

Central Station Main Works

Construction Noise and Vibration Monitoring Program Report

August 2021 – January 2022

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1. Introduction

1.1 Background

Sydney Metro City & Southwest – Chatswood to Sydenham Project is a new 30km metro line extending metro rail from the end of Sydney Metro Northwest at Chatswood under Sydney Harbour, through new CBD stations and southwest to Bankstown. It is due to open in 2024 with the capacity to run a metro train every two minutes each way through the centre of Sydney. The Central Station Main Works Project (CSMW) forms part of the Sydney Metro City & Southwest – Chatswood to Sydenham Project. The works are undertaken by Laing O'Rourke.

The CSMW include the installation of new platforms that will be constructed using sophisticated excavation techniques to create a cavern with an island platform, beneath Central Station's existing heavy-rail platforms 13, 14 and 15. The works include new infrastructure and the adjustments to existing infrastructure at Central Station to construct, operate and maintain the Metro Station Works. The key features of the Central Station works include:

- a new north-south concourse for Central Station which will link the new metro station with the existing northern entrance and north concourse, a new east concourse, and the existing southern baggage tunnel; and
- adjustments to the existing Grand Concourse, Olympic Tunnel, Northern Concourse and northern entrance to Central Station.

The Central Walk works include the provision of infrastructure to provide improved connectivity and other operational enhancements throughout Central Station. The key features of the Central Walk works include:

- a new eastern entrance for Central Station on Chalmers St;
- a new east concourse for Central Station beneath existing platforms 16 to 23, which will link the new eastern entrance, the new north south concourse, existing platforms 16 to 23 and the existing Eastern Suburbs Railway (ESR) concourse; and
- provisions to enable the future construction (by others) of an extension of the Central Walk through a new west concourse and a new western entrance for Central Station.

1.2 Planning Requirements

In accordance with Minister's Condition of Approval (CoA) - C9, the Construction Monitoring Program was developed in consultation with the City of Sydney Council and the Environmental Protection Authority during the Construction Environmental Management Plan (CEMP) consultation and approval phase. Each construction monitoring program has been incorporated into the relevant CEMP sub-plan. The results of the Construction Monitoring Program will be submitted to the Secretary and relevant regulatory agencies for information. This Construction Noise and Vibration Monitoring Report covers the monitoring period from August 2021 to January 2022. The applicable CoA are shown in Table 1-1 and the applicable Environmental Protection Licence (EPL) Conditions are shown in Table 1-2 below.

Table 1-1: SSI 7400 Conditions relating to the Construction Monitoring Program

Condition	Requirement	Reference
C9	<p>The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each Construction Monitoring Program to compare actual performance of construction of the CSSI against predicted performance.</p> <p>Required Construction Monitoring Programs Relevant government agencies to be consulted for each Construction Monitoring Program</p> <p>Noise and Vibration - EPA and Relevant Council(s)</p> <p>Blasting - EPA and Relevant Council(s)</p> <p>Water Quality - EPA and Relevant Council(s)</p> <p>Groundwater - DPI Water/NRAR</p>	<p>Noise and Vibration – refer to the Construction Noise and Vibration Management Plan</p> <p>Blasting – Not applicable</p> <p>Water Quality – refer to the Construction Soil and Water Management Plan</p> <p>Groundwater - refer to the Construction Groundwater Management Plan</p>
C16	<p>The results of the Construction Monitoring Programs must be submitted to the Secretary for information, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program</p>	<p>The Construction Groundwater and Water Quality Monitoring Report will be submitted separately.</p> <p>The results of the Construction Noise and Vibration Monitoring Program are discussed in Section 3.</p> <p>In accordance with CoA C16, this report will be submitted to the following agencies for information:</p> <p>Department of Planning Industry and Environment</p> <p>NSW Environment Protection Authority</p> <p>City of Sydney Council</p> <p>The Independent Environmental Representative will review the reports prior to submission.</p>

Table 1-2: EPL 21148 Monitoring and reporting requirements

Condition	Requirement	Reference
M7.1	<p>Any noise monitoring must be undertaken in accordance with Australian Standard AS 2659.1 – 1998:</p> <p>Guide to the use of sound measuring equipment – portable sound level meters, or any revisions of that standard which may be made by Standards Australia, and the compliance monitoring guidance provided in the NSW Industrial Noise Policy.</p>	<p>Refer to the Construction Noise and Vibration Management Plan.</p> <p>Refer to S 2 for methodology and Appendix A of this report for Noise monitoring result summary.</p>
M7.2	<p>Any vibration monitoring must be undertaken in accordance with the technical guidance provided in the Environmental Noise Management Assessing Vibration: A Technical Guideline (DECC, 2006). All vibration monitoring results may be assessed and reported against the acceptable values of human exposure to vibration set out in Tables 2.2 and 2.4 of the guideline.</p>	<p>Refer to the Construction Noise and Vibration Management Plan.</p> <p>Refer to S 2 for methodology and Appendix B of this report for Vibration monitoring result summary.</p>

1.3 Submission Requirements

In accordance with condition C16, this report will be submitted to the following agencies for information:

- Department of Planning Industry and Environment
- NSW Environment Protection Authority
- City of Sydney Council

The Independent Environmental Representative and Acoustic Advisor will be provided with the report for information prior to submission.

1.4 Criteria

Standard Construction Hours

7:00am to 6:00pm Monday to Friday

8:00am to 1:00pm Saturday

Exceptional Construction Hours:

Due to the Government Gazette Notice No.75 – The standard construction hours at the Sydney Metro site at 20–28 Chalmers Street have changed to 7am-6pm Mon-Sun including public holidays. Works past 13:00 on Saturday or anytime on Sunday would comprise lower impact works including material load out and canopy tube drilling. No high noise impact work is permitted during the extended hours.

1.5 Noise

The LAeq15min is the conventional unit of measure for construction noise impact. It is the continuous average energy over a 15-minute period, measured in decibels (dB). The LAeq15min can be either airborne or ground borne.

In accordance with the EPA's Interim Construction Noise Guidelines (ICNG) and the Project's Construction Noise and Vibration Impact Statement (CNVIS), the Highly Noise Affected Management Level (HNML) of 75 dBA will apply to residential (dwelling) receptors.

Table 1-3 : Internal Noise Criteria

Area	Receptor type	Condition of Approval (CoA)	Time Period	Criteria
Identified Precincts in the CNVIS	All	E37/38	0700-2000	Leq, 15 minute 60 dBA internal, If more than 50% of time (6.5 hours total) Leq, 15 minute 55 dBA internal, more than 25% of time (3.25 hours total)

CoA 37 - The Proponent must identify all receivers likely to experience internal noise levels greater than Leq(15 minute) 60 dB(A) inclusive of a 5 dB penalty, if rock breaking or any other annoying 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 – 8pm at Central.

CoA 38 - The Proponent must consult with all receivers identified in accordance with Condition E37 with the objective of determining appropriate hours of respite so that construction noise (including ground-borne noise), does not exceed internal noise levels of:

- Leq(15 minute) 60 dB(A) inclusive of a 5 dB penalty if rock breaking or any other annoying 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) *Leq(15 minute) 55 dB(A) inclusive of a 5 dB penalty if rock breaking or any other annoying 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 condition does not apply to noise associated with the cutting surface of a TBM as it passes under receivers.*

Note This condition requires that noise levels be less than Leq(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 Leq(15 minute) 55 dB(A). Noise equal to or above Leq(15 minutes) 60 dB(A) is allowed for the remaining 6.5 hours between 7am and 8pm.

1.6 Vibration Criteria

Peak particle velocity (PPV) mm/s is the conventional unit of measure for construction vibration impacts for structural and cosmetic damage and can be applied to determine human comfort.

1.7 Vibration impacts for structural and cosmetic damage

The Sydney Metro Construction Noise and Vibration Strategy (CNVS) provides a conservative vibration damage screening level per receiver type given below:

- Reinforced or framed structures: 25.0 mm/s
 - Unreinforced or light framed structures: 7.5 mm/s
- This screening criteria relates Building Damage Vibration Management Levels (BS 7385) provided below.

Table 1.4

Line	Type of Building	PPV (mm/s) in the Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz & Above
L1	Reinforced or framed structures Industrial and heavy commercial buildings	50mm/s at 4 Hz and above	
L2	Unreinforced or light framed structures Residential or light commercial type buildings	15mm/s at 4 Hz increasing to 20mm/s at 15 Hz	20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above

Source: BS 7385, CNVS

The building damage management level (BS 7385) has been presented in graph form to help with interpretation. The higher the frequency (x axis), the less stringent the criteria for velocity becomes (y-axis) up to 50mm/s. In the example below, all data points fall below both the Line 1 (L1) (less stringent) and the Line 2 (L2) (more stringent) criteria. An exceedance would be observed if data point were to be observed above the L1 or L2 lines on the graph below.

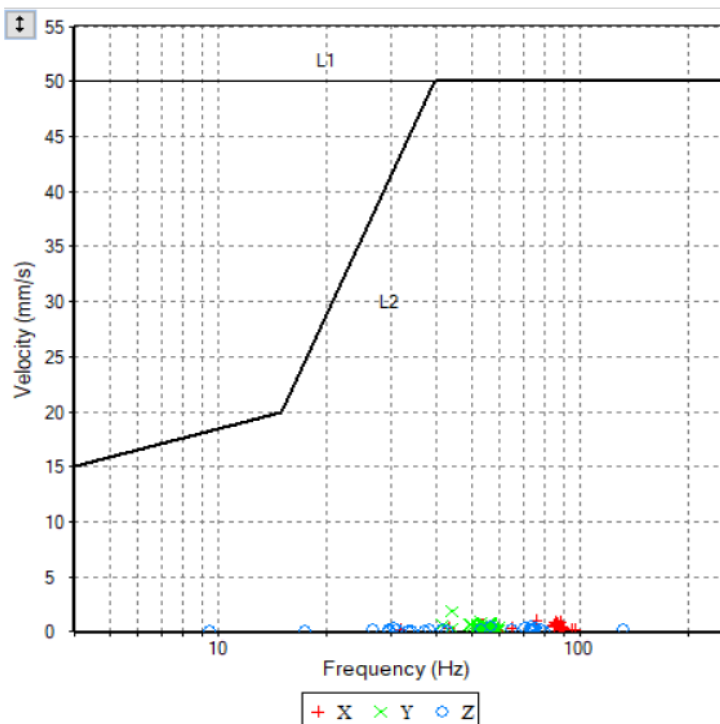


Figure 1: Example of criteria graphed. Note: All structures in the zone of potential construction impact of the Bounce Hotel demolition works are framed or reinforced, hence L1 criteria applies (50mm/s for all frequencies).

1.8 Human Comfort Criteria

The NSW Vibration Guideline provides guidance for assessing human exposure to vibration. The publication is based on British Standard BS 6472:1992.

Table 1.6:

Place	Time	Preferred PPV (mm/s)	Max PPV (mm/s)
Continuous Vibration			
Residences	Day	0.28	0.56
	Night	0.2	0.4
Offices	Day or night	0.56	1.1
Workshops	Day or night	1.1	2.2
Impulsive Vibration			
Residences	Day	8.6	17.0
	Night	2.8	5.6

Offices	Day or night	18.0	36.0
Workshops	Day or night	18.0	36.0

Values given for the most critical frequency range >8Hz assuming sinusoidal motion. Source - Table C1.1 – *The Assessing Vibration: A technical guideline*, NSW Department of Environment and Conservation

Vibration and its associated effects are usually classified as continuous, impulsive or intermittent as follows:

- Continuous vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time).
- Impulsive vibration is a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds.
- Intermittent vibration can be defined as interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude. It may originate from impulse sources (e.g. pile drivers and forging presses) or repetitive sources (e.g. pavement breakers), or sources which operate intermittently, but which would produce continuous vibration if operated continuously (for example, intermittent machinery, railway trains and traffic passing by). *Assessing Vibration: a technical guideline*, DEC NSW, February 2006. (Applicable for Vibration Dose Value (VDV)).

Vibration from the works can be subjectively considered as continuous or intermittent.

Conservatively and based on site observations and on what the receivers may experience, the vibration has been classified as continuous. As identified in Table 1.6 above, continuous vibration is measured in PPV. PPV is the preferred parameter for measuring vibration impacts as it can be obtained in real time, whereas VDV is more of a retrospective measure based on time exposure over a prolonged period of operation (i.e. 8hrs or 16hrs).

1.9 Perception relating to human comfort

An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other associations with the perceived source of the vibration. An indication of the human tactile perception of vibration of random motion is given in the table below.

Table 1.7

Approximate Vibration Level	Degree of Perception
0.10 mm/s	Not Felt
0.20 mm/s	Threshold of Perception
0.35 mm/s	Barely Noticeable
1.0 mm/s	Noticeable
2.2 mm/s	Easily Noticeable
6.0 mm/s	Strongly Noticeable

Source: German Standard DIN 4150: Part 2-1975 - Note: These approximate vibration levels (in

floors of buildings) are for vibration having a frequency content in the range of 8 Hz to 80 Hz.

The table above suggests that most people will be just able to feel continuous floor vibration at levels of about 0.20 mm/s, and that the motion becomes “noticeable” at a level of approximately 1.0 mm/s. The threshold for visible movement of susceptible building contents (e.g. plants, hanging pictures, blinds, etc) is approximately 0.5 mm/s and the audible rattling of loose objects (e.g. crockery) generally occurs at levels of about 0.9 mm/s.

These levels are considerably lower than the BS 7385 criterion of 15mm/s and well below the cited 12.5 mm/s level corresponding to a near-zero probability of damage (refer Sydney Metro CNVS section 5.4.3).

In any premises, day-to-day activities (e.g. footfalls, doors closing, etc) will cause levels of vibration in floors and walls that exceed 1 mm/s (sometimes by quite considerable margins), and therefore visible movement and rattling are often observed. In most instances, however, such movement is considered normal and vibration levels of even much greater magnitude do not result in damage to the objects or building contents.

Because people are able to “feel” very low levels of vibration (even though they may not be disturbed by the motion), it is common to associate building damage with perceptible vibration, particularly when the source of vibration is outside the building and out of the occupants’ control. This largely subjective response is particularly accentuated when perceptible vibration is accompanied by high noise levels, or if there are other adverse effects associated with the source of vibration (e.g. inconvenience, dust, etc).

The Assessing Vibration: A technical guideline, NSW Department of Environment and Conservation provides guidance for assessing human exposure to vibration. The publication is based on British Standard BS 6472:1992.

2. Methodology

The Construction Noise and Vibration Monitoring Program is designed to compare actual performance of construction of the CSSI against predicted performance and to assess the effectiveness of the mitigation measures applied during construction of the CSMW Project. The program has been executed in accordance with Section 10 of the Construction Noise and Vibration Management Plan (CNVMP) and recording requirements as specified in Section 10.2. The Construction Monitoring Program commenced 3 August 2018 and will continue for the duration of the project.

2.1 Sensitive Receivers

The CSMW Construction Noise and Vibration Impact Statement (CNVIS) assessed 50 sensitive receivers potentially affected by construction noise. The receiver locations are seen in the figure below.

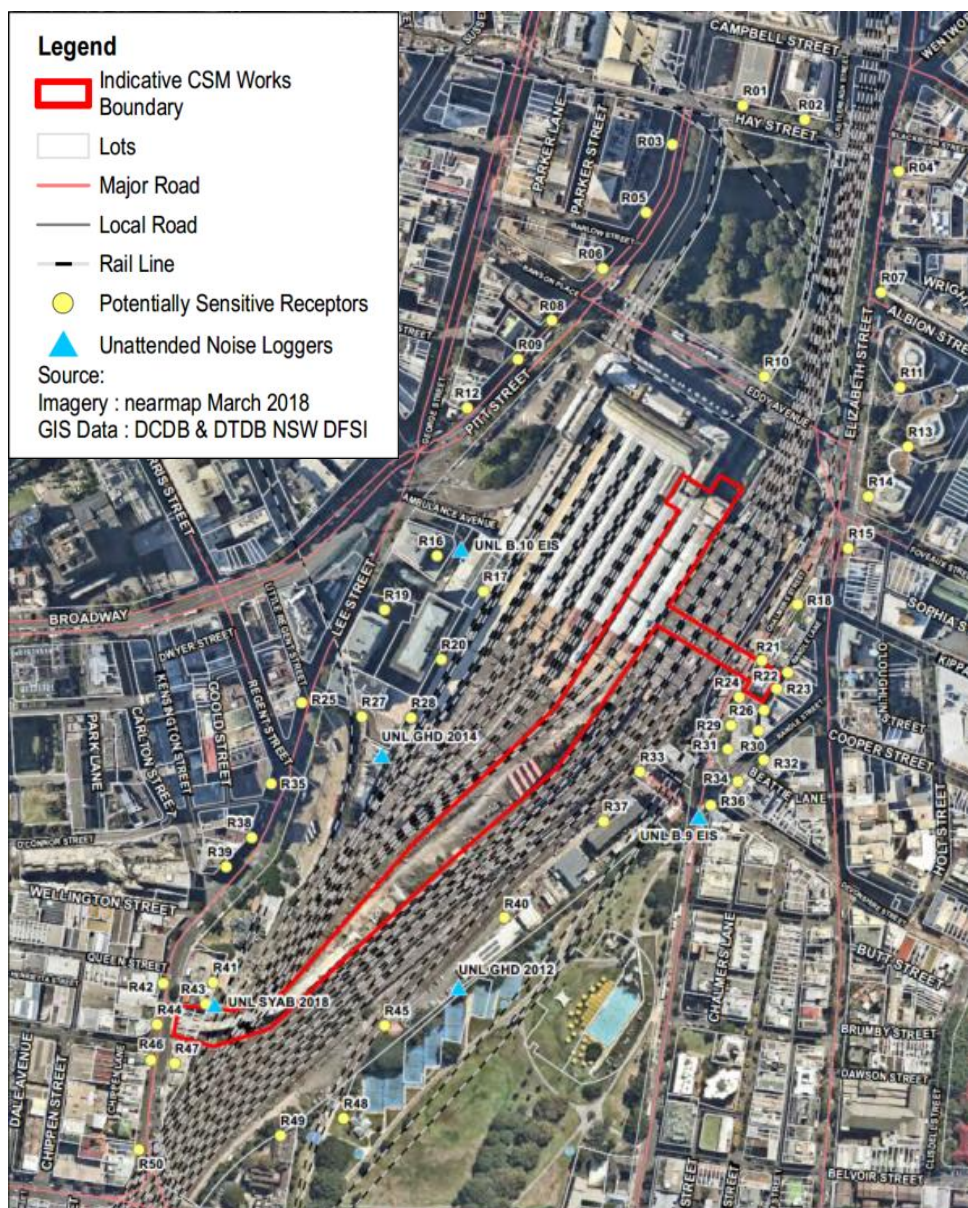


Figure 2-1: Location of Sensitive Receivers

CSM CNVIS

In accordance with CoA E33, ongoing consultation with sensitive receivers is undertaken as the project progresses based on the scenarios identified in the Construction Noise and Vibration Impact Statement (CNVIS). The scenarios are reviewed and refined with the input of construction detail to determine the potential impact and appropriate mitigation. All consultation with potentially affected receivers is undertaken prior to the start of the relevant portion of works. Additional mitigation measures are then tailored based on the consultation feedback.

2.2 Key Noise Monitoring Locations

Based on planned construction work, the area's most regularly impacted by construction noise and vibration during the reporting period are shown in Table 2-1 below:

Table 2-1: Estimated RBLs for Residential Receivers and NMLs for Non-Residential Receiver

Sensitive Receiver Category	Estimated RBLs (dBA)		
	Daytime	Evening	Night Time
Residential			
30 Chalmers St (R24)	56	53	45
38 Chalmers St (R29)	56	53	45
1 Randle St (R22)	56	53	45
YHA (R17)	54	52	49
54 Regent St (R43)	50	50	44
Non- Residential	Daytime	Evening	Night Time
Dental Hospital _ A (north) - 2 Chalmers St (R18)*	55	55	55

* Internal noise levels

2.3 Monitoring

In accordance with CoA C11 unattended real-time noise and vibration monitoring will be the focus of monitoring however attended noise and vibration monitoring is undertaken where specific circumstances warrant. Real-time noise loggers were installed at:

- the rear of 54 Regent Street on 12 December 2018 (the closest to traffic movements on Sydney Yard Access Bridge and activities in Sydney Yard)
- on the hoarding at the Bounce Hotel site at 20-28 Chalmers Street on 11 January 2019 (being the closest to the proximity of the Eastern Entrance works and Central Walk works)
- at the YHA (Platform 1) on 24 October 2019, decommissioned 29/06/2021.

Real-time vibration loggers were installed at:

- Central Station at the State Significant Heritage listed Train Crew Assignment Centre (previously titled the Central Electric building) on 10 January 2019, decommissioned 29/06/2021; and
- Façade of 30 Chalmers St on 14 October 2019, relocated to the centre of the site 19 January 2021, decommissioned 29 June 2021.

The noise and vibration impact due to construction has progressively tapered off as the site activities transition from demolition, excavation to building and installation. Through extensive

assessment and in consultation with the Acoustic Advisor, it was determined that some of the continuous monitoring was no longer warranted as described above. Attended monitoring will continue as required.

As per CoA C11 real time monitoring data was made available to the LOR construction team, Sydney Metro, the Environmental Representative (ER), the Acoustic Advisor (AA), the Department of Planning, Industry and Environment (DPIE) and the Environment Protection Authority (EPA) via the project website <https://centralstationmetro.com/documents/>.

Impacts from vibration are considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (structural / cosmetic damage). Of these considerations, the human comfort limits are the most stringent. Therefore, for occupied buildings, if compliance with human comfort limits is achieved, it will follow that compliance will be achieved with the building damage objectives. In accordance with CoA E28 and the requirements of the CNVIS, the vibration limits have been set in accordance with the British Standard BS 7385-2:1993. Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals (as is the case for select project works), noise or vibration monitoring is conducted at a nominated representative location (typically the nearest receptor where more than one receptor has been identified). Monitoring is also conducted in the event of a complaint being received or during OOHW where the Additional Mitigation Measures Matrix (AMMM) has identified monitoring as a requirement. In addition to monitoring required by the CoA and CNVMP, monitoring is conducted throughout Central Railway Station to assess the impact of construction activities on commuters and station staff with the results reported through a separate stakeholder management process. In the event of an exceedance of a predicted noise level, an investigation is undertaken followed by corrective actions as specified in the CNVIS and CNVMP if the exceedance was determined to be related to the project.

The results of the monitoring are communicated to relevant personnel when the noise or vibration goal is being approached so that work methodology or equipment being used can be altered, and / or additional management measures may be implemented where reasonable and feasible.

Table 2-2: Monitoring Equipment

Unit	Serial	Calibration Type	Frequency	Last calibration
Svantek 977 (noise logger)				
Svantek 977 (noise logger)	36834	Factory	Biennial	12/12/2019
Svantek SV33 (calibration unit)	43175	Factory	Biennial	28/05/2021
Chalmers St	59643	Factory	Biennial	30/03/2020
54 Regent St	59644	Factory	Biennial	27/04/2020
Svantek 958A (vibration logger)				
Svantek 958A (vibration logger)	59157	Factory	Biennial	28/05/2021
Svantek SV84 (transducer)	E3496	Factory	Biennial	28/05/2021

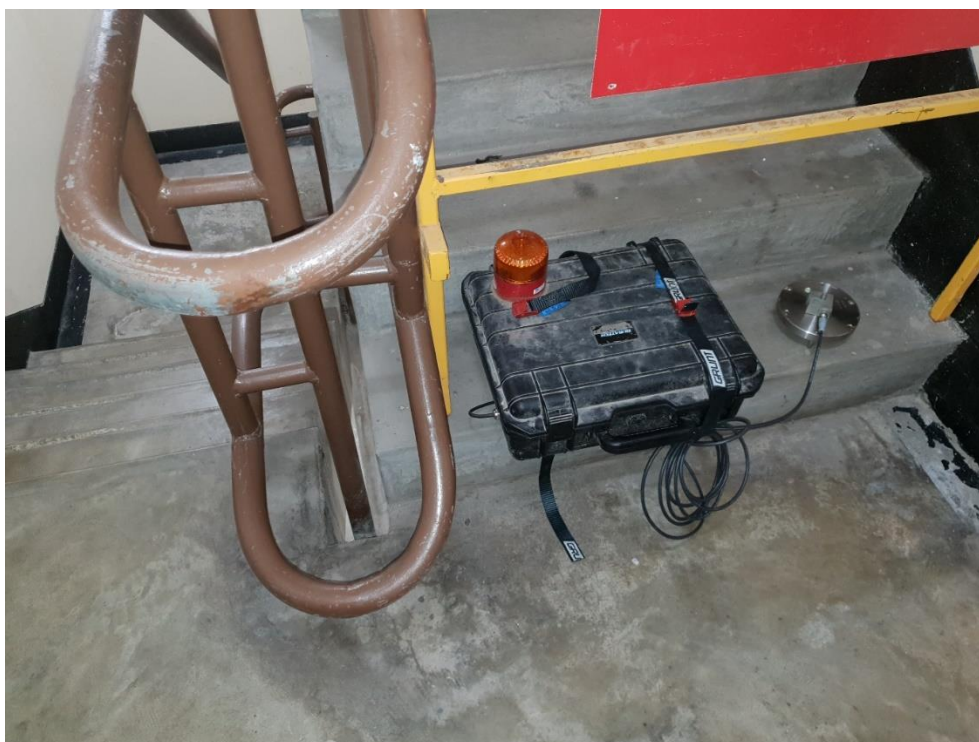


Figure 2-2: Unattended vibration Logger set up at the Dental Hospital southern stairwell



Figure 2-3: Attended noise logger setup on Chalmers St



Figure 2-4: Real time vibration logger 30 Chalmers St



Figure 2-5: Real time noise logger setup at 54 Regent St (in the process of being serviced), installed 12/12/2018

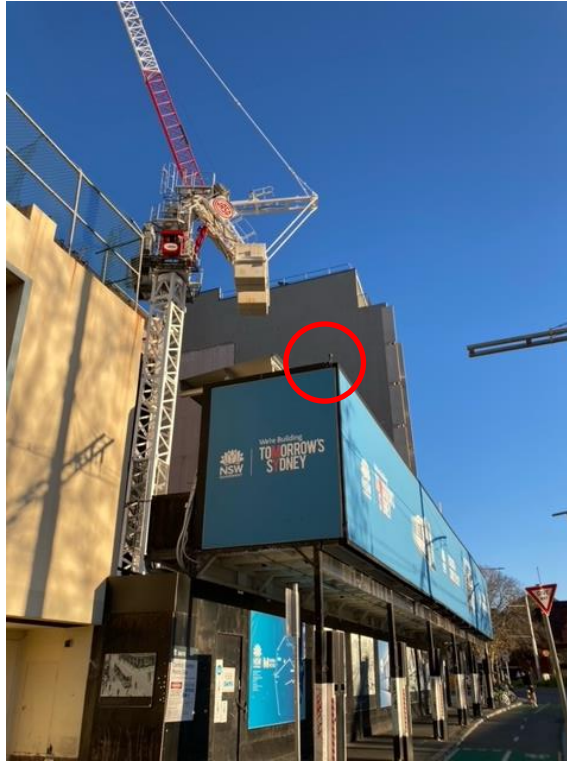


Figure 2-6: Real time noise logger Chalmers St, installed 11/01/2019



Figure 2-7: Real time vibration logger Central Electric Building, installed 11/01/19

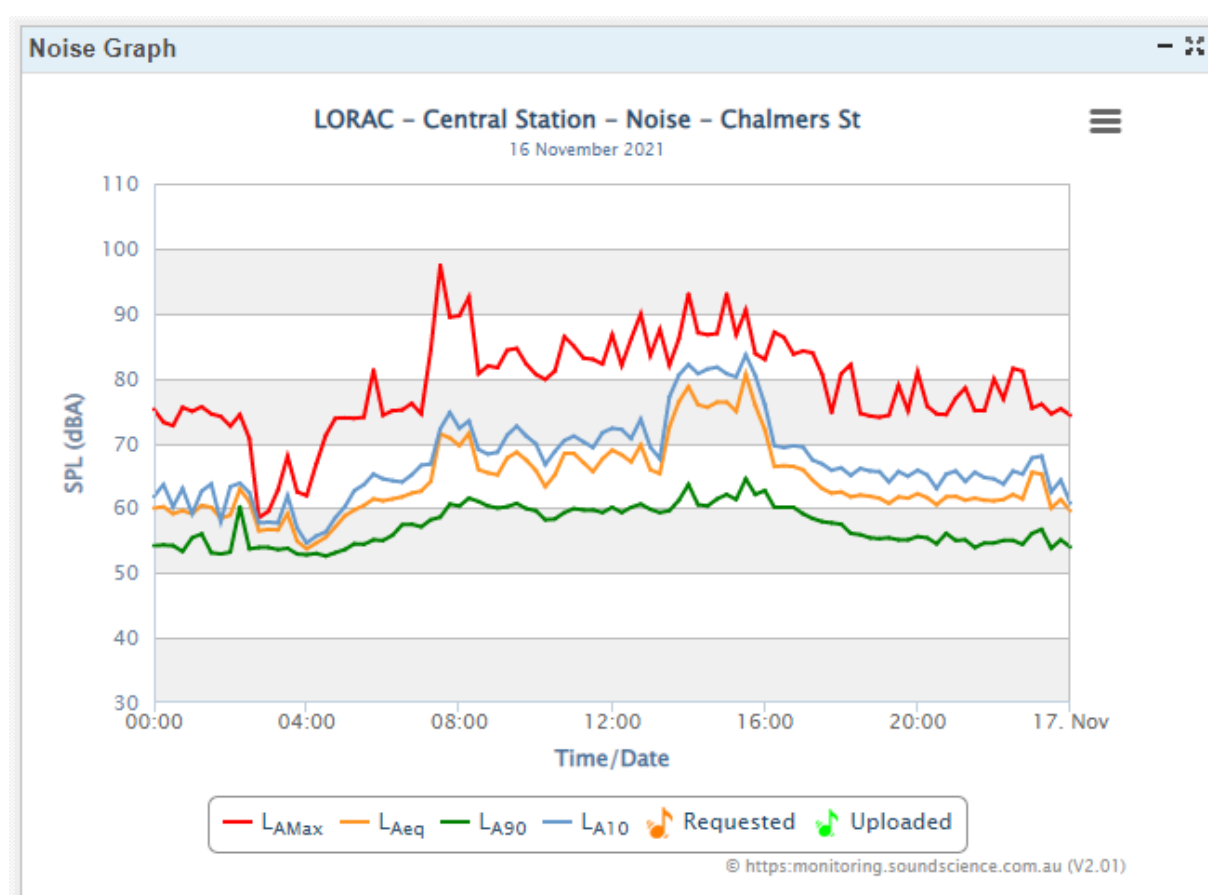


Figure 2-8: Example of real time noise monitoring data

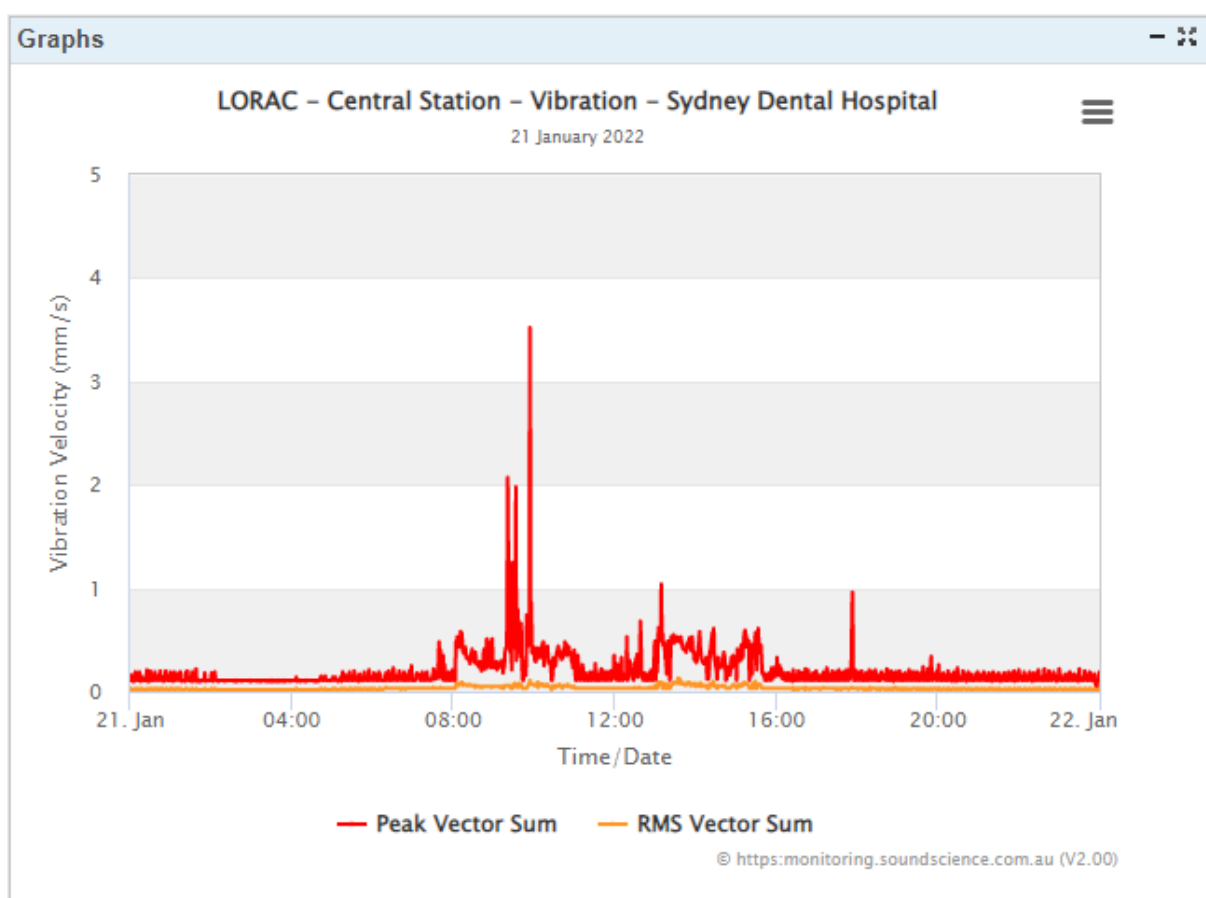


Figure 2-9: Example of real time vibration data. Graph showing general background vibration levels.

Note: general background level slightly elevated due to repositioning geophone to ground level where it is more readily influenced by heavy and light rail movements.

2.4 Noise Monitoring Frequency

Activities were assessed in the CNVIS under the following scenarios. During detailed planning of the activities to be conducted around rail possessions some of the activities were conducted concurrently. The potential noise impacts were reassessed on a monthly basis. Because the works are subject to an EPL, the Out of Hours Work Protocol as per CoA E47 is not applicable. To demonstrate due diligence and establish appropriate additional mitigation measures, the CSM works are assessed and documented on a monthly basis.

Table 2-3: Monitoring requirements for construction scenarios.

ID	Description	Frequency (as per AMMM)
SCN 01	Platforms & Sydney Yard: Stage 6 – Installing Services/Wiring	During OOH works
SCN 02	Platforms & Sydney Yard: Stage 7 – Installing Services / Hoarding / Offices	Daytime standard construction hours
		During OOH works
SCN 03	Platforms & Sydney Yard: Stage 7, 9 & 11 - Combine Services Route / Demolition of Sydney	During OOH work

ID	Description	Frequency (as per AMMM)
	Yard Buildings / Salvage Canopy/ Remove Track / Remove Waste	
SCN 04	Platforms & Sydney Yard: Stage 8 & 10 - OHW on Platform 11/12 / Replace Track Country End 12/13 / Installing CSR	During OOH works
SCN 05	Stage 12 - Piling Works / Removing Track	During OOH works
SCN 06	Platforms & Sydney Yard: Stage 13	Daytime standard construction hours/ During OOH work
SCN 07	Platforms & Sydney Yard: Stage 14, 16, 18 & 20	Daytime standard construction hours/ During OOH work
SCN 08	Platforms & Sydney Yard: Stage 15,17 & 19	Daytime standard construction hours/ During OOH work
SCN 09	Metro Box: Piling for the box perimeter and the plunge columns	Daytime standard construction hours/ During OOH work
SCN 10	Metro Box: FRP Capping Beam	Daytime standard construction hours/ During OOH work
SCN 11	Metro Box: Excavation to underside of Intercity Slab	Daytime standard construction hours/ During OOH work
SCN 12	Metro Box: FRP Platform and Intercity slab	Daytime standard construction hours
SCN 13	Metro Box: Excavation to underside of Metro Concourse	During OOH works
SCN 14	Metro Box: Ongoing Logistical support of Box Construction	During OOH works
SCN 15	Central Walk: Site investigation Works (Tracks 16-23)	Daytime standard construction hours/ During OOH work
SCN 16A	Central Walk: Construction of Olympic Stairs (Temp) - Platform 20/21 and 22/23	During OOH works
SCN 16B		
SCN 16C		
SCN 16D		
SCN 17	Central Walk: Construction of the new Standby Guards Rooms / demolition of existing standby guards rooms	Daytime standard construction hours
		During OOH works
SCN 18	Central Walk: Construction of Platform Canopy Support System to Platforms 16 to 23 and Excavation of Launch Chambers	During OOH works
SCN 19	Central Walk: Platform works including works below the top slab	During OOH works
SCN 20	Central Walk: Platform Remodelling works including platform canopy modifications	During OOH works
SCN 21	ESR: Construction of Shaft to ESR Ghost Platform	Daytime standard construction hours
SCN 22	ESR: Surface Works and Underground works	During OOH works
SCN 23	East Entrance: Demolition of the Bounce Hotel	Daytime standard construction hours
SCN 24	East Entrance: Piling for East Entrance	Daytime standard construction hours
SCN 25	East Entrance: Excavation of East Entrance	Daytime standard construction hours

ID	Description	Frequency (as per AMMM)
SCN 26	East Entrance: Excavation of Adit to ESR Concourse including Canopy Tube installation	Daytime standard construction hours
SCN 27	East Entrance: FRP works to East Entrance	Daytime standard construction hours
SCN 28	East Entrance: East Entrance Works and Underground Works	Daytime standard construction hours
SCN 29	Grand Concourse: Piling in Grand Concourse	During OOH works
SCN 30	Grand Concourse: FRP Pile caps	Daytime standard construction hours
		During OOH works
SCN 31	Grand Concourse: Removal of Existing Canopies	During OOH work
SCN 32	Grand Concourse: Installation of precast / in situ columns and arches	Daytime standard construction hours
		During OOH works
SCN 33	Grand Concourse: Installation of Roof Structure	Daytime standard construction hours/ During OOH work
SCN 34	Northern Concourse & North Entry: Demolition Southern Half	Daytime standard construction hours
SCN 35	Northern Concourse & North Entry: FRP of Structure (Floor, retaining wall, Columns)	Daytime standard construction hours
SCN 36	Northern Concourse & North Entry: Demolition Northern Half	Daytime standard construction hours
SCN 37	Northern Concourse & North Entry: FRP of Structure (Floor, retaining wall, Columns)	Daytime standard construction hours
SCN 38	Northern Concourse & North Entry: Installation of remaining precast columns and Arches	Daytime standard construction hours
SCN 39	Sydney Yard Access Bridge: Heavy Vehicle Traffic on the SYAB	Daytime standard construction hours
		During OOH works

The activities in the OOH were assessed against the scenarios in the CNVIS as show in Table 2-3 above through the OOH assessment process.

2.5 Out of Hours Works Summary

Generally, OOHW at Central Station are scheduled either when trains stop running or electrical isolation has been provided. OOHW are required to provide safe access for personnel and plant to the rail corridor to complete the required works. Additional Mitigation and Management Measures (AMMM) are adopted as required. OOHW are governed by the CoA and reflected in the EPL as required by Part 3.1 Section 45 (i). An EPL (EPL 21148) was issued for the Project on 28 November 2018. The LOR Environmental Manager provides internal approval for any Out of Hours Work (OOHW) conducted under the project EPL.

3. Monitoring Results

3.1 Noise

Construction noise levels for some CSM work activities are predicted in the CNVIS to exceed the external noise management level at times, particularly during works outside of standard hours. Attended and unattended real time noise monitoring was undertaken during the reporting period as required for OOHW, particularly during possessions where noise modelling predicted exceedance of noise management levels.

As identified by modelling in the CNVIS, the majority of noise impacts have occurred at the closest sensitive receivers predominantly on Chalmers Street. Standard mitigation measures were implemented as per Section 8 of the CNVMP and Section 8 of the CNVIS. Additional mitigation and management measures were implemented as per the OOHW approvals. Additional respite periods during high noise activities were provided to Sydney Trains staff and commuters by not undertaking high noise impact activities during peak hours as well as using one of three noisy work programs:

- 1) Working three hours on and one hour off, and then repeating this cycle, or;
- 2) Working 45 minutes on with 15 minutes off for three hours, followed by one-hour break and then repeating this cycle.
- 3) Working one hour on, half hour off

Specific respite periods were also negotiated with the Dental Hospital.

The real time noise data was reviewed at the time of potential high noise impact works by site supervisors. The playback function allowed for differentiation of construction noise from ambient noise levels. Notable high ambient noise levels were recorded during attended noise monitoring sessions and from playback recordings downloaded from the real time logger at Chalmers Street, and Regent Street. Common extraneous noise sources include:

- Other construction works on Chalmers and Elizabeth Streets, particularly maintenance works
- Residences or pedestrians near the measurement position
- Wind-blown vegetation and insects
- Road traffic on public roads, particularly applicable at 54 Regent Street
- A street sweeper going past on Chalmers St
- Light rail on Chalmers St
- Noise from trains passing, diesel trains idling in the intercity platforms, announcements, and train signalling horns at the YHA; and
- Noise from fauna; specifically, cockatoos and seagulls – the latter of which are often active throughout the night.

Noise monitoring results are detailed in Appendix A. Monthly noise data tables have been prepared for each sensitive receiver. The objective of the data tables is to validate the predictions for the specific activities as documented in the CNVIS. To obtain a greater understanding of the noise environment the 'adjusted' ($10 \times \log$ of the attribute) and 'non-adjusted' values are analysed. This is explained further below, and a quick reference table is provided in Table 3-1.

Table 3-1: $10 \times \log$ (attribute) quick reference table

Attribute: % Contribution of magnitude	$10 \times \log(\text{attribute})$ Reduction in dB	Attribute: Event duration (x mins per 15min measure)	$10 \times \log(\text{attribute})$ Reduction in dB
5	-13	1	-12
10	-10	2	-9
15	-8	3	-7

20	-7	4	-6
25	-6	5	-5
30	-5	6	-4
35	-5	7	-3
40	-4	8	-3
45	-3	9	-2
50	-3	10	-2
55	-3	11	-1
60	-2	12	-1
65	-2	13	-1
70	-2	14	0
75 to 85	-1	15	0
90 to 100	0		

Note 1: The Decibel (dB) is a relative unit of measurement corresponding to one tenth of a bel. It is expressed on a logarithmic scale, hence the ratio between decibels also need to be quantified logarithmically.

Note 2: The % Contribution of magnitude is a relatively subjective measure. To keep the methodology repeatable as is required by scientific method, only 5%, 50% and 100% contributions are used in the assessment.

Example: A noise file was reviewed that captured saw cutting. The unadjusted $L_{Aeq15min}$ was 64dB. When in operation the contribution of the saw was 50% to the noise environment due to the distance and use of noise attenuating screens. The other 50% was construction noise confirmed not to be associated with CSM. The saw cutting lasted for 6 minutes over the 15-minute period.

$$64dB + [10 \cdot \log(0.5)] + [10 \cdot \log(6/15)] = 57dB.$$

Therefore the 'unadjusted $L_{Aeq15min}$ ' is 64dB and the 'adjusted $L_{Aeq15min}$ ' is 57dB.

In this example regardless of the 7dB difference, the mitigation for the impact remains the same.

A precautionary approach is used as follows:

- The 'unadjusted $L_{Aeq15min}$ ' measure is used to determine potential noise impact in real time to adjust works in real time accordingly. The next $L_{Aeq15min}$ period can be improved from the last.
- The 'adjusted $L_{Aeq15min}$ ' measure is used as an indicative noise level. It is a tool used to better understand the noise impact contribution of the project on the surrounding noise environment. The adjusted measure was particularly useful when separating CSM works from rail operational noise, and other construction work in the local area not associated with the project.
- It is difficult to assign a percentage of magnitude, so typically 5% is assigned for no magnitude, 50% if other works or noises are still contributing, or 100% if no other works or impacts can be heard at the time of use of that equipment.
- Not all files are 'adjusted' as the corrections are not always applicable due to the dominant nature of the activity, or the works are considered inaudible.
- The $L_{Aeq15min}$ of highest noise period is selected for assessment.
- The data table is prepared to ensure results can be verified.

The real time data is reviewed by the night supervisors by smart phone at the time of a noisy activity with the potential to impact the community. This allows for a review of the $L_{Aeq15min}$ period against predictions. If required, the work methodology is adjusted where feasible. During scheduled rail possessions, options such as amending construction practices and schedules to reduce noise impacts by carrying out the works during less noise sensitive times is not feasible due to a large majority of complex works occurring in limited track and platform possession windows. Additional respite offers have been in the form of customised noise attenuating ear plugs and extensive communications.

Generally, exceedances of predicted noise levels were typically attributed to extraneous noise rather than construction activities (comparing adjusted to non-adjusted). Zero non-conformances were raised during the reporting period for an exceedance attributed to the incorrect implementation of noise mitigation measures or AMM's.

3.1.1 [Possession based noise monitoring](#)

During this reporting period between August 2021 and January 2022, 18 rail possessions were planned. Several of these involved possessions occurring simultaneously on the Suburban Tracks, Intercity Platforms, or the North/Grand Concourse. The possessions likely to be associated with the greatest impact were associated with platform resurfacing/relevelling and drainage works within the Suburban platforms (refer Scenario 18 and 22 in the CNVIS). The works occurring on site included temporary works, excavation, spoil removal, jackhammering and saw cutting, platform relevelling and finishes works.

Platform relevelling works improve drainage, accessibility of the platforms by commuters moving between the platforms and trains, as well as improve the overall aesthetic of the platform surfaces. Re-leveling works typically comprise the removal of the upper layer of the platform surface (concrete, screed and tile) and coping edge, followed by the placement of a newly graded surface comprising concrete, screed and new tiles, as well as drainage channels and pits. The scope of works occurred in several stages across 2020 and 2021, and required wall saws, road saws and excavators with hammer attachments to remove the entire platform surface.

To achieve this, the following was conducted prior to each noisy possession:

- Proactively engage with residents in advance / during cumulative noisy activities to address any specific requirements of sensitive receivers.
- Help residents to understand the reasoning why the work is undertaken out of hours. (due to strict staged program)
- Help residents understand the future benefits (end state) of Central Walk construction.

The outcome of the objectives was measured as follows:

- 8 complaints were received during the period
 - Two were about works not related to Central Station Metro
 - Five were unavoidable
 - One was avoidable (A complaint was received about the noise coming from the workers' stereo. Noise data was reviewed to validate the predictions for CSM works. The noise levels were within the CNVIS predictions. The works occurring at the time of the complaint consisted of HAZMAT removal, hoarding relocation, services and fit out. The site team was briefed, and future workers will toolbox talked on public facing behaviours.)
- Number of residential places/businesses spoken to:
 - Quarterly letter goes to +19,000 letterboxes

- Bi-monthly letter goes to +3,500 letterboxes
- Each specific notification has been distributed to about 150 letterboxes adjacent to the site (businesses & residents),
- Weekly email reminder to a distribution list of 2,250 email addresses.

Generally, exceedances of predicted noise levels were typically attributed to extraneous noise rather than construction activities (comparing adjusted to non-adjusted). Zero non-conformance reports were raised during the reporting period for an exceedance attributed to incorrect noise mitigation measures being emplaced or a failure to implement the correct AMMs as per the CNVIS predictions.

The possession monitoring results demonstrate that there were no exceedances of predictions associated with CSM works at sensitive receivers.

4. Complaints

There was a total of 8 complaints received during the reporting period, with 6 relating to noise and/or vibration. A break-down of these complaints is shown below in Table 4.1.

Table 4-1: Complaint breakdown.

* Note: Complaints with an asterisk were part of a noise related complaint.

Refer to Section 3.1.1 for more details on communications.

The table below summarised actions undertaken following complaints over the current and past

Month	Noise	Vibration	Other	Monthly Total
August	0	0	1	1
September	1	0	0	1
October	2	0	0	2
November	3	0	1	4
December	0	0	0	0
January	0	0	0	0
Totals	6	0	2	8

reporting periods, as well as proactive actions undertaken to minimise the number of complaints. Actions listed are in addition to the monthly & quarterly notifications and email update to the overall project database. Any monitoring undertaken and listed below are in addition to the real time loggers installed around the construction site.

Table 4-1: Sensitive receiver monitoring

Sensitive receivers	Monitoring undertaken	Description of action
Sydney Trains / NSW TL	Yes – ongoing	Staff briefings and meetings to cascade information (Performed via virtual meetings due to COVID - restrictions)
GF01, 30 Chalmers St (Columbus & Co Central)	Yes (Feb-May), no longer required (June onwards)	Ad hoc noise monitoring inside the business as required by construction activities Regular catch up with business owner in person or via phone calls (less often due to COVID - restrictions) Weekly email (1WLA): Tailored communication to Café's owner with upcoming potential high noise/vibration impact activities. Note: A new grocery delivery service opened in this reporting period.
GF02, 30 Chalmers St (Gou Sushi)	Not required	Adhoc catch up with business owner, as required by construction activity (less often due to COVID-restrictions).
30 Chalmers St (Building owner/Strata company)	Yes - ongoing	Sharing monthly noise and vibration monitoring report with the building owner/strata manager.
GF, 38 Chalmers St (City Convenience Store, open 24/7)	Not required	Adhoc discussion with business owner (less often due to COVID – restrictions). Discussion with staff/owner about the status of Randle Lane and OOHV at Central Station as required.
2 Chalmers St (Dental Hospital)	Yes - ongoing	Weekly email (1WLA): Tailored email to Hospital's representative if upcoming high noise/vibration impact is scheduled Three work update briefings for key representatives during this reporting period.
GF, 1-5 Randle St (University Preparation College)	As required	Adhoc discussions with key representatives and staff (less often due to COVID – restrictions).
YHA	As required	Adhoc discussion with key representatives and staff (less often due to COVID – restrictions). Tailored email summary about work activities on Platform 1.
Lee Street buildings	As required	Tailored email summary about work activities on Platform 1 and in the Lee Street driveway.
30 Chalmers St + 38 Chalmers T + 1-5 Randle St (106 units)	Yes – real time only, offered as well if required	<ul style="list-style-type: none"> Specific notification and tailored email to provide update related to status of Randle Lane and OOHV at Central Station with the potential to generate high noise/vibration impact. Attended monitoring was undertaken for a resident in 38 Chalmers St in July. Results are detailed in Appendix A.
52 & 54 Regent Street	Yes – real time	<ul style="list-style-type: none"> Installation of specific real time noise monitoring at the start of the project and noise assessment of truck movements.

* As part of the engagement strategy, the Community Relations team delivered a presentation to workers at 20-28 Chalmers Street site to raise awareness of the surrounding neighbourhood, construction work implications and key mitigation measures.

5. Conclusion

The requirements for noise and vibration monitoring are detailed in the CNVIS and CNVMP. A combination of both real time and attended monitoring has occurred at the closest sensitive receiver locations on Chalmers St, and 54 Regent St during this reporting period. These receivers are considered representative of the area and were used to validate the modelled construction noise. Monitoring records have validated modelled noise and are generally consistent with the predicted impact of construction activities on noise sensitive receivers. As discussed in Section 4, there were a total of 8 complaints related to noise and vibration that were received during the reporting period.

As determined in the planning phase, the potential for physical at source mitigation was limited for platform releveling works on the suburban platforms. Over the reporting period, there were a few minor exceedances of individual $L_{Aeq15min}$ periods, which did not change the application of the AMM's given the thorough notification and community engagement strategy employed by the Community and Stakeholder Management Team at CSM. The communications element (governed partly by the Communications Strategy and partly by the AMM's) was the key mitigation in meeting the best achievable performance objectives of the CNVIS and community expectation.

Appendix A – Noise Monitoring Summary

Date	Time	LOR Works (potentially noisy as per diary entry)	Continuous Real Time or Attended (C or A)	CNVIS SCN	Sensitive Receiver	Observed LAeq15min (dB)	NML for sensitive receiver (dB) (NML=RBL+5dB)	Period Day / Evening / Night	LAeq15min Exceedance of NML (dB)	RBL for Sensitive Receiver	Predicted Exceedance as per OOH for particular activity (RBL)	Exceedance of Predicted OOH (adjusted)	Exceedance of Predicted OOH (non-adjusted, with HN penalty)	Comments
August 2021														
1/08/2021	15:45:00	CW: Sydney Trains maintenance track works. No LOR works due to COVID shutdown.	C	20	Chalmers St	69	61	Day	8	45	27	0	0	Noisy works audible - unsure whether construction or maintenance. Consistent sound of air legging throughout recording. Confirmed not related to CSM works.
1/08/2021	16:30:00	CW: Sydney Trains maintenance track works. No LOR works due to COVID shutdown.	C	20	Chalmers St	72	61	Day	11	56	16	0	0	Same as previous, as well as LR audible. Confirmed not related to CSM works.
3/08/2021	15:36:00	Monitoring CW breaking from inside the new ESR bubble 2 for Occ Hygiene levels. Inside new office space.	A	19	Chalmers St	52	61	Day	-9	56	6	0	0	CW breaking audible from inside bubble 2, approx. 30m from source. Intermittent. Definitely audible but respite provided. Likely not audible from Chalmers St receiver. Monitoring not undertaken at any sensitive receivers.
4/08/2021	3:00:00	CW: working on P16/17 southern escalator scaffold to continue installation of the base channels. P18 C1 screw in the rebar to the couplers, Cb2 N Cb3 breakout overpour. P20/21 and 22/23 lift pit break out cast ins. NC: working on northern elevation scaffold of TCAC.	C	20	Chalmers St	67	50	Night	17	45	27	0	0	Some light construction noise audible, however, spike attributed to the same unidentified noise as in previous months that occurs around 2-3am.
4/08/2021	14:45:00	EE: Tower crane deliveries. Traffic deck: multiple concrete trucks idling.	C	25	Chalmers St	70	61	Day	9	56	25	0	0	General construction noise audible, as well as daytime trains and LR. No particular plant audible.
5/08/2021	2:30:00	CW: works continuing as per previous night. NC: working on northern elevation scaffold of TCAC.	C	20	Chalmers St	63	50	Night	13	45	27	0	0	Some light construction noise audible, however, spike attributed to the same unidentified noise as in previous months that occurs around 2-3am.
6/08/2021	1:45:00	CW: P20/21 escalator pour, extend southern hoarding ahead of escalator install. MB: MH1 traffic deck grouting.	C	20	Chalmers St	64	50	Night	14	45	27	0	0	Some light construction noise audible. Extraction fan audible. Emergency response vehicle drives past at 3-minute mark. Trains and LR intermittently throughout recording. Lots of car honking. Another emergency response vehicle drives past at around 11-minute mark.
6/08/2021	7:15:00	EE: deliveries at Randle Lane and tower crane in use.	C	25	Chalmers St	81	61	Day	20	56	25	0	0	Spike attributed to birds squawking directly next to monitor the very beginning of recording.
7/08/2021	2:45:00	MB: trimming underneath DST, drilling and epoxy works zone 1. Cutting de-load plunge column on GL20, B2, B1 and NSC levels. Once all columns have been cut, concrete break out at metro track level can commence.	C	12	Chalmers St	68	50	Night	18	45	29	0	0	Some light construction noise audible, however spike attributed to the same unidentified noise as in previous months that occurs around 2-3am.
7/08/2021	3:00:00	MB: trimming underneath DST, drilling and epoxy works zone 1. Cutting de-load plunge column on GL20, B2, B1 and NSC levels. Once all columns have been cut, concrete break out at metro track level can commence.	C	12	Chalmers St	64	50	Night	14	45	29	0	0	Some light construction noise audible, however spike attributed to the same unidentified noise as in previous months that occurs around 2-3am.
7/08/2021	4:15:00	MB: trimming underneath DST, drilling and epoxy works zone 1. Cutting de-load plunge column on GL20, B2, B1 and NSC levels. Once all columns have been cut, concrete break out at metro track level can commence.	C	12	Chalmers St	63	50	Night	13	45	29	0	0	Light construction noise audible. What sounds like a truck idling adjacent to the logger starts at 2-minute mark - likely a truck in loading dock of SDH and not related to CSM works.
7/08/2021	17:00:00	No noisy works as per night shift diaries. SCN20 chosen as most conservative.	C	20	Chalmers St	70	61	Day	9	56	16	0	0	General construction noise audible, as well as daytime trains and LR. No particular plant audible. Extraction fan vaguely audible in the background.
7/08/2021	22:00:00	No noisy works as per night shift diaries. SCN20 chosen as most conservative.	C	20	Chalmers St	62	50	Night	12	45	27	0	0	General construction noise audible, as well as daytime trains and LR. No particular plant audible. Extraction fan vaguely audible in the background.
8/08/2021	12:45:00	MEP works in Northern Concourse and Eddy Avenue, ESR BOH and EE. NC likely loudest impact.	C	35	Chalmers St	68	61	Day	7	56	20	0	0	Light construction and background noise. At about 6-minute mark, very loud air legging noise, similar to the one that occurs frequently at 3am. Not related to CSM works as the works listed do not correlate with noise audible.
8/08/2021	14:00:00	MEP works in Northern Concourse and Eddy Avenue, ESR BOH and EE. NC likely loudest impact.	C	35	Chalmers St	76	61	Day	15	56	20	0	0	Max 101.5 (Sunday). Spike attributed to birds squawking directly next to logger at 6-minute mark.
13/08/2021	1:45:00	No noisy works as per night shift diaries. SCN20 chosen as most conservative.	C	20	Chalmers St	64	50	Night	14	45	27	0	0	Very loud clanging/banging happening intermittently throughout recording. Unsure whether related to CSM works or not - worst case scenario assessed, within predictions.

13/08/2021	10:45:00	EE: preparing for concrete wall pour from basement level to metro concourse.	C	20	Chalmers St	72	61	Day	11	56	16	0	0	Light construction and background noise. At about 6-minute mark, very loud air legging noise, similar to the one that occurs frequently at 3am. Unsure whether related to CSM works as could be related to EE works. Worst case scenario assessed, within predictions.
15/08/2021	17:00:00	NC glazing and mobile crane installation to lift glazing panels. MEP works lower northern concourse, Eddy Ave, and Ghost Platform.	C	35	Chalmers St	71	61	Day	10	56	20	0	0	Train announcements and LR movements audible. Spikes attributed to LR passing.
16/08/2021	16:15:00	EE deliveries at Randle Lane and tower crane in use.	C	25	Chalmers St	78	61	Day	17	56	25	0	0	Light construction noise audible. Trains and LR. At 3:45 bird chirps loudly next to logger, accounting for spike.
16/08/2021	22:15:00	NC: works on platform ends (P11). Hoarding amendments on P16. CW: Hi rail deliveries of buffer stop, monorail beam and gantries to P20/21. Drill and fix buffer stop, install monorail beam. NASS demo works in ESR.	C	22	Chalmers St	65	50	Night	15	45	27	0	0	Light construction works audible, as well as train and light rail. Spike attributed to loud train brakes squeaking at around 10-minute mark.
17/08/2021	2:30:00	NC: works on platform ends (P11). Hoarding amendments on P16. CW: Hi rail deliveries of buffer stop, monorail beam and gantries to P20/21. Drill and fix buffer stop, install monorail beam. NASS demo works in ESR.	C	22	Chalmers St	61	50	Night	11	45	27	0	0	Construction noise audible, sounds like platform works. Cannot make out specific plant but faint drilling noise occurs intermittently throughout the recording.
17/08/2021	8:15:00	EE: preparing for concrete wall pour from basement level to metro concourse.	C	27	Chalmers St	72	61	Day	11	56	24	0	0	Construction noise audible, along with background LR and trains. Bird squawks next to logger at around 2:30 minute mark accounting for spike.
20/08/2021	9:58:00	New Ancillary Facility crib room up and running with silent generator. ATF with noise blankets around generator. Generator Barely audible.	A	28	Chalmers St	67	61	Day	6	56	19	0	0	Attended monitoring undertaken at the ATF around the generator at the new Ancillary Facility to get an idea of noise level. Generator running however quiet - crossing and light rail is much louder than generator.
22/08/2021	16:45:00	No noisy works as per night shift diaries. SCN20 chosen as most conservative.	C	20	Chalmers St	71	61	Day	10	56	16	0	0	Spike attributed to birds squawking directly next to monitor at very beginning of recording.
22/08/2021	17:15:00	No noisy works as per night shift diaries. SCN20 chosen as most conservative.	C	20	Chalmers St	69	61	Day	8	56	16	0	0	Spike attributed to birds squawking directly next to monitor at around 7-minute mark.
23/08/2021	7:00:00	No noisy works as per night shift diaries - RDO. SCN20 chosen as most conservative.	C	20	Chalmers St	71	61	Day	10	56	16	0	0	Spike attributed to birds squawking directly next to monitor at around 3-minute mark.
26/08/2021	12:15:00	EE: tower crane deliveries in prep for concrete pour and deck removal.	C	27	Chalmers St	70	61	Day	9	56	24	0	0	Construction noise audible, along with background LR and trains.
26/08/2021	22:45:00	WE 09 CW: Removing steel sets header beams. NC: works for Eddy Ave pump room including hole drilling and reo bar cutting.	C	20	Chalmers St	67	50	Night	17	45	27	0	0	Trains, Light rail, and announcements. Seagulls. Emergency response vehicle at 9-minute mark and honking horn account for spike.
28/08/2021	7:30:00	EE: Concrete wall 3 pour. CW: track 13 and 14 reinstatement investigation. NC: P8 re-tiling, balustrade installation.	C	27	Chalmers St	70	61	Day	9	56	24	0	0	Concrete pour works audible, as well as trains and LR. Construction activity assessed as worst-case scenario.
28/08/2021	9:30:00	EE: Concrete wall 3 pour. CW: track 13 and 14 reinstatement investigation. NC: P8 re-tiling, balustrade installation.	C	27	Chalmers St	75	61	Day	14	56	24	0	0	Concrete pour works audible, as well as trains and LR. Bird squawks loudly adjacent to logger also.
28/08/2021	12:15:00	EE: Concrete wall 3 pour. CW: track 13 and 14 reinstatement investigation. NC: P8 re-tiling, balustrade installation.	C	27	Chalmers St	74	61	Day	13	56	24	0	0	Concrete pour works audible, as well as trains and LR. Construction activity assessed as worst-case scenario.
28/08/2021	12:30:00	EE: Concrete wall 3 pour. CW: track 13 and 14 reinstatement investigation. NC: P8 re-tiling, balustrade installation.	C	27	Chalmers St	76	61	Day	15	56	24	0	0	Concrete pour works audible, as well as trains and LR. Construction activity assessed as worst-case scenario.
28/08/2021	13:30:00	EE: Concrete wall 3 pour. CW: track 13 and 14 reinstatement investigation. NC: P8 re-tiling, balustrade installation.	C	27	Chalmers St	72	61	Day	11	56	24	0	0	Concrete pour works audible, as well as trains and LR. Construction activity assessed as worst-case scenario.
28/08/2021	15:15:00	EE: Concrete wall 3 pour. CW: track 13 and 14 reinstatement investigation. NC: P8 re-tiling, balustrade installation.	C	27	Chalmers St	73	61	Day	12	56	24	0	0	Concrete pour works audible, as well as trains and LR. Construction activity assessed as worst-case scenario.
29/08/2021	7:00:00	No noisy works as per night shift diaries. SCN20 chosen as most conservative.	C	20	Chalmers St	72	61	Day	11	56	16	0	0	Trains and LR, horns honking from traffic and bird chirping. No construction noise audible.
31/08/2021	3:00:00	NC deliveries. No other noisy works as per diaries.	C	35	Chalmers St	69	50	Night	19	45	26	0	0	Some light construction noise audible, however spike attributed to the same unidentified noise as in previous months that occurs around 2-3am.
12/08/2021	6:45:00	Truck and dog movements at SYAB.	C	39	Regent St	63	49	Night	14	44	27	0	0	Background traffic and trains, truck drives in at 10-minute mark.
16/08/2021	6:30:00	Truck and dog movements at SYAB.	C	39	Regent St	62	49	Night	13	44	27	0	0	Background traffic and trains, truck drives in at 7-minute mark.
17/08/2021	5:15:00	Truck and dog movements at SYAB.	C	39	Regent St	62	49	Night	13	44	27	0	0	Background traffic and trains, truck drives in at 10-minute mark.
September 2021														
1/09/2021	3:00:00	NC: grouting tiles in northern concourse, moving cladding panels from TD to top of scaffold.	C	35	Chalmers St	71	50	Night	21	45	31	0	0	Same power on generator noise as previous months. Confirmed not related to CSM works.
2/09/2021	2:45:00	CW: patching steel sets header beams. 2 hi rail delivering excavators to platform. ESR: load in panels to the concourse for future hoarding realignment.	C	20	Chalmers St	65	50	Night	15	45	25	0	0	Same power on generator noise as previous months. Confirmed not related to CSM works.

2/09/2021	10:15:00	EE: truck delivery at Randle Lane, tower crane picking up delivery.	C	25	Chalmers St	73	61	Day	12	56	25	0	0	Trains and LR loudly going past in background. Randle Lane truck delivery and tower crane audible also, roughly same volume.
3/09/2021	22:30:00	CW: patching steel sets header beams.	C	20	Chalmers St	64	50	Night	14	45	25	0	0	Distant construction noise heard sporadically. Loudest peak in noise is light rail passing by.
4/09/2021	3:00:00	WE10 Possession: Light and tile instal P16/17 Central Walk: patching steel sets header beams.	C	20	Chalmers St	71	50	Night	21	45	25	0	1	Some light construction noise audible, however spike attributed to the same unidentified noise as in previous months that occurs around 2-3am.
5/09/2021	21:15:00	WE10 Possession: Light and tile instal P16/17 No noisy works as per night shift diaries. City of Sydney: Hammering on Randle Street.	C	25	Chalmers St	63	50	Night	13	45	36	0	0	Hammering works on Randle Street heard distantly throughout. Loudest peak in noise is light rail passing by.
8/09/2021	8:00:00	No noisy works as per night shift diaries. Suspected Dental Hospital noise.	C	25	Chalmers St	66	61	Day	5	56	25	0	0	Light rail is most significant contributor to noise. Other significant noise is sporadic clanging and banging, sounds very close to microphone and in echoing environment. Suspected to be happening inside Sydney Dental Hospital garage which is adjacent to microphone.
9/09/2021	2:45:00	No noisy works as per night shift diaries. Suspected City of Sydney hammering on Randle Street, and unidentified early morning drone noise.	C	20	Chalmers St	70	50	Night	20	45	25	0	0	Distant hammering noise heard. However, spike attributed to the same unidentified noise as in previous months that occurs around 2-3am.
12/09/2021	6:45:00	No noisy works as per night shift diaries. SCN20 chosen as most conservative.	C	20	Chalmers St	74	50	Night	24	45	25	0	4	Highest peaks in noise are light rail passing by and birds chirping very close to microphone. No CSM works.
12/09/2021	23:00:00	No noisy works as per night shift diaries. SCN20 chosen as most conservative.	C	20	Chalmers St	61	50	Night	11	45	25	0	0	Peaks in noise are light rail passing by. No construction audible, no works planned. Response to complaint.
13/09/2021	21:30:00	No noisy works as per night shift diaries. SCN20 chosen as most conservative.	C	20	Chalmers St	63	50	Night	13	45	25	0	0	Peaks in noise are light rail passing by and police sirens. No CSM works.
17/09/2021	22:30:00	No noisy works as per night shift diaries. SCN20 chosen as most conservative.	C	20	Chalmers St	62	50	Night	12	45	25	0	0	Peaks in noise are light rail passing by, and intoxicated man shouting in the street near the microphone. No CSM works.
18/09/2021	3:30:00	No noisy works as per night shift diaries. SCN20 chosen as most conservative.	C	20	Chalmers St	68	50	Night	18	45	25	0	0	Peaks in noise are street sweeper passing by. No LOR works.
21/09/2021	18:30:00	Steel fixers at EE	C	25	Chalmers St	64	50	Evening	14	45	25	0	0	Additional on-site observations: inaudible at Chalmers St; some clanging audible on Randle Ln but not noisy. Inaudible from noise logger.
25/09/2021	23:30:00	WE13 Possession (25-26/09) - Central Walk	C	20	Chalmers St	64	50	Night	14	45	25	0	0	Selected as highest peak in noise during possession. Cannot listen to audio due to IT issues.
15/09/2021	4:30:00	Truck and dog movements at SYAB.	C	39	Regent St	68	49	Night	19	44	21	0	3	Truck audible, but not dominant noise source.
October 2021														
13/10/2021	0:00:00	Prop relocation on canopy P22/23	C	20	Chalmers St	61	50	Night	11	45	25	0	0	No CSM works audible. Light rail movements and seagulls audible.
13/10/2021	1:00:00	Prop relocation on canopy P22/23	C	20	Chalmers St	67	50	Night	17	45	25	0	0	Intermittent hand hammering and drilling was audible from time to time (<4min over the 15min period) and likely associated with CSM planned works- installing props for canopy load transfer on the northern side of P22/23. These works need to occur OOH when trains stop running. Note: Other night works were being undertaken at the intersection of Elizabeth and Foveaux last night – conducted by City of Sydney.
13/10/2021	0:30:00	Prop relocation on canopy P22/23	C	20	Chalmers St	65	50	Night	15	45	25	0	0	Intermittent hand hammering (2 or 3 hits at a time) and short duration of impact wrench, also light rail movements audible.
13/10/2021	1:15:00	Prop relocation on canopy P22/23	C	20	Chalmers St	65	50	Night	15	45	25	0	0	1 minute of drilling was audible at the same time as the light rail passing by. and likely associated with CSM planned works- installing props for canopy load transfer on the northern side of P22/23.
16/10/2021	1:00:00	WE16 Possession (15-18 October). Northern Concourse works and track 13/14 reinstatement investigation	C	4	Chalmers St	62	45	Night	17	40	35	0	0	Street noise, people, insects and birds and rail movements audible throughout recording, but generally quiet. OSOM vehicle dominant noise source for a short period.
23/10/2021	0:30:00	WE17 Possession (23-24 October). P18/19 tiling works	C	20	Chalmers St	62	45	Night	17	45	30	0	0	Street noise, people, insects and birds and rail movements audible throughout recording, but generally quiet. OSOM vehicle dominant noise source for a short period.
27/10/2021	0:15:00	OSOM vehicles passing over SYAB	C	39a	Regent St	60	49	Night	11	44	21	0	0	Light rail dominant noise, station guard whistle, train horns. No CSM works audible.
27/10/2021	1:00:00	OSOM vehicles passing over SYAB	C	39a	Regent St	62	49	Night	13	44	26	0	0	Light rail dominant noise source. No CSM works audible.
30/10/2021	0:30:00	WE18 Possession (30-31 October). Northern Concourse works and track 13/14 reinstatement investigation and early works	C	37	Chalmers St	65	45	Night	20	40	25	0	0	Light rail dominant noise source. No CSM works audible.
November 2021														
1/11/2021	19:00:00	WK/WE18 Track 13/14 reinstatement investigation	C	4	Chalmers St	76	50	Evening	26	45	20	0	11	Note: these works would be inaudible and may not be happening at night. Droning noise observed but is likely associated with Sydney Trains suburban works.
3/11/2021	2:45:00	General CSM night works	C	20	Chalmers St	70	50	Night	20	45	25	0	0	No exceedance.
6/11/2021	3:30:00	WE19 Northern Concourse works	C	20	Chalmers St	65	50	Night	15	45	25	0	0	No exceedance.
10/11/2021	1:00:00	OSOM delivery	C	39a/b	Regent St	63	49	Night	14	44	21	0	0	No exceedance.
12/11/2021	2:30:00	OSOM delivery	C	39a/b	Regent St	56	49	Night	7	44	26	0	0	No exceedance.

13/11/2021	3:00:00	WE20 intercity canopy installation	C	37	Chalmers St	72	50	Night	22	45	20	0	7	No exceedance.
20/11/2021	3:30:00	WE21 Central Walk finishes P20/21 tiling and lift work and extending hoarding P22/23	C	20	Chalmers St	67	50	Night	17	45	25	0	0	No exceedance.
December 2021														
11/12/2021	8:15:00	WE23 works at Eastern Entrance- concrete coring works	C	20	Chalmers St	70	61	Day	9	56	14	0	0	Light rail audible as well as coring. When light rail goes past, it is the dominant noise source. Coring and other construction noise audible ~80% of the 15min period.
11/12/2021	9:45:00	WE23 works at Eastern Entrance- concrete coring works	C	20	Chalmers St	66	61	Day	5	56	14	0	0	No construction noise audible.
18/12/2021	3:15:00	WE25 Possession P16/17 releveing works	C	20	Chalmers St	68	50	Night	18	45	25	0	0	No construction noise audible.
16/12/2021	10:15:00	WK24 Possession Intercity Platforms track reinstatement- OSOM vehicle movement	C	39	Regent St	65	49	Night	16	44	21	0	0	No exceedance.
26/12/2021	1:00:00	WK26 Possession Intercity Platforms track reinstatement	C	12	Chalmers St	62	50	Night	12	45	18	0	0	No construction noise audible, only light rail and seagulls.
26/12/2021	22:30:00	WK26 Possession Intercity Platforms track reinstatement	C	12	Regent St	63	49	Night	14	44	23	0	0	No exceedance.
27/12/2021	21:00:00	WK26 Possession Intercity Platforms track reinstatement	C	12	Regent St	72	49	Evening	23	44	23	2	5	No exceedance due to construction..
January 2022														
8/01/2022	0:15:00	Sydney Yard Access. Bridge: Heavy Vehicle Traffic on the SYAB. OSOM vehicles from 3rd until the 9th of January 2022 (contingency until the 12th)	C	39a/b	Regent St	70	61	Night	9	56	12	0	2	Highest LAeq15min in OOH period between 3rd and 9th January during OSOM vehicle movements. Reading potentially weather affected.
22/01/2022	3:00:00	WE30 Possession (21-24/01/2022). Platforms 20/21 Releveling Works	C	20	Chalmers St	68	61	Night	7	56	9	0	3	CSM construction works audible for ~8mins of 15min period. No exceedances, all AMMs in place.

APPROVAL

CITY & SOUTHWEST ACOUSTICS ADVISOR

Review of	Central Station Main Works Construction noise and Vibration Monitoring Program Report (CSMW)	Document reference:	Central Station Main Works Construction noise and Vibration Monitoring Program Report August 2021 – January 2022 Prepared by LOR.
Prepared by:	Carl Fokkema Alternate Acoustics Advisor		<i>Revision date: 18/7/2022</i>
Date of issue:	19 July 2022		<i>Revision: 1</i>

As approved Alternate Acoustics Advisor for the Sydney Metro City & Southwest project, I have reviewed and provided comment on the Quarterly Environmental Construction Monitoring Report (CMR) for the Pitt Street Integrated Station Development, as required under A27 (d) of the project approval conditions (SSI 15-7400).

I reviewed and commented on previous revision (0) of the CNVMPP Aug 2021 - Jan 2022. This revision 1 includes minor amendments that required updating or were of an administrative or minor nature and are consistent with the terms of approval and the document approved by the Secretary.

I am satisfied that such amendments are necessary, approve revision 1 of the CNVMPP (dated 18 July 2022), and consider that the document is appropriate for submission to the Secretary for information.



Carl Fokkema, City & Southwest Alternate Acoustics Advisor