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SITE 53, 2 FIGTREE DRIVE, SYDNEY OLYMPIC PARK

Acoustic Assessment for Development Application

23 July 2015

MIRVAC

TH297-01F02 Acoustic Assessment for DA (r0)

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Contents

List of tables

List of figures

1 Introduction

Renzo Tonin & Associates was engaged to conduct a traffic noise and rail noise and vibration assessment for the proposed development at Sydney Olympic Park Site 53, 2 Figtree Drive; including rail noise and vibration associated with the Olympic Park passenger Circuit.

Noise surveys have been conducted by Renzo Tonin & Associates between 5th August and 13th August 2014 at the development site to determine the existing levels of rail noise and vibration affecting the site. These levels were used to predict noise levels within the residential dwellings, and then assessed against the recommended internal noise and vibration criteria for the project.

From our assessment of the proposed development, the following potential acoustic and vibration issues were identified:

- Rail Noise and Vibration associated with the CityRail Olympic Park Line.
- Traffic Noise associated with Australia Avenue and Sarah Durack Drive
- Existing mechanical plant located on neighbouring apartment buildings.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Site Location and Surrounds

The proposed development at 2 Figtree Drive, Sydney Olympic Park is to consist of a 4 residential towers over common basement car parking.

The site is located adjacent to the Olympic Park rail corridor to the south and east of the site. Australia Avenue is located adjacent to the eastern boundary of the site and Sarah Durack Drive located to the south, beyond the rail line.

The site is currently surrounded by commercial premises to the north and west of the site, with new residential buildings currently being constructed to the east along Australia Avenue. The Sydney Olympic Park (SOP Masterplan) also identifies existing neighbouring commercial buildings for future residential development, including 4 Figtree Drive.

Long term noise monitoring has been undertaken at the site to determine the existing acoustic environment.

Figure 1: Site location and surrounds

Figure 2: Proposed building and site layout

3 Criteria

3.1 Airborne Rail Noise

The existing rail line impacting on the proposed development is the Olympic Park Line. This is a circuit passenger train line. The site is located along the rail line, with a pedestrian/cyclist path between the boundary of the site and the rail corridor.

The airborne rail noise criteria for this development are based on the following documents:

- State Environment Planning Policy (Infrastructure 2007) "ISEPP"
- Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008

The noise criteria outlined in the documents listed were considered and Table 1 below summaries the rail noise criteria determined suitable for this development.

Table 1: Recommended Internal Noise Criteria for Rail Noise

Occupancy	Windows & Doors Condition	Design Noise Level	
		Day, LAeq (15hour)	Night, LAeq (9hour)
Bedrooms	Closed	-	35
	Open	-	45
All Other Habitable Areas	Closed	40	40
	Open	50	50

Notes:

Day and Night assessment periods are defined as follows.

1. Day is defined as 7:00am to 10:00pm
2. Night is defined as 10pm to 7am

3.2 Rail Vibration

The Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline", Section 3.6.3 outlines the following documents which recommend train vibration criteria for residential buildings.

- Assessing Vibration: A technical guideline (EPA 2006)
- German Standard DIN 4150, Part 3 1999
- British Standard BS 7385 Part 2 1993
- Australian Standard AS2670.2 1990

The above documents have been reviewed and the criterion for assessment of vibration from train pass-bys affecting the proposed development is quantified using the following Standard:

- Assessing Vibration: A technical guideline (EPA 2006)

Table 2.4 of the Department of Environment Climate Change and Water's document "Assessing Vibration: A technical guideline (EPA 2006)" presents acceptable vibration dose values for intermittent vibration.

Table 2: Acceptable VDVs for intermittent vibration m/s1.75

Period	Preferred VDV m/s1.75
Day time (7am – 10pm)	0.2
Night time (10pm – 7am)	0.13

3.3 Traffic Noise

A number of documents were taken into consideration when determining suitable traffic noise criteria for the proposed development site. These included:

- State Environment Planning Policy (Infrastructure) 2007 **["ISEPP"]**
- Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008 **["ISEPP Guideline"]**
- Rockdale Council Development Control Plan 2012

Neither Australia Avenue nor Sarah Durack Drive are identified as roads requiring a mandatory assessment (greater than AADT 40,000) or recommended for assessment (>20,000 but <40,000 AADT) on The Roads and Maritime Services (RMS) Traffic Volume Maps for ISEPP.

However, as facades impacted on by traffic noise associated with Australia Avenue and Sarah Durack Drive are also impacted on by rail noise, the acoustic criteria as determined in The ISEPP Clause 102 and The Department of Planning's Guideline are considered the most appropriate criteria for this development site and is summarised in the table below.

Table 3 summarises the recommended traffic design sound levels for building interiors in the proposed development.

Table 3: Recommended design sound levels for building interiors

Occupancy	Windows & Doors Condition	Design Noise Level	
		Day, $L_{Aeq\ (15hour)}$	Night, $L_{Aeq\ (9hour)}$
Sleeping areas	Closed	-	35 dB(A)
Living Areas	Closed	40 dB(A)	40 dB(A)
Apartment common areas	Closed	55 dB(A)	55 dB(A)

APPENDIX C presents results of the unattended ambient noise survey conducted on site.

4 Existing Measured Noise Levels

4.1 Existing Train Airborne Noise Levels

4.1.1 Long-term Noise Survey

Two RTA Technology Environmental Noise Loggers were set up for the ambient noise survey from Tuesday 5th August to Wednesday 13th August 2014. One logger was set up at each end of the Site 53 carpark closest to the rail corridor.

The noise logger records noise levels on a continuous basis and stores data every fifteen minutes. The dates of measurement and the results obtained from the logger surveys are shown in Appendix C.

The noise levels were used to predict rail noise levels at the facade of the development.

4.2 Train Noise and Vibration Measurements

The Olympic Park railway circuit is located approximately 25m from the south-eastern boundary of the site. Train noise and vibration levels were recorded at location of the proposed south eastern boundary of the site. Operator-attended noise and vibration measurements were conducted on site on Wednesday 13th August, 2014.

Weather conditions were fine and sunny during the operator-attended surveys with negligible wind speeds at the monitoring locations. All instruments were calibrated before and after measurement. No significant drift in calibration was observed.

These noise levels were used in conjunction with rail timetables published by Sydney trains to predict rail noise levels at the facades of the development.

The design external rail noise levels are presented below.

Table 4: Predicted External Rail Noise Levels

Facade	Time Period, T	Rail Noise Level LAeq,T
Southern facade	Day time (7am to 10pm)	68
	Night time (10pm to 7am)	65
Eastern Facade	Day time (7am to 10pm)	66
	Night time (10pm to 7am)	62

4.3 Rail Vibration Survey

Train vibration levels were measured using the Sinus SoundBook multi-channel analyser and Endevco accelerometers. An accelerometer was fixed to a steel spike hammered into the ground on the south-eastern facade of the site along the railway line as shown in Appendix C & D.

The table below shows the measured Vibration Dose Value (VDV) measured at the proposed development site due to existing operations.

Table 5: Calculated Vibration Dose Value (VDV)

Location	Assessment Period	Calculated VDV m/s1.75
Boundary of Site 53, Sydney Olympic Park with rail corridor	Day time (7am - 10pm)	0.028
	Night time (10pm - 7am)	0.018

The measured VDV at the boundary of the site is well below both the daytime and night time criteria as presented in Table 2. Vibration isolation treatment is not required.

4.4 Noise Associated with the Data Centre at 4 Figtree Drive, Sydney Olympic Park

Currently, mechanical plant associated with the adjoining data centre located at 4 Figtree Drive impact on the proposed development site. An assessment of noise, including establishing of suitable acoustic criteria for the mechanical plant associated with the data centre and in-principle recommendations has been prepared.

It is our understanding that noise associated with the plant operating at the site boundary at 2 Figtree Drive is to be attenuated to comply with the requirements of the EPA's Industrial Noise Policy (INP) prior to the occupation of the residential apartments proposed for 2 Figtree Drive, Sydney Olympic Park.

Figure 3: Data Centre Plant Location

4.5 Calculated Noise Levels

Results from the noise surveys were used to calculate internal noise levels within the proposed development. Noise calculations were performed using glazing design software developed in this office which take into account external noise levels, facade transmission loss and room sound absorption characteristics.

5 Acoustic Treatment - Glazing

The following table presents the recommended glazing selections for facades of the proposed development at 2 Figtree Drive, Sydney Olympic Park. The required acoustic rating of the glazing assembly presented in the table below represents the required acoustic rating of the glazed system as a whole. This includes glass, frames, junctions and seals.

Table 6: Recommended Glazing Treatment

Facade	Floor	Occupancy	Required Acoustic Rating of Glazing Assembly
East Building			
Southern facade facing rail line	Ground Level - Level 6	Bedrooms	Rw 35
		Living/ dining/ areas	Rw 33
	Level 7 +	Bedrooms	Rw 33
		Living/ dining/ areas	Rw 31
Eastern facade facing Australia Avenue	Levels 1-6	Bedrooms	Rw 35
		Living/ dining/ areas	Rw 32
	Level 7 +	Bedrooms	Rw 32
		Living/ dining/ areas	Rw 28
Northern Facade	All levels	Bedrooms	Rw 28
		Living/ dining/ areas	Rw 28
Western Facade	All levels	Bedrooms	Rw 32
		Living/ dining/ areas	Rw 32
South Building			
Southern facade facing rail line	Ground Level - Level 6	Bedrooms	Rw 35
		Living/ dining/ areas	Rw 32
	Level 7 +	Bedrooms	Rw 33
		Living/ dining/ areas	Rw 31
Eastern facade	All levels	Bedrooms	Rw 32
		Living/ dining/ areas	Rw 28
Northern facade	All levels	Bedrooms	Rw 28
		Living/ dining/ areas	Rw 28
Western facade	All levels	Bedrooms	Rw 32
		Living/ dining/ areas	Rw 32

Facade	Floor	Occupancy	Required Acoustic Rating of Glazing Assembly
West Building			
Southern facade (south east corner, exposed to rail line)	All levels	Bedrooms	Rw 32
		Living/ dining/ areas	Rw 28
Southern facade (shielded from rail line by southern building)	All levels	Bedrooms	Rw 28
		Living/ dining/ areas	Rw 28
Eastern Facade	All levels	All habitable rooms	Rw 28
Northern Facade	All levels	All habitable rooms	Rw 28
Western Facade	All levels	All habitable rooms	Rw 28
North Building			
Southern facade	All levels	Bedrooms	Rw 28
		Living/ dining/ areas	Rw 28
Eastern facade facing Australia Avenue	All levels	Bedrooms	Rw 32
		Living/ dining/ areas	Rw 32
Northern facade	All levels	All habitable rooms	Rw 28
Western facade	All levels	All habitable rooms	Rw 28

By way of explanation, the Sound Insulation Rating Rw is a measure of the noise reduction property of the partition, a higher rating implying a higher sound reduction performance.

Note that the Rw rating of systems measured as built on site (R'w Field Test) may be up to 5 points lower than the laboratory result.

NOTES FOR GLAZING CONSTRUCTIONS:

The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.

The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.

The glazing supplier shall ensure that installation techniques will not diminish the Rw performance of the glazing when installed on site.

All openable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the Rw rating performance of the glazing to not be reduced.

The above glazing thicknesses should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.

GENERAL

The information provided in this table is subject to modification and review without notice.

The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

5.1 Typical Glazing Constructions to Achieve Acoustic Ratings

The following table presents typical glazing constructions to achieve the minimum acoustic ratings presented in Table 6, above.

Table 7: Typical Glazing Constructions to Achieve Acoustic Ratings

Rw Rating	Typical Glazing System
Rw 28	Standard 6mm float glazing in an aluminium sliding window frame. Q-lon seals perimeter seals are installed
Rw 31	Minimum 6.38mm laminated glass in an aluminium sliding window frame. Q-lon seals perimeter seals are installed

Rw Rating	Typical Glazing System
Rw 33	10mm toughened glass in a commercial grade aluminium frame with acoustic fin or bulb seals
Rw 35	Minimum 10.38mm laminated glass in a commercial grade aluminium frame with acoustic fin or bulb seals

The table presented above is intended as a guide only and should not be used for construction.

It is the responsibility of the sub-contractor to provide laboratory test reports for the glazed systems proposed for installation at the development site to show compliance with the acoustic ratings presented in Table 6.

The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions.

5.2 Alternate Ventilation

In accordance with the Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008:

If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia

It has long been industry standard to assume a 10dB loss of noise from external to internal through an opened window in a building facade. It is based on the average results of a number of test cases, experimental data and published papers. This assumption has been well documented in The Roads and Traffic Authority (RTA) publications, including the RTA's Environmental Noise Management Manual (ENMM), Table 4.2.

Recent studies on noise reduction through facades with open windows[1] have shown that noise transmission through an open window can vary greatly based on the construction of the facades and noise flanking paths, including exposed floors and roof constructions.

The study indicates that noise loss through an open window of a development consisting of masonry construction with no exposed flooring and a concrete roof will be in the range of 11-15dB.

[1] Ryan, Lanchester and Pugh, 2011

Screening and shielding to balconies, along with the acoustic treatment to the mechanical plant associated with the data centre, is likely to impact on the noise levels at the openable facade elements within the development.

Further investigation into the ventilation requirements of apartments should be undertaken during the detailed design phase of the project so that items such as apartment finishes, room volumes and sizes and orientation of openings to confirm ventilation requirements .

6 External noise emission from building services

6.1 EPA Requirements

The NSW Environmental Protection Authority (EPA) sets out noise criteria in its Industrial Noise Policy (INP) to control the noise emission from industrial sources.

The NSW Industrial Noise Policy (INP) sets criteria to protect noise amenity for residential receivers. 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. The table below presents the amenity criteria relevant to the receivers surrounding the proposed development site.

Table 8: INP Amenity Criteria - Recommended LAeq Noise Levels from Industrial Noise Sources [NSW INP Table 2.1]

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended LAeq(Period) Noise Level	
			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	Day	65	70
		Evening	55	60

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended LAeq(Period) Noise Level	
			Acceptable	Recommended Maximum
	situations only	Night	50	55
Area specifically reserved for passive recreation (e.g. National Park)	All	When in use	50	55
Active recreation area (e.g. school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Note:

Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am

On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

The modification factors in Table 2.2 of the INP (summarised in the table below) are to be applied where the total existing LAeq noise level from *industrial* sources are within 6dB of the acceptable noise level (ANL) presented in the table above.

Table 9: Modification to Acceptable Noise Level (ANL)* to Account for Existing Level of Industrial Noise [NSW INP Table 2.2]

Total Existing LAeq noise level from Industrial Noise Sources	Maximum LAeq Noise Level for Noise from New Sources Alone, dB(A)
≥ Acceptable noise level plus 2	If existing noise level is likely to decrease in future: acceptable noise level minus 10 If existing noise level is unlikely to decrease in future: existing noise level minus 10
Acceptable noise level plus 1	Acceptable noise level minus 8
Acceptable noise level	Acceptable noise level minus 8
Acceptable noise level minus 1	Acceptable noise level minus 6
Acceptable noise level minus 2	Acceptable noise level minus 4
Acceptable noise level minus 3	Acceptable noise level minus 3
Acceptable noise level minus 4	Acceptable noise level minus 2
Acceptable noise level minus 5	Acceptable noise level minus 2
Acceptable noise level minus 6	Acceptable noise level minus 1
< Acceptable noise level minus 6	Acceptable noise level

* ANL = recommended acceptable LAeq noise level for the specific receiver, area and time of day from Table 2.1 (INP)

From observations at the proposed development site, the current LAeq noise level measured at the proposed development site are dominated by existing industrial noise, therefore the modifying factors in Table 2.2 above have been applied to the measured LAeq noise levels.

The following tables present the site specific noise production criteria from industrial noise sources, namely mechanical plant. Currently, the western boundary of the site is impacted on by mechanical plant associated with the use of the adjoining data centre. This plant is to be attenuated prior to the occupation of the proposed residential apartments at 2 Figtree Drive, Sydney Olympic Park.

Table 10: LAeq design criterion for noise production from mechanical plant (EPA INP) - east

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
Time of Day	**Rating Background Level (RBL) LA90**	**Intrusiveness Criterion (RBL+5)**	**Amenity Criterion - Acceptable**	**Measured LAeq Ambient Noise Levels**	**LAeq exceed amenity criterion?**	**Existing noise level likely to decrease in future?**	**Relevant modification to ANL?**	**Project Specific Design Criterion LAeq**
Day (7am to 6pm)	56	61	60	64	Yes 4dB	No	Existing LAeq minus 10dB	54
Evening (6pm to 10pm)	54	59	50	64	Yes 14dB	No	Existing LAeq minus 10dB	54
Night (10pm to 7am)	50	55	45	60	Yes 15dB	No	Existing LAeq minus 10dB	50

Explanatory notes:

Column 3 – Recommended LAeq noise level based on 'Residence –urban' area in Section 2.2, Table 2.1 Amenity Criteria (Recommended LAeq noise levels from industrial noise sources) of the EPA's INP.

Column 4 - Measured in accordance with the INP

Column 7 - Determined from Table 2.2 of the INP

Column 8 – Project Specific Design Criterion based on EPA's INP.

Table 11: LAeq design criterion for noise production from mechanical plant (EPA INP) - west

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
Time of Day	**Rating Background Level (RBL) LA90**	**Intrusiveness Criterion (RBL+5)**	**Amenity Criterion - Acceptable**	**Measured LAeq Ambient Noise Levels**	**LAeq exceed amenity criterion?**	**Existing noise level likely to decrease in future?**	**Relevant modification to ANL?**	**Project Specific Design Criterion LAeq**
Day (7am to 6pm)	61	66	60	66	Yes 6dB	Yes	Acceptable LAeq minus 10dB	50
Evening (6pm to 10pm)	61	66	50	66	Yes 16dB	Yes	Acceptable LAeq minus 10dB	40
Night (10pm to 7am)	56	61	45	63	Yes 18dB	Yes	Acceptable LAeq minus 10dB	35

Explanatory notes:

Column 3 – Recommended LAeq noise level based on 'Residence –urban' area in Section 2.2, Table 2.1 Amenity Criteria (Recommended LAeq noise levels from industrial noise sources) of the EPA's INP.

Column 4 - Measured in accordance with the INP

Column 7 - Determined from Table 2.2 of the INP

Column 8 – Project Specific Design Criterion based on EPA's INP.

Where necessary, noise amelioration treatment will be incorporated in the design to ensure that noise levels comply with the recommended EPA's INP noise emission criteria noted above.

At this stage details of mechanical plant have not been finalised, the following in-principal recommendations are provided.

Acoustic assessment of mechanical services equipment will need to be undertaken during the detail design phase of the development to ensure that they shall not either singularly or in total emit noise levels which exceed the noise limits in EPA's Industrial Noise Policy or Council's requirements;

As noise control treatment can affect the performance of the mechanical services system, it is recommend that consultation with an acoustic consultant be made during the initial phase of mechanical services system design in order to reduce the need for revision of mechanical plant and noise control treatment;

Mechanical plant noise emission can be controllable by appropriate mechanical system design and implementation of common engineering methods that may include any of the following:

- procurement of 'quiet' plant,
- strategic positioning of plant away from sensitive neighbouring premises, maximising the intervening shielding between the plant and sensitive neighbouring premises,
- commercially available silencers or acoustic attenuators for air discharge and air intakes of plant;
- acoustically lined and lagged ductwork;
- acoustic screens and barriers between plant and sensitive neighbouring premises; and/or
- Partially-enclosed or fully-enclosed acoustic enclosures over plant.

Mechanical plant shall have their noise specifications and their proposed locations checked prior to their installation on site; and

Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 "Rotating and Reciprocating Machinery – Mechanical Vibration".

We recommend a full and detailed assessment with fully documented acoustic treatments be undertaken at the detailed design phase of the development, followed by construction/installation supervision of mechanical plant and equipment acoustic treatment. Compliance testing following the installation of the plant should also be undertaken.

7 Internal Sound Insulation

As a minimum requirement, walls and floors of the residential development shall comply with Building Code of Australia (BCA). Soil and waste pipes shall comply with the minimum requirements of the Building Code of Australia (BCA). Appendix B presents a summary of acoustic provisions outlined in Part F5 of the BCA.

7.1 Acoustic Criteria

7.1.1 BCA 2015 Requirements

The acoustic provisions for inter-tenancy walls in Class 2 buildings are outlined in the Building Code of Australia and the following is an extract from the BCA:

F5.2 Determination of airborne sound insulation ratings

A form of construction required to have an airborne sound insulation rating must –

a. have the required value for weighted sound reduction index (Rw) or weighted sound reduction index with spectrum adaptation term (Rw + Ctr) determined in accordance with AS/NZS 1276.1 or ISO 717.1 using results from laboratory measurements; or

b. comply with Specification F5.2.

F5.3 Determination of impact sound insulation ratings

c. A floor in a building required to have an impact sound insulation rating must –

i. *have the required value for weighted normalised impact sound pressure level with spectrum adaptation term (Ln,w+CI) determined in accordance with AS/ISO 717.2 using results from laboratory measurements; or*

ii. *comply with Specification F5.2.*

d. A wall in a building required to have an impact sound insulation rating must –

iii. *for a Class 2 or 3 building be of discontinuous construction;*

e. For the purposes of this part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and

iv. *for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and*

v. *for other than masonry, there is no mechanical linkage between leaves except at the periphery.*

F5.4 Sound insulation rating of floors

f. A floor in a Class 2 or 3 building must have an Rw + Ctr (airborne) not less than 50 and an Ln,w+CI (impact) not more than 62 if it separates –

vi. *sole-occupancy units; or*

vii. *a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification.*

F5.5 Sound insulation rating of walls

g. A wall in a Class 2 or 3 building must –

viii. *have an Rw + Ctr (airborne) not less than 50, if it separates sole-occupancy units; and*

ix. *have an Rw (airborne) not less than 50, if it separates a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification; and*

x. *comply with F5.3(b) if it separates:*

xi. *a bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit; or*

xii. *a sole-occupancy unit from a plant room or lift shaft.*

h. A door may be incorporated in a wall in a Class 2 or 3 building that separates a sole-occupancy unit from a stairway, public corridor, public lobby or the like, provided the door assembly has an Rw not less than 30.

i. Where a wall required to have sound insulation has a floor above, the wall must continue to –

xiii. *the underside of the floor above; or*

xiv. *a ceiling that provides the sound insulation required for the wall.*

F5.6 Sound insulation rating of services

j. If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole-occupancy unit, the duct or pipe must be separated from the rooms of any sole-occupancy unit by construction with an Rw+Ctr (airborne) not less than –

xv. *40 if the adjacent room is a habitable room (other than a kitchen); or*

xvi. *25 if the adjacent room is a kitchen or non-habitable room.*

k. If a storm water pipe passes through a sole-occupancy unit it must be separated in accordance with (a).

8 Conclusion

Renzo Tonin & Associates have completed an assessment of the potential noise impacts to and from the proposed residential development at Site 53, 2 Figtree Drive, Sydney Olympic Park.

The study of external noise and vibration intrusion into the subject development has found that appropriate controls can be incorporated into the building design to achieve a satisfactory accommodation environment consistent with the intended quality of the building and relevant standards. In order to control airborne train noise intrusion and comply with the nominated criteria, glazing recommendations have been made in Section 5 above.

In addition, in-principle design recommendations have been made in relation to noise emission from mechanical plant and equipment to assist with the design of acoustic treatment in accordance with the relevant acoustic criteria determined in this report.

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 A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
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 Assessment and Design Methodology

B.1 SEPP (Infrastructure) 2007

87 Impact of rail noise or vibration on non-rail development

2. This clause applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration:

l. a building for residential use,

m. a place of public worship,

n. a hospital,

o. an educational establishment or child care centre.

3. Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.

4. If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

p. in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,

q. anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.

B.2 Department of Planning – Development near Rail Corridors and Busy Roads

The Guideline provides direction for developments that may be impacted by rail corridors and/or busy roads and consideration for the Guideline is a requirement for development specified under the Infrastructure SEPP.

Table 3.1 of the Guideline summaries noise criteria for noise sensitive developments

Residential Buildings		
Type of occupancy	**Noise Level dBA**	**Applicable time period**
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways	40	At any time
Non–Residential Buildings		
Type of occupancy		**Recommended Max Level dBA**
Educational Institutions including child care centres		40
Places of Worship		40

Residential Buildings		
Type of occupancy	**Noise Level dBA**	**Applicable time period**
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways	40	At any time
Non–Residential Buildings		
Type of occupancy		**Recommended Max Level dBA**
Hospitals	- wards	35
	-other noise sensitive areas	35

Note: airborne noise is calculated as Leq (9h) (night) and Leq (15h)(day). Ground-borne noise is calculated as Lmax (slow) for 95% of rail pass-by events.

APPENDIX C Noise Survey Results

C.1 Location and Results of the Short-term Noise Surveys

Results of short-term train noise measurements along the rail corridor adjacent to Site 53, Sydney Olympic Park are presented below.

Table 12: Short-term Rail Noise Measurements - Train Passbys

Location	Date	Time	Train	Measured SEL
Rail corridor to South-East of Site 53.	13th August 2014	12.58pm	Passenger	93 dB(A)
		1.08pm	Passenger	92 dB(A)
		1.18pm	Passenger	92 dB(A)
		1.28pm	Passenger	92 dB(A)
		1.38pm	Passenger	92 dB(A)
		1.48pm	Passenger	91 dB(A)
		1.58pm	Passenger	93 dB(A)
		2.08pm	Passenger	92 dB(A)
		2.18pm	Passenger	93 dB(A)
		2.28pm	Passenger	92 dB(A)

C.2 Location and Results of the Long-term Noise Surveys

Unattended noise monitoring location 1: Logger was positioned at the Southern corner of the existing Parking Lot located at Site 53. This location is set back from the corner of the site boundary by approximately 5m, and from the railway track by approximately 35m.

Unattended noise monitoring location 2: Logger was positioned at the Eastern side of the existing Parking Lot located at Site 53. This location was set back from Australia Avenue by approximately 50m, and from the railway track by approximately 35m.

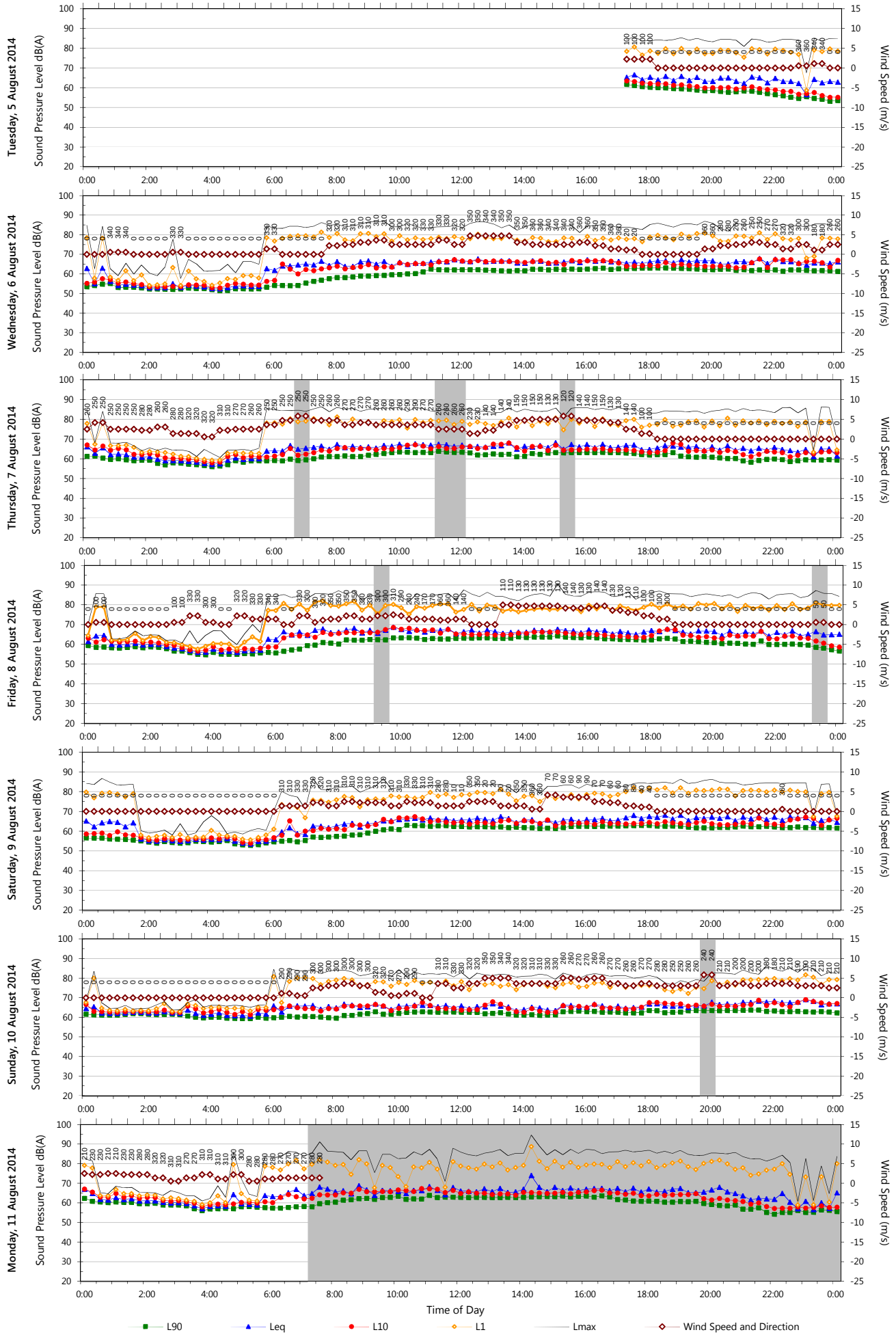
Survey Period: Tuesday 5th August to Wednesday 13th August 2014

APPENDIX D Figures

Figure 4: Site Location and Measurement Locations

Long Term monitoring location

Short Term train noise and vibration monitoring locations

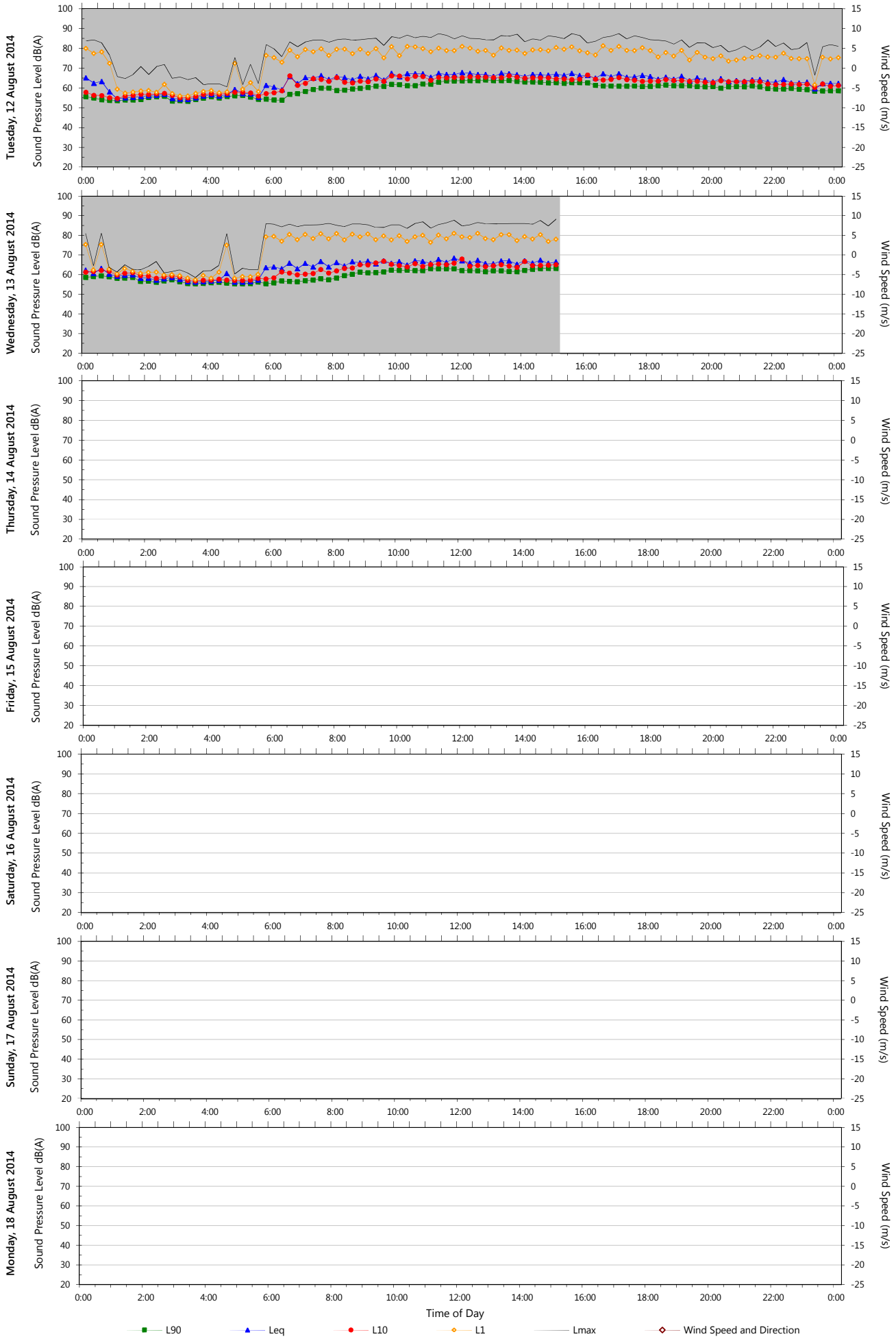


Data File: 2014-08-05_SLM_000_123_Rpt_Report.txt

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

Unattended Monitoring Results

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



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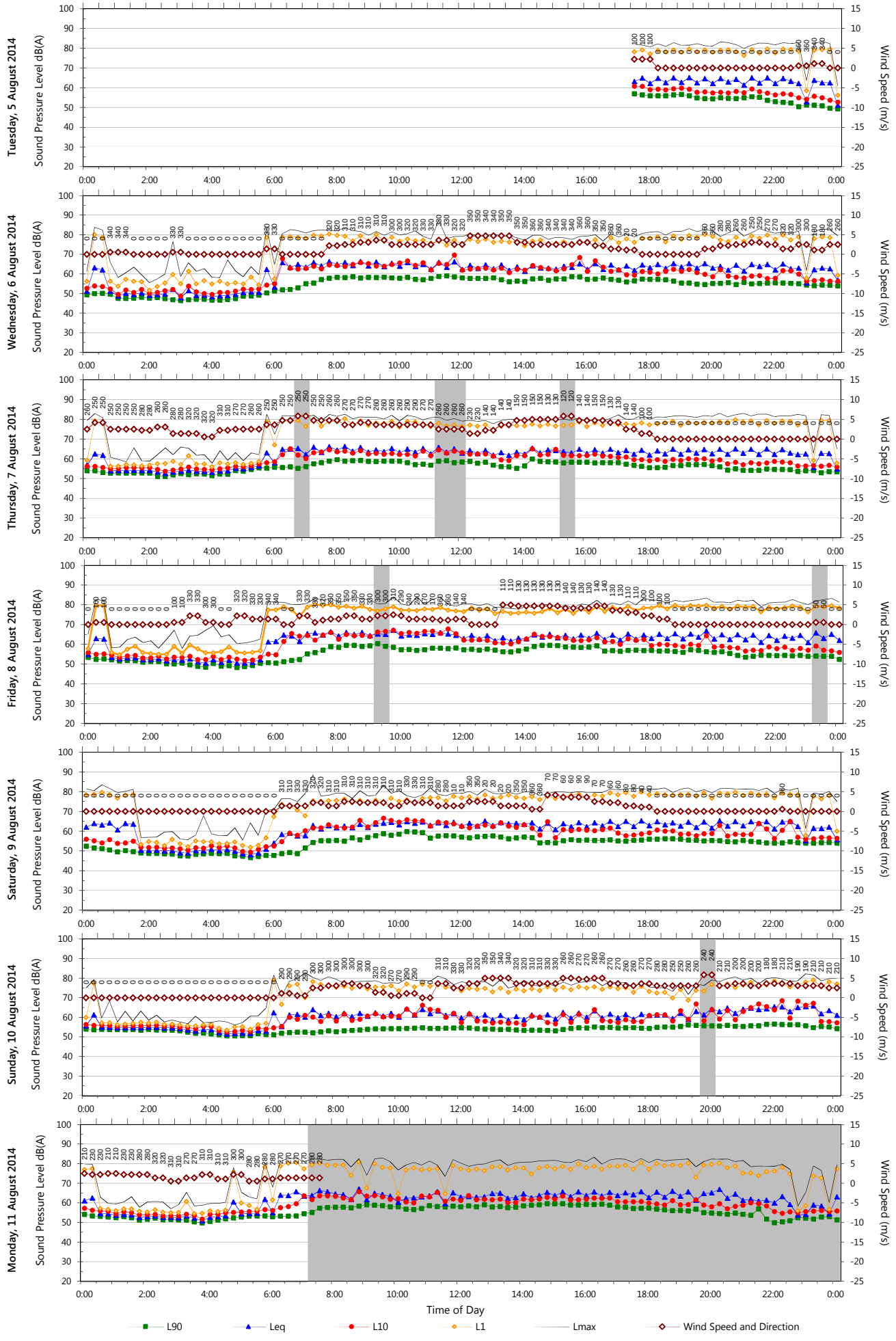
Template QTE-05B (rev 109) Sydney Logger Graphs

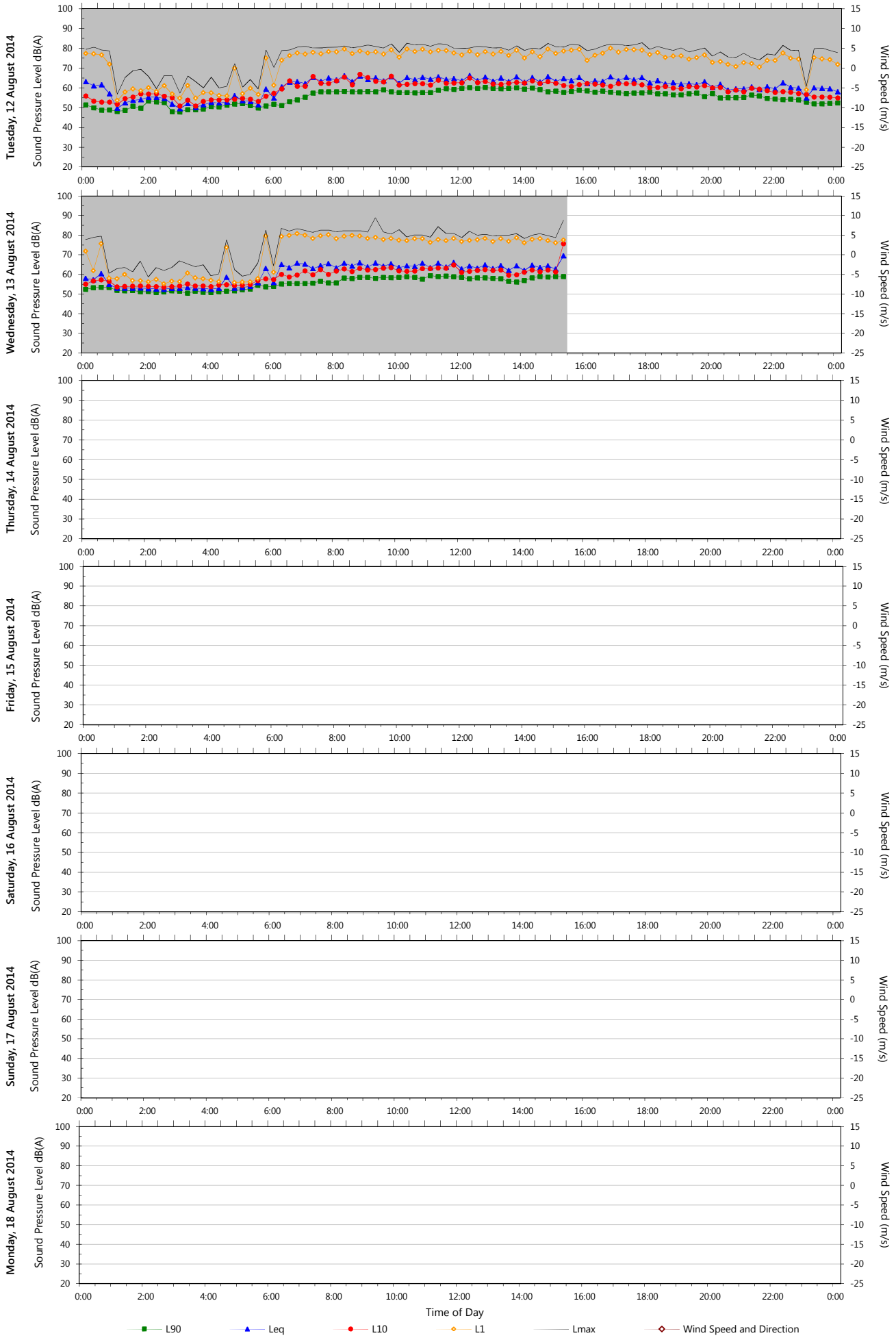


Data File: 2014-08-05_SLM_000_123_Rpt_Report.txt

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

Unattended Monitoring Results

Location: L2 - SOP Site 53 - south east



Data File: 2014-08-05_SLM_000_123_Rpt_Report.txt

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