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SYDNEY METRO CITY & SOUTH WEST (SMCSW)

Operational Noise and Vibration Compliance Monitoring Report

27 May 2025

Metro Trains Sydney

TN498-03F02 SMCSW NV Compliance Monitoring (r2)

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1 Introduction

Renzo Tonin & Associates (RTA) was engaged by Metro Trains Sydney (MTS) to conduct attended ground-borne noise and vibration measurements for the Sydney Metro City & South West (SMCSW) project.

The purpose of the measurements are to evaluate if the project meets the design objectives outlined in the project's *Track Attenuation and Operational Ground-borne Noise Review* (Condition D9), and to fulfil the commitments made in the *Operational Noise and Vibration Monitoring Program* (Condition D13).

SMCSW is a 30 km extension of the existing Sydney Metro Northwest line from Chatswood to Bankstown. It comprises two main sections: Chatswood to Sydenham (C2S); and Southwest Stations and Corridor (SSC - Sydenham to Bankstown). This compliance monitoring report focuses on the C2S section only. The project is considered Critical State Significant Infrastructure (SSI). The C2S section falls under approval SSI 7400 and the SSC section falls under approval SSI 8256.

The report has been prepared to address the specific requirements in Section 2, and presents the results of the ground-borne noise and vibration measurements undertaken between 10 February 2025 and 27 March 2025.

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

2 Requirements

2.1 Conditions of Approval (CoA)

The Noise *and Vibration Management Plan* (NVMP) [3] identified that noise and vibration monitoring would be undertaken after the commencement of operations, to verify compliance with Condition of Approval (CoA) D13.

Approval Condition D13 is provided below:

> *D13 The Proponent must prepare an Operational Ground-borne Noise Monitoring Program to confirm that the operational noise and vibration levels meet the CSSI proposed design objectives as determined in the Track Attenuation and Operational Ground-borne Noise Review in Condition D9 following the commencement of operations.*

An *Operational Ground-borne Noise Monitoring Program* was prepared in accordance with the requirements of Approval Condition D13 [4] and endorsed by the Acoustics Advisor (AA).

This report has been prepared to fulfil the requirements of the endorsed Operational Ground-borne Noise Monitoring Program.

Approval Condition D14 identified the process that needs to be followed if the operational noise and vibration levels exceeded the Critical State Significant Infrastructure (CSSI) design objectives.

Approval Condition D14 is provided below:

> *D14 Should the operational noise and vibration levels exceed the CSSI design objectives, the Proponent is to prepare a report, outlining actions that will be taken so that the CSSI meets the design objectives in the future. The report is to be prepared within three (3) months following the identification of the exceedance and be forwarded to the Secretary for information. All recommendations in the report must be implemented within three (3) months of the date of the report or as agreed with the Secretary.*

2.2 Ground-borne noise and vibration criteria

2.2.1 Ground-borne noise from train operations

Ground-borne noise (GBN) commences as vibration energy due to the wheel and rail interaction. The vibration energy travels through the ground, which transfers into the building walls and floors and re-radiates as low frequency noise which can be heard by occupants. GBN has the potential to be evident where railway tracks are underground or in deep cuttings, where the airborne noise path is not present or negligible. Table 2-1 below shows the applicable GBN trigger levels applicable to heavy rail projects.

Table 2-1 Ground-borne noise trigger levels for heavy rail projects (Rail Infrastructure Noise Guideline [1])

Sensitive land use	Time of day	Internal noise trigger Levels dB(A) Development increases existing rail noise levels by 3 dB(A) or more, *and* resulting rail noise levels exceed:
Residential	Day (7am – 10pm)	40 L_{ASmax}
	Night (10pm – 7am)	35 L_{ASmax}
Schools, educational institutions, places of worship	When in use	40-45 L_{ASmax}

Note: L_{ASmax} refers to the maximum noise level not exceeded for 95% of rail passby events and is measured on the 'slow' response setting on a sound level meter.

In addition, Sydney Metro established design requirements for other sensitive receiver areas, which are shown in Table 2-2.

Table 2-2 Sydney Metro ground-borne noise trigger levels

Location	Requirement
General office areas	$L_{Amax\ (slow)}$ 45dB(A) (when in use)
Private offices and conference rooms	$L_{Amax\ (slow)}$ 40dB(A) (when in use)
Retail areas	$L_{Amax\ (slow)}$ 50dB(A) (when in use)
Cinemas	$L_{Amax\ (slow)}$ 35dB(A) (when in use)
Public halls	$L_{Amax\ (slow)}$ 35dB(A) (when in use)
Lecture theatres	$L_{Amax\ (slow)}$ 35dB(A) (when in use)
Film/TV/sound recording studios	NR15 (refer AS/NZS2107:2000)
Medical institutions	$L_{Amax\ (slow)}$ 40dB(A) (when in use)
Drama theatres	NR 25 (refer AS/NZS2107:2000)
Other critical spaces	Satisfactory levels in AS/NZS2107:2000

2.2.2 Ground-borne vibration from train operations

Assessing Vibration: a technical guideline [2] (AVTG) presents preferred and maximum vibration values for different receiver types. For railway operations, the preferred intermittent vibration dose values (VDVs) are applicable. These are shown in Table 2-3.

Table 2-3 Acceptable vibration dose values for intermittent vibration

Location	Vibration dose value ($m/s^{1.75}$) Preferred value	
	Day-time (7am-10pm)	Night-time (10pm-7am)
Critical areas[1]	0.1	0.1
Residences	0.2	0.13
Offices, schools, educational institutions and places of worship	0.4	0.4
Workshops	0.8	0.8

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

For railway operations, Sydney Metro specified more stringent requirements than the VDV criteria in the above table. The Sydney Metro ground-borne vibration (GBV) goals are shown in Table 2-4 and are consistent with the preferred continuous vibration criteria in AVTG. Additional criteria was also provided in the Track Attenuation and Operational Ground-borne Noise Review[1] referred to in Approval Condition D13.

Table 2-4 Sydney Metro ground-borne vibration goals

Location	Requirement [1]
Residential (Day)	106 dBV (0.2 mm/s) – See Note 2
Residential (Night)	103 dBV (0.14 mm/s) – See Note 2
Commercial	112 dBV (0.4 mm/s) – See Note 2
Educational	112 dBV (0.4 mm/s) – See Note 2
Place of worship	112 dBV (0.4 mm/s) – See Note 2
Industrial	118 dBV (0.8 mm/s) – See Note 2
Theatres	106 dBV (0.2 mm/s) – See Note 2
Studios	102 dBV (0.13 mm/s) – See Note 3
Other critical spaces	Generic Vibration Criterion curves in Institute of Environmental Sciences and Technology industry Standard IEST-RP-CC012.1.Considerations in Clean Room Design (2007) – See Note 2

Note 1: All vibration levels are maximum 1 second rms velocity values

Note 2: Requirement from Sydney Metro – Scope of Works and Technical Criteria – Schedule C1 – Appendix B8 – Noise and Vibration, Revision 2 dated 2 November 2018

Note 3: Requirement from the *Track Attenuation and Operational Ground-borne Noise Review*

[1] Acoustic Studio, *SYDNEY METRO CHATSWOOD TO SYDENHAM (SSI 15_7400) Track Attenuation and Operational Ground-borne Noise Review (Condition D9)*, Doc ref: 20210622 TFN.D9.0002.Let.docx dated 22/6/21

3 Monitoring locations

For evaluating compliance with the GBN and GBV criteria in Section 2.2, the *Operational Noise and Vibration Monitoring Program (ONVMP)* [4] identified locations where the attended compliance noise and vibration monitoring measurements were proposed to be undertaken. The noise and vibration compliance monitoring was undertaken at ten of the thirteen potential locations identified in the ONVMP. The compliance locations included a range of sensitive land use types with predicted noise levels close to the GBN criteria. The measurement locations are illustrated on the map in Figure 3-1.

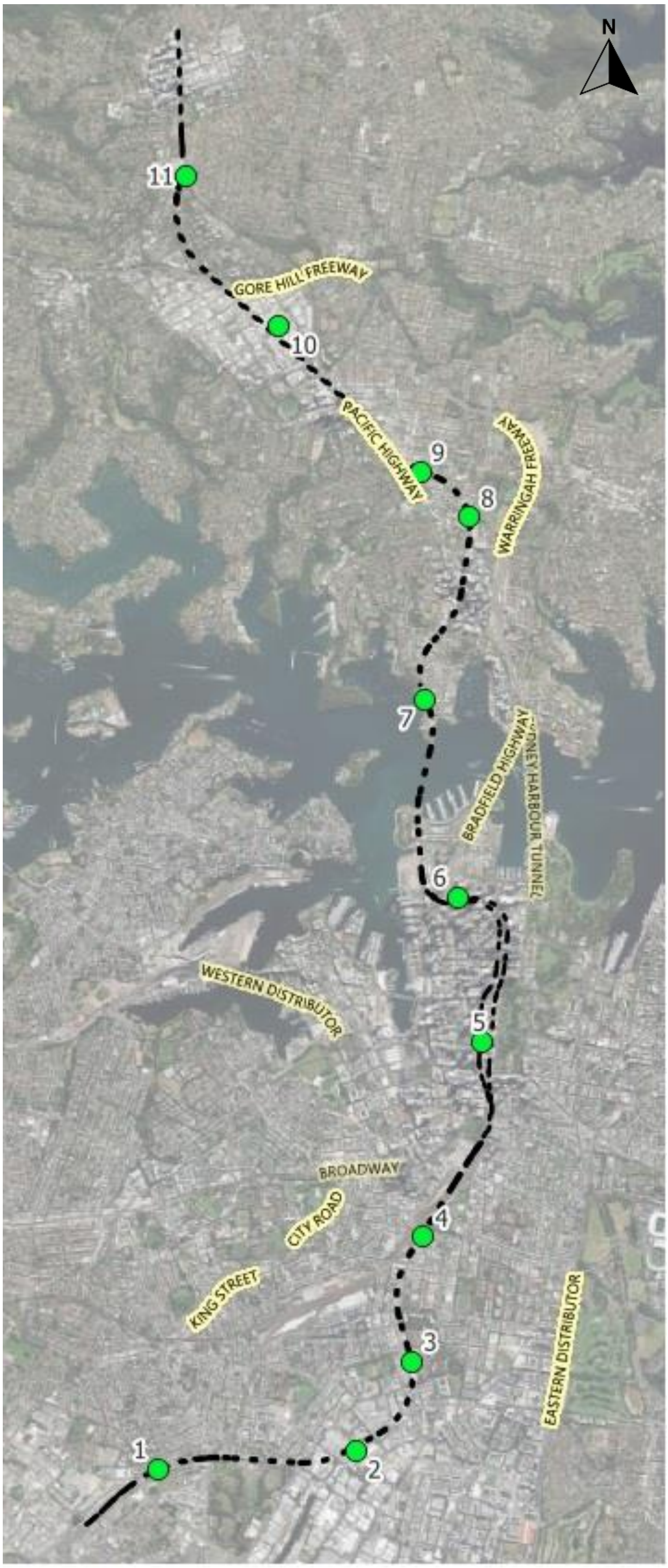
Additional measurement results at [redacted] Mowbray Road, Artarmon were provided by Sydney Metro for inclusion in this report [5].

Table 3-1 Ground-borne noise and vibration measurement locations

ID	Building address	Land Use	Sydney Metro Receiver ID	$L_{ASmax,95\%}$ noise levels, dB(A)		Vibration Design Objective
				GBN Trigger Level	Sydney Metro Predicted Level	
1	[redacted] Lord Street, Newtown	Residential	NEWT_27	35	[redacted]	103 dBV (0.14 mm/s)
2	[redacted], [redacted] Maddox Street, Alexandria	Studio	ALEX_12	NR 15	NR 16	102 dBV (0.13 mm/s)
3	[redacted] Cope Street, Waterloo	Residential	WATE_25	35	28	103 dBV (0.14 mm/s)
4	[redacted] Cleveland Street, Redfern	Residential	REDF_50	35	27	103 dBV (0.14 mm/s)
5	[redacted] Pitt Street, Sydney	Education	SYDN_90	35[1]	8	112 dBV (0.4 mm/s)
6	[redacted], [redacted] Grosvenor Street, The Rocks	Worship	SYDN_116	40	18	112 dBV (0.4 mm/s)
7	[redacted] West Crescent Street, McMahons Point	Residential	MCMA_22	35	25	103 dBV (0.14 mm/s)
8	[redacted], [redacted] Miller Street, North Sydney	Worship	NORT_52	40	20	112 dBV (0.4 mm/s)
9	[redacted] Hayberry Street, Crows Nest	Residential	CROW_63	35	25	103 dBV (0.14 mm/s)
10	[redacted] Herbert Street, Artarmon	Studio	ARTA_147	NR 15	NR 11	102 dBV (0.13 mm/s)
11	[redacted] Mowbray Road, Artarmon	Residential	ARTA_3	35	[redacted] (tunnel) 51 (surface)	103 dBV (0.14 mm/s)

Note 1: A 35 dB(A) noise trigger level is applicable for this location as the theatre is primarily used as a lecture hall and other similar uses.

Figure 3-1 Map of ground-borne noise measurement locations



4 Monitoring systems and instrumentation

The GBN measurements were made in accordance with ISO 14837-1. The GBN levels were measured at a location near the centre of the room, 1.5 m above floor level. The measurements were undertaken with a Class 1 sound level meter as specified in AS/NZS IEC 61672.1:2019 Electroacoustics: sound level meter specifications. The calibration of the sound level meter was verified before and after each measurement period with a field calibrator complying with the requirements of IEC 60942:2017 Electroacoustics: sound calibrators. All noise measurement equipment had current calibration certificates dated not more than 2 years prior to the date of the measurements. The applicable frequency range for GBN is 16 Hz to 250 Hz.

Ground-borne vibration (GBV) measurements were made in accordance with Assessing vibration: a technical guideline (AVTG), using triaxial accelerometers. The measured vibration levels were analysed using a Class 1 spectrum analyser.

The instrumentation details for measurements conducted by RTA is provided in Table 4-1 and a summary of equipment used by RTA at each location is provided in Table 4-2. A summary of site details is provided in APPENDIX B. The equipment set-up at each location is provided in APPENDIX C.

Table 4-1 Instrumentation details

Description	Make	Model	Serial No	Last Date Calibrated
Class 1 Sound Level Meter (SLM)	NTi	XL2	#3009707	4/08/2023
Sound level meter calibrator	Brüel & Kjær	4231	#3009707	18/12/2024
Tri-axial accelerometer	PCB	356B18	#LW380440	11/09/2023
Single Axis Accelerometer (PCB 1)	PCB	393B12	32172	11/01/2024
Single Axis Accelerometer (PCB 2)	PCB	393B12	32173	12/01/2024
Single Axis Accelerometer (PCB 3)	PCB	393B12	32174	12/01/2024
8 channel spectrum analyser	SINUS	Soundbook 1	9194	15/01/2024
8 channel spectrum analyser	SINUS	Soundbook 2	7039	9/01/2025

Table 4-2 Summary of equipment used at each location

Building ID	Class 1 SLM	SLM Calibrator	Tri-axial accelerometer	Uniaxial Accelerometer			8-channel spectrum analyser	
				PCB 1	PCB 2	PCB 3	Soundbook 1	Soundbook 2
1	☒	☒	☒	☐	☐	☐	☐	☒
2	☒	☒	☒	☐	☐	☐	☐	☒
3	☒	☒	☒	☐	☐	☐	☒	☐
4	☒	☒	☒	☐	☐	☐	☐	☒
5	☒	☒	☒	☒	☒	☒	☐	☒
6	☒	☒	☒	☐	☐	☐	☐	☒
7	☒	☒	☒	☐	☐	☐	☐	☒
8	☒	☒	☒	☐	☐	☐	☐	☒

Building ID	Class 1 SLM	SLM Calibrator	Tri-axial accelerometer	Uniaxial Accelerometer			8-channel spectrum analyser	
				PCB 1	PCB 2	PCB 3	Soundbook 1	Soundbook 2
9	☒	☒	☒	☐	☐	☐	☐	☒
10	☒	☒	☒	☐	☐	☐	☐	☒
11	Refer to Operational GBNV Report for [redacted] Mowbray Road, Artarmon [5]							

5 Testing Methodology

GBN levels were measured near the centre of the most-affected noise-sensitive room, using the L_{Amax} noise descriptor and the 'slow' time response setting on the sound-level meter (L_{ASmax}). The 'most-affected noise-sensitive room' means the room where the GBN is the most significant, either in overall level, frequency spectrum, or the time at which it occurs. During measurements, the rooms were furnished, unoccupied and with the windows closed. Measurement samples of the background or ambient noise and vibration conditions were also recorded.

If required, the GBN levels were estimated, based on the guidance in Annex A of *ISO/TS 14837-31 Mechanical vibration - Ground-borne noise and vibration arising from rail systems - Part 31: Guideline on field measurements for the evaluation of human exposure in buildings*.

GBV levels were measured at a location near the centre of the room, close to the GBN measurement location. Double-sided adhesive tape was used to fix the accelerometer to hard floor finishes. A heavy metal plate with spiked feet was used to fix the accelerometer to floors with a resilient covering. A summary of testing details conducted by RTA for each locations is shown in Table 5-1.

The Soundbook software (Samurai Version 3.0.2) was used to record a time history of the vibration levels in the x, y and z directions at a sample rate of 12.8 kHz. For all locations, the spectrum analyser (Soundbook) was set up to measure slow response L_{max} vibration velocity levels in one-third octave frequency bands between 6.3 Hz and 1 kHz. The vibration time histories were reviewed to assist in identifying the start and end positions of each passby. This measurement interval was typically five seconds before the front of the train passed the measurement location and five seconds after the end of the train passed the measurement location. During this time period, the maximum vibration levels in each one-third octave frequency band was determined for each train (slow response L_{max}). The maximum 1-second RMS vibration level ($L_{max(1s\ rms)}$) for each passby was determined.

At each measurement site, vibration measurements were undertaken for a minimum of ten train movements in each direction. As a minimum, the time and direction of each train passby was recorded, together with the measured or estimated GBN levels. The AnyTrip[2] website and the application was used to confirm the presence of, direction and set number of the train passbys on each track.

At some of the measurement locations, the GBN measurements were influenced by local road traffic or other extraneous noise sources. Where the GBV measurements were influenced either by road traffic, by more than one train movement or other extraneous sources, these were excluded from the analysis.

[2] https://anytrip.com.au/region/nsw

Table 5-1 Summary of testing details for each location

Building ID	Measurement Date	Testing Personnel (Engineer)	Testing Organisation	Floor type
1	10/02/2025	Shrey Dixit	Renzo Tonin & Associates	Hard timber floor
2	11/02/2025	Shrey Dixit	Renzo Tonin & Associates	Engineered timber floor
3	11/02/2025	Shrey Dixit	Renzo Tonin & Associates	Timber floor on concrete
4	14/02/2025	Shrey Dixit	Renzo Tonin & Associates	Carpeted floor
5	17/02/2025	Shrey Dixit	Renzo Tonin & Associates	Linoleum floor
6	18/02/2025	Soumyadeep Bhaduri	Renzo Tonin & Associates	Joist timber floor
7	08/03/2025	Shrey Dixit	Renzo Tonin & Associates	Carpeted Floor
8	10/03/2025	Shrey Dixit	Renzo Tonin & Associates	Engineered timber Floor
9	13/03/2025	Shrey Dixit	Renzo Tonin & Associates	Tiled floor
10	27/03/2025	Shrey Dixit	Renzo Tonin & Associates	Concrete floor with pavers
11	Refer to Operational GBNV Report for [redacted] Mowbray Road, Artarmon [5]			

Refer to APPENDIX C, which shows the method used to fix the vibration transducer to the floor.

6 GBNV compliance monitoring results

For each location, the GBN and GBV compliance monitoring results are shown in Table 6-1. The floor vibration levels in the vertical (z) direction were used to estimate the GBN levels at each location[3].

Table 6-1 shows that there were three locations (ID 1, ID 3 and ID 7) where the SMCSW passbys were faintly audible. At three locations (ID 1, ID 4 and ID 6), the GBN levels from Sydney Trains passbys were audibly higher than the GBN levels from SMCSW passbys.

A graphical summary of the measured GBV spectra and estimated GBN spectra for each passby, the background levels are provided in APPENDIX D.

The measured $L_{ASmax,95\%}$ noise level and $L_{max(1s\ rms),95\%}$ vibration level from each passby were documented and analysed for each test location. A tabular and graphical summary of the measured GBV and estimated GBN levels for each passby event are shown in APPENDIX D. A summary of 50th and 95th percentile GBN and GBV spectra for each location is shown in APPENDIX E.

[3] GBN levels were estimated, based on the guidance in Annex A of *ISO/TS 14837-31 Mechanical vibration - Ground-borne noise and vibration arising from rail systems - Part 31: Guideline on field measurements for the evaluation of human exposure in buildings*

Table 6-1 GBNV compliance monitoring results

ID	Building address	Land use	Sydney Metro Receiver ID	$L_{ASmax,95\%}$ noise levels, dB(A)		Vibration Design Objective	SMCSW passbys were audible?	Measured $L_{ASmax,95\%}$ Noise Levels[1], dB(A)	Estimated $L_{ASmax,95\%}$ GBN levels[2], dB(A)	Measured $L_{max(1s\ rms),95\%}$ Vibration level, dBV (mm/s)	Complies?
				GBN Trigger Level	Sydney Metro Predicted Level						
1	[redacted] Lord Street, Newtown	Residential	NEWT_27	35	[redacted]	103 dBV (0.14 mm/s)	Faintly audible (See Note 6)	32	[redacted]	89 dBV (0.029 mm/s)	Yes
2	[redacted], [redacted] Maddox Street, Alexandria	Studio	ALEX_12	NR 15	NR 16	102 dBV (0.13 mm/s)	Inaudible	<NR 25, 26 dB(A)	<NR 8, 17 dB(A)	83 dBV (0.014 mm/s)	Yes [7]
3	[redacted] Cope Street, Waterloo	Residential	WATE_25	35	28	103 dBV (0.14 mm/s)	Faintly audible	28	26	97 dBV (0.071 mm/s)	Yes
4	[redacted] Cleveland Street, Redfern	Residential	REDF_50	35	27	103 dBV (0.14 mm/s)	Inaudible (See Note 6)	<[redacted]	<16	82 dBV (0.013 mm/s)	Yes
5	[redacted] Pitt Street, Sydney	Education	SYDN_90	35	8	112 dBV (0.4 mm/s)	Inaudible	<35	<17	73 dBV (0.004 mm/s)	Yes[3]
6	[redacted] Grosvenor Street, The Rocks	Worship	SYDN_116	40	18	112 dBV (0.4 mm/s)	Inaudible (See Note 6)	<39	<30	97 dBV (0.069 mm/s)	Yes[4]
7	[redacted] West Crescent Street, McMahons Point	Residential	MCMA_22	35	25	103 dBV (0.14 mm/s)	Faintly audible	24	22	89 dBV (0.027 mm/s)	Yes
8	[redacted], [redacted] Miller Street, North Sydney	Worship	NORT_52	40	20	112 dBV (0.4 mm/s)	Inaudible	<[redacted]	<17	83 dBV (0.014 mm/s)	Yes
9	[redacted] Hayberry Street, Crows Nest	Residential	CROW_63	35	25	103 dBV (0.14 mm/s)	Inaudible	<32	<19	81 dBV (0.011 mm/s)	Yes
10	[redacted] Herbert Street, Artarmon	Studio	ARTA_147	NR 15	NR 11	102 dBV (0.13 mm/s)	Inaudible	<NR 22, 27 dB(A)	<NR 8, 17 dB(A)	81 dBV (0.011 mm/s)	Yes [7]

ID	Building address	Land use	Sydney Metro Receiver ID	$L_{ASmax,95\%}$ noise levels, dB(A)		Vibration Design Objective	SMCSW passbys were audible?	Measured $L_{ASmax,95\%}$ Noise Levels[1], dB(A)	Estimated $L_{ASmax,95\%}$ GBN levels[2], dB(A)	Measured $L_{max(1s\ rms),95\%}$ Vibration level, dBV (mm/s)	Complies?
				GBN Trigger Level	Sydney Metro Predicted Level						
11	[redacted] Mowbray Road, Artarmon	Residential	ARTA_3	35	[redacted] (tunnel) 51 (surface)	103 dBV (0.14 mm/s)	Inaudible	Inaudible (tunnel) 57 (surface)	-	98 dBV (0.075 mm/s) from surface trains	Yes[5]

Note 1: The passby measurement results represents the highest noise level measured during the SMCSW passby (i.e. the same time period as the vibration measurements).

Note 2: Estimated $L_{Amax,slow}$ noise levels are based on the measured vibration levels in the Z direction.

Note 3: The measured background $L_{ASmax,95\%}$ noise level was 35 dB(A) and the estimated $L_{ASmax,95\%}$ GBN was 17 dB(A). The measured levels during the SMCSW passbys were dominated by ambient noise. As the estimated $L_{ASmax95\%}$ GBN was less than 17 dB(A), compliance is predicted for this location.

Note 4: The measured background $L_{ASmax,95\%}$ noise level was 39 dB(A) and the estimated $L_{ASmax,95\%}$ GBN was 30 dB(A). The measured levels during the SMCSW passbys were dominated by ambient noise. As the estimated $L_{ASmax95\%}$ GBN was less than 30 dB(A), compliance is predicted for this location.

Note 5: Noise and vibration levels from SMCSW passbys were not measured as they were indiscernible and less than the surface train operations on the North Shore Line.

Note 6: At this location, GBN levels from Sydney Trains passbys were audible and higher than the GBN levels from SMCSW passbys.

Note 7: At these locations GBN levels from Sydney Trains passbys were not audible. The measured background noise levels during periods where SMCSW passbys were not passing by were NR 24 at ID 2 and NR 22 at ID 10. The GBN levels from SMCSW passbys were estimated, based on the measured floor vibration levels and guidance in Annex A of *ISO/TS 14837-31 Mechanical vibration - Ground-borne noise and vibration arising from rail systems - Part 31: Guideline on field measurements for the evaluation of human exposure in buildings*. The estimated GBN levels were well below the applicable NR trigger levels.

7 Conclusion

This report presents the results of the GBN and GBV compliance monitoring for the Sydney Metro City & Southwest project, in accordance with Approval Condition D13 (CoA D13). The measurements were conducted at eleven locations across the project area, as shown in Table 3-1 and Figure 3-1.

There were three locations where the SMCSW passbys were faintly audible. At these locations, the measured GBN levels were below the noise trigger levels.

For locations where the SMCSW passbys were inaudible due to high ambient noise levels, the GBN levels were estimated, based on the measured GBV levels. In all cases, the estimated $L_{ASmax,95\%}$ GBN levels were below the ground-borne noise trigger level.

Table 6-1 provides a summary of the predicted GBN levels that were used in the design stage to determine the required track forms. At all locations, the measured and/or estimated GBN levels were below the predicted levels, indicating that there is a low risk of GBN levels being above the criteria at all locations across the project area.

At all locations, the measured $L_{max(1s\ rms),95\%}$ GBV levels were below the vibration design objectives.

Based on the attended monitoring results, it is concluded that the operational GBN and GBV levels at the selected measurement locations are compliant with the requirements of Planning Approval Conditions D9 and D13, and ultimately confirming that the objectives in the *Track Attenuation and Operational Ground-borne Noise Review* have been met. .

References

[1] Rail Infrastructure Noise Guideline (EPA 2013).

[2] Assessing Vibration: a technical guideline (AVTG) (DEC 2006)

[3] Metro Trains Sydney - *Noise and Vibration Management Plan Sydney Metro City & Southwest*, Document Number SMCSWTS2-MTS-CSW-EM-PLN-002106 Version 01 dated 28/4/24

[4] Renzo Tonin & Associates TN498-01 F03 GBNV Measurement Plan (r3), SYDNEY METRO CITY & SOUTH WEST Operational Noise and Vibration Monitoring Program as required by Condition D13, dated 29 October 2024, and Renzo Tonin & Associates Report TN498-01F03 GBNV Measurement Plan Corrigendum (r0), Sydney Metro City & South West - Corrigendum to GBNV Measurement Plan, dated 23 May 2025.

[5] EMM Consulting Pty Ltd J210527 RP15, As-built Operational Ground Borne Noise and Vibration Report for [redacted] Mowbray Road, Artarmon, dated November 2024.

APPENDIX A Glossary of terminology

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

Acceleration	The rate of change of velocity, often measured in m/s2 or g's. 1 g = 9.81 m/s^2. Commonly used to assess human response to vibration and for machine condition monitoring.
Accelerometer	A vibration transducer sensor that is used to measure acceleration.
Ambient vibration	The all-encompassing vibration occurring at a given location, at a given time, composed of all vibration sources near and far.
Amplification	Vibration amplification refers to an increase in vibration. Amplification may occur due to resonance, when an object or structure is excited at its natural frequency.
Attenuation	Attenuation refers to a reduction in vibration. This may occur due to damping of a vibration system, the inclusion of attenuating devices or, in the case of ground vibration, during propagation through the ground. Ground attenuation is determined by the dynamic properties of the site's soil and rock.
AVTG	Assessing Vibration: A Technical Guideline. NSW Department of Environment and Conservation's (DEC) 2006 guideline for assessing human responses to vibration. Based on BS 6472–1992.
Axis	A fixed reference line for the measurement for the measurement of vibration in a particular direction. Vibration is commonly measured in transverse (T), longitudinal (L) and vertical (V) axes (or X, Y and Z).
Background vibration	The underlying level of vibration present in the ambient environment, measured in the absence of the vibration sources of interest.
Broadband vibration	The overall vibration level which encompasses a wide range of frequencies. As opposed to vibration levels for specific frequency bands (see Octave) or narrowband vibration levels as produced by FFT.
Continuous vibration	Vibration that continues uninterrupted over a defined period.
Coupling loss	The change in vibration level when vibration is transmitted from the ground to a building's foundations.
Crest factor	The ratio of the peak value of a vibration event to the RMS value of a vibration event.
Damping	Reduction of vibrational energy due to friction or other forces.
Decibel [dB]	The logarithmic unit used to represent sound and vibration levels. A vibration level in dB equals 20 times the logarithm to the base 10 of the ratio of the vibration level relative to the reference level. For vibration velocity, the reference level is commonly 1 nm/s. For vibration acceleration, the reference level is commonly 1 μm/s^2. Other reference values are commonly used. The reference value should always be stated.
Displacement	Change in position of a body from a reference point. Usually measured in m or mm.
EPA	Environment Protection Authority.
eVDV	Estimated Vibration Dose Value. See also VDV.
Filter	An electrical circuit that allows signals of certain frequency ranges to pass through, and blocks all other frequencies. Types of filters include low pass filters, high pass filters, and band pass filters.
FFT	Fast Fourier Transform. An algorithm that converts a signal from the time domain to the frequency domain.
Frequency	In the case of vibration, frequency is the number of oscillations that occurs per second. Frequency is measured in units of Hertz (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.
Intermittent vibration	Either interrupted periods of continuous vibration or repeated periods of impulsive vibration.
Impulsive vibration	Vibration that rapidly builds up to a peak followed by a damped decay. May consist of multiple impulsive events, typically less than 2 seconds in duration.
Isolation	The process of reducing the vibrational energy transmitted to an object, such as a piece of equipment or building, from the source of vibrations.
Minor damage	Damage to a structure due to vibration that affects the serviceability of residential style buildings or other sensitive structures but does not affect the structural elements. E.g. cracks in plastered or rendered surfaces, existing cracks enlarged or partitions detached.
Mode	A mode of vibration is a characteristic pattern or shape in which a mechanical system will vibrate. The actual vibration of a structure is a combination of all the vibration modes, but to varying degrees, depending on the vibration source.
Natural frequency	The frequency at which a system tends to oscillate in the absence of any driving or damping force.
Noise floor	The residual level of unwanted signal measured by an instrumentation system. The signal of interest must be above the noise floor to be measured accurately. See also Signal to noise ratio.
Octave	An octave represents a doubling or halving in frequency. Noise or vibration levels across a frequency spectrum are commonly given in octave or one-third octave frequency bands.
Peak-to-peak	The difference between the highest positive peak level and the lowest negative peak of a vibration event.
Peak vibration velocity	The absolute maximum value of the vibration velocity signal measured in the X, Y or Z axis during a given time interval. Also referred to as the peak component particle velocity.
PPV	Peak Particle Velocity. The absolute maximum value of the vibration velocity signal measured in any axis during a given time interval.
Resonance	The phenomenon of increased amplitude that occurs when the frequency of an applied force is equal or close to the natural frequency of the system.
RMS	Root Mean Square value representing the average value of a signal.
Sampling rate	The number of samples per second taken from a continuous signal to make a discrete or digital signal. Measured in Hertz. To accurately record the signal and determine the spectrum, the sampling rate must two or more times the maximum frequency of interest.
Settlement	The movement of soil due to vibration or other forces, often in relation to a building’s foundations. The indirect effect of settlement and ground movement may cause building damage, separately from the direct of effect of building vibration.
Signal to noise ratio	A ratio of the level of a desired signal to the level of the background, often expressed in decibels.
Source vibration	A source that generates vibration. Can be quantified by the amplitude, frequency content and duration of the vibration. Common sources of vibration include rail and road traffic, construction and demolition activities and blasting.
Spectrum	The result of transforming a signal from the time domain to the frequency domain.

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.
Tactile vibration	Vibration of a level that can be felt by humans, dependant on the amplitude and frequency of the source. Note that vibration may also be perceived through indirect effects such as ground-borne noise or the shaking of building elements.
Transducer	A device that converts energy from one form to another. Vibration transducers convert either acceleration, velocity or displacement to an electrical signal that is processed by the monitoring system.
Triaxial	Three axes. Measurement systems often consist of three vibration transducers arranged triaxially – oriented at 90° from each other.
VDV	Vibration Dose Value. A measure of tactile vibration levels used to assess intermittent vibration.
Velocity	The rate of change of vibration displacement, usually measured in mm/s.
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.
V_{rms}	Root mean square (RMS) vibration level for the train passby, typically expressed in mm/s
Waveform	A graphical representation of a vibration event in the time domain, showing the measured vibration levels for each sample.

APPENDIX B Site Details

Table 7-1 provides a summary of the key site details at each location where the SMCSW noise and vibration compliance monitoring was undertaken.

Table 7-1 Measurement sites and track forms

Surface measurement site	Corresponding tunnel measurement locations
[redacted] Lord Street, Newtown (NEWT_27)	Track Chainage – 4.100 km to 4.200 km (Up MSW) Nearest Station – Sydenham Station Track Type – Type 2 Near track – Up track Horizontal distance to near track – Up track is situated beneath the property Approximate Depth to Top of Rail – 22 m Track Curvature – Radius: [redacted] m Presence of turnout or crossover – No
[redacted] Maddox Street, Alexandria (ALEX_12)	Track Chainage – 2.200 km to 2.300 km (Down MSW) Nearest Station – Waterloo Station Track Type – Type 2 Near track – Down track Horizontal distance to near track – 9 m Approximate Depth to Top of Rail – 36 m Track Curvature – Straight track Presence of turnout or crossover - No
[redacted] Cope Street, Waterloo (WATE_25)	Track Chainage – 1.300 km to 1.400 km (Up MSW) Nearest Station – Waterloo Station Track Type – Type 2 Near track – Both tracks Horizontal distance to near track – Both tracks are situated beneath the property Approximate Depth to Top of Rail – 26 m Track Curvature – Radius: 598 m Presence of turnout or crossover - No
[redacted] Cleveland Street, Redfern (REDF_50)	Track Chainage – 0.700 km to 0.800 km (Down MSW) Nearest Station – Central Station Track Type - Type 2 Near track – Down track Horizontal distance to near track – 8 m Approximate Depth to Top of Rail – 38 m Track Curvature – Straight track Presence of turnout or crossover - No
[redacted] Pitt Street, Sydney (SYDN_90)	Track Chainage – 1.400 km to 1.500 km (Down MNW) Nearest Station – Gadigal Station Track Type – Type 2A Near track – Down track Horizontal distance to near track - 5 m Approximate Depth to Top of Rail – 19 m Track Curvature – Straight track Presence of turnout or crossover - No

Surface measurement site	Corresponding tunnel measurement locations
[redacted] Grosvenor Street, The Rocks (SYDN_116)	Track Chainage – 2.900 km to 3.000 km (Down MNW) Nearest Station – Barangaroo Station Track Type – Type 2A Near track – Both tracks Horizontal distance to near track – Both tracks are situated beneath the property Approximate Depth to Top of Rail – 46 m Track Curvature – Curve transition from Radius 250 m to Radius 270 m Presence of turnout or crossover - No
[redacted] West Crescent Street, McMahons Point (MCMA_22)	Track Chainage – 4.966 km to 5.029 km (Down MNW) Nearest Station – Victoria Cross Station Track Type – Type 2 Near track – Down track Horizontal distance to near track - Down track is situated beneath the property Approximate Depth to Top of Rail – 28 m Track Curvature – Straight track Presence of turnout or crossover - No
[redacted] Miller Street, North Sydney (NORT_52)	Track Chainage – 6.700 km to 6.800 km (Down MNW) Nearest Station – Victoria Cross Station Track Type – Type 2 Near track – Both tracks Horizontal distance to near track – Both tracks are situated beneath the property Approximate Depth to Top of Rail – 47 m Track Curvature – Radius: 505 m Presence of turnout or crossover - No
[redacted] Hayberry Street, Crows Nest (CROW_63)	Track Chainage – 7.300 km to 7.400 km (Down MNW) Nearest Station – Crows Nest Station Track Type – Type 2 Near track – 4 m Horizontal distance to near track – Down track Approximate Depth to Top of Rail – 41 m Track Curvature - Straight Presence of turnout or crossover - No
[redacted] Herbert Street, Artarmon (ARTA_147)	Track Chainage – 9.100 km to 9.200 km (UP MNW) Nearest Station – Crows Nest Station Track Type – Type 2 Near track – Up track Horizontal distance to near track – 29 m Approximate Depth to Top of Rail – 42 m Track Curvature – Straight track Presence of turnout or crossover - No

Surface measurement site	Corresponding tunnel measurement locations
[redacted] Mowbray Road, Artarmon (ARTA_3)	Track Chainage – 10.800 km to 10.900 km (Up MNW) Nearest Station – Chatswood Station Track Type – Type 2 (tunnel), Type 0 (surface) Near track – Up track (tunnel), Down track (surface) Horizontal distance to near track – 25 m (tunnel), 12 m (surface) Approximate Depth to Top of Rail – 18 m (tunnel) Track Curvature – Straight track (tunnel), Radius 670 m (surface) Presence of turnout or crossover - No

APPENDIX C Equipment set-up at each location

Figure 7-1 Equipment set-up at [redacted] Lord Street, Newtown

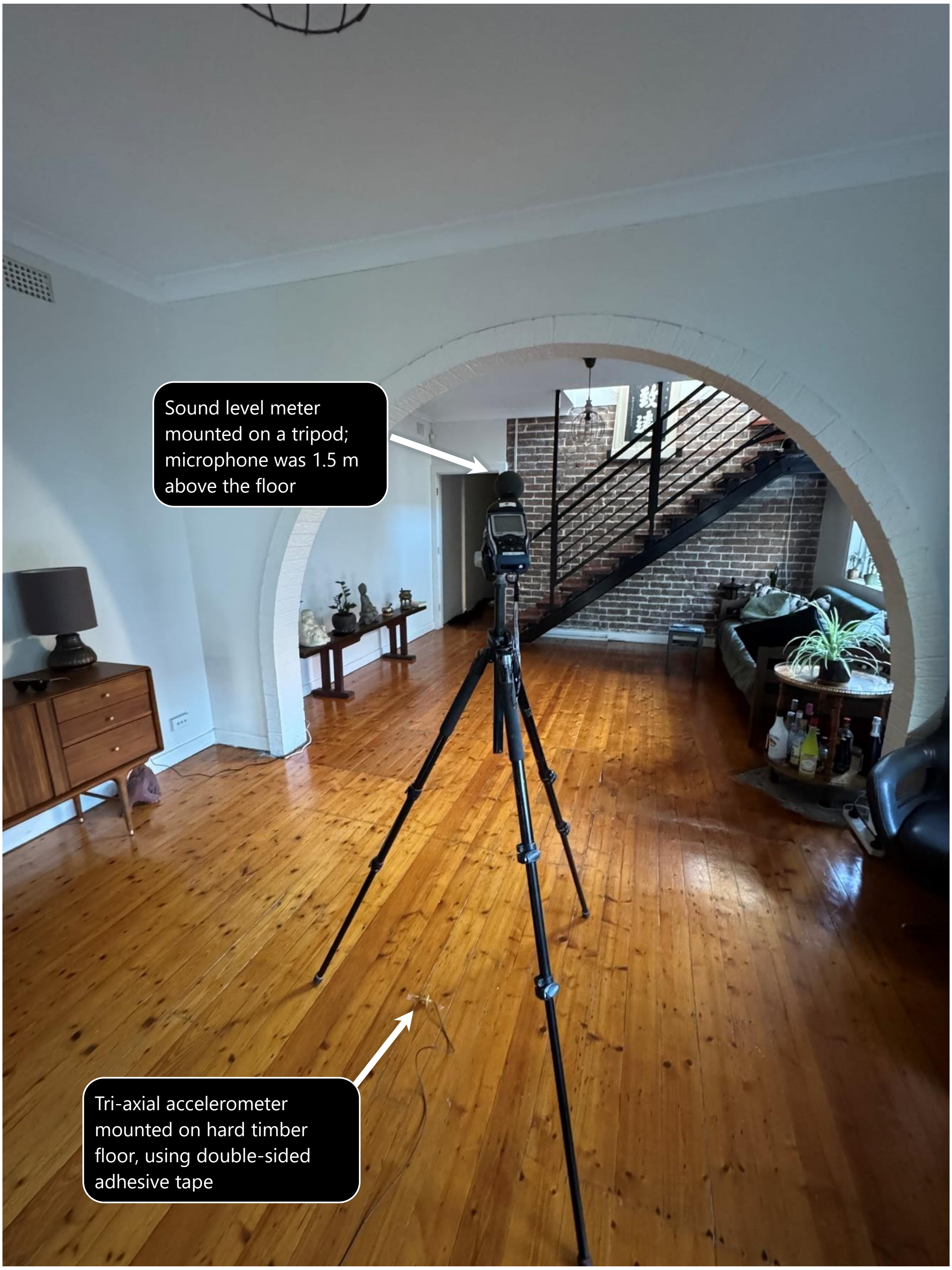


Figure 7-2 Equipment set-up at [redacted] Maddox Street, Alexandria (Studio 6)

Figure 7-3 Equipment set-up at [redacted] Cope Street, Waterloo

Figure 7-4 Equipment set-up at [redacted] Cleveland Street, Redfern

Figure 7-5 Equipment set-up at [redacted] Pitt Street, Sydney

Figure 7-6 Equipment set-up at [redacted] Grosvenor Street, The Rocks

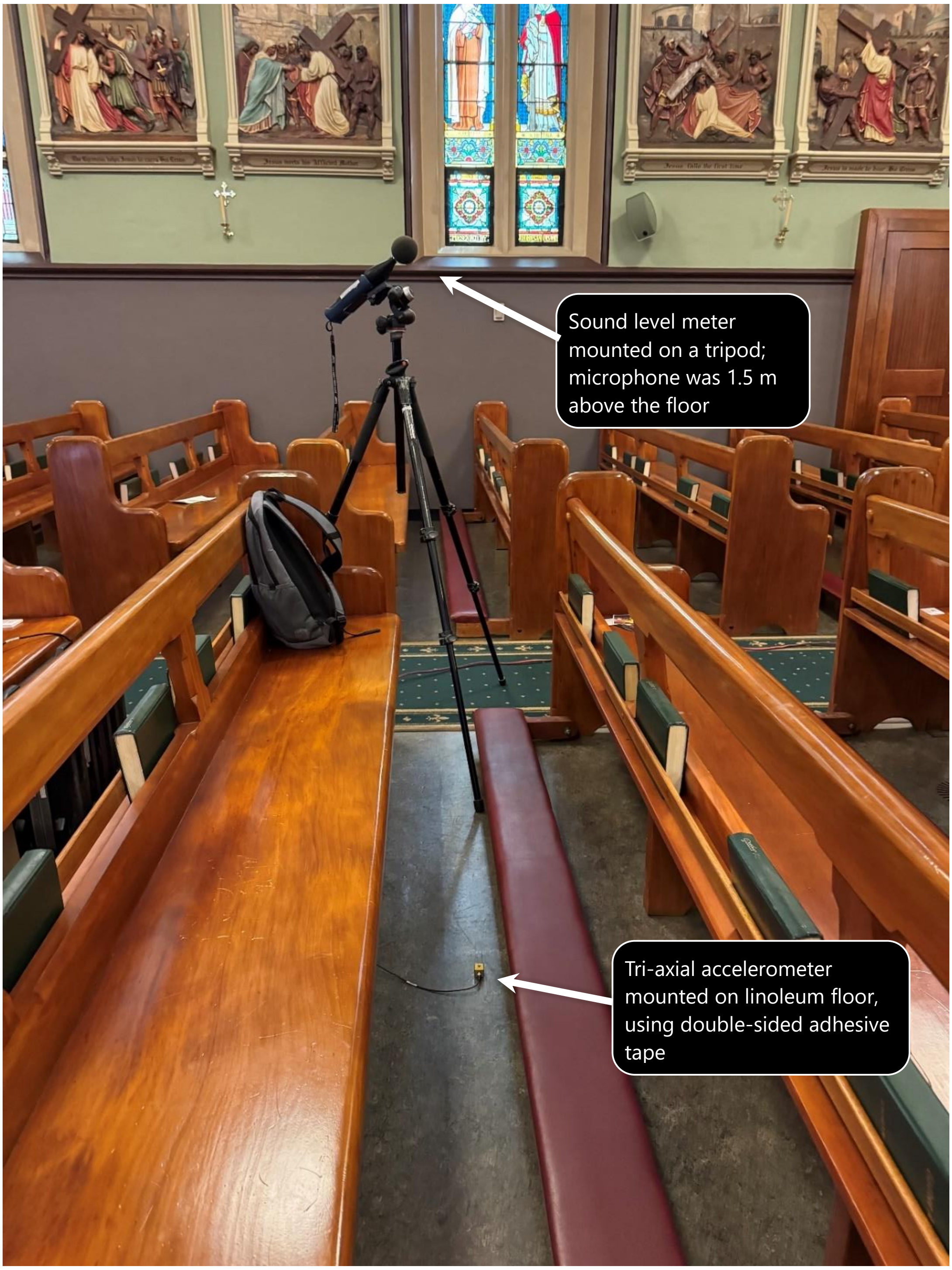
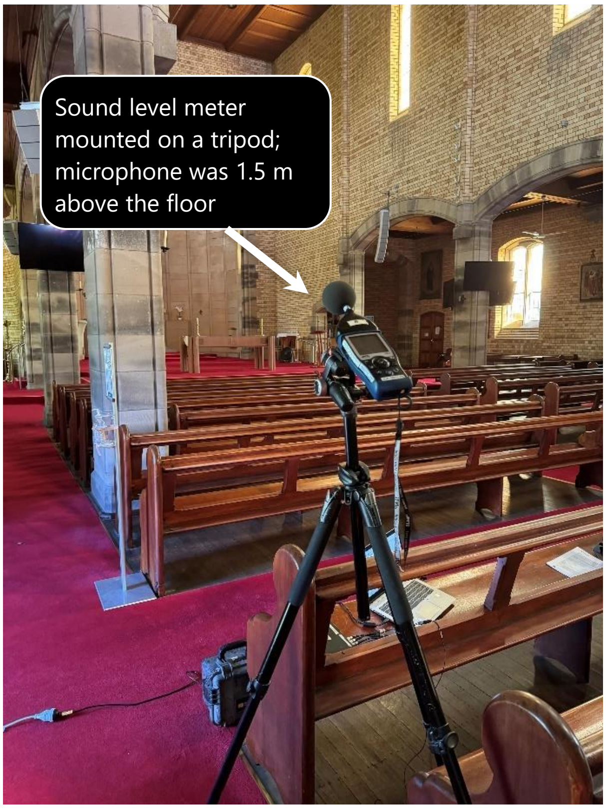


Figure 7-7 Equipment set-up at [redacted] West Crescent Street, McMahons Point

Figure 7-8 Equipment set-up at [redacted] Miller Street, North Sydney



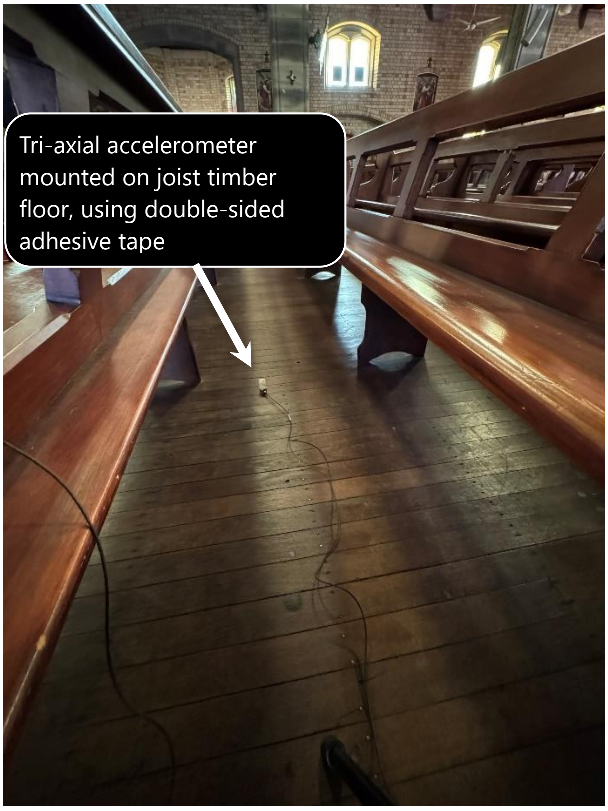


Figure 7-9 Equipment set-up at [redacted] Hayberry Street, Crows Nest

Figure 7-10 Equipment set-up at [redacted] Herbert Street, Artarmon (Studio 9)

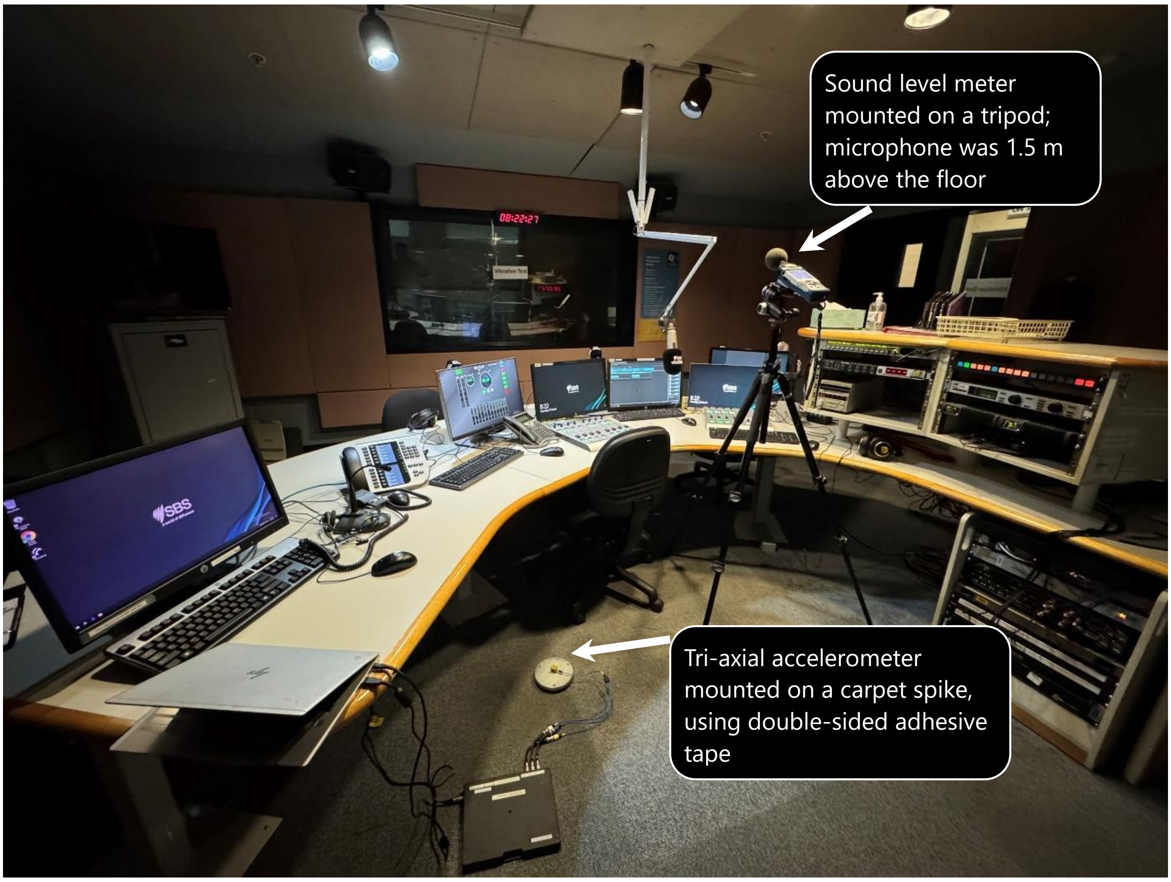


Figure 7-11 Equipment set-up at [redacted] Mowbray Road, Artarmon [5]

APPENDIX D GBN and GBV results for each passby and direction at each location

D.1 GBN and GBV results at [redacted] Lord Street, Newtown

For [redacted] Lord Street Newtown, a tabular summary of the measured GBN and GBV levels of each SMCSW passby event is shown in Table 7-2 . A graphical summary of the 1/3 octave spectra of each SMCSW passby event is shown in Figure 7-12 to Figure 7-15. The background vibration and background GBN spectra are shown, and represent the $L_{max(1s\ rms)}$ vibration levels and $L_{Amax,slow}$ noise levels, respectively during a typical period when there were no SMCSW passbys. The Sydney Trains passbys were audible and higher than the SMCSW passbys at this location. The measured Sydney Trains $L_{ASmax,95\%}$ GBN level was 49 dB(A). The SMCSW passbys were faintly audible at this location.

Table 7-2 Results for each SMCSW passby at [redacted] Lord Street, Newtown

Event ID	Event date and time	SMCSW Passby Direction	Measured L_{ASmax} Noise Levels[1], dB(A)	Estimated L_{ASmax} GBN levels[2], dB(A)	Measured $L_{max(1s\ rms)}$ Vibration level, dBV (mm/s)
DN_1	10/02/2025 8:41:14 AM	DN	30	30	85 dBV (0.017 mm/s)
DN_2	10/02/2025 9:09:15 AM	DN	32	28	84 dBV (0.015 mm/s)
DN_3	10/02/2025 9:13:14 AM	DN	30	32	88 dBV (0.024 mm/s)
DN_4	10/02/2025 9:21:14 AM	DN	28	29	87 dBV (0.022 mm/s)
DN_5	10/02/2025 9:25:12 AM	DN	27	32	85 dBV (0.018 mm/s)
DN_6	10/02/2025 9:33:14 AM	DN	28	32	85 dBV (0.019 mm/s)
DN_7	10/02/2025 9:41:15 AM	DN	31	35	88 dBV (0.024 mm/s)
DN_8	10/02/2025 9:49:12 AM	DN	29	30	84 dBV (0.017 mm/s)
DN_9	10/02/2025 10:04:54 AM	DN	29	32	85 dBV (0.019 mm/s)
DN_10	10/02/2025 10:09:56 AM	DN	30	29	84 dBV (0.015 mm/s)
UP_1	10/02/2025 8:40:54 AM	UP	[redacted]	30	83 dBV (0.014 mm/s)
UP_2	10/02/2025 8:53:07 AM	UP	30	[redacted]	90 dBV (0.030 mm/s)
UP_3	10/02/2025 9:09:01 AM	UP	32	28	85 dBV (0.018 mm/s)
UP_4	10/02/2025 9:17:14 AM	UP	31	29	83 dBV (0.014 mm/s)
UP_5	10/02/2025 9:21:00 AM	UP	32	26	85 dBV (0.018 mm/s)
UP_6	10/02/2025 9:24:58 AM	UP	29	26	85 dBV (0.018 mm/s)
UP_7	10/02/2025 9:32:59 AM	UP	30	28	86 dBV (0.019 mm/s)
UP_8	10/02/2025 9:48:58 AM	UP	29	29	86 dBV (0.019 mm/s)
UP_9	10/02/2025 9:58:52 AM	UP	32	32	89 dBV (0.028 mm/s)
UP_10	10/02/2025 10:04:09 AM	UP	32	25	84 dBV (0.016 mm/s)
		Overall 95th percentile -	**32 dB(A)**	**[redacted] dB(A)**	**89 dBV (0.029 mm/s)**

Note 1: The passby measurement results represents the highest noise level measured during the SMCSW passby (i.e. the same time period as the vibration measurements).

Note 2: Estimated $L_{Amax,slow}$ noise levels are based on the measured vibration levels in the Z direction.

Figure 7-12 SMCSW down passbys GBV spectra at [redacted] Lord Street, Newtown

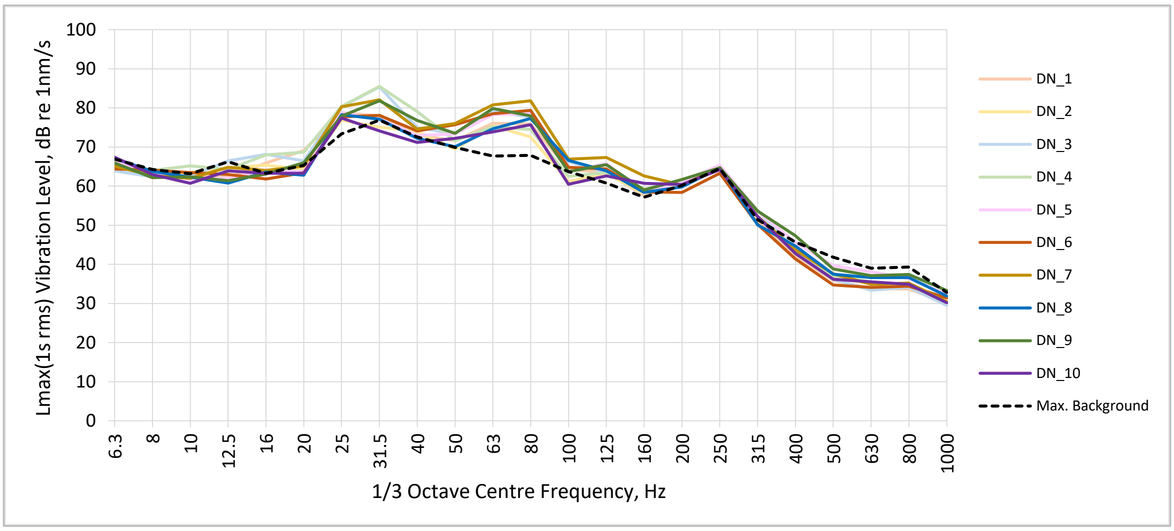


Figure 7-13 SMCSW up passbys GBV spectra at [redacted] Lord Street, Newtown

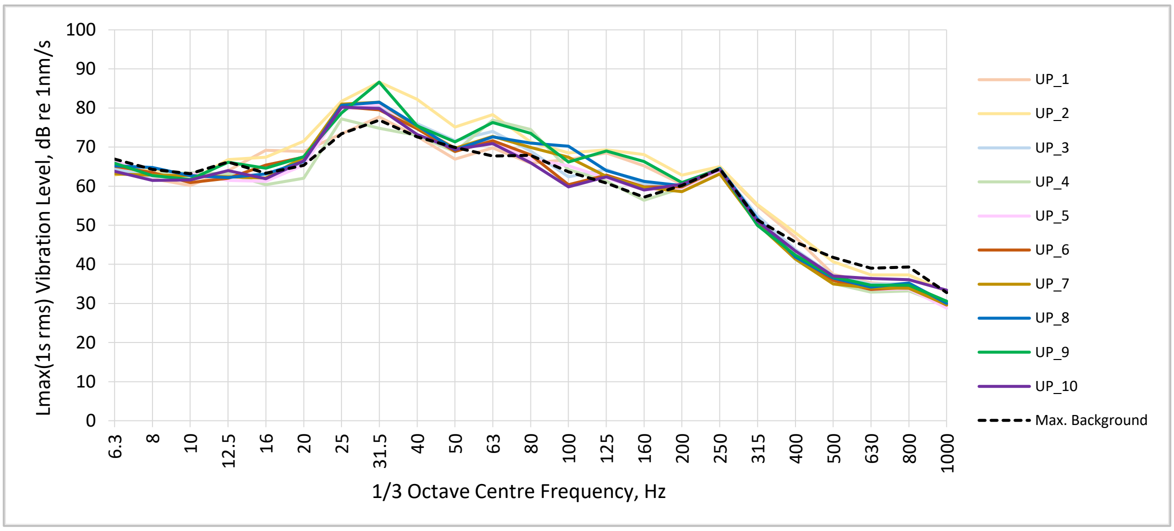


Figure 7-14 SMCSW down passbys GBN spectra at [redacted] Lord Street, Newtown

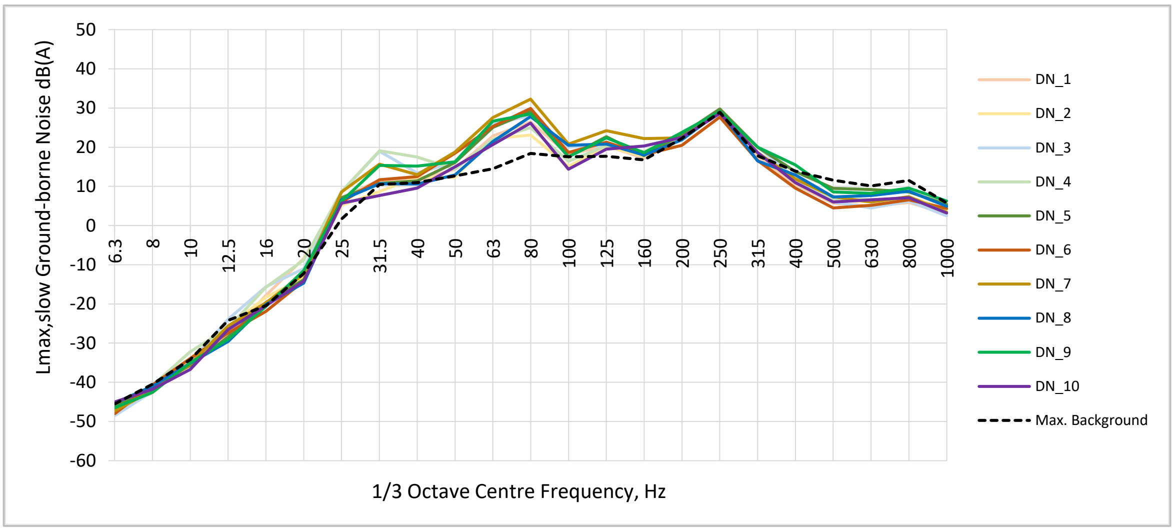
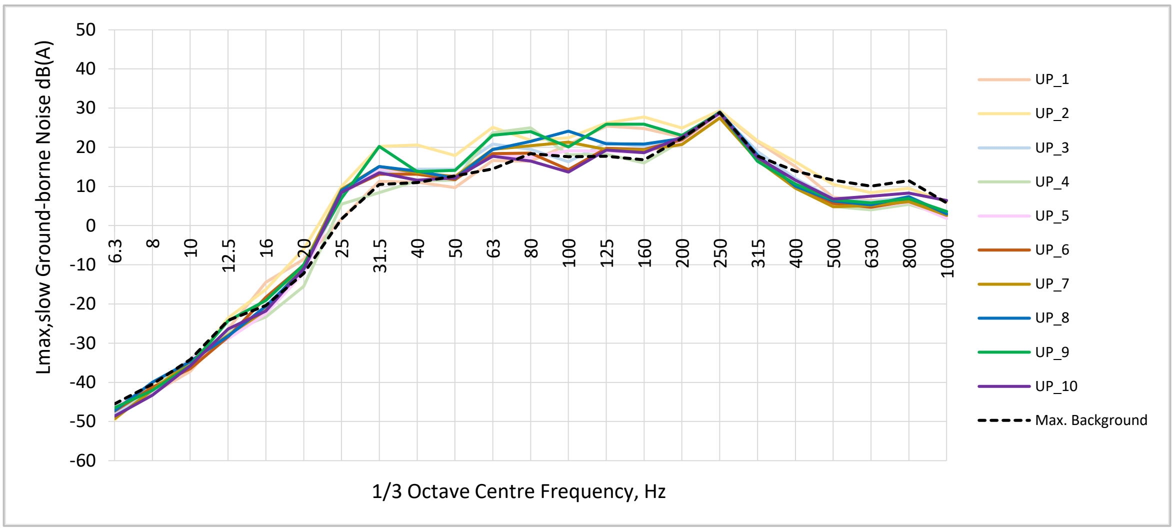


Figure 7-15 SMCSW up passbys GBN spectra at [redacted] Lord Street, Newtown



D.2 GBN and GBV results at [redacted] Maddox Street, Alexandria

For [redacted] Maddox Street, Alexandria, a tabular summary of the measured GBN and GBV levels of each SMCSW passby event is shown in Table 7-3. A graphical summary of the 1/3 octave spectra of each SMCSW passby event is shown in Figure 7-16 to Figure 7-19. The background vibration and background GBN spectra are shown, and represent the $L_{max(1s\ rms)}$ vibration levels and $L_{Amax,slow}$ noise levels, respectively during a typical period when there were no SMCSW passbys.

The SMCSW passbys were inaudible at this location.

Table 7-3 Results for each SMCSW passby at [redacted] Maddox Street, Alexandria

Event ID	Event date and time	SMCSW Passby Direction	Measured L_{ASmax} Noise Levels[1], dB(A)	Estimated L_{ASmax} GBN levels[2], dB(A)	Measured $L_{max(1s\ rms)}$ Vibration level, dBV (mm/s)
DN_1	11/02/2025 11:48:48 AM	DN	NR 24	NR 8	81 dBV (0.012 mm/s)
DN_2	11/02/2025 11:58:41 AM	DN	NR 25	NR 8	84 dBV (0.016 mm/s)
DN_3	11/02/2025 12:03:43 PM	DN	NR 24	NR 8	81 dBV (0.012 mm/s)
DN_4	11/02/2025 12:08:44 PM	DN	NR 25	NR 8	81 dBV (0.011 mm/s)
DN_5	11/02/2025 12:18:42 PM	DN	NR 25	NR 10	81 dBV (0.012 mm/s)
DN_6	11/02/2025 12:23:46 PM	DN	NR 25	NR 8	81 dBV (0.011 mm/s)
DN_7	11/02/2025 12:28:46 PM	DN	NR 24	NR 8	82 dBV (0.012 mm/s)
DN_8	11/02/2025 12[redacted]45 PM	DN	NR 25	NR 8	81 dBV (0.011 mm/s)
DN_9	11/02/2025 12:38:45 PM	DN	NR 24	NR 8	81 dBV (0.011 mm/s)
DN_10	11/02/2025 12:43:44 PM	DN	NR 25	NR 8	81 dBV (0.011 mm/s)
UP_1	11/02/2025 11:50:04 AM	UP	NR 25	NR 8	81 dBV (0.011 mm/s)
UP_2	11/02/2025 11:55:04 AM	UP	NR 25	NR 8	80 dBV (0.010 mm/s)
UP_3	11/02/2025 12:00:03 PM	UP	NR 25	NR 8	80 dBV (0.010 mm/s)
UP_4	11/02/2025 12:05:06 PM	UP	NR 24	NR 8	82 dBV (0.012 mm/s)
UP_5	11/02/2025 12:10:03 PM	UP	NR 25	NR 8	81 dBV (0.011 mm/s)
UP_6	11/02/2025 12:15:06 PM	UP	NR 25	NR 8	81 dBV (0.012 mm/s)
UP_7	11/02/2025 12:20:03 PM	UP	NR 24	NR 8	79 dBV (0.009 mm/s)
UP_8	11/02/2025 12:25:05 PM	UP	NR 25	NR 8	82 dBV (0.013 mm/s)
UP_9	11/02/2025 12:30:07 PM	UP	NR 25	NR 8	83 dBV (0.014 mm/s)
UP_10	11/02/2025 12:40:04 PM	UP	NR 25	NR 8	80 dBV (0.010 mm/s)
		Overall 95th percentile -	**NR 25, 26 dB(A)**	**NR 8, 17 dB(A)**	**83 dBV (0.014 mm/s)**

Note 1: The passby measurement results represents the highest noise level measured during the SMCSW passby (i.e. the same time period as the vibration measurements).

Note 2: Estimated $L_{Amax,slow}$ noise levels are based on the measured vibration levels in the Z direction.

Figure 7-16 SMCSW down passbys GBV spectra at [redacted] Maddox Street, Alexandria

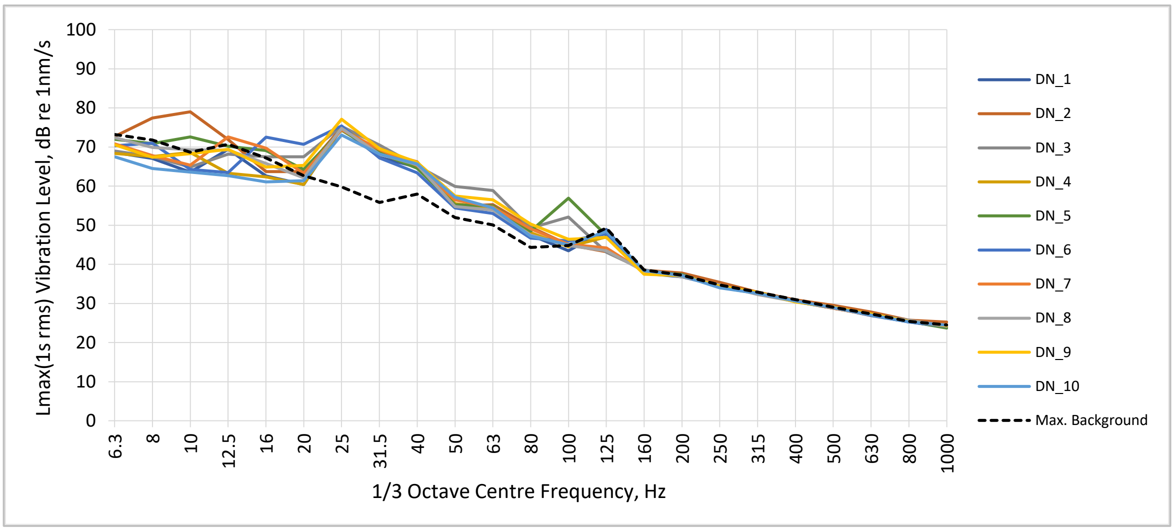


Figure 7-17 SMCSW up passbys GBV spectra at [redacted] Maddox Street, Alexandria

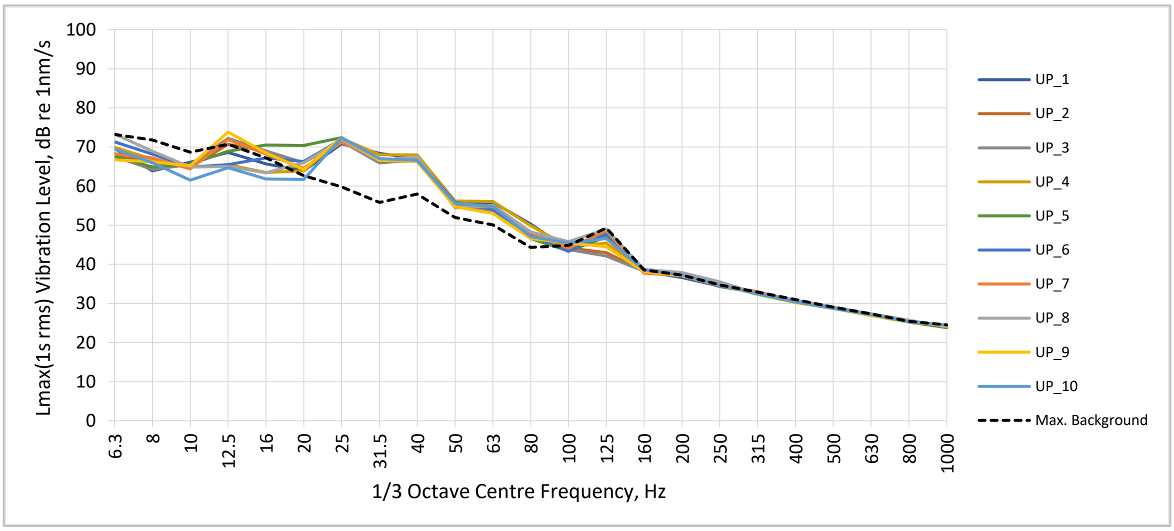


Figure 7-18 SMCSW down passbys GBN spectra at [redacted] Maddox Street, Alexandria

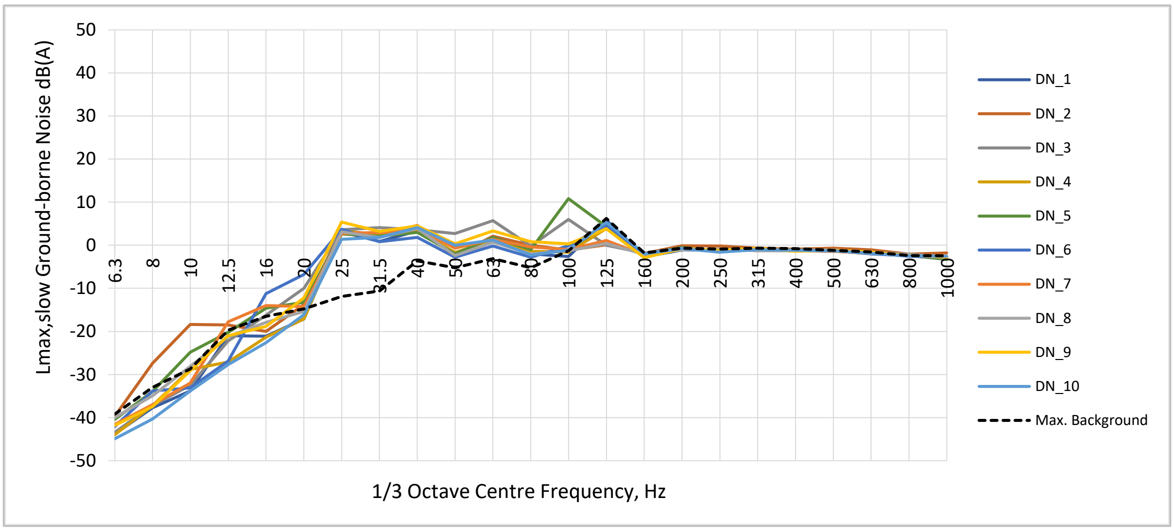
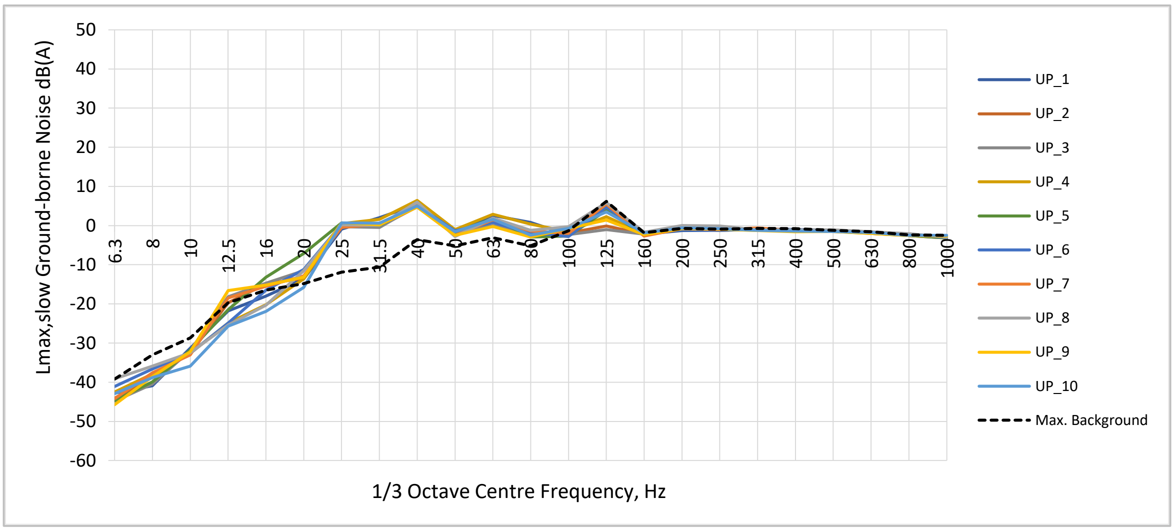


Figure 7-19 SMCSW up passbys GBN spectra at [redacted] Maddox Street, Alexandria



D.3 GBN and GBV results at [redacted] Cope Street, Waterloo

For [redacted] Cope Street, Waterloo, a tabular summary of the measured GBN and GBV levels of each SMCSW passby event is shown in Table 7-4. A graphical summary of the 1/3 octave spectra of each SMCSW passby event is shown in Figure 7-20 to Figure 7-23. The background vibration and background GBN spectra are shown, and represent the $L_{max(1s\ rms)}$ vibration levels and $L_{Amax,slow}$ noise levels, respectively during a typical period when there were no SMCSW passbys.

The SMCSW passbys were faintly audible at this location.

Table 7-4 Results for each SCMSW passby at [redacted] Cope Street, Waterloo

Event ID	Event date and time	SMCSW Passby Direction	Measured L_{ASmax} Noise Levels[1], dB(A)	Estimated L_{ASmax} GBN levels[2], dB(A)	Measured $L_{max(1s\ rms)}$ Vibration level, dBV (mm/s)
DN_1	27/03/2025 9:43:21 AM	DN	27	25	97 dBV (0.070 mm/s)
DN_2	27/03/2025 9:47:28 AM	DN	28	26	85 dBV (0.019 mm/s)
DN_3	27/03/2025 9:51:38 AM	DN	25	23	84 dBV (0.016 mm/s)
DN_4	27/03/2025 9:59:06 AM	DN	27	22	96 dBV (0.063 mm/s)
DN_5	27/03/2025 10:03:05 AM	DN	27	23	91 dBV (0.037 mm/s)
DN_6	27/03/2025 10:18:08 AM	DN	25	23	85 dBV (0.018 mm/s)
DN_7	27/03/2025 10:23:06 AM	DN	25	22	83 dBV (0.014 mm/s)
DN_8	27/03/2025 10:28:09 AM	DN	28	22	83 dBV (0.014 mm/s)
DN_9	27/03/2025 10:43:19 AM	DN	23	23	84 dBV (0.016 mm/s)
DN_10	27/03/2025 10:48:06 AM	DN	26	23	83 dBV (0.014 mm/s)
UP_1	27/03/2025 9:42:40 AM	UP	26	25	100 dBV (0.098 mm/s)
UP_2	27/03/2025 9:46:44 AM	UP	28	24	95 dBV (0.056 mm/s)
UP_3	27/03/2025 9:50:41 AM	UP	26	26	86 dBV (0.021 mm/s)
UP_4	27/03/2025 10:06:00 AM	UP	25	24	88 dBV (0.024 mm/s)
UP_5	27/03/2025 10:10:42 AM	UP	26	25	85 dBV (0.018 mm/s)
UP_6	27/03/2025 10:15:41 AM	UP	28	26	84 dBV (0.016 mm/s)
UP_7	27/03/2025 10:20:44 AM	UP	27	23	92 dBV (0.041 mm/s)
UP_8	27/03/2025 10:25:43 AM	UP	26	25	84 dBV (0.016 mm/s)
UP_9	27/03/2025 10:35:42 AM	UP	27	24	92 dBV (0.041 mm/s)
UP_10	27/03/2025 10:45:41 AM	UP	26	24	85 dBV (0.019 mm/s)
		Overall 95th percentile -	**28 dB(A)**	**26 dB(A)**	**97 dBV (0.071 mm/s)**

Note 1: The passby measurement results represents the highest noise level measured during the SMCSW passby (i.e. the same time period as the vibration measurements).

Note 2: Estimated $L_{Amax,slow}$ noise levels are based on the measured vibration levels in the Z direction.

Figure 7-20 SMCSW down passbys GBV spectra at [redacted] Cope Street, Waterloo

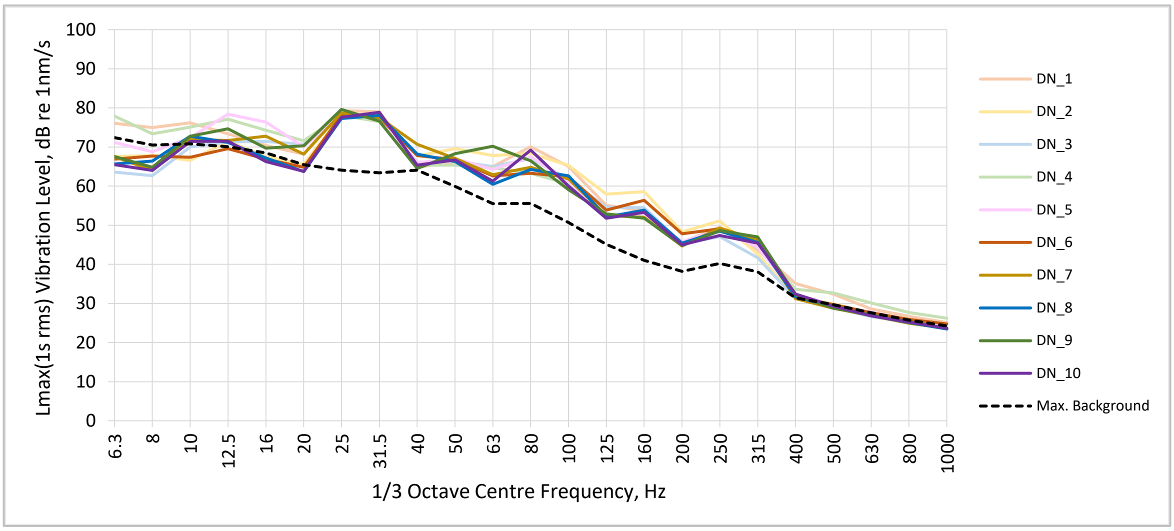


Figure 7-21 SMCSW up passbys GBV spectra at [redacted] Cope Street, Waterloo

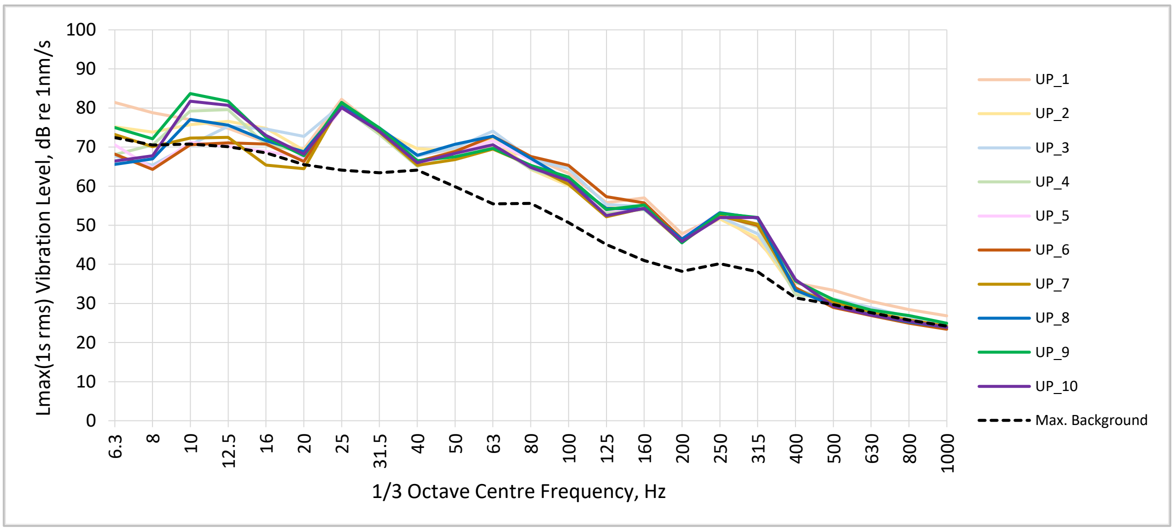


Figure 7-22 SMCSW down passbys GBN spectra at [redacted] Cope Street, Waterloo

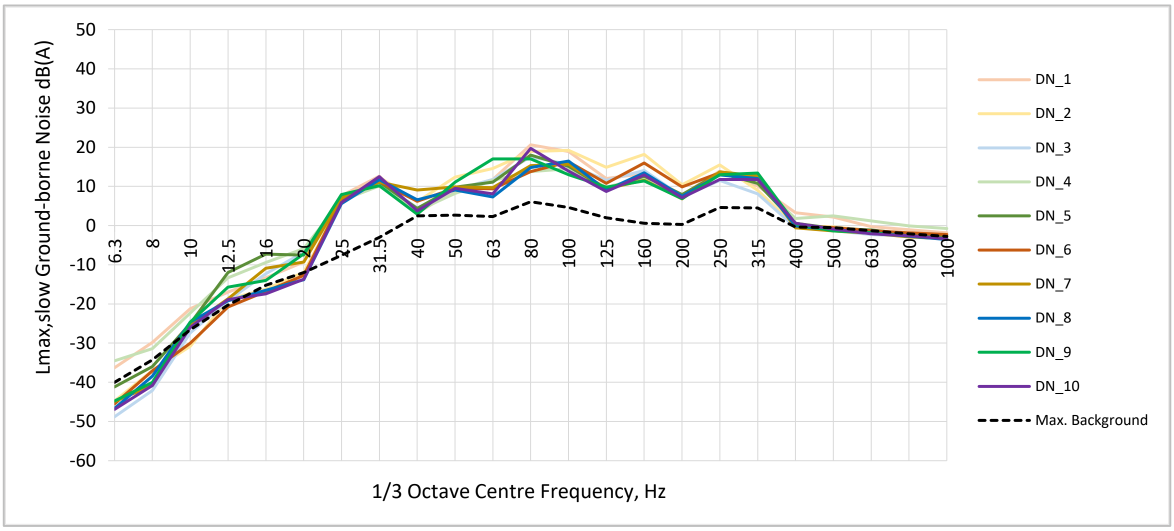
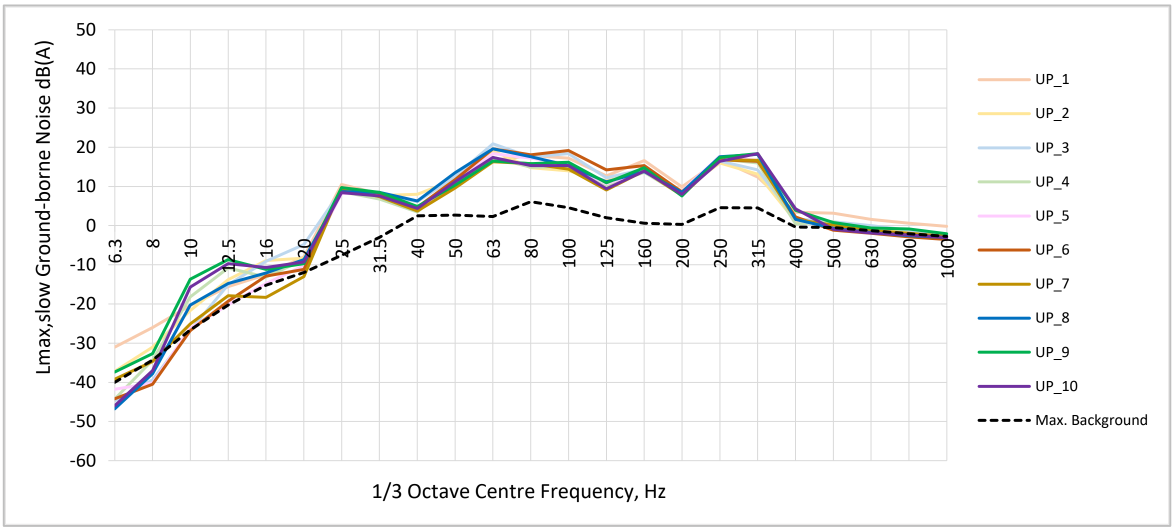


Figure 7-23 SMCSW up passbys GBN spectra at [redacted] Cope Street, Waterloo



D.4 GBN and GBV results at [redacted] Cleveland Street, Redfern

For [redacted] Cleveland Street, Redfern, a tabular summary of the measured GBN and GBV levels of each SMCSW passby event is shown in Table 7-5. A graphical summary of the 1/3 octave spectra of each SMCSW passby event is shown in Figure 7-24 to Figure 7-27. The background vibration and background GBN spectra are shown, and represent the $L_{max(1s\ rms)}$ vibration levels and $L_{Amax,slow}$ noise levels, respectively during a typical period when there were no SMCSW passbys.

Sydney Trains passbys were audible and higher than the SMCSW passbys at this location. The measured Sydney Trains $L_{ASmax,95\%}$ GBN level was 36 dB(A).

The SMCSW passbys were inaudible at this location.

Table 7-5 Results for each SMCSW passby at [redacted] Cleveland Street, Redfern

Event ID	Event date and time	SMCSW Passby Direction	Measured L_{ASmax} Noise Levels[1], dB(A)	Estimated L_{ASmax} GBN levels[2], dB(A)	Measured $L_{max(1s\ rms)}$ Vibration level, dBV (mm/s)
DN_1	13/03/2025 8:37:27 AM	DN	-	13	80 dBV (0.010 mm/s)
DN_2	13/03/2025 8:58:17 AM	DN	-	11	80 dBV (0.010 mm/s)
DN_3	13/03/2025 9:02:10 AM	DN	-	11	80 dBV (0.010 mm/s)
DN_4	13/03/2025 9:09:38 AM	DN	-	9	80 dBV (0.010 mm/s)
DN_5	13/03/2025 9:21:38 AM	DN	-	17	81 dBV (0.011 mm/s)
DN_6	13/03/2025 9:26:03 AM	DN	-	13	81 dBV (0.011 mm/s)
DN_7	13/03/2025 9:29:37 AM	DN	-	10	83 dBV (0.015 mm/s)
DN_8	13/03/2025 10:06:45 AM	DN	-	10	79 dBV (0.009 mm/s)
DN_9	13/03/2025 9:45:40 AM	DN	-	12	79 dBV (0.008 mm/s)
DN_10	13/03/2025 10:21:04 AM	DN	-	11	80 dBV (0.010 mm/s)
UP_1	13/03/2025 8:28:42 AM	UP	-	13	80 dBV (0.010 mm/s)
UP_2	13/03/2025 8:52:10 AM	UP	-	16	80 dBV (0.011 mm/s)
UP_3	13/03/2025 9:01:48 AM	UP	-	12	81 dBV (0.011 mm/s)
UP_4	13/03/2025 9:12:53 AM	UP	-	11	78 dBV (0.008 mm/s)
UP_5	13/03/2025 9:16:44 AM	UP	-	10	79 dBV (0.009 mm/s)
UP_6	13/03/2025 9:28:37 AM	UP	-	11	81 dBV (0.011 mm/s)
UP_7	13/03/2025 10:02:55 AM	UP	-	9	82 dBV (0.012 mm/s)
UP_8	13/03/2025 9:44:37 AM	UP	-	10	82 dBV (0.013 mm/s)
UP_9	13/03/2025 10:07:47 AM	UP	-	9	81 dBV (0.011 mm/s)
UP_10	13/03/2025 10:22:01 AM	UP	-	11	78 dBV (0.008 mm/s)
		Overall 95th percentile -	**-**	**16 dB(A)**	**82 dBV (0.013 mm/s)**

Note 1: The passby measurement results are not applicable as they were dominated by the extraneous sources which affected the measured noise levels using the sound level meter. The measured background $L_{ASmax,95\%}$ was 33 dB(A).

Note 2: Estimated $L_{Amax,slow}$ noise levels are based on the measured vibration levels in the Z direction.

Figure 7-24 SMCSW down passbys GBV spectra at [redacted] Cleveland Street, Redfern

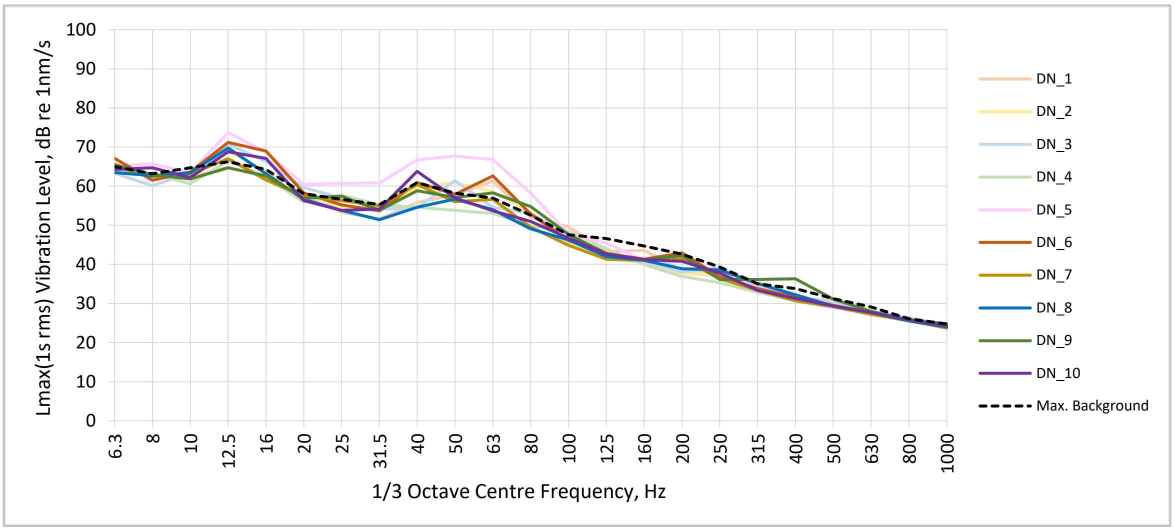


Figure 7-25 SMCSW up passbys GBV spectra at [redacted] Cleveland Street, Redfern

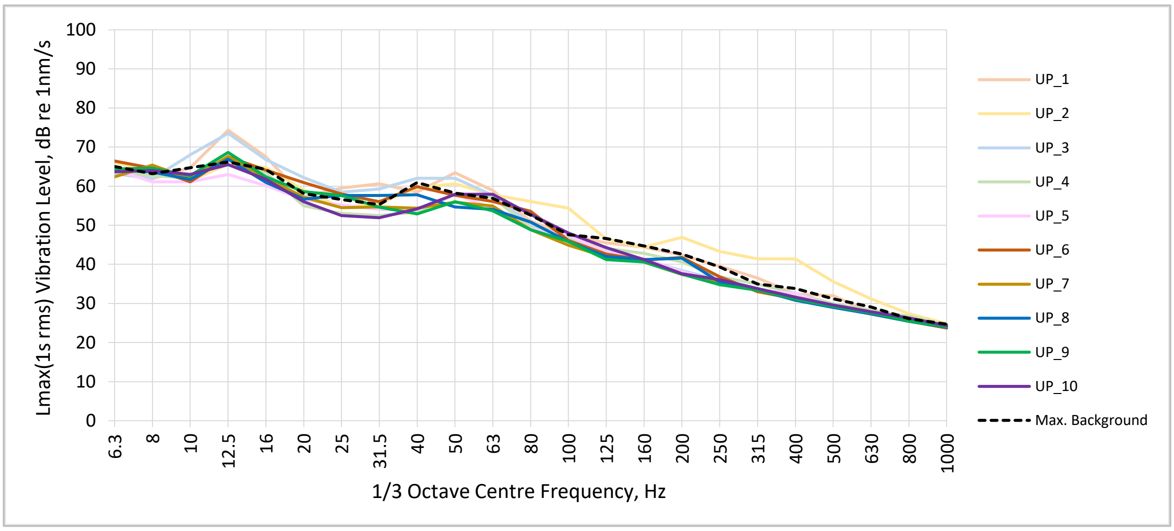


Figure 7-26 SMCSW down passbys GBN spectra at [redacted] Cleveland Street, Redfern

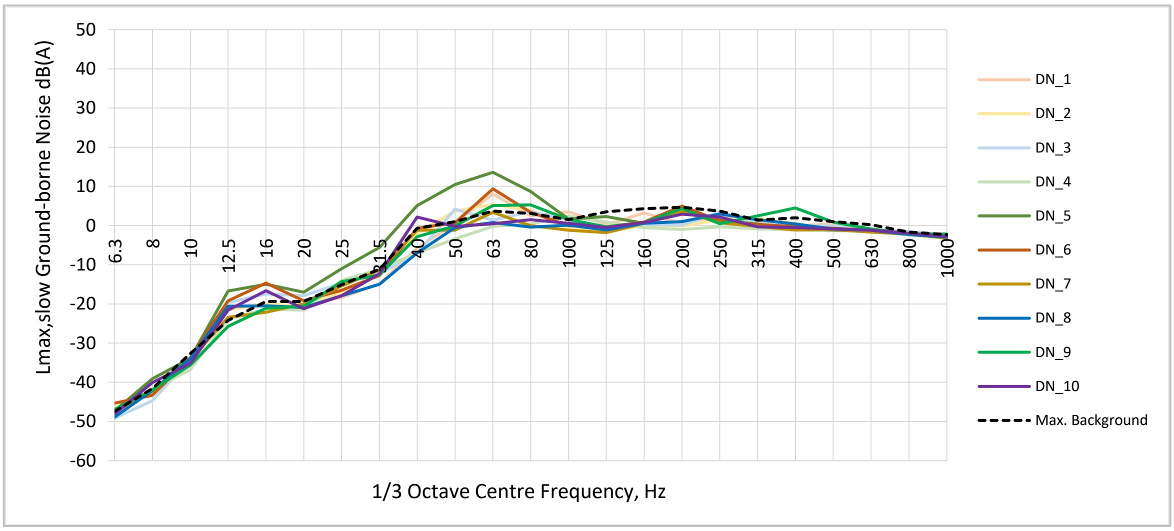
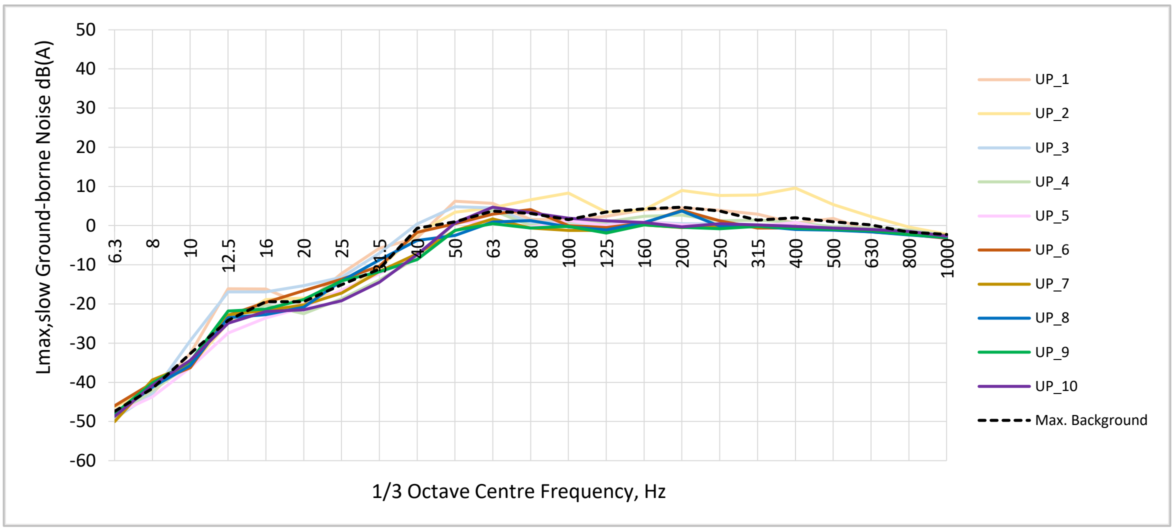


Figure 7-27 SMCSW up passbys GBN spectra at [redacted] Cleveland Street, Redfern



D.5 GBN and GBV results at [redacted] Pitt Street, Sydney

For [redacted] Pitt Street, Sydney, a tabular summary of the measured GBN and GBV levels of each SMCSW passby event is shown in Table 7-6. A graphical summary of the 1/3 octave spectra of each SMCSW passby event is shown in Figure 7-28 to Figure 7-31. The background vibration and background GBN spectra are shown, and represent the $L_{max(1s\ rms)}$ vibration levels and $L_{Amax,slow}$ noise levels, respectively during a typical period when there were no SMCSW passbys.

The SMCSW passbys were inaudible at this location.

Table 7-6 Results for each SMCSW passby at [redacted] Pitt Street, Sydney

Event ID	Event date and time	SMCSW Passby Direction	Measured L_{ASmax} Noise Levels[1], dB(A)	Estimated L_{ASmax} GBN levels[2], dB(A)	Measured $L_{max(1s\ rms)}$ Vibration level, dBV (mm/s)
DN_1	14/02/2025 9:19:12 AM	DN	33	16	73 dBV (0.004 mm/s)
DN_2	14/02/2025 9:23:44 AM	DN	34	15	72 dBV (0.004 mm/s)
DN_3	14/02/2025 9:35:20 AM	DN	34	16	72 dBV (0.004 mm/s)
DN_4	14/02/2025 9:38:39 AM	DN	34	15	72 dBV (0.004 mm/s)
DN_5	14/02/2025 9:43:48 AM	DN	35	15	72 dBV (0.004 mm/s)
DN_6	14/02/2025 10:05:14 AM	DN	34	16	72 dBV (0.004 mm/s)
DN_7	14/02/2025 10:09:58 AM	DN	34	16	73 dBV (0.005 mm/s)
DN_8	14/02/2025 10:15:23 AM	DN	35	15	72 dBV (0.004 mm/s)
DN_9	14/02/2025 10:19:53 AM	DN	35	16	72 dBV (0.004 mm/s)
DN_10	14/02/2025 10:29:37 AM	DN	34	16	73 dBV (0.004 mm/s)
UP_1	14/02/2025 9:17:54 AM	UP	34	16	73 dBV (0.004 mm/s)
UP_2	14/02/2025 9:22:22 AM	UP	34	15	72 dBV (0.004 mm/s)
UP_3	14/02/2025 9:33:56 AM	UP	35	15	72 dBV (0.004 mm/s)
UP_4	14/02/2025 9:38:26 AM	UP	34	19	71 dBV (0.004 mm/s)
UP_5	14/02/2025 9:42:24 AM	UP	34	15	72 dBV (0.004 mm/s)
UP_6	14/02/2025 10:02:43 AM	UP	35	16	73 dBV (0.004 mm/s)
UP_7	14/02/2025 10:07:56 AM	UP	34	15	72 dBV (0.004 mm/s)
UP_8	14/02/2025 10:12:43 AM	UP	34	15	72 dBV (0.004 mm/s)
UP_9	14/02/2025 10:22:38 AM	UP	34	16	71 dBV (0.004 mm/s)
UP_10	14/02/2025 10:27:41 AM	UP	33	17	72 dBV (0.004 mm/s)
		Overall 95th percentile -	**35 dB(A)**	**17 dB(A)**	**73 dBV (0.004 mm/s)**

Note 1: The passby measurement results represents the highest noise level measured during the SMCSW passby (i.e. the same time period as the vibration measurements).

Note 2: Estimated $L_{Amax,slow}$ noise levels are based on the measured vibration levels in the Z direction.

Figure 7-28 SMCSW down passbys GBV spectra at [redacted] Pitt Street, Sydney

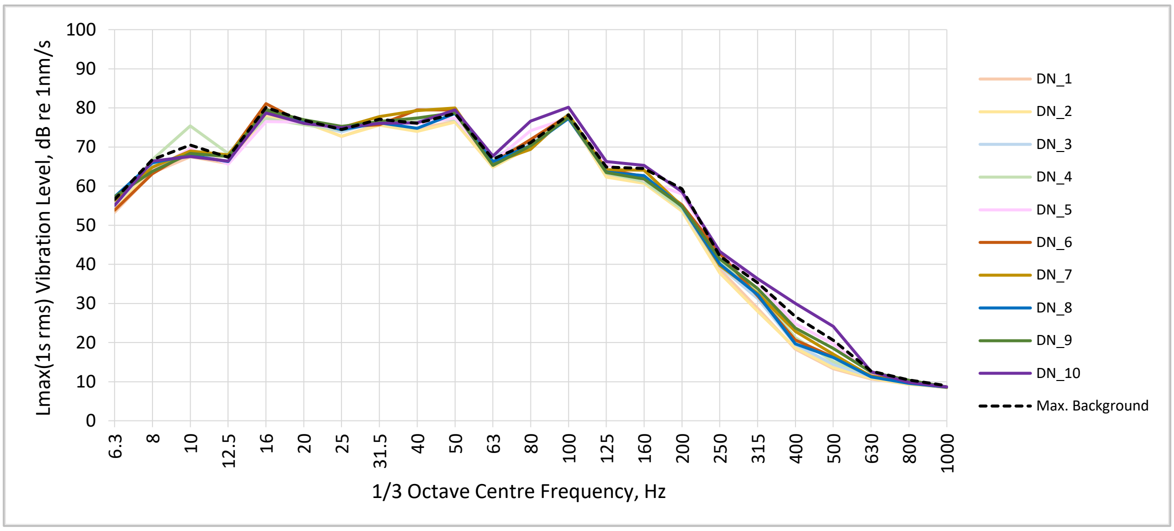


Figure 7-29 SMCSW up passbys GBV spectra at [redacted] Pitt Street, Sydney

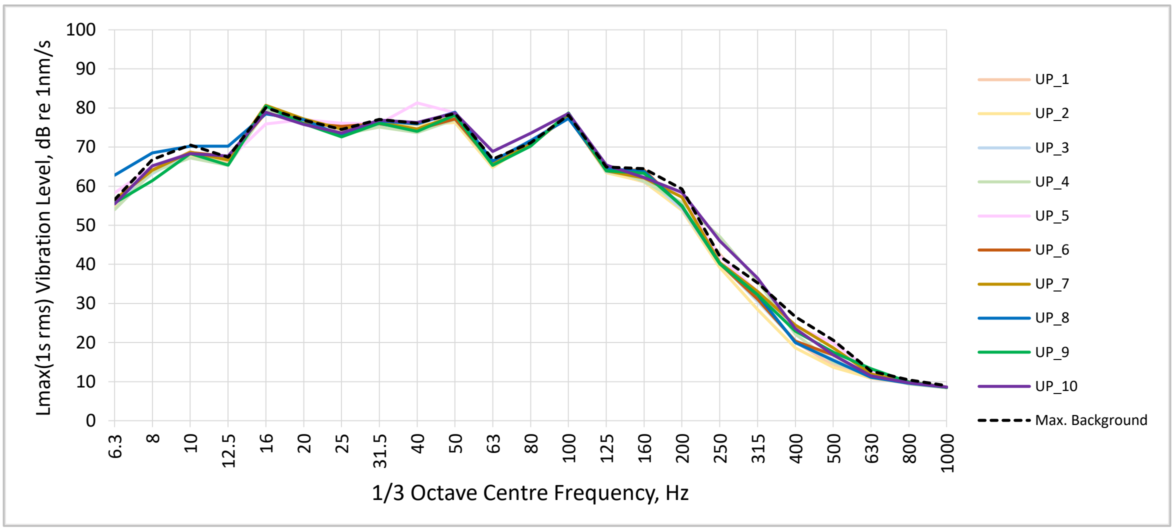


Figure 7-30 SMCSW down passbys GBN spectra at [redacted] Pitt Street, Sydney

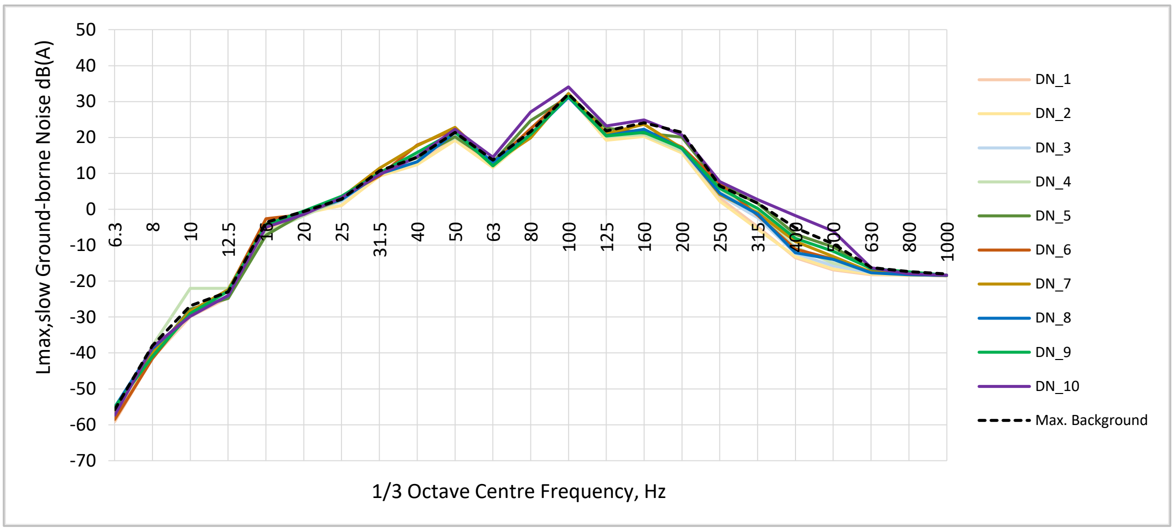
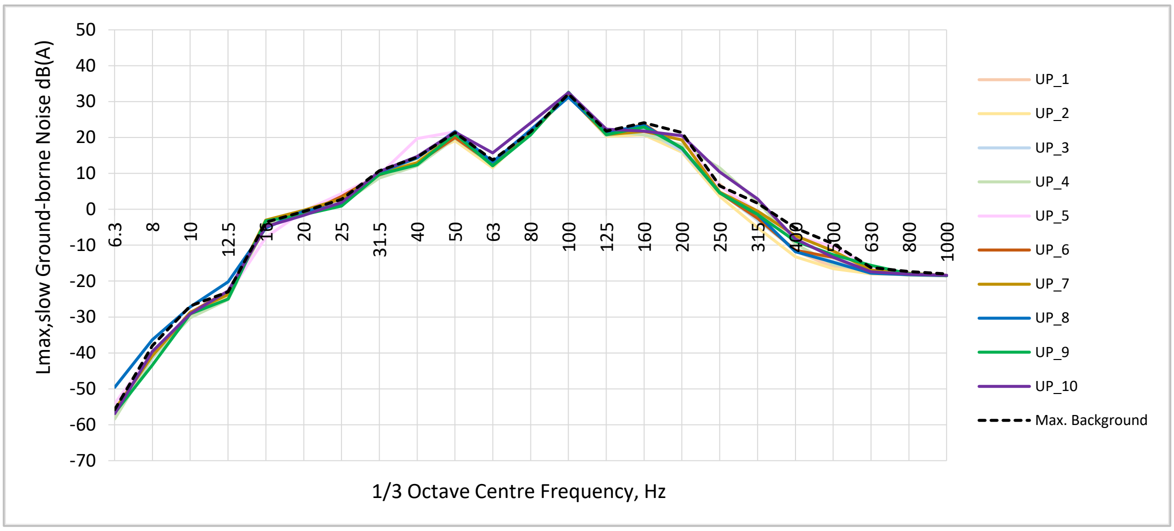


Figure 7-31 SMCSW up passbys GBN spectra at [redacted] Pitt Street, Sydney



D.6 GBN and GBV results at [redacted] Grosvenor Street, The Rocks

For [redacted] Grosvenor Street, The Rocks, a tabular summary of the measured GBN and GBV levels of each SMCSW passby event is shown in Table 7-7. A graphical summary of the 1/3 octave spectra of each SMCSW passby event is shown in Figure 7-32 to Figure 7-35. The background vibration and background GBN spectra are shown, and represent the $L_{max(1s\ rms)}$ vibration levels and $L_{Amax,slow}$ noise levels, respectively during a typical period when there were no SMCSW passbys.

The Sydney Trains passbys were audible and higher than the SMCSW passbys at this location. The measured Sydney Trains $L_{ASmax,95\%}$ GBN level was 45 dB(A).

The SMCSW passbys were inaudible at this location.

Table 7-7 Results for each SMCSW passby at [redacted] Grosvenor Street, The Rocks

Event ID	Event date and time	SMCSW Passby Direction	Measured L_{ASmax} Noise Levels[1], dB(A)	Estimated L_{ASmax} GBN levels[2], dB(A)	Measured $L_{max(1s\ rms)}$ Vibration level, dBV (mm/s)
DN_1	17/02/2025 2:03:45 PM	DN	37	28	97 dBV (0.069 mm/s)
DN_2	17/02/2025 2:38:44 PM	DN	37	28	95 dBV (0.055 mm/s)
DN_3	17/02/2025 2:43:25 PM	DN	39	28	96 dBV (0.061 mm/s)
DN_4	17/02/2025 2:48:40 PM	DN	38	28	96 dBV (0.060 mm/s)
DN_5	17/02/2025 2:58:20 PM	DN	40	28	96 dBV (0.064 mm/s)
DN_6	17/02/2025 3:02:59 PM	DN	36	30	96 dBV (0.061 mm/s)
DN_7	17/02/2025 3:06:32 PM	DN	37	29	96 dBV (0.060 mm/s)
DN_8	17/02/2025 3:18:32 PM	DN	36	28	96 dBV (0.064 mm/s)
DN_9	17/02/2025 3:26:30 PM	DN	38	28	96 dBV (0.062 mm/s)
DN_10	17/02/2025 3:30:19 PM	DN	38	28	95 dBV (0.057 mm/s)
UP_1	17/02/2025 2:05:35 PM	UP	38	28	96 dBV (0.066 mm/s)
UP_2	17/02/2025 2:39:25 PM	UP	39	28	95 dBV (0.057 mm/s)
UP_3	17/02/2025 2:45:25 PM	UP	38	28	95 dBV (0.057 mm/s)
UP_4	17/02/2025 2:50:40 PM	UP	36	28	97 dBV (0.069 mm/s)
UP_5	17/02/2025 2:55:00 PM	UP	36	32	96 dBV (0.061 mm/s)
UP_6	17/02/2025 2:59:32 PM	UP	39	28	95 dBV (0.056 mm/s)
UP_7	17/02/2025 3:03:32 PM	UP	37	28	94 dBV (0.052 mm/s)
UP_8	17/02/2025 3:07:20 PM	UP	39	28	96 dBV (0.061 mm/s)
UP_9	17/02/2025 3:15:19 PM	UP	38	28	95 dBV (0.058 mm/s)
UP_10	17/02/2025 3:19:55 PM	UP	37	28	95 dBV (0.057 mm/s)
		Overall 95th percentile -	**39 dB(A)**	**30 dB(A)**	**97 dBV (0.069 mm/s)**

Note 1: The passby measurement results represents the highest noise level measured during the SMCSW passby (i.e. the same time period as the vibration measurements).

Note 2: Estimated $L_{Amax,slow}$ noise levels are based on the measured vibration levels in the Z direction.

Figure 7-32 SMCSW down passbys GBV spectra at [redacted] Grosvenor Street, The Rocks

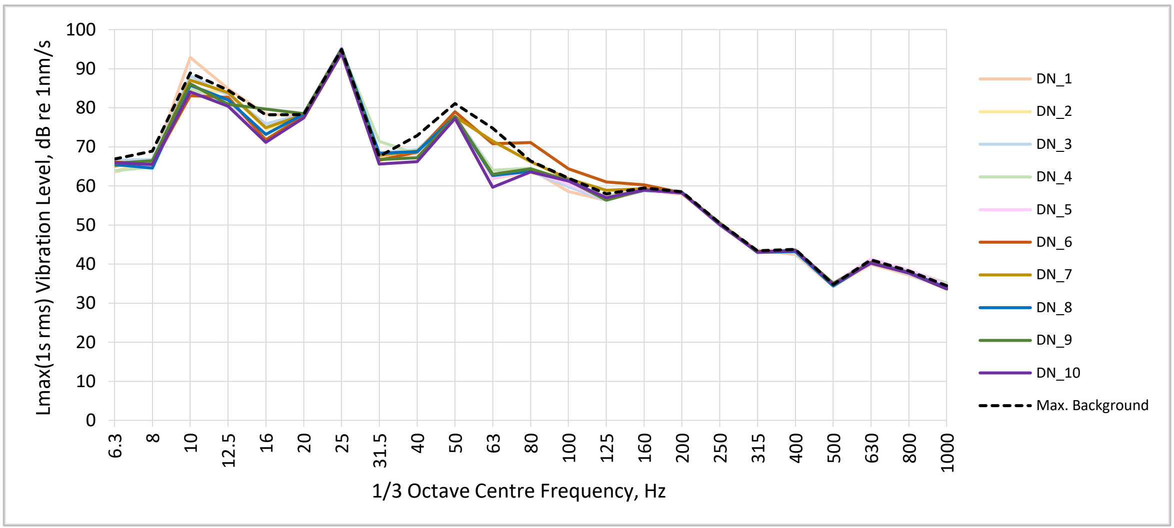


Figure 7-33 SMCSW up passbys GBV spectra at [redacted] Grosvenor Street, The Rocks

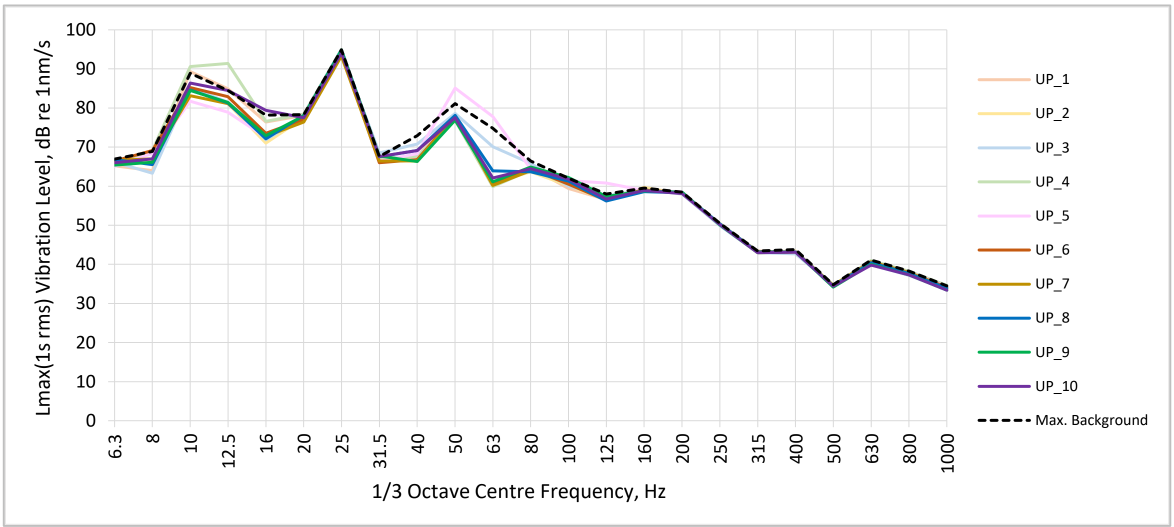


Figure 7-34 SMCSW down passbys GBN spectra at [redacted] Grosvenor Street, The Rocks

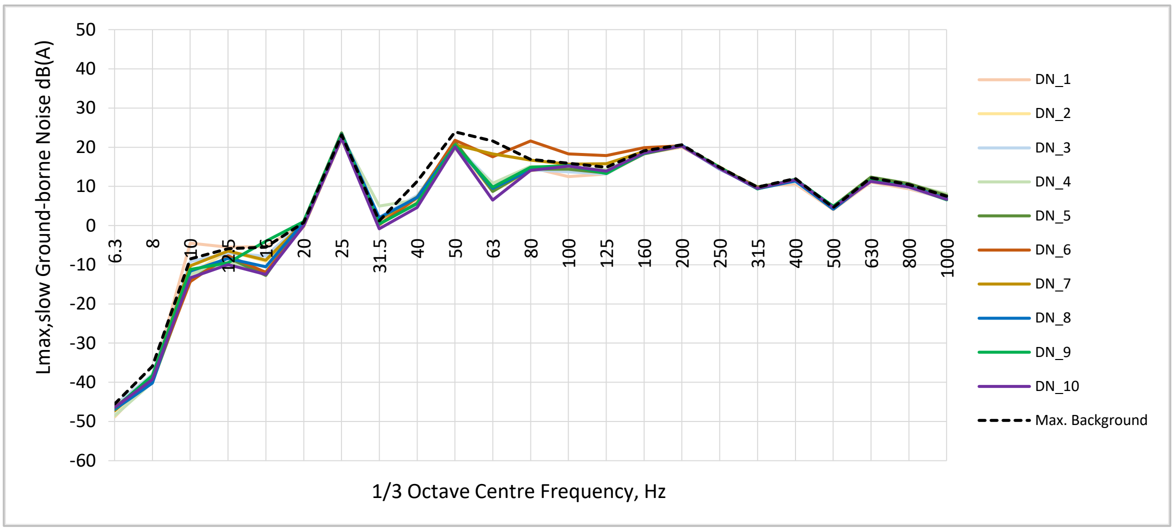
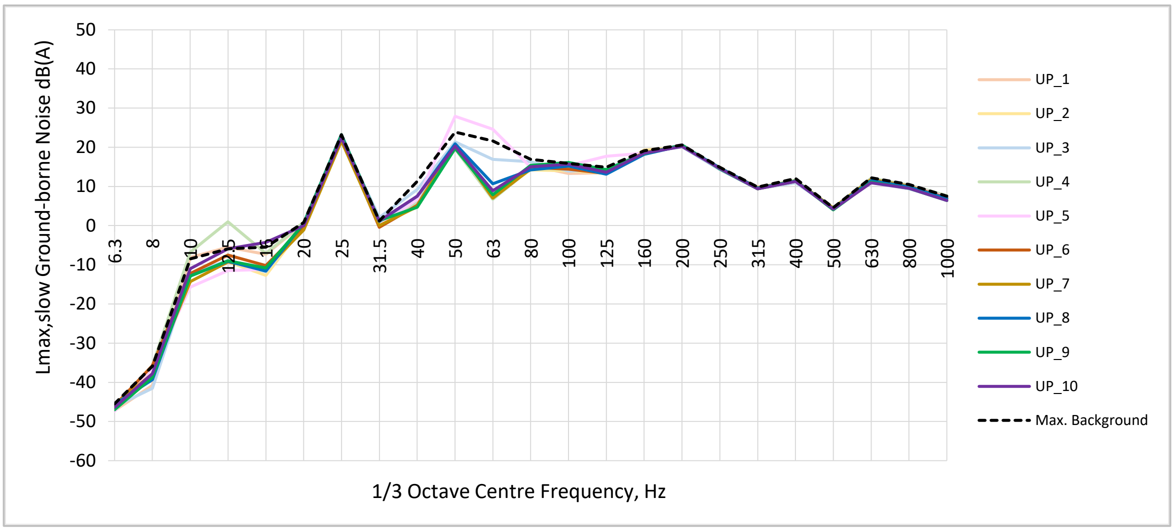


Figure 7-35 SMCSW up passbys GBN spectra at [redacted] Grosvenor Street, The Rocks



D.7 GBN and GBV results at [redacted] West Crescent Street, McMahons Point

For [redacted] West Crescent Street, McMahons Point, a tabular summary of the measured GBN and GBV levels of each SMCSW passby event is shown in Table 7-8. A graphical summary of the 1/3 octave spectra of each SMCSW passby event is shown in Figure 7-36 to Figure 7-39. The background vibration and background GBN spectra are shown, and represent the $L_{max(1s\ rms)}$ vibration levels and $L_{Amax,slow}$ noise levels, respectively during a typical period when there were no SMCSW passbys.

The SMCSW passbys were faintly audible at this location.

Table 7-8 Results for each SMCSW passby at [redacted] West Crescent Street, McMahons Point

Event ID	Event date and time	SMCSW Passby Direction	Measured L_{ASmax} Noise Levels[1], dB(A)	Estimated L_{ASmax} GBN levels[2], dB(A)	Measured $L_{max(1s\ rms)}$ Vibration level, dBV (mm/s)
DN_1	10/03/2025 10:26:08 AM	DN	19	18	86 dBV (0.021 mm/s)
DN_2	10/03/2025 10:31:10 AM	DN	17	15	84 dBV (0.016 mm/s)
DN_3	10/03/2025 10:36:08 AM	DN	22	20	82 dBV (0.012 mm/s)
DN_4	10/03/2025 10:41:06 AM	DN	21	21	82 dBV (0.012 mm/s)
DN_5	10/03/2025 10:46:07 AM	DN	19	21	85 dBV (0.018 mm/s)
DN_6	10/03/2025 10:51:09 AM	DN	21	16	85 dBV (0.017 mm/s)
DN_7	10/03/2025 10:56:09 AM	DN	22	20	80 dBV (0.011 mm/s)
DN_8	10/03/2025 11:01:11 AM	DN	22	16	92 dBV (0.041 mm/s)
DN_9	10/03/2025 11:06:11 AM	DN	24	22	88 dBV (0.026 mm/s)
DN_10	10/03/2025 11:11:08 AM	DN	22	20	81 dBV (0.011 mm/s)
UP_1	10/03/2025 10:22:48 AM	UP	19	15	79 dBV (0.009 mm/s)
UP_2	10/03/2025 10:27:50 AM	UP	17	20	79 dBV (0.009 mm/s)
UP_3	10/03/2025 10:33:03 AM	UP	22	7	78 dBV (0.008 mm/s)
UP_4	10/03/2025 10:37:45 AM	UP	21	19	83 dBV (0.015 mm/s)
UP_5	10/03/2025 10:42:44 AM	UP	22	20	80 dBV (0.010 mm/s)
UP_6	10/03/2025 10:47:47 AM	UP	18	22	85 dBV (0.017 mm/s)
UP_7	10/03/2025 10:52:47 AM	UP	20	21	81 dBV (0.011 mm/s)
UP_8	10/03/2025 10:57:47 AM	UP	18	20	81 dBV (0.011 mm/s)
UP_9	10/03/2025 11:02:46 AM	UP	22	19	81 dBV (0.011 mm/s)
UP_10	10/03/2025 11:07:47 AM	UP	24	20	81 dBV (0.011 mm/s)
		Overall 95th percentile -	**24 dB(A)**	**22 dB(A)**	**89 dBV (0.027 mm/s)**

Note 1: The passby measurement results represents the highest noise level measured during the SMCSW passby (i.e. the same time period as the vibration measurements).

Note 2: Estimated $L_{Amax,slow}$ noise levels are based on the measured vibration levels in the Z direction.

Figure 7-36 SMCSW down passbys GBV spectra at [redacted] West Crescent Street, McMahons Point

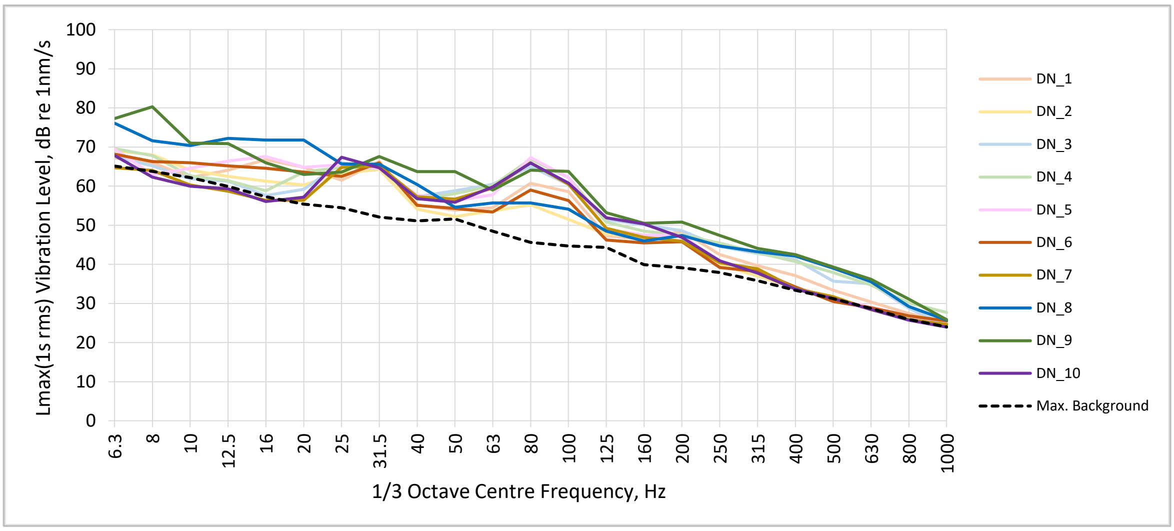


Figure 7-37 SMCSW up passbys GBV spectra at [redacted] West Crescent Street, McMahons Point

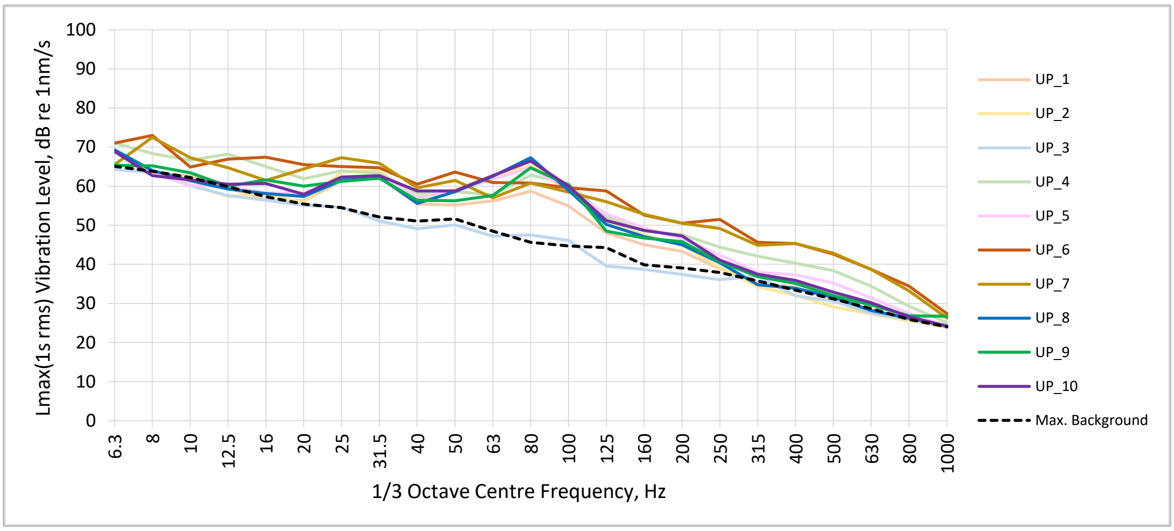


Figure 7-38 SMCSW down passbys GBN spectra at [redacted] West Crescent Street, McMahons Point

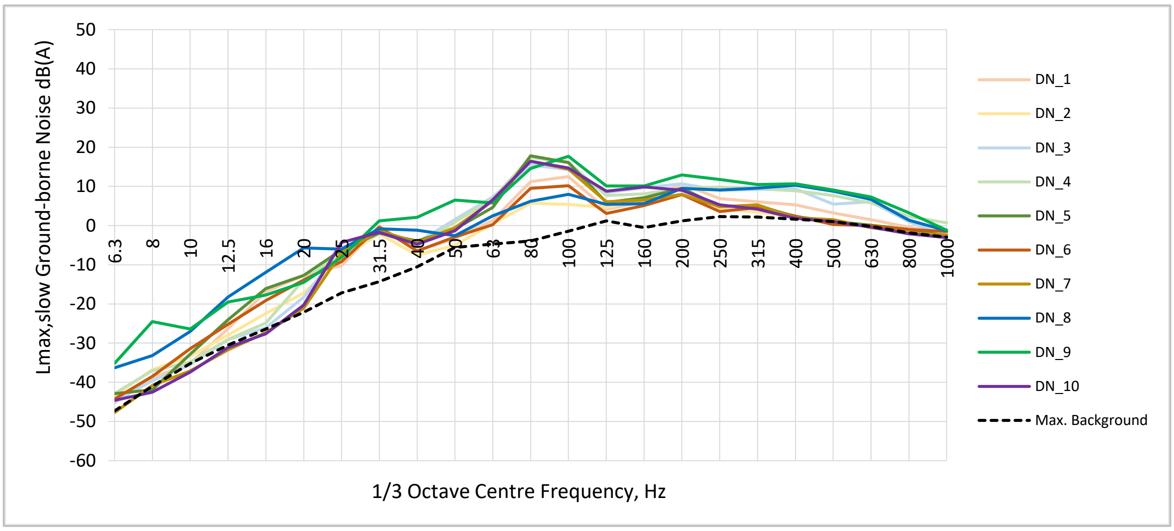
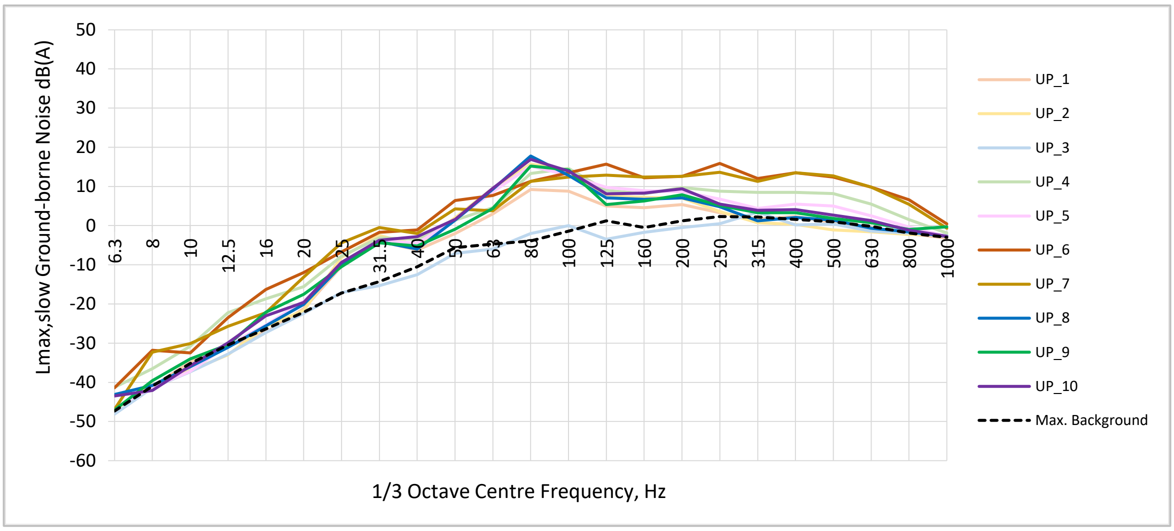


Figure 7-39 SMCSW up passbys GBN spectra at [redacted] West Crescent Street, McMahons Point



D.8 GBN and GBV results at [redacted] Miller Street, North Sydney

For [redacted] Miller Street, North Sydney, a tabular summary of the measured GBN and GBV levels of each SMCSW passby event is shown in Table 7-9. A graphical summary of the 1/3 octave spectra of each SMCSW passby event is shown in Figure 7-40 to Figure 7-43. The background vibration and background GBN spectra are shown, and represent the $L_{max(1s\ rms)}$ vibration levels and $L_{Amax,slow}$ noise levels, respectively during a typical period when there were no SMCSW passbys.

The SMCSW passbys were inaudible at this location.

Table 7-9 Results for each SMCSW passby at [redacted] Miller Street, North Sydney

Event ID	Event date and time	SMCSW Passby Direction	Measured L_{ASmax} Noise Levels[1], dB(A)	Estimated L_{ASmax} GBN levels[2], dB(A)	Measured $L_{max(1s\ rms)}$ Vibration level, dBV (mm/s)
DN_1	18/02/2025 9:55:24 AM	DN	-	12	81 dBV (0.011 mm/s)
DN_2	18/02/2025 9:59:47 AM	DN	-	13	81 dBV (0.012 mm/s)
DN_3	18/02/2025 10:03:31 AM	DN	-	17	84 dBV (0.016 mm/s)
DN_4	18/02/2025 10:13:32 AM	DN	-	11	82 dBV (0.012 mm/s)
DN_5	18/02/2025 10:18:30 AM	DN	-	11	80 dBV (0.010 mm/s)
DN_6	18/02/2025 10:28:31 AM	DN	-	11	82 dBV (0.013 mm/s)
DN_7	18/02/2025 10:33:31 AM	DN	-	12	80 dBV (0.010 mm/s)
DN_8	18/02/2025 10:48:29 AM	DN	-	10	82 dBV (0.013 mm/s)
DN_9	18/02/2025 11:28:31 AM	DN	-	11	81 dBV (0.011 mm/s)
DN_10	18/02/2025 11:40:12 AM	DN	-	17	81 dBV (0.011 mm/s)
UP_1	18/02/2025 9:56:27 AM	UP	-	13	81 dBV (0.011 mm/s)
UP_2	18/02/2025 10:05:17 AM	UP	-	13	80 dBV (0.010 mm/s)
UP_3	18/02/2025 10:10:18 AM	UP	-	12	82 dBV (0.012 mm/s)
UP_4	18/02/2025 10:15:27 AM	UP	-	10	80 dBV (0.010 mm/s)
UP_5	18/02/2025 10:20:19 AM	UP	-	12	81 dBV (0.011 mm/s)
UP_6	18/02/2025 10:30:18 AM	UP	-	12	83 dBV (0.014 mm/s)
UP_7	18/02/2025 10:35:28 AM	UP	-	12	80 dBV (0.010 mm/s)
UP_8	18/02/2025 11:00:20 AM	UP	-	10	80 dBV (0.010 mm/s)
UP_9	18/02/2025 11:20:24 AM	UP	-	11	79 dBV (0.009 mm/s)
UP_10	18/02/2025 11:30:29 AM	UP	-	11	82 dBV (0.012 mm/s)
		Overall 95th percentile -	**-**	**17 dB(A)**	**83 dBV (0.014 mm/s)**

Note 1: The passby measurement results are not applicable as they were dominated by the extraneous sources which affected the measured noise levels using the sound level meter. The measured background $L_{ASmax,95\%}$ was [redacted] dB(A).

Note 2: Estimated $L_{Amax,slow}$ noise levels are based on the measured vibration levels in the Z direction.

Figure 7-40 SMCSW down passbys GBV spectra at [redacted] Miller Street, North Sydney

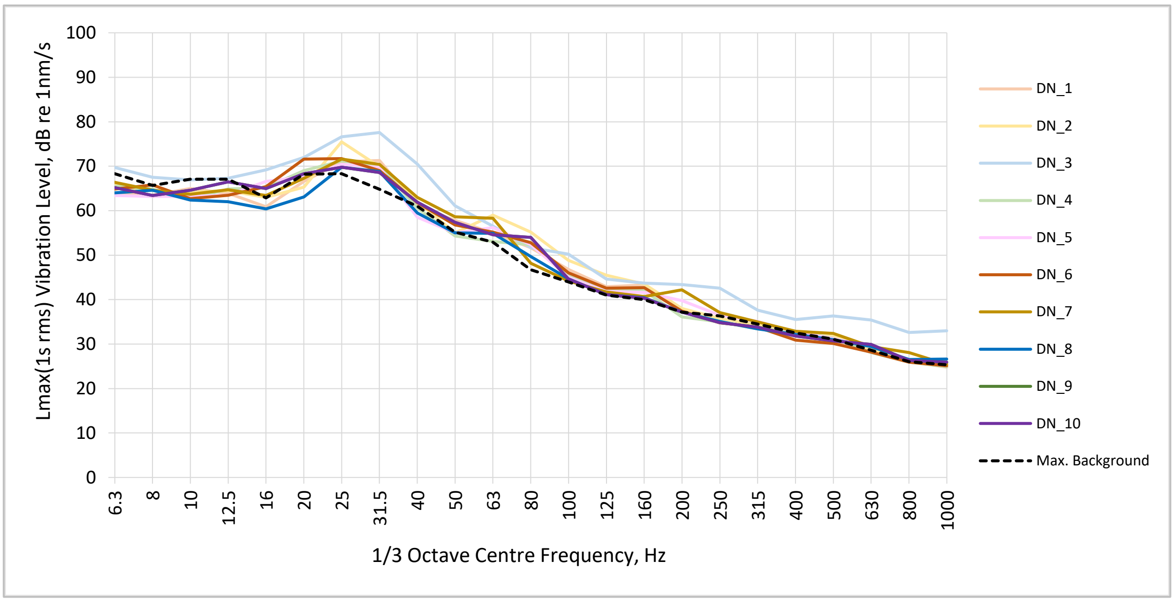


Figure 7-41 SMCSW up passbys GBV spectra at [redacted] Miller Street, North Sydney

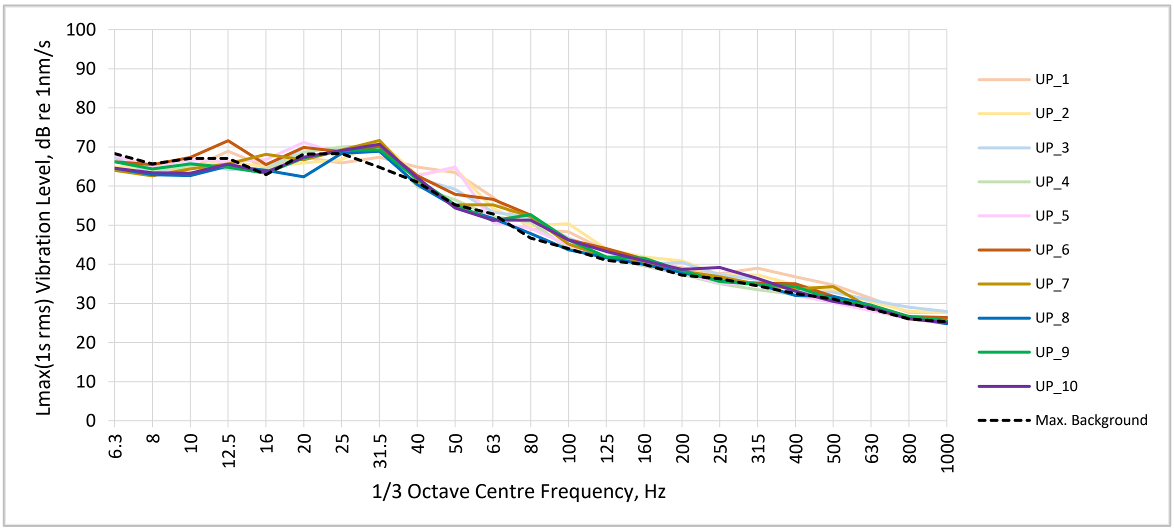


Figure 7-42 SMCSW down passbys GBN spectra at [redacted] Miller Street, North Sydney

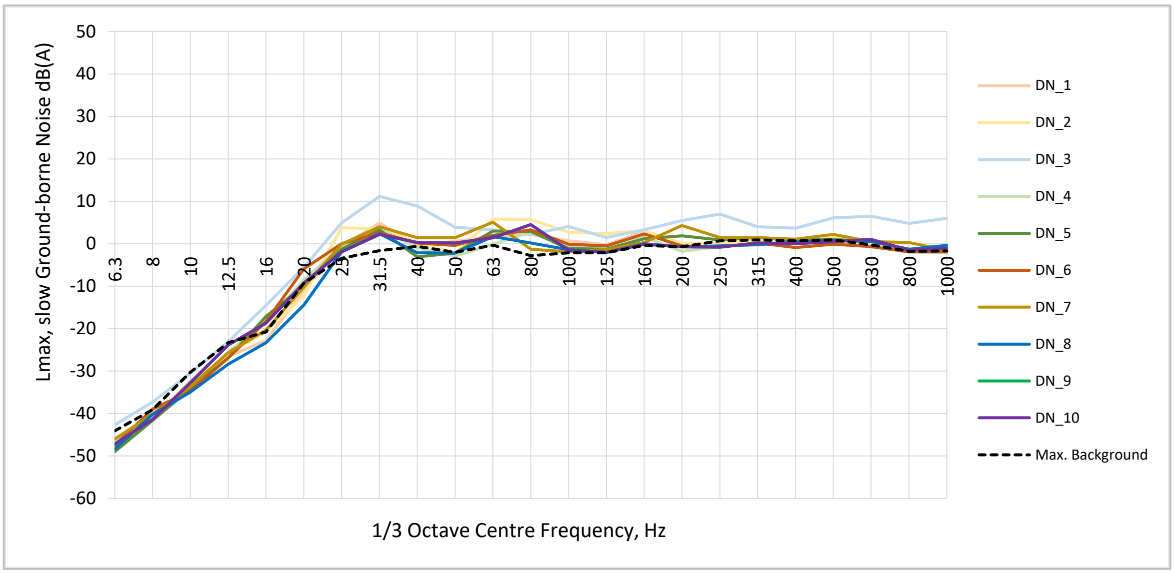
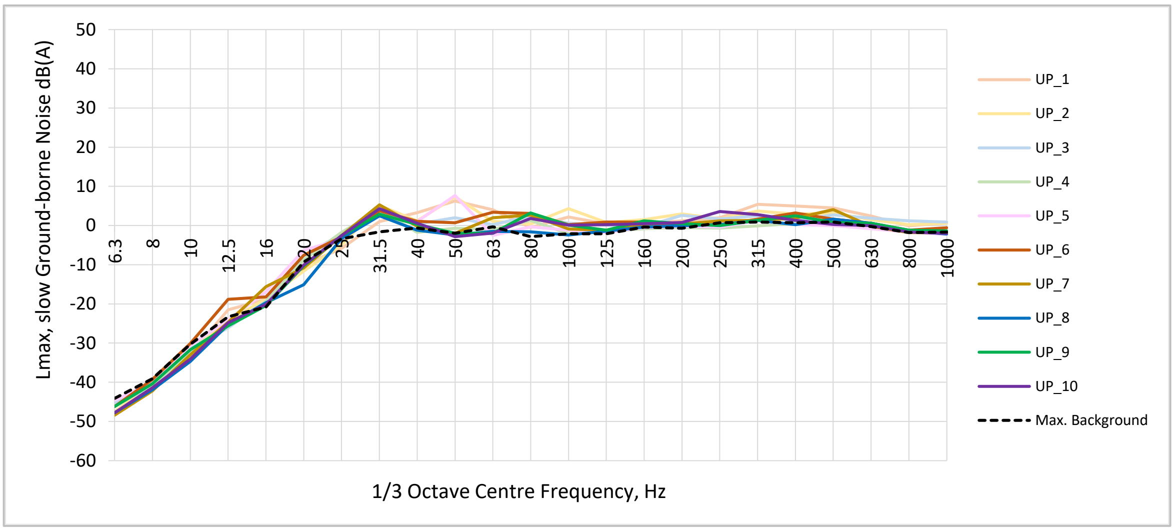


Figure 7-43 SMCSW up passbys GBN spectra at [redacted] Miller Street, North Sydney



D.9 GBN and GBV results at [redacted] Hayberry Street, Crows Nest

For [redacted] Hayberry Street, Crows Nest, a tabular summary of the measured GBN and GBV levels of each SMCSW passby event is shown in Table 7-10. A graphical summary of the 1/3 octave spectra of each SMCSW passby event is shown in Figure 7-44 to Figure 7-47. The background vibration and background GBN spectra are shown, and represent the $L_{max(1s\ rms)}$ vibration levels and $L_{Amax,slow}$ noise levels, respectively during a typical period when there were no SMCSW passbys.

The SMCSW passbys were inaudible at this location.

Table 7-10 Results for each SMCSW passby at [redacted] Hayberry Street, Crows Nest

Event ID	Event date and time	SMCSW Passby Direction	Measured L_{ASmax} Noise Levels[1], dB(A)	Estimated L_{ASmax} GBN levels[2], dB(A)	Measured $L_{max(1s\ rms)}$ Vibration level, dBV (mm/s)
DN_1	11/02/2025 8:44:17 AM	DN	32	12	80 dBV (0.010 mm/s)
DN_2	11/02/2025 8:52:17 AM	DN	30	12	79 dBV (0.009 mm/s)
DN_3	11/02/2025 9:00:48 AM	DN	32	15	80 dBV (0.010 mm/s)
DN_4	11/02/2025 9:03:02 AM	DN	27	22	80 dBV (0.010 mm/s)
DN_5	11/02/2025 9:12:15 AM	DN	29	12	80 dBV (0.010 mm/s)
DN_6	11/02/2025 9:16:16 AM	DN	27	19	81 dBV (0.012 mm/s)
DN_7	11/02/2025 9:19:59 AM	DN	30	16	79 dBV (0.009 mm/s)
DN_8	11/02/2025 9:28:01 AM	DN	29	14	79 dBV (0.009 mm/s)
DN_9	11/02/2025 9:35:57 AM	DN	29	12	80 dBV (0.010 mm/s)
DN_10	11/02/2025 9:39:56 AM	DN	29	12	80 dBV (0.010 mm/s)
UP_1	11/02/2025 8:46:21 AM	UP	35	19	80 dBV (0.010 mm/s)
UP_2	11/02/2025 8:50:17 AM	UP	24	15	79 dBV (0.009 mm/s)
UP_3	11/02/2025 9:02:00 AM	UP	32	15	79 dBV (0.009 mm/s)
UP_4	11/02/2025 9:10:01 AM	UP	28	17	79 dBV (0.009 mm/s)
UP_5	11/02/2025 9:13:59 AM	UP	30	16	81 dBV (0.011 mm/s)
UP_6	11/02/2025 9:18:00 AM	UP	29	17	80 dBV (0.010 mm/s)
UP_7	11/02/2025 9:26:02 AM	UP	31	15	80 dBV (0.010 mm/s)
UP_8	11/02/2025 9:30:00 AM	UP	28	18	78 dBV (0.008 mm/s)
UP_9	11/02/2025 9:34:02 AM	UP	30	15	79 dBV (0.009 mm/s)
UP_10	11/02/2025 9:38:02 AM	UP	26	15	80 dBV (0.010 mm/s)
		Overall 95th percentile -	**32 dB(A)**	**19 dB(A)**	**81 dBV (0.011 mm/s)**

Note 1: The passby measurement results represents the highest noise level measured during the SMCSW passby (i.e. the same time period as the vibration measurements).

Note 2: Estimated $L_{Amax,slow}$ noise levels are based on the measured vibration levels in the Z direction.

Figure 7-44 SMCSW down passbys GBV spectra at [redacted] Hayberry Street, Crows Nest

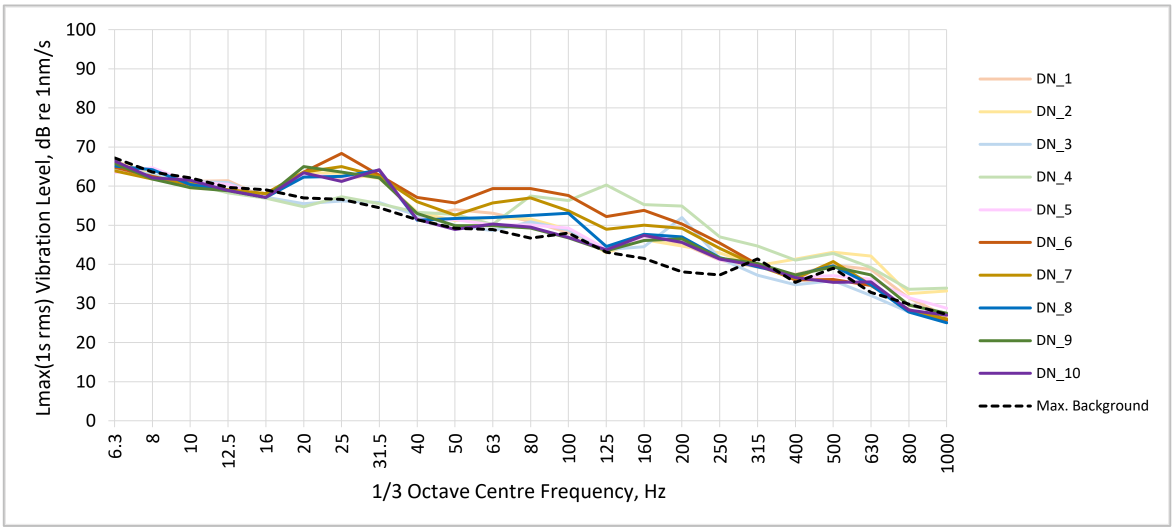


Figure 7-45 SMCSW up passbys GBV spectra at [redacted] Hayberry Street, Crows Nest

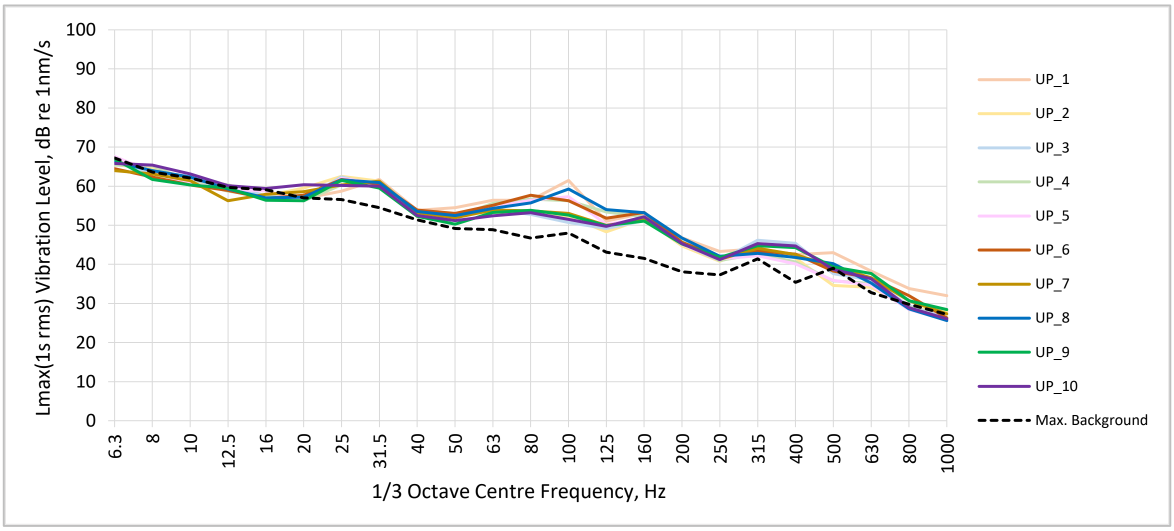


Figure 7-46 SMCSW down passbys GBN spectra at [redacted] Hayberry Street, Crows Nest

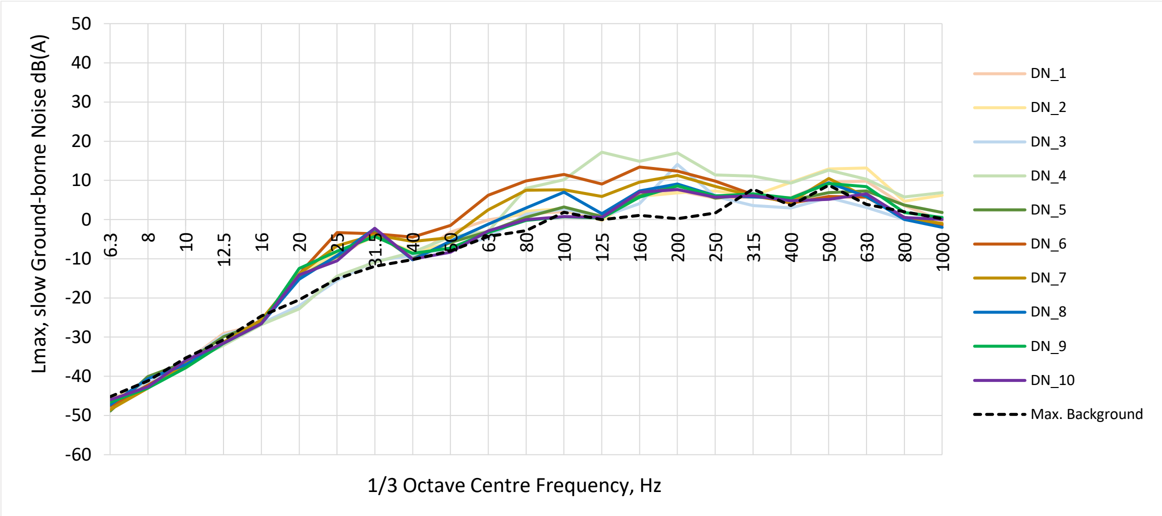
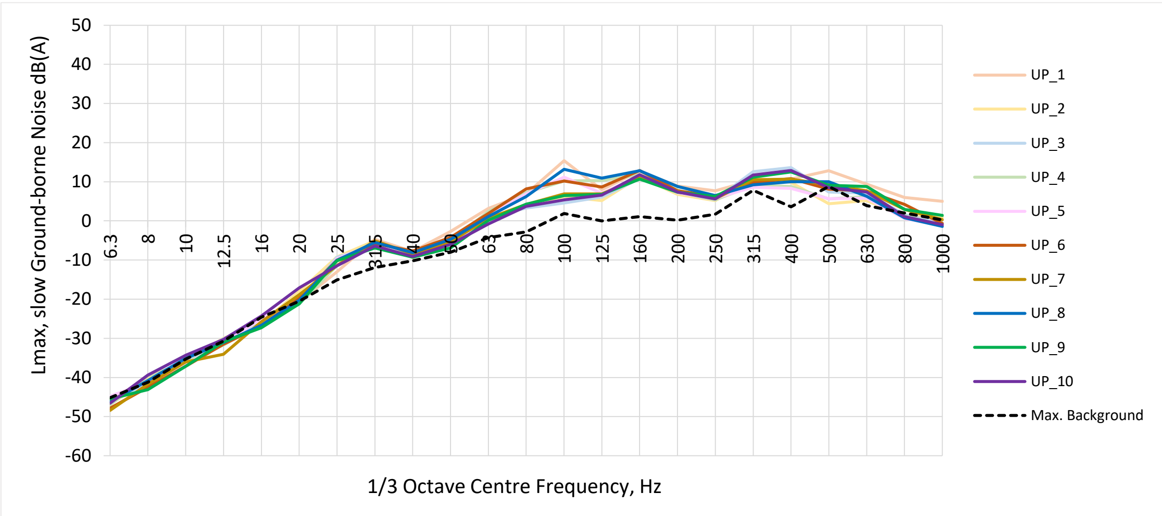


Figure 7-47 SMCSW up passbys GBN spectra at 40 Hayberry Street, Crows Nest



D.10 GBN and GBV results at [redacted] Herbert Street, Artarmon

For [redacted] Herbert Street, Artarmon, a tabular summary of the measured GBN and GBV levels of each SMCSW passby event is shown in Table 7-11. A graphical summary of the 1/3 octave spectra of each SMCSW passby event is shown in Figure 7-48 to Figure 7-51. The background vibration and background GBN spectra are shown, and represent the $L_{max(1s\ rms)}$ vibration levels and $L_{Amax,slow}$ noise levels, respectively during a typical period when there were no SMCSW passbys.

The SMCSW passbys were inaudible at this location.

Table 7-11 Results for each SMCSW passby at [redacted] Herbert Street, Artarmon

Event ID	Event date and time	SMCSW Passby Direction	Measured L_{ASmax} Noise Levels[1], dB(A)	Estimated L_{ASmax} GBN levels[2], dB(A)	Measured $L_{max(1s\ rms)}$ Vibration level, dBV (mm/s)
DN_1	8/03/2025 8:32:12 AM	DN	NR 22	NR 8	79 dBV (0.009 mm/s)
DN_2	8/03/2025 8:52:22 AM	DN	NR 23	NR 8	80 dBV (0.011 mm/s)
DN_3	8/03/2025 9:01:52 AM	DN	NR 22	NR 8	78 dBV (0.008 mm/s)
DN_4	8/03/2025 9:12:04 AM	DN	NR 22	NR 8	80 dBV (0.010 mm/s)
DN_5	8/03/2025 9:22:18 AM	DN	NR 22	NR 8	79 dBV (0.009 mm/s)
DN_6	8/03/2025 9:32:24 AM	DN	NR 22	NR 8	80 dBV (0.010 mm/s)
DN_7	8/03/2025 9:42:02 AM	DN	NR 22	NR 8	80 dBV (0.010 mm/s)
DN_8	8/03/2025 10:12:37 AM	DN	NR 22	NR 8	80 dBV (0.010 mm/s)
DN_9	8/03/2025 10:21:48 AM	DN	NR 22	NR 8	83 dBV (0.014 mm/s)
DN_10	8/03/2025 10:32:28 AM	DN	NR 22	NR 8	80 dBV (0.010 mm/s)
UP_1	8/03/2025 8:37:48 AM	UP	NR 23	NR 8	79 dBV (0.009 mm/s)
UP_2	8/03/2025 8:47:13 AM	UP	NR 23	NR 8	79 dBV (0.009 mm/s)
UP_3	8/03/2025 8:57:58 AM	UP	NR 22	NR 8	80 dBV (0.010 mm/s)
UP_4	8/03/2025 9:07:36 AM	UP	NR 22	NR 8	79 dBV (0.009 mm/s)
UP_5	8/03/2025 9:17:53 AM	UP	NR 24	NR 8	81 dBV (0.011 mm/s)
UP_6	8/03/2025 9:28:12 AM	UP	NR 23	NR 8	79 dBV (0.009 mm/s)
UP_7	8/03/2025 9:37:40 AM	UP	NR 22	NR 8	78 dBV (0.008 mm/s)
UP_8	8/03/2025 9:43:16 AM	UP	NR 23	NR 8	79 dBV (0.009 mm/s)
UP_9	8/03/2025 10:17:43 AM	UP	NR 22	NR 8	80 dBV (0.010 mm/s)
UP_10	8/03/2025 10:27:24 AM	UP	NR 22	NR 8	79 dBV (0.009 mm/s)
		Overall 95th percentile -	**NR 22, 27 dB(A)**	**NR 8, 17 dB(A)**	**81 dBV (0.011 mm/s)**

Note 1: The passby measurement results represents the highest noise level measured during the SMCSW passby (i.e. the same time period as the vibration measurements).

Note 2: Estimated $L_{Amax,slow}$ noise levels are based on the measured vibration levels in the Z direction.

Figure 7-48 SMCSW down passbys GBV spectra at [redacted] Herbert Street, Artarmon

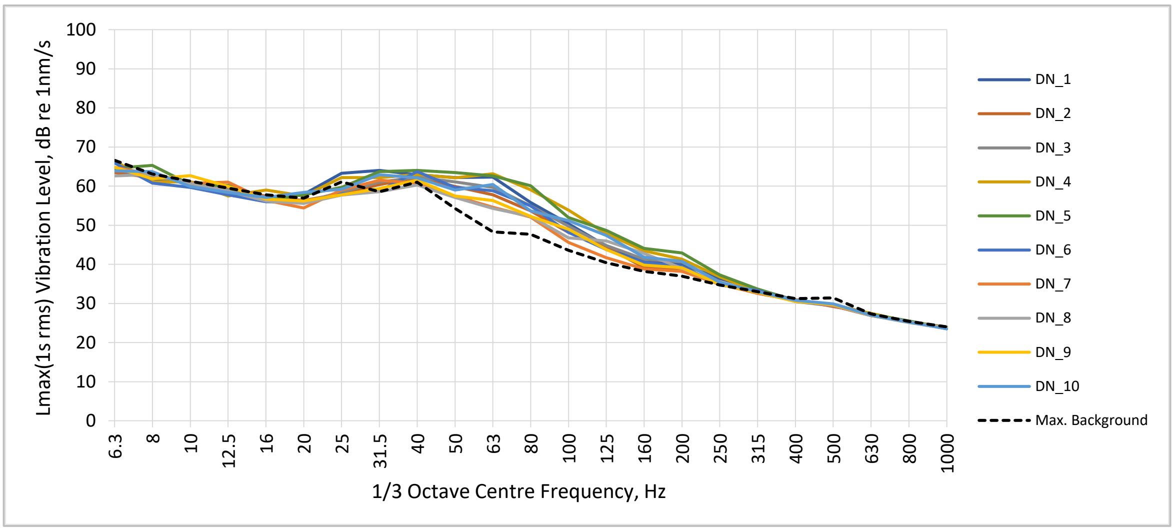


Figure 7-49 SMCSW up passbys GBV spectra at [redacted] Herbert Street, Artarmon

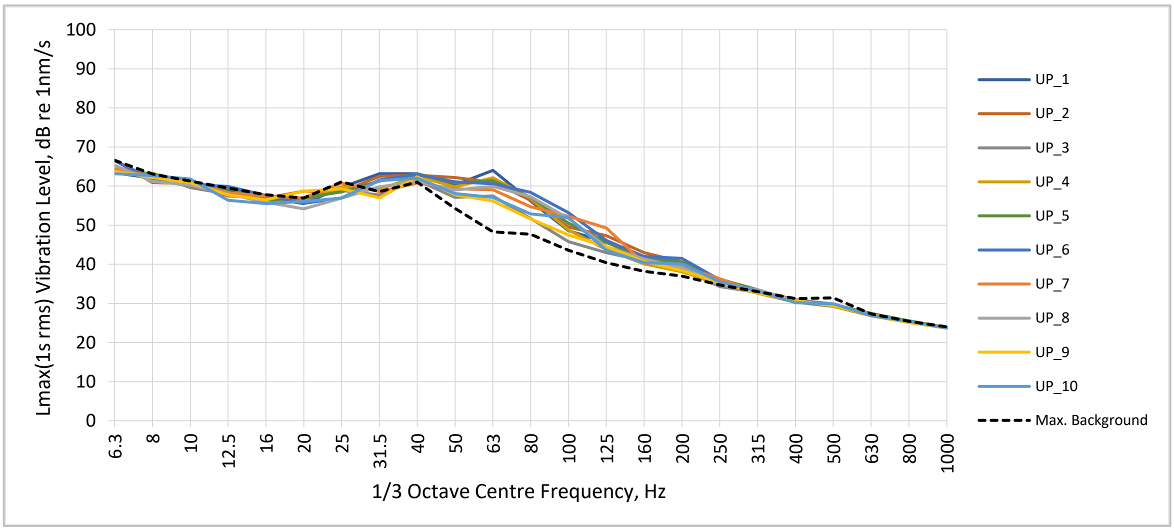


Figure 7-50 SMCSW down passbys GBN spectra at [redacted] Herbert Street, Artarmon

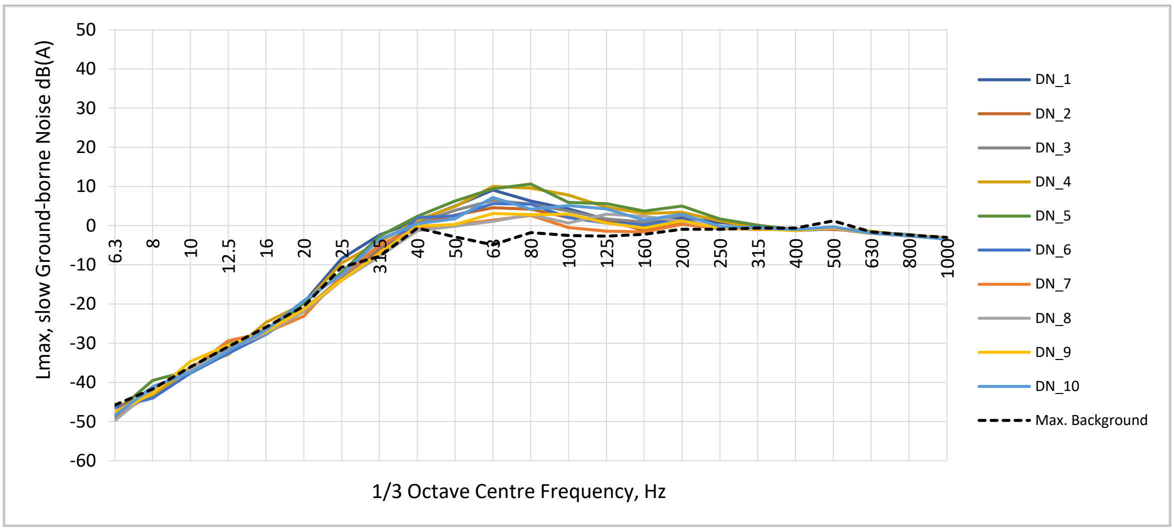
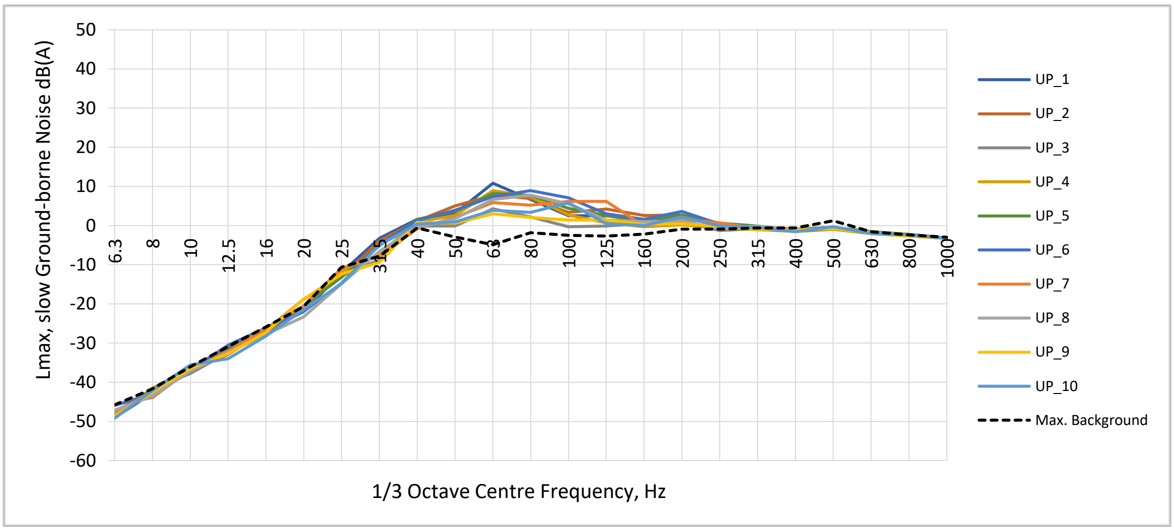


Figure 7-51 SMCSW up passbys GBN spectra at [redacted] Herbert Street, Artarmon



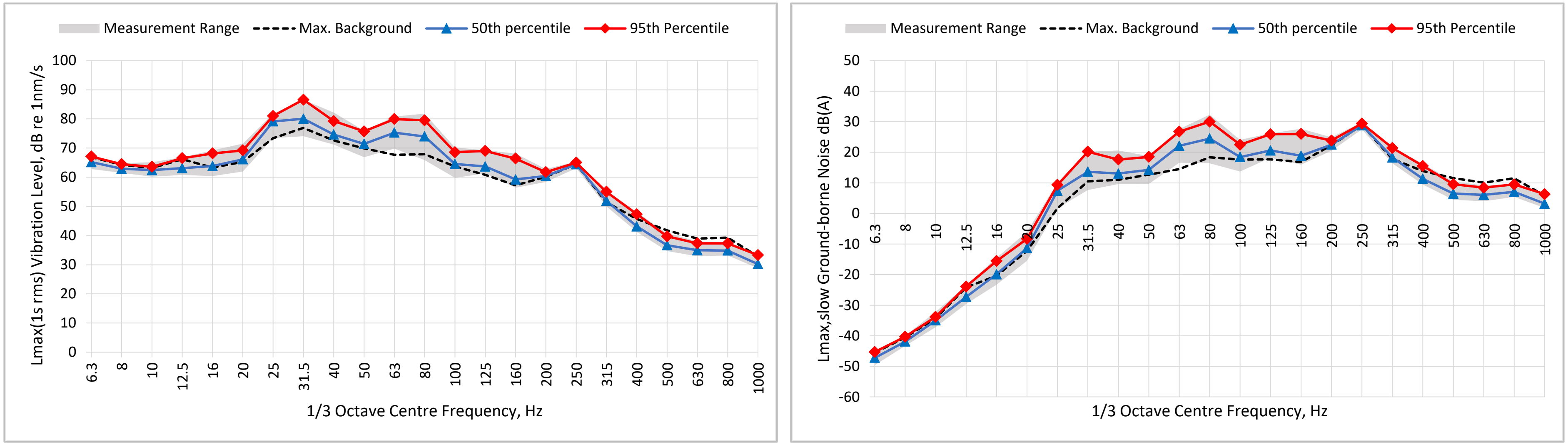
D.11 GBN and GBV results at [redacted] Mowbray Road, Artarmon

Noise and vibration levels from SMCSW passbys were not measured as they were indiscernible and less than the surface train operations on the North Shore Line. The measured $L_{ASmax,95\%}$ from surface Sydney Trains passbys was 57 dB(A) and the measured $L_{max(1s\ rms),95\%}$ vibration level from surface Sydney Trains passbys was 98 dBV (0.075 mm/s).

Refer to Operational GBNV Report for [redacted] Mowbray Road, Artarmon [5] for more details.

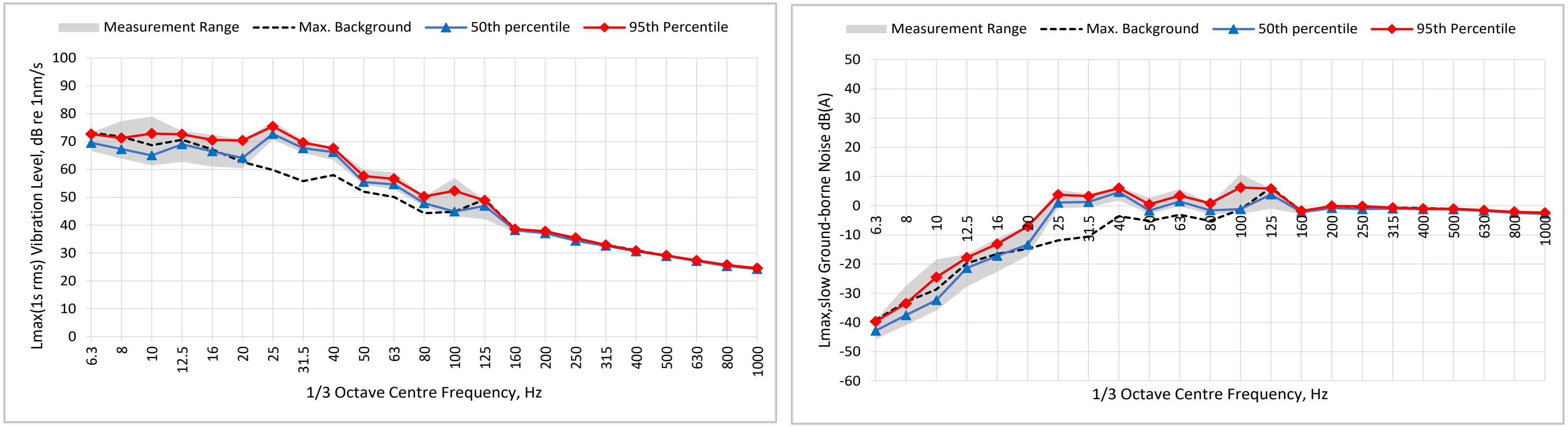
APPENDIX E Summary of 50th and 95th percentile GBN and GBV spectra

Figure 7-52 Summary of GBV and GBN spectra at [redacted] Lord Street, Newtown



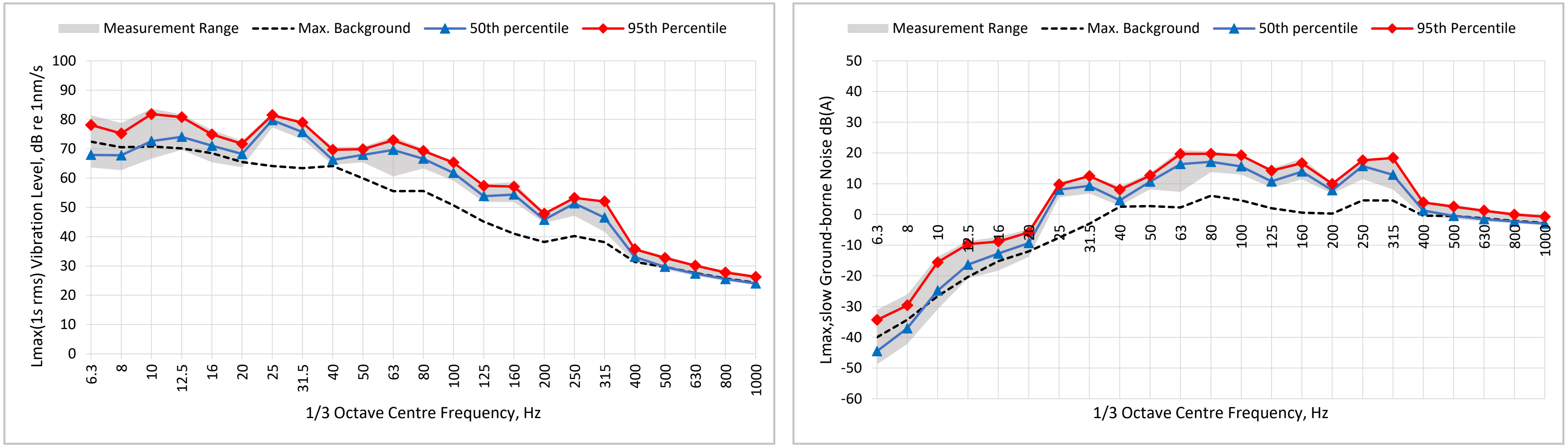
Note: The left figure shows the graphical summary of the 1/3 octave $L_{max,slow}$ GBV spectra and the right figure shows the 1/3 octave $L_{max,slow}$ GBN spectra at [redacted] Lord Street, Newtown.

Figure 7-53 Summary of GBV and GBN spectra at [redacted] Maddox Street, Alexandria



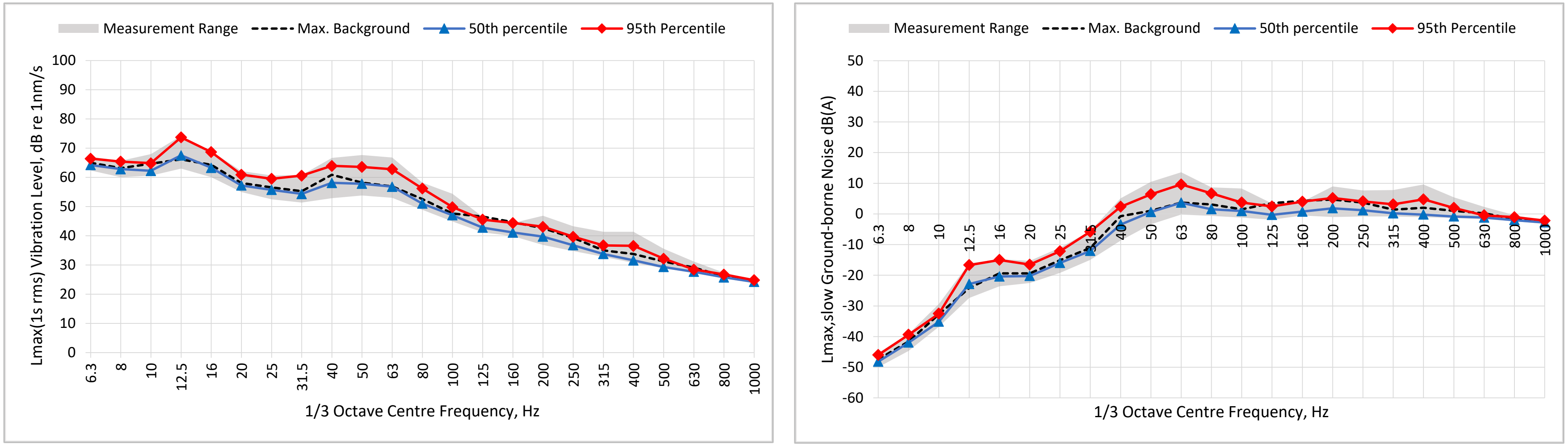
Note: The left figure shows the graphical summary of the 1/3 octave $L_{max,slow}$ GBV spectra and the right figure shows the 1/3 octave $L_{max,slow}$ GBN spectra at [redacted] Maddox Street, Alexandria.

Figure 7-54 Summary of GBV and GBN spectra at [redacted] Cope Street, Waterloo



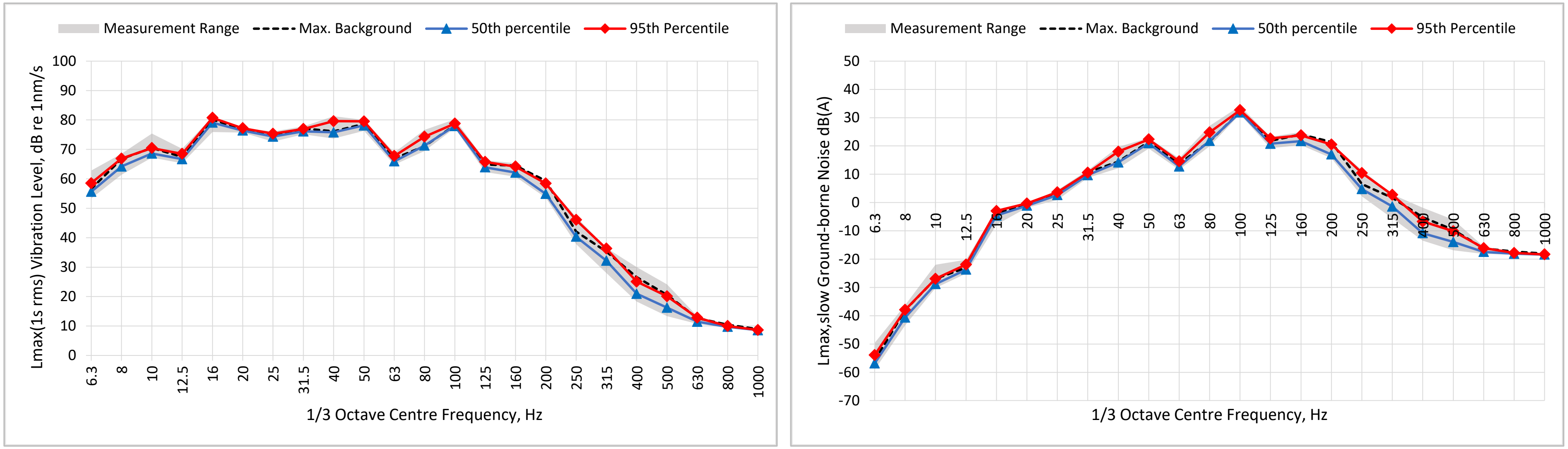
Note: The left figure shows the graphical summary of the 1/3 octave $L_{max,slow}$ GBV spectra and the right figure shows the 1/3 octave $L_{max,slow}$ GBN spectra at [redacted] Cope Street, Waterloo.

Figure 7-55 Summary of GBV and GBN spectra at [redacted] Cleveland Street, Redfern



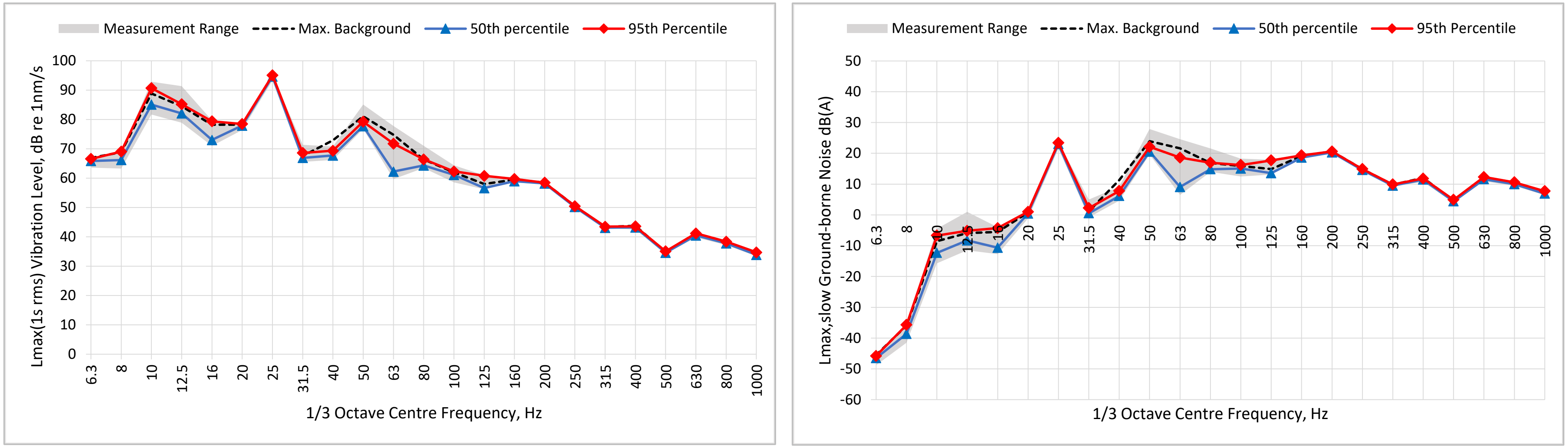
Note: The left figure shows the graphical summary of the 1/3 octave $L_{max,slow}$ GBV spectra and the right figure shows the 1/3 octave $L_{max,slow}$ GBN spectra at [redacted] Cleveland Street, Redfern.

Figure 7-56 Summary of GBV and GBN spectra at [redacted] Pitt Street, Sydney



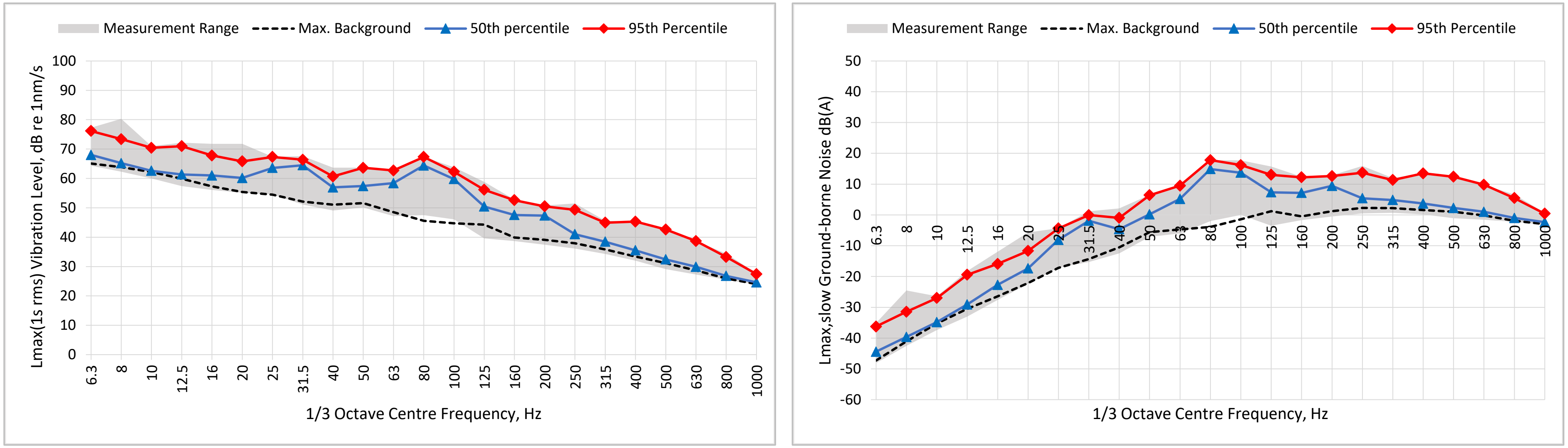
Note: The left figure shows the graphical summary of the 1/3 octave $L_{max,slow}$ GBV spectra and the right figure shows the 1/3 octave $L_{max,slow}$ GBN spectra at [redacted] Pitt Street, Sydney.

Figure 7-57 Summary of GBV and GBN spectra at [redacted] Grosvenor Street, The Rocks



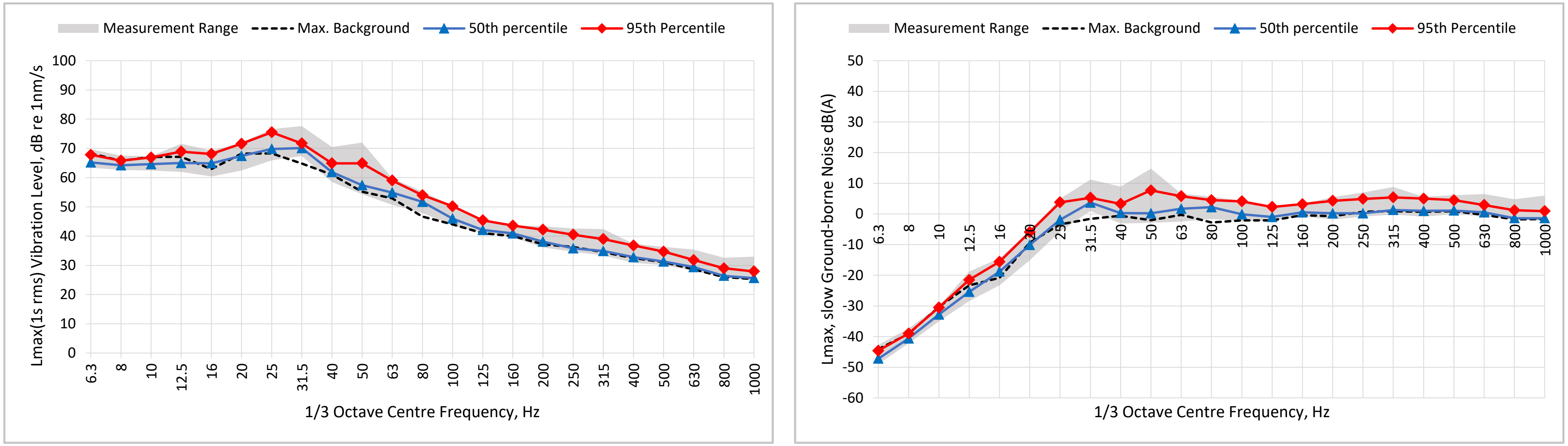
Note: The left figure shows the graphical summary of the 1/3 octave $L_{max,slow}$ GBV spectra and the right figure shows the 1/3 octave $L_{max,slow}$ GBN spectra at [redacted] Grosvenor Street, The Rocks.

Figure 7-58 Summary of GBV and GBN spectra at [redacted] West Crescent Street, McMahons Point



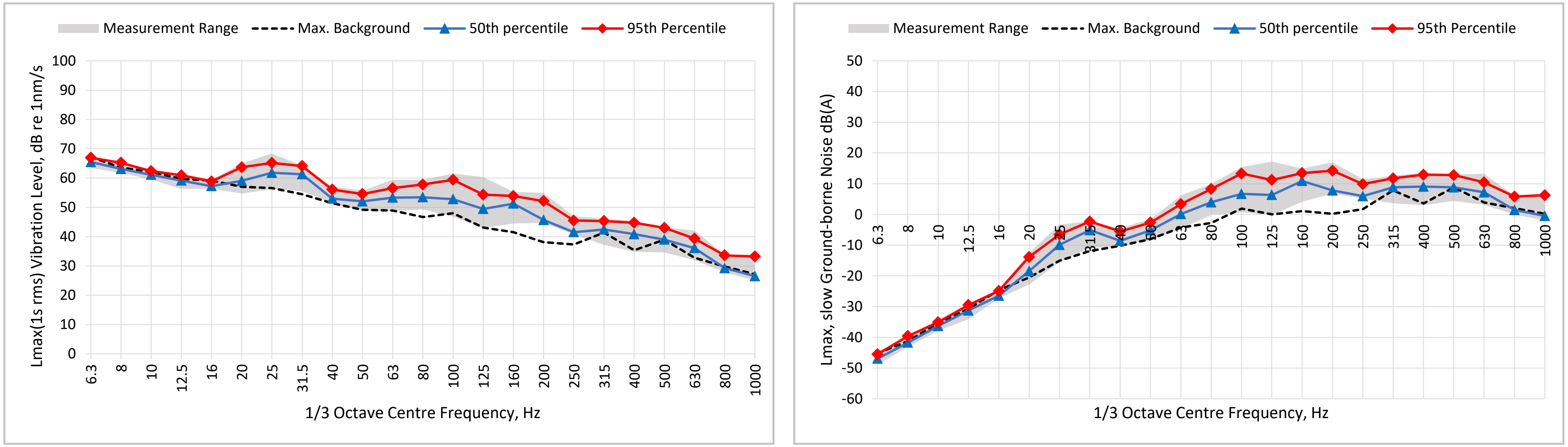
Note: The left figure shows the graphical summary of the 1/3 octave $L_{max,slow}$ GBV spectra and the right figure shows the 1/3 octave $L_{max,slow}$ GBN spectra at [redacted] West Crescent Street, McMahons Point.

Figure 7-59 Summary of GBV and GBN spectra at [redacted] Miller Street, North Sydney



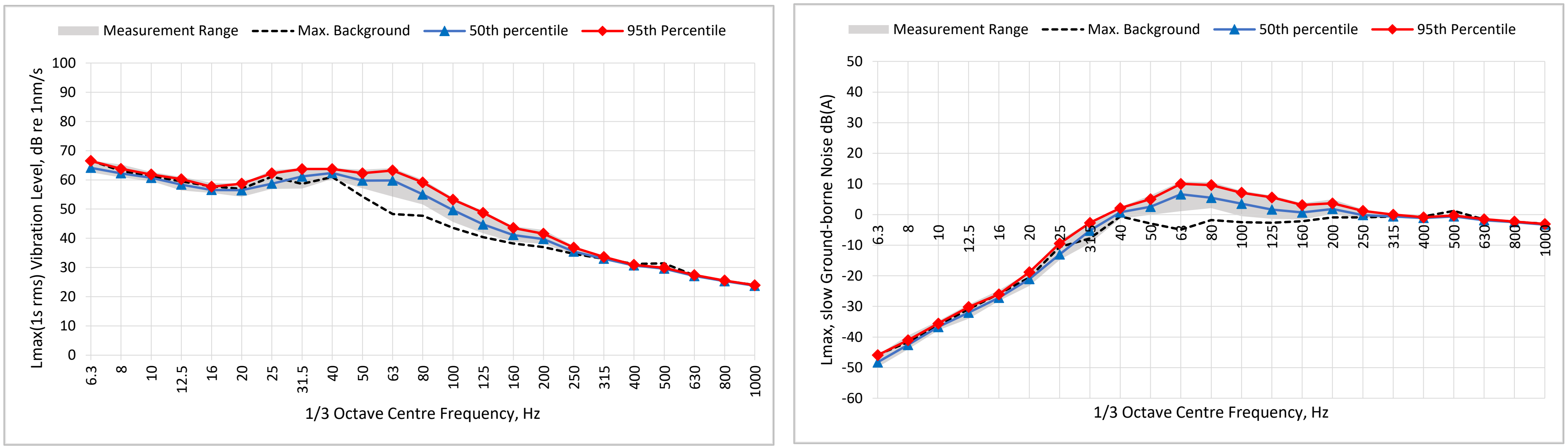
Note: The left figure shows the graphical summary of the 1/3 octave $L_{max,slow}$ GBV spectra and the right figure shows the 1/3 octave $L_{max,slow}$ GBN spectra at [redacted] Miller Street, North Sydney.

Figure 7-60 Summary of GBV and GBN spectra at [redacted] Hayberry Street, Crows Nest



Note: The left figure shows the graphical summary of the 1/3 octave $L_{max,slow}$ GBV spectra and the right figure shows the 1/3 octave $L_{max,slow}$ GBN spectra at [redacted] Hayberry Street, Crows Nest.

Figure 7-61 Summary of GBV and GBN spectra at [redacted] Herbert Street, Artarmon



Note: The left figure shows the graphical summary of the 1/3 octave $L_{max,slow}$ GBV spectra and the right figure shows the 1/3 octave $L_{max,slow}$ GBN spectra at [redacted] Herbert Street, Artarmon