. Air intake located on walls of Pyrmont East Low Shed.	see Table C4b for performance requirements
2.6	Water treatment plant		Additional enclosure subject to compliance testing	see Table C5 for performance requirements
2.7	Residual impacts		Marginal impacts likely at nearest receivers to WEST shaft on PYRMONT STREET and PATERNOSTER ROW	See Table C6
3	**Mined tunnelling and associated activities**			
3.1	Work during Standard Construction Hours	DAY:	Standard hours activities	see Table C1 for details
3.2	Work outside Standard Construction Hours	D(O)/EVE/ NGT:	OOHW activities limited as noted below and in Table C1	see Table C1 for details
3.3	Acoustic enclosures/sheds			
	Acoustic shed and cover over WEST shaft	D(O)/EVE/ NGT:	Acoustic shed to allow OOHW concrete delivery, spoil handling and loading	see Table C4 for details
		D(O)/EVE/ NGT:	1 Gantry Crane inside acoustic shed; excavator with bucket loading kibble; kibble loads directly to spoil truck.	see Table C1 for details
		D(O)/EVE/ NGT:	**Rapid roller door** on the **southern and eastern side** of the shed to be closed in the evening and at night.	see Table C4 for details
	Acoustic shed and cover over EAST shaft	D(O)/EVE/ NGT:	Acoustic shed to allow OOHW concrete delivery, spoil handling and loading	see Table C4 for details
		D(O)/EVE/ NGT:	1 Gantry Crane inside acoustic shed; excavator with bucket loading kibble; kibble loads directly to spoil truck.	see Table C1 for details
		D(O)/EVE/ NGT:	**Rapid roller door** on the **eastern and western side** of the shed to be closed in the evening and at night.	see Table C4 for details
3.4	Truck restrictions during the OOHW period			
			Avoid the use of park air brakes outside the sheds at night. Set up relevant traffic management measures to minimise the use of air brakes when leaving the site.	
			Air brake silencers are to be correctly installed and fully operational for any heavy vehicles (as per CNVMP). Minimise unnecessary acceleration on site.	
	Deliveries (concrete)	D(O)/EVE/NGT:	≤ 4 per hour (concrete trucks at night essential for ground support following mined-tunnel excavation)	see Table C1 for details
	SPOIL trucks on site	D(O)/EVE	≤ 9 per hour	see Table C1 for details
		NIGHT:	No spoil trucks after 10pm	
3.5	**Residual impacts**		Marginal impacts likely at nearest receivers to WEST shaft on PYRMONT STREET and PATERNOSTER ROW	See Table C6

Table C3: Noise Wall / Hoarding Design Specifications **PYRMONT STATION**

Noise wall reference	Location	Noise wall/ hoarding height	Proposed Construction	Acoustic Rating of Construction*
NW01	PYRMONT WEST Site boundary A-Class hoarding as shown in Figure C1-2	2.4 m	17 mm plywood hoarding	Rw 24
NW02	PYRMONT EAST Site boundary A-Class hoarding as shown in Figure C1-4	2.4 m	17 mm plywood hoarding	Rw 24

Notes:

Noise barrier performance: Low - Rw 10-15; Medium - Rw 15-20; Medium-High - Rw 20-25; High - Rw 25; Very High - Rw 30

* estimated by calculations and/or reference to other similar barrier type data

GENERAL

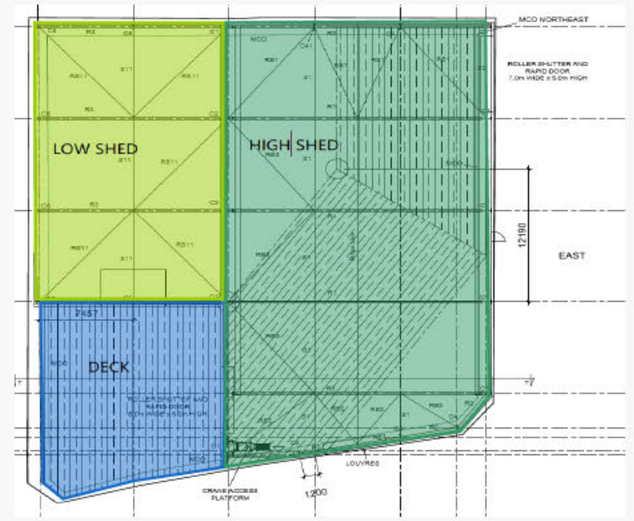
- The specified 'required rating' must be achieved by the product selected.
- By way of explanation, the Sound Insulation Rating Rw is a measure of the noise reduction property of the assembly, a higher rating implying a higher sound reduction performance.
- Note that the Rw rating of systems measured as built on site (R'w Field Test) may be up to 5 points lower than the laboratory result.
- The sealing of all gaps is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.
- Check design of all junction details with acoustic consultant prior to construction.
- Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
- The information provided in this table is subject to modification and review without notice.
- The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

Table C4: Noise Shed / Enclosure Design Specifications

PYRMONT STATION

Area to be Mitigated	Construction component	Reference ID	Indicative element construction
WEST WORKSITE			
Deck	Roof	F060	Steel checkerplate 3mm thick
	Acoustic lining	-	Not required
	Openings (ventilation/ access)	-	No openings or penetrations outside acoustic shed.
Low Shed	Walls	F058	PBS PANEL P-41 PANEL 1mm Thick Mild Steel and 1 mm Thick Mild Steel with 150 mm Thick Air Cavity in between
	Roof	F005	Double Skin Steel, such as External side: 1 x 0.6 mm BMT corrugated sheet steel + 50 mm insulation (24 kg/m3) + 200mm air gap Inside: 1 x 0.6 mm BMT corrugated sheet steel.
	Acoustic lining	-	Acoustic lining with roofing blanket on inner skin facing inside shed: - walls with perforated foil (perforation facing inside of the shed) - underside of roof acoustic insulation with perforated foil (perforation facing inside of the shed)
	Openings (ventilation/ access)	-	Any necessary ventilation openings should face away from neighbours and also fitted with acoustic louvres / attenuators or doors to achieve requirements. See Table C4b for detail.
High Shed	Walls	F058	PBS PANEL P-41 PANEL 1mm Thick Mild Steel and 1 mm Thick Mild Steel with 150 mm Thick Air Cavity in between
	Roof	F005	Double Skin Steel, such as External side: 1 x 0.6 mm BMT corrugated sheet steel + 50 mm insulation (24 kg/m3) + 200mm air gap Inside: 1 x 0.6 mm BMT corrugated sheet steel.
	Insulation inside double skin walls/roofs		Foil side of the acoustic insulation to be interfaced with the steel layer so that glasswool is exposed to the cavity (not against the steel)
	Acoustic lining	-	Acoustic lining with roofing blanket on inner skin facing inside shed of: - upper section of walls (above 4 m) with perforated foil (perforation facing inside of the shed) - Underside of roof with non-perforated foil
	Doors	-	Roller shutter door plus rapid roller doors on the entry and exit of the shed Access doors to be selected to not acoustically comprimise the overall building element it sits within.
	Openings (ventilation/ access)	-	Any necessary ventilation openings should face away from neighbours and also fitted with acoustic louvres / attenuators or doors to achieve requirements. See Table C4b for detail.
EAST WORKSITE			
Deck (Upper/Lower/Office	Roof	F060	Steel checkerplate 3mm thick
	Acoustic lining	-	Not required
	Openings (ventilation/ access)	-	No openings or penetrations outside acoustic shed.
Low Shed	Walls	F058	PBS PANEL P-41 PANEL 1mm Thick Mild Steel and 1 mm Thick Mild Steel with 150 mm Thick Air Cavity in between
	Roof	F011	Double Skin Steel, External side: 1 x 0.42 mm BMT corrugated sheet steel + 50 mm insulation (24 kg/m3) + 200mm air gap Inside: 1 x 0.42 mm BMT corrugated sheet steel.
	Acoustic lining	-	Acoustic lining with roofing blanket on inner skin facing inside shed: - walls with perforated foil (perforation facing inside of the shed) - underside of roof acoustic insulation with perforated foil (perforation facing inside of the shed)
	Openings (ventilation/ access)	-	Any necessary ventilation openings should face away from neighbours and also fitted with acoustic louvres / attenuators or doors to achieve requirements. See Table C4b for detail.
High Shed	Walls	F058	PBS PANEL P-41 PANEL 1mm Thick Mild Steel and 1 mm Thick Mild Steel with 150 mm Thick Air Cavity in between
	Roof	F011	Double Skin Steel, External side: 1 x 0.42 mm BMT corrugated sheet steel + 50 mm insulation (24 kg/m3) + 200mm air gap Inside: 1 x 0.42 mm BMT corrugated sheet steel.
	Insulation inside double skin walls/roofs		Foil side of the acoustic insulation to be interfaced with the steel layer so that glasswool is exposed to the cavity (not against the steel)
	Acoustic lining	-	Acoustic lining with roofing blanket on inner skin facing inside shed of: - upper section of walls (above 4 m) with perforated foil (perforation facing inside of the shed) - Underside of roof with non-perforated foil

Building element key



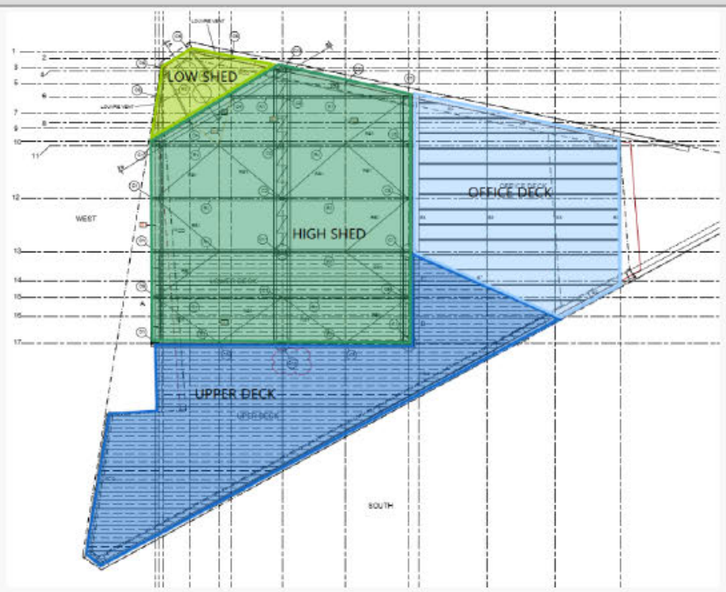


Table C4: Noise Shed / Enclosure Design Specifications

PYRMONT STATION

Area to be Mitigated	Construction component	Reference ID	Indicative element construction	Building element key
East Worksite - High Shed (continued)	Doors	-	Roller shutter door plus rapid roller doors on the entry and exit of the shed Access doors to be selected to not acoustically comprimise the overall building element it sits within.	
	Openings (ventilation/ access)	-	Any necessary ventilation openings should face away from neighbours and also fitted with acoustic louvres / attenuators or doors to achieve requirements. See Table C4b for detail.	

Notes:

1. The final level of noise reduction required from an acoustic shed / enclosure is dependent on a number of factors, however one important factor is whether or not there are noisy plant on site which cannot be acoustically treated and operate outside the acoustic shed / enclosure. Depending on the number and noise emissions of such plant, it may be necessary to apply greater acoustic treatment to the acoustic shed / enclosure in order to keep its

LEGEND * estimated by calculations and/or reference to other similar wall type data. The client is advised not to commit to materials which have not been tested in an approved laboratory or for which an opinion only is available. Testing materials is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested materials, estimates or opinions.

GENERAL

- The underside of the roof and (where possible) internal walls should be lined with acoustic insulation to reduce the build-up of sound inside the shed
- The specified performances must be achieved by the product selected.
- The sealing of all gaps is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.
- Check design of all junction details with acoustic consultant prior to construction.
- Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
- The information provided in this table is subject to modification and review without notice.
- The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.
- Only the buildings elements noted in Table C4 and Table C4a have been assessed. It is assumed that all other items will not impact the acoustic properties, or can be sufficiently acoustically treated.

Table C4a: Specification for acoustic elements of noise sheds/ acoustic enclosures

PYRMONT STATION

Reference	Sound transmission loss per octave spectrum dB							Indicative shed element construction
ID	63	125	250	500	1000	2000	4000	
F005	9	14	29	42	51	47	49	Double Skin Steel, External side: 1 x 0.6 mm BMT corrugated sheet steel + 50 mm insulation (24 kg/m3) + 200mm air gap Inside: 1 x 0.6 mm BMT corrugated sheet steel.
F011	8	9	23	37	47	44	46	Double Skin Steel, External side: 1 x 0.42 mm BMT corrugated sheet steel + 50 mm insulation (24 kg/m3) + 200mm air gap Inside: 1 x 0.42 mm BMT corrugated sheet steel.
F058	22	25	30	37	44	52	61	PBS PANEL P-41 PANEL 1mm Thick Mild Steel and 1 mm Thick Mild Steel with 150 mm Thick Air Cavity in between
F060	19	23	28	33	37	41	37	Steel checkerplate 3mm thick

LEGEND * estimated by calculations and/or reference to other similar wall type data. The client is advised not to commit to materials which have not been tested in an approved laboratory or for which an opinion only is available. Testing materials is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested materials, estimates or opinions.

Table C4b: Fan & Silencer Design Specifications

Fan location	Model	Fan details			Fan Duty Point			Sound Power Level - Octave Band dB								Overall		Notes
		No. fans	Diameter	Power	Air flow	Total pressure	Fan speed	63	125	250	500	1000	2000	4000	8000	dB	dB(A)	
FANS		-	mm	kW	m^3/s	Pa	rpm											
Pyrmont East TBM Fans	Cogemacoustic 1 Stage Fan T2.140.1x110.4 (1.5D/2100mm long silencer no pod)	2	1400	110	34.2	2131	1500	94	97	102	92	94	96	93	87	**105**	**101**	Cogemacoustic Sydney-Metro-West-Eastern Package Technical and Commercial Tender (ref:10346VAU-Otc4b). Fans located in mainline lunnel, ducted to surface air intake plenum on eastern side of Pyrmont East site.
Pyrmont East cavern fans	Cogemacoustic 1 Stage Fan T2.160.200.4 (1.5D/2100mm long silencer no pod)	2	1600	200	76.2	1607	1500	105	103	103	100	100	99	96	89	**110**	**105**	Cogemacoustic Sydney-Metro-West-Eastern Package Technical and Commercial Tender (ref:10346VAU-Otc4b). Fans located in cavern, ducted to surface air intake plenum adjacent to Pyrmont cavern.
Pyrmont West cavern fan	Cogemacoustic 1 Stage Fan T2.160.200.4 (1.5D/2100mm long silencer no pod)	1	1600	200	75.7	1647	1500	105	103	104	100	100	100	96	89	**110**	**105**	Cogemacoustic Sydney-Metro-West-Eastern Package Technical and Commercial Tender (ref:10346VAU-Otc4b). Fans located in cavern, ducted to surface air intake plenum adjacent to Pyrmont cavern.

Fan	Model	Attenuator details			Duct/ plenum details		Insertion Loss - Octave Band dB								Overall loss		Notes
		Length	Width	Open area	Area	Length	63	125	250	500	1000	2000	4000	8000	dB	dB(A)	
RECTANGULAR ATTENUATORS		mm	mm		m^2	m											
Pyrmont East TBM Fans	FanTech NSA20E rectangular attenuator	1800	400	50%	12		6	14	26	43	40	32	23	18		**21**	
Pyrmont East cavern fans	FanTech NSA20G rectangular attenuator	2400	400	50%	24		8	17	34	50	50	40	28	20		**23**	
Pyrmont West cavern fan	FanTech NSA20G rectangular attenuator	2400	400	50%	24		8	17	34	50	50	40	28	20		**23**	
Pyrmont East shed air exhaust louves	Fantech RT10B Rectangular Attenuators with Tapered Splitters	900	7000	33%	-	-	4	8	16	28	35	29	21	16		**27**	Located in the north wall of Pyrmont East high shed, facing Union Street
Pyrmont West shed air exhaust louves	Fantech RT10B Rectangular Attenuators with Tapered Splitters	900	6000	33%	-	-	4	8	16	28	35	29	21	16		**27**	Located in the south wall of Pyrmont West high shed, facing Pyrmont Bridge Road

Fan location	Details	Intake details	Sound Power Level - Octave Band dB								Overall loss		Notes/ [materials]
		Area	63	125	250	500	1000	2000	4000	8000	dB	dB(A)	
TRAVEL PATH		m^2											
Pyrmont East TBM Fans	Air intake louves, air intake plenum on eastern side of Pyrmont East site (facing nortl	12	91	86	79	58	59	67	73	72		**78**	Estimated sound power level - air intake
Pyrmont East cavern fans	Air intake louves, wall of Pyrmont East low shed plenum	24	100	89	72	63	61	63	71	72		**79**	Estimated sound power level - air intake
Pyrmont West cavern fan	Air intake louves, south wall of Pyrmont West low shed plenum	17	97	86	69	54	53	59	68	69		**76**	Estimated sound power level - air intake

Table C5: Plant noise level schedule **PYRMONT STATION**

Building/ Area to be Mitigated	Item	Acoustic Requirement	Lw dB(A)
Ventilation	Dust Scrubber (located within the shed/ tunnel)	Acoustic treatment (attenuator/lined ductwork + enclosure/case wrapping for case radiated noise) to achieve the nominated overall SWL	104
	Shed Ventilation fans (located within the ventilation adit; air intake from roof)	Selected to achieve nominated SWL.	See Table C4b
Plant item (Tunnel support)	Water treatment plant (total plant noise)	Additional partial or full enclosure subject to compliance testing	85
	Gantry Crane	Adjustable volume, non-tonal warning alarm on crane or flashing lights	-
Plant item	Truck & Dog (spoil haulage)	Plant sound power level (on site measurments conducted on 17 April 2020)	102
Plant item	Concrete / shotcrete truck	Plant sound power level (on site measurments conducted on 17 April 2020)	105

Notes:

LEGEND * estimated by calculations and/or reference to other similar plant type data. The client is advised not to commit to fans which have not been tested in an approved laboratory. Testing plant is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested materials, estimates or opinions. The advice provided here is in respect of acoustics only.

GENERAL

- Sound power level of plant assumed based on sound power level of similar plant type, incorporating attenuation (acoustic attenuator/ muffler/ duct lining as required)
- The specified performances must be achieved by the product selected.
- Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
- The information provided in this table is subject to modification and review without notice.
- The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

Table C6: Managing Residual Impacts (airborne noise) during 'out of standard hours' work **PYRMONT STATION**

ID	Noise Mitigation/ Management Measure
1	At some receiver locations noise levels may exceed the NMLs after all reasonable and feasible mitigation measures have been incorporated into the design.
2	Tthe following at-property treatment measures are recommended:

Treatment package 0 (TP0)	
< 2 dB(A) reduction	Given the predictions are based on a worst-case scenario with everything operating at maximum capacity at the same time, it is likely that noise levels are lower than what has been predicted. It is recommended that no immediate action is undertaken for these properties.
Treatment package 1 (TP1)	
3-5 dB(A) reduction	Where external noise levels are less than 5dB(A) above the NML, the internal noise goals can be achieved by simply closing windows. If the internal noise goals can only be achieved with windows closed, then mechanical ventilation (e.g. 240v Aeropac systems) would be considered to ensure fresh airflow inside the dwelling so to meet the ventilation requirements of the NCC. It is important to ensure that mechanical ventilation does not provide a new noise leakage path into the habitable room and does not create a noise nuisance to neighbouring residential premises.
Treatment package 2 (TP2)	
5-10 dB(A) reduction	Where external noise levels are less than 10dB(A) above the NML, the internal noise goals can be achieved with windows closed and wall vents sealed. Special acoustic grade seals may also need to be installed on windows and perimeter doors exposed to noise to enable the internal noise goals to be achieved with windows and doors shut. If the internal noise goals can only be achieved with windows closed, then mechanical ventilation (e.g. 240v Aeropac systems) would be considered to ensure fresh airflow inside the dwelling so to meet the ventilation requirements of the NCC.
Treatment package 3 (TP3)	
10-12 dB(A) reduction	Where external noise levels are only slightly greater than 10dB(A) above the NML, then in addition to installing mechanical ventilation and sealing of wall vents (TP2), special acoustic grade seals should be installed on windows and perimeter doors exposed to road traffic noise to enable the internal noise criteria to be achieved with windows and doors shut.
Treatment package 4 (TP4)	
>12 dB(A) reduction	Where the predicted external noise level exceeds the NML by significantly more than 10dB(A), then upgraded windows and glazing and the provision of solid core doors would be required on the facades exposed to the works, in addition to the mechanical ventilation, sealing of wall vents and acoustic seals for windows and doors described in TP1, TP2 and TP3, respectively. Note that these upgrades are only suitable for masonry type buildings. It is unlikely that this degree of upgrade would provide significant benefits to light framed structures should there be no acoustic insulation in the walls.

3 The following at-property treatment may be required to reduce noise impact from the site:

Treatment Type		Airborne Noise
Level of exceedance	**Treatment**	**Indicative No. Properties***
1-2 dB(A) exceedance	Treatment package 0	6
3-5 dB(A) exceedance	Treatment package 1	2
5-10 dB(A) exceedance	Treatment package 2	1
10-12 dB(A) exceedance	Treatment package 3	0
>12 dB(A) exceedance	Treatment package 4	0

*Number of Properties are INDICATIVE.

Some receivers may have already received at-property treatment or designed for road noise

NCA	Address	Exceedance
NCA04	194 HARRIS STREET PYRMONT NSW 2009	0-2 dB(A)
NCA04	196 HARRIS STREET PYRMONT NSW 2009	0-2 dB(A)
NCA04	200-202 HARRIS STREET PYRMONT NSW 2009	0-2 dB(A)
NCA04	212 HARRIS STREET PYRMONT NSW 2009	0-2 dB(A)
NCA04	200-202 HARRIS STREET PYRMONT NSW 2009	0-2 dB(A)
NCA04	125 PYRMONT STREET PYRMONT NSW 2009**	0-2 dB(A)
NCA04	26 PATERNOSTER ROW PYRMONT NSW 2009**	3-5 dB(A)
NCA04	127 PYRMONT STREET PYRMONT NSW 2009**	3-5 dB(A)
NCA04	28 PATERNOSTER ROW PYRMONT NSW 2009**	5-10 dB(A)

** Receivers relocated during noisy works.

APPENDIX D Construction airborne noise impacts

D.1 Predicted noise levels

The detailed predicted levels have been provided to JCG in a spreadsheet table to more adequately mitigate and manage potential noise impacts.

D.2 Number of receivers above NMLs

The number of exceedances has been provided to JCG in a spreadsheet table.

D.3 Additional management measures

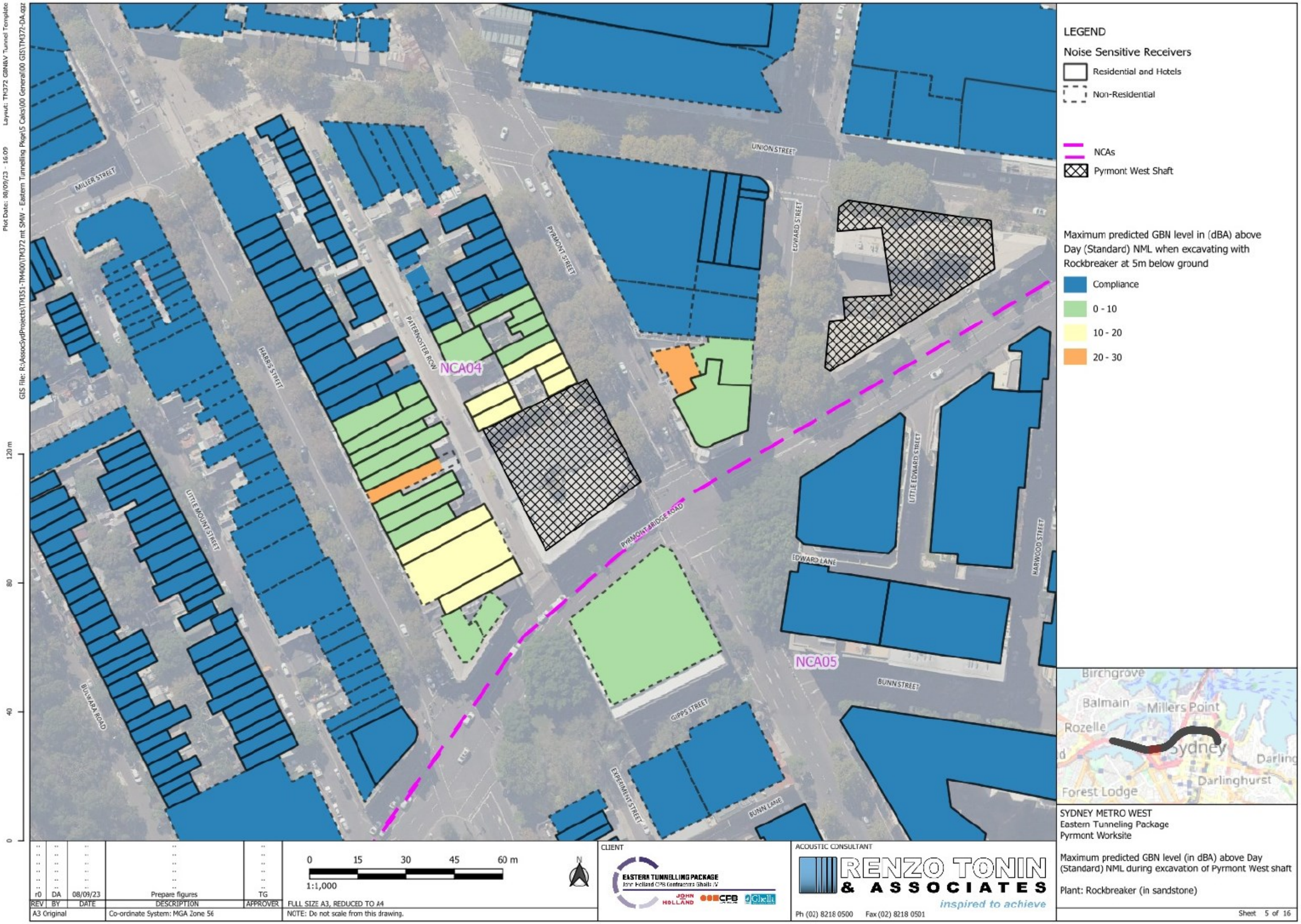
The additional management measures have been provided to JCG in a spreadsheet table to more adequately mitigate and manage potential noise impacts.

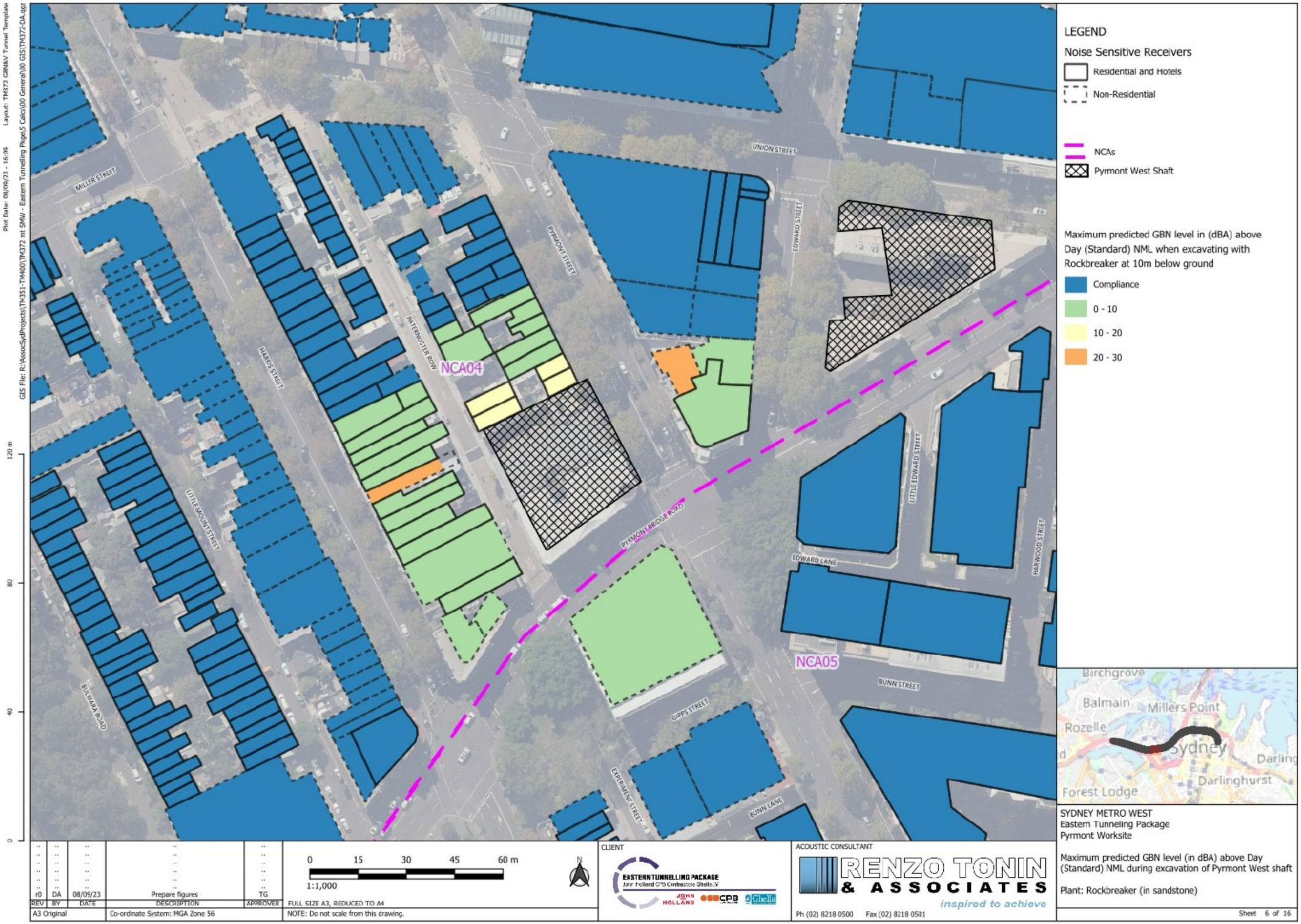
D.4 Predicted ABN levels greater than $L_{eq(15\ minute)}$ 60 dB(A) at receivers (CoA D38)

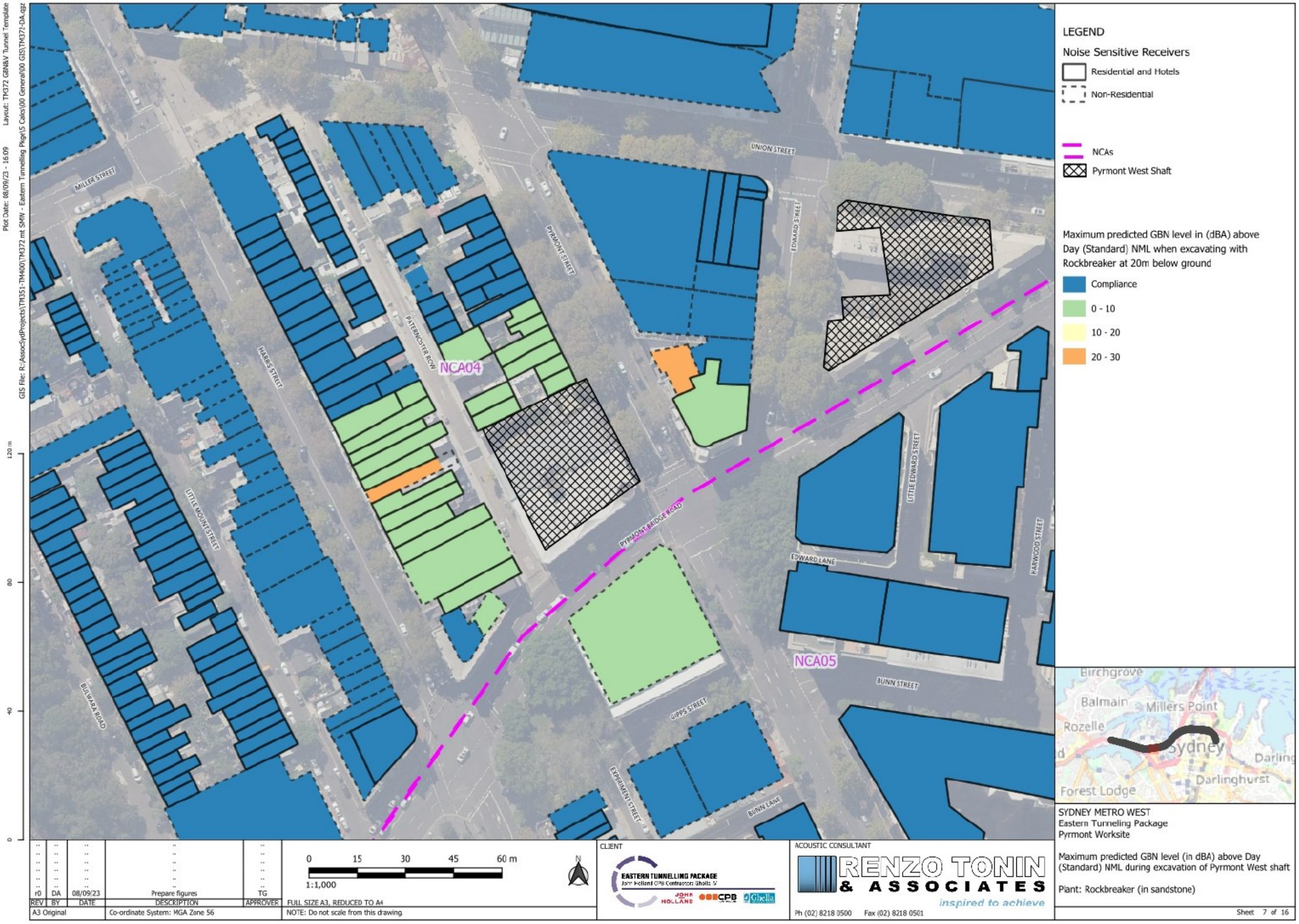
Receivers likely to experience airborne noise levels greater than $L_{eq(15\ minute)}$ 60 dB(A) have been provided to JCG in a spreadsheet table to more adequately mitigate and manage potential noise impacts.

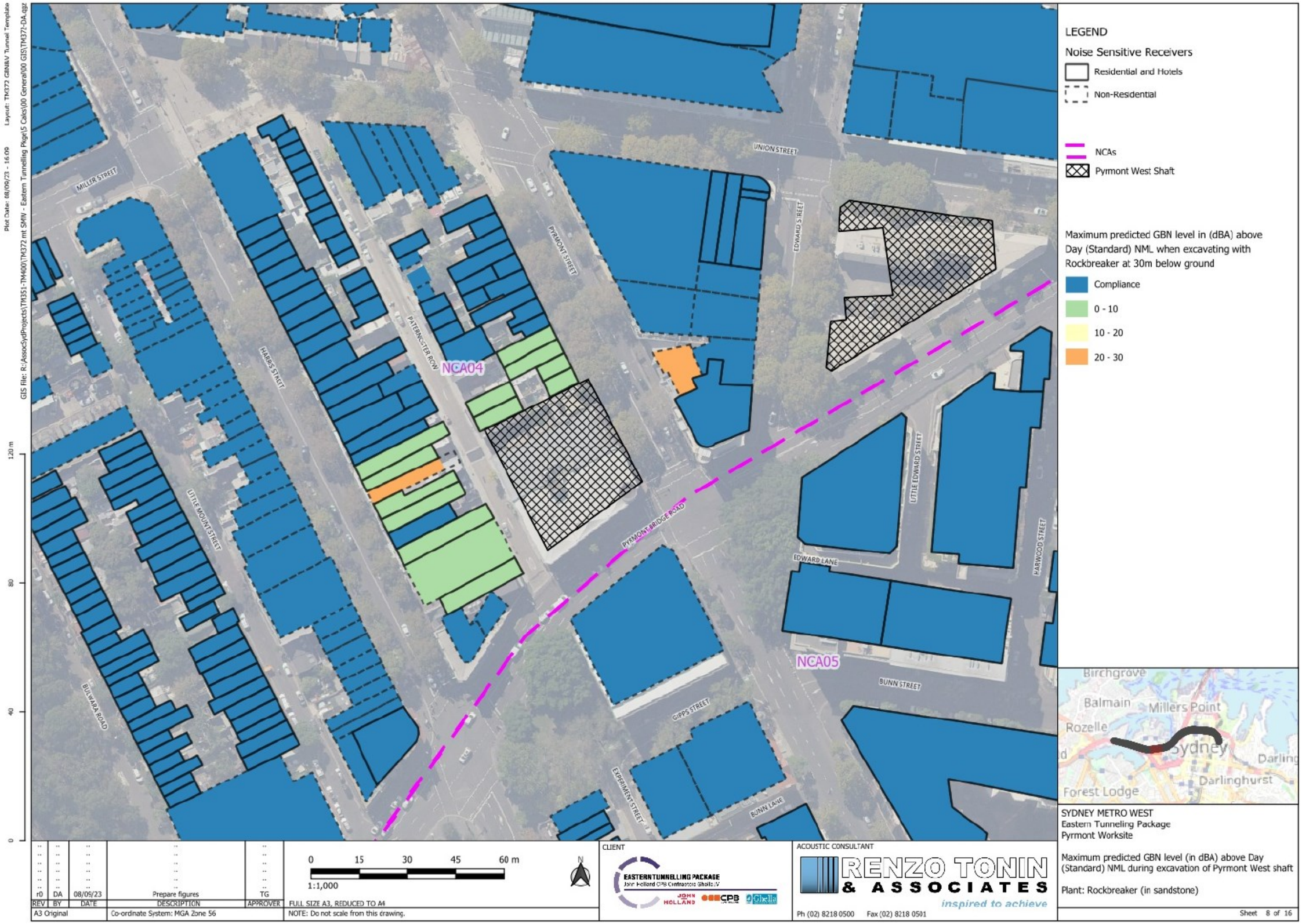
APPENDIX E Construction ground-borne noise impacts

E.1 Pyrmont West worksite – GBN from permanent shaft excavation

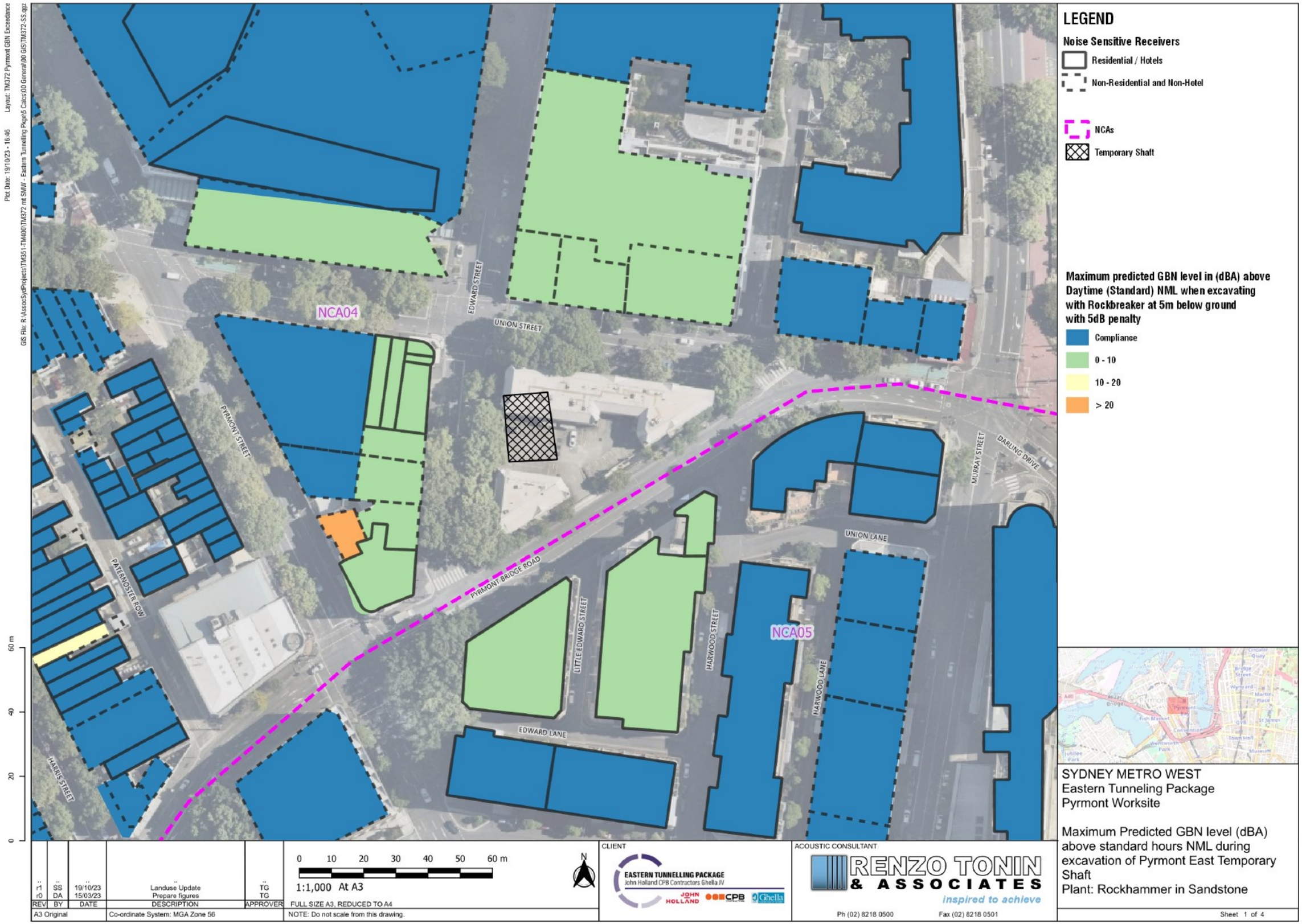

Plot Date: 08/09/23 - 16:09
Layout: TM372 GBNBV Tunnel Template
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 GIS\TM372-DA.qgz
MILLER STREET
UNION STREET
PYRMONT STREET
EDWARD STREET
HARBIS STREET
PATERNOSTER ROW
NCA04
LITTLE MOUNT STREET
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
EDWARD LANE
NCA05
BUNN STREET
GIPPS STREET
BULWARA ROAD
EXPERIMENT STREET
BUNN LANE
120 m
80
40
0
LEGEND
Noise Sensitive Receivers
Residential and Hotels
Non-Residential
NCAs
Pyrmont West Shaft
Maximum predicted GBN level in (dBA) above Day (Standard) NML when excavating with Rockbreaker at 5m below ground
Compliance
0 - 10
10 - 20
20 - 30
Birchgrove
Balmain
Millers Point
Rozelle
Sydney
Darlinghurst
Forest Lodge
0 15 30 45 60 m
1:1,000
N
r0 DA 08/09/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum predicted GBN level (in dBA) above Day (Standard) NML during excavation of Pyrmont West shaft
Plant: Rockbreaker (in sandstone)
Sheet 5 of 16


Plot Date: 08/09/23 - 16:09
Layout: TM372 GBN&V Tunnel Template
GIS File: R:\AssocSyd\Projects\TN351-TM4600\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz
MILLER STREET
HARES STREET
PATERNOSTER ROW
PYRMONT STREET
UNION STREET
EDWARD STREET
NCA04
LITTLE MOUNT STREET
BULWARA ROAD
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
EDWARD LANE
NCA05
BUNN STREET
GIPPS STREET
EXPERIMENT STREET
BUNN LANE
0
40
80
120 m
LEGEND
Noise Sensitive Receivers
Residential and Hotels
Non-Residential
NCAs
Pyrmont West Shaft
Maximum predicted GBN level in (dBA) above Day (Standard) NML when excavating with Rockbreaker at 10m below ground
Compliance
0 - 10
10 - 20
20 - 30
Birchgrove
Balmain
Millers Point
Rozelle
Sydney
Darlinghurst
Forest Lodge
rD DA 08/09/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVED
A3 Original
Co-ordinate System: MGA Zone 56
0 15 30 45 60 m
1:1,000
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
N
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
JOHN HOLLAND
CPB
Ghella
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum predicted GBN level (in dBA) above Day (Standard) NML during excavation of Pyrmont West shaft
Plant: Rockbreaker (in sandstone)
Sheet 6 of 16


Plot Date: 08/09/23 - 16:09
Layout: TM372 GBN&V Tunnel Template
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Cales\00 General\00 GIS\TM372-DA.qgz
MILLER STREET
UNION STREET
PYRMONT STREET
EDWARD STREET
HARRIS STREET
PATERNOSTER ROW
NCA04
LITTLE MOUNT STREET
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
EDWARD LANE
NCA05
BUNN STREET
GIPPS STREET
BULWARA ROAD
EXPERIMENT STREET
BUNN LANE
120 m
80
40
0
LEGEND
Noise Sensitive Receivers
Residential and Hotels
Non-Residential
NCAs
Pyrmont West Shaft
Maximum predicted GBN level in (dBA) above Day (Standard) NML when excavating with Rockbreaker at 20m below ground
Compliance
0 - 10
10 - 20
20 - 30
Birchgrove
Balmain
Millers Point
Rozelle
Sydney
Darlinghurst
Forest Lodge
0 15 30 45 60 m
1:1,000
N
r0 DA 08/09/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum predicted GBN level (in dBA) above Day (Standard) NML during excavation of Pyrmont West shaft
Plant: Rockbreaker (in sandstone)
Sheet 7 of 16


Plot Date: 08/09/23 - 16:09
Layout: TM372 GBNBV Tunnel Template
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Cales\00 General\00 GIS\TM372-DA.qgz
120 m
80
40
0
MILLER STREET
UNION STREET
PYRMONT STREET
EDWARD STREET
HARRIS STREET
PATERNOSTER ROW
NCA04
LITTLE MOUNT STREET
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
EDWARD LANE
HARWOOD STREET
NCA05
BUNN STREET
BURWARA ROAD
GIPPS STREET
EXPERIMENT STREET
BUNN LANE
LEGEND
Noise Sensitive Receivers
Residential and Hotels
Non-Residential
NCAs
Pyrmont West Shaft
Maximum predicted GBN level in (dBA) above Day (Standard) NML when excavating with Rockbreaker at 30m below ground
Compliance
0 - 10
10 - 20
20 - 30
Birchgrove
Balmain
Millers Point
Rozelle
Sydney
Darlinghurst
Forest Lodge
r0 DA 08/09/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56
0 15 30 45 60 m
1:1,000
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum predicted GBN level (in dBA) above Day (Standard) NML during excavation of Pyrmont West shaft
Plant: Rockbreaker (in sandstone)
Sheet 8 of 16

E.2 Pyrmont East worksite – GBN from temporary and permanent shaft excavation


Plot Date: 19/10/23 - 16:46 Layout: TM372 Pyrmont GBN Exceedance
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz
NCA04
NCA05
EDWARD STREET
UNION STREET
PYRMONT STREET
PATERNOSTER ROW
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
UNION LANE
EDWARD LANE
HARRIS STREET
MURRAY STREET
DARLING DRIVE
0
20
40
60 m
LEGEND
Noise Sensitive Receivers
Residential / Hotels
Non-Residential and Non-Hotel
NCAs
Temporary Shaft
Maximum predicted GBN level in (dBA) above Daytime (Standard) NML when excavating with Rockbreaker at 5m below ground with 5dB penalty
Compliance
0 - 10
10 - 20
> 20
0 10 20 30 40 50 60 m
1:1,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
N
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum Predicted GBN level (dBA) above standard hours NML during excavation of Pyrmont East Temporary Shaft
Plant: Rockhammer in Sandstone
Sheet 1 of 4
r1 SS 19/10/23 Landuse Update TG
r0 DA 15/03/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56

Plot Date: 19/10/23 - 16:46 Layout: TM372 Pyrmont GBN Exceedance

GIS File: R:\AssocSydProjects\TMGS1-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\S Calcs\00 General\00 GIS\TM372-SS.qgz

LEGEND

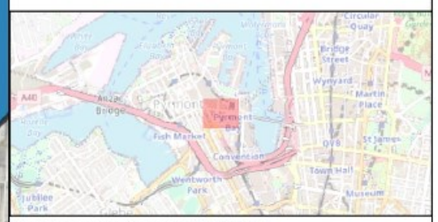
Noise Sensitive Receivers

- Residential / Hotels
- Non-Residential and Non-Hotel

- NCAs
- Temporary Shaft

Maximum predicted GBN level in (dBA) above Daytime (Standard) NML when excavating with Rockbreaker at 10m below ground with 5dB penalty

- Compliance
- 0 - 10
- 10 - 20
- > 20



REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Landuse Update	TG
r0	DA	15/03/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 60 m

1:1,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

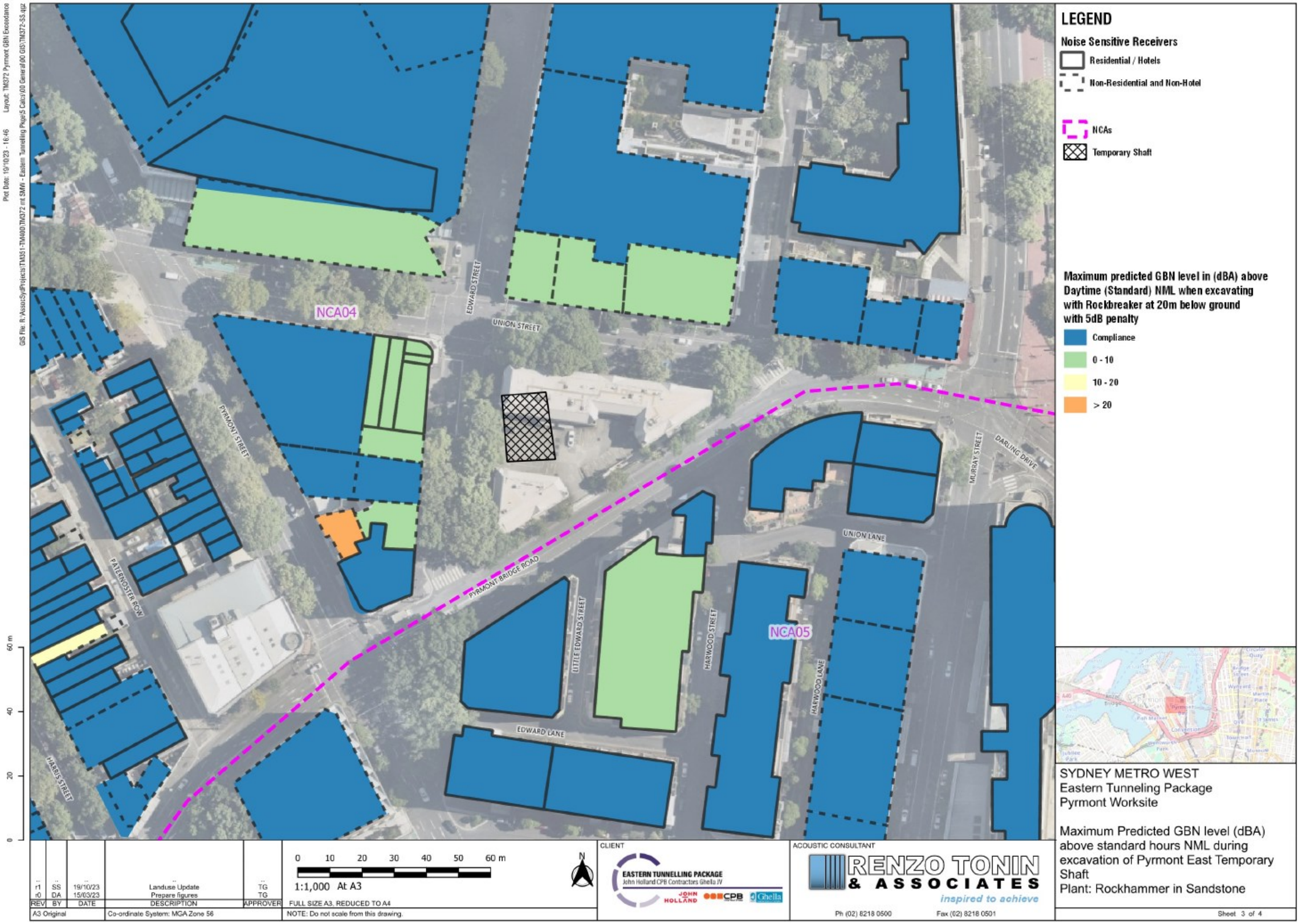
RENZO TONIN & ASSOCIATES
inspired to achieve

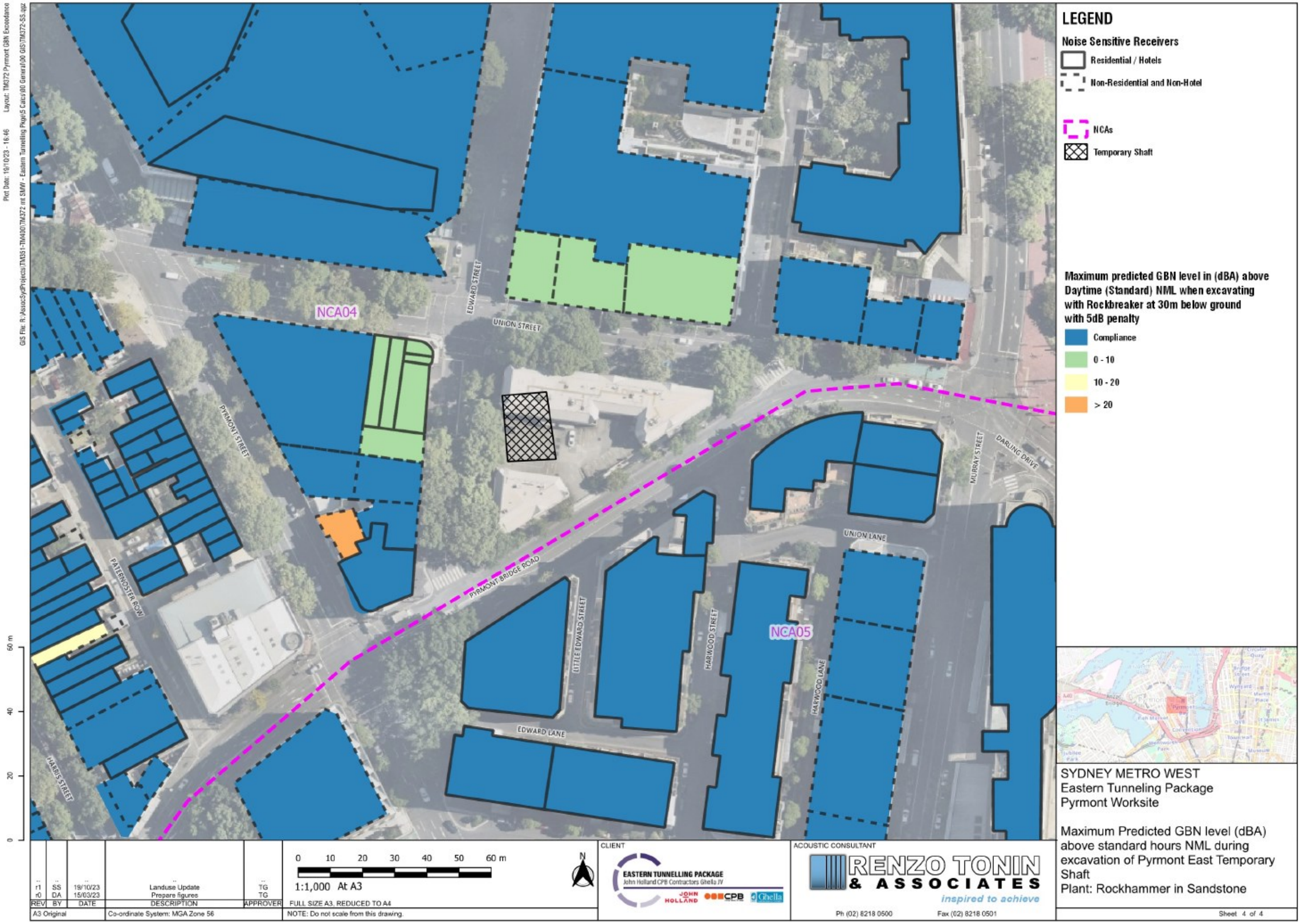
Ph (02) 8218 0500 Fax (02) 8218 0501

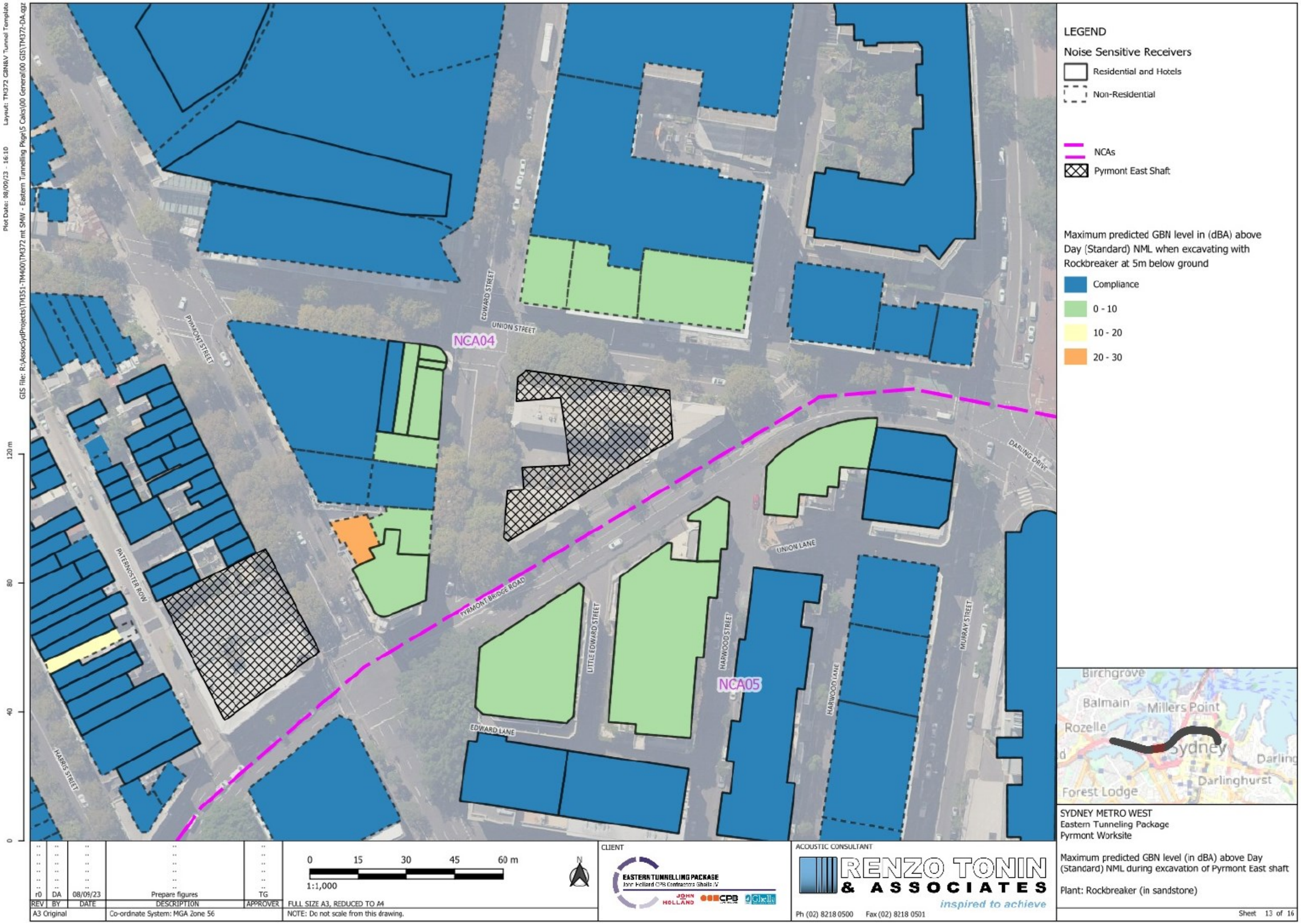
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite

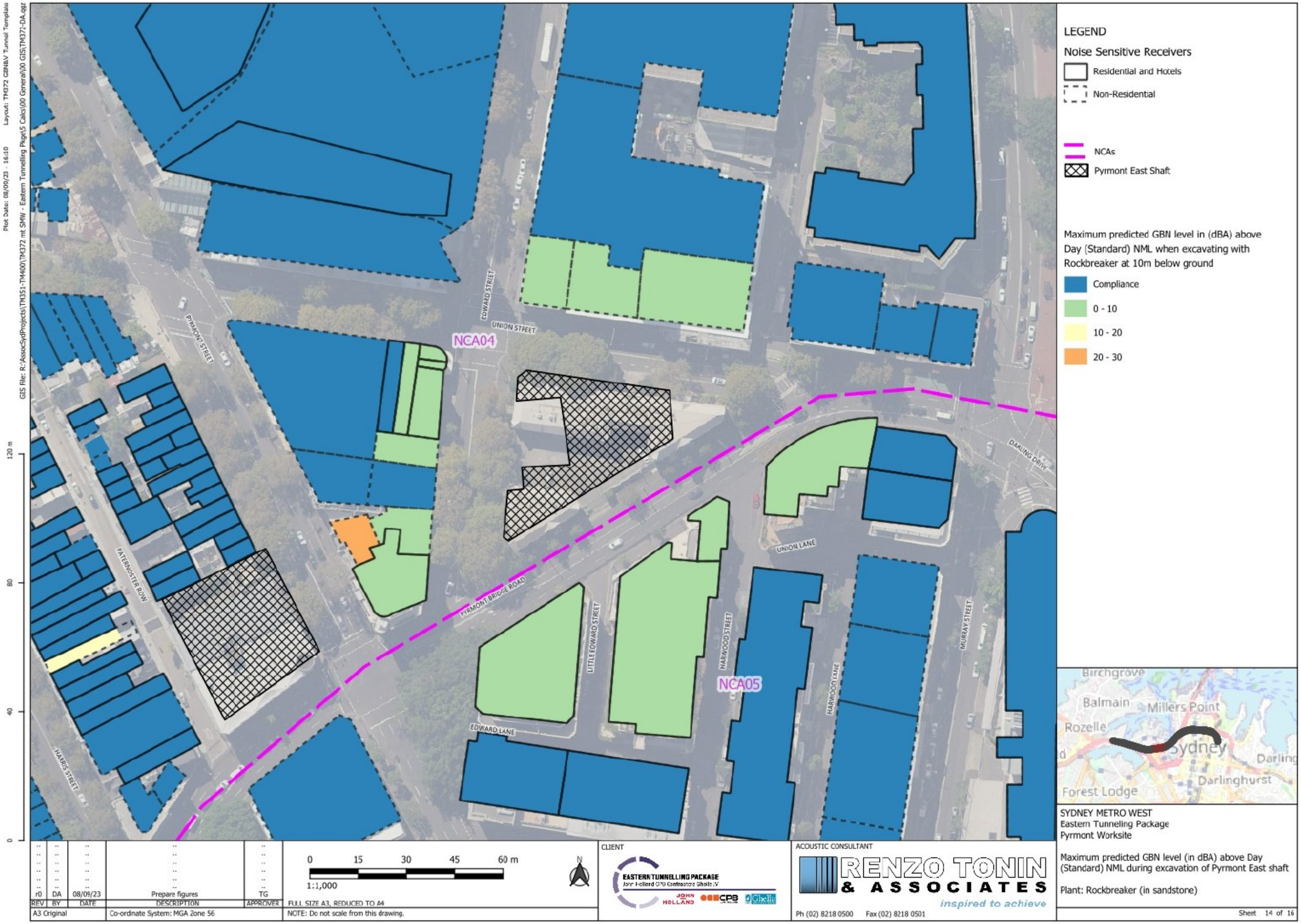
Maximum Predicted GBN level (dBA) above standard hours NML during excavation of Pyrmont East Temporary Shaft
Plant: Rockhammer in Sandstone

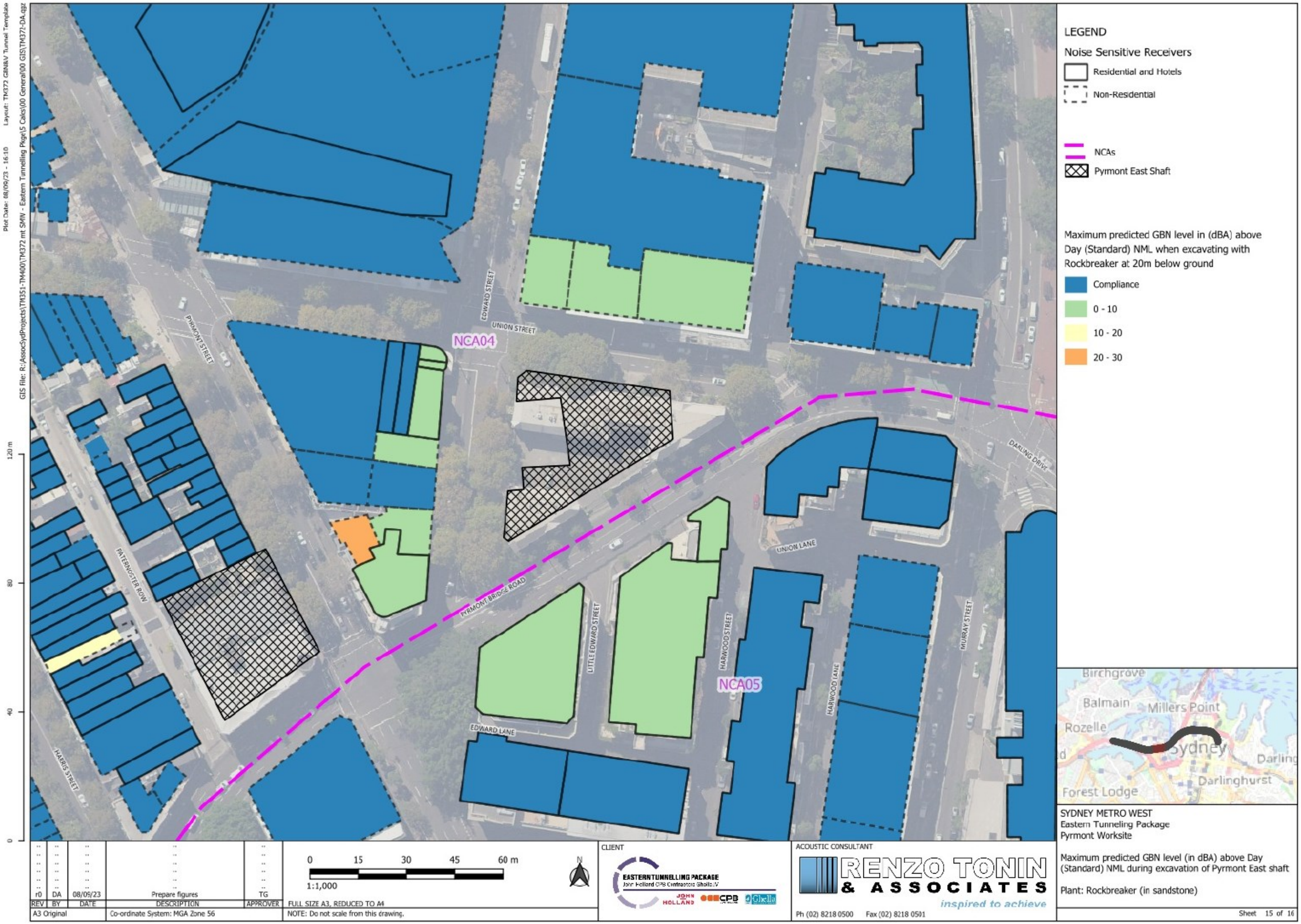
Sheet 2 of 4

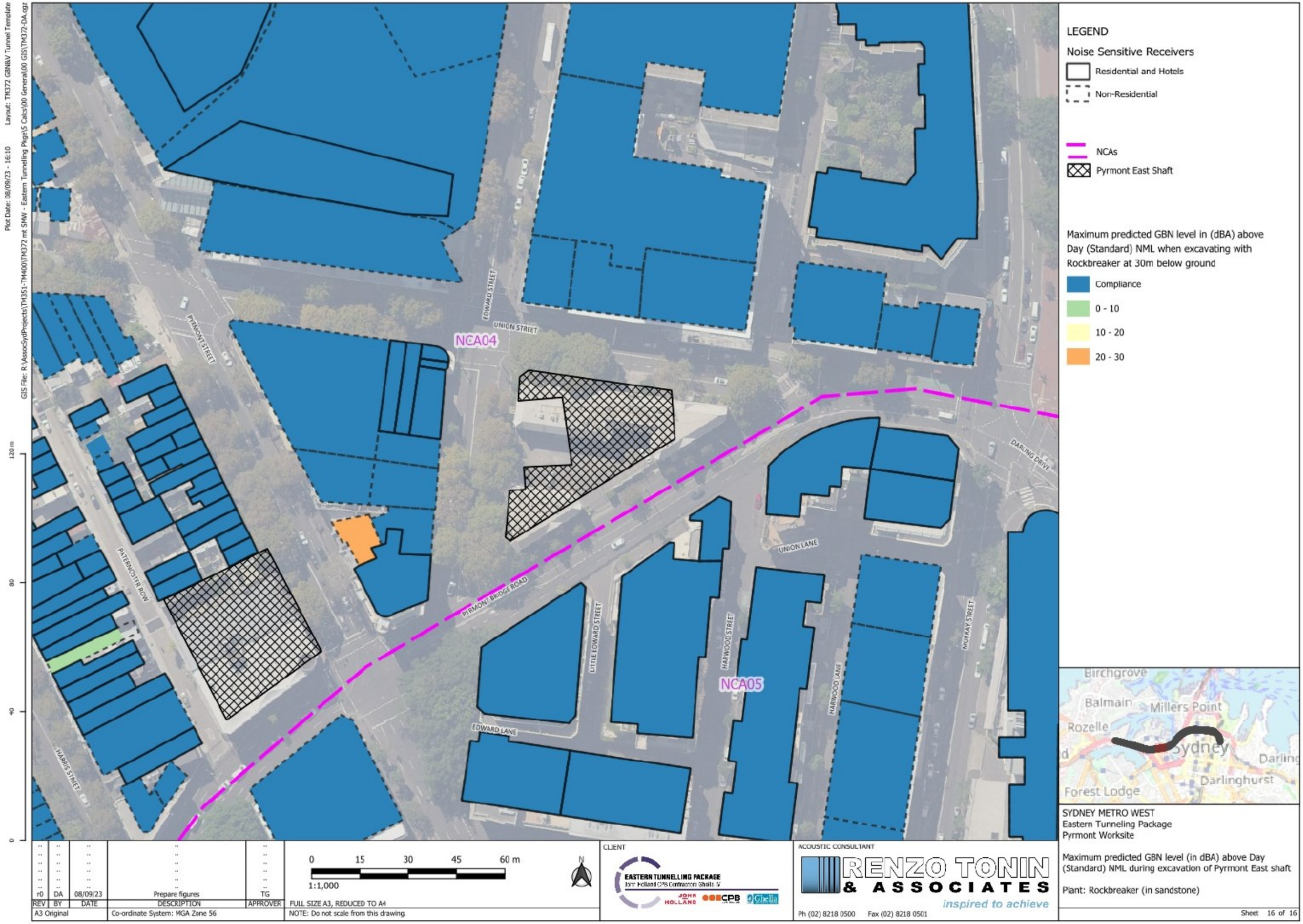

Plot Date: 19/10/23 - 16:46 Layout: TM372 Pyrmont GBN Exceedance
GIS File: R:\Assets\Sydney\Projects\TM351-TM400\TM372 int SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz
NCA04
NCA05
EDWARD STREET
UNION STREET
DYRMONT STREET
PATERNOSTER ROW
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
EDWARD LANE
UNION LANE
MURRAY STREET
DARLING DRIVE
HAREN STREET
60 m
40
20
0
LEGEND
Noise Sensitive Receivers
Residential / Hotels
Non-Residential and Non-Hotel
NCAs
Temporary Shaft
Maximum predicted GBN level in (dBA) above Daytime (Standard) NML when excavating with Rockbreaker at 20m below ground with 5dB penalty
Compliance
0 - 10
10 - 20
> 20
0 10 20 30 40 50 60 m
1:1,000 At A3
N
r1 SS 19/10/23 Landuse Update TG
r0 DA 15/03/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVED
A3 Original
Co-ordinate System: MGA Zone 56
FULL SIZE A3. REDUCED TO A4
NOTE: Do not scale from this drawing.
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
JOHN HOLLAND
CPB
Ghella
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum Predicted GBN level (dBA) above standard hours NML during excavation of Pyrmont East Temporary Shaft
Plant: Rockhammer in Sandstone
Sheet 3 of 4

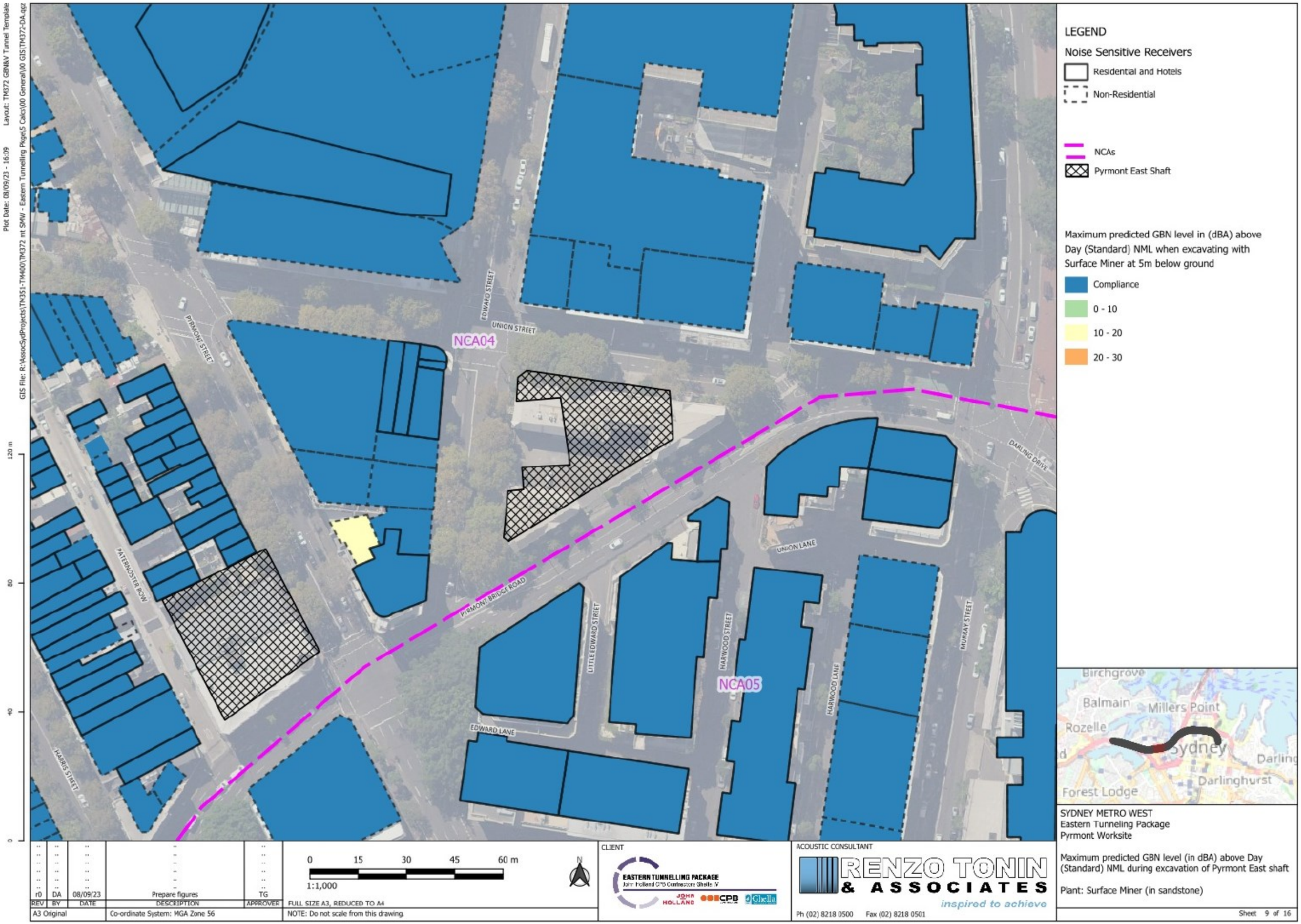

Plot Date: 19/10/23 - 16:46 Layout: TM372 Pyrmont GBN Exceedance
GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Page\5 Calcs\00 General\06 GIS\TM372-SS.qpz
NCA04
NCA05
EDWARD STREET
UNION STREET
PYRMONT STREET
PATERNOSTER ROW
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
UNION LANE
EDWARD LANE
HARRIS STREET
MURRAY STREET
DARLING DRIVE
LEGEND
Noise Sensitive Receivers
Residential / Hotels
Non-Residential and Non-Hotel
NCAs
Temporary Shaft
Maximum predicted GBN level in (dBA) above Daytime (Standard) NML when excavating with Rockbreaker at 30m below ground with 5dB penalty
Compliance
0 - 10
10 - 20
> 20
60 m
40
20
0
r1 SS 19/10/23 Landuse Update TG
r0 DA 15/03/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVED
A3 Original
Co-ordinate System: MGA Zone 56
0 10 20 30 40 50 60 m
1:1,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
N
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum Predicted GBN level (dBA) above standard hours NML during excavation of Pyrmont East Temporary Shaft
Plant: Rockhammer in Sandstone
Sheet 4 of 4


Plot Date: 08/09/23 - 16:10
Layout: TM372 GBN&V Tunnel Template
GIS File: R:\Assoc\Syd\Projects\TM351-TM4000\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz
120 m
80
40
0
NCA04
NCA05
EDWARD STREET
UNION STREET
PYRMONT STREET
DARLING DRIVE
UNION LANE
PYRMONT BRIDGE ROAD
PATERNOSTER ROW
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
MURRAY STREET
EDWARD LANE
HARRIS STREET
LEGEND
Noise Sensitive Receivers
Residential and Hotels
Non-Residential
NCAs
Pyrmont East Shaft
Maximum predicted GBN level in (dBA) above Day (Standard) NML when excavating with Rockbreaker at 5m below ground
Compliance
0 - 10
10 - 20
20 - 30
Birchgrove
Balmain
Millers Point
Rozelle
Sydney
Darlinghurst
Forest Lodge
0 15 30 45 60 m
1:1,000
N
r0 DA 08/09/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVER
FULL SIZE A3, REDUCED TO A4
A3 Original
Co-ordinate System: MGA Zone 56
NOTE: Do not scale from this drawing.
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum predicted GBN level (in dBA) above Day (Standard) NML during excavation of Pyrmont East shaft
Plant: Rockbreaker (in sandstone)
Sheet 13 of 16


Plot Date: 08/09/23 - 16:10
Layout: TM372 GBN&V Tunnel Template
GIS File: R:\AssocSydProjects\TN351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz
120 m
80
40
0
NCA04
NCA05
COWARD STREET
UNION STREET
PYRMONT STREET
DARLING DRIVE
UNION LANE
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
MURRAY STREET
EDWARD LANE
PATERNOSTER ROW
HARRIS STREET
LEGEND
Noise Sensitive Receivers
Residential and Hotels
Non-Residential
NCAs
Pyrmont East Shaft
Maximum predicted GBN level in (dBA) above Day (Standard) NML when excavating with Rockbreaker at 10m below ground
Compliance
0 - 10
10 - 20
20 - 30
Birchgrove
Balmain
Millers Point
Rozelle
Sydney
Darlinghurst
Forest Lodge
r0 DA 08/09/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56
0 15 30 45 60 m
1:1,000
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
N
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum predicted GBN level (in dBA) above Day (Standard) NML during excavation of Pyrmont East shaft
Plant: Rockbreaker (in sandstone)
Sheet 14 of 16


Plot Date: 08/09/23 - 16:10
Layout: TM372 GBN&V Tunnel Template
GIS File: R:\AssocSydProjects\TM351-TM4400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz
120 m
80
40
0
NCA04
NCA05
EDWARD STREET
UNION STREET
PYRMONT STREET
PYRMONT BRIDGE ROAD
DARLING DRIVE
UNION LANE
PATERNOSTER ROW
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
MURRAY STREET
EDWARD LANE
HARRIS STREET
LEGEND
Noise Sensitive Receivers
Residential and Hotels
Non-Residential
NCAs
Pyrmont East Shaft
Maximum predicted GBN level in (dBA) above Day (Standard) NML when excavating with Rockbreaker at 20m below ground
Compliance
0 - 10
10 - 20
20 - 30
Birchgrove
Balmain
Millers Point
Rozelle
Sydney
Darlinghurst
Forest Lodge
r0 DA 08/05/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56
0 15 30 45 60 m
1:1,000
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
N
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0591
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum predicted GBN level (in dBA) above Day (Standard) NML during excavation of Pyrmont East shaft
Plant: Rockbreaker (in sandstone)
Sheet 15 of 16


Plot Date: 08/09/23 - 16:10
Layout: TM372 GBN&V Tunnel Template
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz
120 m
80
40
0
NCA04
NCA05
EDWARD STREET
UNION STREET
PYRMONT STREET
PATERNOSTER ROW
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
UNION LANE
MURRAY STREET
DARLING DRIVE
EDWARD LANE
HARRIS STREET
LEGEND
Noise Sensitive Receivers
Residential and Hotels
Non-Residential
NCAs
Pyrmont East Shaft
Maximum predicted GBN level in (dBA) above Day (Standard) NML when excavating with Rockbreaker at 30m below ground
Compliance
0 - 10
10 - 20
20 - 30
Birchgrove
Balmain
Millers Point
Rozelle
Sydney
Darlinghurst
Forest Lodge
0 15 30 45 60 m
1:1,000
N
r0 DA 08/09/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVER
FULL SIZE A3, REDUCED TO A4
A3 Original
Co-ordinate System: MGA Zone 56
NOTE: Do not scale from this drawing
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum predicted GBN level (in dBA) above Day (Standard) NML during excavation of Pyrmont East shaft
Plant: Rockbreaker (in sandstone)
Sheet 16 of 16


Plot Date: 08/09/23 - 16:09
Layout: TM372 GBN&V Tunnel Template
GIS File: R:\AssocSydProjects\TN351-TM4400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\\0 GIS\TM372-DA.qgz
NCA04
NCA05
UNION STREET
EDWARD STREET
PYRMONT STREET
PYRMONT BRIDGE ROAD
DARLING DRIVE
UNION LANE
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
MURRAY STREET
EDWARD LANE
PATERNOSTER ROW
HARRIS STREET
120 m
80
40
0
LEGEND
Noise Sensitive Receivers
Residential and Hotels
Non-Residential
NCAs
Pyrmont East Shaft
Maximum predicted GBN level in (dBA) above Day (Standard) NML when excavating with Surface Miner at 5m below ground
Compliance
0 - 10
10 - 20
20 - 30
Birchgrove
Balmain
Millers Point
Rozelle
Sydney
Darlinghurst
Forest Lodge
0 15 30 45 60 m
1:1,000
N
r0 DA 08/09/23 Prepare figures TG
REV BY DATE DESCRIPTION APPROVER
FULL SIZE A3, REDUCED TO A4
A3 Original
Co-ordinate System: MGA Zone 56
NOTE: Do not scale from this drawing
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont Worksite
Maximum predicted GBN level (in dBA) above Day (Standard) NML during excavation of Pyrmont East shaft
Plant: Surface Miner (in sandstone)
Sheet 9 of 16

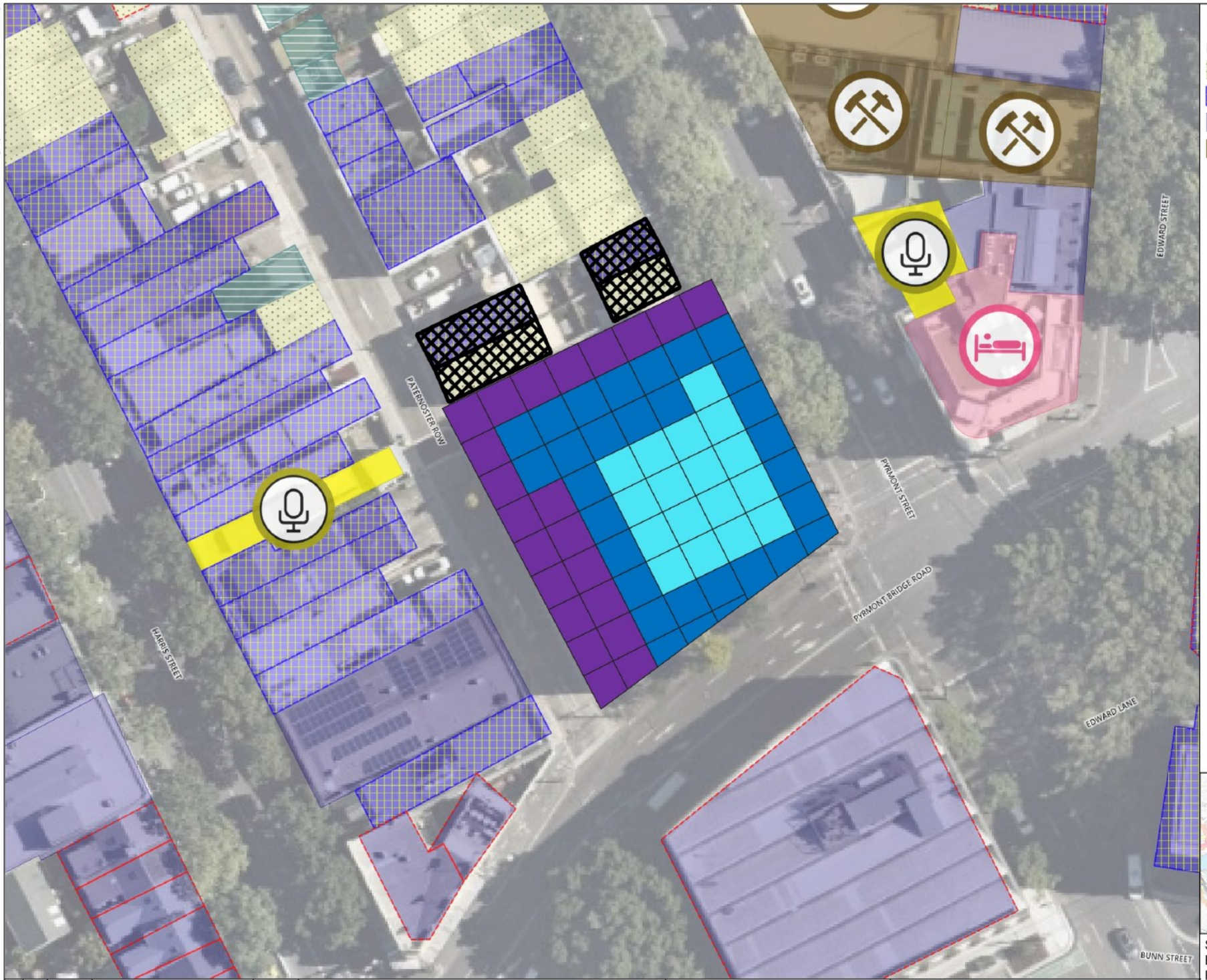
E.3 Predicted GBN levels greater than $L_{eq(15\ minute)}$ 60 dB(A) at receivers (CoA D38)

Receivers likely to experience ground-borne noise levels greater than $L_{eq(15\ minute)}$ 60 dB(A) have been provided to JCG in a spreadsheet table to more adequately mitigate and manage potential noise impacts.

E.4 Pyrmont West worksite – Managing GBN from permanent shaft excavation

Plot Date: 08/09/23 - 15:58 Layout: TM372 Stat# Section figures

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkg#5 Calcs\00 General\00 GIS\TM372-SS.qpr



50 m

25

0

LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Other
- Heritage

Buildings Excluded from evaluation

Maximum GBN impact on receivers when excavating with Rockbreaker at 5m below ground level in dB(A) with 5dB(A) Penalty

- < 55
- 55 - 60
- > 60

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	08/09/23	Update excavation area	TG
r0	SS	16/02/23	Prepare figures	TG

0 10 20 30 40 m N

1:500 At A3

FULL SIZE A3, REDUCED TO A4

A3 Original | Co-ordinate System: MGA Zone 56 | NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS

ACOUSTIC CONSULTANT

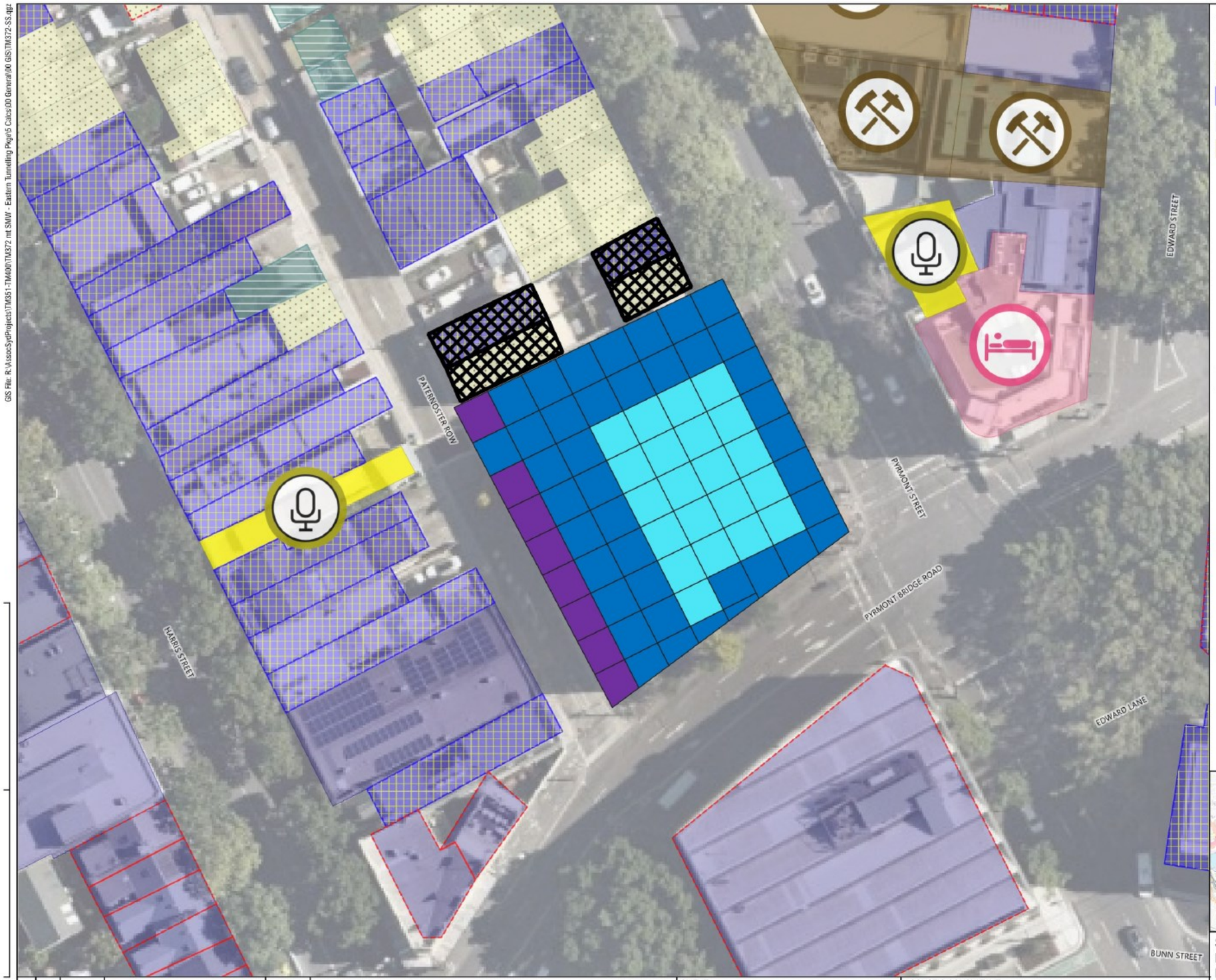
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont WEST

Maximum predicted GBN impact on receivers when excavating at 5m below ground level
Plant: RockBreaker/RockHammer

Plot Date: 08/09/23 - 15:58 Layout: TM372 Shaft Section figures

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz



LEGEND

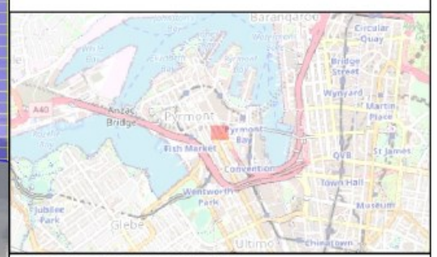
Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Other
- Heritage

Buildings Excluded from evaluation

Maximum GBN impact on receivers when excavating with Rockbreaker at 10m below ground level in dB(A) with 5dB(A) Penalty

- < 55
- 55 - 60
- > 60



REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	08/09/23	Update excavation area	TG
r0	SS	16/02/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 m

1:500 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS

ACOUSTIC CONSULTANT

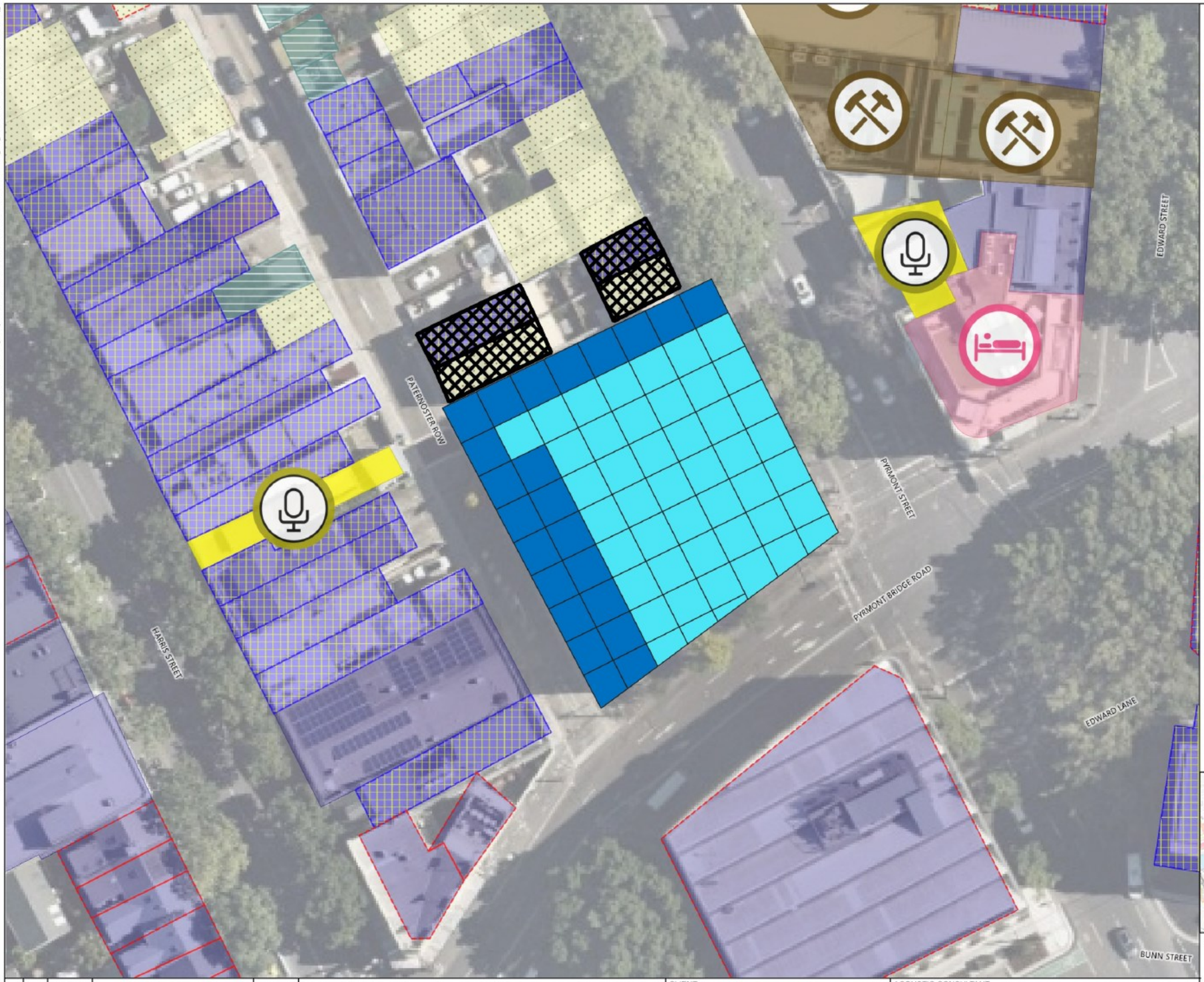
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont WEST

Maximum predicted GBN impact on receivers when excavating at 10m below ground level
Plant: RockBreaker/RockHammer

Plot Date: 08/09/23 - 15:58 Layout: TM372 Shaft Section figures

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Page\5 Calcs\00 General\00 GIS\TM372-SS.qgz



LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Other
- Heritage

Buildings Excluded from evaluation

Maximum GBN impact on receivers when excavating with Rockbreaker at 15m below ground level in dB(A) with 5dB(A) Penalty

- < 55
- 55 - 60
- > 60

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	08/09/23	Update excavation area	TG
r0	SS	16/02/23	Prepare figures	TG

0 10 20 30 40 m N

1:500 At A3

FULL SIZE A3, REDUCED TO A4

A3 Original | Co-ordinate System: MGA Zone 56 | NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS

ACOUSTIC CONSULTANT

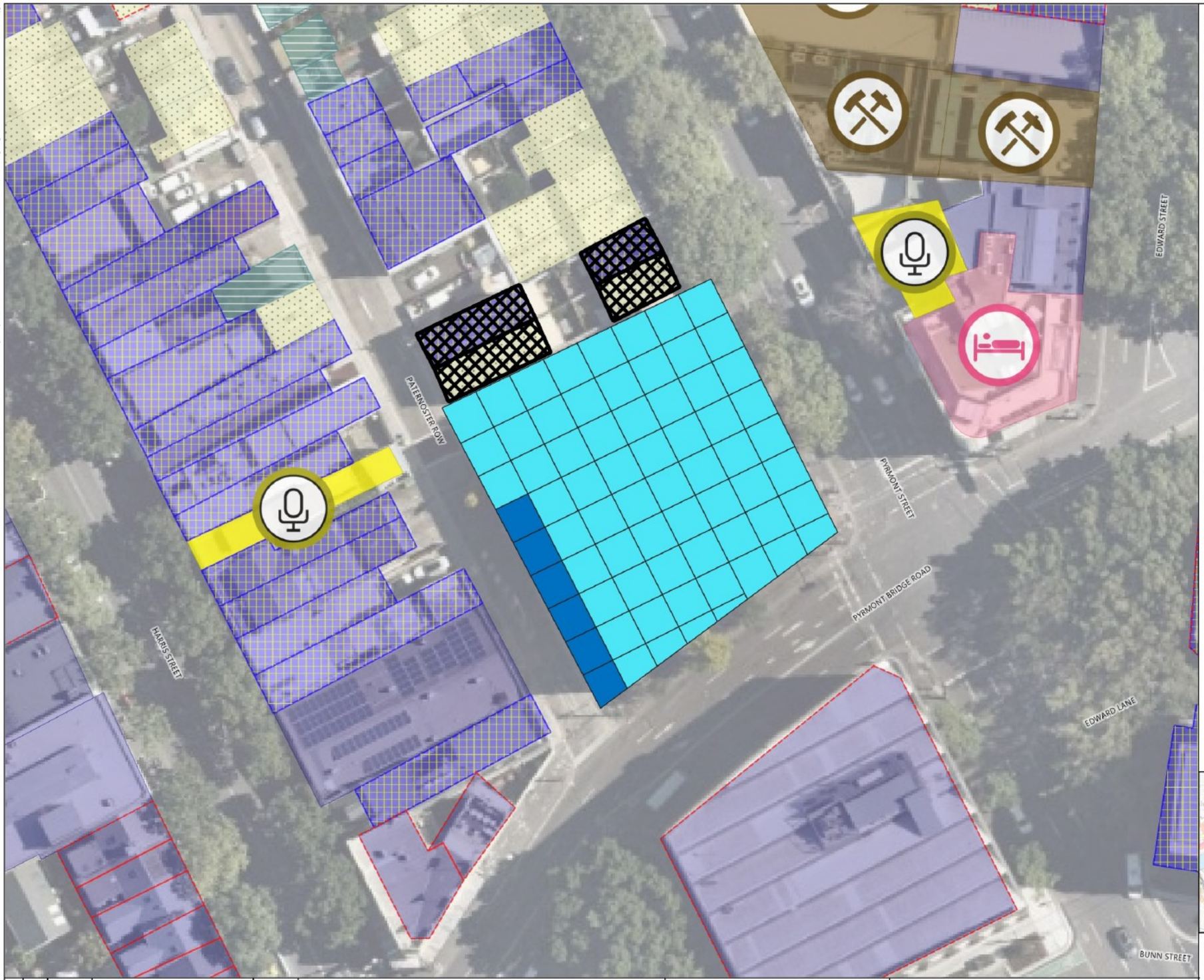
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont WEST

Maximum predicted GBN impact on receivers when excavating at 15m below ground level
Plant: RockBreaker/RockHammer

Plot Date: 08/09/23 - 15:58 Layout: TM372 Shaft Section figures

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz



LEGEND

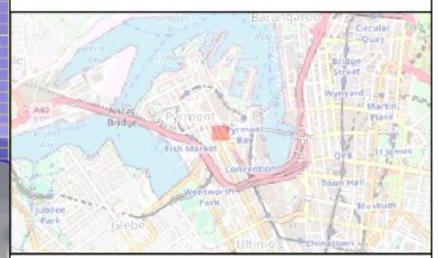
Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Other
- Heritage

Buildings Excluded from evaluation

Maximum GBN impact on receivers when excavating with Rockbreaker at 20m below ground level in dB(A) with 5dB(A) Penalty

- < 55
- 55 - 60
- > 60



REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	08/09/23	Update excavation area	TG
r0	SS	16/02/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 m N

1:500 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS

ACOUSTIC CONSULTANT

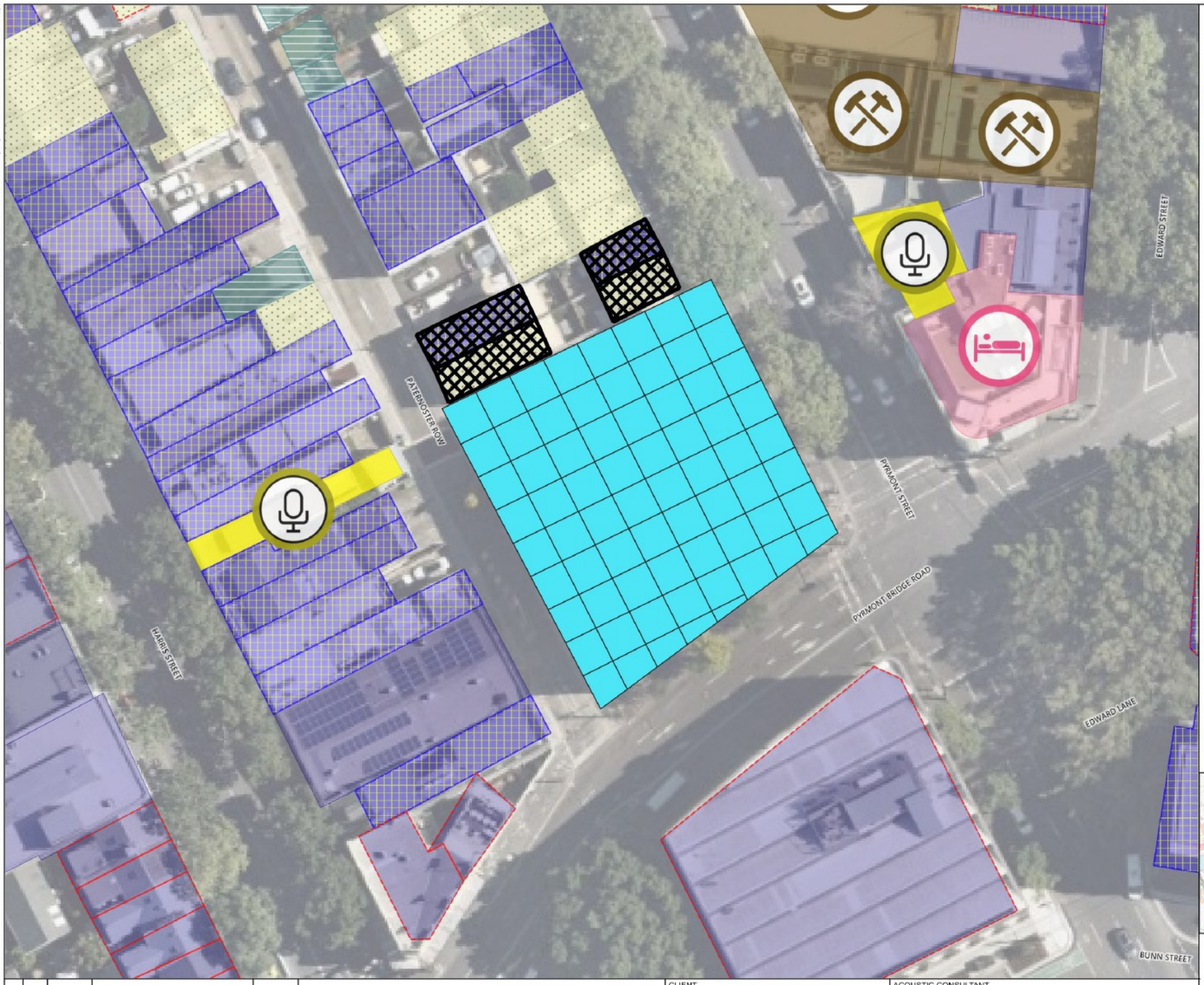
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont WEST

Maximum predicted GBN impact on receivers when excavating at 20m below ground level
Plant: RockBreaker/RockHammer

Plot Date: 08/09/23 - 15:58 Layout: TM372 Shaft Section figures

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz



LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Other
- Heritage

Buildings Excluded from evaluation

Maximum GBN impact on receivers when excavating with Rockbreaker at 30m below ground level in dB(A) with 5dB(A) Penalty

- < 55
- 55 - 60
- > 60

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	08/09/23	Update excavation area	TG
r0	SS	16/02/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 m N

1:500 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont WEST

Maximum predicted GBN impact on receivers when excavating at 30m below ground level
Plant: RockBreaker/RockHammer

E.5 Pyrmont East worksite – Managing GBN from temporary and permanent shaft excavation

Plot Date: 19/10/23 - 14:00 Layout: TM372 Shaft Section figures

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qpz

LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Educational
- Heritage

Maximum GBN impact on receivers when excavating with Rockbreaker at 5m below ground level in dB(A) with 5dB(A) Penalty

- < 55
- 55 - 60
- > 60

SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont EAST

Maximum predicted GBN impact on receivers when excavating at 5m below ground level
Plant: RockBreaker/RockHammer

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Update Landuse	TG
r0	SS	16/02/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 m

1:500 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT: EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT: RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

Plot Date: 19/10/23 - 14:00 Layout: TM372 Shaft Section figures

GIS File: R:\AssocSydProjects\TM351-TW400\TM372 mt SMW - Eastern Tunnelling Page\5 Calcs\00 General\00 GIS\TM372-SS.qpz

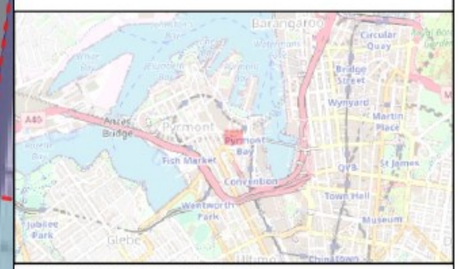
LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Educational
- Heritage

Maximum GBN impact on receivers when excavating with Rockbreaker at 10m below ground level in dB(A) with 5dB(A) Penalty

- < 55
- 55 - 60
- > 60



SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont EAST

Maximum predicted GBN impact on receivers when excavating at 10m below ground level
Plant: RockBreaker/RockHammer

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Update Landuse	TG
r0	SS	16/02/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 m

1:500 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

Plot Date: 19/10/23 - 14:01 Layout: TM372 Shaft Section figures

GIS File: R:\AssocSys\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunneling Pkge\5 Calcs\90 General\00 GIS\TM372-SS.qgz

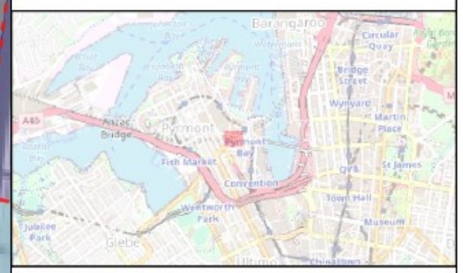
LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Educational
- Heritage

Maximum GBN impact on receivers when excavating with Rockbreaker at 15m below ground level in dB(A) with 5dB(A) Penalty

- < 55
- 55 - 60
- > 60



REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Update Landuse	TG
r0	SS	16/02/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 m

1:500 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont EAST

Maximum predicted GBN impact on receivers when excavating at 15m below ground level
Plant: RockBreaker/RockHammer

Plot Date: 19/10/23 - 14:01 Layout: TM372 Shaft Section figures

GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qpz

LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Educational
- Heritage

Maximum GBN impact on receivers when excavating with Rockbreaker at 20m below ground level in dB(A) with 5dB(A) Penalty

- < 55
- 55 - 60
- > 60

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Update Landuse	TG
r0	SS	16/02/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 10 20 30 40 m N

1:500 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package
Pyrmont EAST

Maximum predicted GBN impact on receivers when excavating at 20m below ground level
Plant: RockBreaker/RockHammer

APPENDIX F Construction vibration impacts

F.1 Pyrmont West worksite - minimum working distance for vibration impact

Plot Date: 19/10/23 - 12:00 Layout: TM372 MWD Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz

LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Recording studio
- Other
- Heritage

Pyrmont West

Receivers within MWD for cosmetic damage

MWD for cosmetic damage and human annoyance during Jackhammer works

- Reinforced structures (25.0mm/s ppv)
- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Human annoyance - Residential (night)

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Heritage and Landuse update	TG
r0	SS	14/03/23	Preparing Figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 20 40 60 80 m

1:1,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

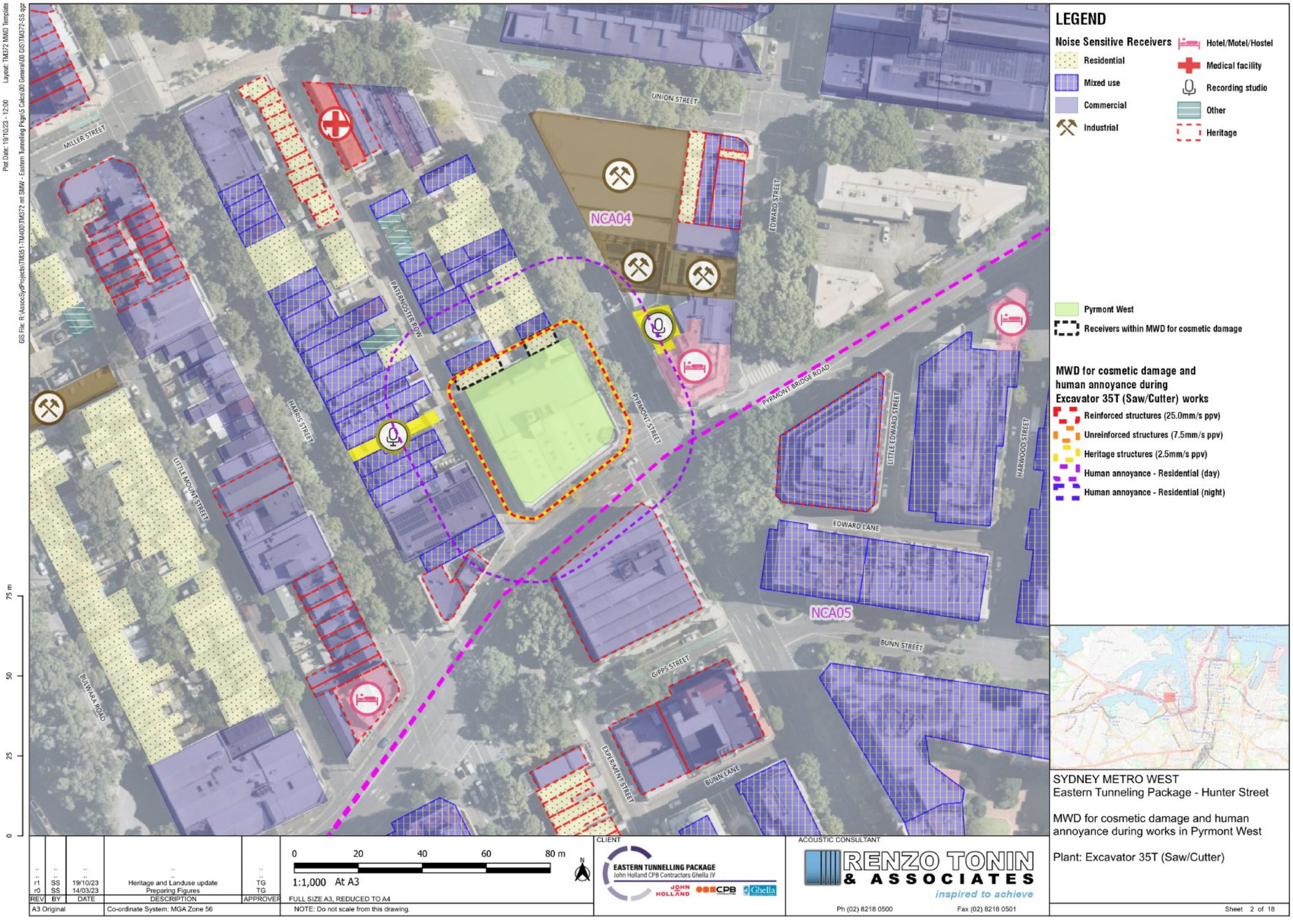
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street

MWD for cosmetic damage and human annoyance during works in Pyrmont West

Plant: Jackhammer

Sheet 1 of 18


Plot Date: 19/10/23 - 12:00 Layout: TM372 MWD Template
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Page\5 Calcs\00 General\00 GIS\TM372-SS.qgz
UNION STREET
MILLER STREET
NCA04
EDWARD STREET
PATERNOSTER ROW
HARRIS STREET
PYRMONT STREET
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
LITTLE MOUNT STREET
EDWARD LANE
NCA05
BUNN STREET
GIPPS STREET
BULWARA ROAD
EXPERIMENT STREET
BUNN LANE
75 m
50
25
0
LEGEND
Noise Sensitive Receivers
Residential
Mixed use
Commercial
Industrial
Hotel/Motel/Hostel
Medical facility
Recording studio
Other
Heritage
Pyrmont West
Receivers within MWD for cosmetic damage
MWD for cosmetic damage and human annoyance during Excavator 35T (Saw/Cutter) works
Reinforced structures (25.0mm/s ppv)
Unreinforced structures (7.5mm/s ppv)
Heritage structures (2.5mm/s ppv)
Human annoyance - Residential (day)
Human annoyance - Residential (night)
r1 SS 19/10/23 Heritage and Landuse update TG
r0 SS 14/03/23 Preparing Figures TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56
0 20 40 60 80 m
1:1,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street
MWD for cosmetic damage and human annoyance during works in Pyrmont West
Plant: Excavator 35T (Saw/Cutter)
Sheet 2 of 18

Plot Date: 19/10/23 - 12:00 Layout: TM372 MWD Template

GIS File: R:\Assoc\Sydl\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Page\5 Calcs\00 General\00 GIS\TM372-SS.qgz

LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Recording studio
- Other
- Heritage

- Pyrmont West
- Receivers within MWD for cosmetic damage

MWD for cosmetic damage and human annoyance during Drill Rig (percussive) works

- Reinforced structures (25.0mm/s ppv)
- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Human annoyance - Residential (night)

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Heritage and Landuse update	TG
r0	SS	14/03/23	Preparing Figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 20 40 60 80 m

1:1,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

JOHN HOLLAND CPB Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street

MWD for cosmetic damage and human annoyance during works in Pyrmont West

Plant: Drill Rig (percussive)

Sheet 3 of 18

Plot Date: 19/10/23 - 12:00 Layout: TM372 MWD Template

GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz

LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Recording studio
- Other
- Heritage

Pyrmont West

Receivers within MWD for cosmetic damage

MWD for cosmetic damage and human annoyance during Piling Rig (Bauer BG36) works

- Reinforced structures (25.0mm/s ppv)
- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Human annoyance - Residential (night)

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Heritage and Landuse update	TG
r0	SS	14/03/23	Preparing Figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 20 40 60 80 m

1:1,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street

MWD for cosmetic damage and human annoyance during works in Pyrmont West

Plant: Piling Rig (Bauer BG36)

Sheet 4 of 18

Plot Date: 19/10/23 - 12:00 Layout: TM372 MWD Template
GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\80 GIS\TM372-SS.qgz

LEGEND

Noise Sensitive Receivers

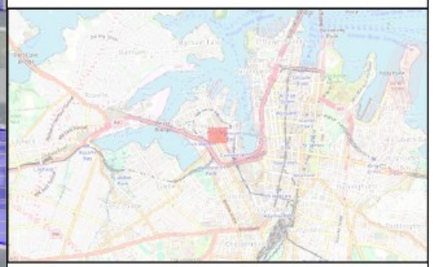
- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Recording studio
- Other
- Heritage

Pyrmont West

Receivers within MWD for cosmetic damage

MWD for cosmetic damage and human annoyance during Excavator 13T (Hammer) works

- Reinforced structures (25.0mm/s ppv)
- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Human annoyance - Residential (night)



REV	BY	DATE	DESCRIPTION	APPROVED
r1	SS	19/10/23	Heritage and Landuse update	TG
r0	SS	14/03/23	Preparing Figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 20 40 60 80 m

1:1,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

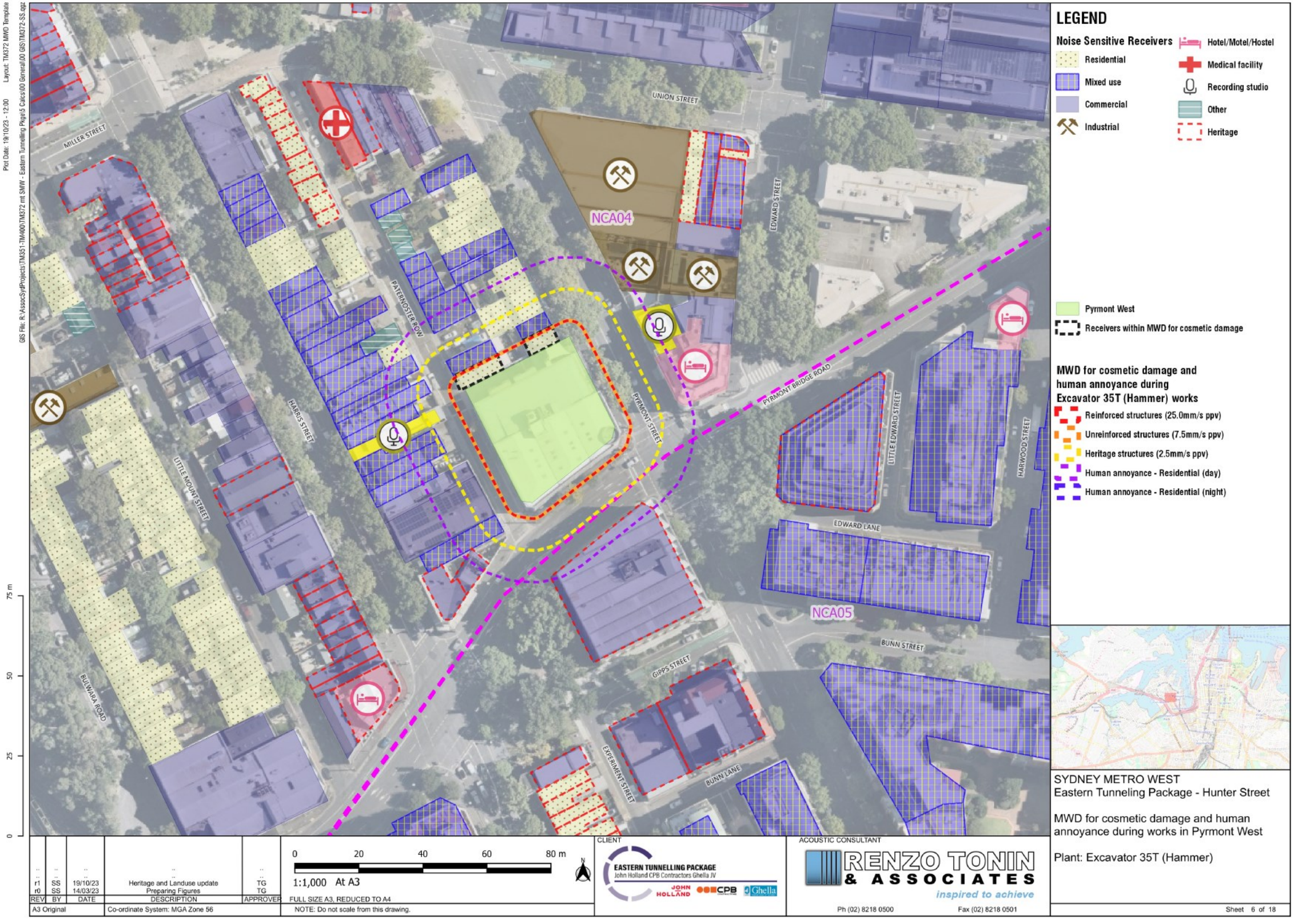
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

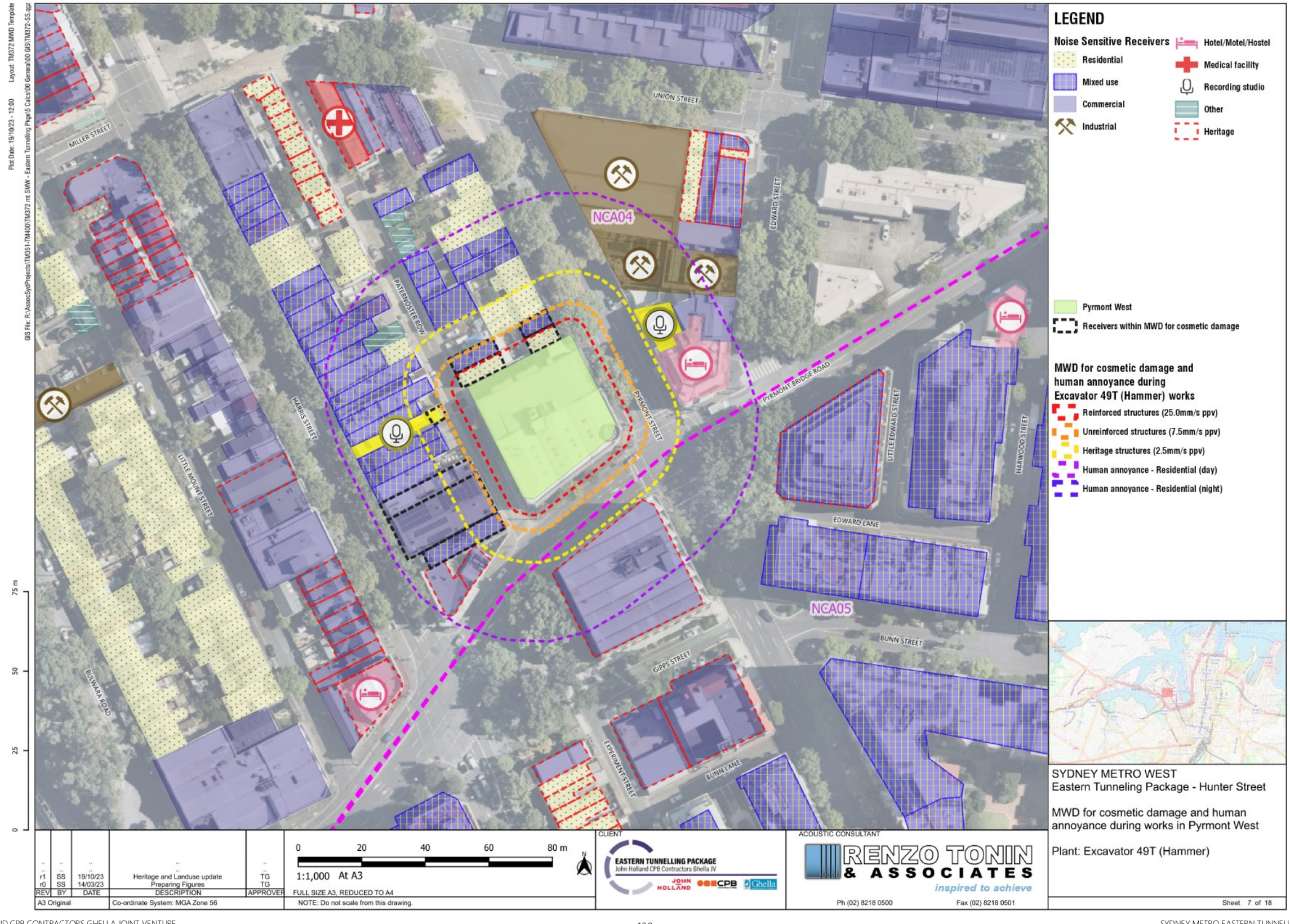
SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street

MWD for cosmetic damage and human annoyance during works in Pyrmont West

Plant: Excavator 13T (Hammer)

Sheet 5 of 18


Plot Date: 19/10/23 - 12:00 Layout: TM372 MWD Template
GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz
LEGEND
Noise Sensitive Receivers
Residential
Mixed use
Commercial
Industrial
Hotel/Motel/Hostel
Medical facility
Recording studio
Other
Heritage
Pyrmont West
Receivers within MWD for cosmetic damage
MWD for cosmetic damage and human annoyance during Excavator 35T (Hammer) works
Reinforced structures (25.0mm/s ppv)
Unreinforced structures (7.5mm/s ppv)
Heritage structures (2.5mm/s ppv)
Human annoyance - Residential (day)
Human annoyance - Residential (night)
NCA04
NCA05
UNION STREET
MILLER STREET
EDWARD STREET
PATERNOSTER ROW
HARRIS STREET
PYRMONT STREET
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
EDWARD LANE
BUNN STREET
GIPPS STREET
EXPERIMENT STREET
BUNN LANE
BULWARA ROAD
LITTLE MOUNT STREET
0 25 50 75 m
0 20 40 60 80 m
1:1,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
r1 SS 19/10/23 Heritage and Landuse update TG
r0 SS 14/03/23 Preparing Figures TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street
MWD for cosmetic damage and human annoyance during works in Pyrmont West
Plant: Excavator 35T (Hammer)
Sheet 6 of 18


Plot Date: 19/10/23 - 12:00 Layout: TM372 MWD Template
GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz
UNION STREET
MILLER STREET
NCA04
EDWARD STREET
PATERNOSTER ROW
HARRIS STREET
PYRMONT STREET
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
LITTLE MOUNT STREET
EDWARD LANE
NCA05
BUNN STREET
GIPPS STREET
BULWARA ROAD
EXPERIMENT STREET
BUNN LANE
75 m
50
25
0
LEGEND
Noise Sensitive Receivers
Residential
Mixed use
Commercial
Industrial
Hotel/Motel/Hostel
Medical facility
Recording studio
Other
Heritage
Pyrmont West
Receivers within MWD for cosmetic damage
MWD for cosmetic damage and human annoyance during Excavator 49T (Hammer) works
Reinforced structures (25.0mm/s ppv)
Unreinforced structures (7.5mm/s ppv)
Heritage structures (2.5mm/s ppv)
Human annoyance - Residential (day)
Human annoyance - Residential (night)
r1 SS 19/10/23 Heritage and Landuse update TG
r0 SS 14/03/23 Preparing Figures TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56
0 20 40 60 80 m
1:1,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
N
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
JOHN HOLLAND
CPB
Ghella
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street
MWD for cosmetic damage and human annoyance during works in Pyrmont West
Plant: Excavator 49T (Hammer)
Sheet 7 of 18

Plot Date: 19/10/23 - 12:01 Layout: TM372 MWD Template

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Page\5 Calcs\00 General\00 GIS\TM372-SS.qgz

LEGEND

Noise Sensitive Receivers

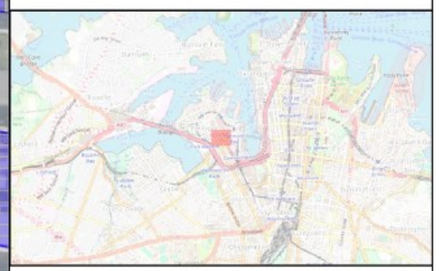
- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Recording studio
- Other
- Heritage

Pyrmont West

Receivers within MWD for cosmetic damage

MWD for cosmetic damage and human annoyance during Roller 16T Smooth (high vibration) works

- Reinforced structures (25.0mm/s ppv)
- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Human annoyance - Residential (night)



REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Heritage and Landuse update	TG
r0	SS	14/03/23	Preparing Figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 20 40 60 80 m

1:1,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

JOHN HOLLAND CPB Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

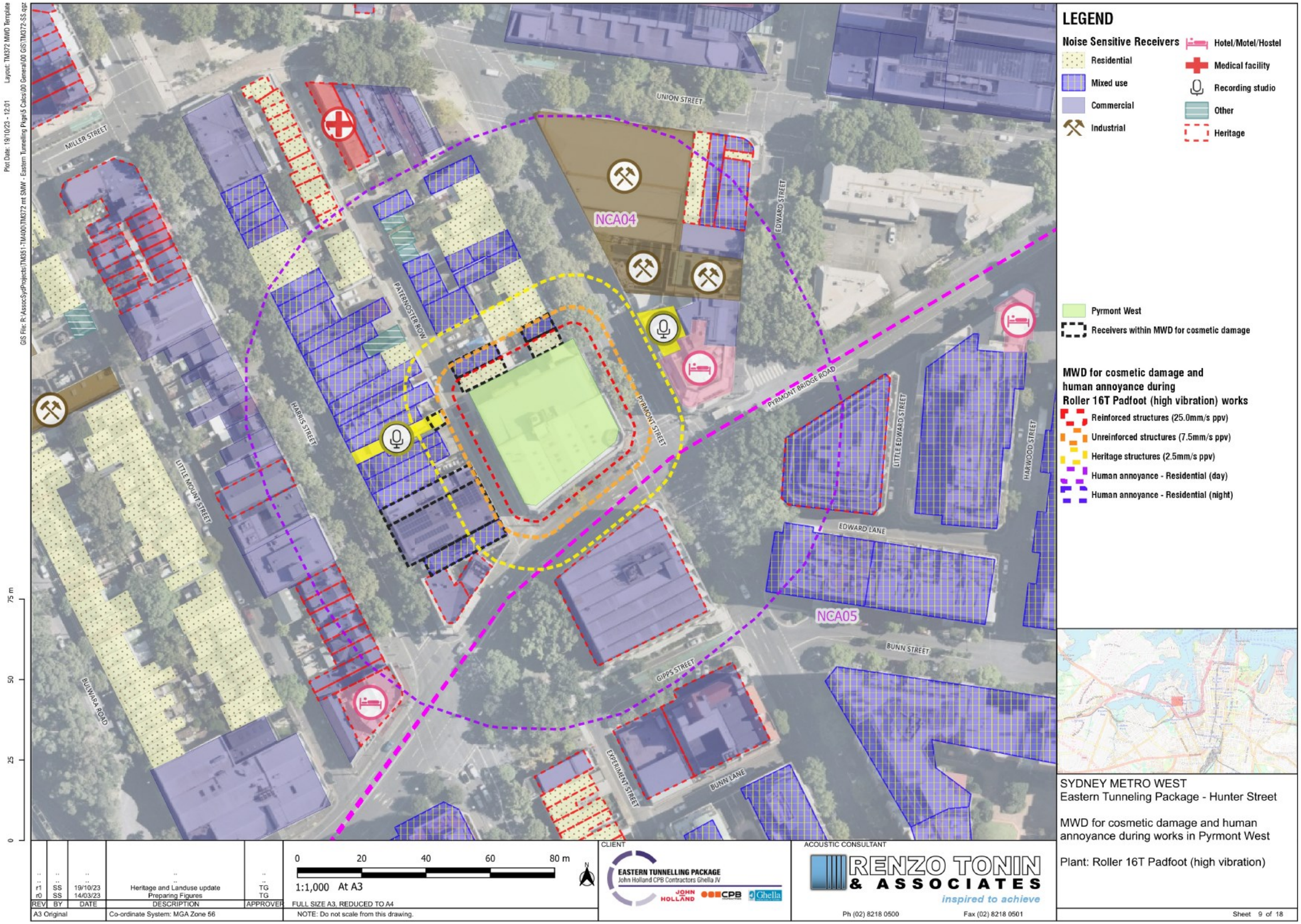
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street

MWD for cosmetic damage and human annoyance during works in Pyrmont West

Plant: Roller 16T Smooth (high vibration)

Sheet 8 of 18


Plot Date: 19/10/23 - 12:01 Layout: TM372 MWD Template
GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz
UNION STREET
MILLER STREET
NCA04
EDWARD STREET
PATERNOSTER ROW
HARRIS STREET
PYRMONT STREET
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
LITTLE MOUNT STREET
EDWARD LANE
NCA05
BUNN STREET
GIPPS STREET
EXPERIMENT STREET
BUNN LANE
BULWARA ROAD
0
25
50
75 m
LEGEND
Noise Sensitive Receivers
Residential
Mixed use
Commercial
Industrial
Hotel/Motel/Hostel
Medical facility
Recording studio
Other
Heritage
Pyrmont West
Receivers within MWD for cosmetic damage
MWD for cosmetic damage and human annoyance during Roller 16T Padfoot (high vibration) works
Reinforced structures (25.0mm/s ppv)
Unreinforced structures (7.5mm/s ppv)
Heritage structures (2.5mm/s ppv)
Human annoyance - Residential (day)
Human annoyance - Residential (night)
r1 SS 19/10/23 Heritage and Landuse update TG
r0 SS 14/03/23 Preparing Figures TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56
0 20 40 60 80 m
1:1,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street
MWD for cosmetic damage and human annoyance during works in Pyrmont West
Plant: Roller 16T Padfoot (high vibration)
Sheet 9 of 18

F.2 Pyrmont East worksite - minimum working distance for vibration impact

LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Library/Museum
- Educational
- Theatre/Auditorium
- Other
- Heritage

- Pyrmont East
- Receivers within MWD for cosmetic damage

MWD for cosmetic damage and human annoyance during Jackhammer works

- Reinforced structures (25.0mm/s ppv)
- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Human annoyance - Residential (night)

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Heritage and Landuse update	TG
r0	SS	14/03/23	Preparing Figures	TG

A3 Original — Co-ordinate System: MGA Zone 56

0 20 40 60 80 m

1:1,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street

MWD for cosmetic damage and human annoyance during works in Pyrmont East

Plant: Jackhammer

Sheet 10 of 18

Plot Date: 19/10/23 - 12:01 Layout: TM372 MWD Template

GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz

LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Library/Museum
- Educational
- Theatre/Auditorium
- Other
- Heritage

Pyrmont East

Receivers within MWD for cosmetic damage

MWD for cosmetic damage and human annoyance during Excavator 35T (Saw/Cutter) works

- Reinforced structures (25.0mm/s ppv)
- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Human annoyance - Residential (night)

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Heritage and Landuse update	TG
r0	SS	14/03/23	Preparing Figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 20 40 60 80 m

1:1,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

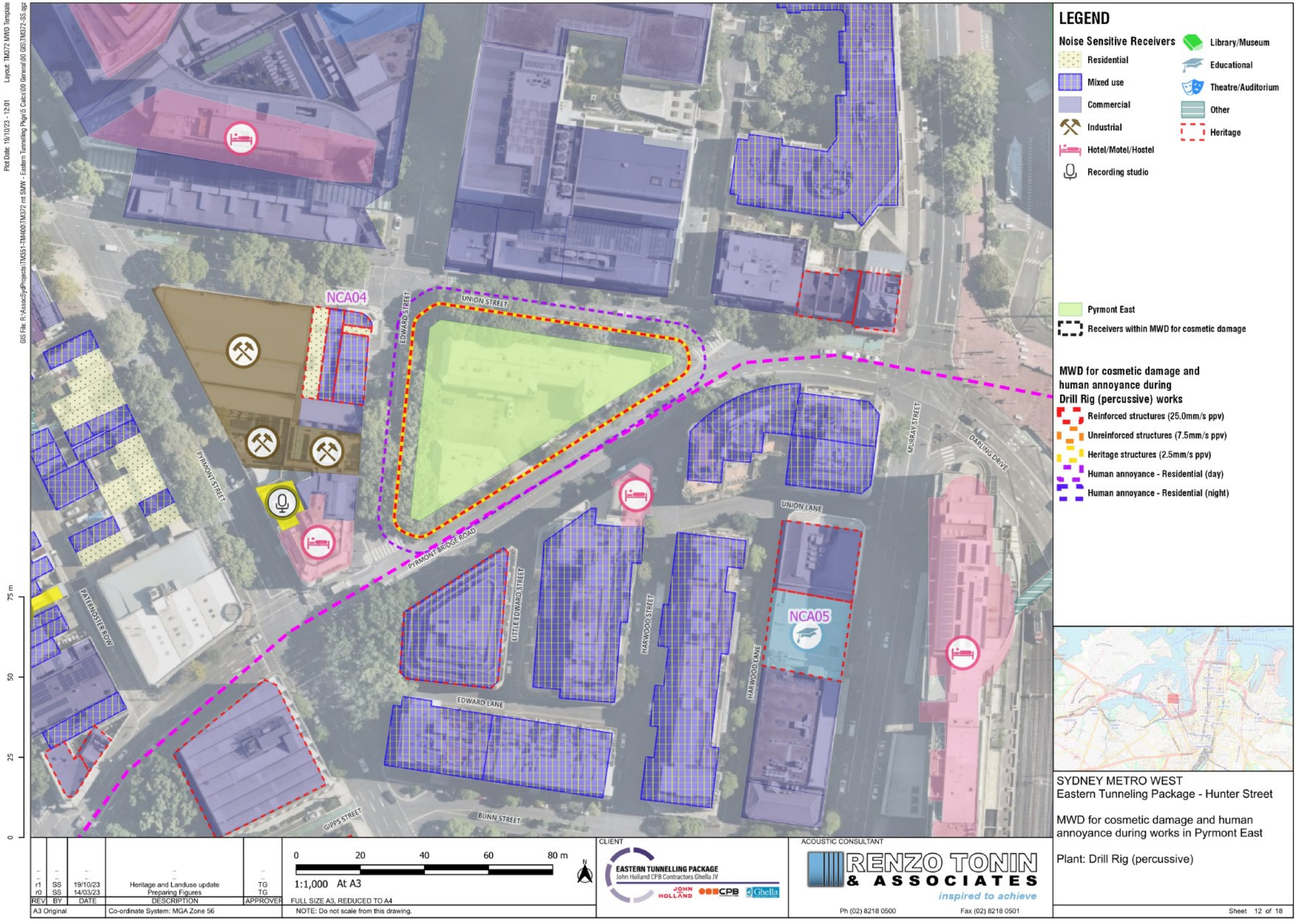
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street

MWD for cosmetic damage and human annoyance during works in Pyrmont East

Plant: Excavator 35T (Saw/Cutter)

Sheet 11 of 18


Plot Date: 19/10/23 - 12:01 Layout: TM372 MWD Template
GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Page\5 Calcs\00 General\80 GIS\TM372-SS.qgz
NCA04
NCA05
UNION STREET
EDWARD STREET
PYRMONT STREET
PYRMONT BRIDGE ROAD
PATERNOSTER ROW
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
EDWARD LANE
GIPPS STREET
BUNN STREET
MURRAY STREET
DARLING DRIVE
UNION LANE
75 m
50
25
0
LEGEND
Noise Sensitive Receivers
Residential
Mixed use
Commercial
Industrial
Hotel/Motel/Hostel
Recording studio
Library/Museum
Educational
Theatre/Auditorium
Other
Heritage
Pyrmont East
Receivers within MWD for cosmetic damage
MWD for cosmetic damage and human annoyance during Drill Rig (percussive) works
Reinforced structures (25.0mm/s ppv)
Unreinforced structures (7.5mm/s ppv)
Heritage structures (2.5mm/s ppv)
Human annoyance - Residential (day)
Human annoyance - Residential (night)
REV BY DATE DESCRIPTION APPROVER
r1 SS 19/10/23 Heritage and Landuse update TG
r0 SS 14/03/23 Preparing Figures TG
A3 Original
Co-ordinate System: MGA Zone 56
0 20 40 60 80 m
1:1,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street
MWD for cosmetic damage and human annoyance during works in Pyrmont East
Plant: Drill Rig (percussive)
Sheet 12 of 18


Plot Date: 19/10/23 - 12:01 Layout: TM372 MWD Template
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Page\5 Calcs\00 General\00 GIS\TM372-SS.qgz
NCA04
NCA05
UNION STREET
EDWARD STREET
PYRMONT BRIDGE ROAD
PYRMONT STREET
PATERNOSTER ROW
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
UNION LANE
MURRAY STREET
DARLING DRIVE
EDWARD LANE
GIPPS STREET
BUNN STREET
75 m
50
25
0
LEGEND
Noise Sensitive Receivers
Residential
Mixed use
Commercial
Industrial
Hotel/Motel/Hostel
Recording studio
Library/Museum
Educational
Theatre/Auditorium
Other
Heritage
Pyrmont East
Receivers within MWD for cosmetic damage
MWD for cosmetic damage and human annoyance during Piling Rig (Bauer BG36) works
Reinforced structures (25.0mm/s ppv)
Unreinforced structures (7.5mm/s ppv)
Heritage structures (2.5mm/s ppv)
Human annoyance - Residential (day)
Human annoyance - Residential (night)
r1 SS 19/10/23 Heritage and Landuse update TG
r0 SS 14/03/23 Preparing Figures TG
REV BY DATE DESCRIPTION APPROVED
A3 Original
Co-ordinate System: MGA Zone 56
0 20 40 60 80 m
1:1,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street
MWD for cosmetic damage and human annoyance during works in Pyrmont East
Plant: Piling Rig (Bauer BG36)
Sheet 13 of 18


Plot Date: 19/10/23 - 12:01 Layout: TM372 MWD Template
GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Phase\5 Calcs\00 General\00 GIS\TM372-SS.qgz
NCA04
NCA05
UNION STREET
EDWARD STREET
PYRMONT STREET
PYRMONT BRIDGE ROAD
PATERNOSTER ROW
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
EDWARD LANE
UNION LANE
MURRAY STREET
DARLING DRIVE
GIPPS STREET
BUNN STREET
0
25
50
75 m
LEGEND
Noise Sensitive Receivers
Residential
Mixed use
Commercial
Industrial
Hotel/Motel/Hostel
Recording studio
Library/Museum
Educational
Theatre/Auditorium
Other
Heritage
Pyrmont East
Receivers within MWD for cosmetic damage
MWD for cosmetic damage and human annoyance during Excavator 13T (Hammer) works
Reinforced structures (25.0mm/s ppv)
Unreinforced structures (7.5mm/s ppv)
Heritage structures (2.5mm/s ppv)
Human annoyance - Residential (day)
Human annoyance - Residential (night)
REV BY DATE DESCRIPTION APPROVER
r1 SS 19/10/23 Heritage and Landuse update TG
r0 SS 14/03/23 Preparing Figures TG
A3 Original
Co-ordinate System: MGA Zone 56
0 20 40 60 80 m
1:1,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
N
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
JOHN HOLLAND
CPB
Ghella
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street
MWD for cosmetic damage and human annoyance during works in Pyrmont East
Plant: Excavator 13T (Hammer)
Sheet 14 of 18


Plot Date: 19/10/23 - 12:01 Layout: TM372 MWD Template
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz
NCA04
NCA05
UNION STREET
EDWARD STREET
PYRMONT STREET
PYRMONT BRIDGE ROAD
PATERNOSTER ROW
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
EDWARD LANE
GIPPS STREET
BUNN STREET
MURRAY STREET
DARLING DRIVE
UNION LANE
75 m
50
25
0
LEGEND
Noise Sensitive Receivers
Residential
Mixed use
Commercial
Industrial
Hotel/Motel/Hostel
Recording studio
Library/Museum
Educational
Theatre/Auditorium
Other
Heritage
Pyrmont East
Receivers within MWD for cosmetic damage
MWD for cosmetic damage and human annoyance during Excavator 35T (Hammer) works
Reinforced structures (25.0mm/s ppv)
Unreinforced structures (7.5mm/s ppv)
Heritage structures (2.5mm/s ppv)
Human annoyance - Residential (day)
Human annoyance - Residential (night)
REV
BY
DATE
DESCRIPTION
APPROVER
r1 SS 19/10/23 Heritage and Landuse update TG
r0 SS 14/03/23 Preparing Figures TG
A3 Original
Co-ordinate System: MGA Zone 56
0 20 40 60 80 m
1:1,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
N
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
JOHN HOLLAND
CPB
Ghella
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street
MWD for cosmetic damage and human annoyance during works in Pyrmont East
Plant: Excavator 35T (Hammer)
Sheet 15 of 18

Plot Date: 19/10/23 - 12:01 Layout: TM372 MWD Template
GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunneling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz

LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Library/Museum
- Educational
- Theatre/Auditorium
- Other
- Heritage

- Pyrmont East
- Receivers within MWD for cosmetic damage

MWD for cosmetic damage and human annoyance during Excavator 49T (Hammer) works

- Reinforced structures (25.0mm/s ppv)
- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Human annoyance - Residential (night)

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/10/23	Heritage and Landuse update	TG
r0	SS	14/03/23	Preparing Figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 20 40 60 80 m

1:1,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

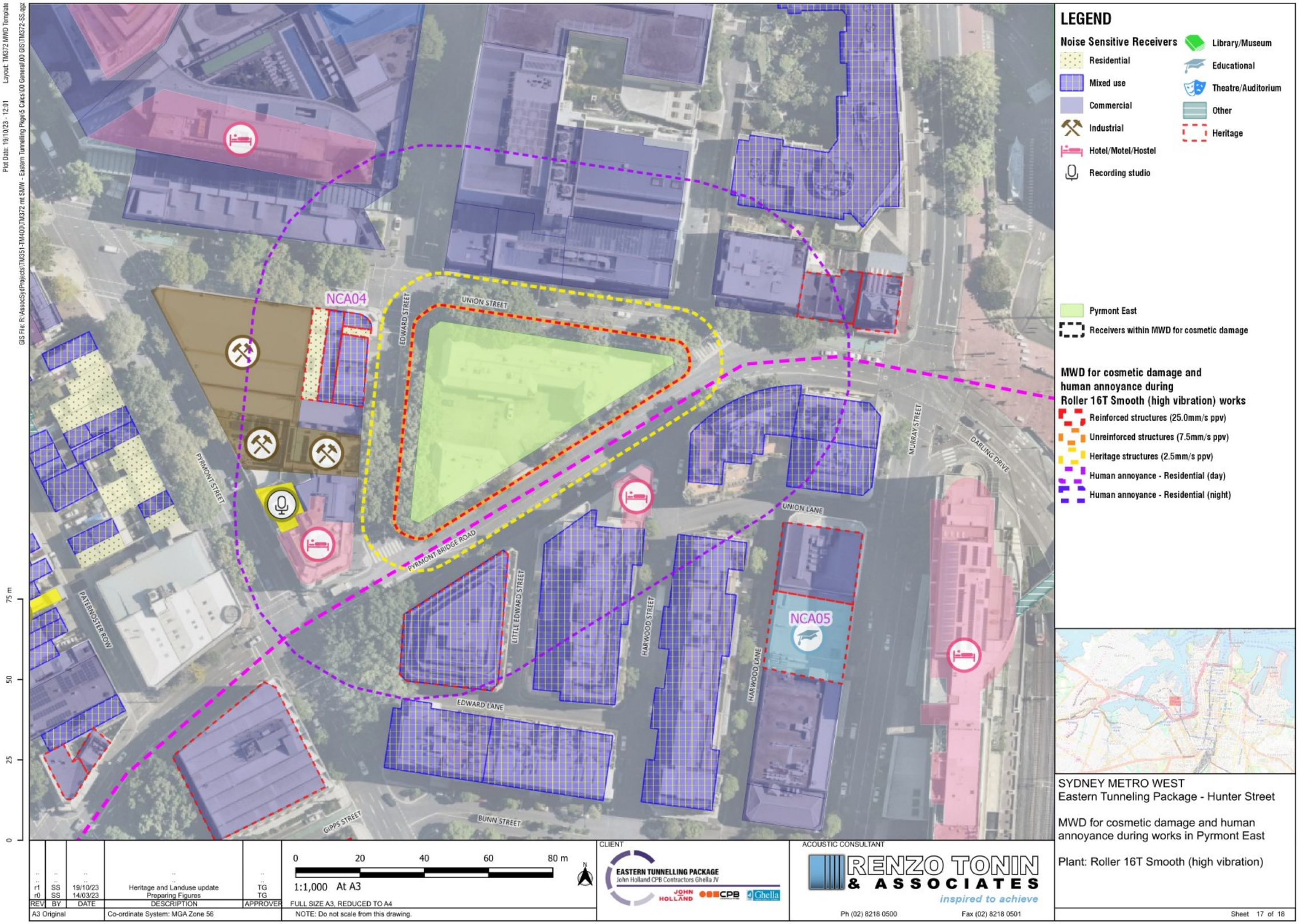
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street

MWD for cosmetic damage and human annoyance during works in Pyrmont East

Plant: Excavator 49T (Hammer)

Sheet 16 of 18


Plot Date: 19/10/23 - 12:01
Layout: TM372 MWD Template
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS.qgz
NCA04
NCA05
UNION STREET
EDWARD STREET
PYRMONT STREET
PYRMONT BRIDGE ROAD
PATERNOSTER ROW
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
EDWARD LANE
UNION LANE
MURRAY STREET
DARLING DRIVE
GIPPS STREET
BUNN STREET
75 m
50
25
0
LEGEND
Noise Sensitive Receivers
Residential
Mixed use
Commercial
Industrial
Hotel/Motel/Hostel
Recording studio
Library/Museum
Educational
Theatre/Auditorium
Other
Heritage
Pyrmont East
Receivers within MWD for cosmetic damage
MWD for cosmetic damage and human annoyance during Roller 16T Smooth (high vibration) works
Reinforced structures (25.0mm/s ppv)
Unreinforced structures (7.5mm/s ppv)
Heritage structures (2.5mm/s ppv)
Human annoyance - Residential (day)
Human annoyance - Residential (night)
r1 SS 19/10/23 Heritage and Landuse update TG
r0 SS 14/03/23 Preparing Figures TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56
0 20 40 60 80 m
1:1,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV
ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500
Fax (02) 8218 0501
SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street
MWD for cosmetic damage and human annoyance during works in Pyrmont East
Plant: Roller 16T Smooth (high vibration)
Sheet 17 of 18

Plot Date: 19/10/23 - 12:02 Layout: TM372 MWD Template
GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\90 GIS\TM372-SS.qgz

LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Recording studio
- Library/Museum
- Educational
- Theatre/Auditorium
- Other
- Heritage

- Pyrmont East
- Receivers within MWD for cosmetic damage

MWD for cosmetic damage and human annoyance during Roller 16T Padfoot (high vibration) works

- Reinforced structures (25.0mm/s ppv)
- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Human annoyance - Residential (night)

REV	BY	DATE	DESCRIPTION	APPROVED
r1	SS	19/10/23	Heritage and Landuse update	TG
r0	SS	14/03/23	Preparing Figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 20 40 60 80 m

1:1,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package - Hunter Street

MWD for cosmetic damage and human annoyance during works in Pyrmont East

Plant: Roller 16T Padfoot (high vibration)

Sheet 18 of 18

F.3 Attended vibration monitoring - nominated representative locations

Table F.3: Attended vibration monitoring - nominated representative locations

Worksite	Plant item(s)	Address	Vibration monitoring for:	
			Cosmetic damage[1]	Human annoyance[2]
Pyrmont West	Jackhammer; Excavator 35T (saw); Drill rig (percussive); Piling Rig (Bauer BG36); Excavator 13T (hammer); Excavator 35T (hammer); Roller <16T smooth (vibratory mode)	28 Paternoster Row, Pyrmont	√	√
		127 Pyrmont Street, Pyrmont	√	√
	Excavator 49T (hammer); Roller <16T padfoot (vibratory mode)	127 Pyrmont Street, Pyrmont	√	√
		125 Pyrmont Street, Pyrmont	√	√
		28 Paternoster Row, Pyrmont	√	√
		26 Paternoster Row, Pyrmont	√	√
		212 Harris Street Pyrmont	√	√
		210 Harris Street Pyrmont	√	√
		212 Harris Street Pyrmont	√	√
		206 Harris Street Pyrmont	√	√
		198 Harris Street Pyrmont	√	√
Pyrmont East	Excavator 49T (hammer); Roller <16T padfoot (vibratory mode)	63 Edward Street, Pyrmont/ 35 Union Street, Pyrmont	√[3]	√

Note: 1. Properties identified as potentially within recommended MWD for cosmetic damage, based on Table 7.2. Vibration monitoring is recommended to determine site specific minimum working distances and/or verify that vibration levels achieve compliance with the structural damage objectives, as outlined in Section 9.6.3

2. Monitoring is required in the event of complaint in relation to vibration

3. Subject to building condition report, as noted in Section 7.2.2

APPENDIX G Community consultation and construction noise respite program

G.1 Evidence of receiver specific consultation

Provided as a spreadsheet table to allow to JCG to update with ingoing *community consultation*.

G.2 Construction noise respite program

G.2.1 Stage 1A: initial demolition

Noise impacts from demolition will be for a short duration and typically only occur for short periods during the day. Pulverisers are required to be used as the primary demolition method in the General Specification and hammers will be restricted to the demolition of the structural slabs.

The respite program for the demolition works will be based on the standard respite periods outlined in Section 9.1.1. Consultation with Condition D38 receivers is ongoing to ensure suitable respite will be provided during demolition of the structural slabs.

G.2.2 Stage 1B: structural slab demolition

Consultation to determine respite requirements in accordance with Condition D37/D38 will be undertaken prior to demolition of the structural slabs. The outcomes of the consultation will determine the noise respite program, which will be included in a future update of this DNVIS.

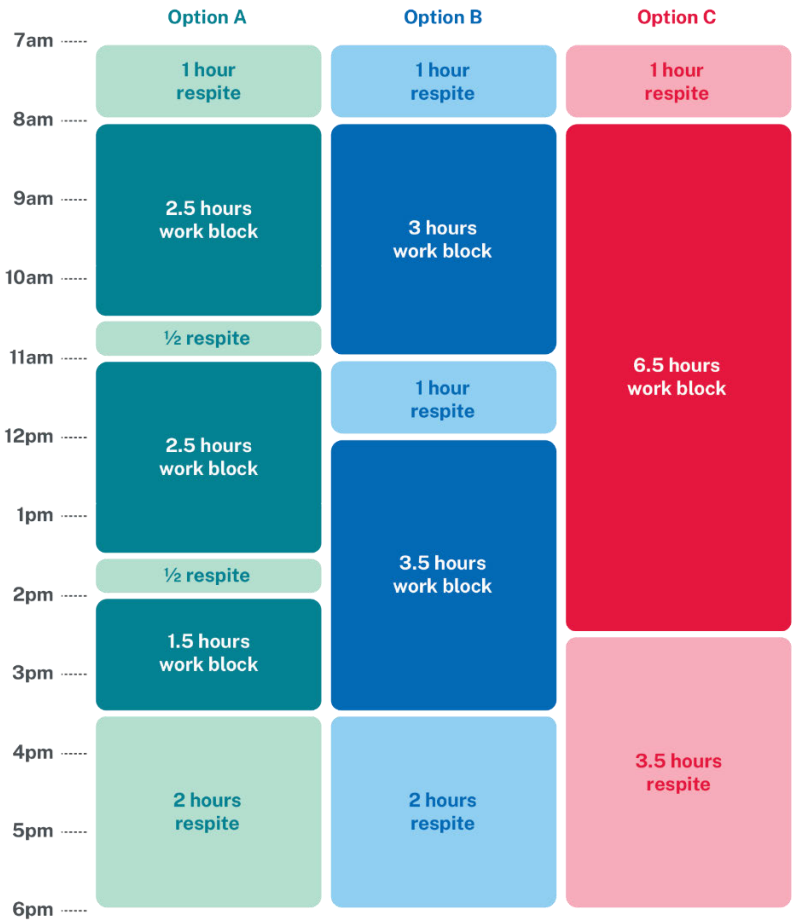
G.2.3 Stage 2: temporary and permanent shaft excavation

Consultation to determine respite requirements in accordance with Condition D37/D38 has been undertaken prior to shaft excavation. The consultation process and outcomes have been summarised in a report prepared by JCG JV, D39 Consultation Report, Pyrmont, which was submitted to the EPA for approval.

JCG prepared three different options for eligible stakeholders to select. The options considered the following:

- The needs of eligible stakeholders and their potential sensitive periods
- General fatigue from ongoing construction noise impact
- Fulfilling 6.5 hours of high impact noise per day to maintain program
- Ensure that safety for workers and the public is maintained.

Figure 4: Respite period options for Pyrmont



Key findings from the survey indicate the following trend:

- The majority of stakeholders responded with their preferred option (C) being high activities starting at 8am and continuing for a straight 6.5-hour work period until 2.30pm.
- There were no significant differences in response between residential and businesses.

JCG will initially undertake high noise activities, working under the agreed respite periods of Option C, starting at 8am and continuing until 2.30pm daily. Low noise activities will continue after this and will finish at 6pm daily.

ACOUSTICS ADVISOR ENDORSEMENT
SYDNEY METRO WEST (SSI 19238057)

Review of	**Eastern Tunnelling Package:** Detailed Noise and Vibration Impact Statement (DNVIS) – Pyrmont Station	**Reviewed document reference:**	TM372-02-1-02F01 SMW-ETP_DNVIS-PYR (rev04) Revision 4 dated 5 March 2024
Prepared by:	[redacted] Acoustics Advisor		
Date of issue:	14 March 2024		

Context

As approved Acoustics Advisor for the Sydney Metro West project, I previously endorsed Rev 0 of Detailed Noise and Vibration Impact Statement (DNVIS) for Pyrmont Station Works in April 2023 and Rev 3 in November 2023 when it was updated to include stage 3 - shaft excavation and mined tunnelling, and stage 4 - decommissioning.

The DNVIS has recently been updated to Rev 4 to include the diesel tower crane. Rev 3 assumed an electric tower crane (which is quieter than diesel), but I understand that it was not possible to implement this due to electricity supply limitations on site and lack of availability of a suitable electric crane. There was a complaint about tower crane noise in January 2024 and the update to the DNVIS (to Rev 4) forms part of JCG's response, following their complaint investigation.

Notes

I am satisfied that the DNVIS documents appropriate feasible and reasonable mitigation of tower crane noise given that it is not currently used out of hours and will be in place for a limited duration. In particular, the operation of the tower crane has been changed from continuous operation to only operating the crane when lifting is required.

I note that JCG is also considering OOH use of the tower crane, but this is the subject of a separate assessment.

Endorsement

I endorse Revision 4 of the DNVIS for implementation.

[redacted]

[redacted] Metro West Acoustics Advisor