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TG930-01F02 (r2) Data Centre Noise

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Sydney Olympic Park, Site 53 - Mechanical noise exposure

1 Introduction

Renzo Tonin & Associates has been engaged to carry out an acoustic review of the subject site and its potential for residential development, in order to complete pertinent due diligence. The site is identified as Site 53 within the Sydney Olympic Park Authority (SOPA) Masterplan.

Investigations to date have involved site inspections to identify existing sources of noise and vibration that could constrain development of the site for residential use. Noise and vibration measurements have been undertaken across the site, to address rail operations, road traffic and other identified ambient noise sources.

From preliminary investigations, a primary constraint to residential development has been identified in the noise exposure from mechanical equipment serving the neighbouring Fujitsu Data Centre (Site 52). While noise from rail and road traffic can be generally be addressed through acoustic design of the building envelope, mechanical/industrial noise sources exhibit a different character of noise that is assessed against different noise policy. This report discusses the applicable noise criteria, measurement survey results and assessment findings in regard to the identified mechanical noise.

2 Site description

The site is located on the corner of Figtree Drive and Australia Avenue, Sydney Olympic Park. Figure 1 presents an aerial photograph of the site, showing its relationship to the surrounds and neighbouring Data Centre to the west. The Sydney Olympic Park (SOP) 2030 Masterplan (Figure 2) identifies Site 53 for residential use. The neighbouring data centre, which occupies Site 52, is also identified for residential development.

Figure 1: Site plan



Figure 2: SOPA Masterplan 2030



3 Noise criteria

While the site is identified for residential use under the SOP 2030 Masterplan, we are not aware of any planning studies having been carried out to identify potential land use conflicts or constraints, either for the future development or as a result of the staging of development. Where changes in land use are proposed, noise conflict can result from more noise sensitive land uses encroaching upon existing noise generating development.

The acoustic amenity for residential development in regard to industrial noise is generally assessed against the NSW EPAs *Industrial Noise Policy* (INP). The basis for its policy relies on two components:

- controlling intrusive noise impacts in the short term for residences, and
- maintaining noise level amenity for particular land uses for residences and other land uses

Noise intrusiveness ensures that industrial noise does not exceed the existing background noise level by an excessive margin. This is commonly referred to as the 'background plus 5' criterion, that is, that the noise level from the new industrial development should not exceed the existing background noise level (measured in the absence of that development) by more than 5dB(A).

Noise amenity ensures that industrial noise levels do not increase without limit, for if a number of industrial noise sources are permitted to increase the background noise level by 5dB(A), in turn there would be a point where the ultimate noise level is unacceptable. A limit on the ultimate acceptable noise level is therefore included in the INP as a way of ensuring that cumulative noise impact from industrial growth is curtailed. This limit is referred to as the 'amenity' goal. The appropriate limit in any circumstance relates to the land use category, for example, there are different limits for rural, suburban and urban areas.

Regarding changes of land use, such as residential subdivisions encroaching upon pre-existing industrial development the concept of there being a background noise level absent of industrial noise is likely to be non-existent. This is the case for the subject site. Residents would therefore come to an area with prevalent industrial noise and the question therefore becomes whether or not that industrial noise is an acceptable noise for the use category of the proposed development.

Table 2.1 of the INP sets appropriate noise amenity limits for residential premises for different land uses for day, evening and night-time periods as replicated in Table 1. The subject site would be classified Urban. These criteria apply to industrial noise only. Consideration must also be given to the modifying factors outlined in the INP for annoying characteristics such as prominent tonal components, impulsiveness, intermittency, irregularity or dominant low-frequency content. The 'noise' to be assessed for the purpose of determining these characteristics is the total ambient noise level including both industrial and other sources.

Table 1: Recommended L_{Aeq} noise levels from industrial noise sources

Type of receiver	Indicative noise amenity area	Time of day	Recommended L_{Aeq} Noise Level, dB(A) for day, evening or night period	
			Acceptable	Recommended maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
	Urban/industrial interface – for existing situations only	Day	65	70
		Evening	55	60
		Night	50	55

Notes: The recommended acceptable noise levels refer only to noise from industrial sources.

Rural—means an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic.

Suburban—an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry.

Urban—an area with an acoustical environment that is dominated by 'urban hum' or industrial source noise or has through traffic with characteristically heavy and continuous traffic flows during peak periods or is near commercial districts or industrial districts or has any combination of the above, where 'urban hum' means the aggregate sound of many unidentifiable, mostly traffic-related sound sources.

Day: the period 7:00am to 6:00pm Monday to Saturday; or 8:00am to 6:00pm on Sundays and public holidays

Evening: the period from 6:00pm to 10:00pm

Night: the remaining periods.

The acceptable and recommended maximum L_{Aeq} noise levels can provide a guide to applying the negotiation process set out in Section 8 of the INP. While negotiation between the proponent and the community for an agreed noise level can occur at any time, typically the proponent would negotiate with the EPA where noise-level emissions fall between the acceptable and recommended maximum. For site levels beyond the recommended maximum levels, the proponent would need to negotiate directly with the community.

3.1 Adoption of Acceptable or Recommended Maximum noise levels

The acceptability or otherwise of approving residential development on the subject land in close proximity to an existing industrial should have regard to whether or not the existing industrial noise levels comply within the range of the *Acceptable* and *Recommended Maximum* noise levels indicated in Table 1 above.

As stated in the Section 2.2 of the INP:

Meeting the acceptable noise levels in [Table 1] will protect against noise impacts such as speech interference, community annoyance and, to some extent, sleep disturbance. These levels represent current best practice for assessing industrial noise sources, based on research and a review of assessment practices used overseas and within Australia.

[Table 1] also includes recommended maximum noise levels for different land uses. These recommended maximum values provide guidance on an upper limit to the level of noise from industry. In all cases it is expected that all feasible and reasonable mitigation measures would be applied before the recommended maximum noise levels are referenced.

In some instances it may not be possible to achieve even the recommended maximum noise level, even after all feasible and reasonable noise mitigation has been applied. Such cases are expected to have a large adverse noise impact. Where a proposed development exceeds the recommended maximum noise levels in [Table 1], substantial benefits in other areas, including a high degree of social worth, would need to be demonstrated.

Current noise exposure has been assessed against the acceptable noise limits.

4 Assessment of existing industrial noise exposure

4.1 Measured noise levels

Long-term noise monitoring was carried out from Tuesday 5 August 2014 to Wednesday, 13 August 2014. 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.

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

Figure 3: Measurement locations

Table 2 presents the overall single Rating Background Levels (RBL) and representative ambient L_{eq} noise levels for each assessment period, determined in accordance with the INP.

Table 2: Long-term noise monitoring results - Representative Week, dB(A)

Monitoring location	L _{A90} Rating Background Level (RBL)			L _{Aeq} Ambient noise levels		
	Day	Evening	Night	Day	Evening	Night
L1 - Site 53, south west corner (adjacent Site 52)	61	61	56	66	66	63
L2 - Site 53, south east boundary (adjacent rail line)	56	54	50	64	64	60

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

Detailed assessment of noise data did not identify any characteristics that would otherwise require penalties to be applied in accordance with Table 4.2 of the INP.

4.2 Assessment of measured noise levels

While the INP criteria adopts the L_{Aeq} noise parameter, being the energy-average noise level, the measured L_{Aeq} from a noise logger is not directly assessable, as it is influenced by intermittent ambient noise sources such as rail operations, road traffic and construction noise.

Noise from the Data Centre equipment is however generally continuous and steady-state, and therefore the measured L_{90} background noise level, a statistical parameter representing the average minimum noise level and not influenced by intermittent events, is representative of the mechanical noise. The measured L_{A90} background noise level at both locations, particularly at night, was deemed to be controlled by noise from the Data Centre.

Utilising measured background noise levels at both locations, Table 3 assesses noise exposure from the Data Centre against the INP amenity criteria. It is noted that a metal fence surrounds the Data centre equipment, which would acoustically shield noise at the monitoring locations. At upper levels of the proposed development, noise exposure would be higher than that measured. It is estimated that the current fence would provide in the order of 8-10dB(A) noise reduction to the measurement locations. Table 3 therefore includes a secondary, elevated assessment location, for each monitor, which includes the estimated 8dB(A).

Table 3: Recommended L_{Aeq} noise levels from industrial noise sources

Description		L_{Aeq} period Industrial Noise Levels, dB(A)		
		Day	Evening	Night
L1 - Site 53, south west corner (measurement location)	Measurement location	61	61	56
	Elevated location, above Data Centre fence height*	69	69	64
L2 - Site 53, south west boundary	Measurement location	56	54	50
	Elevated location, above Data Centre fence height*	64	62	58
NSW INP Amenity Criteria Urban - Acceptable		60	50	45

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
 As required by the INP, the external ambient noise levels presented are free-field noise levels. [ie. no façade reflection]
 * +8dB(A) for elevated location, where no noise shielding is provided by the current fence surrounding the Data Centre equipment

5 Findings and conclusion

The measured noise levels of the Data Centre mechanical equipment indicate that industrial noise exposure on the site exceeds the acceptable amenity criteria for Urban residential development by up to 11dB(A). While the measured noise levels reduce at night, confirmation would be required as to whether higher noise levels could be expected during summer nights, when greater heat load is present. The criteria are also expected to be exceeded by a greater margin at elevated locations (ie. upper levels of residential towers), where noise shielding is not afforded by the metal fence surrounding the Data

Centre equipment. The noise increase is estimated to be 8dB(A), resulting in noise exceedance of up to 19dB(A).

Noise control of industrial noise is best addressed at the source, in this case through acoustic attenuation of the Data Centre equipment. Without control, the acoustic amenity of the residential development is compromised which directly affects the suitability of the site for residential development.

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Authorised
18.08.2014	Issued draft		0	GW	RC	GW
19.08.2014	Revised issue		1	GW	-	GW
09.09.2014		2				

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

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APPENDIX A Glossary of terminology

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

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 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 L90 noise level expressed in units of dB(A).
L _{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B 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	1/3	L1, L2
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 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.

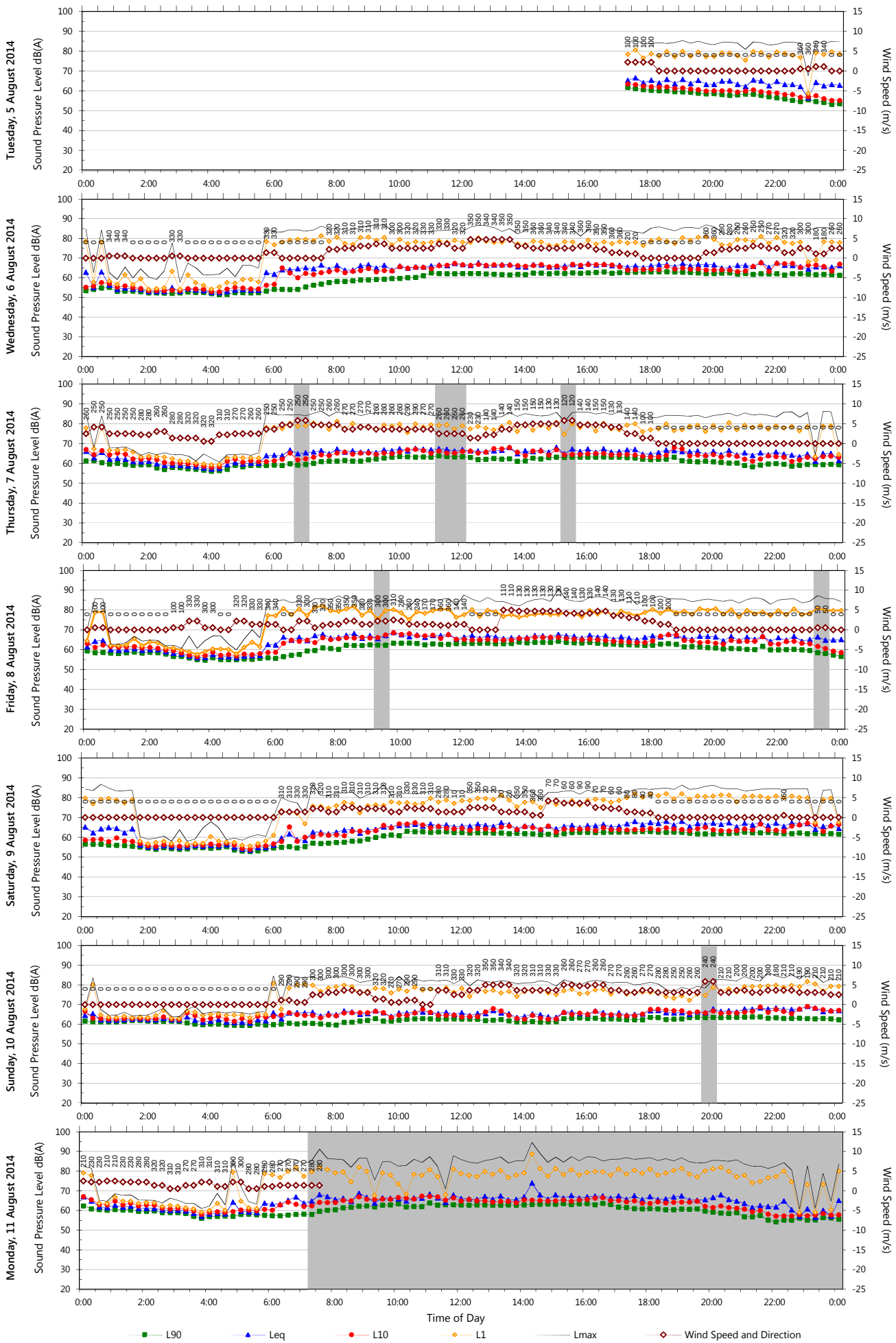
APPENDIX C Long-term noise logger graphs

L1 - SOP Site 53 - south-west corner

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
Tuesday-05-August-2014	-	57	52	-	64	60
Wednesday-06-August-2014	58	62	57	66	66	63
Thursday-07-August-2014	61	59	55	66	66	62
Friday-08-August-2014	62	60	54	67	66	61
Saturday-09-August-2014	58	62	60	65	67	64
Sunday-10-August-2014	61	63	57	66	67	64
Monday-11-August-2014	-	-	-	-	-	-
Tuesday-12-August-2014	-	-	-	-	-	-
Wednesday-13-August-2014	-	-	-	-	-	-
Representative Weekday	61	59	54	66	66	62
Representative Weekend	59	62	58	66	67	64
Representative Week	61	61	56	66	66	63

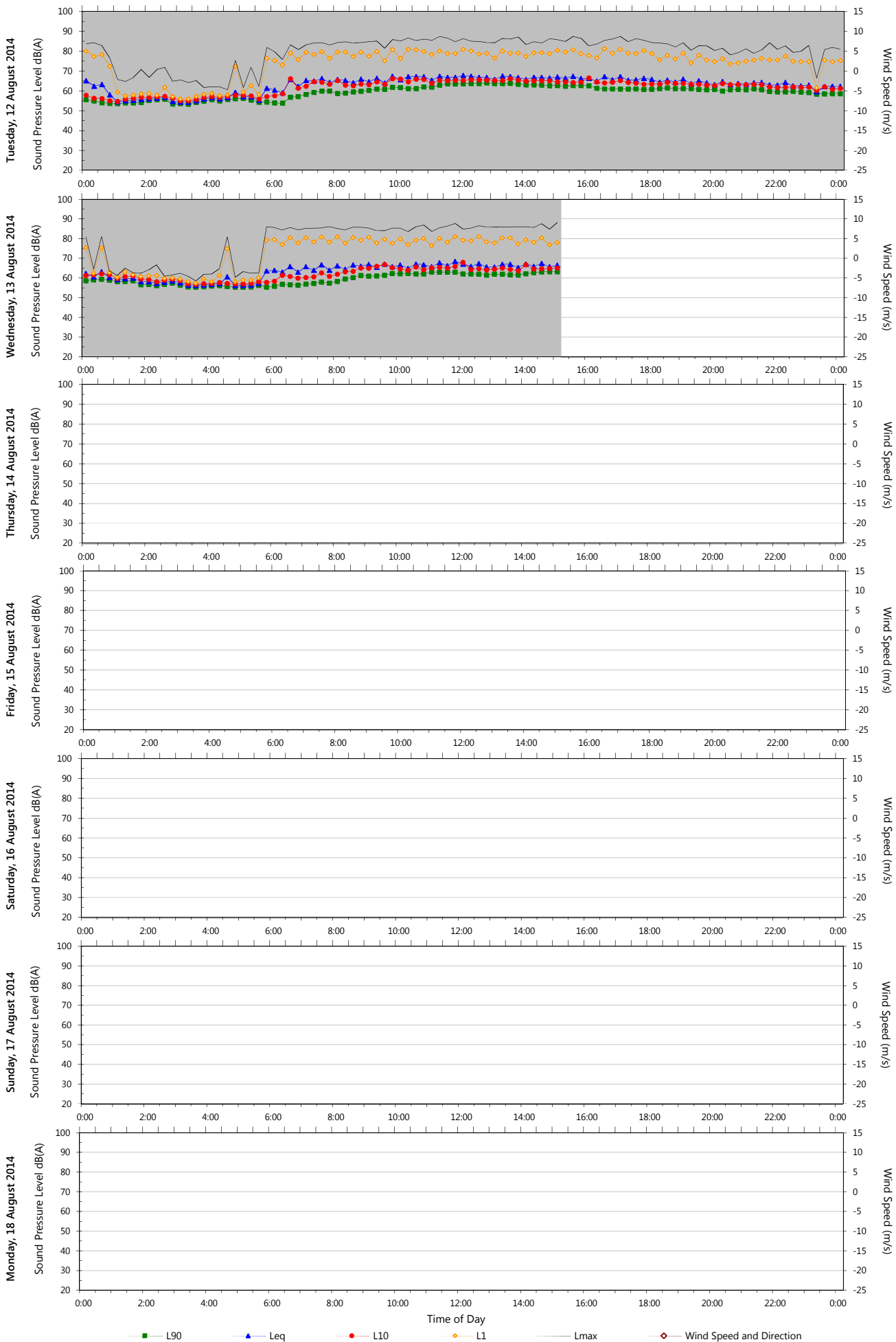
Notes:

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



Unattended Monitoring Results

Location: L1 - SOP Site 53 - south-west corner



Data File: 2014-08-05_SLM_000_123_Rpt_Report.txt

Template QTE-05B (rev 109) Sydney Logger Graphs

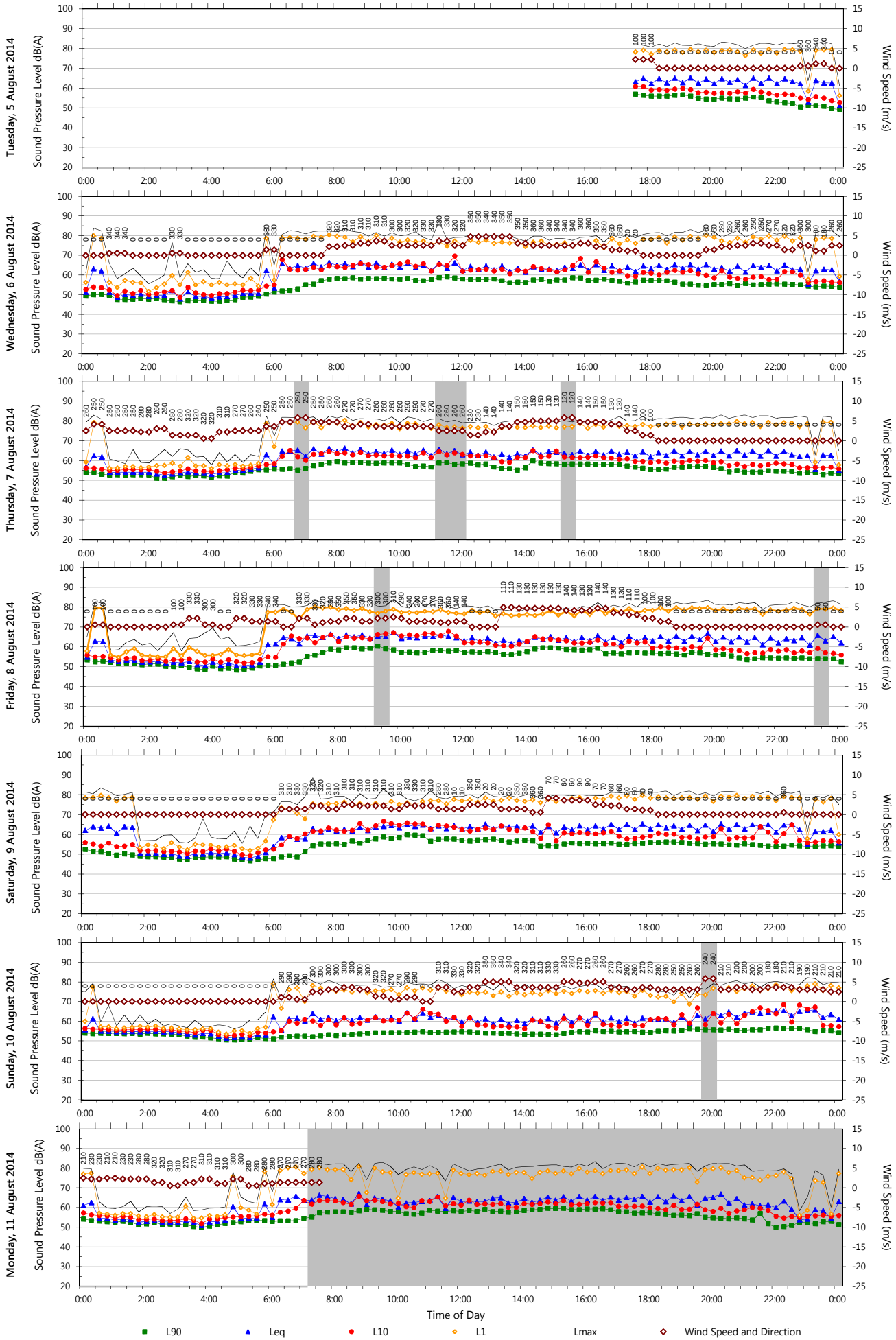
L2 - SOP Site 53 - south east

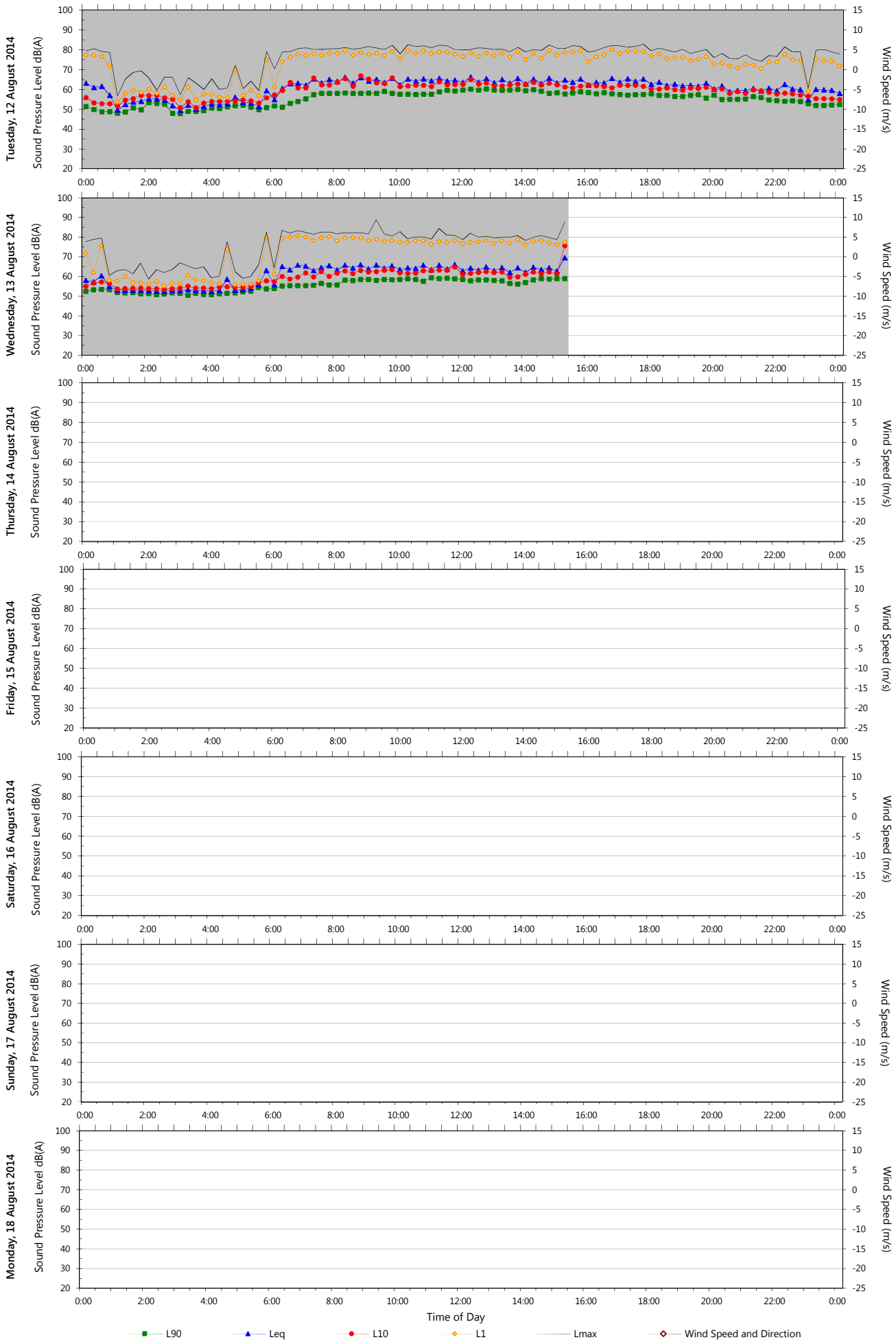
Background & Ambient Noise Monitoring Results - NSW 'Industrial Noise Policy', 2000

Date	L _{A90} Background Noise Levels ⁵			L _{Aeq} Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
Tuesday-05-August-2014	-	54	47	-	64	59
Wednesday-06-August-2014	56	55	52	64	64	60
Thursday-07-August-2014	56	54	49	64	64	60
Friday-08-August-2014	57	54	47	64	64	60
Saturday-09-August-2014	55	54	51	63	64	59
Sunday-10-August-2014	53	55	51	61	63	61
Monday-11-August-2014	-	-	-	-	-	-
Tuesday-12-August-2014	-	-	-	-	-	-
Wednesday-13-August-2014	-	-	-	-	-	-
Representative Weekday	56	54	48	64	64	60
Representative Weekend	54	55	51	63	63	60
Representative Week	56	54	50	64	64	60

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





APPENDIX D Data Centre site map

