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THE STAR - PIRRAMA RD LEVEL 1 UNENCLOSED GAMING AREAS

Speakers and Music Assessment

8 May 2014

Echo Entertainment (The Star)

TG004-13F05 (r2) L1 UGA Report

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1 Introduction

Renzo Tonin & Associates was engaged to provide acoustic services to support the application to amend the existing conditions of approval relating to the use of speakers and music in the Unenclosed Gaming Areas (UGAs) located on Level 1 along the Pirrama Road frontage at The Star, Pyrmont.

This report relates specifically to the S75W application to be lodged to the Department of Planning and Environment relating to the existing conditions set out in the Major Project Approval MP08_0098. The use of the UGA is approved for operation from 7am to midnight, with a 24 hour trial period under Condition F3. It is understood Condition F3 will be the subject of the same S75W application seeking a continuation of the trial period on a permanent basis. The installation of speakers in external areas is restricted under Condition F1. The application seeks to amend Condition F1 to allow the installation of speakers for the purpose of background music and public address (PA) announcements.

This report presents the results of the study undertaken by Renzo Tonin & Associates to establish the project noise goals in accordance with the existing noise criteria in Condition F5 and quantify noise emission from the provision of speakers and music in the Level 1 UGA, to the nearest potentially affected receiver locations surrounding the site.

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.

2 Noise criteria

The standard noise criteria for music and activities at The Star are stipulated in Condition F5 of Major Project Approval MP08-0098 as follows:

> *Noise caused by the approved use including music and other activities must comply with the following criteria:*
>
> *The use must not result in the transmission of "offensive noise" as defined in the Protection of the Environment Operations Act 1997 to any place of different occupancy.*
>
> *The L10 noise level emitted from the use must not exceed 5dB above the background (L90) noise level in an Octave Band Centre Frequency (31.5Hz – 8kHz inclusive) between the hours 7:00am and 12:00 midnight when assessed at the boundary of the nearest affected property. The background noise level must be measured in the absence of noise emitted from the use.*
>
> *The L10 noise level emitted from the use must not exceed the background (L90) noise level in an Octave Band Centre Frequency (31.5Hz – 8kHz inclusive) between the hours 12:00 midnight and 7:00am when assessed at the boundary of the nearest affected property. The background noise level must be measured in the absence of noise emitted from the use.*
>
> *Notwithstanding compliance with the above, the noise from the use must not be audible within any habitable room in any residential property between the hours of 12:00 midnight and 7:00am.*
>
> *The L10 noise level emitted from the use must not exceed the background noise level (L90) in any Octave Band Centre Frequency (31.5Hz to 8kHz inclusive) by more than 3dB when assessed indoors at any affected commercial premises.*

3 Project noise goals

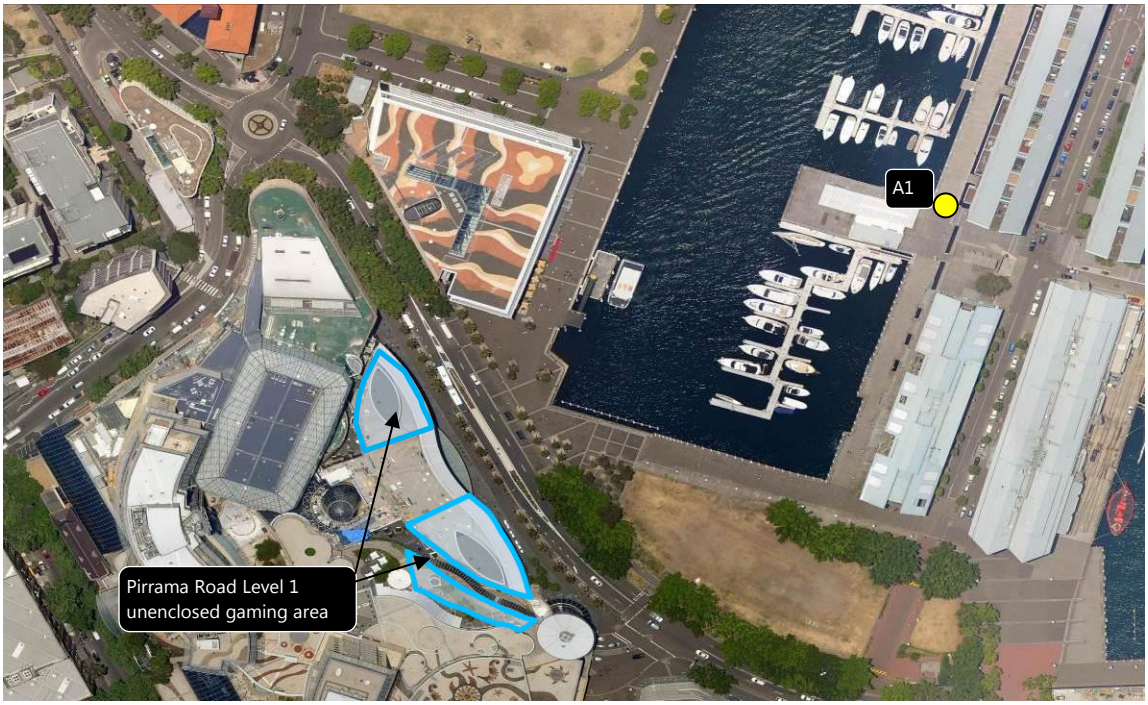
3.1 Assessment locations

The nearest most potentially affected residential receivers are identified in Table 1 and indicated in Figure 1. The assessment locations are consistent with those identified in the Major Project Application acoustic assessment for Project Star.

Table 1: Assessment locations

Location ID	Address	Description
A1	Sydney Wharf 9, 56-56A Pirrama Road, Pyrmont	Four storey residential apartment building approximately 215m to the northeast of the Pirrama Road Level 3 Terrace. Assessment has been carried out to the upper level of the apartment building, which has been defined as Level 3.

Figure 1: Level 1 Unenclosed gaming area and assessment locations



3.2 Existing acoustic environment

Criteria for the assessment of operational noise are derived from the existing noise environment of an area, excluding noise from the subject development.

Appendix B of the NSW EPA *Industrial Noise Policy* (INP, 2000) outlines two methods for determining the background noise level of an area, being 'B1 – Long-term background noise method' and 'B2 – Short-term background noise method'. This assessment has used long-term noise monitoring.

As the noise environment of an area almost always varies over time, background and ambient noise levels need to be determined for the operational times of the proposed development. For example, in a suburban or urban area the noise environment is typically at its minimum at 3am in the morning and at its maximum during the morning and afternoon traffic peak hours. The INP outlines the following standard time periods over which the background and ambient noise levels are to be determined:

- Day: 07:00-18:00 Monday to Saturday and 08:00-18:00 Sundays & Public Holidays
- Evening: 18:00-22:00 Monday to Sunday & Public Holidays
- Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays

The INP also outlines methods for assessing 'shoulder periods' being shorter periods on either side of a standard period, where the standard period noise levels are not representative. A shoulder period has been established between 10pm and midnight, as the night time period is not directly applicable and operational criteria differs after midnight.

3.3 Noise measurement locations

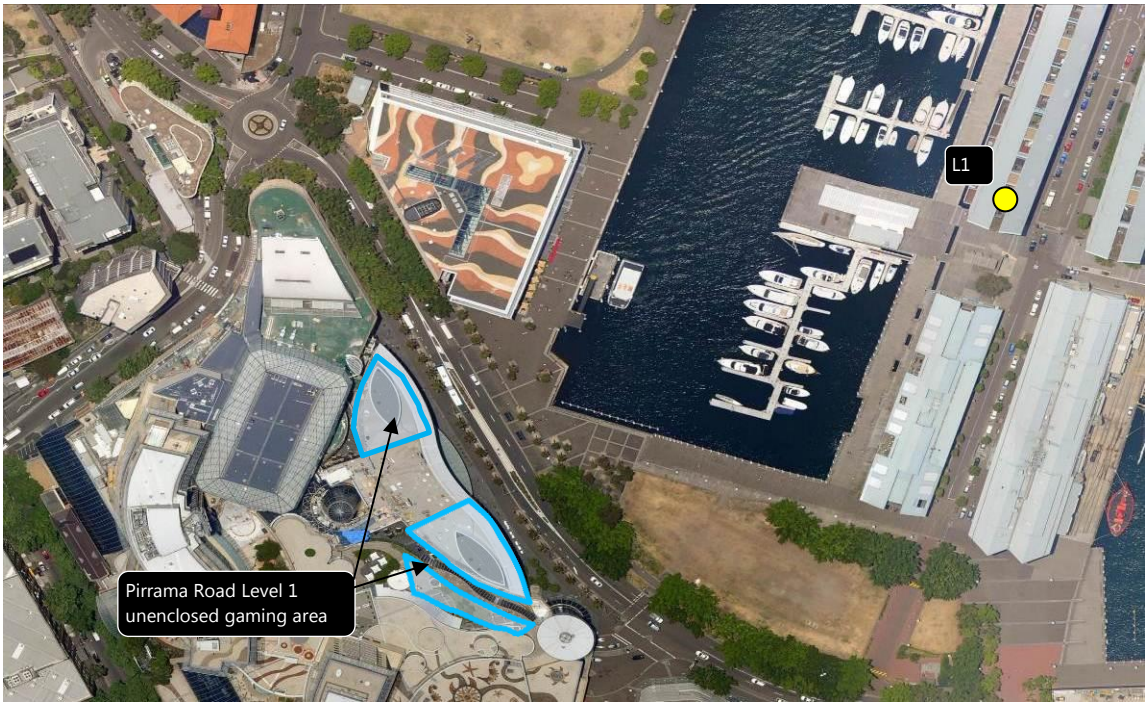
Noise measurements are ideally carried out at the nearest or most potentially affected locations surrounding a development. An alternative, representative location should be established in the case of access restrictions or a safe and secure location cannot be identified. Furthermore, representative locations may be established in the case of multiple receivers as it is usually impractical to carry out measurements at all locations surrounding a site.

The long-term measurement location used for the identified assessment location is outlined in Table 2 and shown in Figure 2.

Table 2: Noise monitoring locations

ID	Address	Description
Long-term noise monitoring		
L1	Unit 14, Wharf 9, Pyrmont	The monitor was located on the rooftop terrace in the free-field (ie away from reflecting surfaces). The noise monitoring location is considered representative of receiver locations at Wharf 9.

Figure 2: Site and noise monitoring locations



3.4 Long-term noise measurement results

Renzo Tonin & Associates undertook monitoring of ambient and background noise levels at the most sensitive receptor, Wharf 8/9 as part of another acoustic testing exercise. This exercise measured noise levels at the closest sensitive noise receiver to the Level 1 UGAs namely Wharf 8/9. A location and accepted dates for monitoring was established through negotiation and consultation with the Chairman of Sydney Wharf Executive Committee. The long-term noise monitor was installed on Monday; 3 February 2014 and was originally to remain on site for a period of two weeks. However due to wind speeds exceeding the minimum 5m/s for a high proportion of the monitoring period, the survey was extended and concluded on Tuesday, 4 March 2014. Following completion of the noise monitoring, the Committee Chairman provided an overview of periods for which extraneous or erroneous noise events occurred. These periods were also reviewed in the analysis of the noise monitoring results and excluded where they affected the background noise level. Periods when the Deck was in operation were also excluded from the data.

Table 3 presents the overall Rating Background Levels (RBL) and octave band data, for each assessment period, determined in accordance with the INP. The long-term noise monitoring methodology is detailed in Appendix B, and noise level-vs-time graphs of the data are included in Appendix C.

Table 3: Long-term noise monitoring results

Descriptor	Period	Overall dB(A)	Octave band centre frequency – Hz (dBZ)								
			31.5	63	125	250	500	1k	2k	4k	8k
L1 - Sydney Wharf 9											
L90	Day	53	59	58	55	53	50	48	42	32	18
	Evening	52	57	54	52	51	50	46	40	29	20
	22:00–00:00	50	56	54	52	50	46	44	38	28	18
	Night	47	55	52	50	48	44	41	35	27	17

Notes: Day: 07:00-18:00 Monday to Saturday and 08:00-18:00 Sundays & Public Holidays

Evening: 18:00-22:00 Monday to Sunday & Public Holidays

Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays

The shoulder period has been established for 22:00-00:00.

As required by the INP, the external ambient noise levels presented are free-field noise levels. [ie. no façade reflection]

3.5 Project noise goals

The background measurement results presented have been used to establish the noise goals for The Star in accordance with Condition F5.

Table 4: Project noise goals – Condition F5

Location	Time	Octave band centre frequency – Hz (dBZ)								
		31.5	63	125	250	500	1k	2k	4k	8k
A1 – Sydney Wharf 9	07:00 – 22:00*	62	59	57	56	55	51	45	34	25
	22:00 – 00:00	61	59	57	55	51	49	43	33	23
	0:00 – 07:00 (inaudibility)	48^	42	40	38	34	31	25	17	7

Notes: * Noise goals for the 07:00 to 22:00 period have been conservatively based on the evening time background noise levels, which include 18:00-22:00.

For the determination of inaudibility Renzo Tonin and Associates consider a design criterion of 10dB below the background noise level in each octave band for intermittent noise sources. It is assumed that if inaudibility goal is achieved externally, the internal inaudibility criterion will also be achieved.

^ Threshold of hearing in accordance with AS3657.1. Lowest third octave level for the respective octave band.

4 Noise assessment

4.1 Noise sources

Application is being made to permit the use of speakers and music within the Level 1 UGAs fronting Pirrama Road. The use of the speakers is being considered for two separate purposes; background music and public address (PA) announcements.

For the effective use of PA announcements, the noise levels of the announcements are required to be greater than the ambient noise level within the gaming area. The nature of PA announcements are intermittent, and of short duration.

The provision of background music is intended to provide general ambiance to the UGAs, and not for entertainment purposes. Music levels would not be intended to be greater than the ambient noise level within the gaming areas.

4.1.1 Ambient noise levels within the unenclosed gaming areas

Noise emission within the UGAs is dominated by gaming noise from machines along with some patron noise. Renzo Tonin & Associates have undertaken monitoring of the existing ambient noise levels within the Level 1 UGA areas as part of compliance testing post-operation in accordance with Condition F6 of MP08_0098.

Measurements were undertaken during three separate surveys, at multiple locations within the gaming area during night time periods. A summary of the measurements is presented in Table 5. The noise levels represent the average levels across all measurement points in the UGAs.

Table 5: Existing average noise levels within the unenclosed gaming areas

Description	Descriptor	Octave Band Centre Frequency – Hz (dBZ)								
		31.5	63	125	250	500	1k	2k	4k	8k
UGAs existing noise levels	L_{10}	63	63	63	64	66	64	60	53	46

Source: *Renzo Tonin & Associates Report TF146-01F02 (rev 2) Survey 1 2010-12-03, MP08-0098 Condition F6*
Renzo Tonin & Associates Report TF146-01F03 (rev 1) Survey 2 2011-02-05 MP08-0098 Condition F6
Renzo Tonin & Associates Report TF146-01F04 (rev 1) Survey 3 2011-02-17 MP08-0098 Condition F6

The surveys carried out in accordance with Condition F6 demonstrated compliance at the nearest sensitive receptor locations for the before and after midnight periods. Compliance measurements included the Wharf 9 receiver location.

4.2 Noise predictions

Noise predictions have been carried out using CadnaA noise modelling software implementing ISO9613 algorithms. The noise model assesses acoustic losses due to distance and shielding by intervening structures, as well as reflections off surrounding buildings.

The predictions and modelling have been undertaken to examine the maximum permissible noise emission from the UGAs and evaluate whether the allowable noise levels would permit either PA announcements above the existing ambient noise levels in UGAs or if lower background music can be provided. Predictions of the maximum noise levels in accordance with the noise goals were calculated at the nearest receiver, being Wharf 8/9. The summary of the predicted maximum allowable levels and existing noise levels within the gaming area is presented Table 6.

Table 6: Noise prediction summary

Description		Descriptor	Octave band centre frequency – Hz (dBZ)								
			31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Predicted maximum allowable sound pressure level from UGAs	07:00 - 22:00	L_{10}	90	86	83	81	79	75	69	62	66
	22:00 - 00:00	L_{10}	89	86	83	80	75	73	67	61	64
	00:00 - 07:00	L_{10}	73	69	66	**63**	**58**	**55**	**49**	**45**	48
Existing ambient noise levels		L_{10}	63	63	63	64	66	64	60	53	46

Notes: Bold text indicates noise levels that are below the existing ambient noise levels.

The noise level predictions presented in Table 6 indicate that the allowable noise levels for the period 7:00am to midnight can be higher than the current noise levels presented in Table 5. Therefore, between 7:00am and midnight it would be permissible to provide PA announcements while not exceeding the Condition F5 noise goals.

With regard to after midnight operations, the predicted maximum levels are generally lower than the existing UGA noise levels that have otherwise been found complaint during attended noise surveys. Therefore, provision of PA announcements between 12:00 midnight and 7:00am would not be possible. However the provision of low level background music, so long as it is below the existing ambient noise levels in the gaming area would be acceptable.

5 Recommendations

5.1.1 PA announcements

The predictions presented in Table 6 reveal that there is sufficient scope for PA announcements to occur up to midnight, while complying with the F5 noise criteria and allowing for cumulative impact with other uses such as the Level 3 Pirrama Road Entertainment Deck. The noise predictions in Table 6 relating to the maximum sound output of the UGAs are conservative as they do not take into account the directional nature of speakers that would be installed in the UGAs. The use of directional speakers will minimise total sound emission from the site while providing practical noise levels in the UGAs for the purpose of PA announcements between 7:00am and midnight. The PA system and noise level limits should be determined during post-commissioning compliance testing.

5.1.2 Background music

Background music in the UGAs would not be provided at a level higher than the existing patron and gaming machine noise measured in the UGAs. As more stringent criteria apply between midnight and 7am compared with 7am to midnight, the background music levels after midnight would need to be set at more stringent limits. Noise levels from speakers can be controlled using sound system limiting devices. The levels can be set to apply different limits at different periods of the day. Further information regarding limiting devices is provided below.

5.1.3 Music noise monitoring and sound system limiting devices

Where an in-house sound system is installed, it is recommended that the noise level is controlled by an electronic frequency dependant RMS limiting device (eg. a Rane HAL, BSS Blu-16, Symetrix Jupiter 8 or MediaMatrix X-Frame 88). Alternative sound-pressure measurement/limiter devices are also available (eg. CESVA LRF-04 and LRF-05, APEX Argos and HERA). Where different noise limits are to apply at different operating times, the device should include or support multiple time-based settings. The noise limits and setting of the device should be made during acoustic compliance testing by an appropriately qualified acoustic consultant in conjunction with the system engineer/technician.

6 Conclusion

Renzo Tonin & Associates has completed an assessment of noise emission from the use of amplified speakers in the Unenclosed Gaming Area (UGA) located on Level 1 along the Pirrama Road frontage at The Star. The current approval under MP08-0098 does not permit the provision of speakers and music in the Level 1 UGAs. The assessment has been prepared to support the S75W application to be lodged to the Department of Planning to modify Condition F1 so as to permit speakers and music within the Level 1 UGAs.

The use of the speakers has been considered for two separate purposes; background music and public address (PA) announcements. The assessment concluded that acceptable noise level for PA announcements could be achieved up to midnight, while only low background music would be practical after midnight. In order to manage and control noise emission from the UGA speakers and music, it is recommended that noise limiting devices are installed with the sound systems.

APPENDIX A Glossary of terminology

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

Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period	The period in a day over which assessments are made.
Assessment Point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background Noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.

L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain L_{eq} sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound Absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Long-term noise monitoring methodology

B.1 Noise monitoring equipment

A long-term unattended noise monitor consists of a sound level meter housed inside a weather resistant enclosure. Noise levels are monitored continuously with statistical data stored in memory for every 15-minute period.

Long term noise monitoring was conducted using the following instrumentation:

Description	Type	Octave band data	Logger location(s)
RTA06 (NTi Audio XL2, with low noise microphone)	Type 1	1/1	L1

Notes: All meters comply with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and designated either Type 1 or Type 2 as per table, and are suitable for field use.

The equipment was calibrated prior and subsequent to the measurement period using a Bruel & Kjaer Type 4230 or 4231 calibrator. No significant drift in calibration was observed.

B.2 Meteorology during monitoring

Measurements affected by extraneous noise, wind (greater than 5m/s) or rain were excluded from the recorded data in accordance with the NSW INP. Determination of extraneous meteorological conditions was based on data provided by the Bureau of Meteorology (BOM), for a location considered representative of the noise monitoring location(s). However, the data was adjusted to account for the height difference between the BOM weather station, where wind speed and direction is recorded at a height of 10m above ground level, and the microphone location, which is typically 1.5m above ground level (and less than 3m). The correction factor applied to the data is based on Table C.1 of ISO 4354:2009 '*Wind actions on structures*'.

B.3 Noise vs time graphs

Noise almost always varies with time. Noise environments can be described using various descriptors to show how a noise ranges about a level. In this report, noise values measured or referred to include the L_{10}, L_{90}, and L_{eq} levels. The statistical descriptors L_{10} and L_{90} measure the noise level exceeded for 10% and 90% of the sample measurement time. The L_{eq} level is the equivalent continuous noise level or the level averaged on an equal energy basis. Measurement sample periods are usually ten to fifteen minutes. The Noise -vs- Time graphs representing measured noise levels, as presented in this report, illustrate these concepts for the broadband dB(A) results.

APPENDIX C Long-term monitoring results

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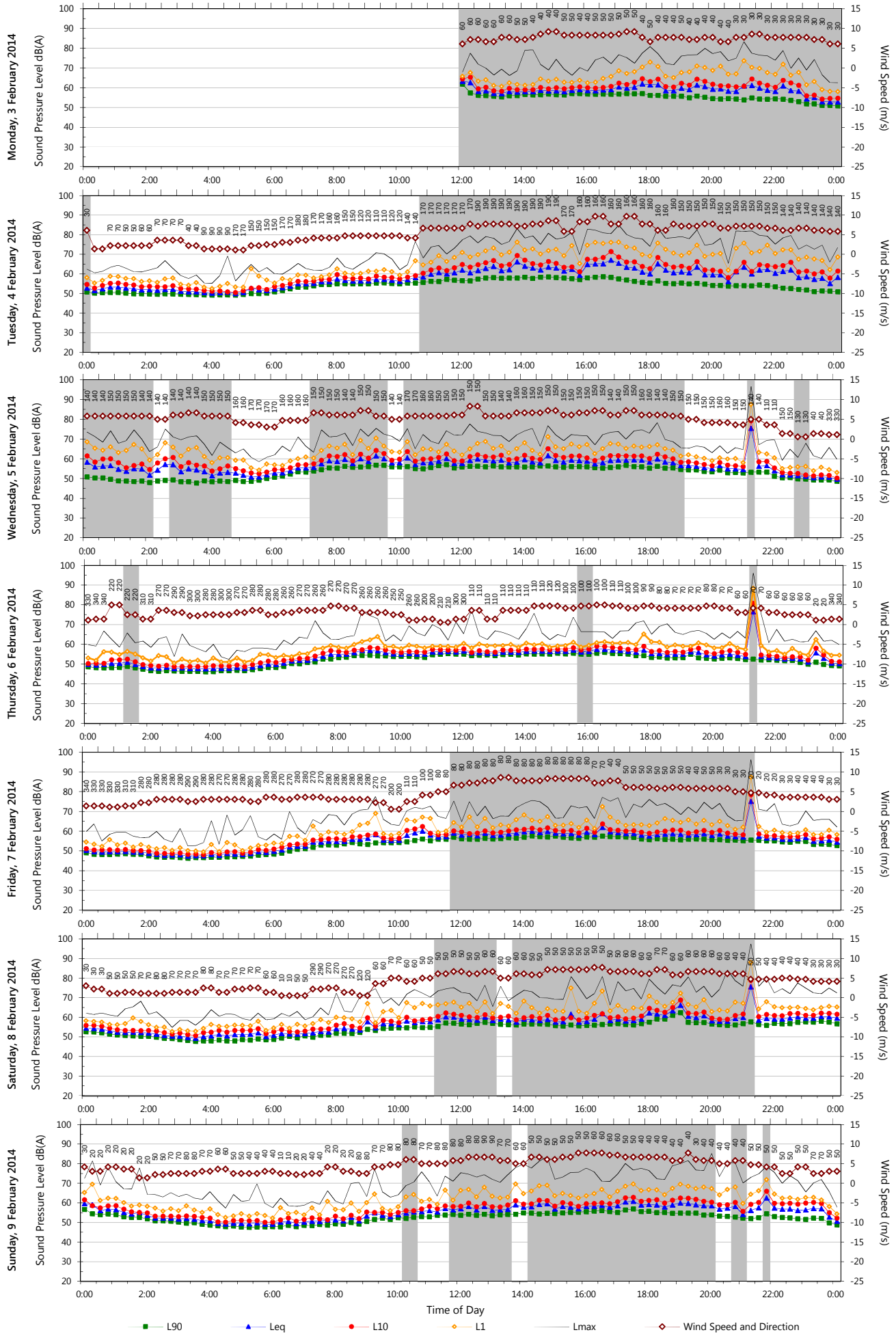
L1 - Rooftop Terrace of Unit 14, Wharf 9, Pyrmont

Background & Ambient Noise Monitoring Results - NSW 'Industrial Noise Policy', 2000						
	L_{A90} Background Noise Levels[5]			L_{Aeq} Ambient Noise Levels		
Date	**Day**	**Evening**	**Night**	**Day**	**Evening**	**Night**
Monday-03-February-2014	-	-	-	-	-	-
Tuesday-04-February-2014	-	-	-	-	-	-
Wednesday-05-February-2014	-	-	46	-	-	50
Thursday-06-February-2014	53	52	47	56	55	50
Friday-07-February-2014	-	-	48	-	-	53
Saturday-08-February-2014	-	-	48	-	-	55
Sunday-09-February-2014	-	-	-	-	-	-
Monday-10-February-2014	-	-	47	-	-	52
Tuesday-11-February-2014	54	-	50	56	-	52
Wednesday-12-February-2014	-	-	-	-	-	-
Thursday-13-February-2014	-	-	48	-	-	51
Friday-14-February-2014	53	54	-	57	57	-
Saturday-15-February-2014	-	-	-	-	-	-
Sunday-16-February-2014	-	-	-	-	-	-
Monday-17-February-2014	-	52	50	-	55	51
Tuesday-18-February-2014	55	52	46	58	55	50
Wednesday-19-February-2014	-	-	47	-	-	51
Thursday-20-February-2014	53	53	-	57	55	-
Friday-21-February-2014	-	-	48	-	-	53
Saturday-22-February-2014	-	-	49	-	-	56
Sunday-23-February-2014	-	-	47	-	-	50
Monday-24-February-2014	-	-	47	-	-	50
Tuesday-25-February-2014	-	-	-	-	-	-
Wednesday-26-February-2014	53	-	-	57	-	-
Thursday-27-February-2014	-	-	-	-	-	-
Friday-28-February-2014	-	54	-	-	56	-
Saturday-01-March-2014	-	-	-	-	-	-
Sunday-02-March-2014	-	51	48	-	54	52
Monday-03-March-2014	53	52	47	58	54	50
Tuesday-04-March-2014	54	-	-	57	-	-
Representative Week	**54**	**52**	**48**	**57**	**55**	**52**

Notes:

1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Rating Background Level (RBL) for L90 and logarithmic average for Leq
5. Assessment Background Level (ABL)
6. Rating Background Level (RBL) for L90 and logarithmic average for Leq



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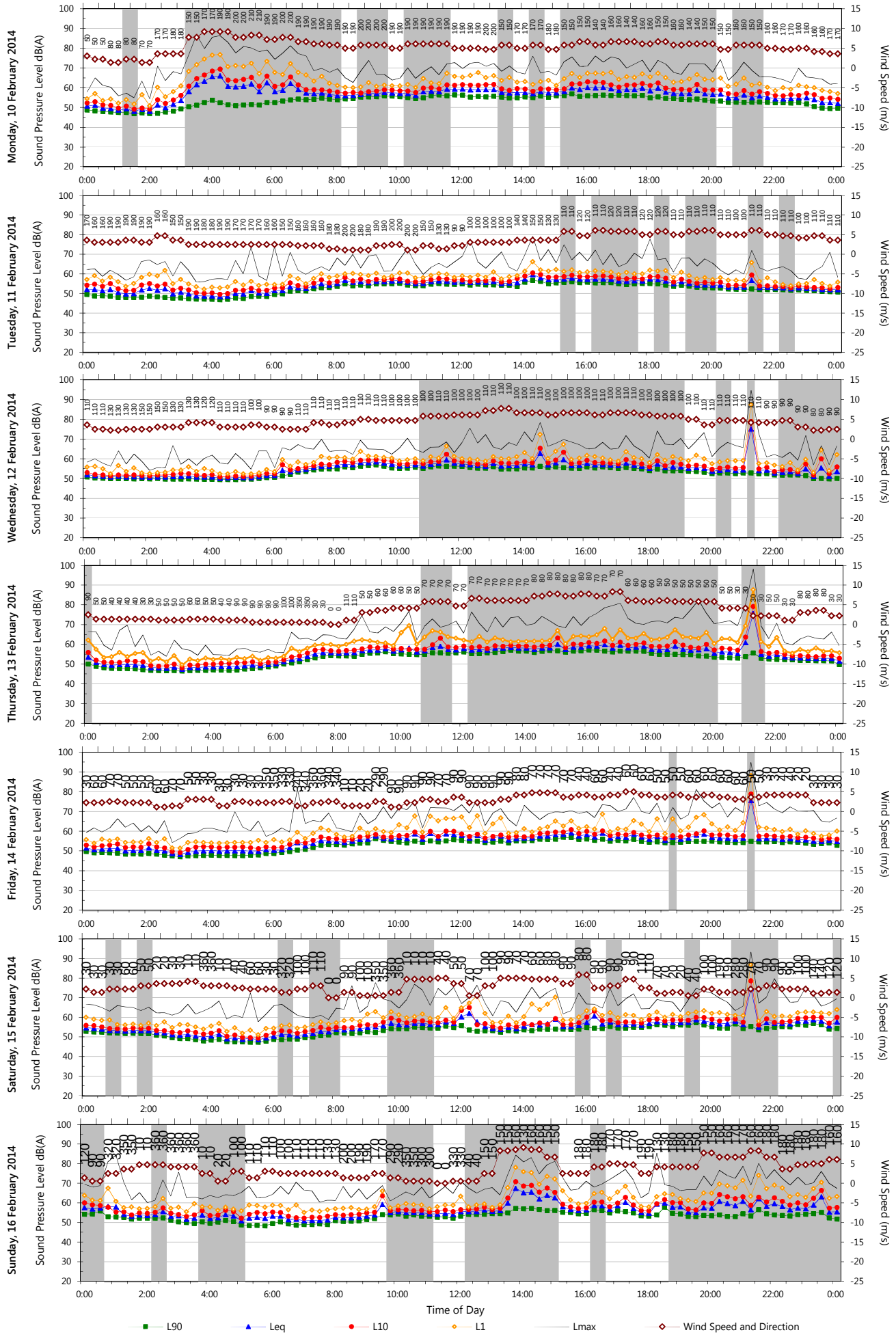

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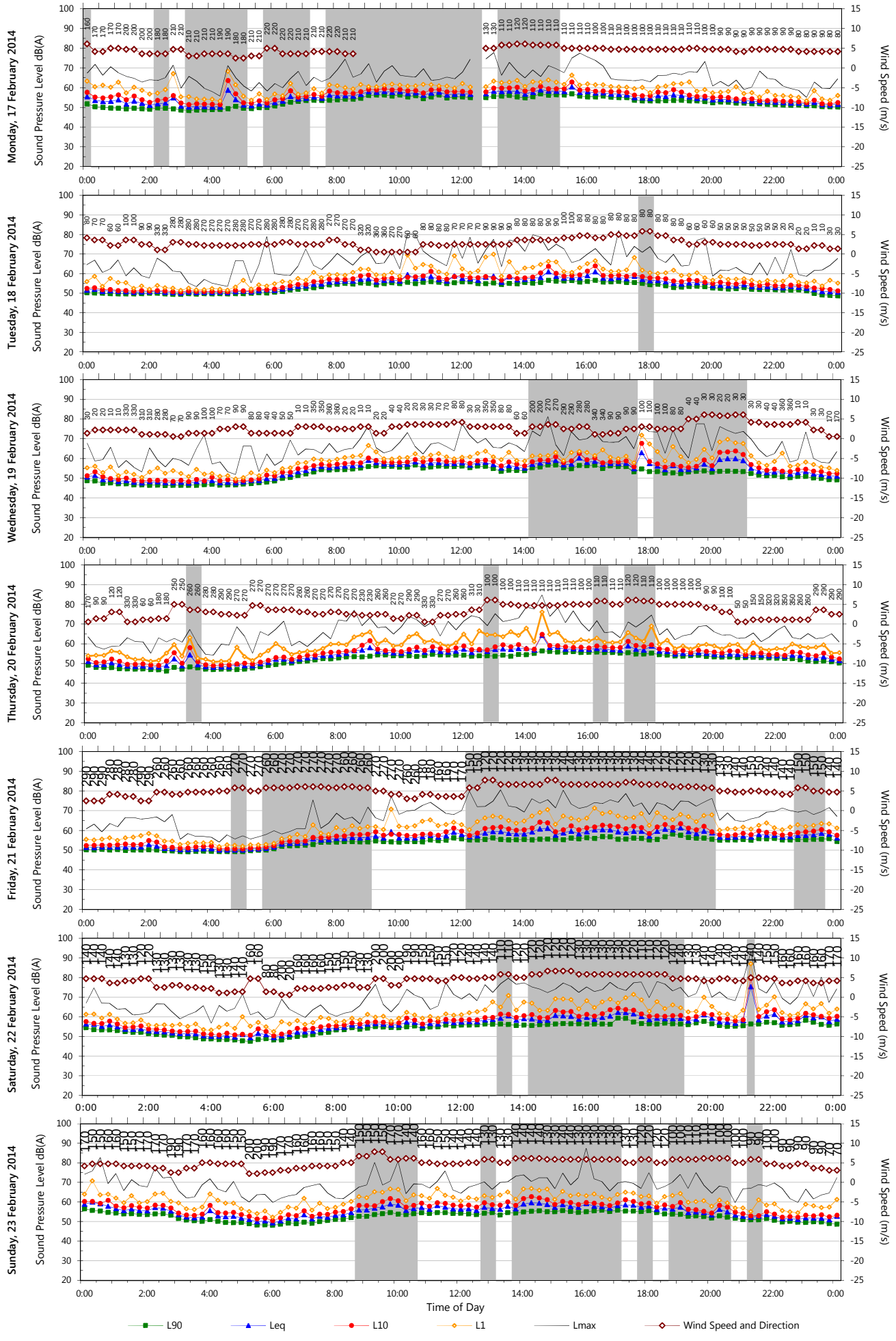

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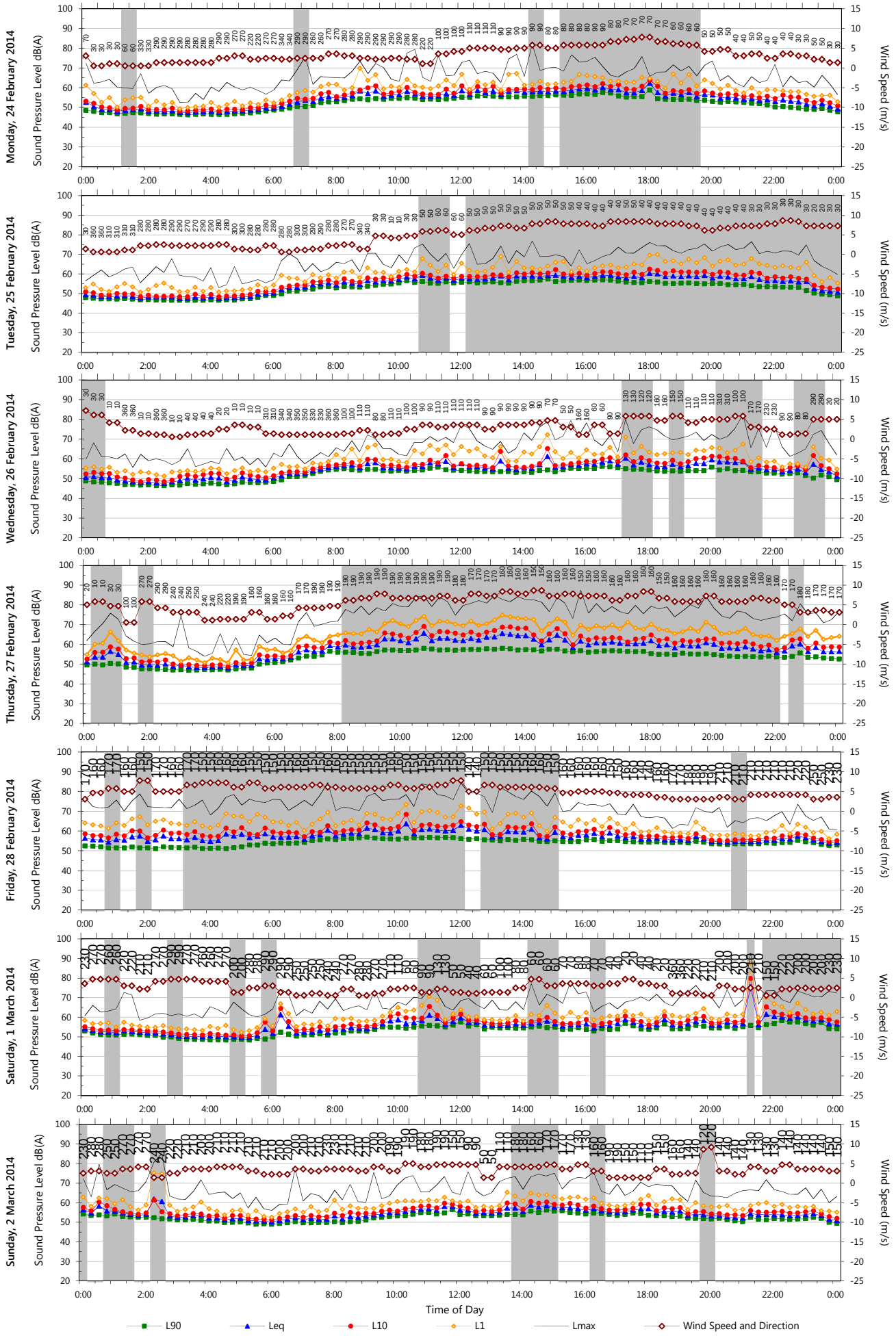

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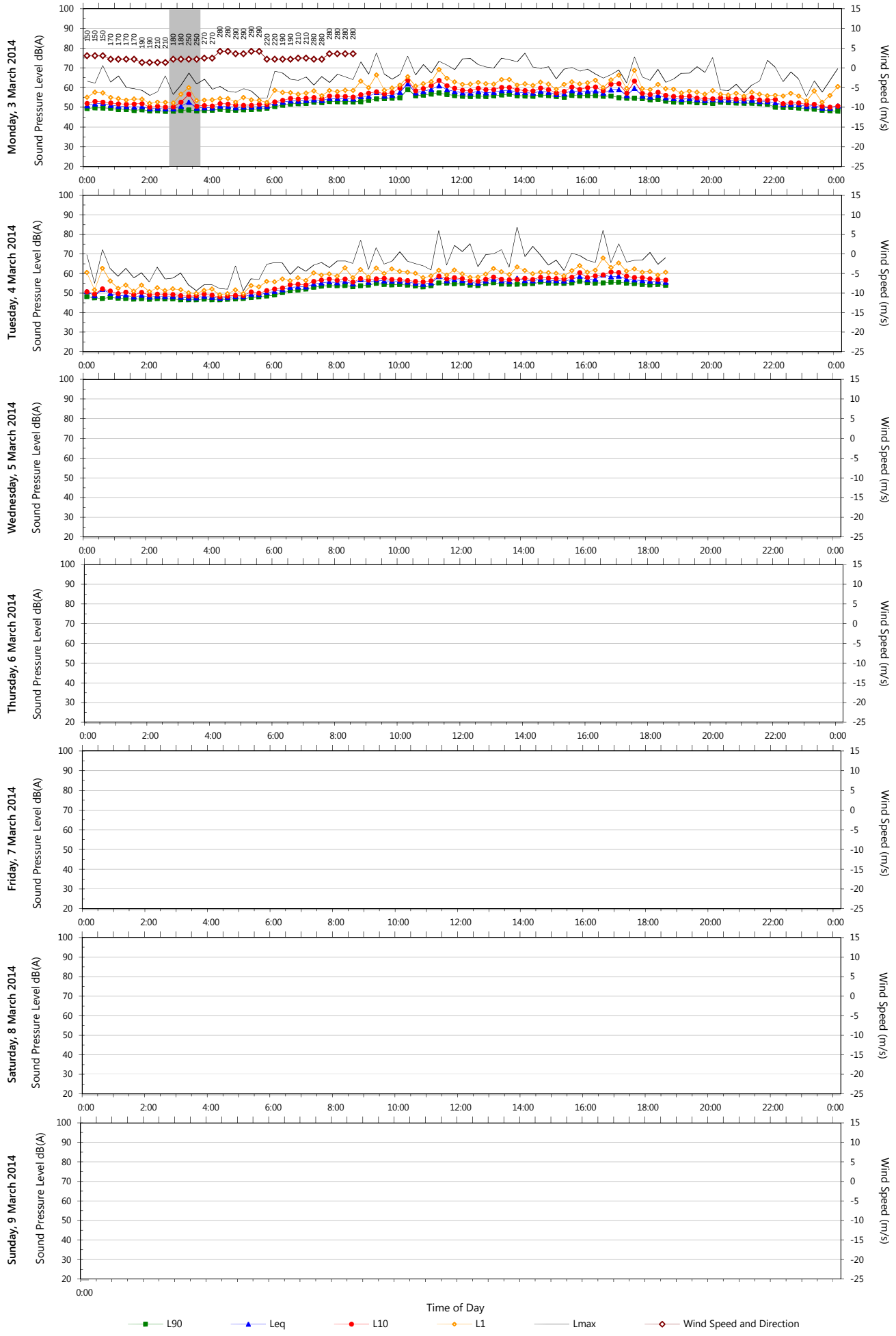

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