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TM372-02-1-02F04 SMW-ETP_ADD-DNVIS-PYR_OOH tower crane(r2)

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Sydney Metro West Eastern Tunnelling Package - Addendum Detailed Noise and Vibration Impact Statement - Pyrmont Station - OOH tower crane unloading deliveries

1 Introduction

A Detailed Noise and Vibration Impact Statement (DNVIS) has been prepared for the Sydney Metro West – Eastern Tunnelling Package (ETP) **Pyrmont Station** surface worksites [1]. The DNVIS was prepared on behalf of John Holland CPB Contractors Ghella Joint Venture (JCG) to meet the requirements of Planning Approval (SSI 19238057) Condition D29 and the Sydney Metro Construction Noise and Vibration Standard (CNVS)[2] for the construction of the ETP Works.

This Addendum has been prepared consistent with the DNVIS to assess short duration works outside the scope of works assessed in the Pyrmont Station DNVIS. Therefore, there are no cumulative impacts.

2 Construction works and hours

2.1 Construction works addressed in this Addendum DNVIS

The works assessed in this Addendum include the unloading of delivery vehicles (including oversized delivery vehicles) delivering the platform and acoustic shed steel to the Pyrmont East worksite, outside standard construction hours (refer to Section 2.2). Vehicles would be unloaded from Pyrmont Bridge Road or within site utilising the diesel tower crane. To avoid double handling of some of the larger beams, it is proposed that they will be placed directly in their final position on site. Additional heavy vehicles will deliver materials for the platforms and sheds to the site via the Union Street access. Materials will be lifted from the trucks and placed in the laydown areas.

The unloading areas and truck route entrance and egress are shown below in Figure 2.1. Table 2.1 presents the list of plant proposed to be used for these works and their assumed sound power levels. Vibration intensive plant are also identified.

Figure 2.1: Pyrmont East – truck route and unloading areas for oversized deliveries

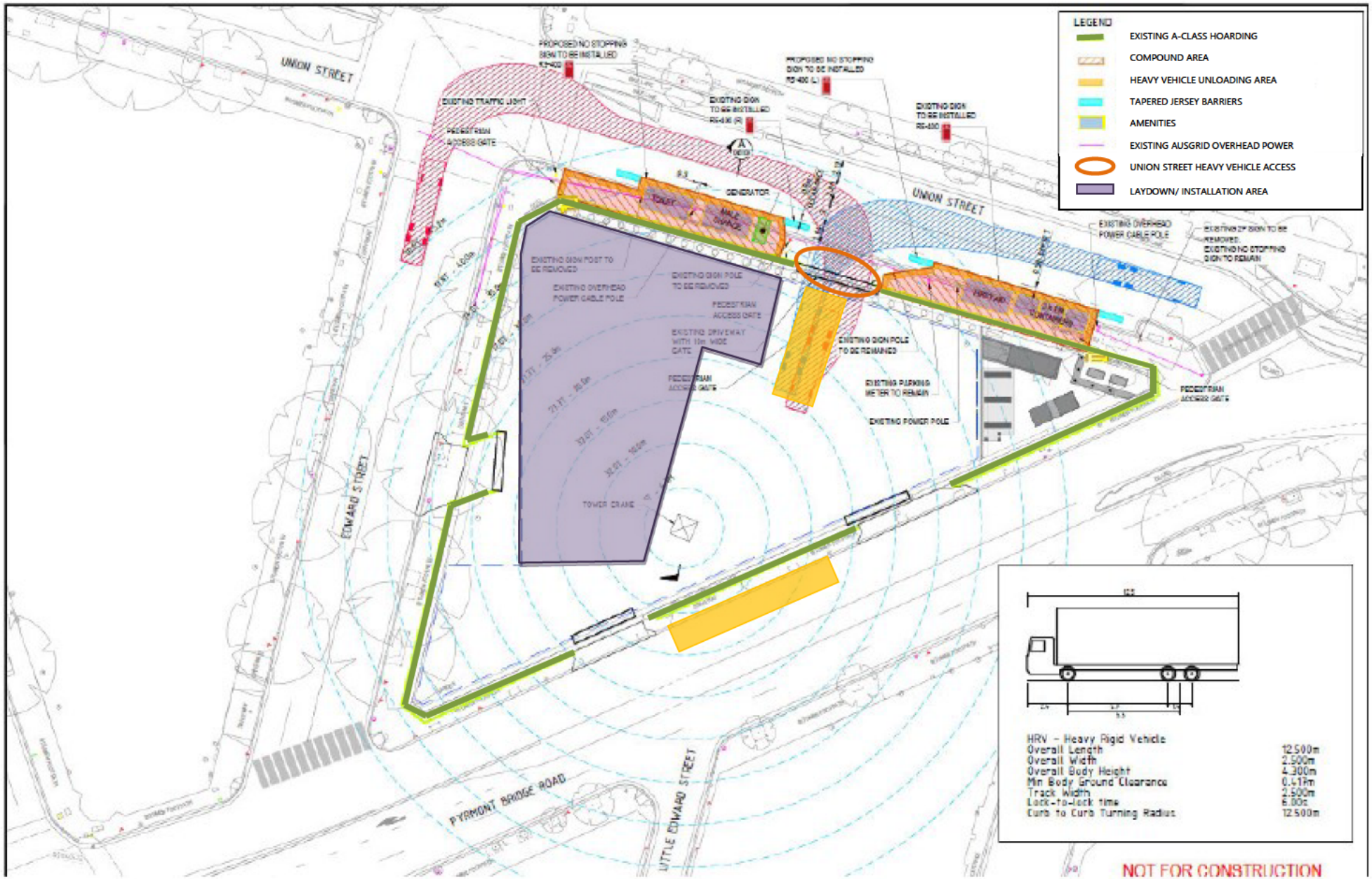

Table 2.1 Construction activities and equipment sound power levels used in noise modelling

Activity description/ Work area	Aspect (Activity/ Aspect ID)	Plant/ Equipment	Evening[1] 6pm – 10pm	Night[1] 10pm – 12am	Night[1] 12am – 7am	Sound Power Level (Lw re: 1pW), dB(A)		Hight noise plant	Vibration intensive plant
						$L_{Aeq(15min)}$	L_{Amax}		
Pyrmont Bridge Road, Union Street and Pyrmont East worksite (see Figure 2.1) - oversized deliveries for acoustic shed and tunnelling establishment, including: - Unloading trucks from within site - Unloading trucks from Pyrmont Bridge Road - Tower operation unloading trucks for steel laydown within site footprint - Possible installation of steel	Delivery (OOH tower crane unloading deliveries (TC))	Delivery truck (via Union Street)	4 trucks per night		-	106	111	-	-
		Delivery truck (on Pyrmont Bridge Road)	4 trucks per night		-	106	111	-	-
		Tower Crane (diesel)	1	1	-	114	119	-	-
		Traffic Control truck (MR Truck)	2	2	-	89	100	-	-
		Generator (1500 RPM; 1200 kW)	1	1	-	105	107	-	-
	Installation (As above with installation (TC+P))	Elevated Work Platform (EWP)	2	2	-	95	98	-	-
		Hand tools (non-powered, no hammering)	2	2	-	95	111	-	-
		Compressor	1	-	-	102	103	-	-
		Rattle Gun	1[2]	-	-	106	109	-	-

Notes: 1. Oversized deliveries likely to occur up to 3 weeknights (i.e. Monday to Friday) per week (no more than 2 consecutive nights), 10 nights per month between March and July (inclusive) 2024 .

2. Use of rattle guns to fix steel in place will be limited to standard hours only, where is safe to do so. Rattle guns may only be used during the OOH period up until 10:00 pm where an alternative fastening method would compromise safety on site.

2.1.1 Construction traffic noise

Based on the proposed activities presented in Table 2.1, the construction traffic is consistent with construction generated traffic noise impacts assessed in the DNVIS. No further assessment is required.

2.1.2 Ground-borne noise and vibration

There are no vibration intensive activities required to complete the OOH tower crane unloading oversized deliveries. Ground-borne noise and vibration impact will be negligible. No further assessment is required.

2.2 Construction Hours

Construction hours are as reported in the DNVIS Section 2.2. The works assessed in this Addendum will be undertaken outside standard construction hours under the Environment Protection License (EPL) number 21784, in accordance with Planning Approval Condition D23(c).

Oversized deliveries will occur from 6:00 pm to 12:00 am, up to three nights per week (no more than two consecutive), Monday to Friday and up to 10 nights period month. Deliveries will occur from March to July (inclusive).

2.2.1 Justification for OOHW

Oversized deliveries would require the closure of a lane on Pyrmont Bridge Road and therefore a Road Occupancy Licence (ROL). Furthermore, and in relation to the deliveries to the Union Street entrance, the requirement of maintaining exclusion zones around suspended loads means the proposed cranage works cannot be undertaken during standard construction hours as a large number of workers would be working within the worksite in a confined area.

In accordance with EPL condition L5.8(d), works may be undertaken outside of standard construction hours if the TfNSW Transport Management Centre (or other road authority) have refused to issue a road occupancy license during standard construction hours. In addition, in accordance with EPL condition L5.8(a), works may be undertaken outside of standard construction hours if the proposed works would result in a high risk to construction personnel or public safety, based on a risk assessment carried out in accordance with AS/NZS ISO 31000:2009 “Risk Management”.

The OOH delivery works will also satisfy conditions L4.9(c), (d) and (e) and will only occur between 6:00 pm on Mondays, Tuesdays, Wednesdays, Thursdays, Fridays and 12:00 am the following day. Furthermore, OOH delivery works will not impact the same noise sensitive receivers on more than 2 consecutive evenings or nights per week, 3 evenings or nights per week and 10 evenings or night per month.

The OOH tower crane unloading oversized deliveries would benefit the community by allowing installation of the acoustic shed to be completed more quickly, which will reduce noise impacts from the site during and outside of standard construction hours.

3 Construction noise objectives

The DNVIS Section 3 describes the Land Use Survey and Noise Catchment Areas used to identify sensitive receivers potentially impacted by the Project and establish receiver groups for the purpose of assessment and management of impact.

Construction airborne noise objectives are detailed in the CNVS Section 2. A summary of the objectives as applicable to the Pyrmont Station works is provided in Table 4.1 of the DNVIS. Construction noise objectives specific to these works are presented in Table B1 in APPENDIX B.

4 Construction airborne noise impacts

The airborne noise prediction methodology is consistent with the DNVIS (Section 5.1).

4.1 Predicted noise levels

Airborne 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 4.2 presents a summary of the number of residential receivers and 'other sensitive receivers' (in use) likely to be noise affected by the additional activity associated with the OOH works. 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 4.1.

Table 4.1: Key to the predicted construction airborne noise results tables

Assessment	Time of day	Key			
$L_{Aeq(15min)}$	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 4.2 summarises the number of construction air-borne 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. Predicted noise levels are presented in Appendix D.1.

Noise monitoring was undertaken by JCG JV several times during February and March 2024 during standard construction hours to measure the crane operational noise. The monitoring results were used

to verify the noise model, to increase accuracy of the predicted noise levels (refer to APPENDIX C for detail).

Table 4.2: Number of receiver buildings over the airborne noise management level (all NCAs)

Worksite	Construction activity	Evening[1]				Night[1]				Hotel/Motel/ Hostel[2]				Sleep disturbance[1]	
		L_{Aeq}				L_{Aeq}				L_{Aeq}				L_{Amax}	L_{Amax}
		1 – 2 dB(A)	3 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 2 dB(A)	3 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 2 dB(A)	3 – 10 dB(A)	11 – 20 dB(A)	> 30 dB(A)	> 52 or RBL+15 dB	> 65 dB(A)
Pyrmont East	OOH tower crane unloading deliveries (TC)	18	75	13	0	44	84	25	1	1	2	1	0	9	6
	As above with installation (TC+P) with rattle guns	17	75	14	0	44	84	25	1	1	2	1	0	9	6

Note: 1. Applies to residential receivers

2. Other sensitive receiver likely to be in use at the time of works. Impacts to all 'other sensitive receivers included in Appendix C.

4.1.1 Standard construction hours

Deliveries to the site during standard construction hours are included in the DNVIS (section 5).

4.1.2 Out of hours work

The results summarised in Table 4.2 show that the activities required during the OOH unloading of delivery vehicles (including oversized delivery vehicles) and installation of large items will exceed the NMLs during the evening and night period. The dominant noise source is the operation of the tower crane. For the purpose of this assessment it is assumed that the tower crane will be operational for 100% of the OOH work period. Noise impact to the neighbouring sensitive receivers will be managed by concluding the OOH deliveries and unloading by midnight.

Although predicted noise levels show minimal increase in impact from the delivery (TC), compared with delivery and installation with rattle guns (TC+P), the use of rattle guns are likely to be distinguishable above other noise generated on site and more likely to cause annoyance. The use of rattle guns to fix steel in place will be limited to standard hours only, where is safe to do so. The steel components of the shed and platforms would be installed using the crane and elevated work platforms, with the use of hand tools to tighten components into place. The following day the components will be tightened as required using the elevated work platforms and rattle guns. For some larger components it may be necessary to use rattle guns to tighten components into place. This would be completed by 10:00pm, with no rattle guns in use after 10:00 pm.

Noise monitoring data from the real time monitor established at 63 Edward Street in 2023 has been reviewed for the period 30 March to 31 July 2023. The review found that the background noise levels

between 10:00 pm and 12:00 am varied between $L_{A90(15min)}$ 46 to 65 dB(A). The RBL for this period was $L_{A90(15min)}$ 48 dB(A). The ambient noise levels varied between $L_{Aeq(15min)}$ 61 to 79 dB(A). The average ambient noise level for this period was $L_{Aeq(15min)}$ 67 dB(A). The monitoring shows that noise levels are typically quite high at receivers surrounding the Pyrmont East worksite up to midnight. For comparison, predicted noise levels from the delivery and installation works at the worst affected receivers surrounding the worksite are $L_{Aeq(15min)}$ 67 to 74 dB(A). This is within the range of existing ambient noise levels reported above, although it is noted that the character of the noise from the delivery and installation works differs from the existing ambient noise levels, which are predominantly generated by traffic flow in the area.

Mitigation and management measures summarised in Section 9 of the DNVIS will continue to be implemented during the OOH unloading of delivery vehicles.

4.1.3 Sleep disturbance

The results summarised in Table 4.2 show that there are residential receiver buildings would experience construction noise levels above the $L_{Aeq(15min)}$ sleep disturbance screening level. Predicted instantaneous noise levels at up to 9 residential receiver buildings are above the initial L_{Amax} sleep disturbance screening level, with 6 residential buildings likely to be exposed to events above 65 dB(A) (external).

Due to the nature of the activities to be undertaken, it is difficult to quantify how many events above the screening level are likely to occur. Instantaneous noise events will be dependent on materials handling, crane operator and truck driver behaviour on site.

4.2 Mitigation and management measures

4.2.1 Specific mitigation measures

In addition to the mitigation and management measures outlined in Section 9 of the DNVIS, the following specific mitigation measures will be implemented as applicable during the OOH unloading of delivery vehicles (including oversized delivery vehicles) and installation of large items, taking into consideration industry best practice methods in accordance with Planning Condition of Approval D28.

Table 4.3: Specific mitigation measures

Control measure	Description of the control measure	Feasible/ reasonable test	Adopted?
Mitigation of tower crane engine and exhaust	Options to mitigate the tower crane have been discussed with the crane supplier. Modifications to the crane, including mufflers and attenuators on the exhaust and engine components have been discussed with the tower crane supplier and determined to be not reasonable or feasible due to access constraints to retrofit the modifications and the effectiveness in reducing noise. The installation of noise blankets around the inside edge of the walkway mesh surrounding the main winch and motors has been successful on similar cranes and is a potential mitigation option subject to temporary design approvals. The noise blankets should block line of sight from the noisiest part of the crane engine.	Mufflers and attenuators are not feasible. Noise blankets around main winch and motors are reasonable. Feasibility subject to design approval. Estimated 5 dB noise reduction.	No TBC
Use of existing construction hoarding surrounding site.	Trucks will be unloaded within the worksite (access from Union Street) where practicable. Only oversized deliveries would be unloaded from Pyrmont Bridge Road.	This measure could be feasibly and reasonably be implemented.	Yes
Access gates closed during unloading on worksite.	The access gate at Union Street would be closed once the delivery truck is on site, where there is sufficient space for the delivery vehicle to park wholly on site.	This measure could be feasibly and reasonably be implemented.	Yes
Smooth access driveways	Access driveways to the worksites will be maintained smooth, to minimise the occurrence of clangs or bangs as trucks enter the worksite	This measure could be feasibly and reasonably be implemented.	Yes
Switch off plant not in use.	Any plant not in use for an extended period (e.g. delivery trucks) would be switched off and not left idling on site.	This measure could be feasibly and reasonably be implemented.	Yes
Management of truck unloading on site	Higher levels of instantaneous noise levels can be generated by unloading of steel components onto the worksite. Careful lifting and placement of materials onto the worksite. No dropping components or materials from height. Use of slings instead of chains when manoeuvring shed components using the mobile crane.	This measure may reduce instantaneous noise levels by up to 10 dB(A) and could be feasibly and reasonably be implemented.	Yes
Limit activity duration	OOH deliveries and (where required) installation works would be limited to a maximum of four deliveries per shift and would not extend beyond 12 am midnight on any scheduled night, where practicable, to limit impacts on the most sensitive part of the night period after midnight.	This measure could be feasibly and reasonably be implemented.	Yes
Alternative audible alarms, such as 'quackers' or flashing lights	All plant would be fitted with non-tonal audible alarms as a minimum. Where practicable, flashing lights would be used for the EWP and/or crane to reduce instantaneous noise, provided this does not compromise safety on site.	This measure could be feasibly and reasonably be implemented.	Yes

Control measure	Description of the control measure	Feasible/ reasonable test	Adopted?
OOH deliveries on Sundays (instead of nights)	The option of OOH deliveries on Sunday (8am to 6pm) instead of night time deliveries was reviewed. This option would be suitable for shed components delivered to the Union Street site access, not oversized deliveries requiring lane closure on Pyrmont Bridge Road. The Sunday day period is a respite day from construction activity at the Pyrmont site and a time when residential receivers are more likely to be enjoying outdoor spaces, including balconies and courtyards near the worksite. Review of residential and hotel receivers most impacted by the works found that many were architecturally treated for the higher ambient noise levels in the area, and they had mechanical ventilation or air conditioning that would allow windows to be closed overnight. "Windows closed" provides a minimum of 20 dB noise reduction for standard construction and at least 25 dB noise reduction for upgraded window glazing. Applying this reduction to predicted external noise levels results in instantaneous noise events below the awakening level of 55 dB(A)(internal) at all receivers.	Sunday (day) deliveries to Union Street site access are feasible, but not reasonable. Night deliveries (up to 12:00 am) are considered more reasonable, as impact to internal spaces mitigated by receiver building design. This ensures respite day on Sundays is maintained.	Yes
Toolbox talks	Toolbox Talks will be provided to all personnel involved in the OOH unloading of delivery vehicles and installation activity (as per the DNVIS), specifically targeted to ensure the noise impacts from unloading and installation of the steel components of the acoustic shed and platforms. Toolbox talks should encourage employees to limit the occurrence of high instantaneous noise sources that may trigger sleep disturbance by following good behavioural practices, including: - No swearing or unnecessary shouting or loud stereos/radios on site. - Use of slings instead of chains when manoeuvring shed components using the mobile crane. - No dropping of materials from height, throwing of metal items and slamming of doors. - No excessive revving of plant and vehicle engines. - Controlled release of compressed air.	This measure could be feasibly and reasonably be implemented.	Yes

4.2.2 Additional noise mitigation measures

The steps to be carried out to determine the additional airborne noise management measures to be implemented are identified in Section 9.4.1 of the DNVIS. 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.

4.2.3 Consultation with noise affected receivers

The following proposed actions will be completed by the Communications Team prior to the OOH delivery and installation works. JCG JV will start proactively engaging with stakeholders the week commencing 11 March 2023.

Table 4.4: Proposed consultation plan prior to commencement of and during OOHW

Date	Item	Status
One week prior	Work notification – Out of hours work	In draft
One week prior	Install flyers in building foyers	In draft
14 March 24	1 – 5 Harwood Street Body Corporate - meeting	Yet to start
14 March 24	17 – 21 Pyrmont Bridge Road – Building Manager update	Yet to start
14 March 24	1 – 9 Pyrmont Bridge Road – Building Manager update	Yet to start
15 March 24	Weekly email update	Yet to start
18 March 24	Direct email to residents / building managers	Yet to start
22 March 24	Weekly email update	Yet to start
One day prior (and as required)	Text message	Yet to start
Ongoing	Weekly email updates – notify specific nights for the following week	Yet to start

4.2.4 Attended airborne noise monitoring

As noted in Section 9.6.1 of the DNVIS, attended noise monitoring is to be undertaken to verify that noise levels resulting from OOH unloading of delivery vehicles (including oversized delivery vehicles) and installation of large items are in accordance with the levels predicted in this report. Noise monitoring will be completed in publicly accessible areas on or near the nominated receivers, subject to gaining access to properties. The nominated monitoring locations are:

Table 4.5: Nominated verification monitoring locations

Type of monitoring	NCA/ Receiver type	Nominated receiver address
Unattended	PYR-E FIXED RTM	69 EDWARD STREET PYRMONT, NSW
Unattended	PYR-W FIXED RTM	28 PATERNOSTER ROW, PYRMONT, NSW
Attended	NCA05	1-5 HARWOOD STREET, PYRMONT, NSW
Attended	OSR (HOTEL)	104 PYRMONT STREET, PYRMONT, NSW (THE SEBEL HOTEL)

5 Impact classification

The impact classification from the in Section 10 of the DNVIS has been reviewed taking into consideration the outcomes of this Addendum assessment report. The impact classification for these works is **moderate**, consistent with the classification in the DNVIS. It is noted that the OOH delivery works will potentially expedite the installation of the acoustic shed, which will provide a significant noise reduction from the works, including shaft excavation, to be undertaken at Pyrmont East.

Whilst predicted noise levels from the OHW were found to exceed the NMLs, the impacts will be managed through the mitigation and management measures outlined in Section 9 of the DNVIS and Section 4.2 of this Addendum report, including suitable community notification regarding potential impacts from the works.

6 Conclusion

In conclusion, works associated the Pyrmont Station east worksite OOH works unloading of delivery vehicles (including oversized delivery vehicles) and installation of large items have been described in this Addendum DNVIS to identify potential environmental risks associated with construction noise and vibration. Construction noise and vibration objectives have been established in the DNVIS, consistent with the conditions of approval for the Project and the EIS.

Construction airborne noise

The predicted airborne noise levels indicate were found to exceed the NMLs during the evening and night period. Airborne noise impacts will be managed through the mitigation and management measures outlined in Section 9 of the DNVIS and Section 4.2 of this Addendum report, including concluding unloading and installation works by 12:00 am and implementing community notification regarding potential impacts from the works.

Construction ground-borne noise and vibration

There are no vibration significant plant or equipment proposed to be used during the OOH works. Ground-borne noise and vibration impacts are unchanged from the impacts presented in the DNVIS.

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
08.03.2024	Initial issue (non-reviewed)	-	0	[redacted]	-	-
11.03.2024	Reviewed issue	-	1	[redacted]	-	[redacted]
15.03.2024	Respond to SM/ER/AA comments	-	2	[redacted]	-	[redacted]

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

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References

[1] Renzo Tonin & Associates 2023 Sydney Metro West Eastern Tunnelling Package - Detailed Noise and Vibration Impact Statement – Hunter Street Station – 24 May 2023 (TM372-02-1-03F01 SMW-ETP_DNVIS-HUN (revB))

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

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

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

[5] 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

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

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

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

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

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

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

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

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

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

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

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

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

[18] 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.

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.
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).
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 100dBThe sound of a rock band 115dBLimit of sound permitted in industry 120dBDeafening
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.
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.
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.
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.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
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	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
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

Plot Date: 25/01/24 - 13:49 Layout: TM372 LU Template
Atlas feature: TM372 Large Overall LU atlas
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Page\5 Calcs\00 General\00 GIS\TM372-SS.qpz

LEGEND

Noise Sensitive Receiver

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

- Tunnel Alignment
- Project Worksites
- Project NCAs

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

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

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

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 m
1:3,000 At A3
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.

N

CLIENT
SYDNEY METRO WEST
JOHN HOLLAND CPB Ghella

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SYDNEY METRO WEST – EASTERN TUNNELLING PACKAGE
Hunter Street Station Site

Landuse, Worksites and NCAs

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) RBL Day	RBL Evening	RBL Night	LAeq_D	LAeq_E	LAeq_N	Airborne NMLs based on ICNG (external) NMLD(S)	NMLD(O)	NMLE	NMLN	NMLMS	Sleep Dist. L_{Amax} $L_{Aeq(15min)}$	L_{AFmax}	Comments
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

APPENDIX C Verification noise monitoring

Noise monitoring was undertaken by JCG JV whilst the tower crane was operating during standard construction hours. Noise monitoring was undertaken at two locations:

- Location M1 – Level 9 50 Murray St (with the Acoustic Advisor) on 23 and 24 January 2024;
- Location M2 – at street level on Pyrmont Bridge Road on 24 January 2024.

Further monitoring is scheduled to be undertaken in March 2024 at 1-5 Harwood Street, Pyrmont, subject to gaining access to the property.

The monitoring locations are depicted in Figure C.1. The monitoring results are summarised in .

Figure C.1: Noise monitoring locations for tower crane operation at Pyrmont East worksite

Table C.1: Noise monitoring results summary - tower crane operation at Pyrmont East worksite

Location	Date	Predicted $L_{Aeq(15min)}$	Measured $L_{Aeq(15min)}$	Comment
M1	23/1/2023	-	58-59 dB(A)	The tower crane wasn't operating at the time. Background was recorded with traffic noise, construction noise from the Harbourside development and HVAC on nearby buildings.
M1	24/1/2023	60 dB(A)	Idling: 58-59 dB(A) Revving: ≤ 63 dB(A)	The tower crane was operating sporadically but was not able to be differentiated from background noise at the time. The predicted levels are consistent with the measured levels.

Location	Date	Predicted $L_{Aeq(15min)}$	Measured $L_{Aeq(15min)}$	Comment
M2	24/1/2024	71	68-69 dB(A)	There is the potential or two different noise sources (tower crane cab at height and the generator at ground level) however this could not be confirmed from the monitoring. The predicted levels are consistent with the measured levels.

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 exceedances per NCA

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

D.3 Additional noise mitigation and receiver notifications

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

ACOUSTICS ADVISOR ENDORSEMENT
SYDNEY METRO WEST (SSI 19238057)

Review of	**Eastern Tunnelling Package:** Addendum to Detailed Noise and Vibration Impact Statement (DNVIS) – Pyrmont Station – OOH Tower Crane Unloading Deliveries	**Reviewed document reference:**	**TM3**72-02-1-02F04 SMW-ETP_ADD-DNVIS-PYR_OOH tower crane(r2) Rev 2 dated 15 March 2024
Prepared by:	[redacted], Acoustics Advisor		
Date of issue:	20 March 2024		

Context

As approved Acoustics Advisor for the Sydney Metro West project, I recently endorsed Rev 4 of the Detailed Noise and Vibration Impact Statement (DNVIS) for Pyrmont Station Works which covered the use of the diesel tower crane during standard construction hours. This addendum to the DNVIS covers the OOH use of the tower crane for unloading components of the deck and acoustic shed at the Pyrmont East site.

Notes

I understand that this OOH work will be carried out under JCG's Environment Protection Licence (EPL), which is consistent with Condition D23(c)(i) of the approval. The EPL is regulated by the EPA; my role, as Acoustics Advisor, is to assess the DNVIS addendum prepared in accordance with Condition D29 of the approval.

I provided comments on Rev 1 of this DNVIS addendum, and I have considered the responses to my comments in preparing this endorsement.

I note that the proposed approach seeks to avoid double-handling of large structural elements by placing them directly in their final position on site. This requires more OOH work and the use of rattle guns to tighten bolts. However, I am satisfied that it makes sense to avoid double-handling materials provided the associated OOH impacts can be managed appropriately.

The proposal involves working until midnight on 40 to 50 nights in total, over a period of 4 to 5 months. This means that there is significant potential for noise impacts during evening and night time periods. However, I am satisfied that the impact will be reduced by ceasing work by midnight, ceasing rattle gun use by 10pm, avoiding cumulative impacts of concurrent OOH work in the area, and by implementing feasible and reasonable mitigation (discussed further below). I also understand that JCG has considered alternatives, including the option of carrying out this work on Sundays or the option of excluding construction personnel from the site during daytime when tower crane lifting is underway (noting that the exclusion zone extends to most of the site), and determined that this proposal is the preferred approach.

Regarding sleep disturbance, JCG has confirmed that the residential receivers potentially affected by sleep disturbance impacts have sufficient sound insulation to achieve internal sleep disturbance criteria provided they keep windows closed at night.

The DNVIS addendum sets out how feasible and reasonable mitigation will be implemented for this work, including:

- Source noise control of the crane, via the installation of noise blankets around the inside edge of the walkway mesh surrounding the tower crane winch and motors.
- Regular inspection and monitoring of the work, including from receiver locations (where it is practical to obtain access).
- Ongoing consultation with the community and the implementation of respite, including in accordance with the Pyrmont Respite Proposal (Noise and Vibration) documented separately.

I note that the proposed source noise control of the crane is subject to temporary design approvals and will take 3 to 4 weeks to implement. It also assumes noise blankets will block line of sight from the noisiest part of the crane engine to achieve worthwhile noise benefit at receivers. My endorsement of the DNVIS addendum is therefore valid for 6 weeks to allow JCG to:

1. Implement the proposed source noise control. Timing: within 4 weeks.
2. Obtain evidence to confirm the effectiveness of source control, and to provide evidence to demonstrate that there are no further feasible and reasonable source control mitigation measures that could be implemented. Timing: as soon as practical after the source control is implemented, and within 6 weeks.
3. Demonstrate the effectiveness of supervision and monitoring of the work and of ongoing consultation with the community and implementation of respite. Timing: progressively, throughout the works.

Endorsement

I endorse Rev 2 of this DNVIS addendum for an initial period of 6 weeks from the date of this endorsement (4 weeks for item 1 above plus 2 weeks for item 2).

I will consider an extension of dates or an unconditional endorsement pending the results of the work carried out during the initial period and the evidence provided regarding items 1 to 3 above.

[redacted]

[redacted], Metro West Acoustics Advisor

ACOUSTICS ADVISOR ENDORSEMENT
SYDNEY METRO WEST (SSI 19238057)

Review of	**Eastern Tunnelling Package:** Extension of dates for conditional endorsement – Pyrmont Station – OOH Tower Crane Unloading Deliveries	**Reviewed document reference:**	JCG latter dated 15 April 2024
Prepared by:	[redacted], Acoustics Advisor		
Date of issue:	17 April 2024		

Context

On 20 March 2024 I endorsed an addendum to the Pyrmont DNVIS that covers the OOH use of the tower crane for unloading components of the deck and acoustic shed at the Pyrmont East site.

My endorsement was conditional and included a requirement for JCG to complete their investigation of the feasibility of source control of the crane (in the form of temporary noise blankets around the crane walkway) and, if found to be feasible, to implement the treatment within 4 weeks.

The 4-week period has now expired and JCG has proposed an extension of the deadline to complete their investigation and, if found to be feasible, to implement the treatment. My endorsement of 20 March noted that I would "consider an extension of dates pending the results of the work carried out during the initial period".

Notes

I understand that the delay in completing the investigation of source control feasibility is due, in part, to the Easter holiday period, which has led to delays in response from the crane supplier.

My endorsement of 20 March was based on an understanding that the tower crane could be used OOH, including up until midnight, on up to 3 occasions per week and 10 per month. However, the crane was only operated OOH on 25 March (until 10pm) and 16 April (until 10pm). On that basis I am satisfied that the proposed extension of dates does not amount to a significant increase in night-time impact for the affected receivers.

I also note that JCG will implement other feasible and reasonable ways to manage noise impacts, identified during the works completed to date. These include using lower crane engine revs and implementing ways to reduce noise from chains, such as sheaths (or similar).

Endorsement

I endorse the proposed extension of dates. The revised deadlines are as follows:

1. Implement the proposed source noise control: by 15 May.
2. Obtain evidence to confirm the effectiveness of source control, and to provide evidence to demonstrate that there are no further feasible and reasonable source control mitigation measures that could be implemented. Timing: as soon as practical after the source control is implemented, and before 29 May.

With the exception of the dates, all other requirements of my endorsement dated 20 March still apply.

[redacted]

[redacted], Metro West Acoustics Advisor