SYDNEY METRO - WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

Noise and Vibration Monitoring Report May 2024 to December 2024

Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works

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Document approval

Rev	Date	Prepared by	Reviewed by	Approved by
01	18/12/2024	Joshua Cosier	Andrew Smith	Andrew Smith
02	4/2/2025	Andrew Smith	Andrew Smith	Andrew Smith

Details of Revision Amendments

Document Control

The Project Director is responsible for ensuring that this report is reviewed and approved. The Project Discipline Director is responsible for updating this plan to reflect changes to construction, legal and other requirements, as required.

Amendments

Any revisions or amendments must be approved by the Project Director and/or client before being distributed/implemented.

Revision Details

Revision	Details
01	Compliance report for issue to SM and stakeholders
02	Update per Sydney Metro comments

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1.Introduction

1.1. Background

The Sydney Metro Western Sydney Airport will become the transport spine for Greater Western Sydney, connecting communities and travellers with the new Western Sydney International (Nancy-Bird Walton) Airport (referred to as Western Sydney International) and the growing region.

The Project forms part of the broader Sydney Metro network. It involves the construction and operation of a 23km new metro rail line that extends from the existing Sydney Trains suburban T1 Western Line (at St Marys) in the north to Bradfield (formerly Aerotropolis, at Bringelly) in the south. The alignment includes a combination of tunnels and civil structures, including viaduct, bridges, surface and open-cut troughs between the two tunnel sections (**Error! Reference source not found.**)

The Sydney Metro Western Sydney Airport EIS was prepared in October 2020 to assess the impacts of construction and operation of the Project and was placed on public exhibition between 21 October 2020 and 2 December 2020. The Project was declared a Critical State Significant Infrastructure (CSSI) Project and is listed in Schedule 5 of *State Environmental Planning Policy (State and Regional Development)*.

The Sydney Metro Western Sydney Airport was approved by the Minister for Planning and Public Spaces on 23 July 2021 (SSI 10051) under section 5.19 of the *Environmental Planning and Assessment Act 1997* (EP&A Act).

The Project will be delivered through the following stages:

- **Advanced and Enabling Works (AEW)** – Site investigations, modification of the existing transport network, power and water supply for construction sites, utility and stormwater diversions and some demolition works.
- **Station Boxes and Tunnelling Works (SBT)** – delivered through the following sub-stages:
  - Preparatory Works - included NSW (off-airport) demolition works, site levelling/grading, site access and parking, utility and temporary services works, erection of demountable buildings and noise barriers, tunnelling preparatory works and use of ancillary facilities including onsite parking.
  - Bulk Excavation and Tunnelling Works – bulk excavation, acoustic shed installation, tunnelling and cross passage installation.
- **Surface and Civil Alignment Works (SCAW)** – Construction of bridges and viaducts to cross floodplains, watercourses and existing and proposed permanent infrastructure.
- **Stations, Systems, Trains, Operations and Maintenance (SSTOM) –** Station design and fitout, testing and commissioning, and operation of the Western Sydney Airport metro service
- **Finalisation Auxiliary Works.**

Each package of work is to be delivered under separate contracts on behalf of the proponent Sydney Metro.

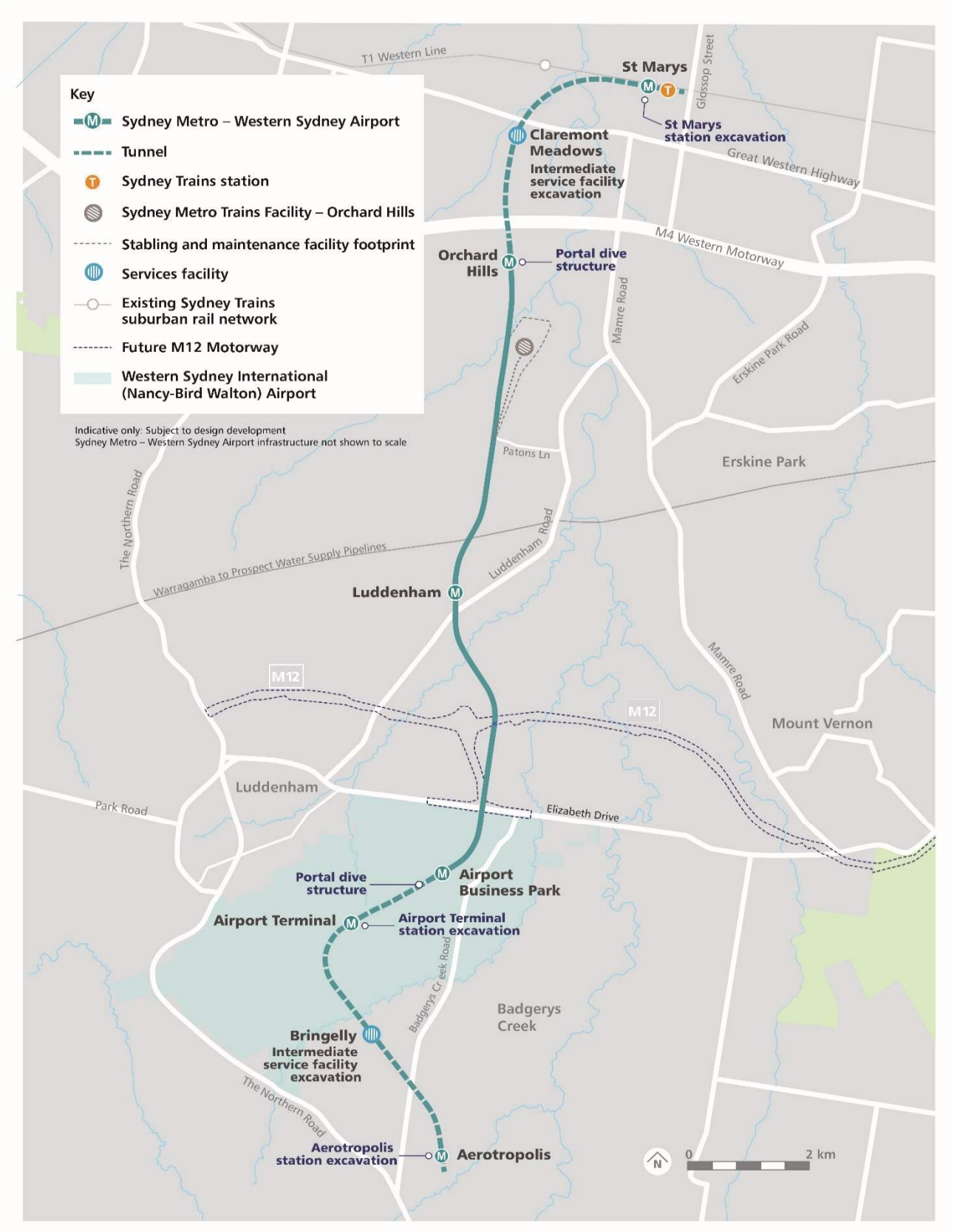


Figure 1: Overview of the Project

1.2. Station Boxes and Tunnelling Works

The CPB Ghella JV (CPBG) has been engaged to deliver the SBT Works. The SBT Works include the design and construction of:

- Two sections of twin tunnels with a total combined length of approximately 9.8km, including associated portal structures; Orchard Hills to St Marys and Western Sydney International (WSI) airport to the new Bradfield Station in NSW
- Excavations at either end to enable trains to turn back and stub tunnels to enable future extensions.
- Station box excavations with temporary ground support for four stations at St Marys, Orchard Hills, Airport Terminal and Bradfield
- Excavations for two intermediate service facilities, one in each of the tunnel sections at Claremont and Bringelly.

Completed sections of the SBT Works, including established construction worksites, will be progressively handed over to Sydney Metro to enable follow-on contractors to commence works or, if on-airport, handed back to Western Sydney Airport Corporation (WSACo) for their future works.

1.3. Site List

CPBG has eight Project sites, five of which are in NSW under the CSSI 10051 and the other three are on Commonwealth land under the Airport Plan. The Airport Plan sites are greyed out in the below table. The CSSI sites are north and south of the Commonwealth airport site.

Table 1: SBT Worksite overview

Jurisdiction	Worksite	Abbreviation
NSW (north of Airport)	St Marys	STM
NSW (north of Airport)	Claremont Meadows	CMF
NSW (north of Airport)	Orchard Hills	OHE
On-Airport	Airport Portal Dive Structure	APB
On-Airport	Airport Terminal and TBM shaft	ATL
On-Airport	Primary Spoil Receival	FS01
NSW (south of Airport)	Bringelly	BSF
NSW (south of Airport)	Bradfield (formerly Aerotropolis)	AEC

Note: Worksites shown in grey are within the boundary of the Western Sydney International (On-Airport), are regulated under the *Commonwealth Airports Act 1996* and are outside the scope of EPL 21672.Works in blue have been handed back to Sydney Metro.

1.4. Handover portions

During this monitoring period, SSTOM works commenced at St Marys, Orchard Hills and Bradfield (formerly Aerotropolis).

During the reporting period SBT handed over St Marys Figure 1 after the completion of TBM retrieval which commenced on 25/03/2024 and was handed back on 15/08/2024 and similarly at Bradfield Figure 3 which commenced on 25/03/2024 and was handed back on 28/08/2024.

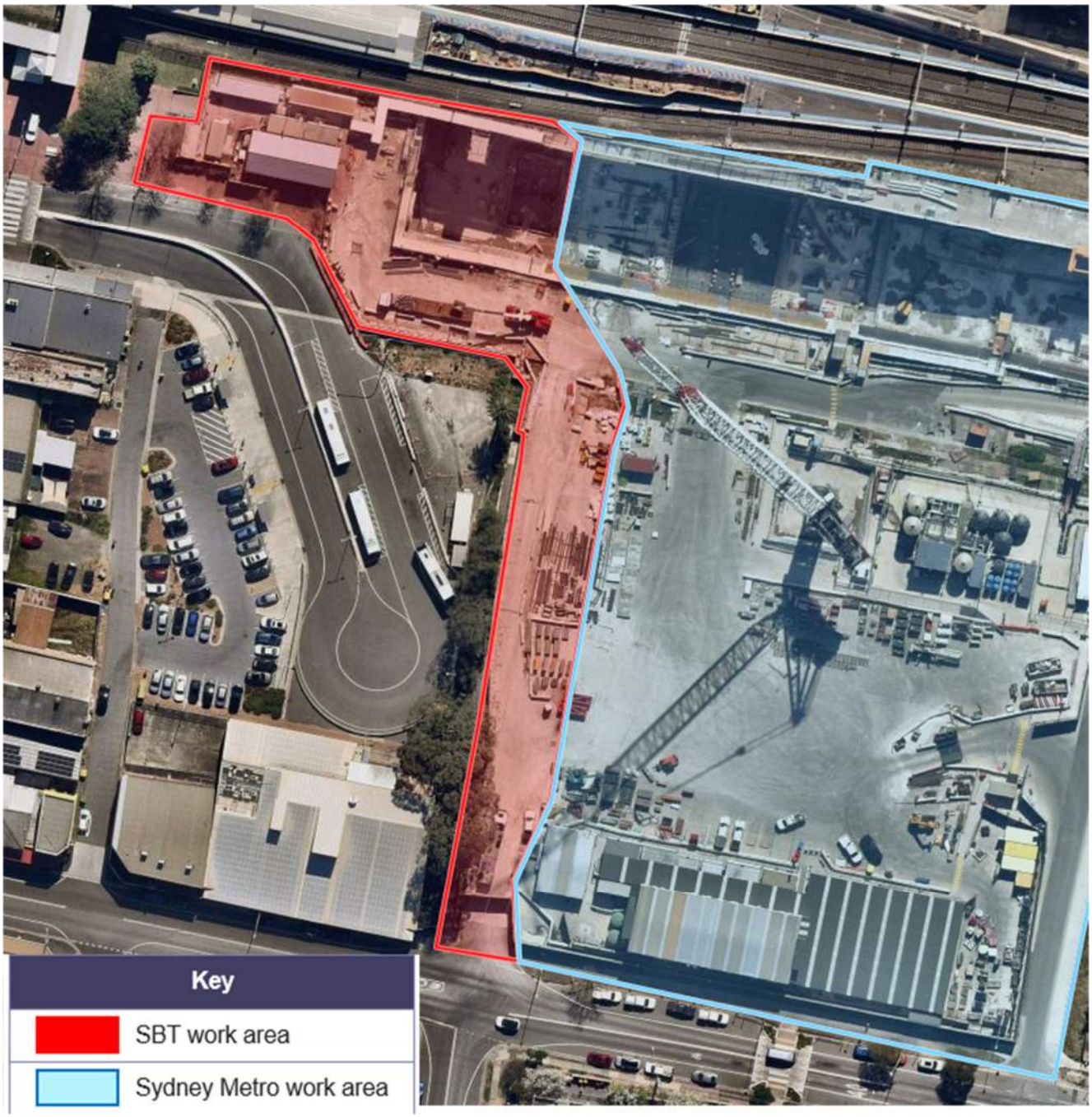


Figure 2: St Marys Site Map between 25/03/2024 and 15/08/2024

Figure 3: Bradfield Site Map between 25/03/2024 and 28/08/2024

1.5. Purpose of this report

The purpose of this 6-monthly Noise & Vibration Monitoring Report is to present results of the Noise and Vibration Monitoring Program outlined in the SBT Construction Environmental Management Plan (CEMP) and Construction Noise and Vibration Management Sub-plan (NVMP), including the results of the construction monitoring programs referred to in Condition C13 of the Infrastructure Approval, between May and December 2024.

The Noise and Vibration Monitoring Report has been prepared to address Minister's Condition of Approval (CoA) C22 of the Infrastructure Approval (refer to Table 3). Per the NVMP, this report will be provided to the stakeholders detailed in Table 2, 60 days after the end of the reporting period.

Environmental monitoring is undertaken to:

- Validate the predicted impacts of the Infrastructure Works (as discussed in NVMP)
- Measure the effectiveness of environmental controls in minimising and managing environmental impacts.

The monitoring requirements for noise and vibration are included in the NVMP and summarised in Table 2.

Table 2: Environmental Monitoring Reporting Requirements

CEMP or Sub-plan	Monitoring Program	Report	Distribution	Schedule (during construction)
Noise and Vibration Management Sub-Plan	Noise and Vibration Monitoring Program	Noise and Vibration Monitoring Report	60 days after end of reporting period to DPE, ER	Semi-annual

Table 3: Conditions of Approval (CoA)

CoA	Detail	Addressed
C15	The Noise and Vibration Construction Monitoring Program must include: (a) noise and vibration monitoring at representative residential and other locations (including at the worst- affected residences), subject to property owner approval, to confirm construction noise and vibration levels;	NVMP
	(b) monitoring undertaken during the day, evening and night-time periods throughout the construction period and cover the range of activities being undertaken;	NVMP Section 1.5
	(c) method and frequency for reporting monitoring results; and	NVMP Section 1.5
	(d) a process to undertake real time noise and vibration monitoring.	NVMP

CoA	Detail	Addressed
		1.8.2 Continuous Noise Monitoring
	The results of the monitoring must be readily available to the construction team, the Proponent and ER. The Planning Secretary and EPA must be provided with access to the results on request.	This Report
C22	The results of the Construction Monitoring Programs must be submitted to the Planning Secretary, ER and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program	This Report

1.6. On-site Activity

All station boxes and service facility sites have been established with all support services completed. All four TBM's have completed tunnelling and have been retrieved from site. Cross passage excavation has been completed, with majority of waterproofing and concrete lining is finished. Removal of spoil occurred from Orchard Hills, Bringelly and Claremont Meadows.

It is noted these sites are due to be handed back to Sydney Metro in November or December 2024.

Additional noise mitigation measures have been put in place for out of hours works at Bringelly and Claremont Meadows for tunnel support activities, including noise barriers installed at both Bringelly and Claremont Meadows. An electric crane is being used at Claremont Meadows to reduce noise impacts when compared to a diesel crane. All noise mitigation measures are installed as per site specific DNVIS.

Additional information for on-site activities is found in the following Section 1.7 Monthly Construction Updates.

1.7. Monthly Construction Updates

1.7.1. May

Preparation for TBM breakthroughs with excavation of all four TBM drives planned to be completed by mid-June.

TBM1 (Catherine) has broken through at St Marys (20/05/24) and TBM3 (Eileen) has broken through at Bradfield (29/05/24).

Cross passage works continue, including excavation, waterproofing and FRP.

Defects and invert construction planning is underway and works onsite will commence in June.

Bringelly civil works, Claremont civil works and Orchard Hills civil works are due to commence and are in detailed planning stage.

1.7.2. June

All four TBMs have broken through. TBM 2 (Marlene) broke through at St Marys on 20/6/24 and TBM 4 (Peggy) broke through at Bradfield on 7/6/24.

Cross passage works continue, including excavation, waterproofing and FRP.

Invert construction has commenced in the north. South have commenced with removal of cross passage temporary ramps in preparation for invert construction.

Defects close out is being undertaken across the project.

Following the completion of the TBM excavation the conveyor structures are being progressively removed and works have commenced on the permanent structures.

1.7.3. July

All TBMs at both St Marys and Bradfield have now been dismantled and removed from site.

All remaining cross passages have commenced excavation, waterproofing and FRP are progressing.

Invert construction has commenced across the project.

Permanent structures at Orchard Hills have commenced and conveyor structures have been removed. Tower crane dismantling and demobilisation is ongoing.

1.7.4. August

Cross passage excavation works are almost complete, heading excavation is complete across the entire project.

Invert construction is ongoing across the project. Works on permanent structures at Orchard Hills continue. Waterproofing and FRP works are ongoing.

St Marys works have been completed and handed over to Sydney Metro on the 16/08/24. Bradfield was handed over to Sydney Metro on the 28/8/24.

1.7.5. September

Cross passage excavation works are complete. Cross passage waterproofing and FRP is complete is the south with only a few remaining in the north.

Works on permanent structures at Orchard Hills continue. Waterproofing and FRP works are ongoing.

Permanent wall works are ongoing at Claremont & Bringelly.

1.7.6. October

Cross passage waterproofing and FRP is complete is the south with only a few remaining in the north. Defects close out continues across the project, with a dedicated defect repair crew prioritising TBM segment and Cross passage lining repairs.

Permanent structures at Orchard Hills are ongoing. Waterproofing & FRP works are ongoing.

Permanent shaft wall works are ongoing at Claremont & Bringelly

1.7.7. November

Tunnel invert pours are complete on the project. . Finalising waterproofing with the shaft. The Claremont permanent wall works are complete. The Bringelly permanent wall works are ongoing.

All construction and Demobilisation of Orchard hills has been completed. Handover of Orchard hills occurred on the 10 November 2024.

1.7.8. December

Concrete pours completed at Bringelly. Claremont Meadows and Bringelly sites being demobilised ready for handover of both sites by 20 December 2024.

1.8. Noise Monitoring

Noise monitoring is a requirement of both the CSSI 10051 approval and EPL 21672 (Table 4: Noise and Vibration Monitoring requirements). The following monitoring is required:

Attended noise monitoring

- To validate the noise predictions for works undertaken outside of the standard construction hours as per the DNVIS.
- Where modelled noise levels exceed NMLs at a noise sensitive receiver
- As a result of noise and vibration complaints; or
- As otherwise directed

Ground-Borne noise monitoring

- As per the tunnelling DNIVS, noise monitoring would offered in response to a complaint where ongoing tunnelling works are occurring (e.g. cross-passage excavation)

Fixed continuous monitoring

- Provide real time noise monitoring data.
- Confirm noise emissions are within the predicted noise levels identified shown in the DNVIS. Results of monitoring will be used for:
  - The evaluation of performance relative to legal, regulatory, contract, permit, licence and other commitments
  - The prompt identification and correction of incidents or possible incidents
  - Providing feedback on approval documents; and
  - Providing the basis of internal and external reporting.

Noise monitoring results can be found in Section 2**Error! Reference source not found.** of this report.

Table 4: Noise and Vibration Monitoring requirements

Approvals document	Relevant Section	Frequency	Type of monitoring
EPL	L 5.9 *	For new Out of hours works	Attended
	M 7.6 *	In response to a noise and /or vibration complaint	Attended
COA	A5	Written requirements or directions of the Planning Secretary	Attended and /or Continuous

Approvals document	Relevant Section	Frequency	Type of monitoring
	C15 *	As Per Noise and Vibration Sub- Plan	Attended and /or Continuous
	A18 (e)*	Where appropriate or required as per CEMP or Sub-Plan	Attended and /or Continuous
	E54 *	Where heritage items may be impacted due to construction impacts	Attended and /or Continuous
	E55 *	Where appropriate or required as per CEMP or Sub-Plan	Attended and /or Continuous
Noise and Vibration Monitoring Program	3.4.2.1 Fixed station (real time) noise monitoring *	During construction	Continuous
	3.4.2.2 Activities based airborne noise monitoring	In response to Surface works complaints	Attended and /or Continuous
	3.4.2.3 Ground-borne noise monitoring *	In response to tunnelling works complaints and model validation	Attended and /or Continuous
	3.4.3 Plant/equipment noise checks *	Noise intensive plant and equipment	Attended
	3.5.2.1 Fixed Station (real time) vibration monitoring *	Duration of project at the Goods Shed	Continuous

*Has been triggered during this reporting period

1.8.1. Complaints

Between May 2024 and December 2024, the project has had 15 community complaints relating to noise and 2 relating to vibration. A breakdown of complaints by month and site can be found in Table 5.

Table 5: Community Noise and Vibration Complaints (May to December 2024)

Month	Site	Complaint Type	Works undertaken at the time of complaint
May	Orchard Hills	Noise	OOHW Tunnelling / Traffic
	St Marys	Noise	TBM retrieval works
	Bringelly	Noise	OOHW Tunnelling
June	Orchard Hills	Noise	OOHW Tunnelling / Traffic
		Noise	OOHW Tunnelling / Traffic

Month	Site	Complaint Type	Works undertaken at the time of complaint
	St Marys	Noise	TBM retrieval works
July	Orchard Hills	Noise	OOHW Tunnelling / Traffic
		Noise	OOHW Tunnelling / Traffic
		Noise	OOHW Tunnelling / Traffic
August	Orchard Hills	Noise	OOHW Tunnelling / Traffic
	Claremont Meadows	Noise	OOHW Tunnelling / Tunnel Support
	Bringelly	Noise & Vibration	OOHW Tunnelling / Tunnel Support
September	Orchard Hills	Noise	OOHW Tunnelling / Traffic
		Noise & Traffic	OOHW Tunnelling / Traffic
	Bringelly	Noise & Vibration	OOHW Tunnelling / Tunnel Support
October	Nil		
November	Nil		
December	Nil		

After a complaint is made an internal investigation takes place, which may include on-site noise and vibration monitoring. Investigations following each complaint concluded that SBT works were permissible at the time and the noise or vibration levels were within those determined in the DNVIS. CPBG undertook all measures to address any complaints where it was practicable to do so. In most cases, there were other reasons for the complaints.

The results of monitoring between May and December 2024 are presented below. Any anomalous readings or exceedances are identified within the “comments” column of the tables.

1.8.2. Continuous Noise Monitoring

Continuous noise monitoring was undertaken across each site by Sitehive units recording LAeq, in compliances with the CNVMP. The results from each Sitehive unit are shown in Annexure A. Each unit has undertaken monitoring throughout the reporting period.

Noise levels shown within Sitehive data have the potential to be impacted by external sources including weather, and is not the noise levels experienced by nearby receivers.

Spikes above the DNVIS prediction are sent as an email to SBT environmental team members which are investigated. The triggers shown in Annexure A are the predicted noise levels from the DNVIS shown in Table 6: DNVIS Predicted Laeq LAeq over 15 minutes.

Generally, observed spikes in noise levels were significantly contributed to by external noise impacts. Occasionally Sitehive units have gone into fault or had erroneous readings, in these cases it has been the result of atmospheric conditions or a hardware/software problem within the Sitehive unit. These are rectified as soon as practicable, noting at times the whole Sitehive unit may have needed replacing.

The Claremont Meadows Sitehive unit did not record noise data between the 1st of April and 19th of June due to technical issues and difficulty sourcing replacement parts.

The Orchard Hills Sitehive unit did not record noise data between 24th of May and 19th of June due to technical issues and difficulty sourcing replacement parts.

Continuous noise monitoring was not required to be undertaken at St Marys and Aerotropolis for their respective TBM retrieval activities between April – August 2024 as attended noise monitoring of these activities found noise levels were consistently below predicted noise levels in the DNVIS Addendum.

Table 6: DNVIS Predicted Laeq

Site	Day LAeq	OOHW1 LAeq	OOHW2 LAeq
CMF	65	65	65
OHE (TBM-S)	62	62	57
BSF (PTBM-P3)	73	73	73

1.8.3. Vibration monitoring

1.8.3.1. Residential vibration monitoring

During the reporting period vibration monitoring was undertaken within residential buildings at the two locations for tunnelling model verification as described in the DNVIS, 190 Badgerys Creek Road and 49 Kalanga Ave. Monitoring that was undertaken at 45 Derwent road was in response to a complaint. Refer to Annexure B for Vibration Monitoring Reports.

- 190 Badgerys Creek Road, Bringelly (20/04/2024 – 04/05/2024)
- 49 Kalang Ave, St Marys (04/05/2024 – 10/05/2024)
- 45 Derwent Road, Bringelly (06/06/2024 – 12/06/2024)

Monitoring results indicated vibration impacts were mostly below the predicted levels. Monitoring at 45 Derwent Road had a slight spike above the predicted levels from the DNVIS during tunnelling works due to both TBM's being within 60m of each other. This spike didn't trigger the need for additional mitigation measures or further monitoring, nor did it exceed human disturbance levels. As this is the only spike shown during ground-borne noise and vibration monitoring it did not warrant an update to the model.

1.8.3.2. Goods Shed vibration monitoring

Throughout the reporting period, the St Marys Railway station group has been monitored for vibration from all Project works. Continuous monitoring sensors and devices, representative of the St Marys Railway Group, are located within the Goods Shed, on the Goods Shed wall and along the alignment of the tunnel which detects any appreciable motion as a result of Project works that

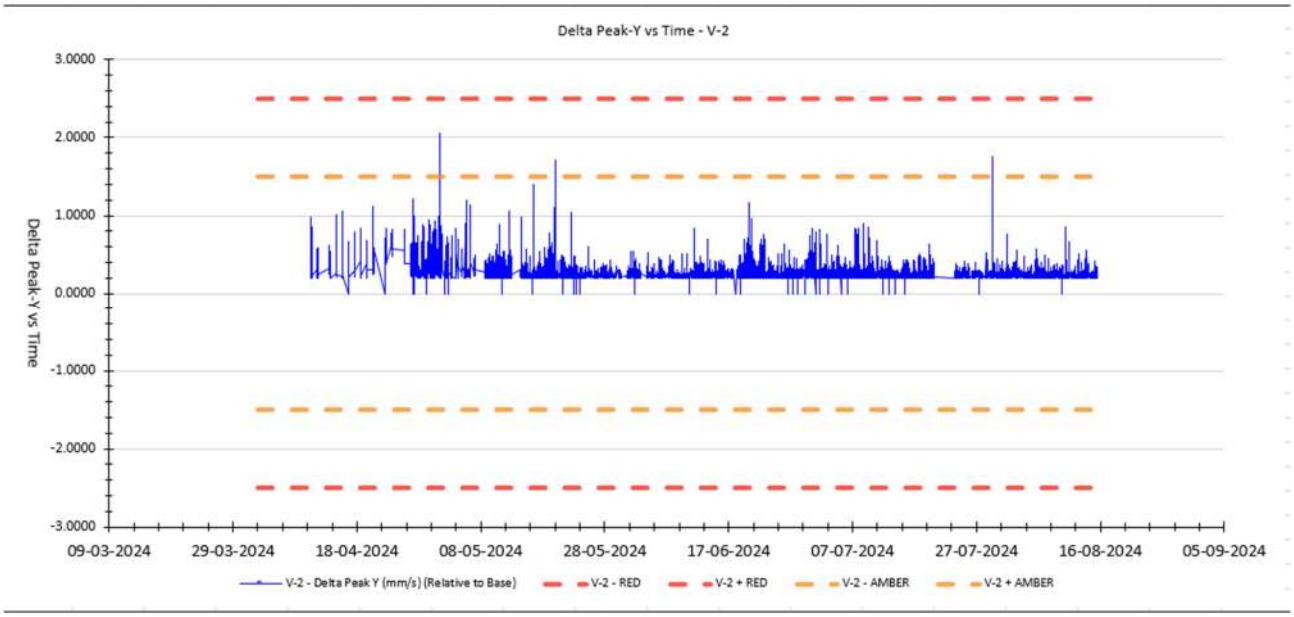
could potentially impact the Goods Shed, the jib crane, the overhead walkway and the platform buildings. Automatic notifications are sent to the project team whenever there is a potential trigger event.

No significant exceedances were recorded during the reporting period, except for three minor instances of the Goods Shed device exceeding the amber limit by 0.25mm/s above the threshold of 1.05mm/s. These events did not exceed that of unreinforced light framed structures (7.5mm/s). The Goods Shed has two early warning triggers set with amber being 1.05mm/s and red at 2.5mm/s.

These exceedances were investigated and methodology was changed where required to reduce impact.

During the reporting period, three amber spikes were identified:

- 1 May 2024 due to a manual reset on the monitoring device;
- 20 May 2024 due to TBM 1 Breakthrough at St Marys Station Box; and
- 29 July due to shotcrete trimming within the station box. CPBG reduce the amount of shotcrete trimming that was taking place from two rigs simultaneously to a single rig.



1.8.3.3. Cross-Passage works.

Cross-passage excavation actives were modelled by Renzo Tonin to predict the impact on sleep disturbance and the outcome of this modelling is shown in Figure 4:Allowable periods for each cross-passage excavation . Cross passage excavation was only undertaken during the allowable time period as shown in Figure 4:Allowable periods for each cross-passage excavation.

Cross-passage ID	Allowable period		Cross-passage ID	Allowable period	
	Rockhammer (brokk)	Roadheader		Rockhammer (brokk)	Roadheader
XP-N02	Day	Day	XP-S02	Day, Evening, Night	Day, Evening, Night
XP-N03	Day	Day, Evening, Night	XP-S03	Day, Evening, Night	Day, Evening, Night
XP-N04	Day, Evening, Night	Day, Evening, Night	XP-S04	Day, Evening, Night	Day, Evening, Night
XP-N05	Day, Evening, Night	Day, Evening, Night	XP-S05	Day, Evening, Night	Day, Evening, Night
XP-N06	Day, Evening, Night	Day, Evening, Night	XP-S06	Day, Evening, Night	Day, Evening, Night
XP-N07	Day, Evening, Night	Day, Evening, Night	XP-S08	Day, Evening, Night	Day, Evening, Night
XP-N08	Day, Evening, Night	Day, Evening, Night	XP-S09	Day, Evening, Night	Day, Evening, Night
XP-N09	Day, Evening, Night	Day, Evening, Night	XP-S10	Day, Evening, Night	Day, Evening, Night
XP-N10	Day, Evening, Night	Day, Evening, Night	XP-S11	Day, Evening, Night	Day, Evening, Night
XP-N11	Day, Evening, Night	Day, Evening, Night	XP-S12	Day, Evening, Night	Day, Evening, Night
XP-N13	Day	Day	XP-S13	Day, Evening, Night	Day, Evening, Night
XP-N14	Day	Day	XP-S14	Day, Evening, Night	Day, Evening, Night
XP-N15	Day	Day	XP-S15	Day, Evening, Night	Day, Evening, Night
XP-N16	Day	Day	XP-S17	Day	Day
XP-N17	Day	Day	XP-S18	Day, Evening, Night	Day, Evening, Night
XP-N18	Day	Day, Evening	XP-S19	Day, Evening, Night	Day, Evening, Night
XP-N19	Day	Day	XP-S20	Day	Day
XP-N20	Day, Evening, Night	Day, Evening, Night	XP-S21	Day, Evening, Night	Day, Evening, Night
XP-N21	Day, Evening, Night	Day, Evening, Night	XP-S22	Day, Evening, Night	Day, Evening, Night
			XP-S23	Day, Evening, Night	Day, Evening, Night

Note: XP-N01, XP-N12, XP-N22, XP-S01, XP-S07, XP-S16 and XP-S24 are within the station boxes and have not been assessed for ground-borne noise as airborne noise will be dominant.

Figure 4:Allowable periods for each cross-passage excavation

2. Monthly Noise data

Noise monitoring undertaken in accordance with both the CSSI 10051 approval and EPL 21672 is presented in the following Tables.

2.1. May 2024

No attended monitoring was undertaken during the month of May. No OOHW that required noise monitoring was undertaken. Continuous noise monitoring results undertaken in May are shown in Annexure A.

2.2. June 2024

Monitoring undertaken in June was largely due to new out of hours works activities starting and a requirement to verify predicted noise levels. These works included TBM retrieval works and tunnel support. The below table shows the predicted noise levels and the exceedances compared to the predicted noise levels from modelling.

Date	Time	Works Period	Construction Activity	Activity Location	Monitoring Location	NML (dBA)	Predicted (dBA)	Additional Mitigation Measures	Recorded $L_{eq,\ 15min}$ (dBA)	L_{Amax}	L_{Amin}	Exceedance of Predicted (dBA)	Exceedance of Predicted	Comments
20/06/2024	9:29pm	OOHW 1	TBM Retrieval Works	SBT Bradfield (former Aerotropolis) Site	97 Kelvin Park Drive, Bradfield NSW	40	47	LB, M	48.1	66.2	36.3	+1.1	Yes	Verification noise monitoring. Non-construction noise was the main source of noise during this monitoring event.
20/06/2024	8:50pm	OOHW 1	TBM Retrieval Works	SBT Bradfield (former Aerotropolis) Site	SBT Bradfield Site	40	47	LB, M	51.3	74.5	36.1	+4.3	Yes	Verification noise monitoring. Non-construction noise was the main source of noise during this monitoring event.
20/06/2024	9:12pm	OOHW 1	TBM Retrieval Works	SBT Bradfield (former Aerotropolis) Site	SBT Bradfield Site	40	47	LB, M	47.5	66.2	36.3	+0.5	Yes	Verification noise monitoring. Non-construction noise was the main source of noise during this monitoring event.
20/06/2024	10:42pm	OOHW 1	Concrete Pour into shaft	SBT Claremont Meadows	5 Dolphin Close, Claremont Meadows	40	47	LB, M	50.2	66.6	41.5	+3.2	Yes	Verification noise monitoring. Non-construction noise was the main source of noise during this monitoring event.

2.3. July 2024

Monitoring undertaken in July was largely due to new out of hours works activities starting and a requirement to verify predicted noise levels. These works included road works. The below table shows the predicted noise levels and the exceedances compared to the predicted noise levels from modelling.

Date	Time	Works Period	Construction Activity	Activity Location	Monitoring Location	NML (dBA)	Predicted (dBA)	Additional Mitigation Measures	Recorded $L_{eq,\ 15min}$ (dBA)	L_{Amax}	L_{Amin}	Exceedance of Predicted (dBA)	Exceedance of Predicted	Comments
30/07/2024	10:36pm	Night	Removal of Water Barriers	STM	34 Phillip St	41	51	LB, M	49.6	49.6	61.6	-1.4	No	Verification noise monitoring - extraneous noise was dominant noise source - construction was audible
30/07/2024	11:11pm	Night	Jersey Barrier Installation	STM	31 Phillip St	41	51	LB, M	47.3	63.5	42.7	-3.7	No	Verification noise monitoring - extraneous noise was dominant noise source - construction was audible
31/07/2024	12:09am	Night	Jersey Barrier Installation	STM	30 Phillip St	41	51	LB, M	47.3	58.6	42.1	-3.7	No	Verification noise monitoring - extraneous noise was dominant noise source - construction was audible
31/07/2024	1:02am	Night	Jersey Barrier Installation	STM	3 Station St	41	51	LB, M	42	57.9	37.1	-9	No	Verification noise monitoring - extraneous noise was dominant noise source - construction was audible

2.4. August 2024

Monitoring undertaken in August was due to new out of hours works activities starting and a requirement to verify predicted noise levels. These works included tunnel support. The below table shows the predicted noise levels and the exceedances compared to the predicted noise levels from modelling.

Date	Time	Works Period	Construction Activity	Activity Location	Monitoring Location	NML (dBA)	Predicted (dBA)	Additional Mitigation Measures	Recorded $L_{eq, 15min}$ (dBA)	L_{Amax}	L_{Amin}	Exceedance of Predicted (dBA)	Exceedance of Predicted	Comments
16/08/2024	7:38pm	Evening	Concrete pump	STM	34/36 Phillip St	41	50	LB, M	62	79.8	45.2	+12	Yes	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible

2.5. September 2024

Monitoring undertaken in September was due to new out of hours works activities starting and a requirement to verify predicted noise levels. These works included tunnel support and Shaft work. The below table shows the predicted noise levels and the exceedances compared to the predicted noise levels from modelling.

Date	Time	Works Period	Construction Activity	Activity Location	Monitoring Location	NML (dBA)	Predicted (dBA)	Additional Mitigation Measures	Recorded $L_{eq, 15min}$ (dBA)	L_{Amax}	L_{Amin}	Exceedance of Predicted (dBA)	Exceedance of Predicted	Comments
2/09/2024	8:30pm	Evening	Steel fixing	OHE	Kent Road Orchard Hills	46	50	LB, M	55.4	77.8	44.6	+5.4	Yes	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible
2/09/2024	9:45pm	Evening	Crane Lifts	CMF	8 Dolphin Cl Claremont	42	42	LB, M	45	64	39.7	+3	Yes	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible
13/09/2024	5.44 pm	Day	Concrete pours	OHE	95 Samuel Marsden drive	54	44	LB	46.4	70	36.4	+2.4	Yes	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible
13/09/2024	6.05pm	Evening	Concrete pours	OHE	71-81 Samuel Marsden drive	46	46	LB, M	47.4	61.6	41.8	+1.4	Yes	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible
27/09/2024	7:25pm	Evening	Concrete Pours	BSF	38 Derwent Rd, Bringelly	40	42	LB, M	41.9	52.9	37.1	-0.1	No	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible
27/09/2024	8:08pm	Evening	Concrete Pours	BSF	42 Derwent Rd, Bringelly	35	51	LB, M, SN, RO	55.1	74.9	40.9	+4.1	Yes	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible
27/09/2024	8:32pm	Evening	Concrete Pours	BSF	155 Mersey Rd, Bringelly	39	42	LB, M	38.6	50.8	33.4	-3.4	No	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible

2.6. October 2024

Monitoring undertaken in October was due to new out of hours works activities starting and a requirement to verify predicted noise levels. These works were for a throw screen replacement. The below table shows the predicted noise levels and the exceedances compared to the predicted noise levels from modelling.

Date	Time	Works Period	Construction Activity	Activity Location	Monitoring Location	NML (dBA)	Predicted (dBA)	Additional Mitigation Measures	Recorded $L_{eq,\ 15min}$ (dBA)	L_{Amax}	L_{Amin}	Exceedance of Predicted (dBA)	Exceedance of Predicted	Comments
1/10/2024	1am	1:15am	Throw Screen Replacement	Kent Road	51 Kent Rd , Orchard Hills	50	55	LB, M	50.4	71.3	36.8	-4.6	No	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible

2.7. November 2024

No attended Monitoring was undertaken during the month of November. No OOHW that required noise monitoring was undertaken. Continuous noise monitoring results undertaken in November are shown in Annexure A.

2.8. December 2024

No attended Monitoring was undertaken during the month of December. No OOHW that required noise monitoring was undertaken. Continuous noise monitoring results undertaken in December are shown in Annexure A.

3. Measured Noise Exceedances

The table below represents all noise monitoring exceedances during the reporting period found in Section 2 Monthly Noise data. During attended noise monitoring notes are taken when a spike in noise occurs which describes what triggered the spike and noise level.

External factors with no relation to the project are noted as extraneous noise or non-construction noise. The most common occurring non-project related impacts are from the following

- Non-project related traffic movements
- Non-project related construction (identified during the attended monitoring)
- Non-project related people talking
- Animals

Date	Site	Activity	Above predicted (dBA)	Explanation
20/06/2024	Bradfield (formerly Aerotropolis)	TBM Retrieval Works	+1.1	Verification noise monitoring. Non-construction noise was the main source of noise during this monitoring event.
20/06/2024	Bradfield (formerly Aerotropolis)	TBM Retrieval Works	+4.3	Verification noise monitoring. Non-construction noise was the main source of noise during this monitoring event.
20/06/2024	Bradfield (formerly Aerotropolis)	TBM Retrieval Works	+0.5	Verification noise monitoring. Non-construction noise was the main source of noise during this monitoring event.
20/06/2024	Claremont Meadows	Concrete Pour into shaft	+3.2	Verification noise monitoring. Non-construction noise was the main source of noise during this monitoring event.
16/08/2024	St Marys	Concrete pump	+ 12	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible
2/09/2024	Orchard Hills	Steel fixing	+5.4	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible
2/09/2024	Claremont Meadows	Crane Lifts	+3	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible

Date	Site	Activity	Above predicted (dBA)	Explanation
13/09/2024	Orchard Hills	Concrete pours	+2.4	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible
13/09/2024	Orchard Hills	Concrete pours	+1.4	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible
27/09/2024	Bringelly	Concrete Pours	+4.1	Verification noise monitoring - extraneous noise was dominant noise source - construction wasn't audible

4. Plant Sound Power Level

On-site plant sound power level checks were conducted to validate the accuracy of the noise modelling estimations. The monitoring data presented in Table 7confirmed that all the plant equipment met the maximum allowed LAeq, demonstrating compliance. All monitoring was lower than predicted.

Table 7: Plant Sound Power Levels

Site	Equipment	Max LAeq allowed at 7m (predicted)	On-Site LAeq at 7m (actual)	Exceedance of Predicted	db below predicted LAeq
STM	Truck and Dog	83	81	No	-2
STM	Crane - Fixed	88	84	No	-4
CMF	EWP	73	71.4	No	-1.6
CMF	Concrete Truck	84	83	No	-1
OHE	Truck and Dog	83	78	No	-5
OHE	Truck and Dog	83	71	No	-12
OHE	Water cart	82	77	No	-5
OHE	30T excavator	85	83	No	-2
OHE	Vacuum Truck	109	103	No	-6
OHE	Light vehicle	78	71	No	-7
BSF	Truck and Dog	83	78	No	-5
BSF	Water cart	82	69	No	-13
BSF	Truck and Dog	83	82.4	No	-0.6
BSF	Concrete Truck	84	83	No	-1
BSF	EWP	73	67.5	No	-5.5
AEC	Crane - Fixed	88	84.67	No	-3.33
AEC	Franna	78	75.4	No	-2.6

5. Additional Mitigation Measures

Surface Noise Impacts

Section 5 of the CNVS directs that in instances where, after the application of all reasonable and feasible mitigation and management measures, the LAeq(15minute) airborne construction noise levels are still predicted to exceed the NMLs, additional airborne noise management measures can be applied to further limit the risk of annoyance from construction noise. The CNVS suggests the Project should consider implementing additional mitigation measures such as:

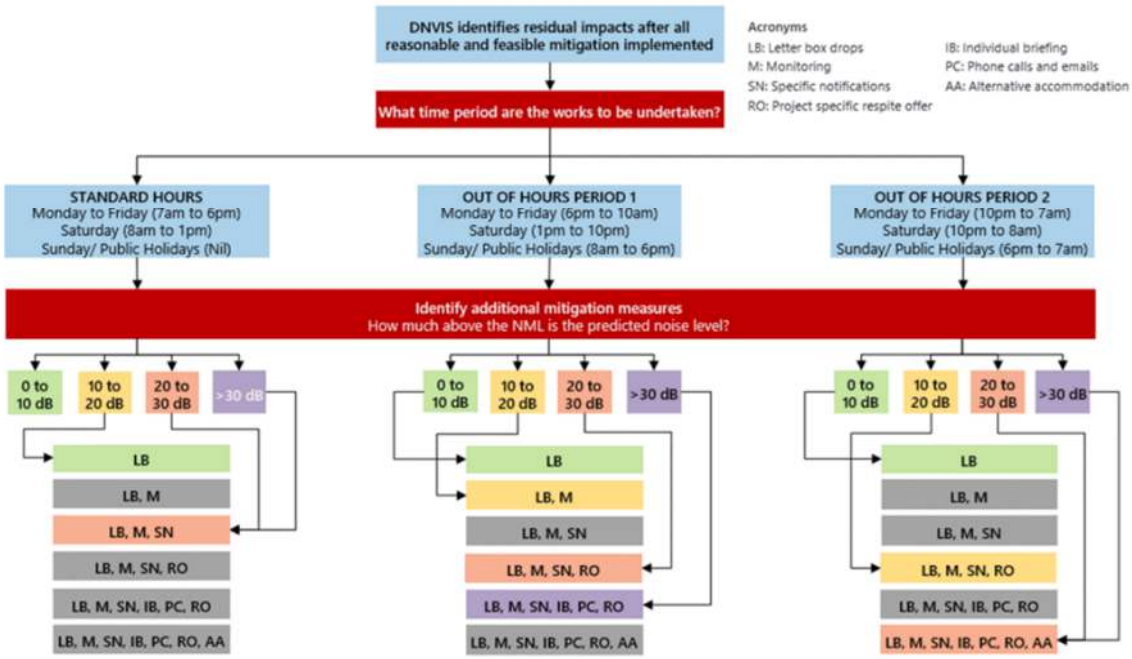


Figure 5:Project additional mitigation measures for surface works NV disturbance

Additional Mitigation Measures

LB = Letter box drops
M = Monitoring
SN = Specific Notification
RO = Project Specific Respite Offer
IB = Individual Briefing
PC = Phone Calls and Emails
AA = Alternate Accommodation

OOHW1 is defined as:

a. 8:00am to 6:00pm Sunday and public holidays (days).

OOHW2 is defined as:

a. 10:00pm to 7:00am (nights) Monday to Saturday and
b. 6:00pm to 8:00am (nights) Sundays and public holidays.

Ground-borne Noise Impacts

Section 5 of the CNVS directs that in instances where, after the application of all reasonable and feasible mitigation and management measures, the LAeq(15minute) ground-borne construction noise levels are still predicted to exceed the NMLs, additional ground-borne noise management measures can be applied to further limit the risk of annoyance from construction noise. The CNVIS requires the Project will implementing additional mitigation measures such as:

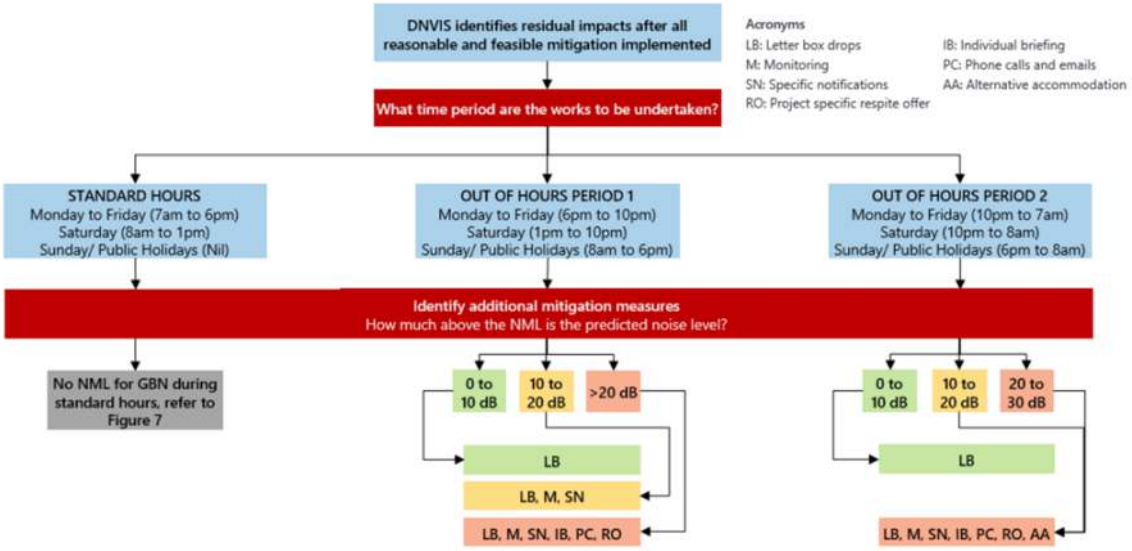


Figure 6: Additional ground-borne noise mitigation measures

Additional Mitigation Measures

LB = Letter box drops
M = Monitoring
SN = Specific Notification
RO = Project Specific Respite Offer
IB = Individual Briefing
PC = Phone Calls and Emails
AA = Alternate Accommodation

OOHW1 is defined as:

b. 8:00am to 6:00pm Sunday and public holidays (days).

OOHW2 is defined as:

b. 10:00pm to 7:00am (nights) Monday to Saturday and
c. 6:00pm to 8:00am (nights) Sundays and public holidays.

6. Discussion

6.1. Noise

During this reporting period, noise monitoring was conducted to ensure the range of construction activities being undertaken is consistent with predictions. This monitoring would target the first opportunity within the first month of starting new tunnelling works as well as during the day, evening and night-time periods throughout construction.

Throughout the reporting period 13 noise complaints were received from the community, all of which were investigated, reported and closed out. Monitoring was undertaken when required.

During noise monitoring a total of 10 exceedances of the predicted noise levels were recorded for attended noise monitoring events within the reporting period, however all exceedances were noted as being a result of external noise sources such as traffic and animals and not site activities. noise sources included the following:

- Extraneous noise sources including traffic was the dominant noise source during all attended monitoring events.
- On some occasions, background noise monitoring undertaken when no works were occurring measured higher noise levels than what was recorded while construction activities were taking place within the same out-of-hours period.

A summary of exceedances is shown in Measured Noise Exceedances 3.

Continuous noise monitoring was undertaken during the reporting period using Sitehive, results are shown in Annexure A.

Noise levels shown within sitehive data have the potential to be impacted by external sources and weather and is not the noise levels representative of nearby receivers. Spikes above the DNVIS predicted are sent as an email to SBT environmental team members which are investigated and addressed as required.

6.2. Vibration

Throughout the reporting period two vibration complaints were received from the community, all of which were investigated and closed out. Both complaints were from 45 Derwent Road. Monitoring was undertaken at 45 Derwent Road Bringelly in response to a complaint.

Ground borne vibration reports prepared by Renzo Tonin are shown in Annexure B. Monitoring result showed no exceedances to human disturbance, with only minor exceedances in predicted vibration levels.

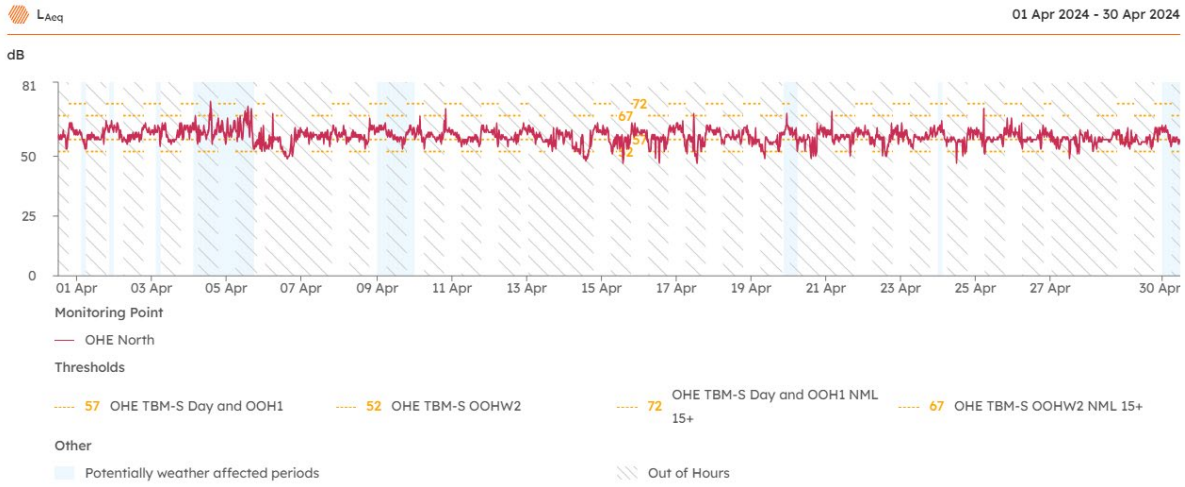
No monitoring resulted in the need for changes in construction methodology as TBM were the main factor for vibration. All Cross-passage excavation was undertaken during the time periods shown in Figure 4.

Annexure A Sitehive Data

April

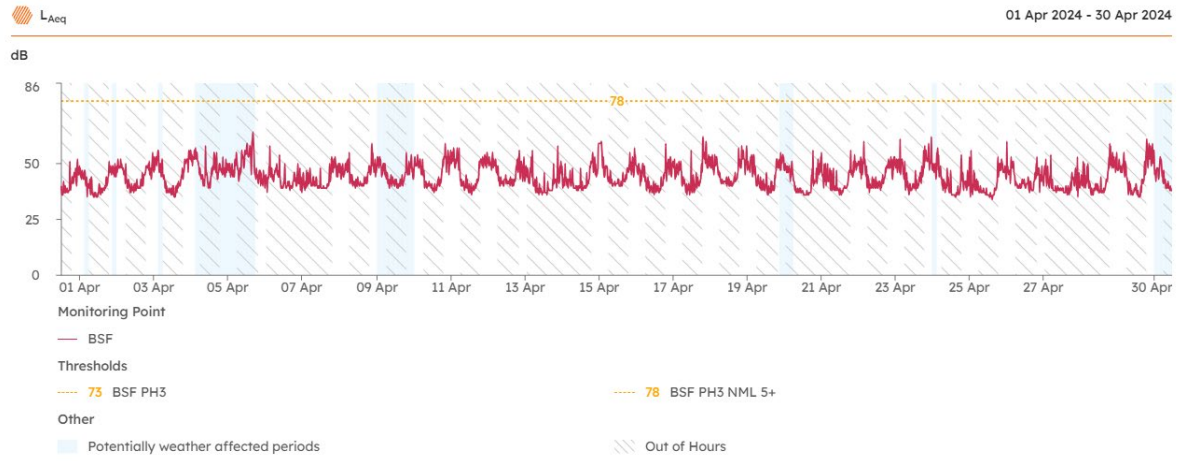
CMF – Nil results

OHE



During the reporting period one spikes was above predicted within the DNIVS occurred. This was investigated by the SBT environmental team and was due to rainfall.

BSF

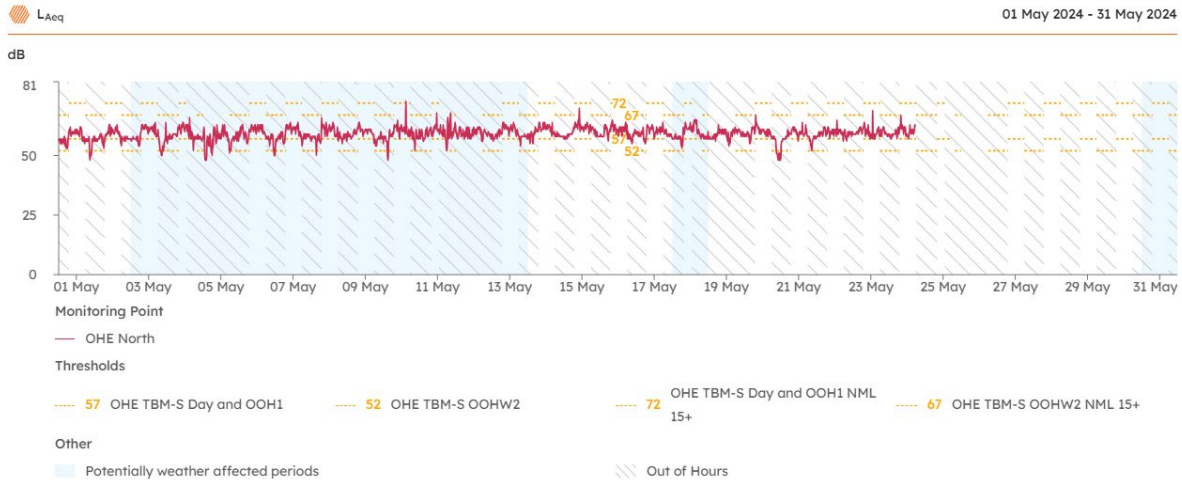


During the reporting period no spikes above predicted within the DNIVS occurred.

May

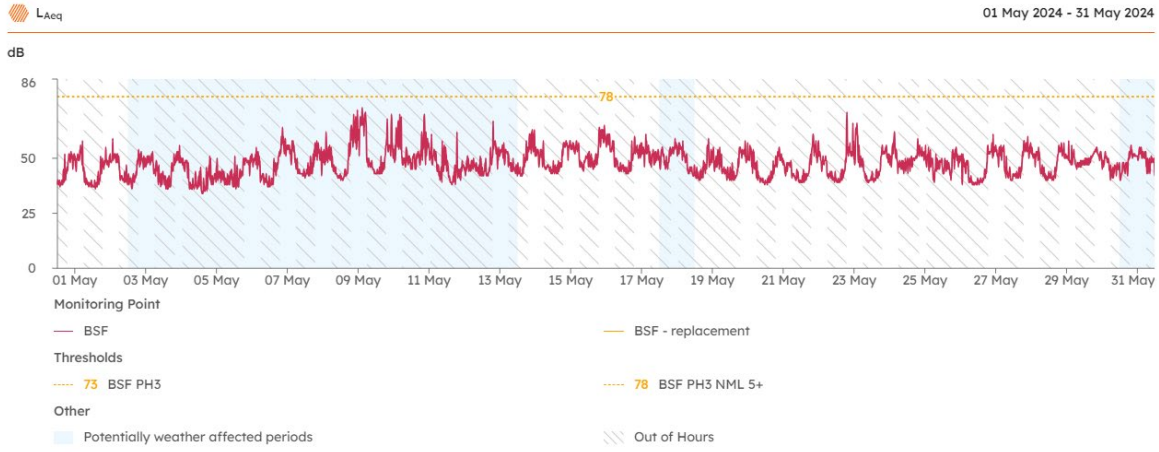
CMF – Nil results

OHE



During the reporting period one spikes was above predicted within the DNIVS occurred. This was investigated by the SBT environmental team and was due to rainfall.

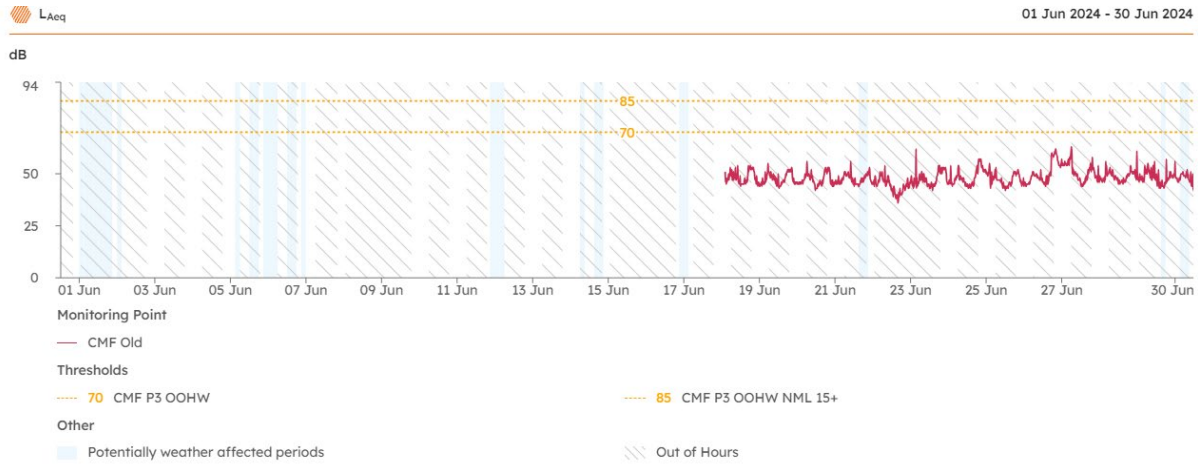
BSF



During the reporting period no spikes above predicted within the DNIVS occurred.

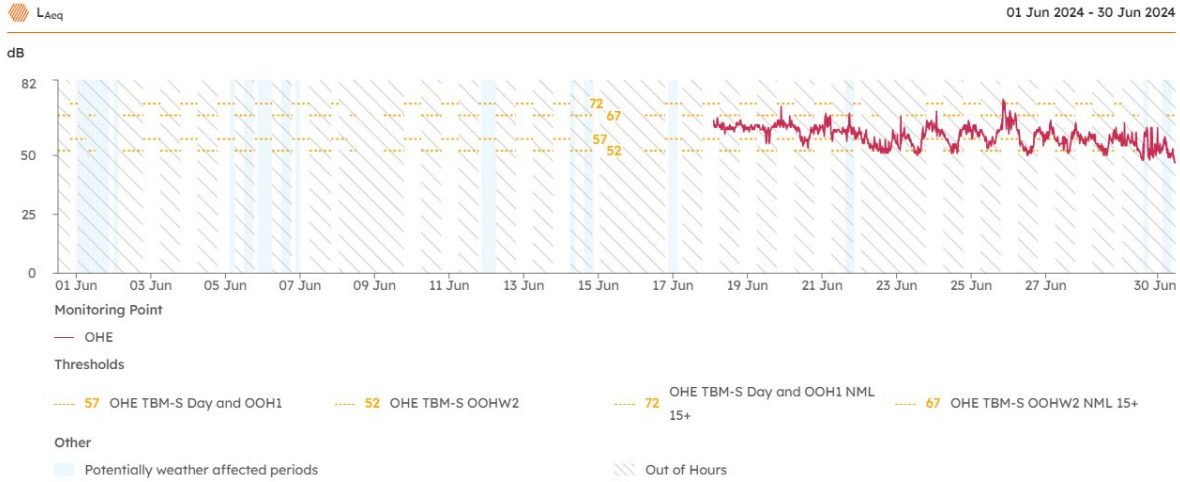
June

CMF



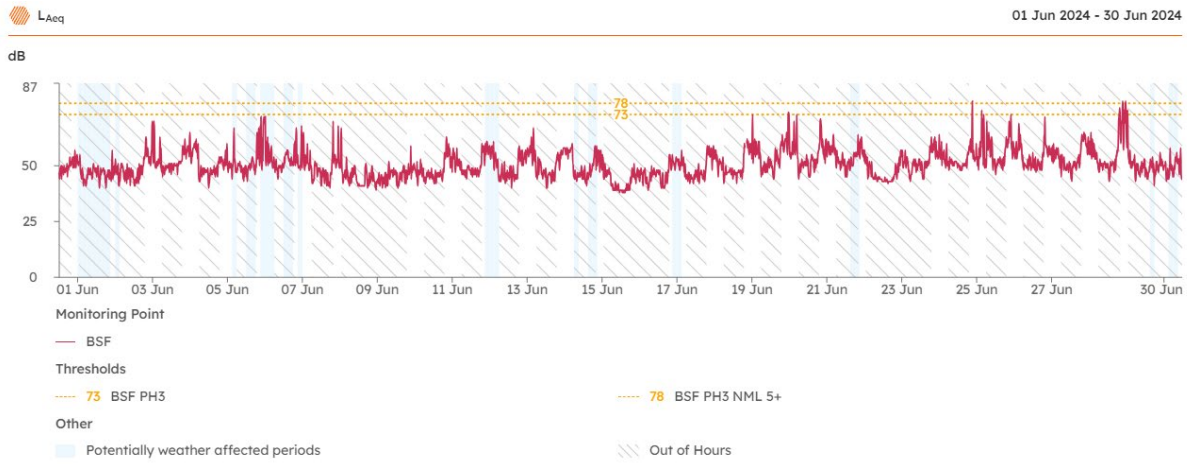
During the reporting period no spikes above predicted within the DNIVS occurred.

OHE



During the reporting period one spikes was above predicted within the DNIVS occurred. This was investigated by the SBT environmental team and was due to a helicopter flying above site.

BSF



During the reporting period three spikes was above predicted within the DNIVS occurred. This was investigated by the SBT environmental team.

The spike that occurred on the 25th of June at 9:15am was due to skip bins being collected on site.

The two spikes that occurred on the 29th of June at 9:30am and 11:30am was due to a road sweeper undertaking work next to the sitehive.

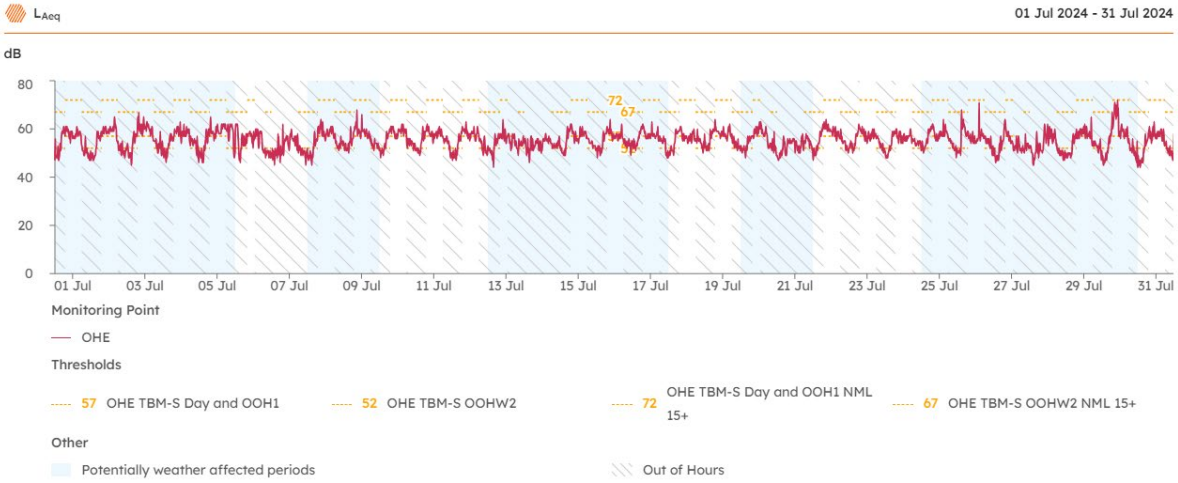
All three spikes were due to works occurring on site close to the sitehive unit, not due to non-complaint activities.

July

CMF

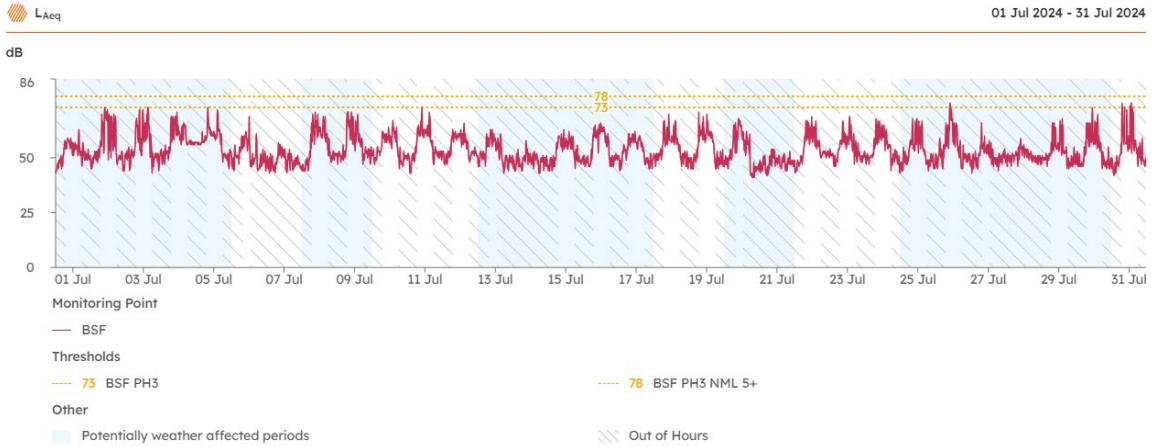
During the reporting period no spikes above predicted within the DNIVS occurred.

OHE



During the reporting period no spikes above predicted within the DNIVS occurred.

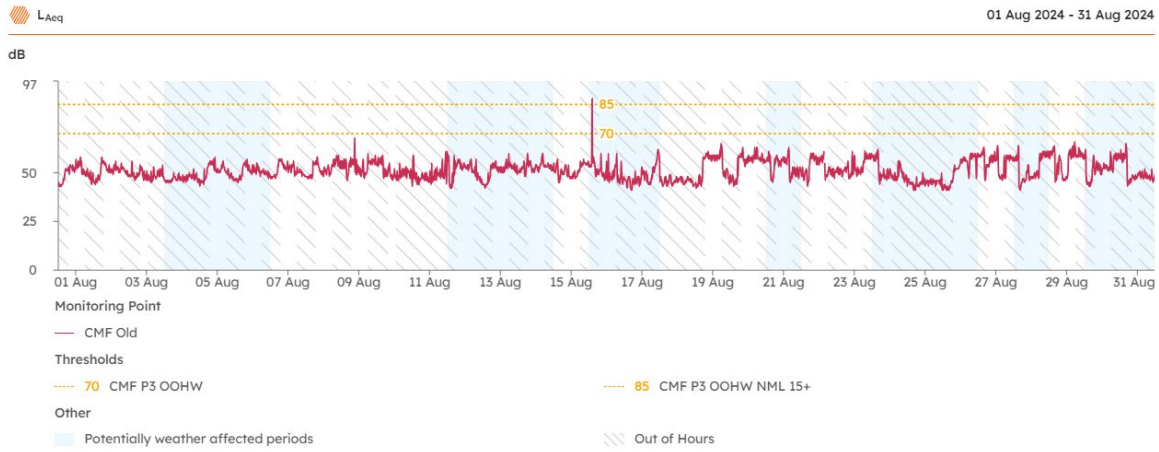
BSF



During the reporting period no spikes above predicted within the DNIVS occurred.

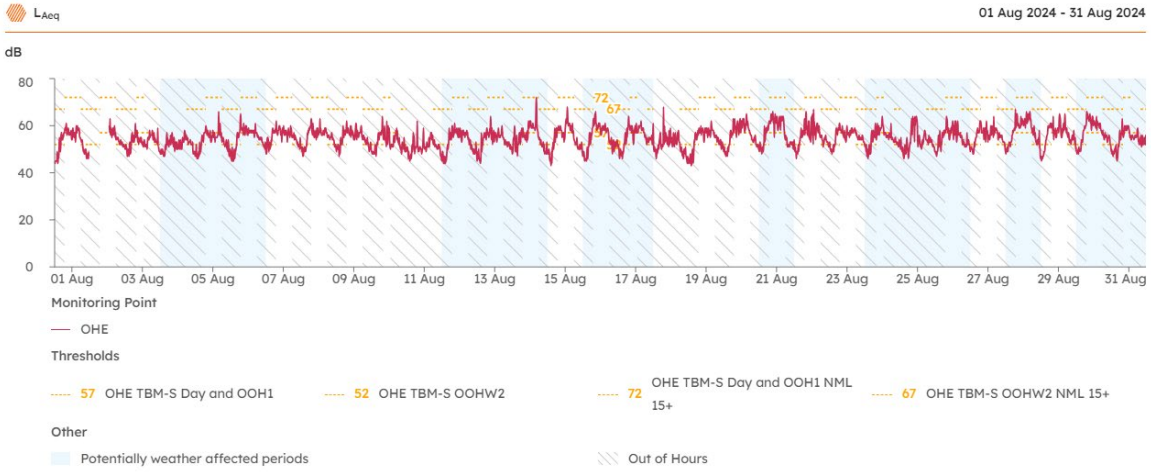
August

CMF



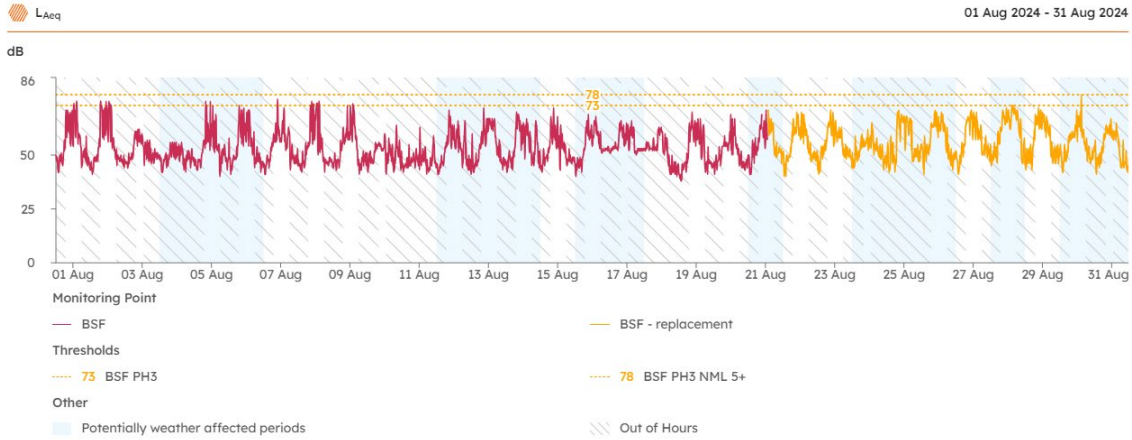
During the reporting period one spikes was above predicted within the DNIVS occurred. This was investigated by the SBT environmental team and was due to external emergency sirens .

OHE



During the reporting period no spikes above predicted within the DNIVS occurred.

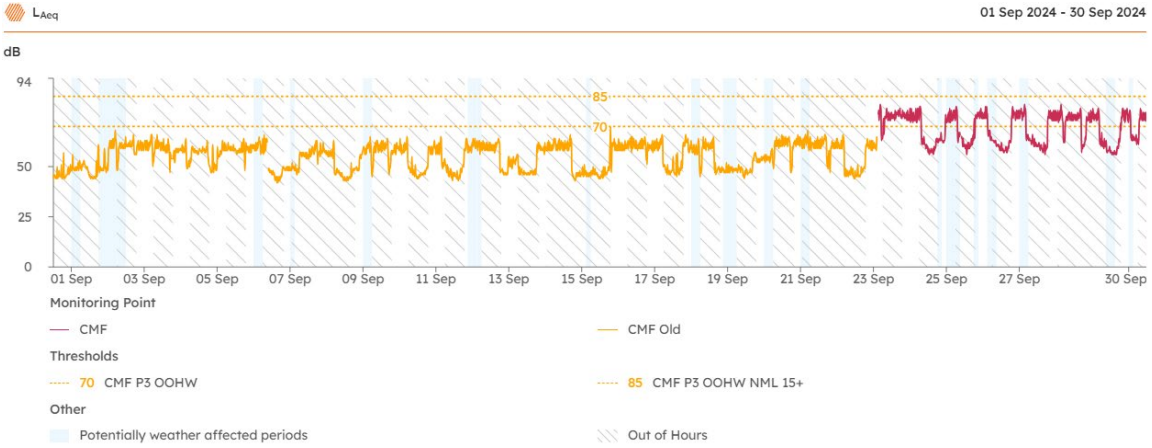
BSF



During the reporting period no spikes above predicted within the DNIVS occurred.

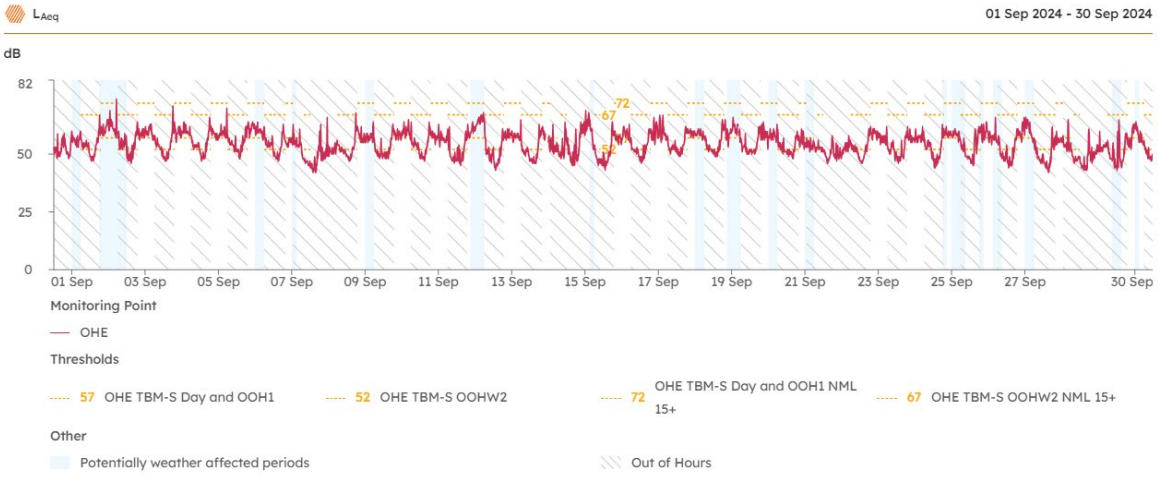
September

CMF



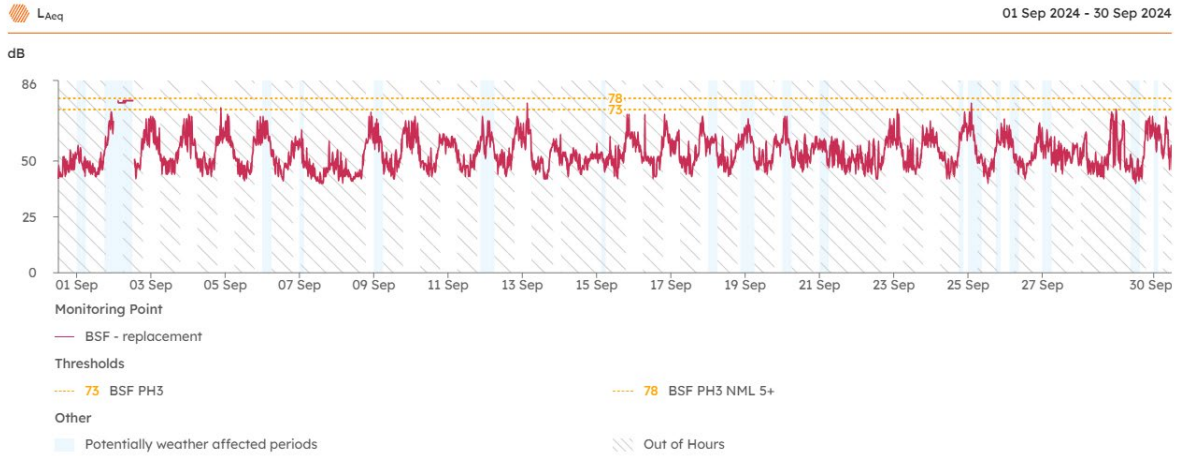
During the reporting period no spikes above predicted within the DNIVS occurred.

OHE



During the reporting period one spikes was above predicted within the DNIVS occurred. This was investigated by the SBT environmental team and was due to wind.

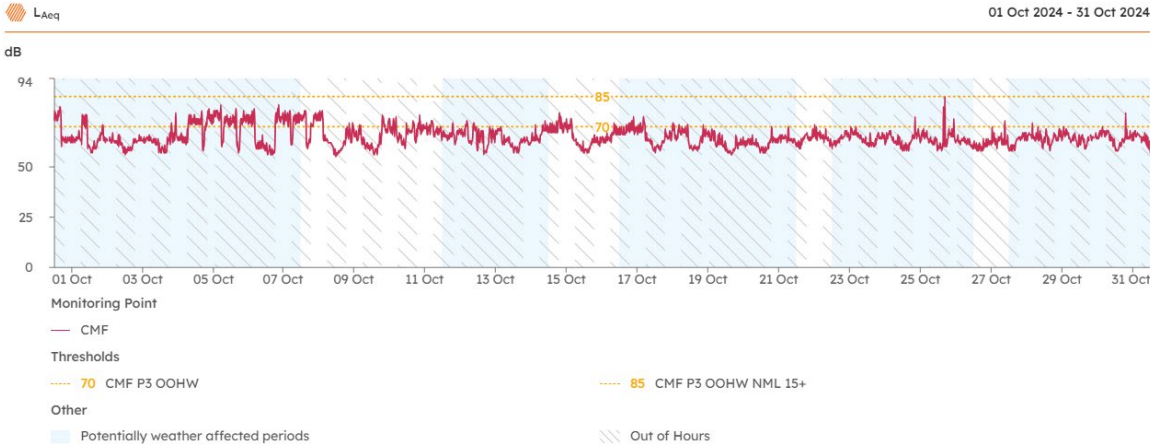
BSF



During the reporting period no spikes above predicted within the DNIVS occurred.

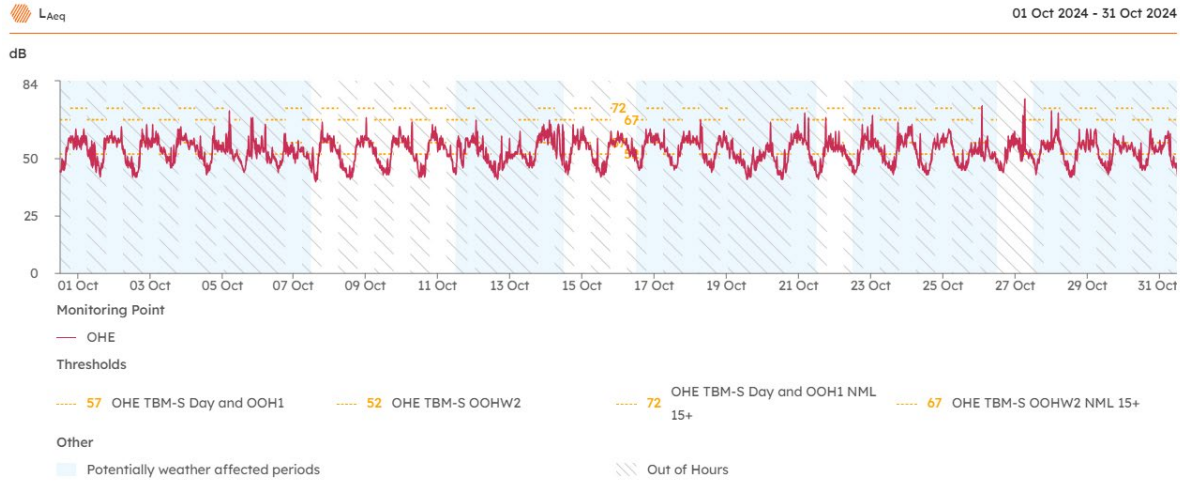
October

CMF



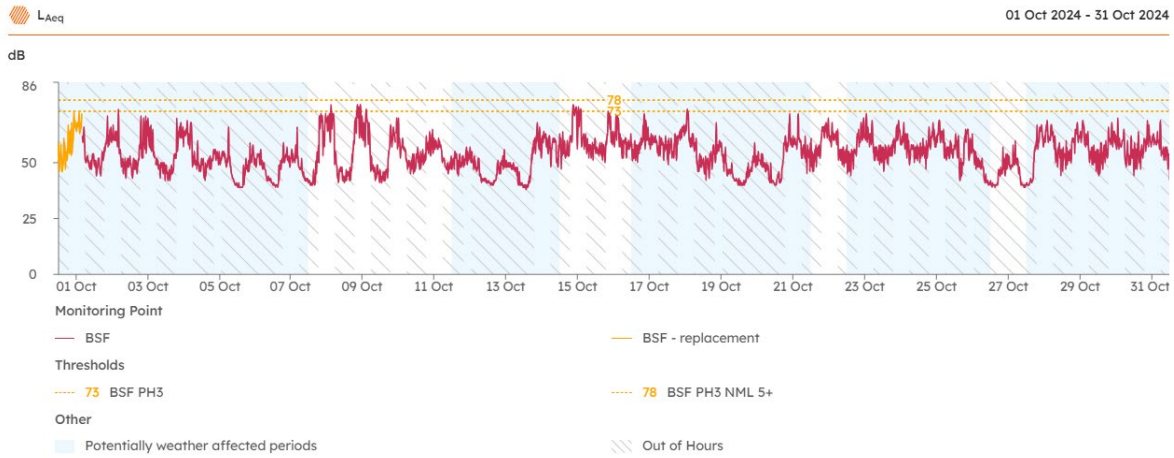
During the reporting period no spikes above predicted within the DNIVS occurred.

OHE



During the reporting period one spikes was above predicted within the DNIVS occurred. This was investigated by the SBT environmental team and was due to animal active near the sitehive unit.

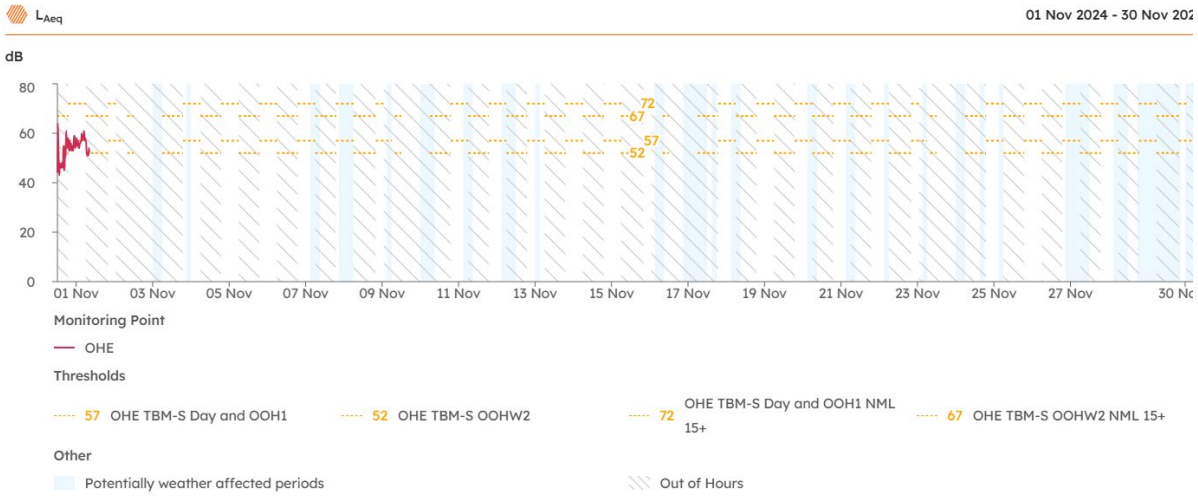
BSF



During the reporting period no spikes above predicted within the DNIVS occurred.

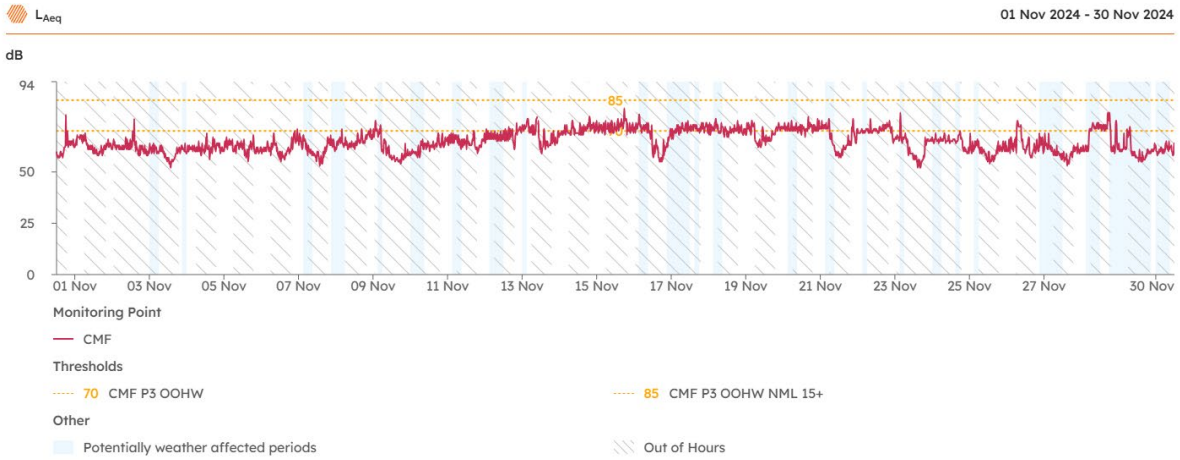
November

OHE



During the reporting period no spikes above predicted within the DNIVS occurred. This unit was no longer required due to construction being completed on November 3rd.

CMF



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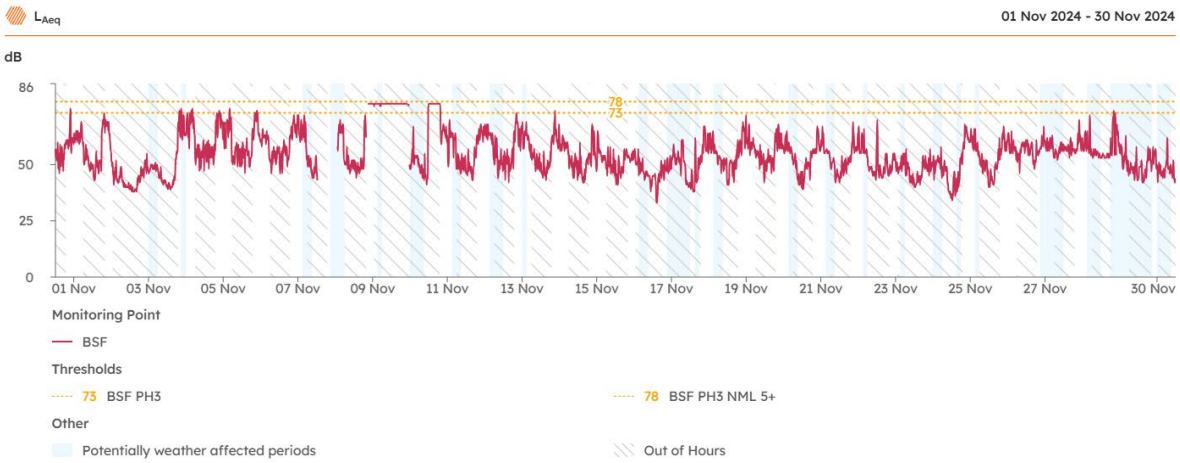
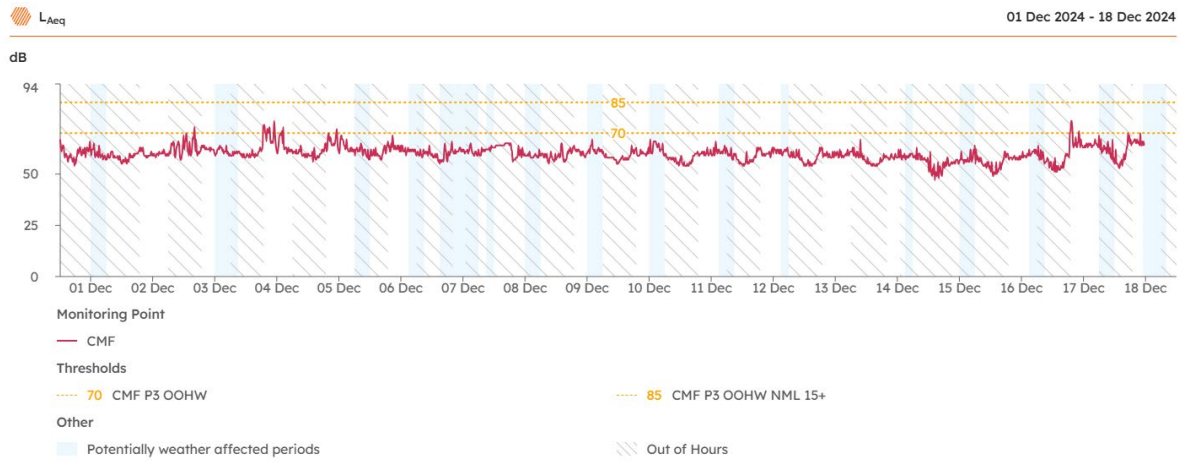
BSF



During the reporting period no spikes above predicted within the DNIVS occurred.

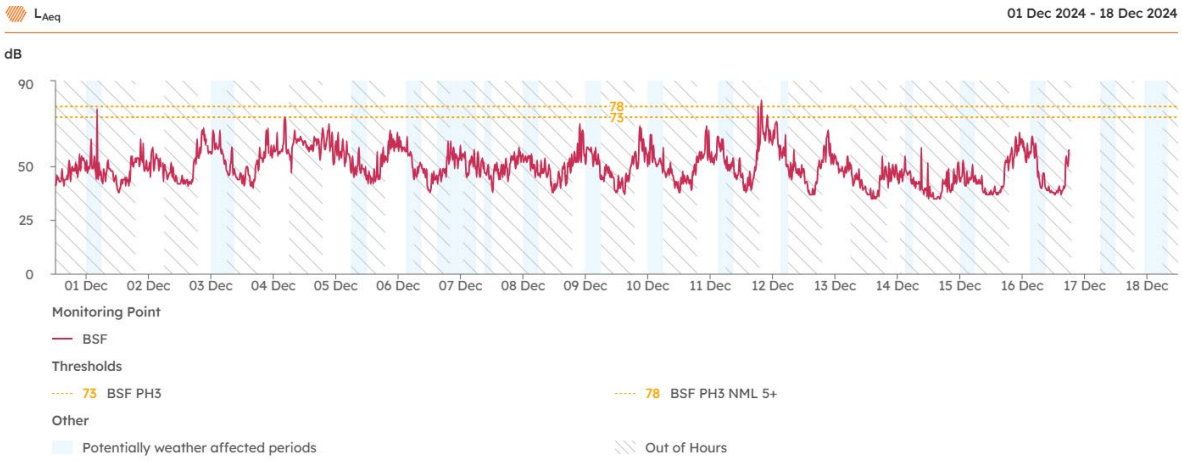
December

CMF



During the reporting period no spikes above predicted within the DNIVS occurred.

BSF



During the reporting period one spikes was above predicted within the DNIVS occurred. This was investigated by the SBT environmental team and was due to animal active near the sitehive unit.

Annexure B Ground-borne noise and vibration validation monitoring report.

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

SYDNEY METRO - WESTERN SYDNEY AIRPORT - STATION BOXES AND TUNNELLING WORKS

Ground-borne noise and vibration validation monitoring report - Tunnelling

9 July 2024

CPB Ghella

TM008-07-01F05 SMWSA-SBT_Monitoring-45 Derwent Road (r1)

Document details

Detail	Reference
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Prepared for:	CPB Ghella
Address:	14 Great Western Highway, L2/ Ste 4 Werrington Park Corporate Centre Werrington NSW 2747
Attention:	Emma Kline

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
08.07.2024	45 Derwent Road	0	1	A. Hannelly	T. Gowen	T. Gowen

File Path: \\192.168.168.249\data\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\1 Docs\07 TUNNELS\TM008-07-01F05 SMWSA-SBT_Monitoring-45 Derwent Road (r1).docx

Contents

List of tables

1 Introduction

Renzo Tonin and Associates has undertaken Ground-Borne Noise and Vibration (GBNV) monitoring on behalf of CPB Ghella Joint Venture (CPBG) during underground excavation works, as required by the Construction Noise and Vibration Management Plan[1] and the Detailed Noise and Vibration Impact Statement for tunnelling[2].

The monitoring was undertaken in response to a complaint about GBNV during tunnelling works. The purpose of the monitoring is to verify the predicted ground-borne noise and vibration levels during tunnel excavation works. Where GBNV levels are found to be above the predicted levels, appropriate action would be taken with regard to mitigating and managing impacts.

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

Appendix A contains a glossary of acoustic terms used in this report.

[1] CPB Ghella Joint Venture, Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works, NSW (Off-airport) Construction Noise and Vibration Management Sub-Plan, SMWSASBT-CPG-1NL-NL000-NV-PLN-000001

[2] Renzo Tonin and Associates, Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works, Detailed Noise and Vibration Impact Statement - Tunnelling, TM008-07-01F01 SMWSA-SBT_DNVIS-TUN

2 Ground-borne noise and vibration monitoring details

2.1 Methodology

Noise and vibration measurements were undertaken in accordance with Sections 3 of the Noise and Vibration Monitoring Program[3].

2.2 Measurement locations

The GBN&V measurements were conducted at the locations presented in Table 2-1.

Table 2-1 – Measurement locations

ID	Date (from)	Date (to)	Plant/ location	Address	Location
M1	06/06/2024	12/06/2024	Hand tools, Segment Patching and Chemical Injections/ XP17	45 Derwent Road, Bringelly	Lounge room

2.3 Results summary

The results of the GBN&V validation are summarised in the table below.

Table 2-2 – Summary of GBN&V validation results

ID	Address	Validation results	Validation Outcome	Comment
M1	45 Derwent Road, Bringelly	See Appendix B.1 for details	GBN&V monitoring results were below with predictions.	Monitoring results not applicable for validation. See Appendix B.1 for details.

[3] CPB Ghella Joint Venture, Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works, NSW (Off-airport) Construction Noise and Vibration Monitoring Plan, TM008-02-1-00F01 SM-SBT_NV Mon Program

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.

Air-borne noise	Noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise source and receiver.
AS	Australian Standard
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.
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. 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 LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.
Decibel [dB]	The units of sound measurement. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear, defined as 20 micro Pascal 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 110dB Operating a chainsaw or jackhammer 120dB Deafening
dB(A)	A-weighted decibel. 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 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. The dB(C) level is not widely used but has some applications.
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.
Ground-borne noise	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.

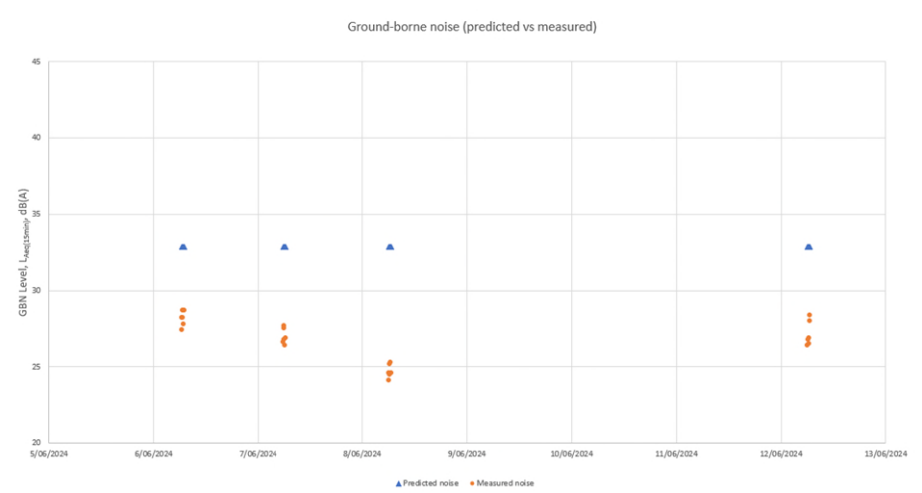
Habitable Area	Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom. Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.
L_{Aeq} or L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a steady sound level occurring over the same period of time. When A-weighted, this is written as the L_{Aeq}.
L_{max}	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the L_{Amax}.
L_{min}	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the L_{Amin}.
Microphone	An electro-acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.
Noise	Unwanted sound
Sound	A fluctuation of air pressure which is propagated as a wave through air.
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 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 of 1 pico watt.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 mico Pascal.
Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source itself. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.
Vibration	A mechanical phenomenon whereby oscillations occur about an equilibrium point; a periodic back-and-forth motion of an elastic body or medium, commonly resulting when almost any physical system is displaced from its equilibrium condition.

APPENDIX B Measurement results

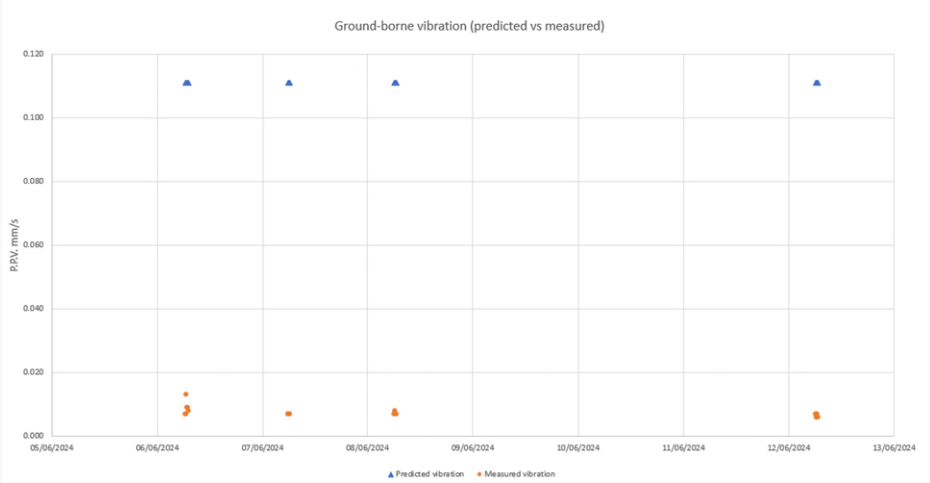
B.1 45 Derwent Road, Bringelly

Measurement ID:	**M1**
Address:	**45 Derwent Road, Bringelly**
Tunnel chainage	**XPS17**
Start / End Dates:	06/06/2024 – 12/06/2024
Building type:	Slab on ground
Meas. location:	Loungeroom
Floor level:	Ground floor
Geology:	Ashfield Shale
Plant:	Assumed for noise prediction modelling: roadheader excavation of cross passage Operating during monitoring period: Hand tools, Segment Patching and Chemical Injections (no excavation)
Instrumentation:	Noise: RTA07-037 (#A2A-15538-E0), Vibration: RTA07-041 (#A2A-18950-E0), Accelerometer: PCB Accelerometer 393B12 #1 (SN: #32172)
Notes:	The noise monitor was placed in lounge room approximately 1.5m from the walls as this was the only available location. The vibration monitor was installed directly onto the floor next to the noise monitor.

GBV results



GBN results



Comments

Noise and vibration measurements were undertaken during finishing works withing XPS17. It is understood that excavation of XPS17 was completed prior to the commencement of monitoring at 45 Derwent Road. Measured GBNV was below the predictions, however activities in XPS17 were not representative of the activities assumed for the GBNV predictions. Results are not applicable to GBNV prediction model validation.

Table B. 1: Monitoring results summary

Measurement dates	Distance from works (m)	GBV p.p.v. (mm/s)			GBN $L_{Aeq,15min}$ (dB(A))		
		Predicted vibration level	Measured (Max)	Measured (95%)	Predicted noise level	Measured (Max)	Measured (95%)
06/06/2024	36.1	0.11	0.01	0.01	33	29	28
07/06/2024	36.1	0.11	0.01	0.01	33	28	27
08/06/2024	36.1	0.11	0.01	0.01	33	25	25
09/06/2024			**No works from 09/06/2024 to 11/06/2024**				
10/06/2024							
11/06/2024							
12/06/2024	36.1	0.11	0.01	0.01	33	28	27

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SYDNEY METRO - WESTERN SYDNEY AIRPORT - STATION BOXES AND TUNNELLING WORKS

Ground-borne noise and vibration validation monitoring report - Tunnelling

27 June 2024

CPB Ghella

TM008-07-01F04 SMWSA-SBT_Monitoring-TUN_Kalang Ave (r1)

Document details

Detail	Reference
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Prepared for:	CPB Ghella
Address:	14 Great Western Highway, L2/ Ste 4 Werrington Park Corporate Centre Werrington NSW 2747
Attention:	Emma Kline

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
27.06.2024	First revision	0	1	A. Hannelly	T. Gowen	T. Gowen

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List of tables

1 Introduction

Renzo Tonin and Associates has undertaken Ground-Borne Noise and Vibration (GBNV) monitoring on behalf of CPB Ghella Joint Venture (CPBG) during underground excavation works, as required by the Construction Noise and Vibration Management Plan[1] and the Detailed Noise and Vibration Impact Statement for tunnelling[2].

The purpose of the monitoring is to validate the ground-borne noise and vibration model used to predict impacts during tunnel excavation works. The prediction model will be updated as required to provide accurate predictions across the tunnel alignment.

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

Appendix A contains a glossary of acoustic terms used in this report.

[1] CPB Ghella Joint Venture, Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works, NSW (Off-airport) Construction Noise and Vibration Management Sub-Plan, SMWSASBT-CPG-1NL-NL000-NV-PLN-000001

[2] Renzo Tonin and Associates, Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works, Detailed Noise and Vibration Impact Statement - Tunnelling, TM008-07-01F01 SMWSA-SBT_DNVIS-TUN

2 Ground-borne noise and vibration monitoring details

2.1 Methodology

Noise and vibration measurements were undertaken in accordance with Sections 3 of the Noise and Vibration Monitoring Program[3].

2.2 Measurement locations

The GBN&V measurements were conducted at the locations presented in Table 2-1.

Table 2-1 – Measurement locations

ID	Date (from)	Date (to)	Plant	Address	Location
M1	04/05/2024	10/05/2024	TBM1 and TBM2	49 Kalang Ave, St Marys	Garage

2.3 Results summary

The results of the GBN&V validation are summarised in the table below.

Table 2-2 – Summary of GBN&V validation results

ID	Address	Validation results	Validation Outcome	Comment
M1	49 Kalang Ave, St Marys	See Appendix B.1 for details	Monitor battery fail. No data recorded	Additional monitoring is recommended for a more accurate calibration of the GBN&V empirical algorithms.

[3] CPB Ghella Joint Venture, Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works, NSW (Off-airport) Construction Noise and Vibration Monitoring Plan, TM008-02-1-00F01 SM-SBT_NV Mon Program

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.

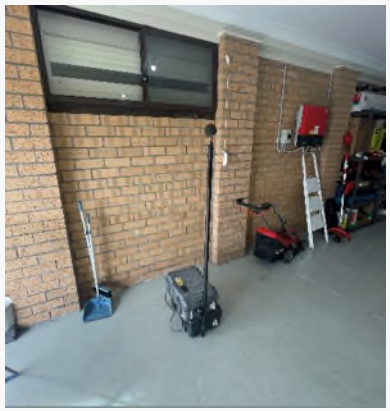
Air-borne noise	Noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise source and receiver.
AS	Australian Standard
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.
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. 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 LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.
Decibel [dB]	The units of sound measurement. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear, defined as 20 micro Pascal 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 110dB Operating a chainsaw or jackhammer 120dB Deafening
dB(A)	A-weighted decibel. 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 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. The dB(C) level is not widely used but has some applications.
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.
Ground-borne noise	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.

Habitable Area	Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom. Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.
L_{Aeq} or L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a steady sound level occurring over the same period of time. When A-weighted, this is written as the L_{Aeq}.
L_{max}	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the L_{Amax}.
L_{min}	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the L_{Amin}.
Microphone	An electro-acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.
Noise	Unwanted sound
Sound	A fluctuation of air pressure which is propagated as a wave through air.
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 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 of 1 pico watt.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 mico Pascal.
Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source itself. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.
Vibration	A mechanical phenomenon whereby oscillations occur about an equilibrium point; a periodic back-and-forth motion of an elastic body or medium, commonly resulting when almost any physical system is displaced from its equilibrium condition.

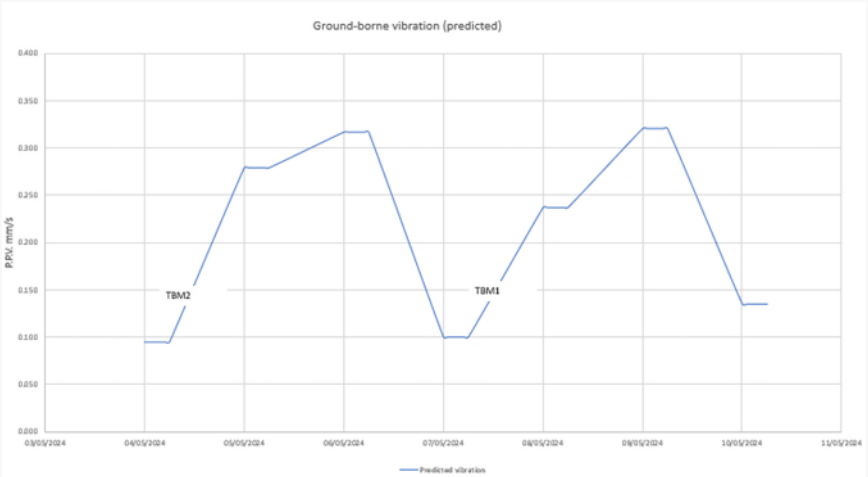
APPENDIX B Measurement results

B.1 49 Kalang Ave, St Marys

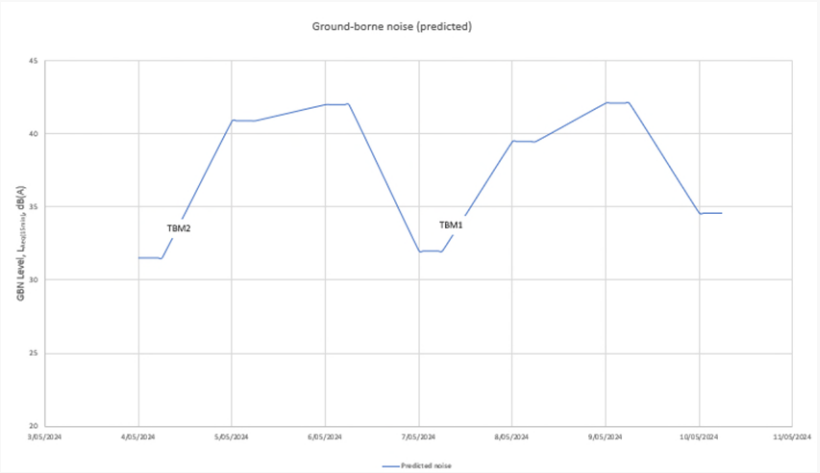
Measurement ID:	**M1**
Address:	**49 Kalang Ave, St Marys**
Tunnel chainage	**CH18025.88 – CH18127.92**
Start / End Dates:	04/05/2024 – 10/05/2024
Building type:	Slab on ground (foundation in rock)
Meas. location:	Garage
Floor level:	Ground floor
Geology:	Ashfield Shale
Plant:	TBM
Instrumentation:	Noise: NTi XL2 (#A2A-18950-E0), Vibration: NTi XL2 (#A2A-16217-E0), Accelerometer: PCB Accelerometer 393B12 (SN: #32172)
Notes:	The noise monitor was placed in garage approximately 1m from the wall as this was the only available location. The vibration monitor was installed directly onto the floor next to the noise monitor.



GBV results



GBN results



Comments

Due to not being able to gain access to the residence when the battery of the monitors depleted, no data was recorded during the period where the TBM passed the residence. The data presented above shows the predicted noise and vibration levels at 49 Kalang Ave.

Table B. 1: Monitoring results summary

Measurement dates	Distance from excavation (m)	GBV p.p.v. (mm/s)			GBN $L_{Aeq,15min}$ (dB(A))		
		Predicted vibration level	Measured (Max)	Measured (95%)	Predicted noise level	Measured (Max)	Measured (95%)
04/05/2024	40.2	0.10	-	-	32	-	-
05/05/2024	17.3	0.28	-	-	41	-	-
06/05/2024	15.5	0.32	-	-	42	-	-
07/05/2024	38.7	0.10	-	-	32	-	-
08/05/2024	19.8	0.24	-	-	39	-	-
09/05/2024	15.3	0.32	-	-	42	-	-
10/05/2024	31.0	0.14	-	-	35	-	-

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SYDNEY METRO - WESTERN SYDNEY AIRPORT - STATION BOXES AND TUNNELLING WORKS

Ground-borne noise and vibration validation monitoring report - Tunnelling

30 May 2024

CPB Ghella

TM008-07-01F02 SMWSA-SBT_Monitoring-TUN (r4)

40 YEARS 1982-2022 ACOUSTIC ENGINEERING EXCELLENCE

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

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Address:	14 Great Western Highway, L2/ Ste 4 Werrington Park Corporate Centre Werrington NSW 2747
Attention:	Emma Kline

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
20.11.2023	75A Blackwood St	0	1	M. Tabacchi	T. Gowen	T. Gowen
13.12.2023	11 Falcon Cres, 6 Powie Close	-	2	M. Tabacchi	T. Gowen	T. Gowen
07.05.2024	45 Derwent Road	-	3	T. Gowen	-	M. Tabacchi
28.05.2024	190 Badgerys Creek Road	-	4	A. Hannelly	T. Gowen	T. Gowen

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1 Introduction

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The purpose of the monitoring is to validate the ground-borne noise and vibration model used to predict impacts during tunnel excavation works. The prediction model will be updated as required to provide accurate predictions across the tunnel alignment.

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

Appendix A contains a glossary of acoustic terms used in this report.

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[2] Renzo Tonin and Associates, Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works, Detailed Noise and Vibration Impact Statement - Tunnelling, TM008-07-01F01 SMWSA-SBT_DNVIS-TUN

2 Ground-borne noise and vibration monitoring details

2.1 Methodology

Noise and vibration measurements were undertaken in accordance with Sections 3 of the Noise and Vibration Monitoring Program[3].

2.2 Measurement locations

The GBN&V measurements were conducted at the locations presented in Table 2-1.

Table 2-1 – Measurement locations

ID	Date (from)	Date (to)	Plant	Address	Location
M1	27/10/2023	03/11/2023	TBM Catherine	75A Blackwood Street, Claremont Meadows	Living room
M2	15/11/2023	19/11/2023	TBM Catherine	11 Falcon Cres, Claremont Meadows	Spare room/study
M3	23/11/2023	25/11/2023	TBM Catherine	6 Powie Close, Claremont Meadows	Living room
M4	5/03/2024	4/04/2024	TBM3 and TBM4	45 Derwent Road, Bringelly	Lounge room
M5	20/04/2024	04/05/2024	TBM3 and TBM4	190 Badgerys Creek Road, Bringelly	Dining Room

2.3 Results summary

The results of the GBN&V validation are summarised in the table below.

Table 2-2 – Summary of GBN&V validation results

ID	Address	Validation results	Validation Outcome	Comment
M1	75A Blackwood Street, Claremont Meadows	See Appendix B.1 for details	GBN&V monitoring results were below with predictions.	Additional monitoring is recommended for a more accurate calibration of the GBN&V empirical algorithms.
M2	11 Falcon Cres, Claremont Meadows	See Appendix B.2 for details	GBN&V monitoring results were below with predictions.	Additional monitoring is recommended for a more accurate calibration of the GBN&V empirical algorithms.
M3	6 Powie Close, Claremont Meadows	See Appendix B.3 for details	GBN&V monitoring results were below with predictions.	GBN&V empirical algorithms have been calibrated for site conditions.

[3] CPB Ghella Joint Venture, Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works, NSW (Off-airport) Construction Noise and Vibration Monitoring Plan, TM008-02-1-00F01 SM-SBT_NV Mon Program

ID	Address	Validation results	Validation Outcome	Comment
M4	45 Derwent Road, Bringelly	See Appendix B.4 for details	GBN&V monitoring results were mostly below with predictions.	Calibration of GBNV algorithms confirmed. Verified for two TBMs operating concurrently within approx. 60 m (slant).
M5	190 Badgerys Creek Road, Bringelly	See Appendix B.5 for details	GBN&V monitoring results were below with predictions.	No Addition monitoring is required.

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.

Air-borne noise	Noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise source and receiver.
AS	Australian Standard
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.
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Decibel [dB]	The units of sound measurement. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear, defined as 20 micro Pascal 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 110dB Operating a chainsaw or jackhammer 120dB Deafening
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Sound	A fluctuation of air pressure which is propagated as a wave through air.
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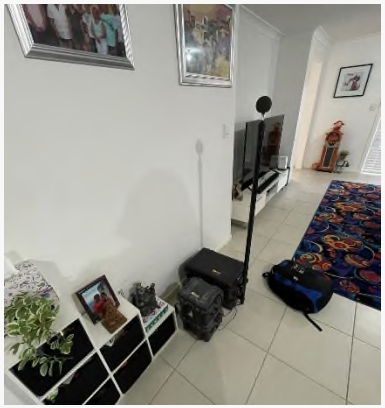
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 mico Pascal.
Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source itself. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.
Vibration	A mechanical phenomenon whereby oscillations occur about an equilibrium point; a periodic back-and-forth motion of an elastic body or medium, commonly resulting when almost any physical system is displaced from its equilibrium condition.

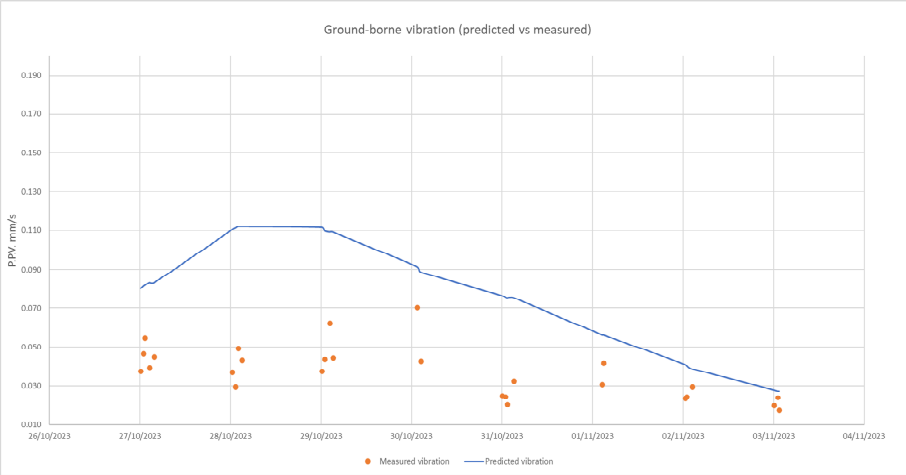
APPENDIX B Measurement results

B.1 75A Blackwood Street, Claremont Meadows

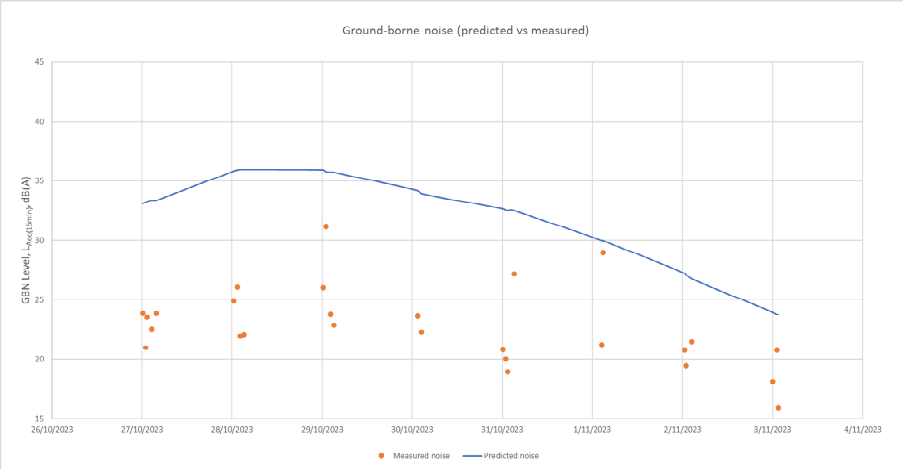
Measurement ID:	**M1**
Address:	**75A Blackwood Street, Claremont Meadows**
Tunnel chainage	**TMB Catherine (TBM 1), CH21500-CH21100**
Start / End Dates:	27/10/2023 – 03/11/2023
Building type:	Slab on ground (foundation in rock)
Meas. location:	Living room
Floor level:	Ground floor
Geology:	Ashfield Shale
Plant:	TBM
Instrumentation:	Noise: RTA07-052 (#A2A-17457-E0), Vibration: XL2-B (#A2A-16217-E0), Accelerometer: PCB Accelerometer 393B12 #1 (SN: #32172)
Notes:	The noise monitor was placed in living room approximately 50cm from the wall as this was the only available location. The vibration monitor was installed directly onto the floor next to the noise monitor.



GBV results



GBN results



Comments

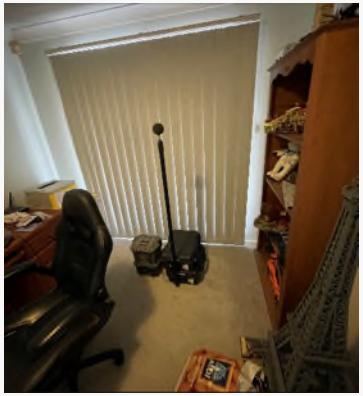
Noise and vibration measurements were below the predictions. Additional monitoring is recommended for a more accurate calibration of the GBN&V empirical algorithms.

Table B. 1: Monitoring results summary

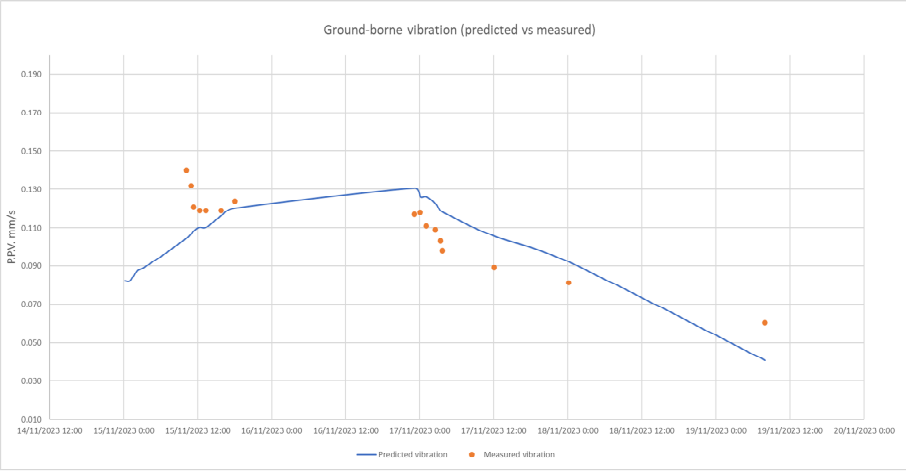
Measurement dates	Distance from excavation (m)	GBV p.p.v. (mm/s)			GBN $L_{Aeq,15min}$ (dB(A))		
		Predicted vibration level	Measured (Max)	Measured (95%)	Predicted noise level	Measured (Max)	Measured (95%)
27/10/2023	56.9	0.08	0.05	0.05	33	24	24
28/10/2023	46.1	0.11	0.05	0.05	36	26	26
29/10/2023	46.5	0.11	0.06	0.06	36	31	30
30/10/2023	53.4	0.09	0.07	0.07	34	24	24
31/10/2023	59.3	0.08	0.03	0.03	33	27	26
1/11/2023	70.7	0.06	0.04	0.04	30	29	29
2/11/2023	87.0	0.04	0.03	0.03	27	21	21
3/11/2023	103.7	0.03	0.02	0.02	24	21	21

B.2 11 Falcon Cres, Claremont Meadows

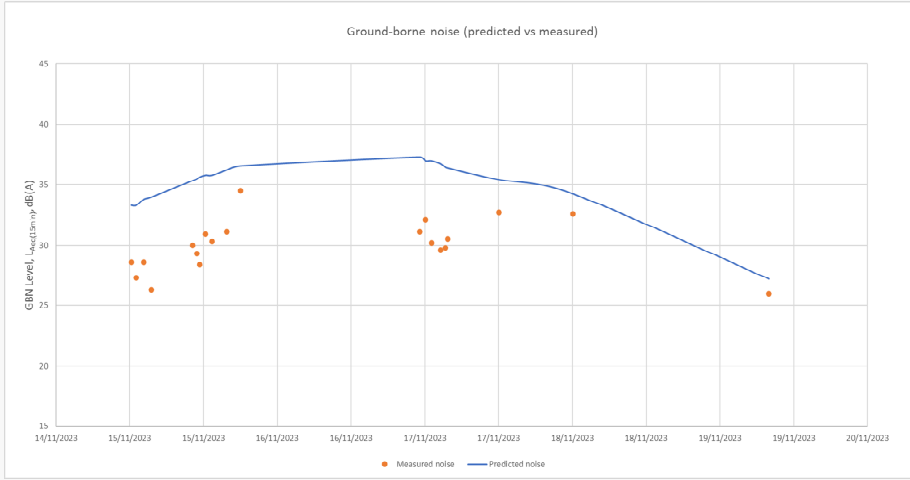
Measurement ID:	**M2**
Address:	**11 Falcon Cres, Claremont Meadows**
Tunnel chainage	**TMB Catherine (TMB 1), CH20800-CH20700**
Start / End Dates:	15/11/2023 – 19/11/2023
Building type:	Slab on ground (foundation in rock)
Meas. location:	Spare room/study
Floor level:	Ground floor
Geology:	Ashfield Shale
Plant:	TBM
Instrumentation:	Noise: RTA07-052 (#A2A-17457-E0), Vibration: XL2-B (#A2A-16217-E0), Accelerometer: PCB Accelerometer 393B12 #1 (SN: #32172)
Notes:	The noise monitor was placed in living room approximately 50cm from a window as this was the only available location. The vibration monitor was installed directly onto the floor next to the noise monitor.



GBV results



GBN results



Comments

Noise and vibration measurements were below the predictions. Additional monitoring is recommended for a more accurate calibration of the GBN&V empirical algorithms.

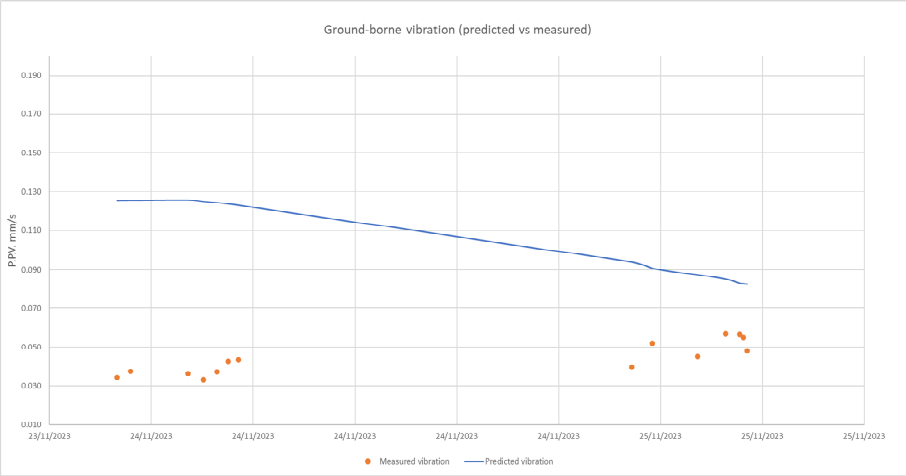
Table B. 2: Monitoring results summary

Measurement dates	Distance from excavation (m)	GBV p.p.v. (mm/s)			GBN $L_{Aeq,15min}$ (dB(A))		
		Predicted vibration level	Measured (Max)	Measured (95%)	Predicted noise level	Measured (Max)	Measured (95%)
15/11/2023	55.9	0.12	0.27	0.24	37	35	33
16/11/2023	41.0	0.13	0.12	0.12	37	31	31
17/11/2023	47.5	0.13	0.12	0.12	37	33	33
18/11/2023	52.0	0.09	0.08	0.08	34	33	33
19/11/2023	84.7	0.04	0.06	0.06	27	26	26

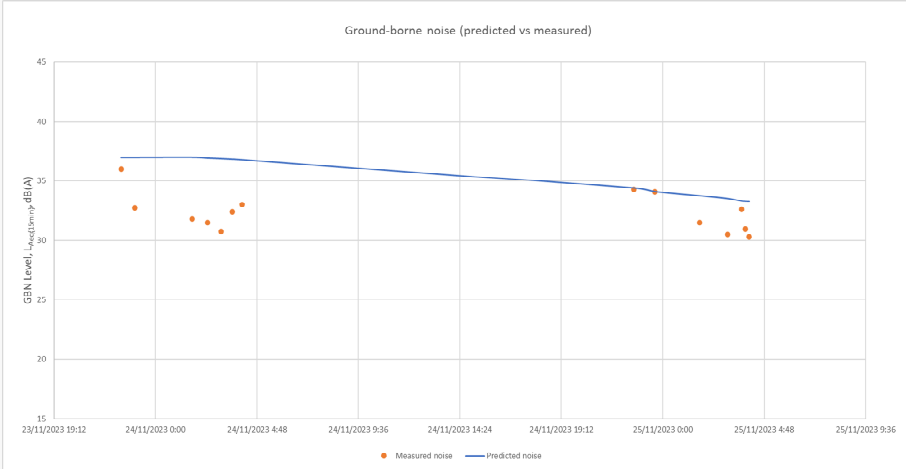
B.3 6 Powie Close, Claremont Meadows

Measurement ID:	**M3**
Address:	**6 Powie Close, Claremont Meadows**
Tunnel chainage	**TMB Catherine (TBM 1), CH20700-CH20600**
Start / End Dates:	23/11/2023 – 25/11/2023
Building type:	Slab on ground (foundation in rock)
Meas. location:	Living room
Floor level:	Ground floor
Geology:	Ashfield Shale
Plant:	TBM
Instrumentation:	Noise: RTA07-052 (#A2A-17457-E0), Vibration: XL2-B (#A2A-16217-E0), Accelerometer: PCB Accelerometer 393B12 #1 (SN: #32172)
Notes:	The noise monitor was placed in living room approximately 50cm from the wall as this was the only available location. The vibration monitor was installed directly onto the floor next to the noise monitor.

GBV results



GBN results



Comments

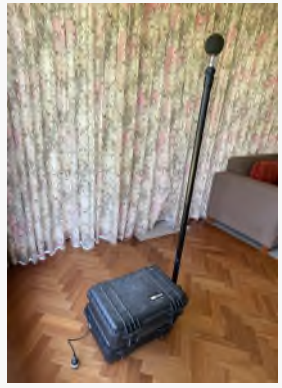
Noise and vibration measurements were below the predictions.

Table B. 3: Monitoring results summary

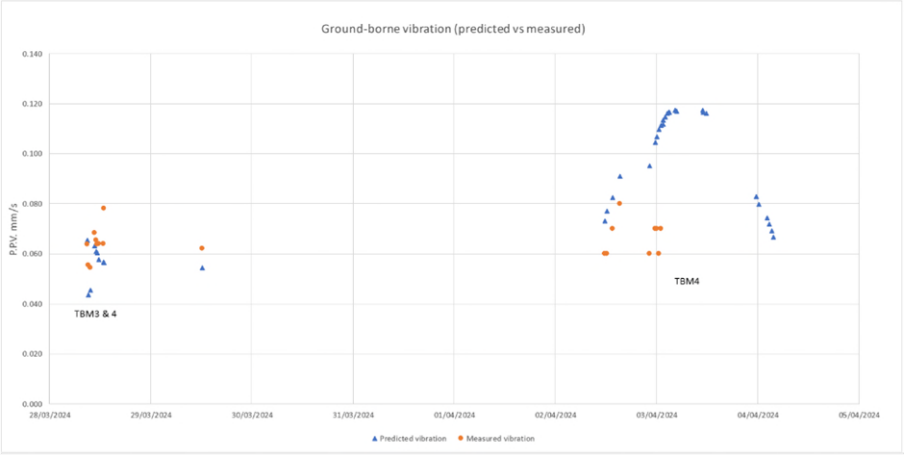
Measurement dates	Distance from excavation (m)	GBV p.p.v. (mm/s)			GBN $L_{Aeq,15min}$ (dB(A))		
		Predicted vibration level	Measured (Max)	Measured (95%)	Predicted noise level	Measured (Max)	Measured (95%)
23/11/2023	42.2	0.13	0.04	0.04	37	36	36
24/11/2023	52.7	0.13	0.05	0.05	37	34	34
25/11/2023	56.0	0.09	0.06	0.06	34	33	32

B.4 45 Derwent Road, Bringelly

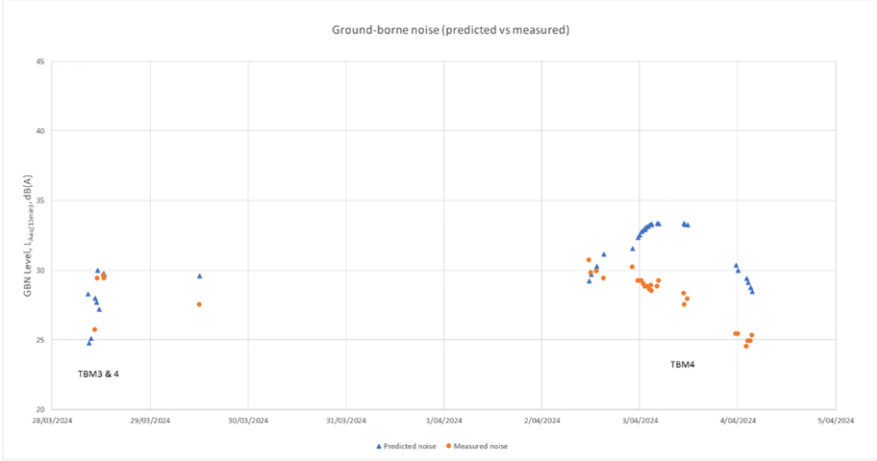
Measurement ID:	**M4**
Address:	**45 Derwent Road, Bringelly**
Tunnel chainage	**TMB Eileen (TBM 3), CH20700-CH20600; TBM Peggy (TBM4)**
Start / End Dates:	28/03/2024 – 04/04/2024
Building type:	Slab on ground
Meas. location:	Lounge room
Floor level:	Ground floor
Geology:	Ashfield Shale
Plant:	TBM
Instrumentation:	Noise: RTA07-052 (#A2A-17457-E0), Vibration: XL2-B (#A2A-16117-E0), Accelerometer: PCB Accelerometer 393B12 #1 (SN: #32172)
Notes:	The noise monitor was placed in lounge room approximately 1.5m from the walls as this was the only available location. The vibration monitor was installed directly onto the floor next to the noise monitor.



GBV results



GBN results



Comments

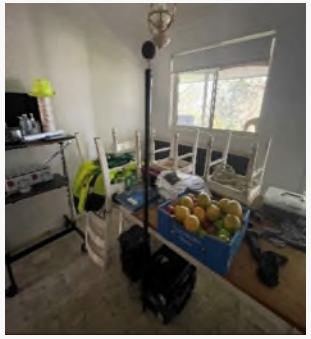
Monitoring data was compared to predictions using algorithm adjusted from previous measurements. Noise and vibration measurements were mostly below the predictions. On 28/03/2024 TBM3 and TBM4 were both within 60 m of the monitor. Cumulative impact from two TBMs verified.

Table B. 4: Monitoring results summary

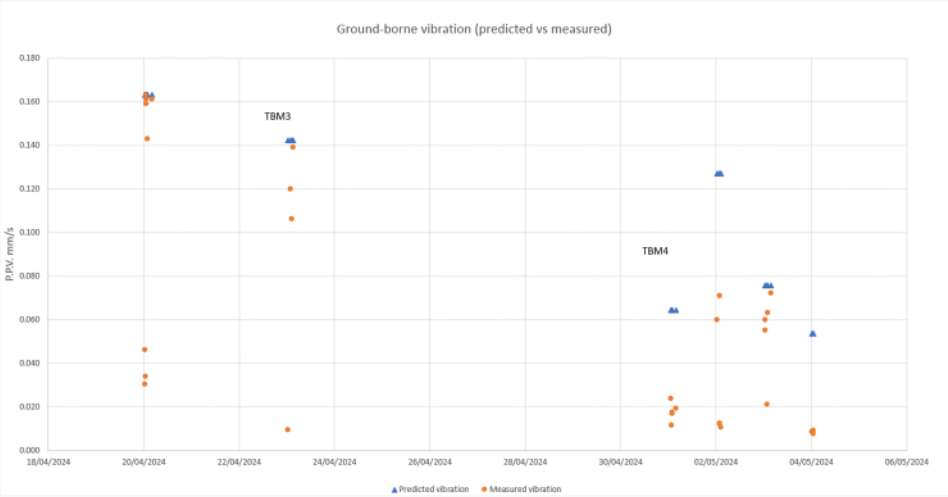
Measurement dates	Distance from excavation (m)	GBV p.p.v. (mm/s)			GBN $L_{Aeq,15min}$ (dB(A))		
		Predicted vibration level	Measured (Max)	Measured (95%)	Predicted noise level	Measured (Max)	Measured (95%)
28/03/2024	67.0	0.07	0.08	0.07	30	30	30
29/03/2024	58.6	0.05	0.06	0.06	30	28	28
2/04/2024	48.3	0.10	0.08	0.08	32	31	31
3/04/2024	44.3	0.12	0.07	0.07	33	29	29
4/04/2024	51.3	0.08	-	-	30	25	25

B.5 190 Badgerys Creek Road, Bringelly

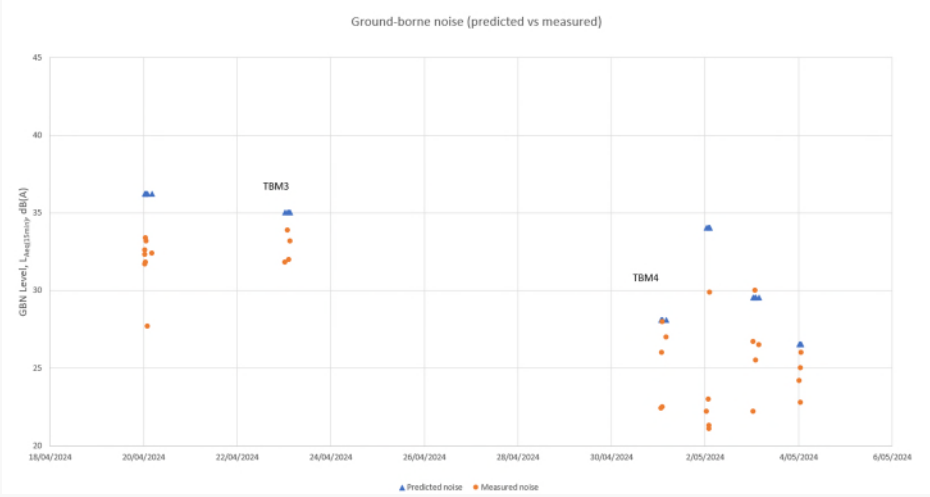
Measurement ID:	**M5**
Address:	**190 Badgerys Creek Road, Bringelly**
Tunnel chainage	**TMB Eileen (TBM 3), CH20700-CH20600; TBM Peggy (TBM4)**
Start / End Dates:	20/04/2024 – 04/05/2024
Building type:	Slab on ground
Meas. location:	Dining Room
Floor level:	Ground floor
Geology:	Ashfield Shale
Plant:	TBM
Instrumentation:	Noise: RTA07-037 (#A2A-15538-E0), Vibration: RTA07-041 (#A2A-18950-E0), Accelerometer: PCB Accelerometer 393B12 #1 (SN: #32172)
Notes:	The noise monitor was placed in dining room approximately 2.5m from the walls as this was the only available location. The vibration monitor was installed directly onto the floor next to the noise monitor.



GBV results



GBN results



Comments

Noise and vibration measurements were below the predictions.

Table B. 5: Monitoring results summary

Measurement dates	Distance from excavation (m)	GBV p.p.v. (mm/s)			GBN $L_{Aeq,15min}$ (dB(A))		
		Predicted vibration level	Measured (Max)	Measured (95%)	Predicted noise level	Measured (Max)	Measured (95%)
20/04/2024	26.8	0.16	0.16	0.16	36	33	33
23/04/2024	29.8	0.14	0.14	0.13	35	34	34
1/05/2024	52.6	0.06	0.02	0.02	28	28	28
2/05/2024	32.5	0.13	0.07	0.09	34	30	29
3/05/2024	47.2	0.08	0.07	0.07	30	30	29
4/05/2024	59.1	0.05	0.01	0.01	27	26	26