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Detailed Noise and Vibration Impact Statement - Pyrmont Station

13 April 2023

John Holland CPB Contractors Ghella Joint Venture

TM372-02-1-02F01 SMW-ETP_DNVIS-PYR (rev 0)

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Contents

List of tables

List of figures

1 Introduction

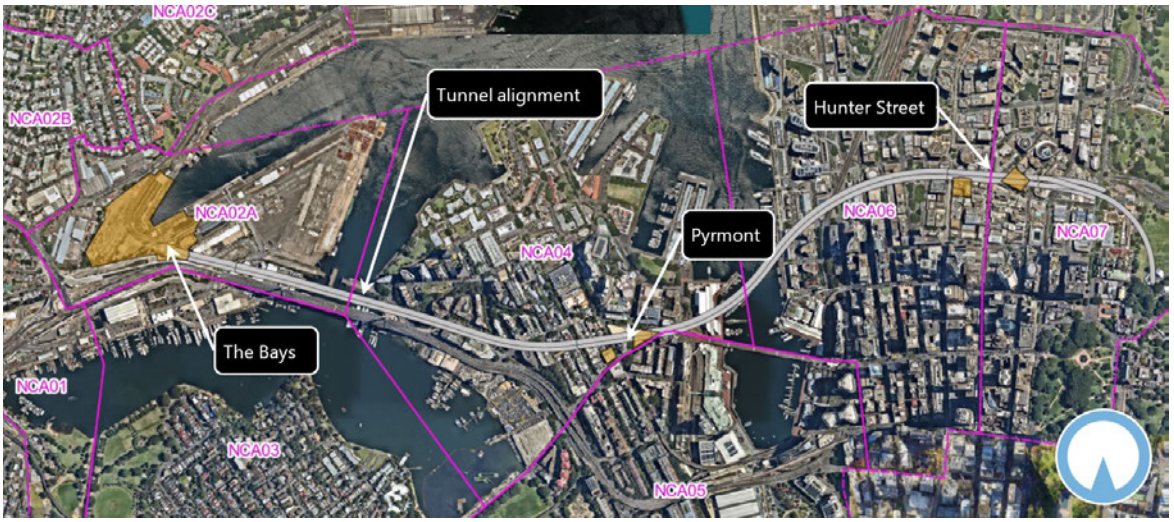
1.1 Purpose and application

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), following its approval.

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

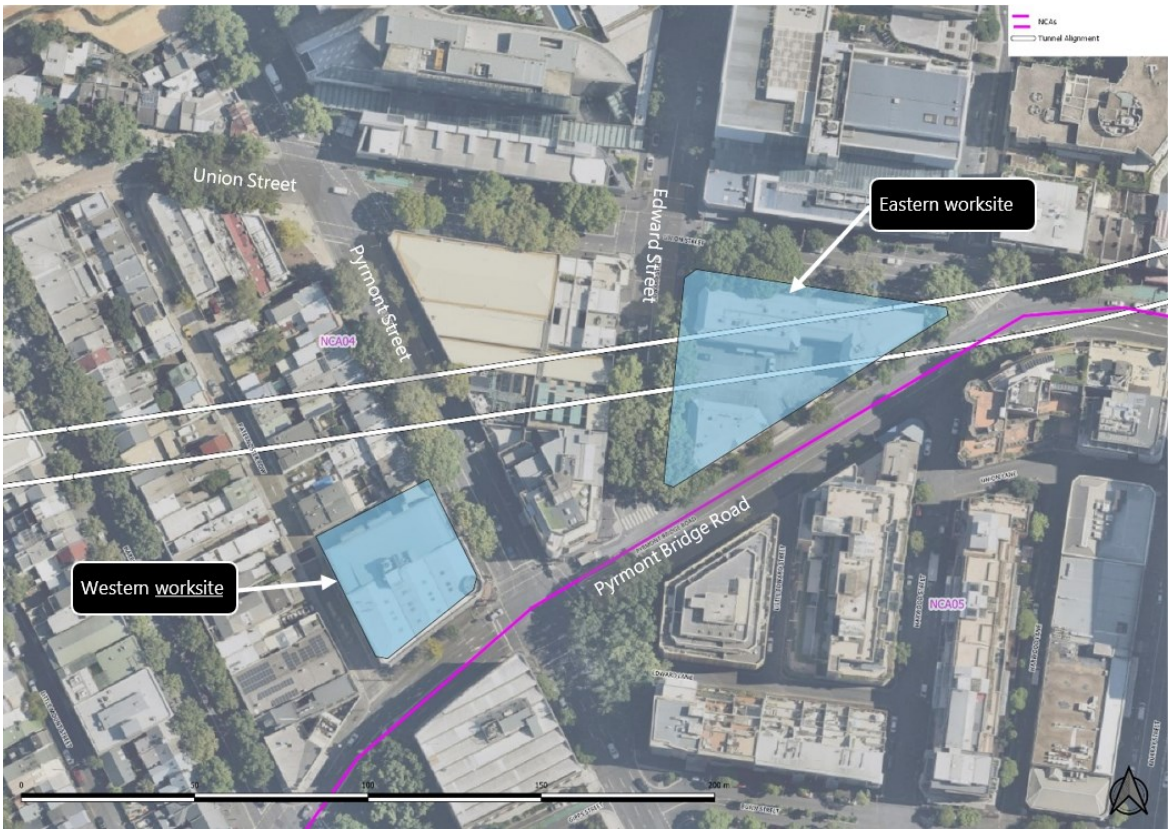
2.1 Construction works addressed in this DNVIS

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 the following sub-stages:

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

  - Shaft excavation: Temporary Shaft(s) (to allow access to mined tunnelling work area);

- Stage 3: (not included in this issue of the DNVIS)
  - Shaft excavation: Permanent Shaft(s);
  - Mined tunnel support for station cavern and adits;
- Stage 4: Demobilisation (not included in this issue of the DNVIS).

The works are proposed to be undertaken during standard construction hours. Some works will also be completed 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	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
Temporary shaft excavation(without shed and with shed)	Shaft excavation (and spoil handling)	Standard hours (D)	12 weeks
	Support works (concreting)	Standard hours (D)	12 weeks
Permanent shaft excavation	Shaft excavation	Standard hours (D)	
	Spoil Handling	Standard hours (D)	
	Support works	Standard hours + OOHW (D/E)	
Mined tunnel support (surface)	Tunnel excavation & support	Standard hours + OOHW (D/E/N)	
	Spoil handling	Standard hours + OOHW (D/E)	
	Tunnel Lining (concreting)	Standard hours	
Demobilisation	...	Standard hours + OOHW (D/E)	
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
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 and with shed)	Shaft excavation (and spoil handling)	Standard hours (D)	12 weeks
	Support works (concreting)	Standard hours (D)	12 weeks

Activity/ work area	Aspect	Construction hours	Timing of activity
Mined tunnel support (surface)	Tunnel excavation & support	Standard hours + OOHW (D/E/N)	
	Spoil handling	Standard hours + OOHW (D/E)	
	Tunnel Lining (concreting)	Standard hours	
Permanent shaft excavation	Shaft excavation	Standard hours (D)	
	Spoil Handling	Standard hours (D)	
	Support works	Standard hours + OOHW (D/E)	
Demobilisation	...	Standard hours + OOHW (D/E)	

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

Grey text indicates works not included in this issue of the DNVIS

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.

During the demolition works at Pyrmont West, the primary access route will be left from Pyrmont Bridge Road onto Pyrmont Street and left into the worksite. Once demolition has been completed, an access point will be constructed on Pyrmont Bridge Road and the primary access route will be via Pyrmont Bridge Road, turning left onto the worksite.

The primary route of egress from the site will be right out of the worksite onto Pyrmont Street (southbound) and right turn onto Pyrmont Bridge Road westbound. The primary egress route will be used when traffic flow along Pyrmont Street provides sufficient gaps to turn right out of the worksite safely, without impacting or blocking the traffic flow. A secondary egress route would be utilised when it is not safe or possible to turn right out of the site onto Pyrmont Street, (i.e. during peak periods).

Using the secondary route vehicles would exit the site turning left onto Pyrmont Street, then right onto Union Street, then left onto Pyrmont Bridge Road and continuing along Darling Drive to the round-about and returning along Darling Drive and Pyrmont Bridge Road to the Western Distributer (or Harris Street). This outbound heavy vehicle route was the primary outbound B route for Pyrmont East in the EIS and Submissions Report. The direction of travel has been reversed to allow the route to be adopted for Pyrmont West.

Construction traffic will access the eastern worksite via Pyrmont Bridge Road turning left onto Edward Street, then right into the worksite. Vehicles would exit the site via by turning left onto Pyrmont Bridge Road and continuing along Darling Drive to the round-about and returning along Darling Drive and

Pyrmont Bridge Road to the Western Distributer (or Harris Street). Concrete trucks bringing shotcrete to the site will access and exit the site from Pyrmont Bridge Road (left in, left out).

The proposed truck routes are shown in Figure 2.2

Figure 2.2:Pyrmont Station worksite heavy vehicle route

Source: Submissions Report - Major civil construction between The Bays and Sydney CBD [5] edited to remove vehicle routes not used

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 required during mined tunnelling, to be assessed in the next issue of this DNVIS)
  - Spoil trucks removing spoil from the site (typically standard hours. There will be some spoil handing during mined tunnelling up to 10pm, to be assessed in the next issue of this DNVIS).

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 by tunnel boring machine[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]
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. Excluding cut and cover tunnelling and surface excavation works. Tunnelling does not include station box excavation.
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 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

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 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).

Works within an acoustic shed, tunnelling and tunnel support works for the cavern and adits at the eastern and western shaft sites are a prescribed activity permitted 24 hours a day under condition D29(d).

All reasonable and feasible mitigation and management measures will be implemented to reduce noise from the works to within NMLs.

Out-of-hours work under CoA D29(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.

2.2.2 Assessment periods

The standard hours and out of hours work (OOHW) periods for construction works are depicted in Table 2.3. 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 2.3: 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 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.

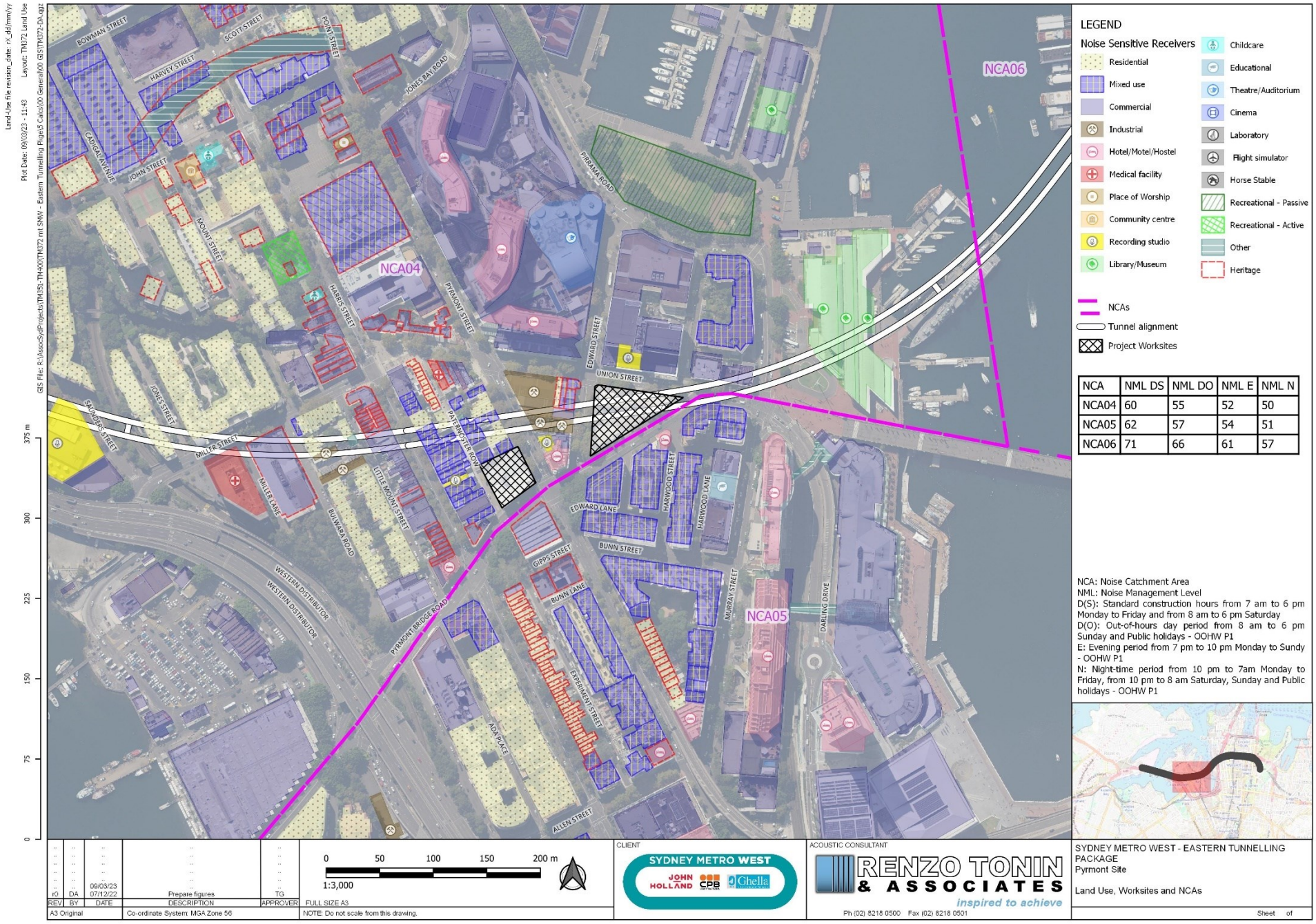
Table 3.1: Summary of baseline noise monitoring data from EIS

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

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]	Initial screening level • 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).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.

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)	11-20 dB(A) above NML (yellow)	21-30 dB(A) above NML (orange)	>30 dB(A) above NML (purple)
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	23	52	2	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Piling and capping beams	PW-PC	9	15	5	0	0	20	11	3	0	22	17	3	1	29	17	6	1	53	68
	Platform and acoustic shed erection	PW-PAS	3	15	4	0	0	10	12	2	1	13	18	3	1	19	15	6	1	41	53
	Shaft excavation at surface level[3]	PW-SE(S)	25	79	3	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Shaft excavation at 5m depth[3]	PW-SE(5m)	16	18	5	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Shaft excavation at 10m depth[3]	PW-SE(10m)	16	18	5	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Support works at surface level[3]	PW-GS(S)	18	22	4	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Support works at 5m depth[3]	PW-GS(5m)	8	12	5	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Support works at 10m depth[3]	PW-GS(10m)	3	11	4	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
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	26	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	5	0	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Shaft excavation at surface level[3]	PE-SE(S)	7	38	4	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Shaft excavation at 5m depth[3]	PE-SE(5m)	5	27	4	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Shaft excavation at 10m depth[3]	PE-SE(10m)	5	27	4	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	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]
	Support works at 5m depth[3]	PE-GS(5m)	3	8	1	0	0	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]	-[4]
	Support works at 10m depth[3]	PE-GS(10m)	3	8	1	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	Shaft excavation and support works within the acoustic shed	SW-SE	0	18	11	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 last line item of this table.
4. No work is proposed outside standard construction hours for this work activity.

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	2	0	0	0	0	0	0	1	0	0	1	0	0	0
	Demolition - above hoarding[3]	PW-DE(AH)	16	2	1	0	2	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	5	3	1	0	1	0	1	0
	Demolition - below hoarding[3]	PW-DE(BH)	5	3	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	6	1	1	0	0	1	0	0
	Dismantle Class-B; erect Class-A hoarding	PW-SE(A)	4	2	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	0	1	0	0	1	0	0
	Preliminary earthworks and piling pad[3]	PW-PE	5	2	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	6	1	1	0	0	1	0	0
	Piling and capping beams	PW-PC	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0
	Platform and acoustic shed erection	PW-PAS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0
	Shaft excavation at surface level[3]	PW-SE(S)	12	2	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	6	1	1	0	0	1	0	0
	Shaft excavation at 5m depth[3]	PW-SE(5m)	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	1	1	0	1	0	0	0
	Shaft excavation at 10m depth[3]	PW-SE(10m)	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	1	1	0	1	0	0	0
	Support works at surface level[3]	PW-GS(S)	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	1	0	0
	Support works at 5m depth[3]	PW-GS(5m)	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	1	0	0	0
	Support works at 10m depth[3]	PW-GS(10m)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	1	0	0	1	0	0	0
Pyrmont East	Class-B hoarding erection	PE-SE(B)	3	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	2	1	0	0	0	0	1	0
	Demolition - above hoarding	PE-DE(AH)	6	6	0	0	1	0	0	0	0	1	0	0	2	0	2	0	0	0	0	0	2	2	2	0	3	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)
	Demolition - below hoarding	PE-DE(BH)	4	6	0	0	1	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	2	2	2	0	2	0	0	0
	Dismantle Class-B; erect Class-A hoarding	PE-SE(A)	7	5	0	0	1	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	3	1	2	0	3	0	0	0
	Preliminary earthworks and piling pad	PE-PE	5	5	0	0	1	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	2	1	2	0	2	0	0	0
	Piling and capping beams	PE-PC	3	3	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	1	2	1	0	0	0	0	0
	Platform and acoustic shed erection	PE-PAS	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0
	Shaft excavation at surface level[3]	PE-SE(S)	7	5	0	0	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	3	2	2	0	2	0	0	0
	Shaft excavation at 5m depth[3]	PE-SE(5m)	7	4	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	1	2	2	0	2	0	0	0
	Shaft excavation at 10m depth[3]	PE-SE(10m)	8	3	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	1	2	2	0	2	0	0	0
	Support works at surface level[3]	PE-GS(S)	3	2	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	1	3	0	0	0	0	0	0
	Support worksat 5m depth[3]	PE-GS(5m)	4	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	3	0	0	0	0	0	0
	Support works at 10m depth[3]	PE-GS(10m)	4	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	3	0	0	0	0	0	0
Site wide	Shaft excavation and support works within the acoustic shed	SW-SE	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	0	0	0	0	1	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.

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 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. 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.

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 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.

Mitigation and management measures to reduce construction noise levels towards 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.

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 criteria. Where feasible all circular saw operation should be completed before 10pm and if required after 10pm no circular sawing after 12am.

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

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:

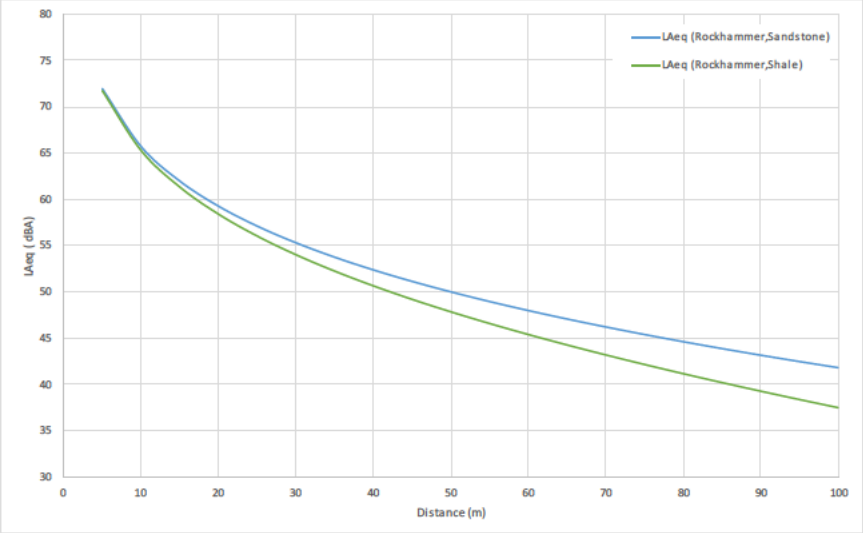
- the position of equipment within the shaft and distance to the receiver;
- the excavation activity being undertaken/ plant items and equipment in use;
- construction methodology.

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 10 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 rockbreaker 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. A 3 dB(A) engineering margin has been applied to all GBN level predictions. **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	Temporary shaft - Rockbreaker excavation - 10 m deep	21	5	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Temporary shaft - Rockbreaker excavation - 20 m deep	25	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Temporary shaft - Rockbreaker excavation - 30 m deep	22	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
Pyrmont East	Temporary shaft - Rockbreaker excavation - 5 m deep	6	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Temporary shaft - Rockbreaker excavation - 10 m deep	6	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Temporary shaft - Rockbreaker excavation - 20 m deep	5	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Temporary shaft - Rockbreaker excavation - 30 m deep	4	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 - Rockbreaker excavation - 10 m deep	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2
	Temporary shaft - Rockbreaker excavation - 20 m deep	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1
	West temporary shaft - Rockbreaker excavation - 30 m deep	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0
Pyrmont East	Temporary shaft - Rockbreaker excavation - 5 m deep	6	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	2	0
	Temporary shaft - Rockbreaker excavation - 10 m deep	6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0
	Temporary shaft - Rockbreaker excavation - 20 m deep	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0
	Temporary shaft - Rockbreaker excavation - 30 m deep	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	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.

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.

There are five (5) residential receivers to the north of the Pyrmont West worksite will experience ground-borne noise levels 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)). 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.

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.

6.2.1 Out of hours work

Temporary shaft excavation works 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
Temporary shaft excavation/ Permanent shaft excavation	Shaft excavation	Excavator 35T (Hammer; Saw attachment; Cutter attachment)
	Spoil Handling	Nil
	Support works	Drill Rig (percussive)
Mined tunnel support (surface)	Tunnel excavation & support; spoil handling and tunnel lining	Nil on surface; tunnelling assessed in Tunnelling DNVIS
Demobilisation	...	
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	Excavator 35T (Hammer; Saw attachment; Cutter attachment)
	Spoil Handling	Nil
	Support works	Drill Rig (percussive)
Mined tunnel support (surface)	Tunnel excavation & support; spoil handling and tunnel lining	Nil on surface; tunnelling assessed in Tunnelling DNVIS
Demobilisation	...	

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)	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
Unreinforced or light framed structures[1, 2]	5	5	5	5	5	5	5	10	5	10
Structurally unsound heritage structures[1, 2]	5	5	5	5	5	10	15	20	15	20
Disturbance to building occupants										
Critical areas[4,7]	25	40	40	20	20	30	40	65	105	120
Residences – Day	15	25	25	10	15	20	25	45	55	70
Residences – Night	-	-	-	-	-	-	-	-	-	-
Offices[6,7]	10	15	15	5	10	15	20	30	30	40
Workshops[7]	5	10	10	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)	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
Unreinforced or light framed structures[1, 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
Disturbance to building occupants									
Critical areas[2,7]	0	0	0	0	0	0	0	0	0
Residences – Day	11	19	4	11	15	18	28	31	44
Residences – Night	0	1	1	1	1	3	4	9	6
Offices[4,7]	0	0	0	0	0	0	0	0	0
Workshops[7]	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
Unreinforced or light framed structures[1, 2]	0	0	0	0	0	0	0	0	0
Structurally unsound heritage structures[1, 2]	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
Residences – Day	0	4	0	0	2	4	5	8	11
Residences – Night	0	0	0	0	0	3	5	6	5
Offices[4,7]	0	0	0	0	0	0	1	1	1
Workshops[7]	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.

Where a building condition report on this building finds it to be 'structurally unsound', vibration monitoring and review of construction methodology would be undertaken as outlined in Section 7.2.1.

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).

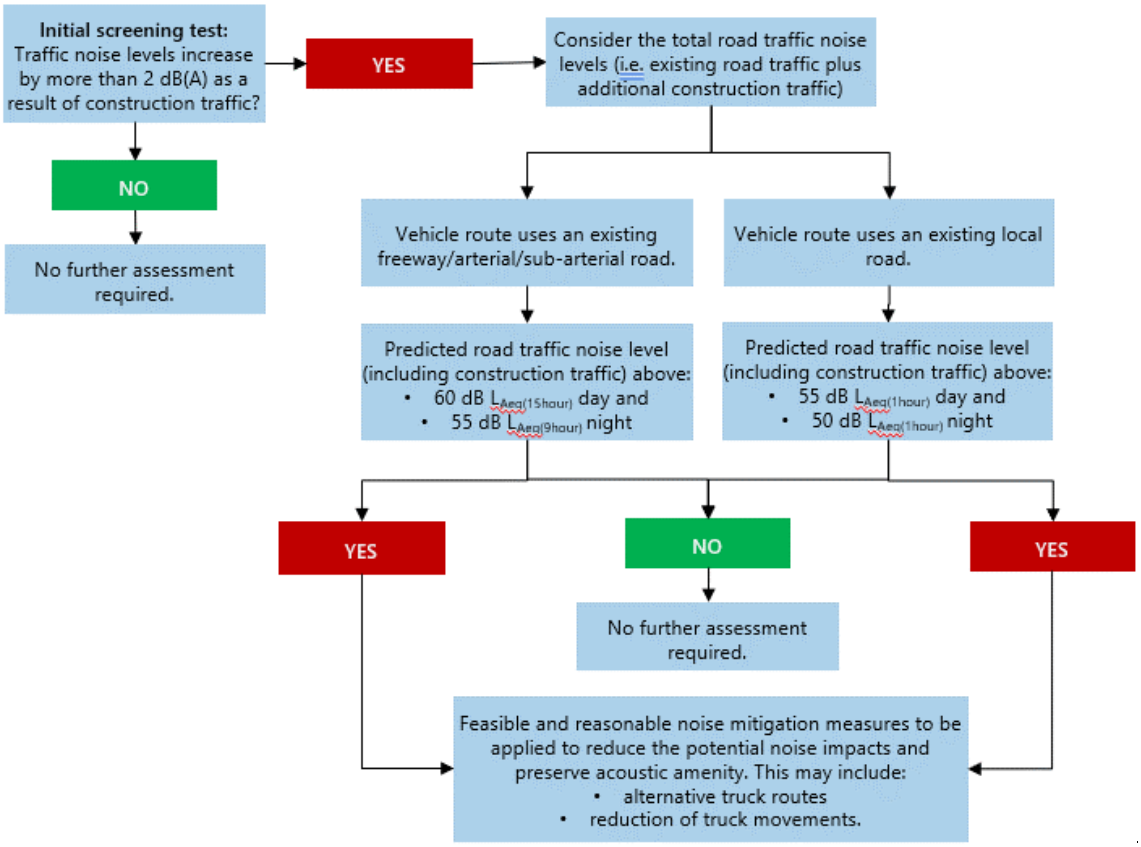
After applying all feasible and reasonable vibration mitigation measures, if vibration monitoring still identifies that measured vibration levels are above the relevant vibration criteria for human annoyance, appropriate additional management measures should be considered (see Section 9).

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
	Temporary Shaft excavation	150	240	-	60
East	Site establishment and demolition	90	240	-	20
	Acoustic shed construction	60	240	4	20
	Temporary Shaft excavation	110	240	-	20

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 may be some heavy vehicles up to 10 pm of OOHW is triggered (e.g. concrete deliveries for the acoustic shed construction where this is required to be completed under ROL) and typically no heavy vehicles after 10 pm, except for oversized deliveries or where OOHW is triggered by say 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.). During the construction stages assessed in this DNVIS heavy vehicles during the evening period (6:00 pm to 10:00 pm) are likely to be less than 4 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.

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.	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.	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.	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.
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 coring or alternative methods to reduce vibration transmission 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.
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.	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.
Non-tonal reversing alarms	Alternative reverse alarms, such as 'quackers' will be installed on all vehicles & mobile plant regularly used on site and on all vehicles & mobile plant required for OOHW.	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.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
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							
Acoustic shed	An existing acoustic shed 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 next issue of this report.
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.	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.
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.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
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.
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.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
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.
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.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
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.
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.						

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

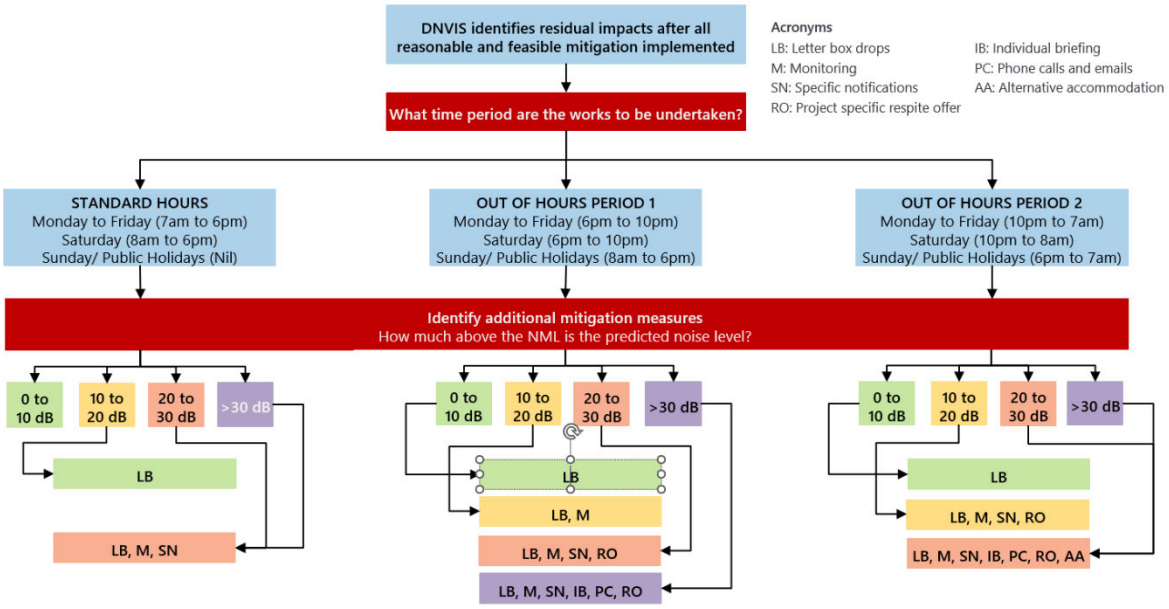


Figure 9.1 presents a summary of the additional management measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, construction noise levels are still above the NMLs.

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

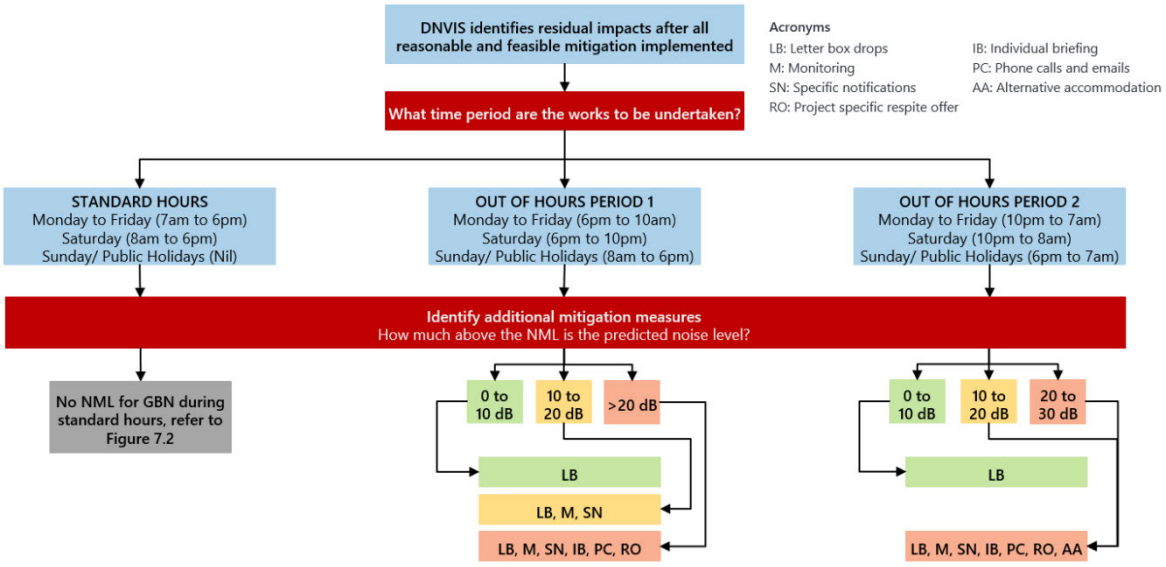


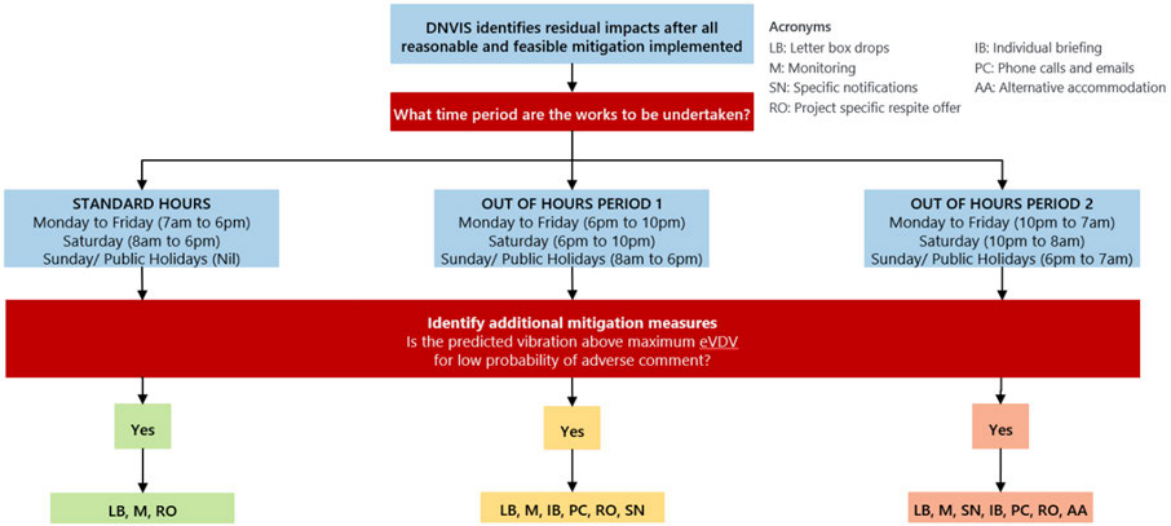
Figure 9.2 presents a summary of the additional ground-borne noise management measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, ground-borne noise levels are still above the NMLs.

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 Indicative condition.

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 Indicative 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 indicative 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	NCA04	PYR-W - E 333070; N 6250750*
Fixed, real-time	NCA04	PYR-E - E 333130; N 6250790*
Attended	NCA04	127 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 (HOTEL)	SEBEL HOTEL, 104 PYRMONT STREET PYRMONT
Attended	OSR (COMMERCIAL)	60 UNION STREET, PYRMONT
Attended	OSR (STUDIO)	198 HARRIS STREET PYRMONT
Attended	OSR (STUDIO)	102 PYRMONT 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 monitoring locations

Activity	NCA/ Receiver type	Address	Nominated location
West shaft excavation	NCA04	127 PYRMONT STREET PYRMONT	Internal, within ground floor rooms situated away from Pyrmont Bridge Road
	NCA04	28 PATERNOSTER ROW PYRMONT	
	NCA04	53 PATERNOSTER ROW PYRMONT	
	OSR (HOTEL)	SEBEL HOTEL, 104 PYRMONT STREET PYRMONT	
	OSR (STUDIO)	102 PYRMONT STREET PYRMONT	Within lowest floor level studio facing worksite
	OSR (STUDIO)	198 HARRIS STREET PYRMONT	
East shaft excavation	NCA04	63 EDWARD STREET PYRMONT	Internal, within ground floor rooms situated away from Pyrmont Bridge Road
	NCA04	65-67 EDWARD STREET PYRMONT	
	OSR (HOTEL)	SEBEL HOTEL, 104 PYRMONT STREET PYRMONT	
Station and crossover caverns and adit excavation	TBC	TBC	TBC

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

Worksite	Purpose/ requirement for monitoring	Address	Vibration monitoring for:	
			Cosmetic damage[1]	Human annoyance[2]
Pyrmont West	Project duration (fixed, real-time vibration, unattended monitor)	E 333070; N 6250750*	√	√
Pyrmont East	Project duration (fixed, real-time vibration, unattended monitor)	E 333130; N 6250790*	√	√
Pyrmont West	When plant listed are within MWD: 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	√	√
	When plant listed are within MWD: 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	When plant listed are within MWD: Excavator 49T (hammer); Roller <16T padfoot (vibratory mode)	63 Edward Street, Pyrmont/ 35 Union Street, Pyrmont	√[3]	√

Note: * To be confirmed 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

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 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 are 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 is short term in nature and 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 indicative condition allocations for the Project and the EIS.

Construction airborne noise

During Stage 1 and 2 works (i.e. demolition and 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 western and eastern worksites. 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.

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.

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 Indicative condition.
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

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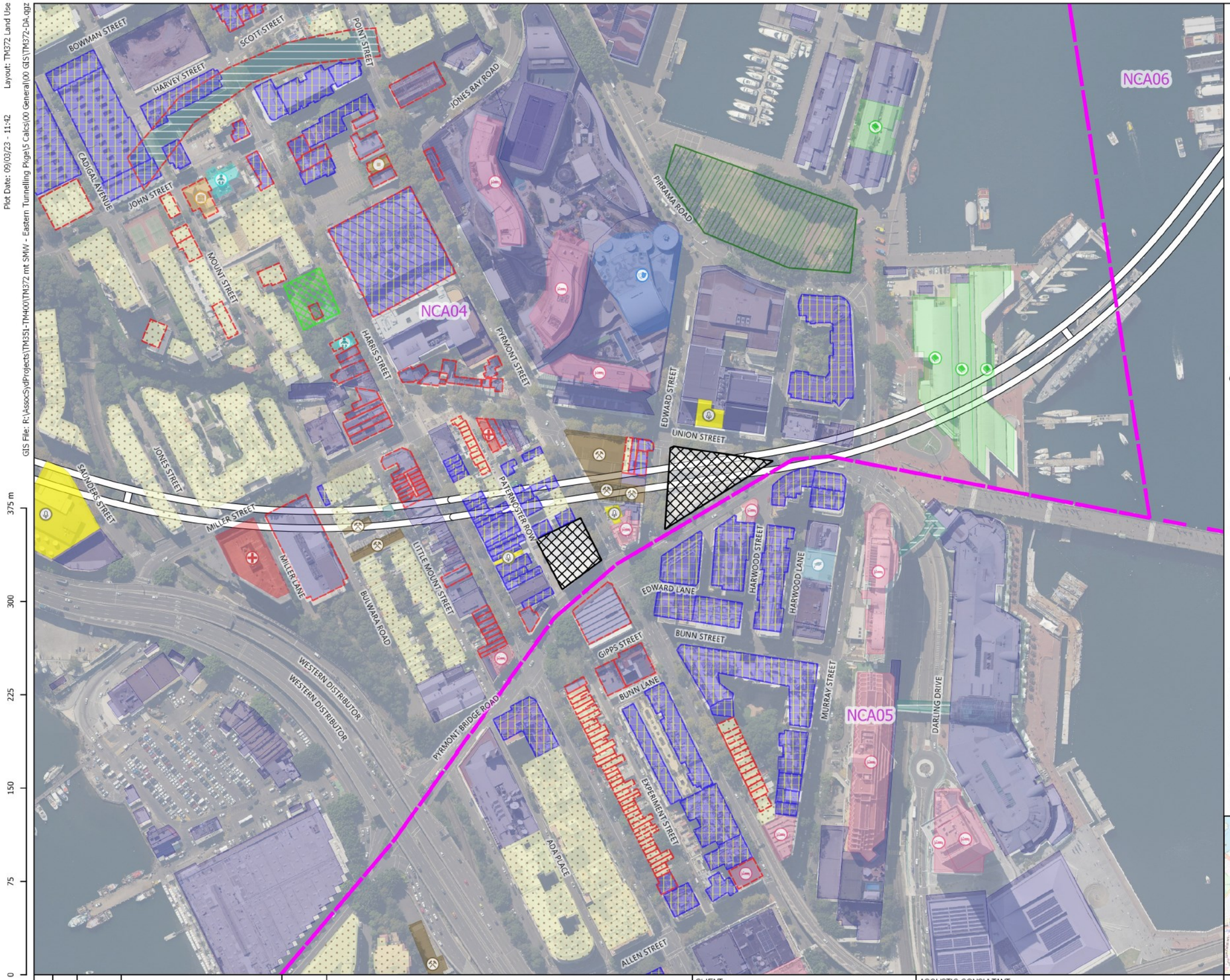

LEGEND

Noise Sensitive Receivers

- 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
- Horse Stable
- Recreational - Passive
- Recreational - Active
- Other
- Heritage

- NCAs
- Tunnel alignment
- Project Worksites

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 7 pm to 10 pm Monday to Sundy - OOHW P1
N: Night-time period from 10 pm to 7am Monday to Friday, from 10 pm to 8 am Saturday, Sunday and Public holidays - OOHW P1

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r0	DA	09/03/23 07/12/22	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

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1:3,000
FULL SIZE A3
NOTE: Do not scale from this drawing.

CLIENT
SYDNEY METRO WEST
JOHN HOLLAND CPB CONTRACTORS Ghella

ACOUSTIC CONSULTANT
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SYDNEY METRO WEST - EASTERN TUNNELLING PACKAGE
Pyrmont Site

Land Use, Worksites and NCAs

Sheet of

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**

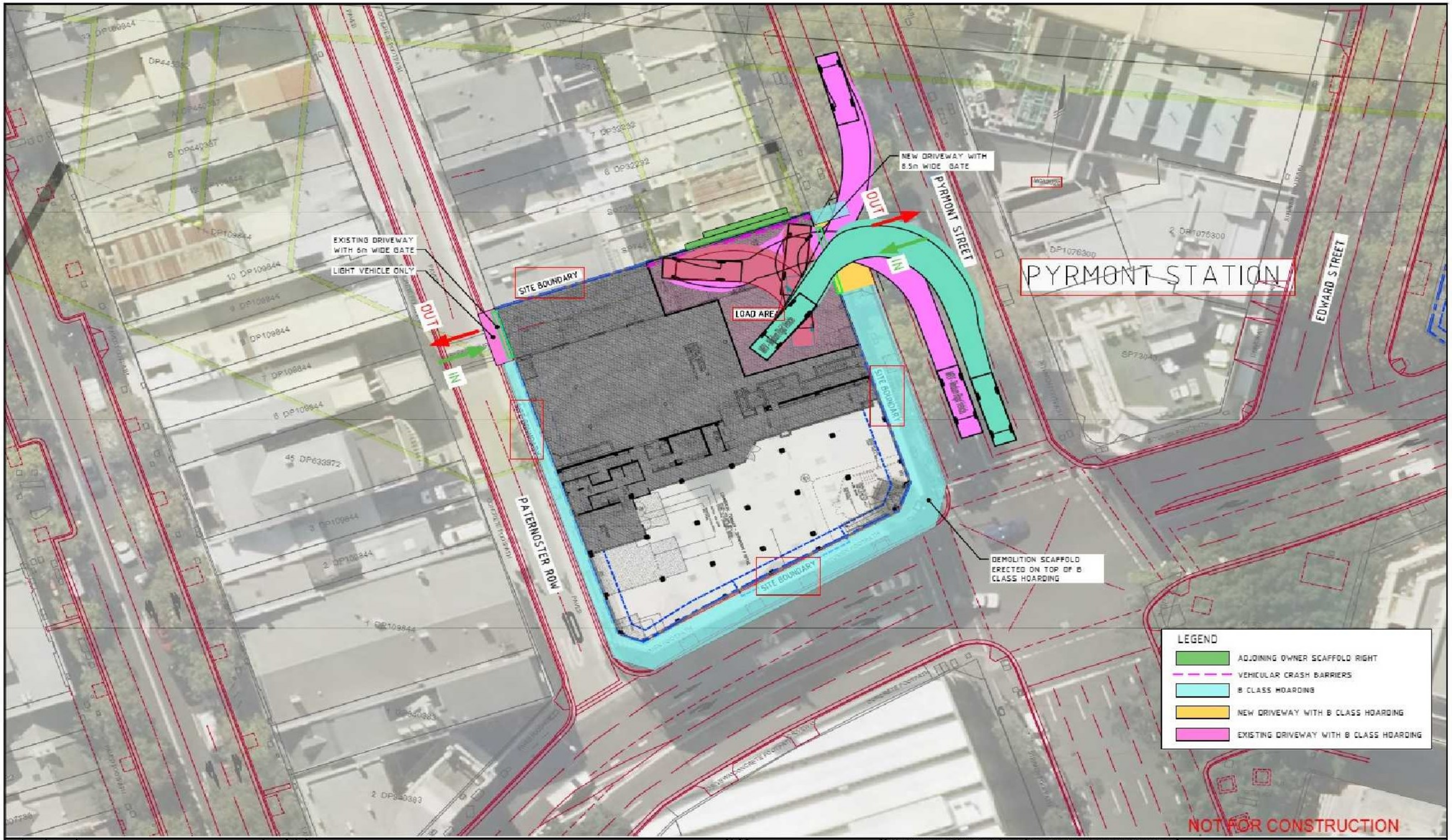
Activity/ Work Area	Aspect	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity		Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
			7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	Duration	L_{Aeq}	Penalty	L_{Amax}			
WEST WORKSITE													
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	-	-	
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	-	-	Apr-23	20 weeks	106	-	111	-	-	(Rigid Body, 10 Wheeler)
		Dust Suppression Fan	2	-	-	Apr-23	20 weeks	99	-	102	-	-	
	Assessment ref: **PW-DE(AH)**	Skid Steer 3T	3	-	-	Apr-23	8 Weeks	102	-	107	-	-	
	[Demolition above hoarding]	Excavator 5T (Bucket, Grabs)	3	-	-	Apr-23	8 Weeks	101	-	114	-	-	
		Excavator 13T (Bucket, Grabs and Shears)	1	-	-	Apr-23	12 weeks	103	-	108	-	-	
	Assessment ref: **PW-DE(BH)**	Excavator 13T (Hammer)	1	-	-	Apr-23	4 Weeks	118	5	123	HN	X	
	[Demolition below hoarding]	Oxy Acetylene	2	-	-	Apr-23	20 weeks	96	-	107	-	-	
		Mobile Crane 40T	-	1	-	Apr-23	2 weeks	104	-	108	-	-	OOHW required where ROL prohibits lane closure during standard construction hours
		EWP / Scissor Lift	2	-	-	Apr-23	4 Weeks	95	-	98	-	-	
		Dust Suppression Fan	2	-	-	Jun-23	8 Weeks	99	-	102	-	-	
		Excavator 49T (Bucket, Grabs and Shears)	1	-	-	Jun-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	Aug-23	2 weeks	99	-	103	-	-	A-class hoarding installed post demolition
		EWP / Scissor Lift	2	2	2	Aug-23	2 weeks	95	-	98	-	-	Install from August 2023
		Circular Saw (petrol)	3	3	3	Aug-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	Aug-23	2 weeks	106	-	109	-	-	
		Rattle Gun	3	3	3	Aug-23	2 weeks	90	-	105	-	-	
		Hiab Truck	2	2	2	Aug-23	2 weeks	95	-	98	-	-	
	Prelim Earthworks and Piling Pad Construction	Excavator 35T w hammer	2	-	-	Aug-23	2weeks	118	5	126	HN	X	Levelling site and piling pad; stripping and loading of subgrade
		Excavator 30T w bucket	2	-	-	Aug-23	2weeks	103	-	108	-	-	Spread and place fill for piling pad
	Assessment ref: **PW-PE**	Vibratory Roller 16T (Smoothdrum)	2	-	-	Aug-23	2weeks	108	5	113	HN	X	
		Vibratory Roller 16T (Padfoot)	2	-	-	Aug-23	2weeks	108	5	113	HN	X	
		Truck (spoil haulage)	2 p.h.	-	-	Aug-23	2weeks	106	-	111	-	-	Import / export material
		Moxy 20T	2	-	-	Aug-23	2weeks	109	-	119	-	-	Cart to/from stockpile
Acoustic shec construction	Piling and capping beams for acoustic shed footings and initial shoring	Piling Rig (Bauer BG36)	1	-	-	Aug-23	1 week	107	-	116	-	X	
		Excavator 20T	1	1	1	Aug-23	8 weeks	103	-	108	-	-	
		Shotcrete rig	1	1	1	Aug-23	8 weeks	104	-	107	-	-	
		Concrete pump	1	1	1	Aug-23	8 weeks	103	-	107	-	-	Capping beam on Pyrmont Bridge Road and Pyrmont Street will require OOHW due to ROL
	Assessment ref: **PW-PC**	Concrete agitator	4	4	4	Aug-23	8 weeks	108	-	111	-	-	Capping beam on Pyrmont Bridge Road and Pyrmont Street will require OOHW due to ROL
		Compressor	2	2	2	Aug-23	6 weeks	102	-	103	-	-	Capping beam on Pyrmont Bridge Road and Pyrmont Street will require OOHW due to ROL
		Crawler Crane 100t	1	-	-	Aug-23	6 weeks	104	-	108	-	-	
		Delivery truck	1	-	-	Aug-23	6 weeks	106	-	111	-	-	
		Power hand tools	1	-	-	Aug-23	6 weeks	108	-	118	-	-	
		Jackhammer	1	-	-	Aug-23	6 weeks	111	5	121	HN	X	
	Platform and acoustic shed (west) constructior	Mobile Crane 100T	1	1	1	Nov-23	18 weeks	104	-	108	-	-	
		Franna Crane	1	1	1	Nov-23	18 weeks	98	-	102	-	-	
	Assessment ref: **PW-PAS**	Delivery Trucks	4 p.h.	4 p.h.	4 p.h.*	Nov-23	18 weeks	106	-	111	-	-	Oversized deliveries OOH
		EWF	-	-	-	Nov-23	18 weeks	95	-	98	-	-	
Temporary Shaft Excavation	Shaft excavation	Power hand tools	1	-	-	Apr-24	12 weeks	108	-	118	-	-	
	Assessment ref: **PW-SE(S)**;	Generator	1	-	-	Apr-24	12 weeks	94	-	95	-	-	
	PW-SE(5m); **PW-SE(10m)**	Water pump (diaphragm pump)	1	-	-	Apr-24	12 weeks	106	-	109	-	-	
	[Shaft excavation at surface; 5m	Excavator 35T (rockhammer)	3	-	-	Apr-24	12 weeks	118	5	126	HN	X	
	deep; and 10m deep, inc spoil	Excavator with saw attachment	1	-	-	Apr-24	12 weeks	121	5	129	HN	X	
	handling]	Excavator with cutter attachment	-	-	-	Apr-24	12 weeks	121	5	129	HN	X	
	SW-SE [Site wide shaft excavation	Site Forklift	1	-	-	Apr-24	12 weeks	99	-	103	-	-	
	in acoustic shed.]	Compressor	1	-	-	Apr-24	12 weeks	102	-	103	-	-	
	Spoil Handling	Truck (spoil haulage)	4-6 p.h	-	-	Apr-24	12 weeks	106	-	111	-	-	
		Excavator 30T w bucket	1	-		Apr-24	12 weeks	103	-	108	-	-	
		Mobile Crane 100T	1	-	-	Apr-24	12 weeks	104	-	108	-	-	

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}			
	Support works (concreting) Assessment ref: **PW-GS(5)**; **PW-GS(5m)**; **PW-GS(10m)** [Ground support at surface; 5m deep; and 10m deep]	Drill Rig (percurssion)	1	-	-	Apr-24	12 weeks	114	-	118	HN	X	
		Power hand tools	4	-	-	Apr-24	12 weeks	108	-	118	-	-	
		Concrete truck	4 p.h.	-	-	Apr-24	12 weeks	108	-	111	-	-	6-10pm only if we can't finish the concrete pour in time
		Concrete pump	1	-	-	Apr-24	12 weeks	103	-	107	-	-	6-10pm only if we can't finish the concrete pour in time
		Shotcrete rig	1	-	-	Apr-24	12 weeks	104	-	107	-	-	6-10pm only if we can't finish the concrete pour in time
		Welding equipment	1	-	-	Apr-24	12 weeks	96	-	107	-	-	
Permanent Shaft Excavation	Shaft excavation	Power hand tools	1	-	-	Apr-24	12 weeks	108	-	118	-	-	*Permanent Shaft excavation happening concurrently with Mined Tunnel excavation and lining.*
		Generator	1	-	-	Apr-24	12 weeks	94	-	95	-	-	*Shed installation complete*
		Water pump (diaphragm pump)	1	-	-	Apr-24	12 weeks	106	-	109	-	-	
		Excavator 35T (rockhammer)	3	-	-	Apr-24	12 weeks	118	5	126	HN	X	
		Excavator with saw attachment	1	-	-	Apr-24	12 weeks	121	5	129	HN	X	
		Excavator with cutter attachment	-	-	-	Apr-24	12 weeks	121	5	129	HN	X	
		Site Forklift	1	-	-	Apr-24	12 weeks	99	-	103	-	-	
		Compressor	1	-	-	Apr-24	12 weeks	102	-	103	-	-	
	Spoil Handling	Truck (spoil haulage)	4-6 p.h	4-6 p.h	-	Apr-24	12 weeks	106	-	111	-	-	
		FE Loader (CAT980)	1	-	-	Apr-24	12 weeks	110	-	115	-	-	
	Support works (concreting)	Drill Rig (percurssion)	1	1	-	Apr-24	12 weeks	114	-	118	HN	X	
		Power hand tools	4 p.h.	4 p.h.	-	Apr-24	12 weeks	108	-	118	-	-	
		Concrete truck	4 p.h.	4 p.h.	-	Apr-24	12 weeks	108	-	111	-	-	
		Concrete pump	1	1	-	Apr-24	12 weeks	103	-	107	-	-	
		Shotcrete rig	1	2	-	Apr-24	12 weeks	104	-	107	-	-	
		Welding equipment	1	1	-	Apr-24	12 weeks	96	-	107	-	-	
Mined tunnel excavation	Adit excavation & support	Road Header 1,000V Electric	1	1	1		8 weeks	104	-	108	-	-	Adits
		Bolting rig Robodrill 525	1	1	1		8 weeks	106	-	116	-	X	Adits
		Shotcrete rig (Potenza)	1	1	1		8 weeks	104	-	107	-	-	Adits
		Concrete site agitator	2	2	2		8 weeks	108	-	111	-	-	Shaft / Adits
		Concrete road agitator	2 p.h	2 p.h	2 p.h (TBC)		8 weeks	108	-	111	-	-	Inside shed
		Skid steer	1	1	1		8 weeks	109	-	113	-	X	Adits
		Excavator 8t w hammer	1	-	-		8 weeks	118	5	123	HN	X	Adits
		Excavator 25t w bucket	1	1	0		8 weeks	103	-	108	-	-	Adits
		Dust Scrubber with silencer	1	1	1		8 weeks	104	-	107	-	-	Shaft from commencement - to be acoustically treated
		Ventilation fan with silencer	2	2	2		8 weeks	98	-	102	-	-	Inside shed - to be acoustically treatec
	Spoil Handling	Dump truck (Moxy CAT 725)	1	1	1		8 weeks	109	-	119	-	-	Adit / temp shaft
		Truck (spoil haulage)	7-9 p.h.	7-9 p.h.	-		8 weeks	106	-	111	-	-	Inside shed
	Tunnel Lining (concreting)	Concrete pump	2	-	-		6 weeks	103	-	107	-	-	Adit - form pumps
		Compressor	1	-	-		6 weeks	102	-	103	-	-	On form for vibrators
		Genset	1	-	-		6 weeks	94	-	95	-	-	2 / 3 days usage for form power
		Ventilation fan with silencer	2	2	2		6 weeks	98	-	102	-	-	Same fans from excavation
		Pneumatic vibrator	40	-	-		6 weeks	97	-	100	-	-	During crown concrete pours - every 2-3 days, significantly less during invert and kicker works
		Concrete road agitator	5 p.h	-	-		6 weeks	108	-	111	-	-	Inside shed during concrete pours - every 2-3 days
		Concrete site agitator	5	-	-		6 weeks	108	-	111	-	-	Adits
		Telehandler	1	-	-		6 weeks	98	-	102	-	-	Adits
		Gantry Crane	1	1	1		8 weeks	106	-	110	-	-	Inside shed

Figure C1-1: Site Layout and Hoardings

PYRMONT STATION - WEST WOKSITE



REV.	BY	DATE	DESCRIPTION	APPD.
C	JF	06/05/25	SWEPT PATHS REVISED	S.D.
B	JF	10/01/23	ISSUED FOR INFORMATION	S.D.
A	JF	21/12/22	ISSUED FOR INFORMATION	S.D.

A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: GDA2020 | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing | ALT. DRG No.

SCALES: SCALE 1:200 AT A1 SIZE

CLIENT: NSW GOVERNMENT | sydney METRO

SERVICE PROVIDERS: JOHN HOLLAND | CPB | Ghella

DRAWN: JFAN | DESIGNED: Y.FONG | DRG CHECK: Y.FONG | DESIGN CHECK: S.NAYTON | APPROVED: S.DONYOR

SYDNEY METRO WEST - EASTERN TUNNELING PACKAGE
PYRMONT STATION
SHAFT EXCAVATION
WEST SHAFT SITE LAYOUT - STAGE 1
DEMOLITION

STATUS: WORK IN PROGRESS | SHEET 1 OF 1 | DRG No. SMWSTETP-JCG-PYR-SN150-CV-DRG-045100 | REV. C

Figure C1-2: Site Layout and Hoardings

PYRMONT STATION - WEST WOKSITE

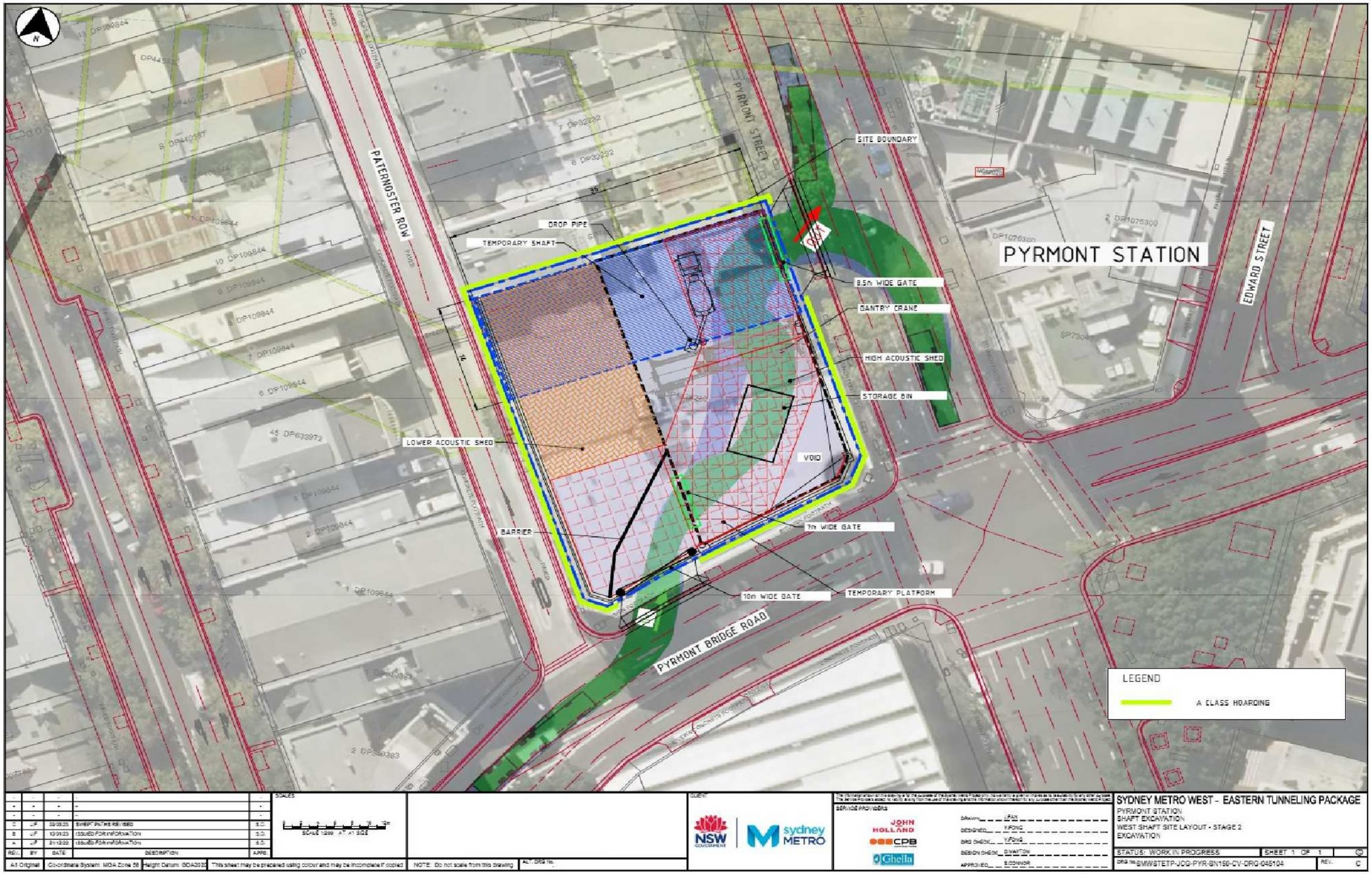


Table C1-2: Construction timetable/ activities/ equipment **PYRMONT STATION - EAST WORKSITE**

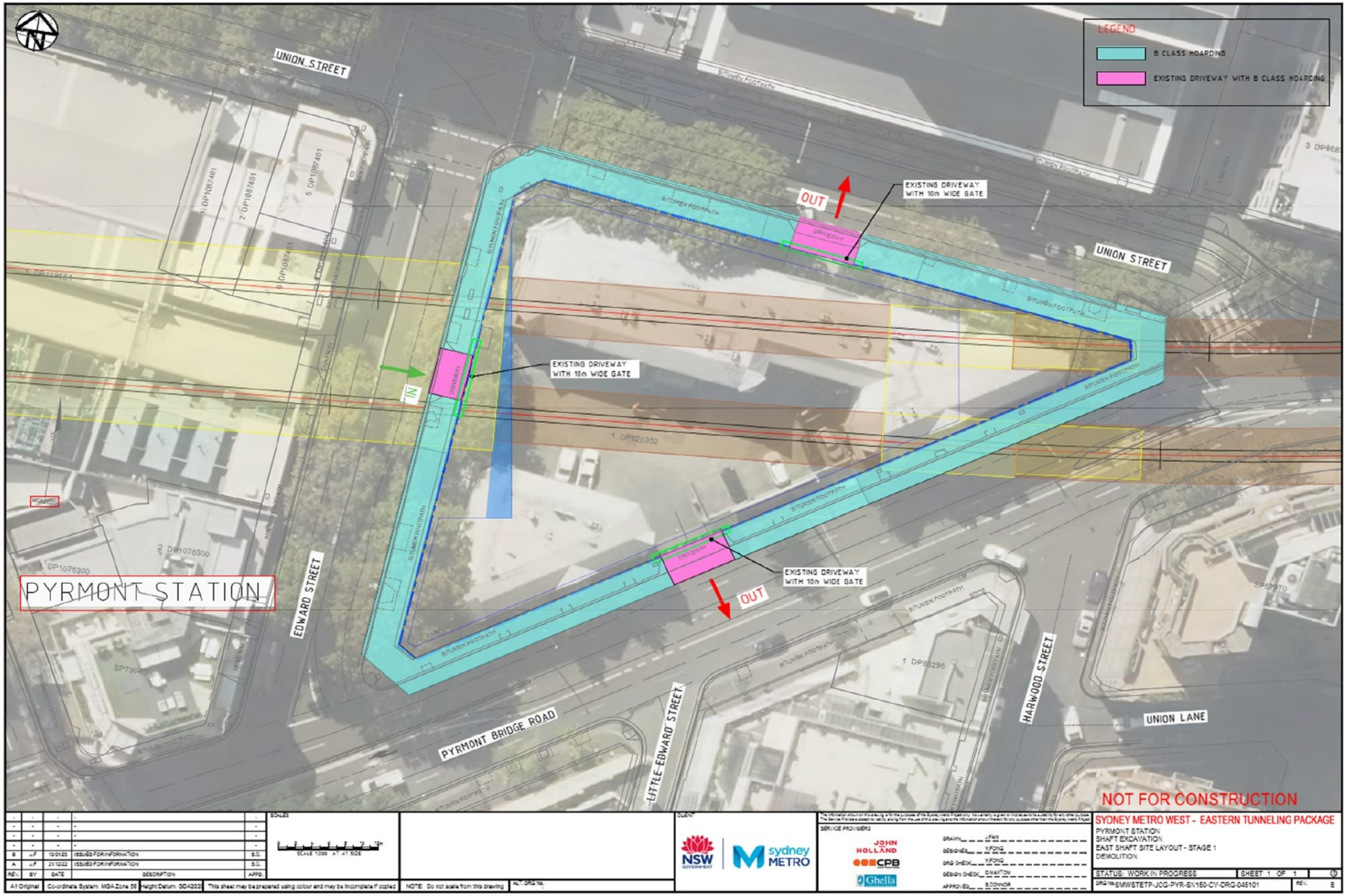
Activity/ Work Area	Aspect	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity		Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
			7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	Duration	L_{Aeq}	Penalty	L_{Amax}			
EAST WORKSITE													
Compound	Deliveries; Maintenance; Office areas; Storage areas; Car parking	Delivery truck	4 per hour	-	-	Aug-23	100 weeks	106	-	111	-	-	
		Light vehicle	30 in/ out	20 in/ out	20 in/ out	Aug-23	100 weeks	89	-	100	-	-	
		Water Treatment Plant pump	2	2	2	Aug-23	100 weeks	99	-	101	-	-	
		Compressor	2	-	-	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	-	-	
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.	-	-	May-23	12 weeks	106	-	111	-	-	(Rigid Body, 10 Wheeler)
		Skid Steer 3T	2	-	-	May-23	12 weeks	102	-	107	-	-	
	Assessment ref: **PE-DE(AH)**	Excavator 5T (Bucket, Grabs)	2	-	-	May-23	12 weeks	101	-	114	-	-	
	[Demolition above hoarding]	EWP / Scissor Lift	2	-	-	May-23	1 week	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	-	-	Jul-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 w hammer	2	-	-	Aug-23	4 weeks	118	5	126	HN	X	Levelling site and piling pad; stripping and loading of subgrade
		Excavator 30T w bucket	2	-	-	Aug-23	4 weeks	103	-	108	-	-	Spread and place fill for piling pad
		Vibratory Roller 16T (Smoothdrum)	2	-	-	Aug-23	4 weeks	108	5	113	HN	X	
	Assessment ref: **PE-PE**	Vibratory Roller 16T (Padfoot)	2	-	-	Aug-23	4 weeks	108	5	113	HN	X	
		Truck (spoil haulage)	2 p.h.	-	-	Aug-23	4 weeks	106	-	111	-	-	Import / export material
		Moxy 20T	2	-	-	Aug-23	4 weeks	109	-	119	-	-	Cart to/from stockpile
Acoustic shec construction	Piling and capping beams	Piling Rig (Bauer BG36)	1	-	-	Aug-23	14 weeks	107	-	116	-	X	Assumes piling in series (temp east, then permanent west, then permanent east)
		Excavator 20T	1	-	-	Aug-23	14 weeks	103	-	108	-	-	
		Shotcrete rig	1	-	-	Aug-23	14 weeks	104	-	107	-	-	
	Assessment ref: **PE-PC**	Concrete pump	1	-	-	Aug-23	14 weeks	103	-	107	-	-	
		Concrete truck	4 p.h.	-	-	Aug-23	14 weeks	108	-	111	-	-	
		Compressor	2	-	-	Aug-23	14 weeks	102	-	103	-	-	
		Crawler Crane 100t	1	-	-	Aug-23	14 weeks	104	-	108	-	-	
		Delivery truck	1	-	-	Aug-23	14 weeks	106	-	111	-	-	
		Power hand tools	1	-	-	Aug-23	14 weeks	108	-	118	-	-	
		Jackhammer	1	-	-	Aug-23	14 weeks	111	5	121	HN	X	
	Platform and acoustic shed (east) construction	Mobile Crane 150T	1	1	1	Oct-23	20 weeks	104	-	108	-	-	Shed erection and temporary shaft happening concurrently
		Franna Crane	2	2	2	Oct-23	20 weeks	98	-	102	-	-	
		Delivery Trucks	4 p.h.	4 p.h.	1	Oct-23	20 weeks	106	-	111	-	-	Oversize deliveries will be required during nightshift.
	Assessment ref: **PE-PAS**	Impact wrench	4	-	-	Nov-23	21 weeks	107	-	118	-	-	
		Hand tools	4	-	-	Nov-23	21 weeks	105	-	118	-	-	
		EWP	2	-	-	Oct-23	20 weeks	95	-	98	-	-	
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(5)**;	Generator	1	-	-	Jan-24	12 weeks	94	-	95	-	-	
	PE-SE(5m); **PE-SE(10m)**	Water pump (diaphragm pump)	1	-	-	Jan-24	12 weeks	106	-	109	-	-	
	[Shaft excavation at surface; 5m	Excavator 35T (rockhammer)	3	-	-	Jan-24	12 weeks	118	5	126	HN	X	
	deep; and 10m deep, inc spoil	Excavator with saw attachment	1	-	-	Jan-24	12 weeks	121	5	129	HN	X	
	handling]	Excavator with cutter attachment	-	-	-	Jan-24	12 weeks	121	5	129	HN	X	
	SW-SE [Site wide shaft excavation	Site Forklift	1	-	-	Jan-24	12 weeks	99	-	103	-	-	
	in acoustic shed.]	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 w bucket	1	-		Jan-24	12 weeks	103	-	108	-	-	
		Mobile Crane 100T	1	-	-	Jan-24	12 weeks	104	-	108	-	-	
	Support works (concreting)	Drill Rig (percurssion)	1	-	-	Jan-24	12 weeks	108	-	118	-	-	
	Assessment ref: **PE-GS(5)**;	Power hand tools	4	-	-	Jan-24	12 weeks	108	-	111	-	-	
	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

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}			
Mined tunnel excavation	Cavern excavation & support	Road Header 1,000V Electric	2	2	2	Apr-24	16 weeks	104	-	108	-	-	
		Bolting rig Robodrill 525	1	1	1	Apr-24	16 weeks	106	-	116	-	X	Adits
		Shotcrete rig (Potenza)	1	1	1	Apr-24	16 weeks	104	-	107	-	-	Adits
		Concrete site agitator	2	2	2	Apr-24	16 weeks	108	-	111	-	-	Adits
		Concrete road agitator	2 p.h	2 p.h	2 p.h	Apr-24	16 weeks	108	-	111	-	-	Shaft / Adits
		Skid steer	1	1	1	Apr-24	16 weeks	109	-	113	-	-	Inside shed
		Excavator 25t w hammer	1	-	-	Apr-24	16 weeks	118	5	126	HN	X	Adits
		Excavator 8t w hammer	1	-	-	Apr-24	16 weeks	118	5	123	HN	X	Adits
		Dust Scrubber with silencer	2	2	2	Apr-24	16 weeks	104	-	107	-	-	Adits
	Spoil Handling	Ventilation fan with silencer	2	2	2	Apr-24	16 weeks	98	-	102	-	-	Shaft from commencement - to be acoustically treated
		Dump truck (Moxy CAT 725)	3	3	3	Apr-24	16 weeks	109	-	119	-	-	Inside shed - to be acoustically treatec
		Excavator 25t w bucket	1	1	1	Apr-24	16 weeks	103	-	108	-	-	Cavern / temp shaft
		Excavator 8t w bucket	1	1	1	Apr-24	16 weeks	103	-	108	-	-	Cavern
		Excavator 30T w bucket	1	1	1	Apr-24	16 weeks	103	-	108	-	-	Cavern
		Gantry Crane	2	2	2	Apr-24	16 weeks	106	-	110	-	-	Inside shed at bottom of shaft
		Truck (spoil haulage)	8-9 p.h.	8-9 p.h.	-	Apr-24	16 weeks	106	-	111	-	-	Inside shed
	Tunnel Lining (concreting)	Concrete pump	2			Oct-24	8 months	103	-	107	-	-	Inside shed
		Compressor	1			Oct-24	8 months	102	-	103	-	-	Adit - form pumps
		Genset	1			Oct-24	8 months	94	-	95	-	-	On form for vibrators
		Ventilation fan with silencer	2	2	2	Oct-24	8 months	98	-	102	-	-	2 / 3 days usage for form power
		pneumatic vibrator	40			Oct-24	8 months	97	-	100	-	-	Same fans from excavation
		Concrete road agitator	6 p.h			Oct-24	8 months	108	-	111	-	-	During crown concrete pours - every 2-3 days, significantly less during invert and kicker works
		Concrete site agitator	5			Oct-24	8 months	108	-	111	-	-	Inside shed during concrete pours - every 2-3 days
		Telehandler	1			Oct-24	8 months	98	-	102	-	-	
Permanent Shaft Excavation	Shaft excavation	Power hand tools	1	-	-	Apr-24	12 weeks	108	-	118	-	-	*Permanent Shaft excavation happening concurrently with Mined Tunnel excavation and lining*
		Generator	1	-	-	Apr-24	12 weeks	94	-	95	-	-	*Shed installation complete*
		Water pump (diaphragm pump)	1	-	-	Apr-24	12 weeks	106	-	109	-	-	
		Excavator 35T (rockhammer)	3	-	-	Apr-24	12 weeks	118	5	126	HN	X	
		Excavator with saw attachment	1	-	-	Apr-24	12 weeks	121	5	129	HN	X	
		Excavator with cutter attachment	-	-	-	Apr-24	12 weeks	121	5	129	HN	X	
		Site Forklift	1	-	-	Apr-24	12 weeks	99	-	103	-	-	
		Compressor	1	-	-	Apr-24	12 weeks	102	-	103	-	-	
	Spoil Handling	Bogie (spoil haulage)	4-6 p.h	4-6 p.h	-	Apr-24	12 weeks	106	-	111	-	-	
	Support works (concreting)	Drill Rig (percurssion)	1	1	-	Apr-24	12 weeks	114	-	118	HN	X	
		Power hand tools	4 p.h.	4 p.h.	-	Apr-24	12 weeks	108	-	118	-	-	
		Concrete truck	4 p.h.	4 p.h.	-	Apr-24	12 weeks	108	-	111	-	-	
		Concrete pump	1	1	-	Apr-24	12 weeks	103	-	107	-	-	
		Shotcrete rig	1	2	-	Apr-24	12 weeks	104	-	107	-	-	
		Welding equipment	1	1	-	Apr-24	12 weeks	96	-	107	-	-	
		FE Loader (CAT980)	1	-	-	Apr-24	12 weeks	110	-	115	-	-	

Figure C1-1: Site Layout and Hoardings

PYRMONT STATION - EAST WORKSITE



REV.	BY	DATE	DESCRIPTION	APPD.
B	JF	10/01/25	ISSUED FOR INFORMATION	S.C.
A	JF	21/12/22	ISSUED FOR INFORMATION	S.C.

SCALES: SCALE 1:200 AT A1 SIZE

A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: SDA2020 | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing | ALT. DRG No.

CLIENT: NSW GOVERNMENT | sydney METRO

SERVICE PROVIDERS: JOHN HOLLAND | CPB | Ghella

DRAWN: J.FAN | DESIGNER: Y.FONG | DRG CHECK: Y.FONG | DESIGN CHECK: D.WATTON | APPROVED: S.CONNOR

SYDNEY METRO WEST - EASTERN TUNNELING PACKAGE
PYRMONT STATION
SHAFT EXCAVATION
EAST SHAFT SITE LAYOUT - STAGE 1
DEMOLITION

STATUS: WORK IN PROGRESS | SHEET 1 OF 1 | A1

DRG No: SMWSTETP-JCG-PYR-SN150-CV-DRG-045101 | REV: B

Figure C1-2: Site Layout and Hoardings

PYRMONT STATION - EAST WORKSITE

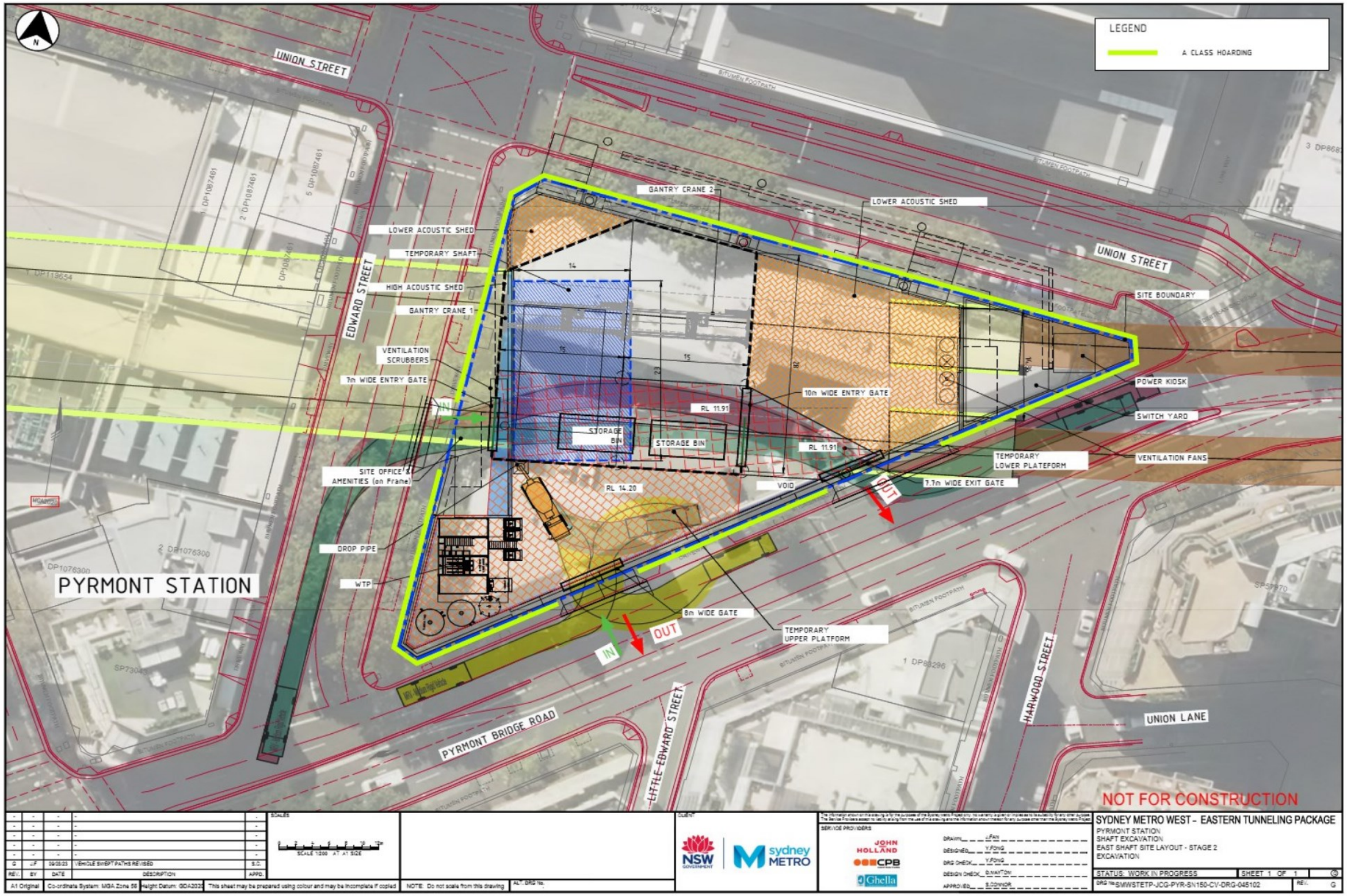


Table C1-3: Construction timetable (indicative)

Activity/ Work Area	Aspect	April 2023				May 2023					June 2023					July 2023				August 2023				September 2023				October 2023				November 2023				December 2023				January 2024				February 2024				March 2024				April 2024				May 2024				June 2024				July 2024				August 2024			
		3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25	1	8	15	22	29	6	13	20	27	4	11	18	25	1	8	15	22	29	5	12	19	26	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26
WEST WORKSITE																																																																											
Compound	Deliveries; Maintenance; Office areas; Storage areas; Car parking																																																																											
Site establishment	B-Class Hoarding/ Scaffold																																																																											
	Demolition																																																																																
	A-Class Hoarding construction																																																																															
	Prelim Earthworks and Piling Pad Construction																																																																																
Acoustic shed construction	Piling and capping beams																																																																																
	Platform and acoustic shed (west)																																																																																
Temporary Shaft Excavation	Shaft excavation																																																																															
	Spoil Handling																																																																																
	Support works																																																																															
Permanent Shaft Excavation	Shaft excavation																																																																															
	Spoil Handling																																																																																
	Tunnel Lining																																																																															
Mined tunnel excavation (Adits)	Adit excavation & support																																																																															
	Spoil Handling																																																																															
	Tunnel Lining																																																																															
EAST WORKSITE																																																																																
Compound	Deliveries; Maintenance; Office areas; Storage areas; Car parking																																																																															
Site establishment	B-Class Hoarding/ Scaffold																																																																															
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	Platform and acoustic shed (east)																																																																															
Temporary Shaft Excavation	Shaft excavation																																																																															
	Spoil Handling																																																																															
	Support works																																																																															
Mined tunnel excavation (Station Cavern)	Cavern excavation & support																																																																															
	Spoil Handling																																																																															
	Tunnel Lining																																																																															
Permanent Shaft Excavation	Shaft excavation																																																																															
	Spoil Handling																																																																															
	Support works																																																																															

C.2 Construction mitigation and management measures

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

Area to be Managed			Specific Mitigation/ Management Measure	Details
Airborne Noise				
1	**Temporary shaft excavation**			
1.1	Work during Standard Construction Hours	DAY:	Standard hours activities	see Table C1 for details
			Properties that are are to be GBN affected by more than 60 dB(A) (internal) will be consulted with to determine the objective of determining appropriate hours of respite so that construction noise (including ground-borne noise), does not exceed internal noise levels	see Table D.4 for details
1.2	Work outside Standard Construction Hours	D(O)/EVE/ NGT:	OOHW activities limited as noted below and in Table C1	see Table C1 for details
1.5	Ventilation Fan (TBC)		Ventilation fans with silencer + additional attenuation (duct lining/ inlet attenuator/ plenum room). Intake to be orientated away from receivers. To achieve maximum sound power level as per Table C5	see Table C5 for performance requirements
1.6	Water treatment plant		Additional enclosure subject to compliance testing	see Table C5 for performance requirements
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	**Mined tunnelling**			
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
Ground-borne Noise				
3	**Temporary shaft excavation**	(where airborne noise not significant, i.e. where works are inside shed, or where receivers have treated facade to reduce external noise transmission)		
3.1	GBN impacts from rockhammer excavation of shaft	DAY:	Properties that are are to be GBN affected by more than 60 dB(A) (internal) will be consulted with to determine the objective of determining appropriate hours of respite so that construction noise (including ground-borne noise), does not exceed internal noise levels Properties that are highly GBN affected (> 60 dB(A)) identified in APPENDIX G. Consultation regarding appropriate respite required to meet Condition D39.	See Table E.3 for details.
3.2	Respite periods	GBN affected senstive receivers require consultation to identify sensitive times where respite should be provided. Highly GBN affected may be eligible for project specific respite offer, subject to detailed design, programming and verification monitoring. Consider temporary relocation of 4 properties adjacent to western shaft due to GBN and vibration during western shaft excavation (127 Pyrmont Street, 28 Paternoster Row, 125 Pyrmont Street, 26 Paternoster Row)		
Vibration Assessment				
4	Temporary shaft excavation			
4.1	Structural damage			
		Reinforced or frame structures	Receivers within inimum working distance identified in APPENDIX F	
		Screening criteria - non-heritage, unreinforced structures	Receivers within inimum working distance identified in APPENDIX F	
		Screening criteria - heritage structures	Poteially impacted heritage items identified in APPENDIX F	
4.2	Human disturbance	DAY/EVE:		
		Human disturbance screening	Receivers above human disturbance screening limit for vibration intensive works identified in APPENDIX F	
4.4	Minimum working distances		Measurement of vibration on site from rockhammers and other vibration inducing equipment to establish site specific minimum working distances	
4.5	Alternative low vibration excavation techniques		The use of rock saws should be always considered whenever reasonable and feasible. Space constraints and ground conditions limit alternative methodology such as surface miners and bulldozers with rippers. However, when vibration measurements show exceedance of relevant vibration criteria, alternative low vibration plant are strongly recommended.	
4.6	Long-term monitoring		Long-term monitoring refer to DNVIS Section 9.6	
4.7	Dilapidation survey and structural engineering assessment	General	Consistent with the EIS, building dilapidation surveys would be required on all buildings located within the minimum working distances for cosmetic damage prior to commencement, and after completion.	see Table F.3
		Heritage items	Structural assessment of the heritage items around the site to identify more specific vibration criteria.	refer to DNVIS Section 7.2.2
4.8	Notification		Notification should be sent to all vibration affected receivers	refer to APPENDIX F
Traffic on Public Roads				
1	Heavy Vehicle Movements	DAY/ NIGHT:	As per EIS	
2	Light Vehicle Movements		As per EIS	

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 EAST Site boundary as shown in Figure C1	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 C5: Plant noise level schedule

PYRMONT STATION

Building/ Area to be Mitigated	Item	Acoustic Requirement	Lw dB(A)
Ventilation	**Ventilation fans**	****Acoustic silencing - this will be difficult to achieve (duct lining/ inlet attenuator/ plenum room)****	**85**
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.

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.

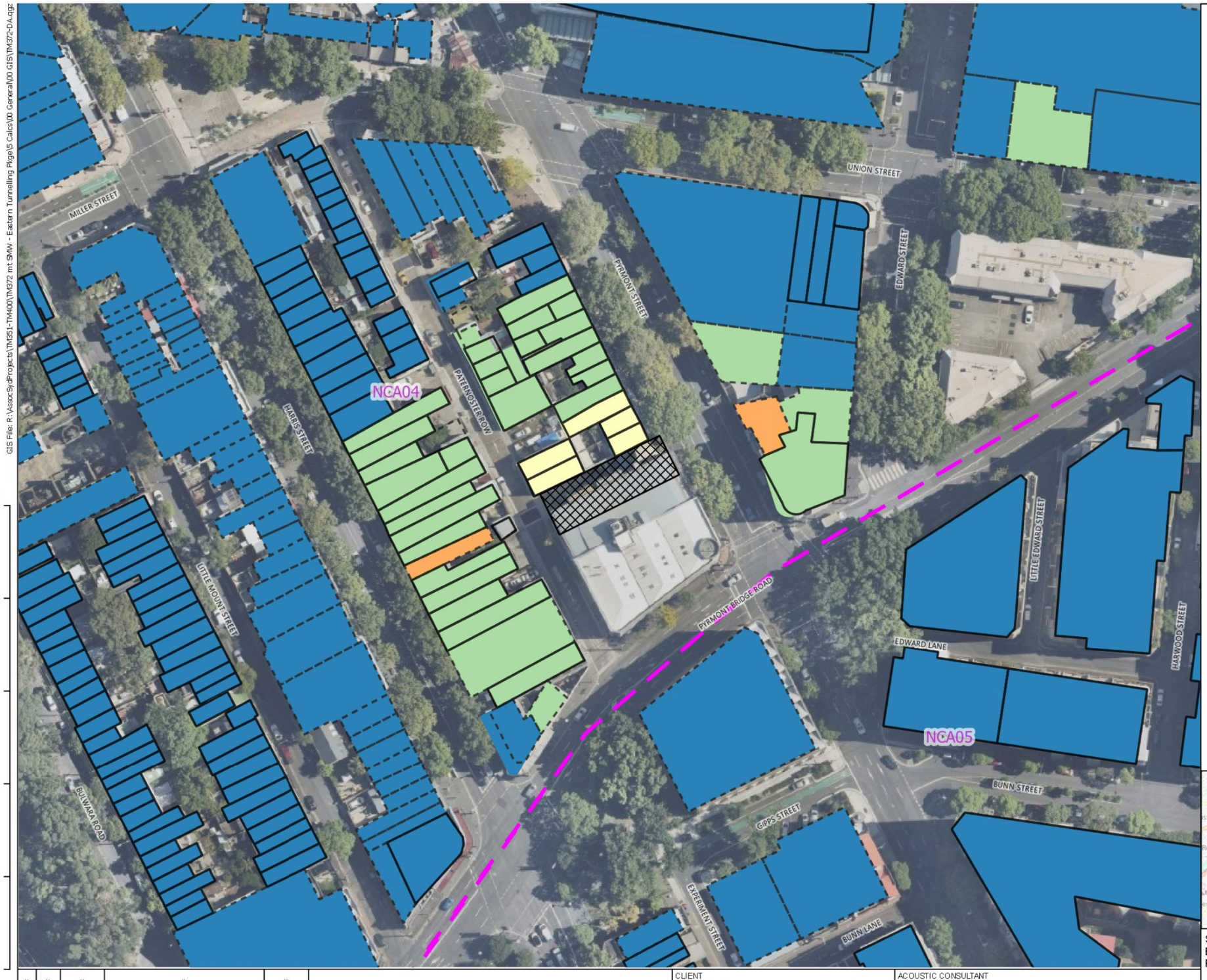
D.4 Predicted ABN levels greater than $L_{eq(15\ minute)}$ 60 dB(A) at receivers (CoA D38)

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 temporary shaft excavation

Land-Use file revision_date: rX_dd/mm/yy Layout: TM372 Noise Exeedance
Plot Date: 15/03/23 - 17:34 GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\S Calcs\00 General\00 GIS\TM372-DA.qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- 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
r0	DA	15/03/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 15 30 45 60 m
1:1,000
FULL SIZE A3
NOTE: Do not scale from this drawing.

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
Pyrmont Worksite

Maximum predicted GBN level (in dBA) above standard hours NML during excavation of Pyrmont West temporary shaft
Plant: Rockbreaker (in sandstone)

Sheet 1 of 7

Land-Use file revision_date: rX_dd/mm/yy
Layout: TM372 Noise Exeedance
Plot Date: 15/03/23 - 17:34
GIS File: R:\Assoc Syd Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- 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

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	15/03/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 15 30 45 60 m

1:1,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT: SYDNEY METRO WEST — JOHN HOLLAND CPB Ghella

ACOUSTIC CONSULTANT: RENZO TONIN & ASSOCIATES — inspired to achieve

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SYDNEY METRO WEST
Eastern Tunnelling Package
Pyrmont Worksite

Maximum predicted GBN level (in dBA) above standard hours NML during excavation of Pyrmont West temporary shaft
Plant: Rockbreaker (in sandstone)

Sheet 2 of 7

Land-Use file revision_date: rX_dd/mm/yy
Plot Date: 15/03/23 - 17:34
Layout: TM372 Noise Exeedance
GIS File: R:\Assoc Syd Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- 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

REV	BY	DATE	DESCRIPTION	APPROVER
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A3 Original | Co-ordinate System: MGA Zone 56

0 15 30 45 60 m

1:1,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

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
Pyrmont Worksite

Maximum predicted GBN level (in dBA) above standard hours NML during excavation of Pyrmont West temporary shaft
Plant: Rockbreaker (in sandstone)

Sheet 3 of 7

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

Land-Use file revision_date: rX_dd/mm/yy
Plot Date: 15/03/23 - 17:34 Layout: TM372 Noise Exeedance
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- 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

REV	BY	DATE	DESCRIPTION	APPROVER
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A3 Original | Co-ordinate System: MGA Zone 56

0 15 30 45 60 m

1:1,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

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
Pyrmont Worksite

Maximum predicted GBN level (in dBA) above standard hours NML during excavation of Pyrmont East temporary shaft
Plant: Rockbreaker (in sandstone)

Sheet 4 of 7

Land-Use file revision_date: rX_dd/mm/yy
Plot Date: 15/03/23 - 17:34
Layout: TM372 Noise Exeedance
GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- 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
r0	DA	15/03/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 15 30 45 60 m
1:1,000
FULL SIZE A3
NOTE: Do not scale from this drawing.

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
Pyrmont Worksite

Maximum predicted GBN level (in dBA) above standard hours NML during excavation of Pyrmont East temporary shaft
Plant: Rockbreaker (in sandstone)

Sheet 5 of 7

Land-Use file revision_date: rX_dd/mm/yy
Plot Date: 15/03/23 - 17:34
Layout: TM372 Noise Exeedance
GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- 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

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	15/03/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 15 30 45 60 m
1:1,000
FULL SIZE A3
NOTE: Do not scale from this drawing.

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
Pyrmont Worksite

Maximum predicted GBN level (in dBA) above standard hours NML during excavation of Pyrmont East temporary shaft
Plant: Rockbreaker (in sandstone)

Sheet 6 of 7

Land-Use file revision_date: rX_dd/mm/yy
Plot Date: 15/03/23 - 17:34
Layout: TM372 Noise Exeedance
GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- 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

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	15/03/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 15 30 45 60 m

1:1,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

SYDNEY METRO WEST

JOHN HOLLAND | CPB | Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES

inspired to achieve

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SYDNEY METRO WEST
Eastern Tunnelling Package
Pyrmont Worksite

Maximum predicted GBN level (in dBA) above standard hours NML during excavation of Pyrmont East temporary shaft
Plant: Rockbreaker (in sandstone)

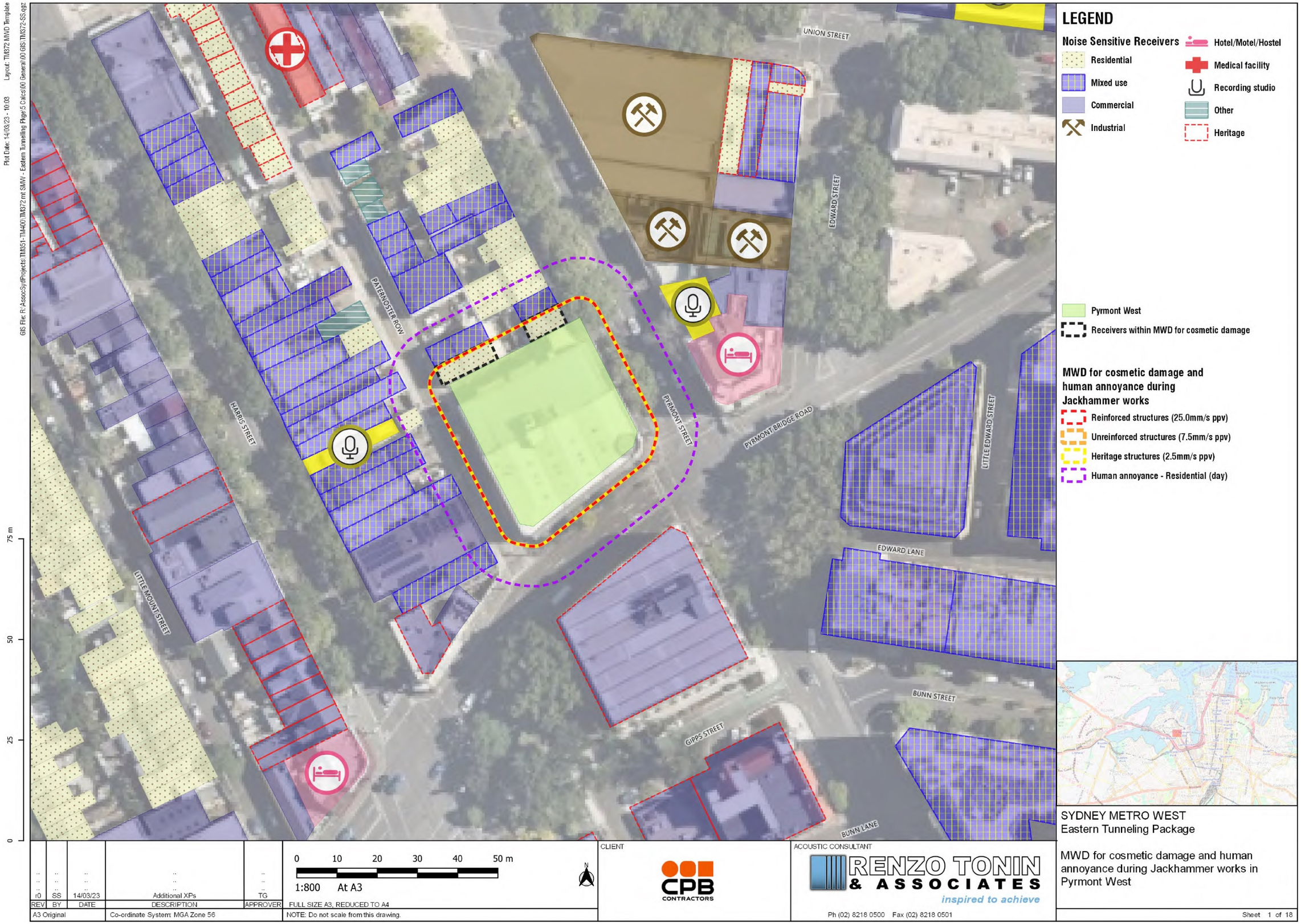
Sheet 7 of 7

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.

APPENDIX F Construction vibration impacts

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



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)

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES

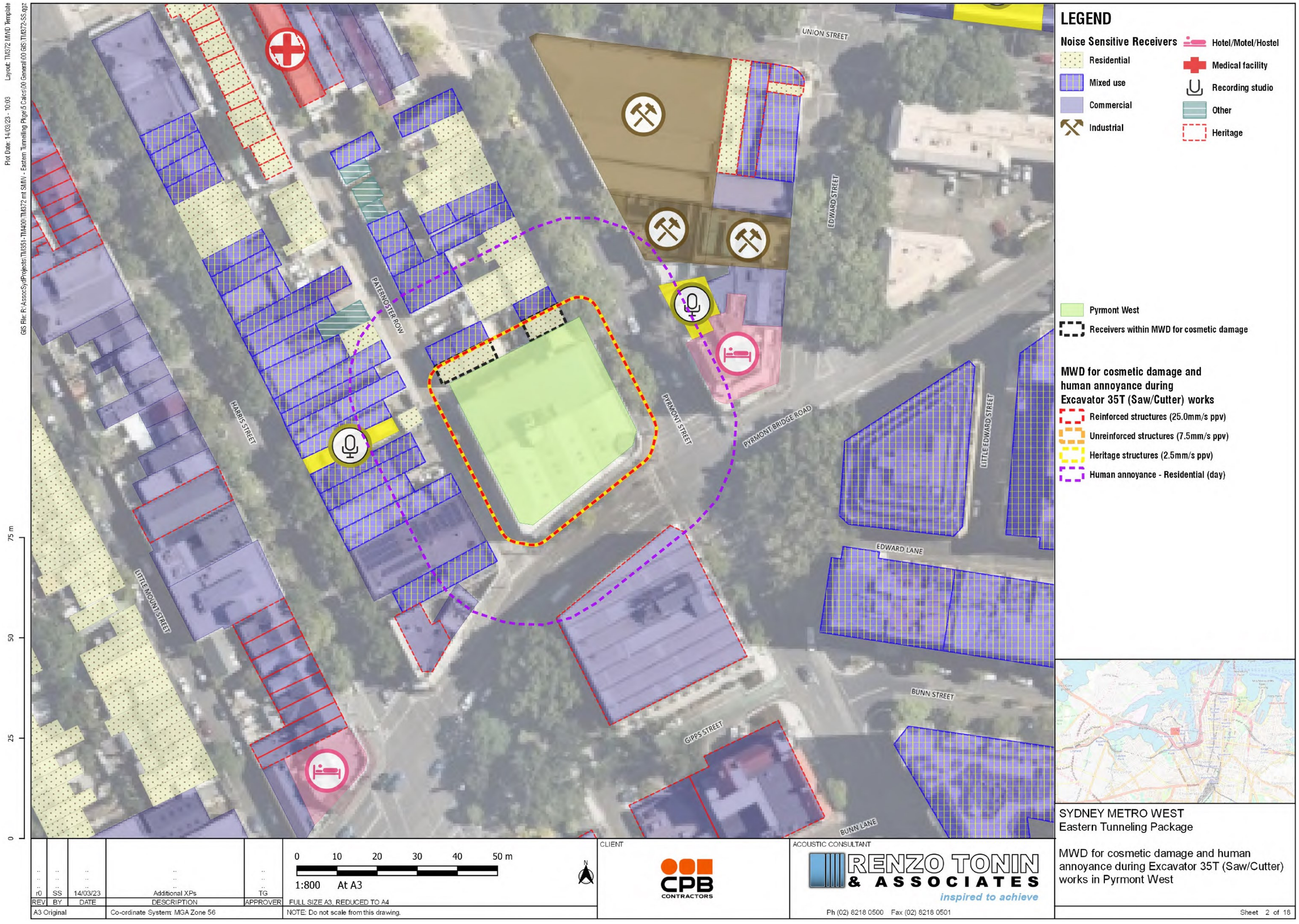
inspired to achieve

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

SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 1 of 18



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)

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

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

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

CLIENT: CPB CONTRACTORS

ACOUSTIC CONSULTANT: RENZO TONIN & ASSOCIATES inspired to achieve

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SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 2 of 18

Plot Date: 14/03/23 - 10:03 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 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)

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

CLIENT

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SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 3 of 18

Plot Date: 14/03/23 - 10:03 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 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)

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 4 of 18

Plot Date: 14/03/23 - 10:03 Layout: TM372 MWD Template

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Cad\s00 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 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)

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

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

0 10 20 30 40 50 m

1:800 At A3 | FULL SIZE A3, REDUCED TO A4

N

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SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 5 of 18

Plot Date: 14/03/23 - 10:03 Layout: TM372 MWD Template
GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Cad\cs\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)

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

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

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

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SYDNEY METRO WEST
Eastern Tunneling Package

MWD for cosmetic damage and human annoyance during Excavator 35T (Hammer) works in Pyrmont West

Sheet 6 of 18

Plot Date: 14/03/23 - 10:04 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 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)

REV	BY	DATE	DESCRIPTION	APPROVER
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 7 of 18

Plot Date: 14/03/23 - 10:04 Layout: TM372 MWD Template

GIS File: R:\Assoc\Syd\Projects\TM\351-TM400\TM372 m1 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 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)

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 8 of 18

Plot Date: 14/03/23 - 10:04 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.qpz

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)

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

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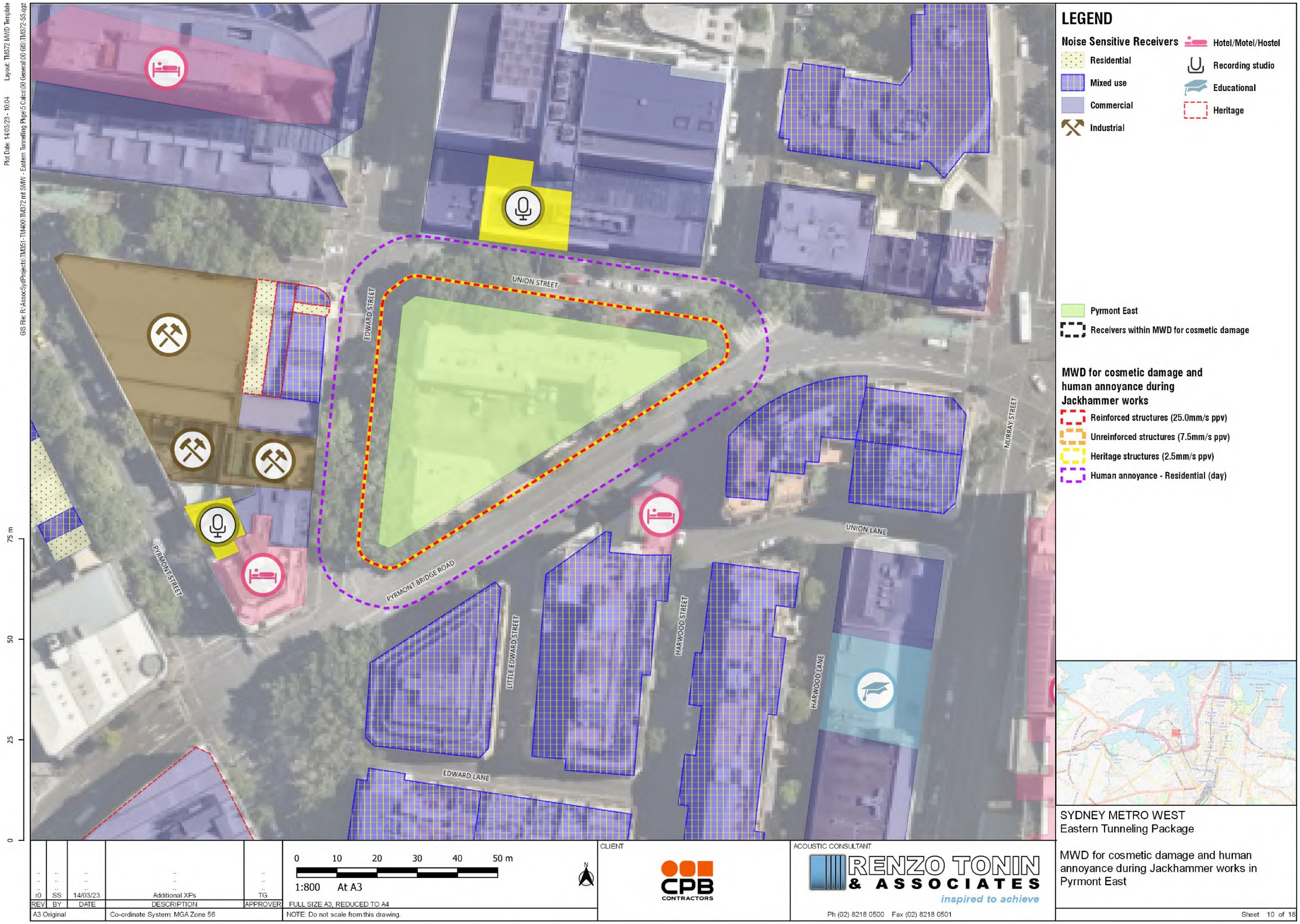
SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 9 of 18

F.2 Pyrmont East worksite - minimum working distance for vibration impact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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
EDWARD STREET
MURRAY STREET
PYRMONT STREET
PYRMONT BRIDGE ROAD
UNION LANE
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
EDWARD LANE
0
25
50
75 m
LEGEND
Noise Sensitive Receivers
Residential
Mixed use
Commercial
Industrial
Hotel/Motel/Hostel
Recording studio
Educational
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)
r0 SS 14/03/23 Additional XPs TG
REV BY DATE DESCRIPTION APPROVER
A3 Original
Co-ordinate System: MGA Zone 56
0 10 20 30 40 50 m
1:800 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.
N
CLIENT
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SYDNEY METRO WEST
Eastern Tunneling Package
MWD for cosmetic damage and human annoyance during Jackhammer works in Pyrmont East
Sheet 10 of 18

Plot Date: 14/03/23 - 10:04 Layout: TM372 MWD Template

GIS File: R:\Assoc\Syd\Projects\TM351-TM400\TM372 m4 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
- Educational
- 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)

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 11 of 18

GIS File: R:\Assocs\Syd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Cad\cs\00 General\00 GIS\TM372-SS.qgz
Layout: TM372 MWD Template
Plot Date: 14/03/23 - 10:04

LEGEND

Noise Sensitive Receivers

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

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 12 of 18

Plot Date: 14/03/23 - 10:04 Layout: TM372 MWD Template

GIS File: R:\AssocSydd\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
- Educational
- 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)

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3 | FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT: CPB CONTRACTORS

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SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 13 of 18

Plot Date: 14/03/23 - 10:04 Layout: TM372 MWD Template

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

LEGEND

Noise Sensitive Receivers

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

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 14 of 18

LEGEND

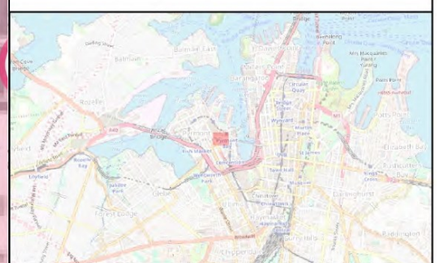
Noise Sensitive Receivers

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



REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

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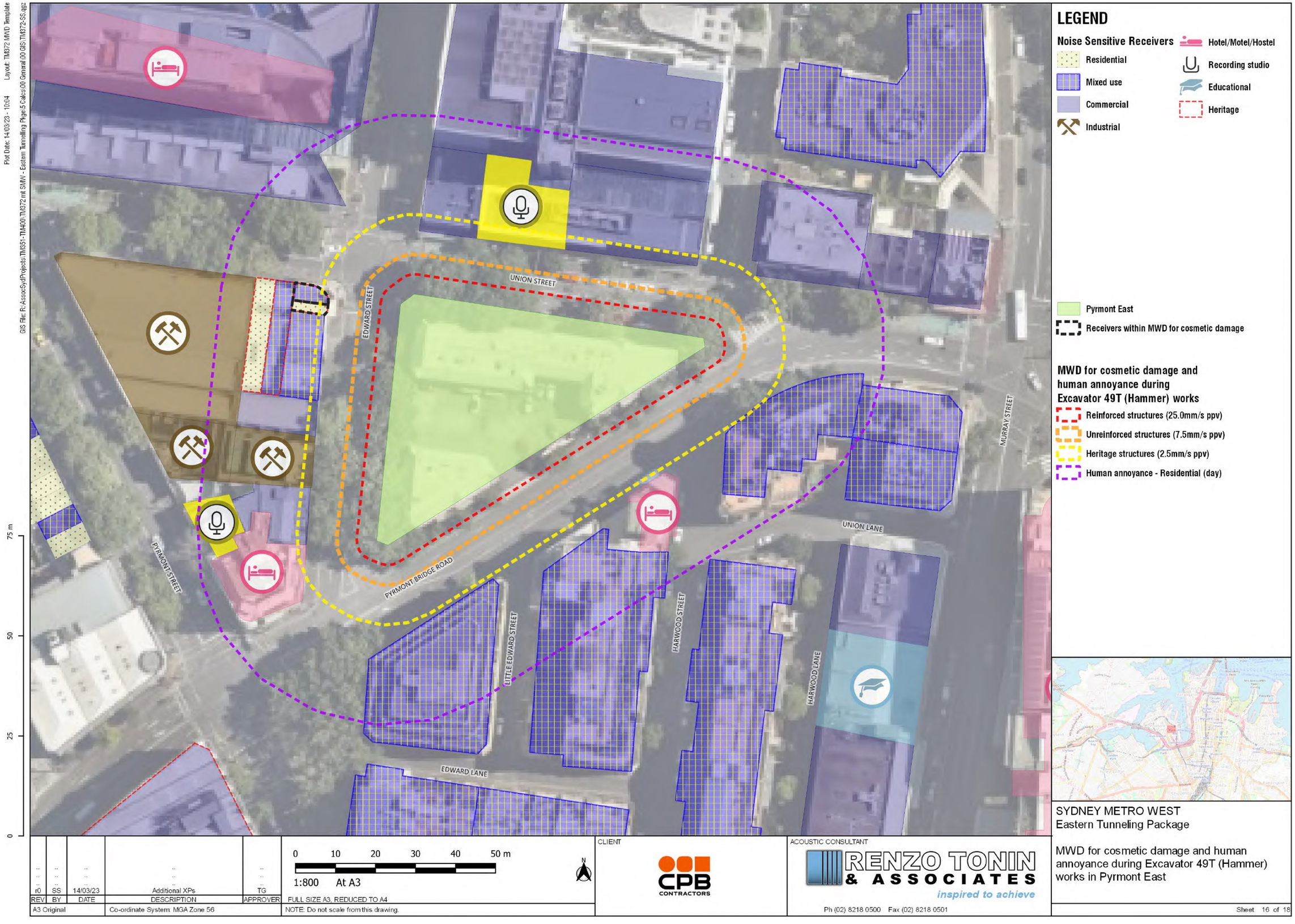
SYDNEY METRO WEST
Eastern Tunneling Package

MWD for cosmetic damage and human annoyance during Excavator 35T (Hammer) works in Pyrmont East

Sheet 15 of 18


Plot Date: 14/03/23 - 10:04 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
EDWARD STREET
MURRAY STREET
UNION LANE
PYRMONT STREET
PYRMONT BRIDGE ROAD
LITTLE EDWARD STREET
HARWOOD STREET
HARWOOD LANE
EDWARD LANE
0
25
50
75 m
LEGEND
Noise Sensitive Receivers
Residential
Mixed use
Commercial
Industrial
Hotel/Motel/Hostel
Recording studio
Educational
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)
0 10 20 30 40 50 m
1:800 At A3
N
r0 SS 14/03/23 Additional XPs 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
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SYDNEY METRO WEST
Eastern Tunneling Package
MWD for cosmetic damage and human annoyance during Excavator 49T (Hammer) works in Pyrmont East
Sheet 16 of 18

Plot Date: 14/03/23 - 10:04 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
- Educational
- 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)

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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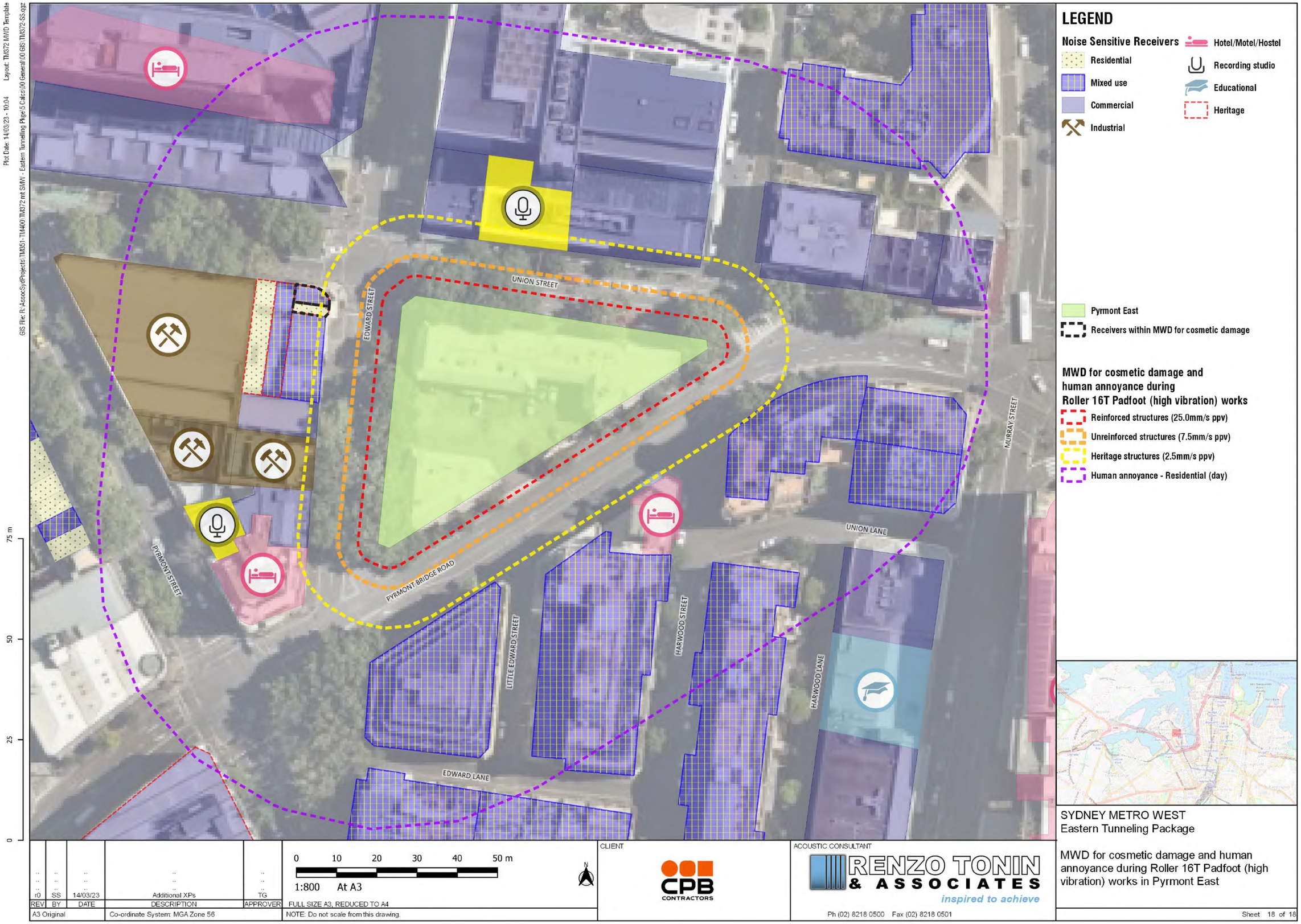
SYDNEY METRO WEST
Eastern Tunneling Package

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

Sheet 17 of 18



LEGEND

Noise Sensitive Receivers

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

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	14/03/23	Additional XPs	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:800 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS

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SYDNEY METRO WEST
Eastern Tunneling Package

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

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

To be added following 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 shaft excavation

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

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 (rev 0) Revision 0 dated 13 April 2023
Prepared by:	[redacted], Acoustics Advisor		
Date of issue:	13 April 2023		

As approved Acoustics Advisor for the Sydney Metro West project, I have reviewed and provided comment on Revisions A and B of the Detailed Noise and Vibration Impact Statement (DNVIS) for Pyrmont Station Works. The DNVIS was prepared by Renzo Tonin Associates on behalf of JCG, the contractor for Eastern Tunnelling Package works.

I am satisfied that Revision 0 has addressed my comments and endorse it for implementation with the following notes:

- The DNVIS covers 2 of the 4 stages of work: site establishment (including demolition), and excavation of the temporary (including acoustic shed construction). The DNVIS will be updated in future to cover excavation of the permanent shaft, support for the mined tunnelling of the station cavern and adits, and demobilisation. A separate project-wide DNVIS will cover the tunnelling (including both TBM tunnels and the mined caverns for Pyrmont station and crossover cavern).

- The DNVIS commits to the use of concrete shears / pulveriser attachments as the primary demolition method for concrete walls and suspended concrete slabs, instead of rock hammers. This is an example of industry best practice (as required by Condition D28) and experience from previous projects indicates that this will result in a significant reduction in noise and vibration, compared with hammering. Rock hammers would still be necessary as a secondary demolition method, particularly for larger structural elements.

- Several conditions of approval require consultation with affected receivers about noise and vibration management (including D29, D30, D37, D38, D39). Section 9.2 of the DNVIS summarises consultation progress to date and I have also been provided with Appendix G (in spreadsheet form). The DNVIS commits to ongoing consultation and progressive updates of the records and outcomes. The DNVIS also identifies receivers likely to experience noise levels greater than 60dBA internally in accordance with Condition D38. Consultation in accordance with Condition D39 is ongoing but I understand that high noise impacts from demolition will be for short durations and typically only occur for short periods during the day, with respite implemented in accordance with Condition D22. On that basis I am satisfied that the D39 consultation process does not need to be complete until the shaft excavation stage.

- There are two properties near the Pyrmont West site that include recording studio facilities, which are noise and vibration sensitive businesses under Condition D27. JCG has committed to ongoing consultation with these businesses and to address the requirements of D27 with consideration for the long-term noise and vibration impacts of the excavation and tunnelling works (beyond those covered in this version of the DNVIS).

- The DNVIS identifies one heritage structure within the recommended minimum working distance for the conservative screening limit for cosmetic damage for ‘structurally unsound’ structures. JCG has confirmed to me that an assessment of whether or not this building is ‘structurally unsound’ will be completed prior to the vibration-generating activity.

I endorse Revision 0 of the DNVIS for implementation.

[redacted]

[redacted], Metro West Acoustics Advisor