NOISE IMPACT ASSESSMENT
URBAN PERSPECTIVES
PROPOSED SYDNEY SUPERYACHT MARINA
ROZELLE BAY, NSW

Prepared for: Urban Perspectives

Prepared by: Felipe Torres, Acoustical Engineer
Samuel T. Grieve, Acoustical Engineer
R T Benbow, Principal Consultant
BENBOW ENVIRONMENTAL
North Parramatta NSW

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Benbow
ENVIRONMENTAL

Engineering a Sustainable Future for Our Environment

13 Daking Street North Parramatta NSW 2151 AUSTRALIA
Tel: 61 2 9890 5099 Fax: 61 2 9890 5399
Email: admin@benbowenviro.com.au
Visit our website at: www.benbowenviro.com.au

EXECUTIVE SUMMARY

This report presents the findings of a detailed noise impact assessment carried out for the proposed operations associated with the Sydney Superyacht Marina located at Rozelle Bay, NSW 2039.

As required by the NSW Department of Planning and Infrastructure, the NSW Office of Liquor, Gaming and Racing Noise Criteria was utilized for assessing potential noise impacts from the Superyacht Marina development.

Unattended noise monitoring was undertaken continuously between Wednesday 15 February 2012 and Thursday 23 February 2012 at two residential locations at Glebe Point Road. The noise data was measured per octave band frequency between 31.5 Hz and 8 kHz in order to accurately establish the background noise level of the area.

Predictive noise modelling was carried out using the Concawe algorithm within SoundPLAN v7.1. Model scenarios were configured to provide a realistic assessment of potential site-related noise emissions. Therefore, several reasonable assumptions were made in order to assess worst case scenarios considering a 15 minute assessment period. Moreover, each scenario was run with neutral and adverse weather conditions.

Noise exceedances were predicted at several residential receiver locations primarily under adverse weather conditions. Therefore, noise mitigation measures and recommendations have been included as a means to reduce the potential for noise impacts associated with the subject site.

By implementing the noise control measures and recommendations detailed in Section 6 of the following report, it has been predicted that the proposed activities of the Sydney Superyacht Marina will not generate significant noise impact at the various receivers and the Project Specific Noise Levels will be achieved.

Felipe Torres
Acoustical Engineer

Samuel T. Grieve
Acoustical Engineer

R T Benbow
Principal Consultant

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1. INTRODUCTION

This report presents the findings of a detailed noise impact assessment carried out for the proposed operations associated with the Sydney Superyacht Marina located at Rozelle Bay, NSW 2039. The report also responds to issues raised by the NSW Department of Planning and Infrastructure received on the 21 December 2011 regarding a previous 'Environmental Noise Impact Assessment' report (110056_Rep_Rev5), a previous 'Response to Public Submissions' report (111026_Responses_Rev2) and a 'Project Specific Noise Limits' report (111026_PSNL_Rep_Rev4) prepared by Benbow Environmental in 2011. The key issue to be addressed, and consequently the primary focus of the following report, surrounds the assessment of noise emissions from licensed venues against the Office of Liquor, Gaming and Racing (OLGR) noise criteria. All other issues identified by the NSW Department of Planning and Infrastructure have been addressed within the opening introduction section of this report below.

Issue 1

"The PPR (p36) states that the proponent will 'consider' various provisions to restrict access to the balconies to limit noise reaching the residents – this should be included in Statement of Commitments (SoC)."

Benbow Environmental's Response to Issue 1

This is addressed in the Response to Issue 2 as the issues are similar.

Issue 2

"Clarification is required regarding the use of outdoor balconies after 10pm. The PPR (p36) states that 'the use of these areas is limited from 7am - 10pm' however this is contradicted by the statement that 'and after 10pm all windows and doors from these tenancies will be kept closed, expect when needed for ingress/egress."

Benbow Environmental's Response to Issue 2

To clarify the above contradiction Benbow Environmental states in Section 6.1 of the following report:

- "The use of the balconies, terraces and outdoor areas has to be limited between 7:00 am and 10:00 pm", and
- "The external doors and windows of the eastern and western buildings should be closed after 10:00 pm.

Issue 3

"The PPR states that the future design of the building shall have an STC rating, acoustic seals and have self closing doors (p37) - this should be included within the SoC."

Benbow Environmental's Response to Issue 3

Section 5.2.3 of the following report details the considered construction materials (as indicated by John Ferres from Scott Carver Pty Ltd) utilised within the predictive noise model for the external walls, external glazing and roof. In addition to the description of construction materials utilised in Section 5.2.3, more detailed technical Sound Transmission Class (STC) data, obtained from INSUL (Sound Insulation Prediction Software) and Viridian, has been provided in Attachment 5.

Issue 4

"The 10 November 2011 Benbow report (p13) states that 'analysis of noise spectra was undertaken and no inherent tonal, low frequency, impulsive or intermittent characteristics were found to be present'. This contrasts to the 17 May 2011 Benbow report (p4) which states 'the presence of impulsive characteristics have been identified from the music simulation noise testing and these would be removed by the restrictions on types of instruments that could be played'."

Benbow Environmental's Response to Issue 4

The first comment, *'analysis of noise spectra was undertaken and no inherent tonal, low frequency, impulsive or intermittent characteristics were found to be present'* contained within the Benbow Environmental Project Specific Noise Limits report (111026_PSNL_Rep_Rev4) released 10 November 2011 addresses the character of the existing level of industrial noise present in the surrounding area to the subject site. This comment deals with noise emissions completely unrelated to the proposed noise emissions from the Superyacht Marina, rather it deals with the derivation of Project Specific Noise Levels as per the NSW Industrial Noise Policy.

The second comment, *'the presence of impulsive characteristics have been identified from the music simulation noise testing and these would be removed by the restrictions on types of instruments that could be played"* contained within the Benbow Environmental Response to Public Submissions report (111026_Responses_Rev2) released 17 May 2011 addresses the character of potential noise emissions from the operation of the Superyacht Marina, in particular noise emissions from live bands.

As a result, the two comments identified by the NSW Department of Planning and Infrastructure are not in contrast to one another as they are addressing two rather different issues.

Issue 5

"10 November 2011 Benbow report recommends that a detailed Noise Management Plan be prepared. The key components of a Noise Management Plan should be included in the proposal or included within the SoC."

Benbow Environmental's Response to Issue 5

The key components that should be included within a detailed Noise Management Plan (NMP) for the successful operation of the Superyacht Marina include:

- Site location;
- Surrounding land use;
- Operations overview;
- Noise criteria:
  - Industrial Noise Policy noise criteria;
  - Office of Liquor, Gaming and Racing noise criteria;
- Noise management strategy:
  - Complaint procedure;
  - Noise measurement procedure;
  - Education and training for site personnel;
  - Late evening parking;
  - Traffic wardens to address car parking noise issues;
  - Use of the Marina during emergency maintenance;
  - Consultation with the community;
  - Contractual arrangements with bands; and
  - Lease agreements to include noise management.
- Recommendations detailed in Section 6 of this report.

Issue 6

"Please provide a photograph or location details of 8/501 Glebe Point Road and 28/501 Glebe Point Road."

Benbow Environmental's Response to Issue 6

Photographs of the above mentioned residential locations which were utilised for long-term and short term noise monitoring have been provided in Section 3.2 of the following report as Figure 3-1, Figure 3-2, Figure 3-3, Figure 3-4.

The remainder of this Noise Impact Assessment has focused on the potential noise impacts associated with the operational phase of the proposed Superyacht Marina. The predominant noise sources associated with the proposed licensed operations of the Marina include music bands playing outdoors, outdoor seating areas, café, restaurant, bar, marine facilities, fan units and a car park. The proposed Marina is located within an existing industrial / urban area and is proposed to be in operation 24 hours a day, 7 days per week depending on the type of activities. These activities are addressed in detail in Section 2.3 Project Description and hours of operation listed in Table 2-2.

In order to satisfy the NSW Department of Planning and Infrastructure requirements, this assessment has been carried out in accordance with the Office of Liquor, Gaming and Racing (OLGR) noise criteria. Therefore, long-term unattended noise monitoring were undertaken at two (2) locations in the vicinity of the subject site in order to measure the existing background noise level of the area.

In addition to noise emissions from licensed premises, the development will also include comparatively minor industrial noise source emissions triggering assessment against the guidelines established by the NSW EPA Industrial Noise Policy (INP).

The identified industrial noise sources are considered to be:

- Pennant Crane; maximum capacity 5000kg.
- Workshop activities; minor repairs including occasional hammering and sawing.
- Truck deliveries including:
  - Mini fuel tankers for the refuelling of super yachts taking place throughout day time hours as and when required. There are currently 24 super yachts.
  - Weekly waste collection.
  - Food, commercial and retail deliveries each day during day time hours.

The L_{A90} noise descriptor was measured and assessed to fluctuate between 48 – 53 dB(A) depending on the time period throughout the day (Day, Evening and Night) at residential locations 28/501 and 8/501 Glebe Point Rd. This results in an Intrusive Criterion ranging between 53 – 58 dB(A) according to the INP.

Due to the minimal nature of the identified industrial noise sources in comparison to the licensed premises noise sources, a noise impact assessment considering industrial noise sources has not been undertaken within this report. Benbow Environmental ensures that noise emissions associated with the above identified industrial noise sources will achieve compliance with the NSW EPA Industrial Noise Policy noise criteria, namely the Intrusive Criterion.

The nearest residential dwellings are located 210 metres to the south of the subject site on Glebe Point Road, Glebe, 340 metres to the north west on Lilyfield Road, Rozelle, and 620 metres to the east of the subject site at Pyrmont. Based on the location of the nearest residential receivers, potential for noise impacts associated with the operations of the proposed licensed premises exist.

However, it is expected that with the implementation of recommended noise control measures contained within this report, associated noise impacts from the subject site would comply with the OLGR noise criteria.

1.1 SCOPE

The noise impact assessment has been limited to the following:

a) Clarifications of the issues raised by the NSW Department of Planning and Infrastructure;
b) Measurement of existing background noise levels;
c) Establishment of site-specific noise design objectives;
d) Review of proposed site operations;
e) Determine all potential noise sources associated with the development application;
f) Collection of required noise samples;
g) Predict potential noise impacts from the development at the nearest potentially affected residential receivers;
h) Assessment of potential noise impacts against relevant legislation and guidelines;
i) Investigate ameliorative measures/control solutions (where required); and
j) The compilation of this report containing concise statements of potential noise impact.

2. PROJECT INFORMATION

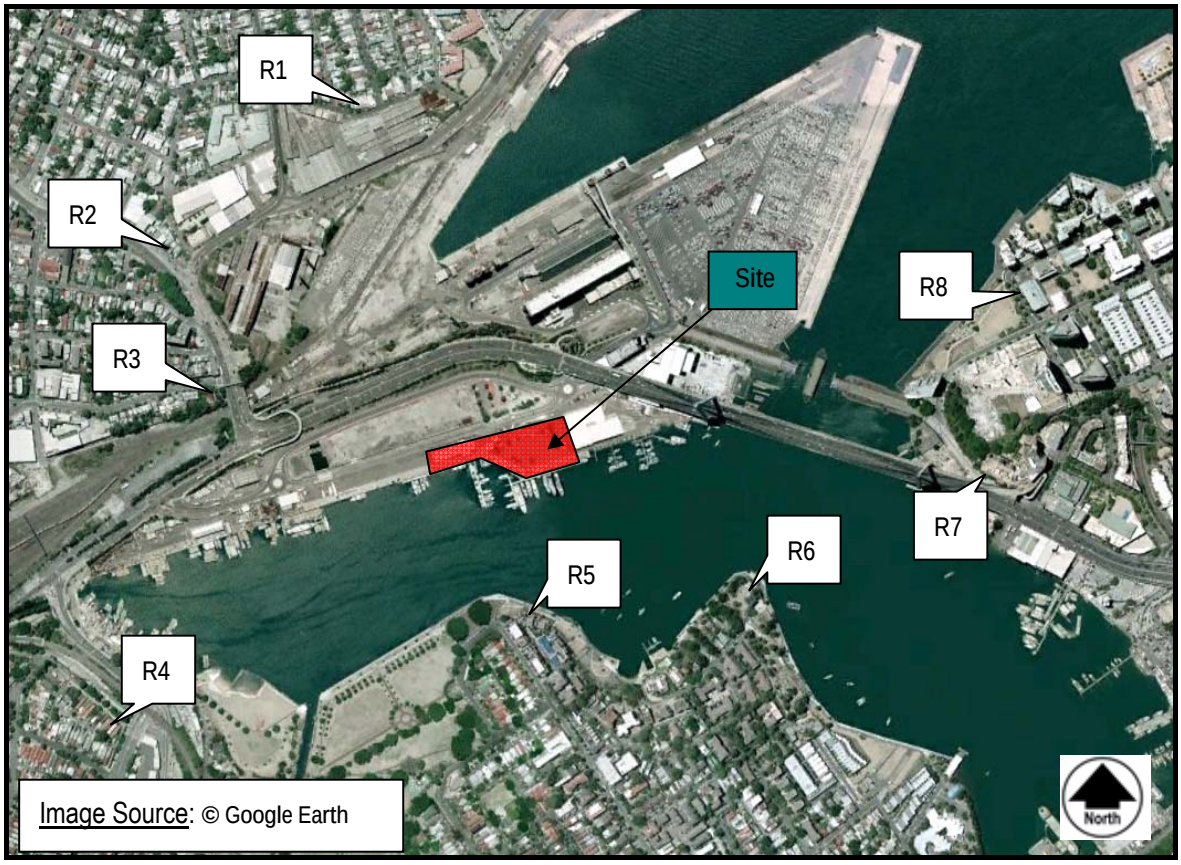
A brief description of the subject site and proposed operations has been provided below.

2.1 SITE LOCALITY

A site locality plan has been provided in Figure 2-1 below while the nearest identified residential receiver locations considered in this assessment have been identified in Figure 2-2.

Figure 2-1: Site Aerial and Locality

Figure 2-2: Nearest Potentially Affected Receivers



2.2 SURROUNDING LAND USE

The subject site is bordered by existing allotments that are consistent with the land use and zoning for the region.

Site inspections determined that the immediate area surrounding the location of the proposed development is comprised of marine and industrial uses. In the far field are the residential areas of Rozelle, Glebe Point and Pyrmont. Accordingly, the surrounding land uses were found to predominantly comprise an 'urban and industrial' setting.

The subject site and its surrounding landscapes are subject to minor variations in topographical grade (based on the 1:10,000 topographic map for the region, Leichhardt U0945).

Eight (8) potentially affected residential receivers have been specifically considered at locations marked R1 to R8, as outlined in Table 2-1 below. Each receiver location has several levels depending on the height of the actual building adjacent to the respective receiver location.

Table 2-1: Residential Receiver Locations Considered

Receiver	Location	Approx. Separation Distance †	Bearing	Indicative Noise Amenity Area
R1	Mansfield Street	515 m	N	Urban
R2	Victoria Road	480 m	NW	Urban
R3	Lilyfield Road	330 m	W	Urban
R4	Bayview Crescent	620 m	SW	Urban
R5	Glebe Point Road	210 m	S	Urban
R6	Leichhardt Street	330 m	SE	Urban
R7	Bank Street	620 m	E	Urban
R8	Tambua Street	720 m	NE	Urban

Note: † denotes assessed from proposed site

2.3 PROJECT DESCRIPTION

The proposed development will involve several activities including one live jazz band or one live rock band playing outdoors at ground level between 11:00am and 8:00 pm, excluding special event days such as Christmas, Boxing Day, New Year Eve, New Year's Day, Australia Day and 5 additional days throughout the year in which case the allowable time period would be between the hours of 9:00 to 10:00 pm. The most likely days for live music would be on weekends.

There are to be outdoor seating areas located on the balconies and terraces. Use of these outdoor seating areas would be limited to the hours between 7:00am and 10:00pm on any day. After 10:00pm all windows and doors from the tenancies are to remain closed.

A yacht club is proposed for the subject site which will have the benefit of providing lounge and relaxation facilities for Superyacht owners and crew and other members of the Club. It is anticipated that the club will include a bar/lounge area, restaurant and/or café, and function facilities.

A car parking facility containing a total of 187 car spaces is proposed containing 120 car spaces within the car park building, 64 car spaces outside and 3 disabled car spaces within the site.

Numerous other activities with a diverse range of acoustic impact will take place within the site. The time operation of these activities, the percentage of use and the location are shown in Table 2-2, Table 2-3, Table 2-4 and Figure 2-3 respectively.

Table 2-2: Proposed hours of operation

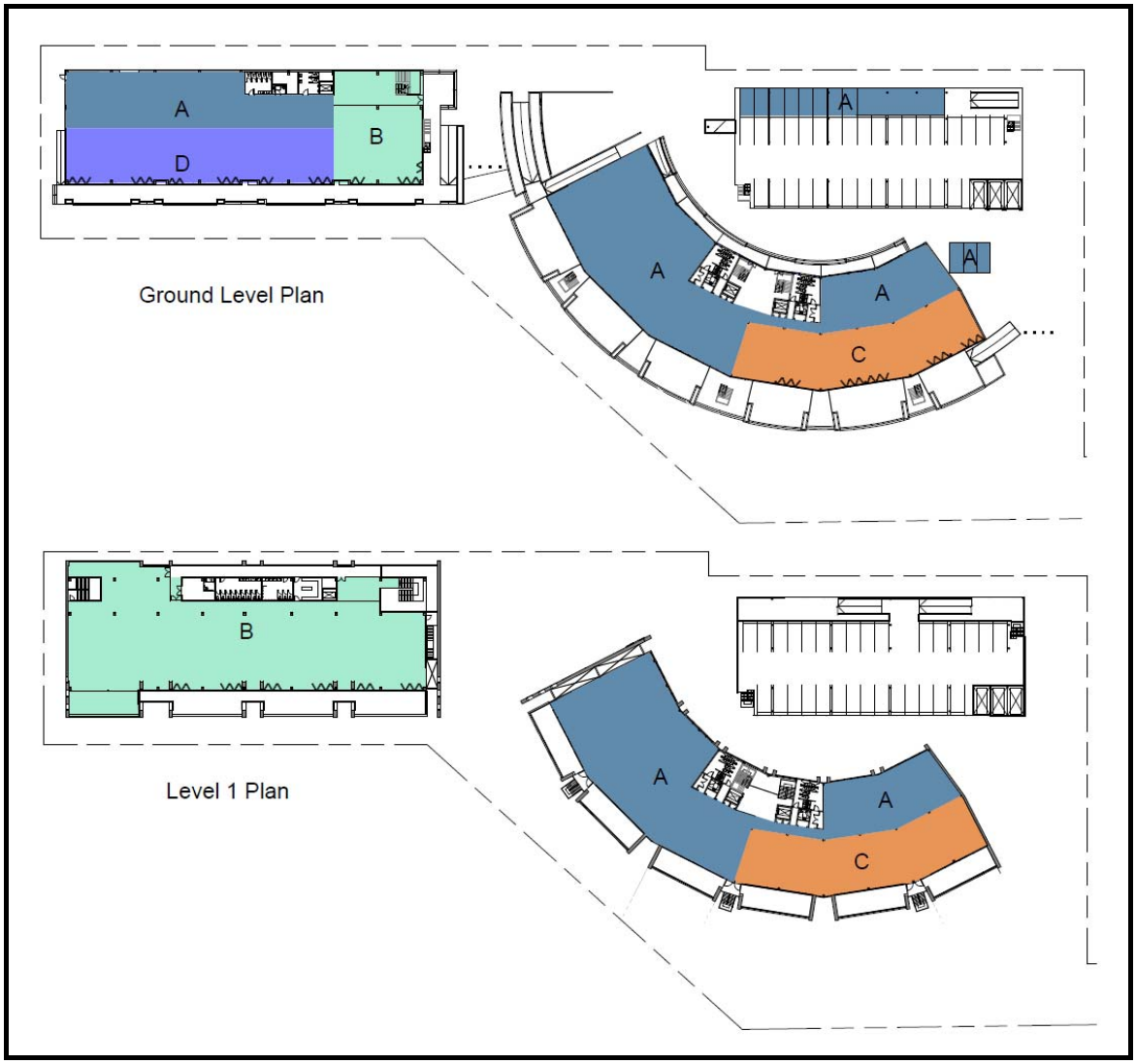
Activity	Day	Time
Marine chandlery & retail outlets	Monday - Friday Saturday - Sunday	7:00 am to 7:00 pm 7:00 am to 8:00 pm
Café / restaurant / Takeaway / bars	Sunday - Wednesday Thursday - Saturday	7:00 am to 11:00 pm 7:00 am to 12:00 am
Yacht Club	Monday - Sunday (7 days)	7:00 am to 12:00 am
Marina Facilities, commercial	Monday to Sunday	24

Table 2-3: Percentage of use within the proposed buildings (Refer Figure 2-3)

Use	Maximum/ minimum %	Identified on sketch plan as:	Estimated GFA per SREP 26
Marine related offices, retail and workshops, including not more than 3 marina attendant/crew dormitories	Not < 40%	A – marine	Not < 2576 m2
Yacht Club	Not > 30%	B – yacht club	Not > 1932 m2
Ancillary restaurants / takeaway /café / bars	Not > 15%	C - ancillary	Not > 966 m2
Marine Provedore / Seafood retail / seafood restaurant	Not > 7%	D – provedore/ seafood	Not > 451 m2

Table 2-4: Detailed percentage of use within the proposed buildings (Refer Figure 2 3)					
Building	Level	GFA m^2	Land Use	m^2	% GFA of Site
Western	Ground	1335	A Marine	517	8.0%
			B Yacht Club	367	5.7%
			D Provedore	451	7.0%
	First Floor	1565	B Yacht Club	1565	25.6%
Eastern	Ground	1650	A Marine	1167	
			C Ancillary restaurants/bars	483	7.5%
	First Floor	1650	A Marine	1167	
			C Ancillary restaurants/bars	483	7.5%
Car Park Storage	240		A Marine	240	3.7%
Total m^2				6440	
Identified on sketch plan as:			A Marine	3091	48.0%
			B Yacht Club	1932	30.0%
			C Ancillary restaurants/bars	966	15.0%
			D Provedore/ seafood restaurant	451	7.0%
Total %				6440	100%

Figure 2-3: Percentage of Use of the Buildings (Table 2-3)



The primary noise sources associated with the proposed Marina include:

- Outdoor live band;
- Outdoor seating areas on the balconies and terraces;
- Function facilities within the buildings;
- Café, restaurant, takeaway and bars;
- Air conditioning plant and Fan units on the roof; and
- Car park.

Noise modelling scenarios have been established based on all of these operations in order to assess the potential noise impacts under worst-case scenarios. The proposed site plans are shown in Figure 2-4, Figure 2-5 and Figure 2-6.

Figure 2-4: Proposed Site Plan (Ground Floor)

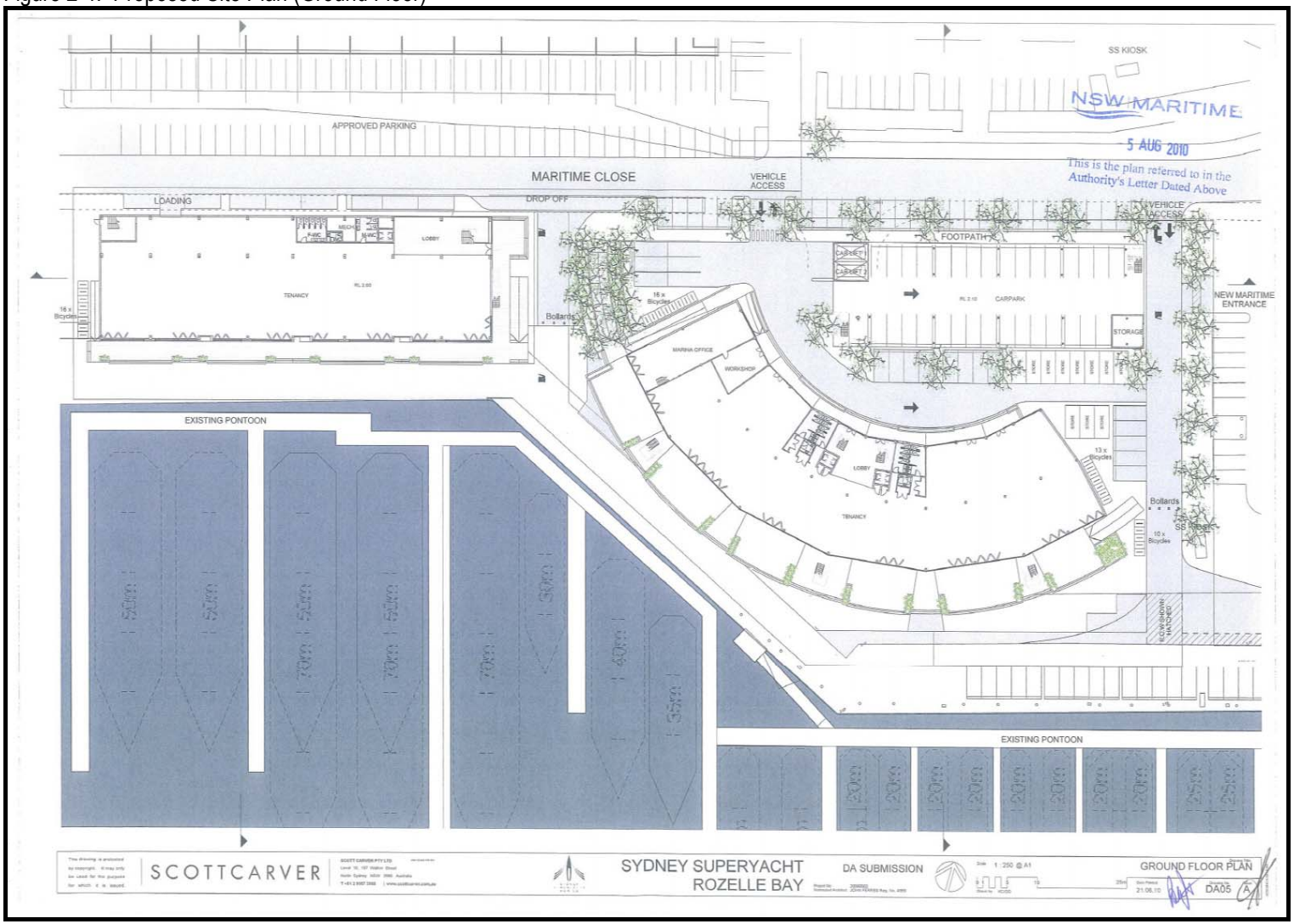


Figure 2-5: Proposed Site Plan (First Floor)

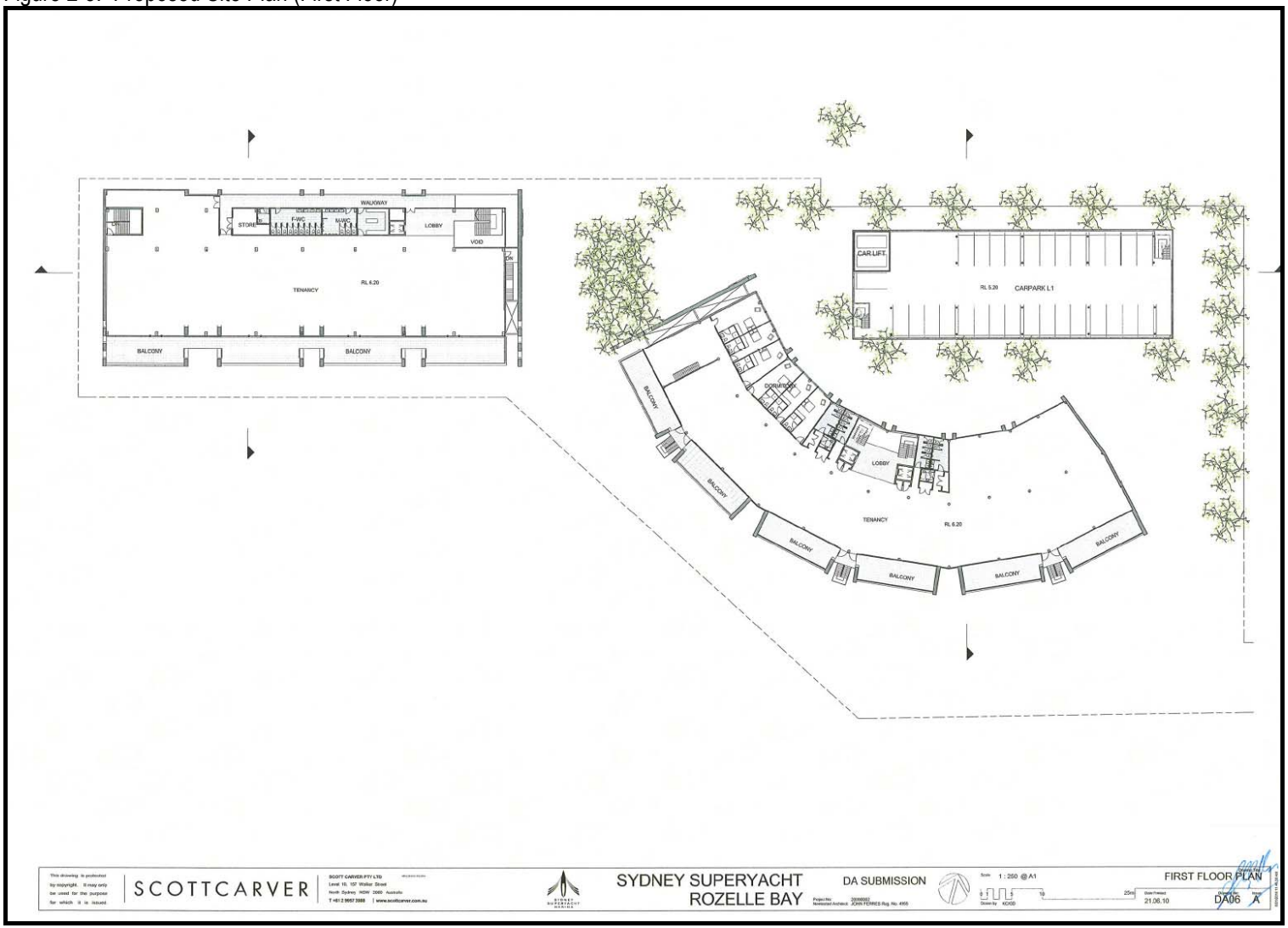
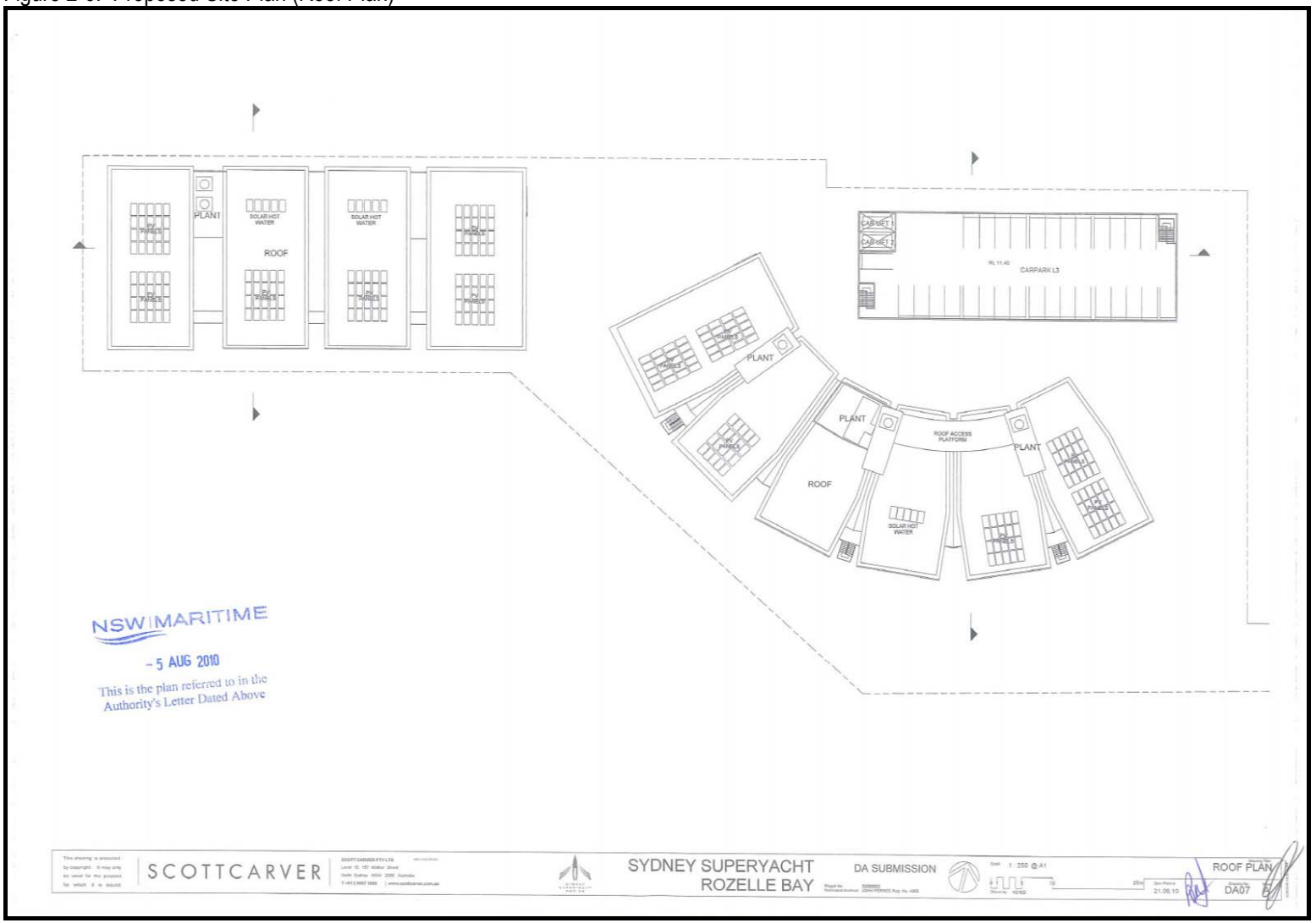


Figure 2-6: Proposed Site Plan (Roof Plan)



3. EXISTING AMBIENT NOISE ENVIRONMENT

3.1 METHODOLOGY

The attended noise measurements were carried out using a SVANTEK Type 1 Sound Level Meter and long-term unattended noise monitoring was carried out using Acoustic Research Laboratories statistical Environmental Noise Loggers, (Ngara).

To ensure accuracy and reliability in the results, field reference checks were applied both before and after the measurement period with an acoustic calibrator. There were no excessive variances observed in the reference signal between the pre-measurement and post-measurement calibration. The instruments were set on A-weighted Fast Response and noise levels were measured over 15-minute statistical intervals. QA/QC procedures applied for the measurement and analysis of noise levels have been presented in the Attachments. The microphones were fitted with windsocks and were positioned between 1.2 and 1.5 meters above ground level.

In assessing the background noise levels, any data affected by rain has been discarded. The weather data was sourced from the Bureau of Meteorology (BOM), this data came from the Sydney (Observatory Hill) Automatic Weather Station (AWS).

The level of background noise would vary over the course of any 24 hour period, typically from a minimum at around 3.00am in the morning to a maximum during morning and afternoon traffic peak hours. Therefore the level of background and ambient noise was assessed separately for the daytime, evening and night time periods as follows:

- Day defined as 7:00am to 6:00pm, Monday to Sunday;
- Evening defined as 6:00pm to 10:00pm, Monday to Sunday;
- Night$_1$ defined as 10:00pm to 0:00am, Monday to Sunday; and
- Night$_2$ defined as 0:00pm to 7:00am, Monday to Sunday.

3.2 MEASUREMENT LOCATIONS

The following two residential locations were chosen for the long-term and short-term noise monitoring programme:

- Location A – Residence at Unit 28, 501 Glebe Point Road, located at the first floor of the building, approximately 210m to the south of the site.
- Location B – Residence at Unit 8, 501 Glebe Point Road, located at the fifth floor of the building, approximately 250m to the south of the site.

Figure 3-1, Figure 3-2, Figure 3-3 and Figure 3-4 presented below identify the locations of the noise monitoring.

Figure 3-1: Location A

Figure 3-2: Location A Facing the Site

Figure 3-3: Location B

Figure 3-4: Location B Facing the Site

3.3 MEASURED NOISE LEVELS

The long-term noise monitoring was undertaken continuously between Wednesday 15 February 2012 and Thursday 23 February 2012.

Attended noise monitoring is not specifically requested by the OLGR however for purposes of this assessment it was undertaken throughout logger establishment in order to identify the main noise contributors of the area. The attended short-term noise monitoring was carried out on Tuesday 14 February 2012 during the day time.

The results of the short-term and long-term noise monitoring are detailed in Table 3-1, Table 3-2 and Table 3-3. The resultant data is considered representative of the background noise levels for the area, and therefore suitable for use in this noise impact assessment.

Table 3-1: Attended Noise Monitoring at Logger Locations (Day Time Period), dB(A)					
Location & Measurement Period	Noise Descriptor				Comments
	L_{A1}	L_{A10}	L_{A90}	L_{Aeq}	
Location A Tuesday 14/02/2012 (14:34 – 14:49)	61	55.9	52.1	54.5	Traffic audible constantly 52-54 dB(A) Airplane ≤ 65 dB(A) People passing ≤ 50 dB(A) Birds ≤ 55 dB(A) Cars accelerating 57 dB(A) Sporadic insects 50-58 dB(A)
Location B Tuesday 14/02/2012 (15:47 – 16:02)	62.3	57.4	53.3	57.4	Traffic audible constantly 54-56 dB(A) Airplane ≤ 67 dB(A) Small constant water fall 50 dB(A) Boat horn 87 dB(A) Metal clanging 64 dB(A)

Table 3-2: Measured Background Noise Levels, Unattended Long-term Noise Monitoring (L_{90}) - Location A: Unit 28, 501 Glebe Point Road, dB(A)

Date	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
15/02/2012	$Night_2$	-	-	-	-	-	-	-	-	-	-
	Day	25	35	36	42	47	51	46	36	22	54
	Evening	25	34	35	41	46	50	49	36	22	54
	$Night_1$	21	30	33	40	46	51	46	35	20	54
16/02/2012	$Night_2$	20	30	32	37	43	46	42	32	19	49
	Day	27	37	38	44	49	52	48	38	24	55
	Evening	25	35	37	44	50	54	50	39	26	57
	$Night_1$	22	31	35	41	47	52	47	36	20	55
17/02/2012	$Night_2$	19	30	32	37	43	47	43	32	18	50
	Day	27	37	38	43	47	51	46	37	23	54
	Evening	25	36	37	43	48	53	50	38	22	56
	$Night_1$	23	32	34	39	46	50	46	34	18	53
18/02/2012	$Night_2$	22	30	31	35	41	45	42	30	17	48
	Day	24	34	35	38	43	46	42	32	18	50
	Evening	22	32	33	37	43	47	49	33	19	52
	$Night_1$	21	31	32	35	43	47	42	31	21	50
19/02/2012	$Night_2$	17	27	29	34	41	46	41	29	17	48
	Day	23	33	35	40	46	49	45	34	21	52
	Evening	23	34	37	42	48	52	50	38	25	55
	$Night_1$	#	#	#	#	#	#	#	#	#	#
20/02/2012	$Night_2$	19	30	32	35	40	45	41	31	18	48
	Day	25	35	37	40	44	47	44	34	20	51
	Evening	24	33	34	38	43	46	43	33	20	50
	$Night_1$	18	27	29	34	39	43	42	30	18	47
21/02/2012	$Night_2$	17	27	29	33	37	42	39	32	18	45

Table 3-2: Measured Background Noise Levels, Unattended Long-term Noise Monitoring (L_{90}) - Location A: Unit 28, 501 Glebe Point Road, dB(A)

Date	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
	Day	25	34	36	39	44	47	44	35	21	50
	Evening	22	32	33	37	42	46	49	35	21	52
	$Night_1$	19	28	30	34	40	44	41	30	18	47
22/02/2012	$Night_2$	17	28	30	34	40	44	41	29	16	47
	Day	25	35	36	40	44	47	43	33	19	51
	Evening	23	33	34	37	43	46	45	32	19	50
	$Night_1$	19	29	31	35	42	46	42	30	17	49
23/02/2012	$Night_2$	15	26	28	32	39	43	39	28	16	46
	Day	-	-	-	-	-	-	-	-	-	-
	Evening	-	-	-	-	-	-	-	-	-	-
	$Night_1$	-	-	-	-	-	-	-	-	-	-
Median	$Night_2$	18	29	31	35	41	45	41	31	18	48
	Day	25	35	36	40	45	48	44	34	21	52
	Evening	24	33	35	39	45	48	49	36	21	53
	$Night_1$	21	30	32	35	43	47	42	31	18	49

Note: - indicates data was not recorded for that period.
# indicates periods of inclement weather which nullifies the noise levels for that period.
Cell in bold indicates the median value for each octave band.

Table 3-3: Measured Background Noise Levels, Unattended Long-term Noise Monitoring (L_{90}) - Location B: Unit 8, 501 Glebe Point Road, dB(A)

Date	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
15/02/2012	$Night_2$	-	-	-	-	-	-	-	-	-	-
	Day	19	34	40	43	48	51	46	40	33	54
	Evening	16	31	37	41	46	50	46	38	31	53
	$Night_1$	13	28	35	39	44	48	43	33	23	51
16/02/2012	$Night_2$	14	30	37	39	43	46	41	34	26	49
	Day	21	35	41	44	49	52	47	41	34	55
	Evening	19	33	39	45	49	52	48	41	33	56
	$Night_1$	12	27	35	39	44	48	43	34	24	51
17/02/2012	$Night_2$	14	29	36	40	44	47	42	35	27	50
	Day	19	34	40	43	48	50	46	41	33	54
	Evening	17	32	38	42	47	51	47	39	32	54
	$Night_1$	14	26	34	37	42	46	41	32	24	49
18/02/2012	$Night_2$	13	27	35	37	41	45	41	34	27	48
	Day	17	30	37	41	44	47	44	39	33	51
	Evening	14	28	35	38	43	47	43	38	32	50
	$Night_1$	13	26	33	37	42	46	40	32	23	49
19/02/2012	$Night_2$	9	23	31	35	40	44	39	33	26	47
	Day	17	32	38	41	46	50	45	40	33	53
	Evening	17	31	38	41	46	50	47	40	33	54
	$Night_1$	#	#	#	#	#	#	#	#	#	#
20/02/2012	$Night_2$	15	29	36	39	43	46	41	35	27	49

Table 3-3: Measured Background Noise Levels, Unattended Long-term Noise Monitoring (L_{90}) - Location B: Unit 8, 501 Glebe Point Road, dB(A)

Date	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
	Day	19	32	39	42	46	48	45	40	33	52
	Evening	15	28	35	39	43	47	44	39	33	51
	$Night_1$	9	22	30	34	37	41	38	32	24	45
21/02/2012	$Night_2$	14	26	33	37	40	43	40	35	28	47
	Day	19	29	36	41	45	47	45	41	34	52
	Evening	15	25	33	37	42	45	42	38	32	49
	$Night_1$	10	22	31	34	38	42	37	30	23	45
22/02/2012	$Night_2$	14	26	35	38	42	45	40	33	26	48
	Day	19	29	37	41	45	47	43	39	32	51
	Evening	14	26	34	38	43	46	42	37	31	50
	$Night_1$	9	21	31	35	40	43	37	25	15	46
23/02/2012	$Night_2$	7	20	30	34	38	40	35	24	14	44
	Day	-	-	-	-	-	-	-	-	-	-
	Evening	-	-	-	-	-	-	-	-	-	-
	$Night_1$	-	-	-	-	-	-	-	-	-	-
Median	$Night_2$	14	27	35	37	42	45	40	34	27	48
	Day	19	32	38	42	46	49	45	40	33	53
	Evening	15	29	36	40	45	48	45	39	32	52
	$Night_1$	12	26	33	37	42	46	40	32	23	49

Note: - indicates data was not recorded for that period.
# indicates periods of inclement weather which nullifies the noise levels for that period.
Cell in bold indicates the median value for each octave band.

4. CURRENT LEGISLATION AND GUIDELINES

4.1 NSW OFFICE OF LIQUOR, GAMING AND RACING NOISE CRITERIA

The NSW Office of Liquor, Gaming and Racing noise criteria was developed in order to assess licensed premises that may generate noise impacts at particular residential areas. As required by the NSW Department of Planning and Infrastructure, this guideline was utilized for assessing the potential noise impact from the Sydney Superyacht Marina development.

This noise criteria states:

> *"The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8k Hz inclusive) by more than 5 dB between 07:00 am and 12:00 midnight at the boundary of any affected residence. The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8k Hz inclusive) between 12:00 midnight and 07:00 am at the boundary of any affected residence. Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 07:00 am.*
>
> *Where L_{A10} is the average maximum deflection of the noise emission from the licensed premises."*

4.2 PROJECT-SPECIFIC NOISE LIMITS

Noise limits for the development can now be established in accordance with the measured background noise levels and the NSW Office of Liquor, Gaming and Racing noise criteria.

The selected Project-Specific Noise Limits for all the receiver locations are presented below in Table 4-1. The unattended noise monitoring shown in Table 3-2 for Location A was considered to be representative of the background noise levels for all the considered receptors at the first floor whist the results shown in Table 3-3 are representative for all the considered receptors at the fifth floor.

Table 4-1: Project-Specific Noise Limits (PSNL), dB(A)

Receivers	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1-R8 1st floor	Day	30	40	41	45	50	53	49	39	26	57
	Evening	29	38	40	44	50	53	54	41	26	58
	$Night_1$	26	35	37	40	48	52	47	36	23	54
	$Night_2$	18	29	31	35	41	45	41	31	18	48
R1-R8 5th floor	Day	24	37	43	47	51	54	50	45	38	58
	Evening	20	34	41	45	50	53	50	44	37	57
	$Night_1$	17	31	38	42	47	51	45	37	28	54
	$Night_2$	14	27	35	37	42	45	40	34	27	48

Note: Day indicates time period between 7:00 am to 6:00 pm
Evening indicates time period between 6:00 pm to 10:00 am
$Night_1$ Indicates time period between 10:00 pm to 00:00 am
$Night_2$ Indicates time period between 00:00 am to 7:00 am

5. PREDICTED NOISE MODELLING

An outline of the predictive noise modelling methodology and operating scenarios has been provided below.

5.1 NOISE SOURCES DATA

The third octave sound power levels for the noise sources identified have been either calculated from on-site measurements of sound pressure levels undertaken by environmental engineers from Benbow Environmental or have been measured at similar facilities.

The results are presented in Table 5-1 below. The data will be used to model noise emissions from the site at the nearest potentially affected sensitive receivers to the site.

Table 5-1: A-weighted Sound Power Levels Based on L_{A10} Measurements, dBA

Frequency Band (Hz)	Item							
	Live Music		Car Park		Café, Restaurant, Bar			
	Moderate Jazz Band	Moderate Rock Band	Car Manoeuvring 20km/hr	Starting	4 People Conversation at Moderate Level	4 People Conversation at Elevated Level	Air Conditioning Fan Unit	Moderate PA System
Overall dB(A)	107	114	78	78	80	90	85	79
25	48	49	43	31	29	39	44	34
31.5	52	55	45	37	34	44	46	36
40	61	75	51	41	44	54	49	36
50	69	94	55	36	46	56	53	46
63	74	92	53	41	36	46	55	51
80	77	93	54	45	42	52	58	55
100	82	101	56	50	43	53	60	57
125	82	91	53	54	54	64	63	66
160	84	99	54	59	55	65	72	68
200	86	101	57	55	61	71	68	65
250	87	95	62	53	70	80	67	64
315	89	94	62	52	66	76	68	71
400	98	102	65	50	70	80	67	67
500	102	102	67	57	75	85	70	67
630	98	100	68	64	73	83	71	68

Table 5-1: A-weighted Sound Power Levels Based on L_{A10} Measurements, dBA

Frequency Band (Hz)	Item							
	Live Music		Car Park		Café, Restaurant, Bar			
	Moderate Jazz Band	Moderate Rock Band	Car Manoeuvring 20km/hr	Starting	4 People Conversation at Moderate Level	4 People Conversation at Elevated Level	Air Conditioning Fan Unit	Moderate PA System
800	100	103	69	63	68	78	70	71
1000	93	99	71	61	64	74	69	69
1250	92	100	70	65	65	75	69	66
1600	86	100	70	71	64	74	68	65
2000	91	100	68	71	64	74	69	63
2500	89	102	63	69	63	73	68	60
3150	88	101	60	69	60	70	71	58
4000	86	101	59	64	62	72	80	55
5000	87	102	55	66	58	68	78	58
6300	87	101	52	66	55	65	69	60
8000	86	99	50	64	52	62	69	58
10000	82	96	44	58	50	60	60	49
12500	82	97	39	53	46	56	57	45
16000	84	95	31	47	43	53	-	39
20000	84	87	17	38	43	53	-	34

Note: - indicates data was not considered

The noise sources utilised as part of this assessment comprise of the primary noise generating activities associated with the effective operation of the proposed facility.

5.2 MODELLING METHODOLOGY

5.2.1 Noise Model

Predictive Noise Modelling was carried out using the Concawe algorithm within SoundPLAN v7.1. This model has been extensively utilised by Benbow Environmental for assessing noise emissions for existing and proposed developments, and is recognised by regulatory authorities throughout Australia. The model allows for the prediction of noise from the site (at the specified receptor) by calculating the contribution of each noise source.

The noise sources as well as the topographical features of the subject area and receiver locations, were all input into the noise model to determine the noise emissions of the proposed development at the nearest potentially affected residences. On-site structures were included in the model to conservatively account for shielding provided by the building walls.

Modelling scenarios have been carried out using the L_{A10} descriptor. Using this descriptor, noise emission levels were predicted at the receiver locations to determine potential noise impacts against the relevant noise criteria in accordance with the Office of Liquor, Gaming and Racing. The relevant noise criteria are presented in Section 4.2.

5.2.2 Scenarios

Model scenarios were configured to provide a realistic assessment of potential site-related noise emissions. Each model configuration was used to calculate noise levels at the nearest potentially affected receivers under the proposed maximum operations.

Three (3) operating scenarios were established for the modelling of on-site noise generation so as to provide an accurate estimation of the potential noise impacts at different times of the day, evening and night time periods.

Each scenario was modelled considering the maximum attendance of guest. Table 5-2 shows the number of people and PA system utilized within the different buildings and areas of the site.

Each scenario is further detailed in Table 5-3 below.

Table 5-2: People and PA System Considered in the Model (Refer Figure 2-3)

Level	Building Use	Area	Source
Ground Level	Use D	Indoor	8 PA system 159 people moderate level
		Terrace	141 moderate level
	Use C	Indoor	16 PA system 58 people moderate level
		Terrace	210 people moderate level
Level 1	Use B	Indoor	16 PA system 569 people elevated level
		Balcony	130 people moderate level
	Use C	Indoor	16 PA system 58 people moderate level
		Balcony	100 people moderate level

Table 5-3: Modelled Noise Scenarios

Scenario	Description	Sources Included	Source Locations
1	Indoor Moderate Rock Band	Sources Table 5.2	Refer Table 5.2
		48 cars manoeuvring	Car park
		24 cars ignition	Car park
		7 fan units	4 fans roof western building
			3 fans roof eastern building
		Indoor rock band	Within level 1 western building
2	Outdoor Moderate Jazz Band	Sources Table 5.2	Refer Table 5.2
		48 cars manoeuvring	Car park
		24 cars ignition	Car park
		7 fan units	4 fans roof western building
			3 fans roof eastern building
		Outdoor jazz band	South eastern end of eastern building
3	Outdoor Moderate Rock Band	Sources Table 5.2	Refer Table 5.2
		48 cars manoeuvring	Car park
		24 cars ignition	Car park
		7 fan units	4 fans roof western building
			3 fans roof eastern building
		Outdoor rock band	South eastern end of eastern building

Each scenario was run with noise enhancing meteorological conditions. The following conditions were considered:

- Condition A: neutral weather conditions;
- Condition B: 3 m/s wind from source to receiver; and
- Condition C: 3 °C/100m temperature inversion with 2m/s wind from source to receiver.

These meteorological conditions have been displayed in detail in Table 5-4 below.

Table 5-4: Meteorological Conditions Assessed in Noise Propagation Modelling

Condition	Classification	Ambient Temp.	Ambient Humidity	Wind Speed	Wind Direction	Temperature Inversion	Affected Receiver	Applicability
A	Neutral	10 °C	70%	-	-	-	All	All periods
B	Gradient Flow	10 °C	70%	3m/s	Receiver	-	All	All periods
C	Inversion	10 °C	70%	2m/s	Receiver	3 °C/100m	All	All periods

5.2.3 Assumptions Made for Noise Modelling

In establishing configurations within a noise-modelling package, it is inherent that several reasonable assumptions be made. It should be noted that the relevant assessment period for this noise impact assessment was considered to be 15 minutes; therefore noise source durations detailed throughout the following assumptions section should be considered per 15 minute period in view of potential noise impacts under worst-case scenarios.

- All receivers were modelled at 1.5 m and 12.7 m above ground level in order to model residential receivers at ground level and the fifth floor level.

- The eastern and western facades of the buildings were modelled considering 12mm CSR Fibre Cement Wallboard, air cavity of 100 mm filled with 50mm of Fibre Glass (24 kg/m^3) and an internal panel of 13mm Gypsum Plasterboard. The expected Rw of this system was predicted to be 45 dB. See attachments for more detailed information.

- The southern and northern facades of the buildings were modelled considering a double glazing system consisting of 10 mm glass, 12 mm air cavity and 4 mm glass. The expected Rw of this system was predicted to be 36 dB. See attachments for more detailed information.

- The roof of the buildings were modelled considering 0.5 Steel Kliplok, air cavity of 50 mm filled with 50mm of Fibre Glass (24 kg/m^3) and an internal panel of 12mm Plywood. The expected Rw of this system was predicted to be 36 dB. See attachments for more detailed information.

- The operations of the considered licensed activities were modelled from 7.00 am to 00.0 am for three different time periods (day, evening and nght$_1$).

- A rock band was modelled as a single point source within the first floor of the western building for Scenario 1 at a height of 1.5 m above the floor. Noise generated by the rock band was considered to last for 100% of the time.

- An outdoor jazz band was modelled as a single point source at the south eastern end of the eastern building for Scenario 2 at a height of 1.5 m above the floor. Noise generated by the jazz band was considered to last for 100% of the time.

- An outdoor rock band was modelled as a single point source at the south eastern end of the eastern building for Scenario 3 at a height of 1.5 m above the floor. Noise generated by the rock band was considered to last for 100% of the time.

- People were modelled as single point sources within the buildings, on the terraces and on the balconies at a height of 1.5m above the floor. Noise generated by people was considered to last for 100% of the time. A total of 569 people were modelled talking at an elevated level within the first floor of the eastern building and 856 people talking at a moderate level distributed over the Superyacht marina facilities. In reality the above mentioned number of people simultaneously utilising the venue is unlikely to occur, however it was considered within the model as it represents the maximum capacity of the development.

- The use of the balconies, terraces and outdoor areas was limited from 7.00 am to 10.00 pm.

- The doors and windows of the eastern and western buildings were modelled in the closed position after 10.00 pm.

- PA systems were modelled as single point sources only within the buildings at a height of 2m above the floor. Noise generated by the PA system was considered to last for 100% of the time.

- The fan units were modelled as single point sources on the roof of the buildings. Noise generated by the fan units was considered to last for 100% of the time.

- A total of 48 cars were modelled as moving point sources at a height of 1m above ground level. The cars were considered to travel on-site at a speed of 20km/h entering the site from James Craig Road. Noise generated by cars manoeuvring has been calculated using the following formula:

$$Time = \frac{Dis\tan ce}{Speed}$$

  Where 'Distance' is equal to the total distance travelled, considering the modelled path length and 'Speed' is equal to 20km/h.

- A total of 24 cars were modelled as single point sources at a height of 1m above ground level in order to represent the car ignition when starting. Noise generated by car ignition was considered to last for duration 4 seconds each.

- All ground areas surrounding the subject site and the nearest nominated occupancies have been modelled considering different ground absorption coefficients ranging from 0 to 0.6. Hard ground such as asphalt and water was modelled with an absorbent coefficient of 0 resulting in 100% of the acoustic energy being reflected off it and 0% of the acoustic energy being absorbed. Consequently, soft ground such as fields and grass was modelled with an absorbent coefficient of 0.6.

5.3 PREDICTED NOISE LEVELS

Results of the predictive noise modelling have been displayed from Table 5-5 to Table 5-16. The exact same results were obtained for conditions B and C consequently the results of these weather conditions have been presented in the same tables.

Scenario 1: Table 5-5 to Table 5-8

The predicted results for this scenario indicated that compliance is achievable for all considered residential receivers under neutral weather conditions. However, noise exceedances up to 4 dB were observed at receiver R5 during the day and evening time period when the doors and windows are in the open position. Minor noise exceedances up to 1 dB were predicted for receiver R5 at the fifth level during the night time before midnight. This exceedance is considered to be negligible as the human hearing cannot distinguish an increase of 1 dB for a particular frequency band.

Scenario 2: Table 5-9 to Table 5-12

A minor exceedance of 1 dB was predicted at receiver R5 for the octave band of 500 Hz during the day and evening time periods. However, under adverse weather conditions the levels were predicted to exceed this frequency band by 5 dB and additionally the 250 Hz band by 2 dB.

Scenario 3: Table 5-13 to Table 5-16

The predicted results for this scenario indicated that compliance is not achievable for receiver R5 and R6 under neutral weather conditions, and for R1, R5, R6, and R7 under adverse weather conditions. Considerable noise exceedances up to 11 dB were predicted for receiver R5 during the day and evening time periods. Therefore, control measures are strictly necessary in order to comply with the noise limits at all the considered octave bands.

Table 5-5: Noise Modelling Results – Scenario 1, Receivers 1st floor dB(A) - Condition A

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1	Day	9	24	27	27	27	22	17	11	0	33
	Evening	9	24	27	27	27	22	17	11	0	33
	$Night_1$	9	24	27	27	24	19	14	11	0	32
R2	Day	10	25	28	27	26	21	16	12	0	33
	Evening	10	25	28	27	26	21	16	12	0	33
	$Night_1$	10	25	27	27	24	19	14	11	0	32
R3	Day	14	29	31	30	30	25	20	18	0	36
	Evening	14	29	31	30	30	25	20	18	0	36
	$Night_1$	13	28	30	30	27	22	18	17	0	36
R4	Day	9	24	26	28	37	33	27	16	0	39
	Evening	9	24	26	28	37	33	27	16	0	39
	$Night_1$	8	23	25	24	22	17	10	5	0	30
R5	Day	17	32	37	43	50	45	42	37	25	52
	Evening	17	32	37	43	50	45	42	37	25	52
	$Night_1$	15	30	33	33	30	26	23	26	9	39
R6	Day	11	26	30	35	43	39	35	26	8	46
	Evening	11	26	30	35	43	39	35	26	8	46
	$Night_1$	10	24	27	26	24	21	16	16	0	32
R7	Day	5	20	24	24	29	22	15	5	0	32
	Evening	5	20	24	24	29	22	15	5	0	32
	$Night_1$	5	20	23	19	19	15	9	3	0	27
R8	Day	4	19	23	23	26	19	12	0	0	30
	Evening	4	19	23	23	26	19	12	0	0	30
	$Night_1$	4	19	22	19	18	13	6	0	0	26
Criteria	Day	30	40	41	45	50	53	49	39	26	57
	Evening	29	38	40	44	50	53	54	41	26	58
	$Night_1$	26	35	37	40	48	52	47	36	23	54

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level

Table 5-6: Noise Modelling Results – Scenario 1, Receivers 5th floor dB(A) - Condition A

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1*	Day	10	25	27	28	28	22	17	12	0	34
	Evening	10	25	27	28	28	22	17	12	0	34
	$Night_1$	9	24	27	27	24	19	14	11	0	32
R2*	Day	10	26	28	28	27	22	17	12	0	34
	Evening	10	26	28	28	27	22	17	12	0	34
	$Night_1$	10	25	28	28	25	19	14	11	0	33
R3*	Day	14	29	31	31	31	25	21	18	0	37
	Evening	14	29	31	31	31	25	21	18	0	37
	$Night_1$	13	29	31	31	28	22	18	17	0	36
R4*	Day	9	24	27	28	32	25	18	8	0	35
	Evening	9	24	27	28	32	25	18	8	0	35
	$Night_1$	8	23	26	24	22	17	10	5	0	30
R5*	Day	17	32	38	44	50	45	42	37	25	53
	Evening	17	32	38	44	50	45	42	37	25	53
	$Night_1$	15	30	33	33	31	27	23	26	9	39
R6*	Day	11	26	31	36	43	38	33	25	6	45
	Evening	11	26	31	36	43	38	33	25	6	45
	$Night_1$	10	24	28	26	25	21	16	16	0	33
R7*	Day	6	20	24	25	30	22	16	5	0	33
	Evening	6	20	24	25	30	22	16	5	0	33
	$Night_1$	5	20	23	20	19	15	9	3	0	27
R8*	Day	6	21	24	25	28	21	13	1	0	32
	Evening	6	21	24	25	28	21	13	1	0	32
	$Night_1$	5	20	23	21	19	13	7	0	0	27
Criteria	Day	24	37	43	47	51	54	50	45	38	58
	Evening	20	34	41	45	50	53	50	44	37	57
	$Night_1$	17	31	38	42	47	51	45	37	28	54

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level
* indicates receiver at fifth floor

Table 5-7: Noise Modelling Results – Scenario 1, Receivers 1st floor dB(A) - Condition B & C

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1	Day	12	27	30	32	33	26	21	18	0	37
	Evening	12	27	30	32	33	26	21	18	0	37
	$Night_1$	12	26	30	31	29	24	18	17	0	36
R2	Day	13	28	31	32	32	26	21	18	0	37
	Evening	13	28	31	32	32	26	21	18	0	37
	$Night_1$	13	28	31	32	29	24	18	17	0	36
R3	Day	16	31	33	34	34	29	25	24	4	40
	Evening	16	31	33	34	34	29	25	24	4	40
	$Night_1$	16	31	33	34	32	27	22	23	2	39
R4	Day	11	27	30	33	43	38	32	23	0	45
	Evening	11	27	30	33	43	38	32	23	0	45
	$Night_1$	11	26	29	29	28	22	15	12	0	35
R5	Day	19	34	39	47	53	49	47	42	30	56
	Evening	19	34	39	47	53	49	47	42	30	56
	$Night_1$	18	32	36	38	41	38	34	32	15	45
R6	Day	14	28	33	40	48	44	39	33	14	50
	Evening	14	28	33	40	48	44	39	33	14	50
	$Night_1$	12	27	31	33	36	32	26	23	2	40
R7	Day	8	22	27	30	35	27	20	12	0	38
	Evening	8	22	27	30	35	27	20	12	0	38
	$Night_1$	7	22	27	25	26	20	13	10	0	32
R8	Day	7	22	26	28	33	24	16	7	0	35
	Evening	7	22	26	28	33	24	16	7	0	35
	$Night_1$	6	21	26	24	24	18	11	6	0	30
Criteria	Day	30	40	41	45	50	53	49	39	26	57
	Evening	29	38	40	44	50	53	54	41	26	58
	$Night_1$	26	35	37	40	48	52	47	36	23	54

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level

Table 5-8: Noise Modelling Results – Scenario 1, Receivers 5th floor dB(A) - Condition B & C

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1*	Day	12	27	30	32	33	27	21	18	0	38
	Evening	12	27	30	32	33	27	21	18	0	38
	$Night_1$	12	27	30	31	29	24	18	17	0	36
R2*	Day	13	28	31	32	32	26	21	18	0	38
	Evening	13	28	31	32	32	26	21	18	0	38
	$Night_1$	12	28	31	32	30	24	18	17	0	37
R3*	Day	16	31	34	35	35	30	25	24	4	41
	Evening	16	31	34	35	35	30	25	24	4	41
	$Night_1$	16	31	33	34	32	27	22	23	2	39
R4*	Day	11	27	30	33	38	30	23	14	0	41
	Evening	11	27	30	33	38	30	23	14	0	41
	$Night_1$	11	26	29	29	28	22	15	12	0	34
R5*	Day	19	35	40	47	53	49	47	42	30	56
	Evening	19	35	40	47	53	49	47	42	30	56
	$Night_1$	18	32	36	38	41	38	33	32	15	45
R6*	Day	14	28	33	41	47	42	37	31	12	49
	Evening	14	28	33	41	47	42	37	31	12	49
	$Night_1$	12	27	31	33	35	31	25	23	2	39
R7*	Day	8	23	28	30	36	27	20	12	0	38
	Evening	8	23	28	30	36	27	20	12	0	38
	$Night_1$	7	22	27	26	27	21	14	10	0	32
R8*	Day	8	23	28	30	34	26	17	7	0	37
	Evening	8	23	28	30	34	26	17	7	0	37
	$Night_1$	7	22	26	26	25	18	11	6	0	31
Criteria	Day	24	37	43	47	51	54	50	45	38	58
	Evening	20	34	41	45	50	53	50	44	37	57
	$Night_1$	17	31	38	42	47	51	45	37	28	54

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level
* indicates receiver at fifth floor

Table 5-9: Noise Modelling Results – Scenario 2, Receivers 1st floor dB(A) - Condition A

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1	Day	7	14	23	28	38	35	24	15	0	40
	Evening	7	14	23	28	38	35	24	15	0	40
R2	Day	8	9	17	24	26	20	14	11	0	29
	Evening	8	9	17	24	26	20	14	11	0	29
R3	Day	11	12	20	27	29	23	18	17	0	32
	Evening	11	12	20	27	29	23	18	17	0	32
R4	Day	6	12	20	27	37	31	23	10	0	39
	Evening	6	12	20	27	37	31	23	10	0	39
R5	Day	16	24	33	43	51	46	40	33	20	53
	Evening	16	24	33	43	51	46	40	33	20	53
R6	Day	10	20	28	36	45	41	33	24	9	47
	Evening	10	20	28	36	45	41	33	24	9	47
R7	Day	4	15	23	28	38	34	23	11	0	40
	Evening	4	15	23	28	38	34	23	11	0	40
R8	Day	3	13	21	26	36	32	20	7	0	38
	Evening	3	13	21	26	36	32	20	7	0	38
Criteria	Day	30	40	41	45	50	53	49	39	26	57
	Evening	29	38	40	44	50	53	54	41	26	58

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level

Table 5-10: Noise Modelling Results – Scenario 2, Receivers 5th floor dB(A) - Condition A

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1*	Day	7	15	24	29	38	35	24	15	0	40
	Evening	7	15	24	29	38	35	24	15	0	40
R2*	Day	7	9	18	25	26	21	15	11	0	30
	Evening	7	9	18	25	26	21	15	11	0	30
R3*	Day	11	12	21	28	30	24	19	17	0	34
	Evening	11	12	21	28	30	24	19	17	0	34
R4*	Day	6	12	20	27	35	29	19	8	0	37
	Evening	6	12	20	27	35	29	19	8	0	37
R5*	Day	16	24	33	43	51	46	40	33	20	53
	Evening	16	24	33	43	51	46	40	33	20	53
R6*	Day	10	20	28	37	45	41	32	24	9	47
	Evening	10	20	28	37	45	41	32	24	9	47
R7*	Day	5	15	23	28	39	34	23	11	0	40
	Evening	5	15	23	28	39	34	23	11	0	40
R8*	Day	4	14	21	26	36	32	20	7	0	38
	Evening	4	14	21	26	36	32	20	7	0	38
Criteria	Day	24	37	43	47	51	54	50	45	38	58
	Evening	20	34	41	45	50	53	50	44	37	57

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level
* indicates receiver at fifth floor

Table 5-11: Noise Modelling Results – Scenario 2, Receivers 1st floor dB(A) - Condition B & C

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1	Day	10	17	27	33	44	40	28	21	0	46
	Evening	10	17	27	33	44	40	28	21	0	46
R2	Day	10	12	20	29	31	25	19	17	0	34
	Evening	10	12	20	29	31	25	19	17	0	34
R3	Day	13	14	23	31	34	28	23	23	2	37
	Evening	13	14	23	31	34	28	23	23	2	37
R4	Day	9	14	24	33	43	36	28	17	0	45
	Evening	9	14	24	33	43	36	28	17	0	45
R5	Day	18	27	36	46	55	50	44	38	25	57
	Evening	18	27	36	46	55	50	44	38	25	57
R6	Day	13	23	31	40	50	46	38	30	15	52
	Evening	13	23	31	40	50	46	38	30	15	52
R7	Day	7	18	27	34	45	39	27	18	0	46
	Evening	7	18	27	34	45	39	27	18	0	46
R8	Day	6	16	25	31	42	37	24	14	0	44
	Evening	6	16	25	31	42	37	24	14	0	44
Criteria	Day	30	40	41	45	50	53	49	39	26	57
	Evening	29	38	40	44	50	53	54	41	26	58

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level

Table 5-12: Noise Modelling Results – Scenario 2, Receivers 5th floor dB(A) - Condition B & C

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1*	Day	10	17	27	33	44	40	28	21	0	46
	Evening	10	17	27	33	44	40	28	21	0	46
R2*	Day	10	12	21	29	32	25	19	17	0	35
	Evening	10	12	21	29	32	25	19	17	0	35
R3*	Day	13	15	23	32	35	29	23	23	2	38
	Evening	13	15	23	32	35	29	23	23	2	38
R4*	Day	9	14	24	33	41	34	23	15	0	42
	Evening	9	14	24	33	41	34	23	15	0	42
R5*	Day	18	27	36	46	55	50	44	38	25	57
	Evening	18	27	36	46	55	50	44	38	25	57
R6*	Day	13	23	32	41	50	46	37	30	15	52
	Evening	13	23	32	41	50	46	37	30	15	52
R7*	Day	7	18	27	34	45	39	27	18	0	46
	Evening	7	18	27	34	45	39	27	18	0	46
R8*	Day	6	16	25	32	43	37	24	14	0	44
	Evening	6	16	25	32	43	37	24	14	0	44
Criteria	Day	24	37	43	47	51	54	50	45	38	58
	Evening	20	34	41	45	50	53	50	44	37	57

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level
* indicates receiver at fifth floor

Table 5-13: Noise Modelling Results – Scenario 3, Receivers 1st floor dB(A) - Condition A

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1	Day	11	31	38	37	40	39	35	26	5	45
	Evening	11	31	38	37	40	39	35	26	5	45
R2	Day	8	22	25	25	26	22	17	12	0	32
	Evening	8	22	25	25	26	22	17	12	0	32
R3	Day	11	22	25	28	29	24	20	18	0	34
	Evening	11	22	25	28	29	24	20	18	0	34
R4	Day	11	32	37	36	40	37	32	20	0	44
	Evening	11	32	37	36	40	37	32	20	0	44
R5	Day	20	42	47	47	52	49	47	43	32	56
	Evening	20	42	47	47	52	49	47	43	32	56
R6	Day	16	38	43	42	46	45	42	36	22	51
	Evening	16	38	43	42	46	45	42	36	22	51
R7	Day	11	33	38	37	40	38	34	24	2	45
	Evening	11	33	38	37	40	38	34	24	2	45
R8	Day	10	31	36	34	38	36	31	20	0	43
	Evening	10	31	36	34	38	36	31	20	0	43
Criteria	Day	30	40	41	45	50	53	49	39	26	57
	Evening	29	38	40	44	50	53	54	41	26	58

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level

Table 5-14: Noise Modelling Results – Scenario 3, Receivers 5th floor dB(A) - Condition A

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1*	Day	11	32	38	37	40	39	35	26	5	45
	Evening	11	32	38	37	40	39	35	26	5	45
R2*	Day	8	22	25	26	27	22	17	12	0	32
	Evening	8	22	25	26	27	22	17	12	0	32
R3*	Day	11	25	28	29	31	25	21	18	0	35
	Evening	11	25	28	29	31	25	21	18	0	35
R4*	Day	11	32	37	36	39	37	31	20	0	44
	Evening	11	32	37	36	39	37	31	20	0	44
R5*	Day	20	42	47	47	52	49	47	43	32	56
	Evening	20	42	47	47	52	49	47	43	32	56
R6*	Day	16	38	43	42	46	44	42	36	22	51
	Evening	16	38	43	42	46	44	42	36	22	51
R7*	Day	11	33	38	37	40	38	34	24	2	45
	Evening	11	33	38	37	40	38	34	24	2	45
R8*	Day	10	32	36	35	38	36	31	20	0	43
	Evening	10	32	36	35	38	36	31	20	0	43
Criteria	Day	24	37	43	47	51	54	50	45	38	58
	Evening	20	34	41	45	50	53	50	44	37	57

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level
* indicates receiver at fifth floor

Table 5-15: Noise Modelling Results – Scenario 3, Receivers 1st floor dB(A) - Condition B & C

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1	Day	13	34	42	42	46	44	39	33	12	50
	Evening	13	34	42	42	46	44	39	33	12	50
R2	Day	11	24	28	30	32	27	21	18	0	36
	Evening	11	24	28	30	32	27	21	18	0	36
R3	Day	13	25	29	32	34	29	25	24	3	38
	Evening	13	25	29	32	34	29	25	24	3	38
R4	Day	13	34	41	42	46	42	36	27	1	50
	Evening	13	34	41	42	46	42	36	27	1	50
R5	Day	23	44	50	51	55	53	51	48	37	60
	Evening	23	44	50	51	55	53	51	48	37	60
R6	Day	19	41	46	47	51	49	46	42	28	56
	Evening	19	41	46	47	51	49	46	42	28	56
R7	Day	14	36	42	42	46	43	38	31	9	50
	Evening	14	36	42	42	46	43	38	31	9	50
R8	Day	12	34	40	40	44	41	35	27	1	48
	Evening	12	34	40	40	44	41	35	27	1	48
Criteria	Day	30	40	41	45	50	53	49	39	26	57
	Evening	29	38	40	44	50	53	54	41	26	58

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level

Table 5-16: Noise Modelling Results – Scenario 3, Receivers 5th floor dB(A) - Condition B & C

Receiver	Time Period	Frequency (Hz)									
		31.5	63	125	250	500	1000	2000	4000	8000	Overall
R1*	Day	14	35	42	42	46	44	39	33	12	50
	Evening	14	35	42	42	46	44	39	33	12	50
R2*	Day	11	25	29	31	32	27	21	18	0	37
	Evening	11	25	29	31	32	27	21	18	0	37
R3*	Day	14	27	31	33	35	30	25	24	3	39
	Evening	14	27	31	33	35	30	25	24	3	39
R4*	Day	13	34	41	42	45	42	36	27	1	49
	Evening	13	34	41	42	45	42	36	27	1	49
R5*	Day	23	44	50	51	55	53	51	48	37	60
	Evening	23	44	50	51	55	53	51	48	37	60
R6*	Day	19	41	46	47	51	49	46	42	28	56
	Evening	19	41	46	47	51	49	46	42	28	56
R7*	Day	14	36	42	42	46	43	38	31	9	50
	Evening	14	36	42	42	46	43	38	31	9	50
R8*	Day	12	34	40	40	44	41	35	27	1	48
	Evening	12	34	40	40	44	41	35	27	1	48
Criteria	Day	24	37	43	47	51	54	50	45	38	58
	Evening	20	34	41	45	50	53	50	44	37	57

Note: Shaded cells indicate that the predicted noise exceeds the Project Specific Noise Level
* indicates receiver at fifth floor

6. NOISE CONTROLS FOR PROPOSED DEVELOPMENT

Several management and noise mitigation measures have been included which reduce the potential for noise impacts from the subject site. These control measures have been classified into general and specific recommendations.

These are discussed in detail below.

6.1 GENERAL RECOMMENDATIONS

A total of two (2) and four (4) receiver locations did not achieve compliance under neutral and adverse weather conditions respectively for scenario 3. For this reason, general considerations have to be applied in order to achieve the project specific noise limits.

- The on-site activities during site operations should be limited to the assumptions considered within this report. If this is not feasible, further noise predictions should be undertaken.
- Alternative construction materials may be used for the proposed buildings only if a greater noise reduction (Rw) for all the frequency bands is expected.
- The use of the balconies, terraces and outdoor areas has to be limited between 7:00 am and 10:00 pm.
- The band playing outdoors is limited to playing at ground level between 11:00 am and 8:00 pm, and between 9:00 am to 10:00 pm for special event days such as Christmas, Boxing Day, New Year Eve, New Year's Day, Australia Day and 5 additional days throughout the year.
- The external doors and windows of the eastern and western buildings should be closed after 10:00 pm.
- The simultaneous operation of a band outdoors and a band within the western building should not occur.
- The PA system considered in all the scenarios should only be used for background and/or ambient music.

6.2 SPECIFIC RECOMMENDATIONS

In order to achieve compliance with all three scenarios, several noise controls should be applied.

Scenario 1: compliance is expected for this scenario under neutral weather conditions. However, noise exceedances are expected to occur under adverse weather conditions during the day, evening and night time periods. Therefore, in order to achieve compliance, the doors and windows must remain in the closed position during the day, evening and night when a rock band plays indoors. Alternatively, a jazz band or music with a similar noise spectrum may play indoors without the need to close the doors and windows during the day and evening; however, this is strictly necessary after 10:00 pm.

Scenario 2 and 3: compliance is not achievable at all the receiver locations unless considerable control measures such as a barrier around the band are applied. However, an adequate and feasible alternative is to calibrate the volume of the speakers that will amplify the live bands playing outdoors. Therefore, a reference location 5 m south of the main speakers of the band, in direct line to receiver R5, was considered in the model in order to determine the maximum sound pressure level that will allow compliance.

As a consequence of these calculations, attended noise monitoring should be undertaken at this reference location when the band is playing and therefore, establish the maximum volume of the speakers that will generate compliance at all the residential receivers. The maximum levels per octave bands are shown in Table 6-1.

Table 6-1: Maximum Sound Power Level (SWL) and Sound Pressure Level (SPL) Allowed for the Outdoor Band, dB(A)

Descriptor	Frequency (Hz)									
	31.5	63	125	250	500	1000	2000	4000	8000	Overall
SWL	71	88	93	90	95	105	102	94	90	108
SPL at 5 m	49	66	72	69	74	84	83	73	69	87

It is recommended to not locate/orientate the speakers either facing the façade of the building or the water as this will generate an increase in the noise levels due to the energy reflected from these surfaces. By applying the recommended measures in outlined above, noise compliance is expected to be achieved at all of the considered receivers.

7. CONCLUSIONS

A detailed noise impact assessment of the proposed operations of the Sydney Superyacht Marina located at Rozelle Bay, NSW 2029 has been carried out.

The Office of Liquor, Gaming and Racing noise criteria has been used as a basis to set more reasonable Project Specific Noise Limits due to the shared acoustic environment amongst the local community and its associated services and activities.

Long-term and short term noise monitoring was undertaken at two residential locations surrounding the site in order to obtain information regarding the existing background noise levels of the area. Noise data was obtained per octave band as is indicated by the Office of Liquor, Gaming and Racing, and therefore, noise limits were established for all the octave bands from 31.5 to 8k Hz.

Receiver R5 has been identified to be the nearest receiver location in direct line of sight with the proposed development and therefore has been the focus when considering noise mitigation measures due to the proposed bands playing outdoors.

The different scenarios assumed for the purpose of this assessment provide a meaningful analysis based on realistic events that are likely to occur. In order to validate the predicted noise levels under normal operations, post-construction noise monitoring is recommended.

The noise impact assessment has provided a detailed evaluation of the existing acoustic environment. The assessment has proposed a number of best practice mitigation measures that can be applied so that the nearest potentially affected residents are able to experience acceptable noise levels during events.

By implementing the noise control measures and recommendations detailed in Section 6 of the report, the proposed activities of the Superyacht Marina will not create any significant noise impact at the various receivers and the Project Specific Noise Levels will be achieved.

This concludes the report.

Prepared by:

Felipe Torres
Acoustical Engineer

Samuel T. Grieve
Acoustical Engineer

R T Benbow
Principal Consultant

8. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use by Urban Perspectives, as per our agreement for providing environmental assessment services. Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that required by law) in relation to the information contained within this document.

Urban Perspectives is entitled to rely upon the findings in the report within the scope of work described in this report. No responsibility is accepted for the use of any part of the report in any other context or for any other purpose.

Opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal opinions.

ATTACHMENTS

Glossary of Noise Terminology

Acceptable Noise Level: The acceptable L_{Aeq} noise level from industrial sources, recommended by the NSW EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.

Acoustic Barrier*:* Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc used to reduce noise, without eliminating it.

Adverse Weather: Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for 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: position at which noise measurements are undertaken 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_{A90} noise level.

Decibel [dB] : The units of sound pressure level.

dB(A): A-weighted decibels. Noise measured using the A filter.

Free field: An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground.

Frequency: Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).

Impulsive noise: 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: Level that drops to the background noise level several times during the period of observation.

L_{Amax} The maximum sound pressure level measured over a period.

L_{Amin} The minimum sound pressure level measured over a period.

L_{A1} The sound pressure level that is exceeded for 1% of the time for which the sound is measured.

L_{A10} The sound pressure level that is exceeded for 10% of the time for which the sound is measured.

L_{A90} The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{A90} noise level expressed in units of dB(A).

L_{Aeq} 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 meeting on its path.

R-w: The Sound Insulation Rating R-w is a measure of the noise reduction performance of the partition.

SEL: Sound Exposure Level 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_{Aeq} sound levels over any period of time and can be used for predicting noise at various locations.

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.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 11838

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Rion
Type No: NC-73 **Serial No:** 10186522
Owner: Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

Tests Performed: Measured output sound pressure level was found to be:
Before adiustment: 93.97 dB re 20 uPa at 994.7 Hz THD< 1%.
After adjustment: 93.97 dB re 20 uPa at 994.7 Hz THD< 1%,

Uncertainty (at 95% c.l.) k=2: Output ±0.11dB
Freq. ±0.05 Hz

CONDITION OF TEST:

Ambient Pressure: 993 hPa ±1.5 hPa **Relative Humidity:** 66 % RH ±5% RH
Temperature: 23 °C ±2° C
Date of Calibration: 18/01/2011 **Issue Date:** 18/01/2011
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004
CHECKED BY: AH **AUTHORISED SIGNATORY:** ..... Jack Kiely

This document is issued in accordance with NATA's accreditation requirements.
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The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

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ELECTRONICS
HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 96806133 Fax: (02)96808233
Mobile: 0413 809806
Web site: www.acu-vib.com.au

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Test Method: AS IEC 60942 - 2004
CHECKED BY: AA **AUTHORISED SIGNATORY:** ..... Jacob Kielt

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ACU-VIB
ELECTRONICS
HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 96806133 Fax: (02)96806233
Mobile: 0413 809806
Web site: www.acu-vib.com.au

Acoustic Research Laboratories
Proprietary Limited A.B.N. 47 050 100 804
Noise and Vibration Monitoring Instrumentation for Industry and the Environment

Sound Level Meter Test Report

Report Number : C11621

Date of Test : 2/12/2011

Report Issue Date : 5/12/2011

Equipment Tested/ Model Number: **Ngara S-Pack Sound Acquisition System**

Instrument Serial Number: 8780AC

Microphone Serial Number: 317859

Preamplifier Serial Number: 27984

Client Name : Benbow Environmental

13 Daking Street

North Parramatta NSW 2151

Contact Name : Daniel Albanese

Tested by : Ken Williams

Approved Signatory :

Date : 5th December 2011

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Level 7 ♦ Building 2 ♦ 423 Pennant Hills Rd ♦ Pennant Hills ♦ NSW 2120 ♦ AUSTRALIA
Telephone +61 2 9484 0800 ♦ Facsimile +61 2 9484 0884
www.acousticresearch.com.au

Acoustic Research Laboratories
Proprietary Limited A.B.N. 47 050 100 804
Noise and Vibration Monitoring Instrumentation for Industry and the Environment

Sound Level Meter Test Report

Report Number : C11623

Date of Test : 2/12/2011

Report Issue Date : 5/12/2011

Equipment Tested/ Model Number: **Ngara S-Pack Sound Acqusition System**

Instrument Serial Number: 8780AE

Microphone Serial Number: 317855

Preamplifier Serial Number: 27982

Client Name : Benbow Environmental

13 Daking Street

North Parramatta NSW 2151

Contact Name : Daniel Albanese

Tested by : Adrian Walker

Approved Signatory :

Date : **5th December 2011**

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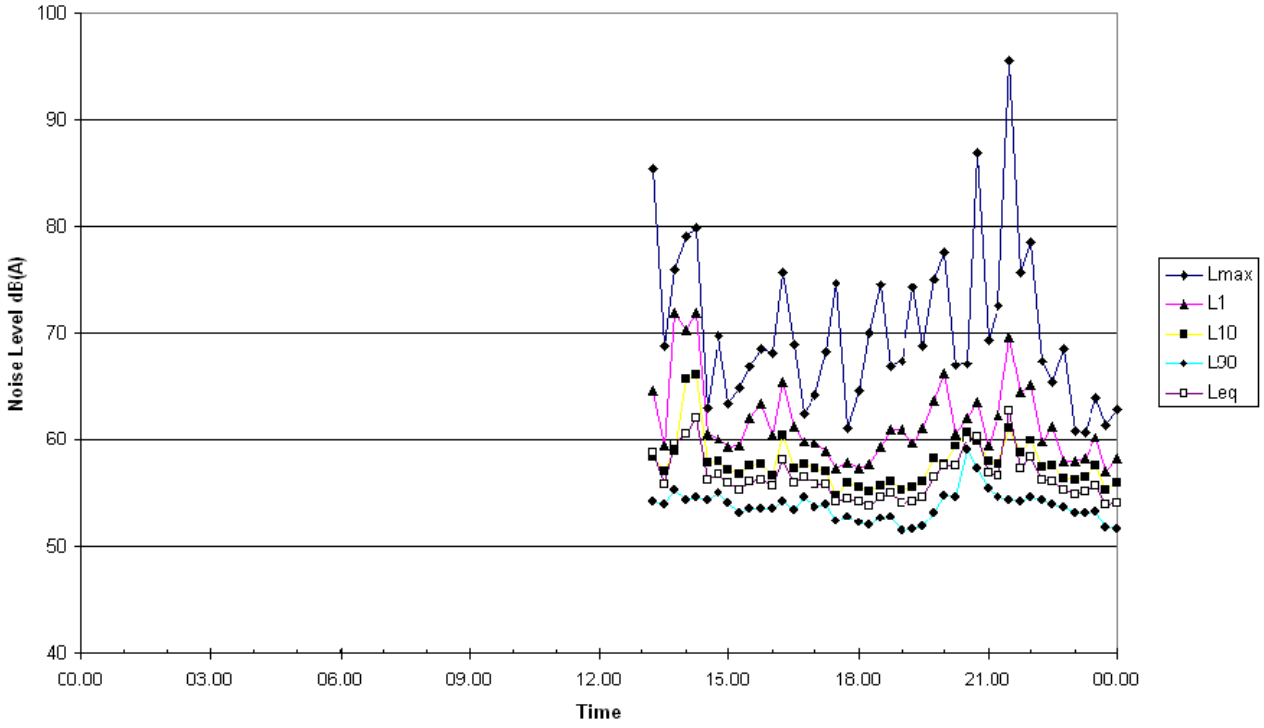
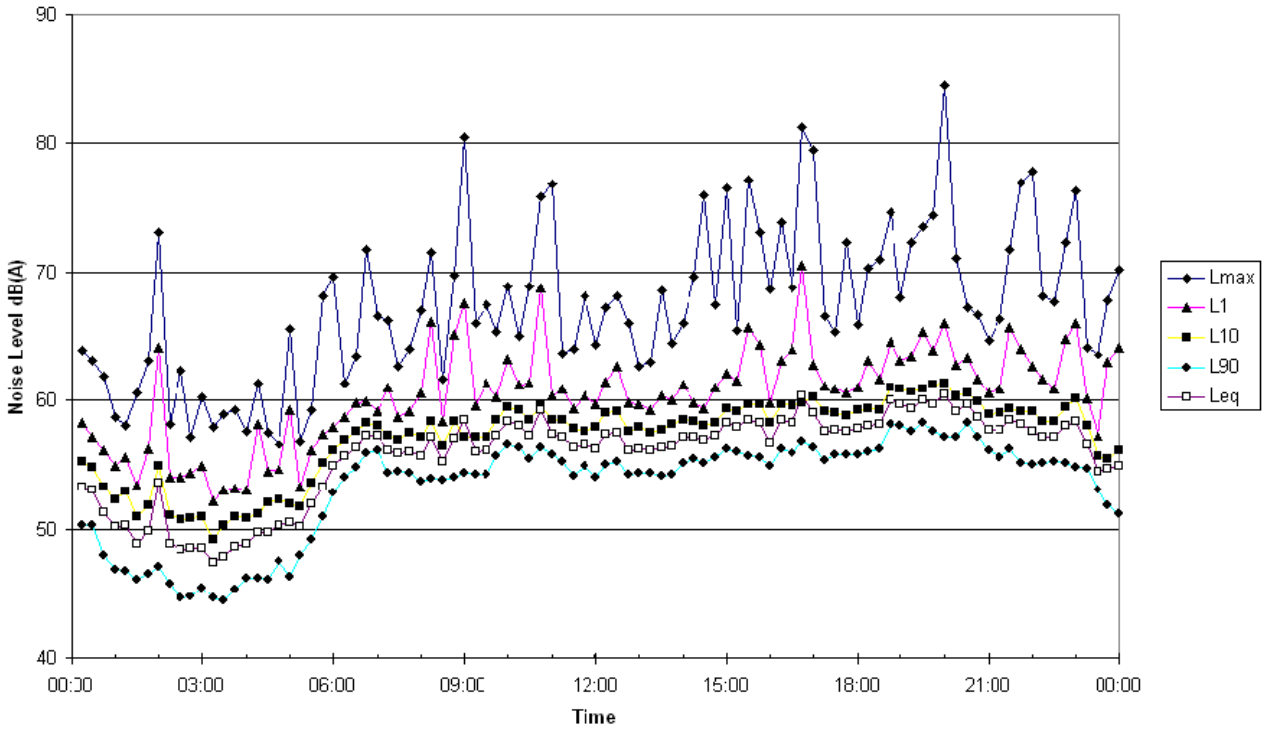
Telephone +61 2 9484 0800 ♦ Facsimile +61 2 9484 0884
www.acousticresearch.com.au

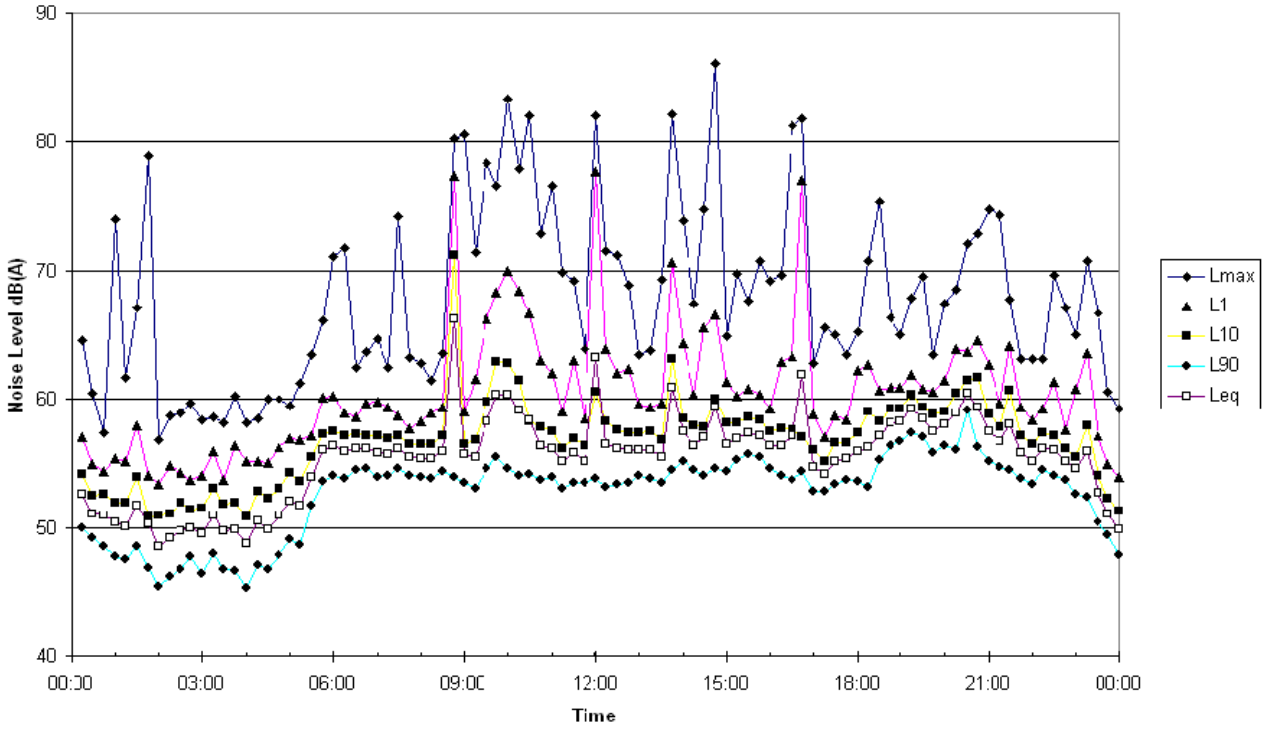
Measured Noise Levels
Unit 28, 501 Glebe Point Road - Wednesday 15/02/2012



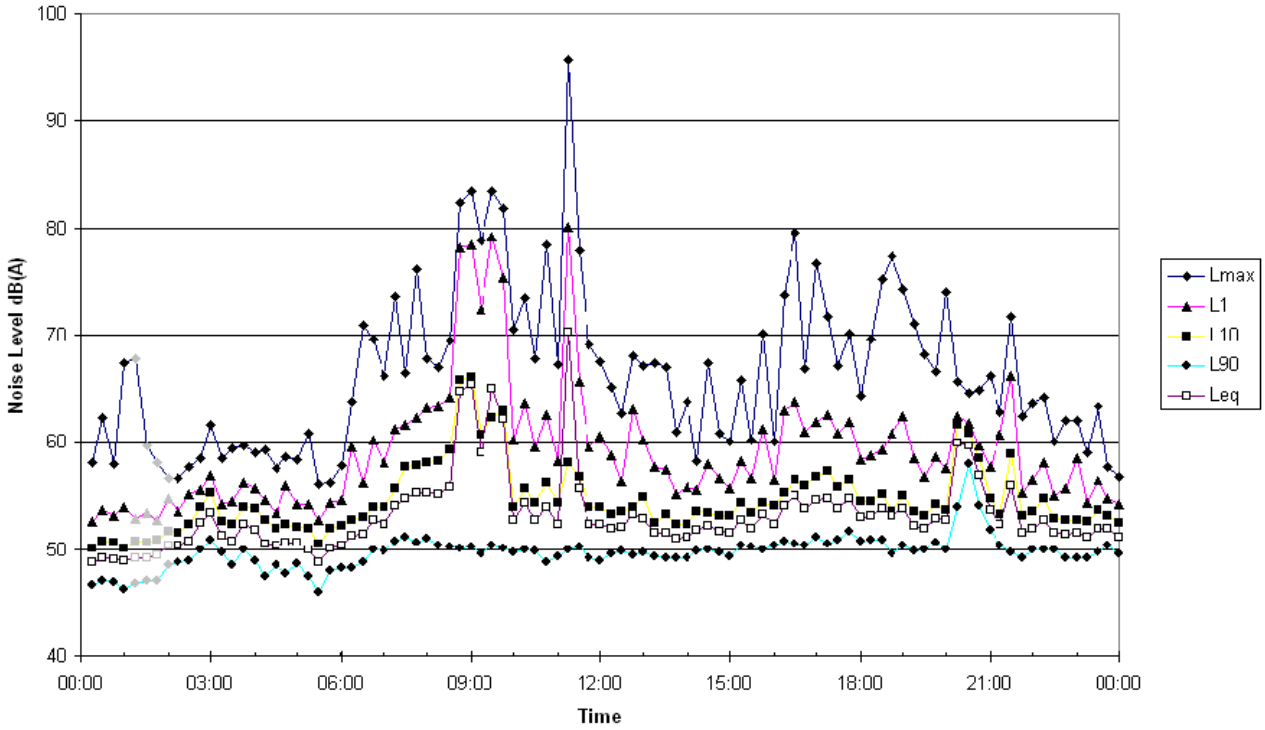
Measured Noise Levels
Unit 28, 501 Glebe Point Road - Thursday 16/02/2012



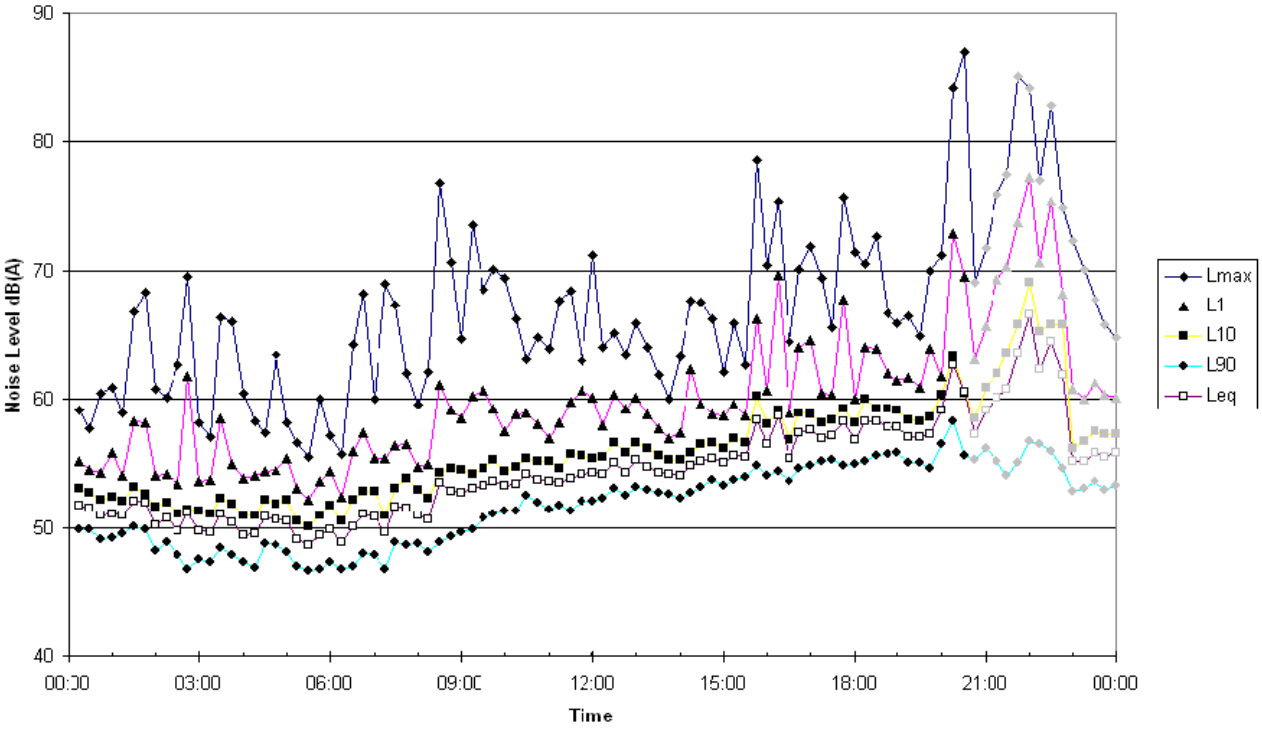
Measured Noise Levels
Unit 28, 501 Glebe Point Road - Friday 17/02/2012



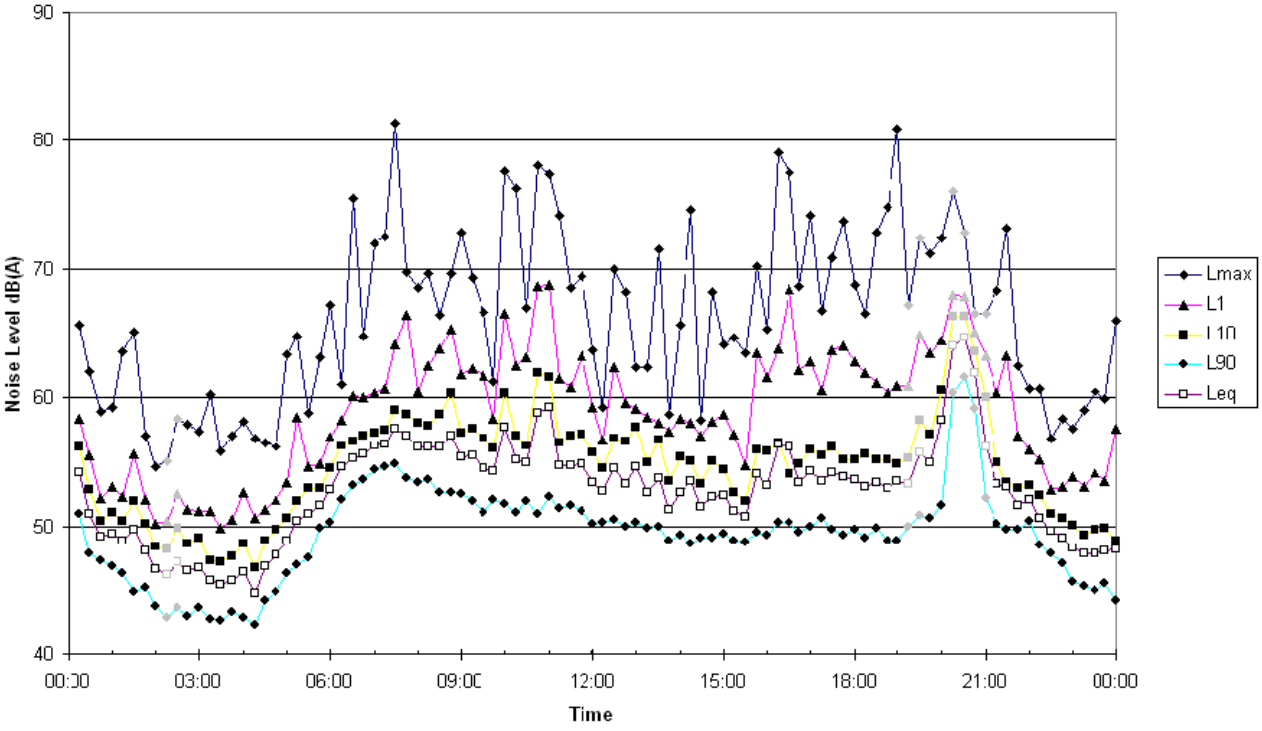
Measured Noise Levels
Unit 28, 501 Glebe Point Road - Saturday 18/02/2012



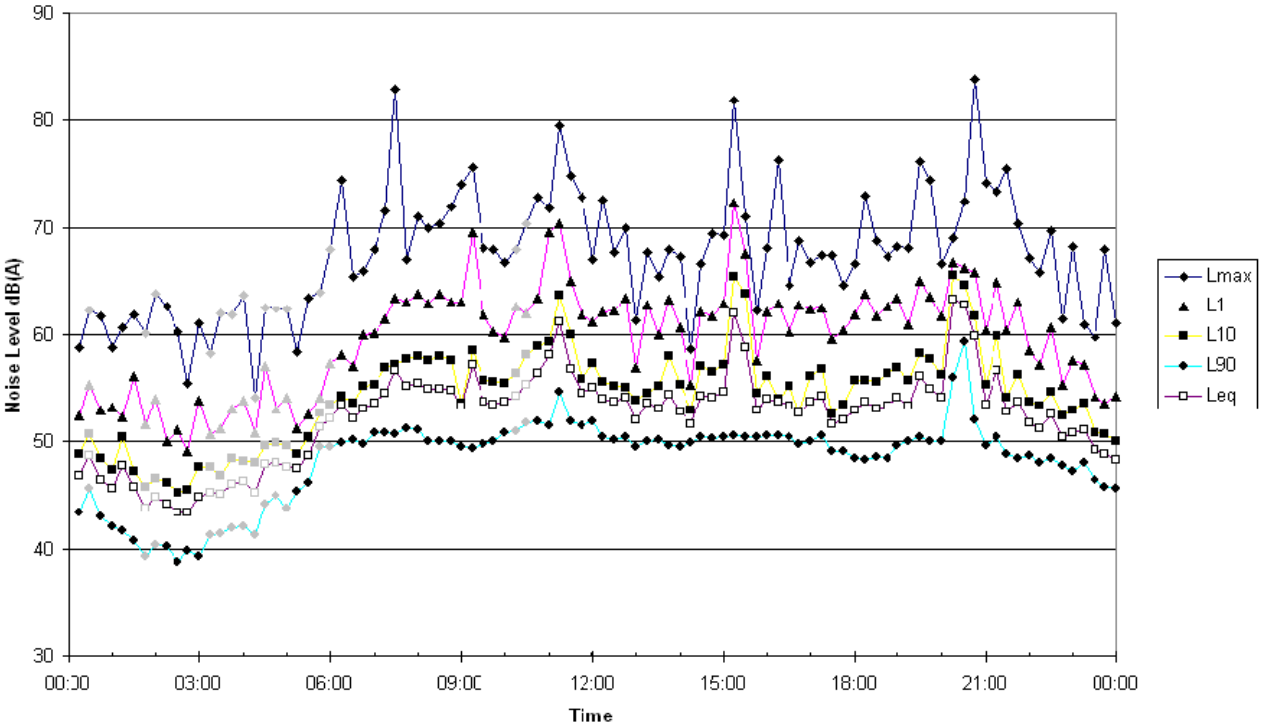
Measured Noise Levels
Unit 28, 501 Glebe Point Road - Sunday 19/02/2012



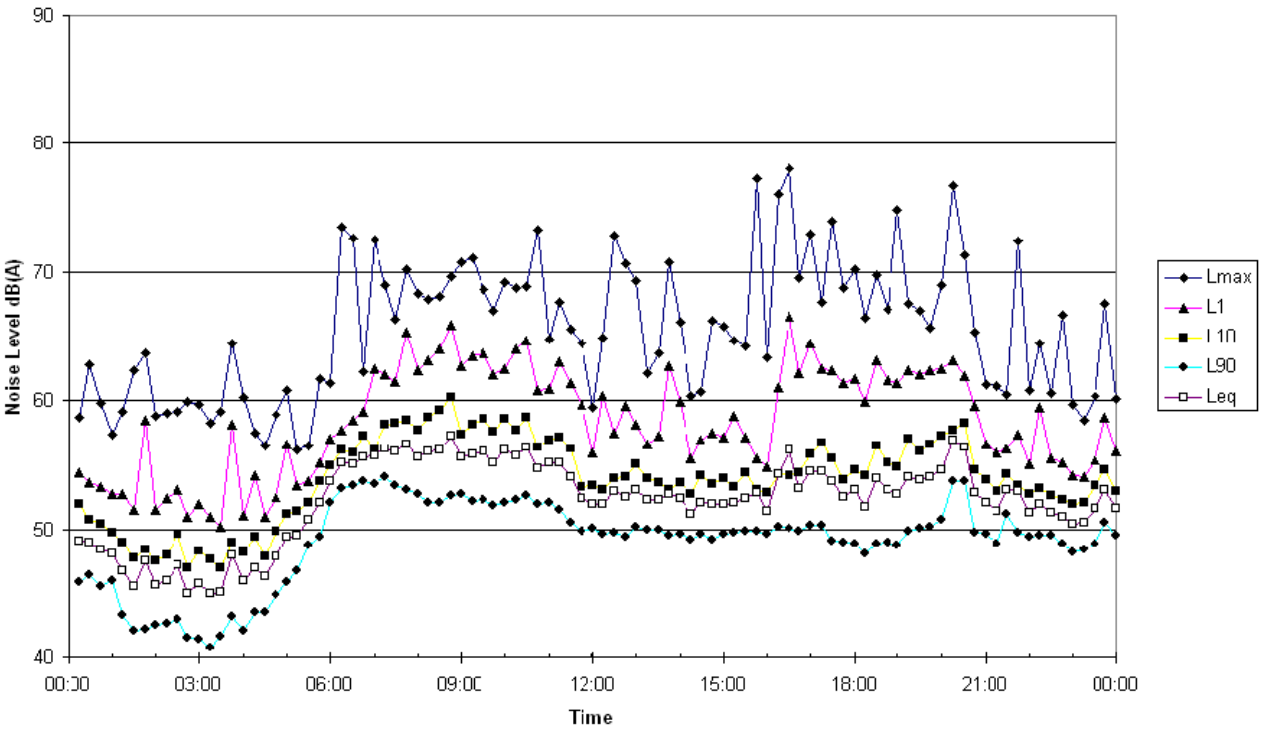
Measured Noise Levels
Unit 28, 501 Glebe Point Road - Monday 20/02/2012



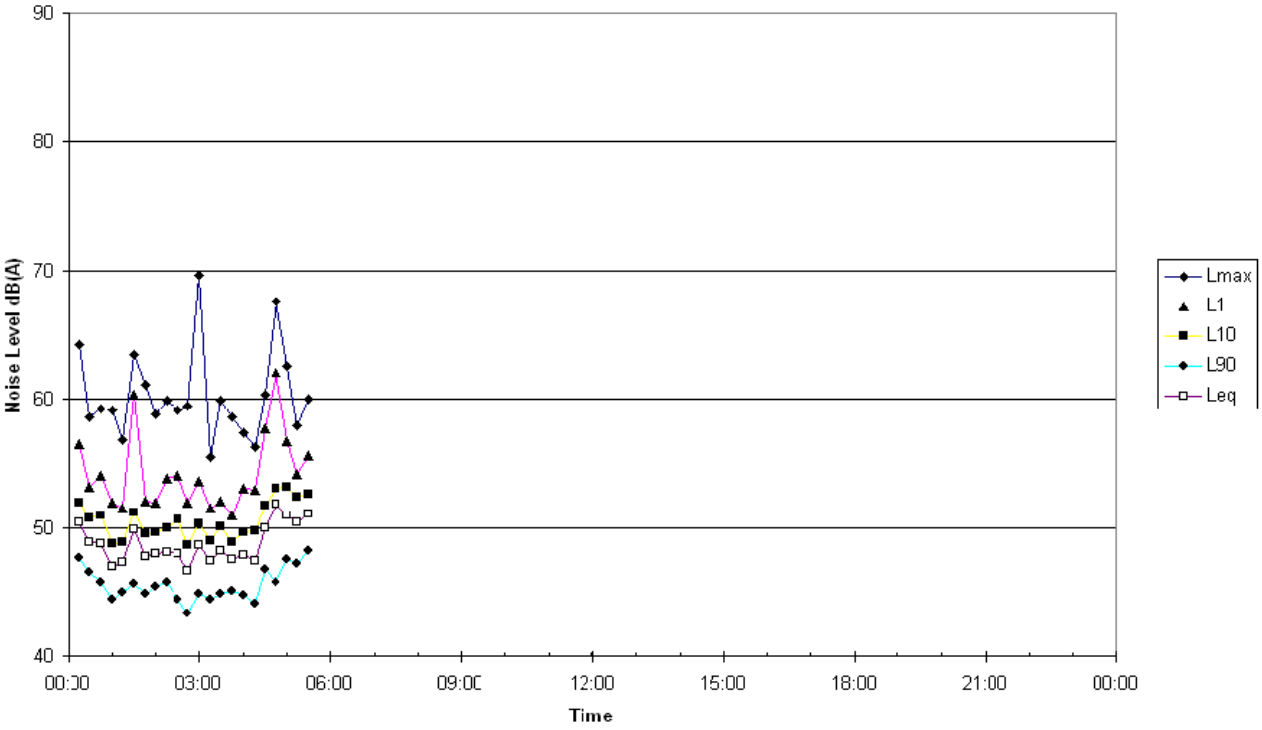
Measured Noise Levels
Unit 28, 501 Glebe Point Road - Tuesday 21/02/2012



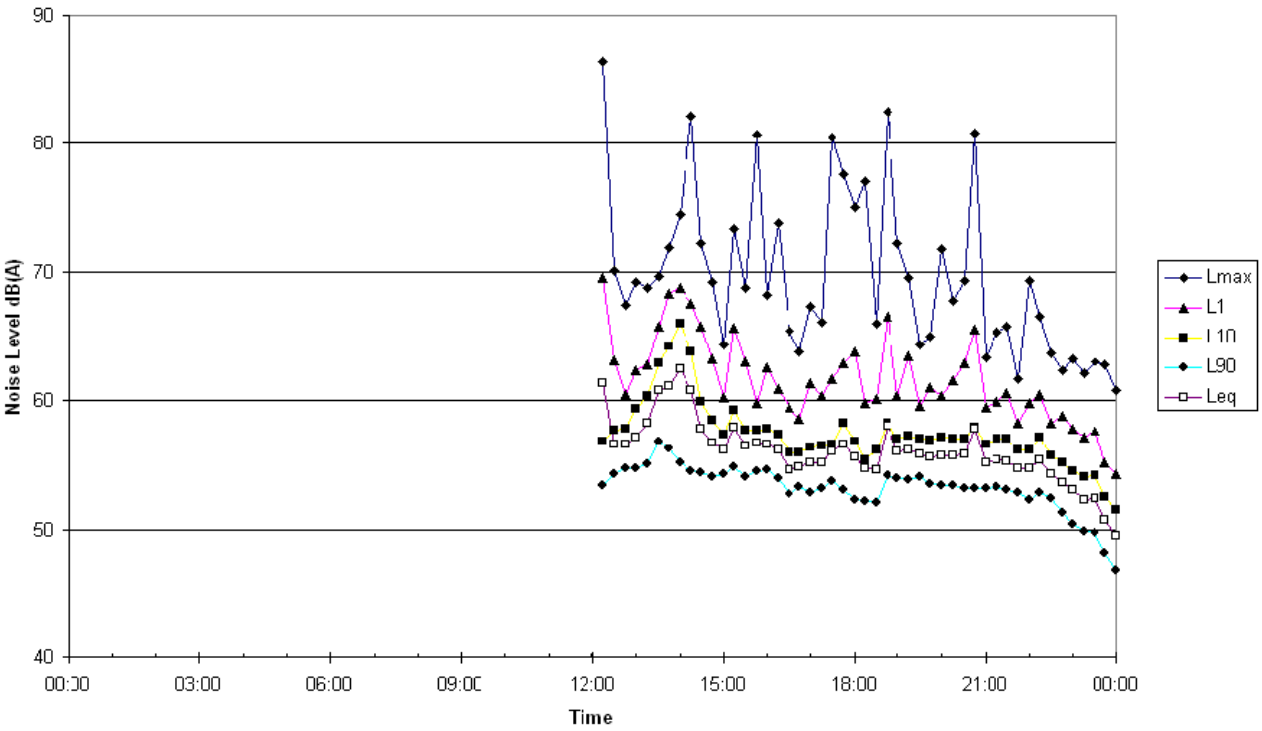
Measured Noise Levels
Unit 28, 501 Glebe Point Road - Wednesday 22/02/2012



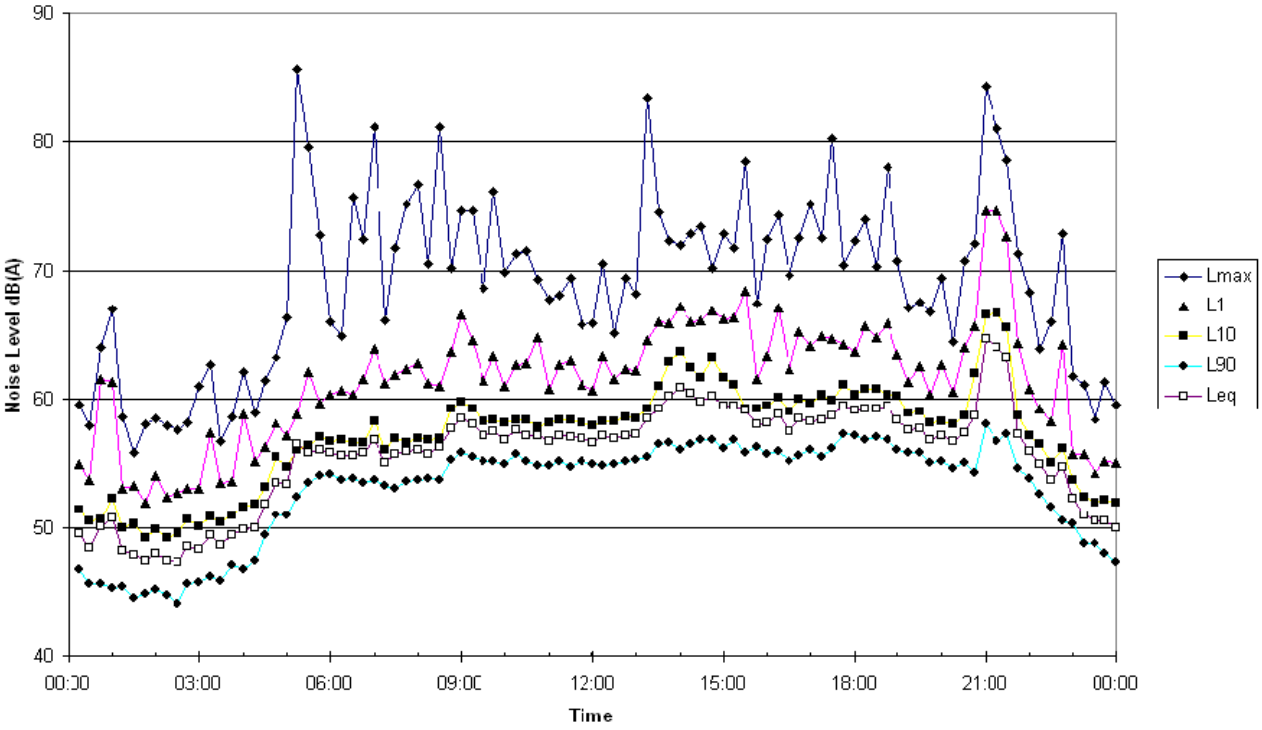
Measured Noise Levels
Unit 28, 501 Glebe Point Road - Thursday 23/02/2012



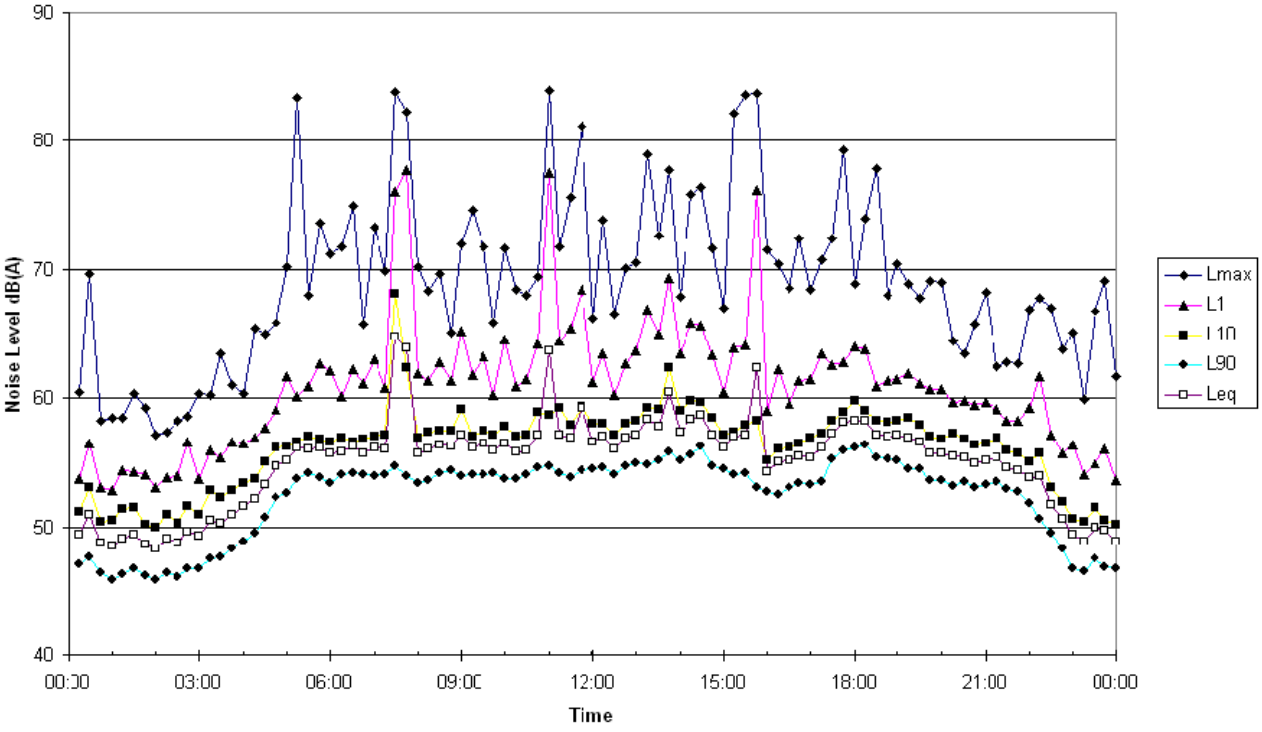
Measured Noise Levels
Unit 8, 501 Glebe Point Road - Wednesday 15/02/2012



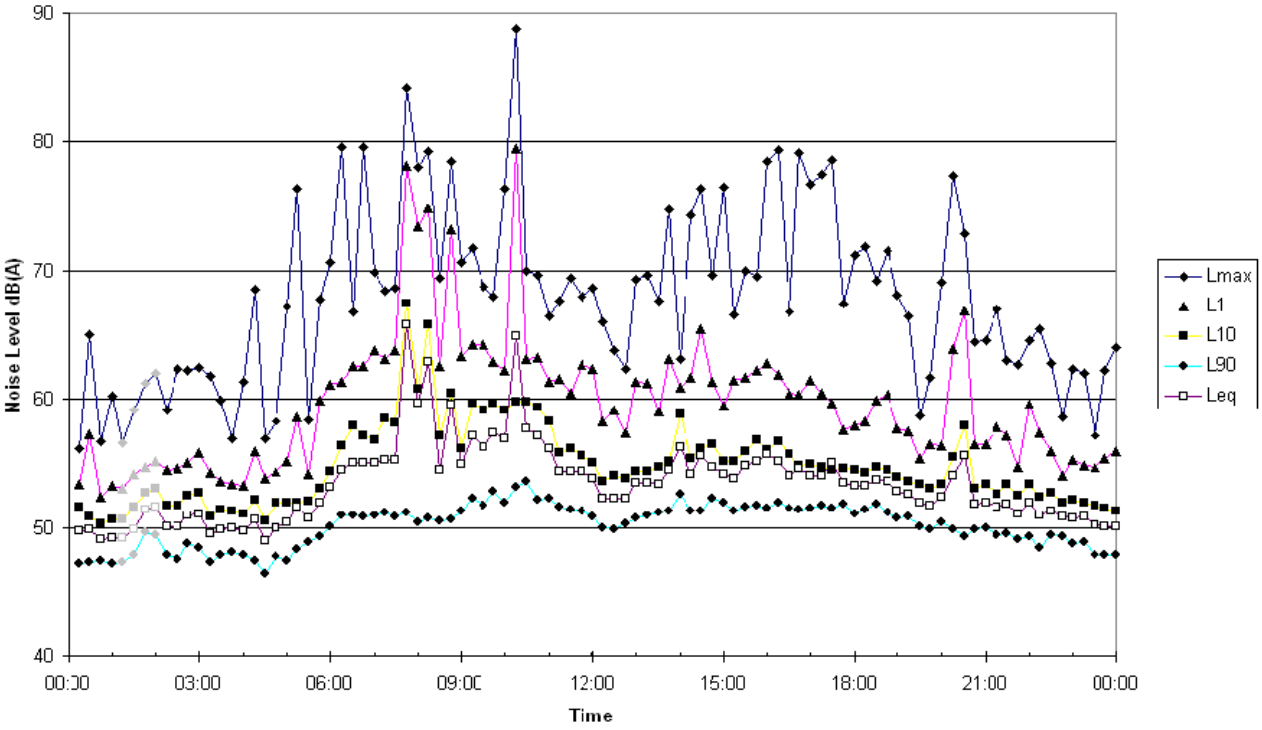
Measured Noise Levels
Unit 8, 501 Glebe Point Road - Thursday 16/02/2012



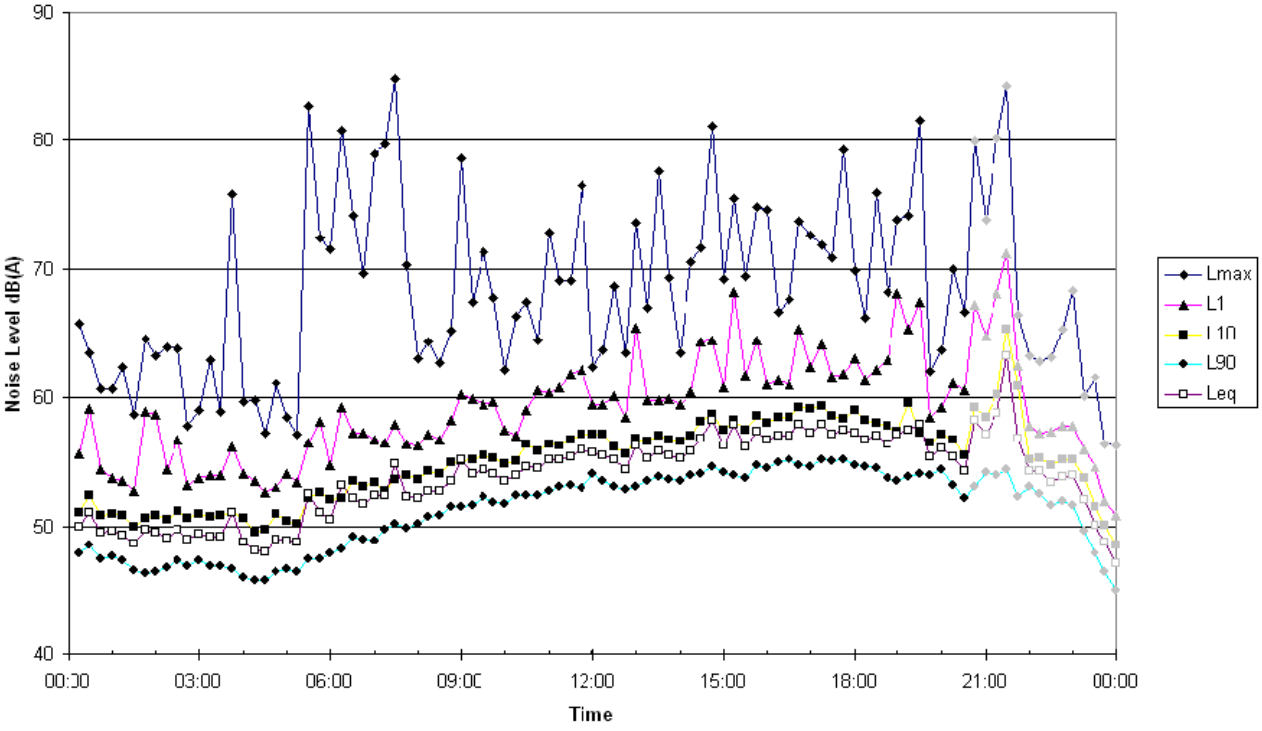
Measured Noise Levels
Unit 8, 501 Glebe Point Road - Friday 17/02/2012



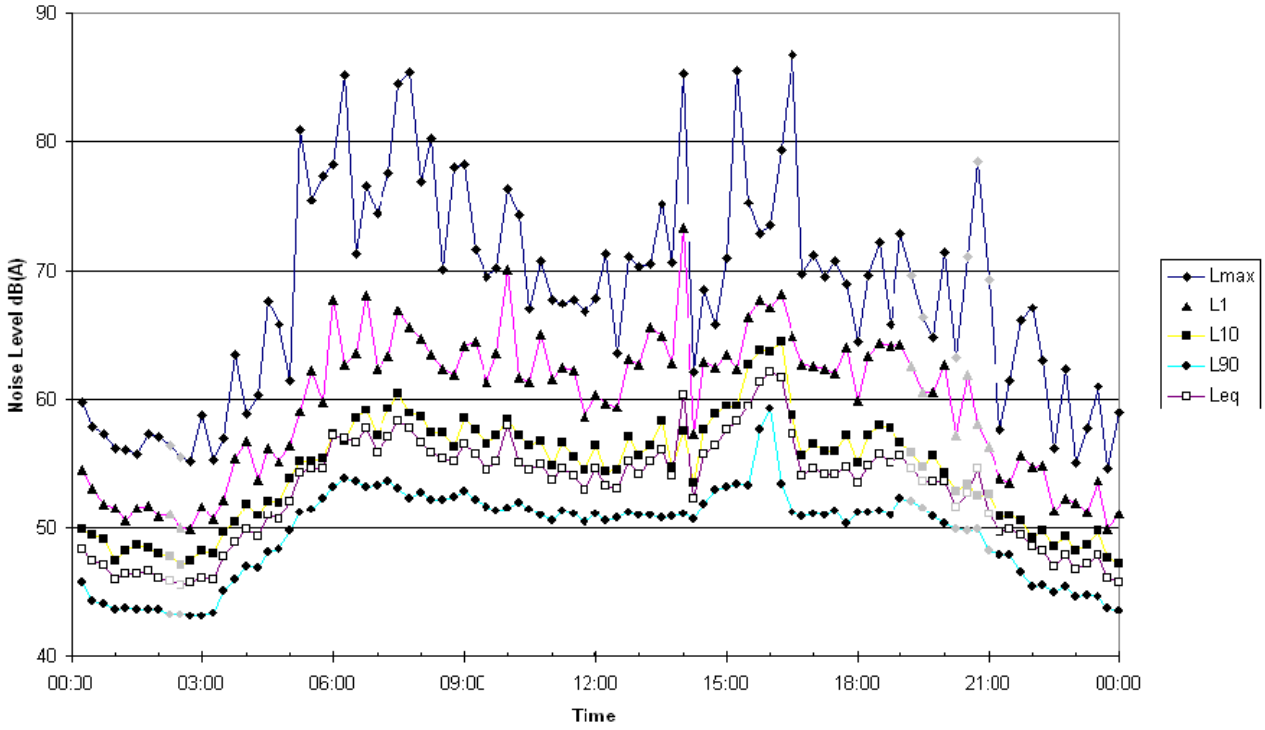
Measured Noise Levels
Unit 8, 501 Glebe Point Road - Saturday 18/02/2012



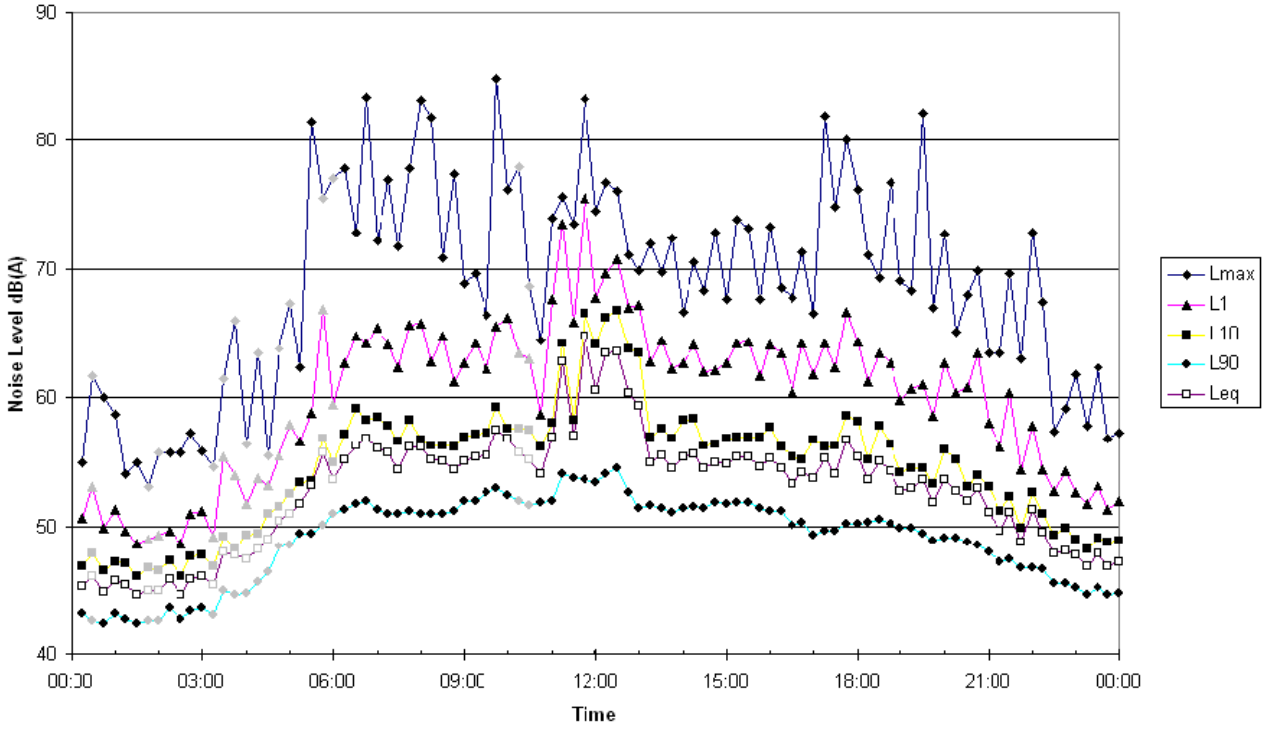
Measured Noise Levels
Unit 8, 501 Glebe Point Road - Sunday 19/02/2012



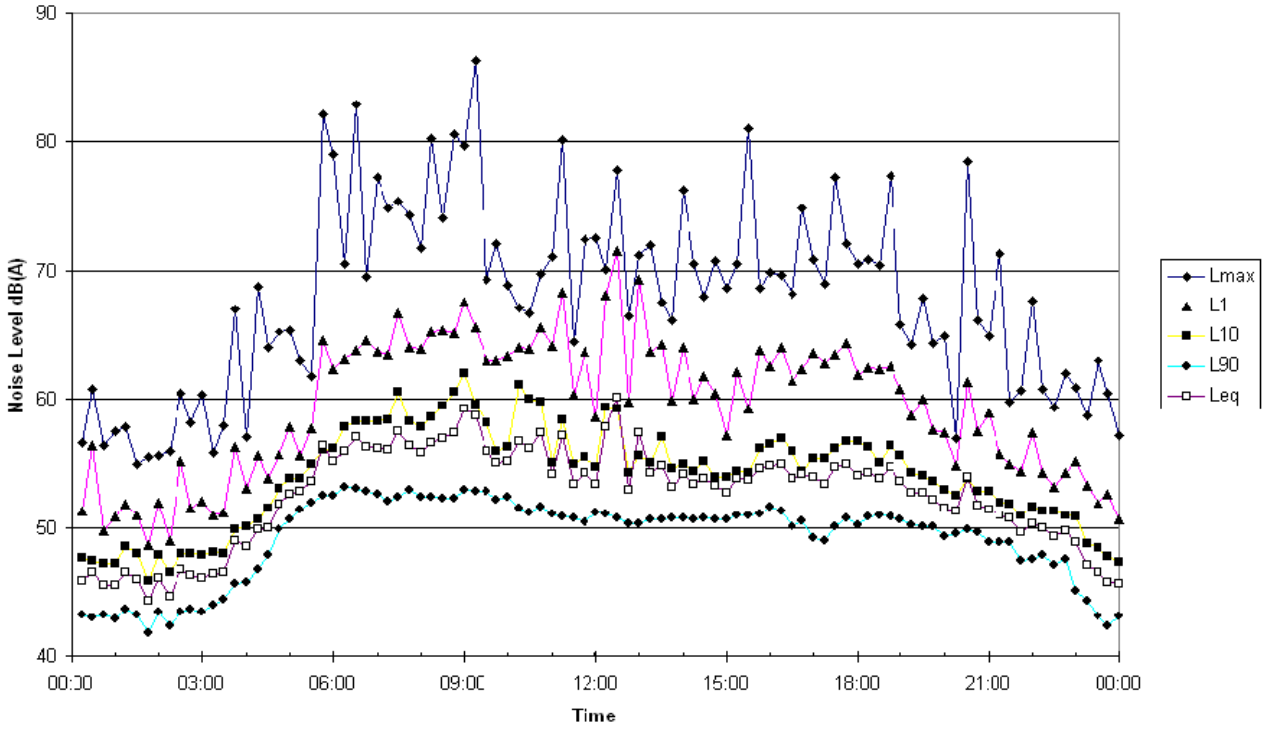
Measured Noise Levels
Unit 8, 501 Glebe Point Road - Monday 20/02/2012



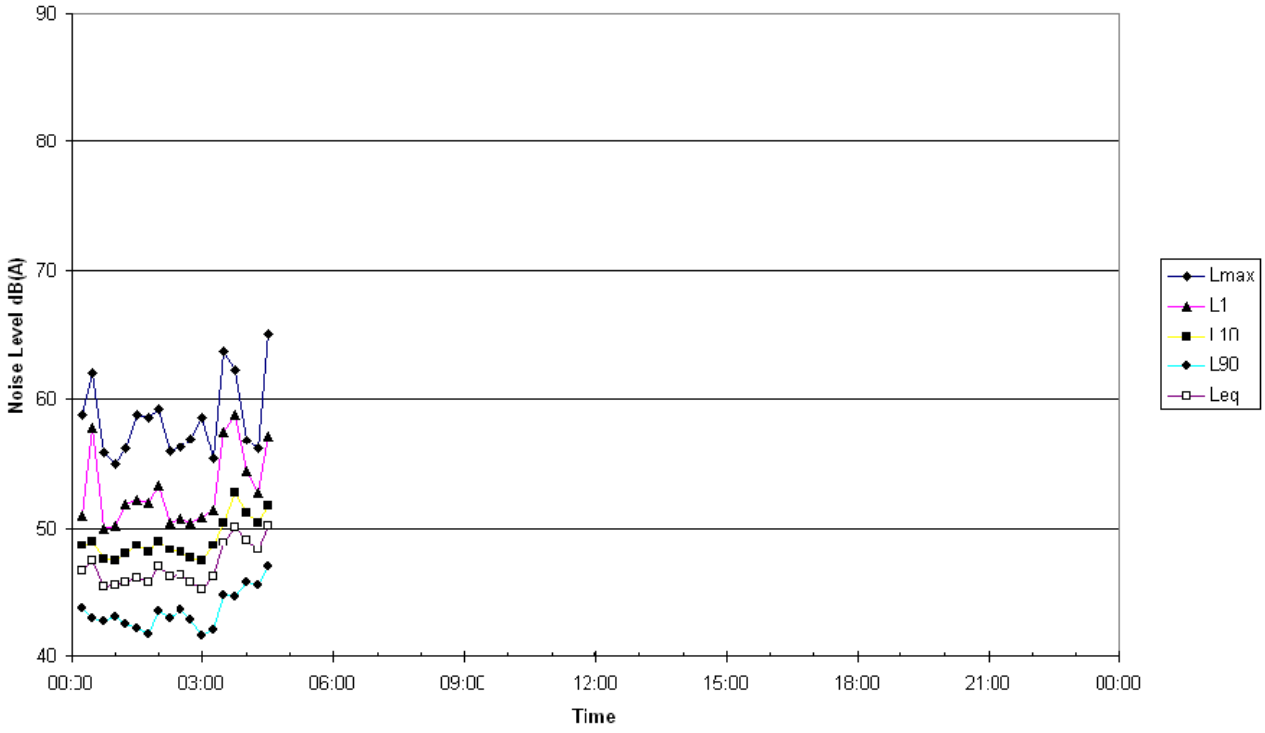
Measured Noise Levels
Unit 8, 501 Glebe Point Road - Tuesday 21/02/2012



Measured Noise Levels
Unit 8, 501 Glebe Point Road - Wednesday 22/02/2012



Measured Noise Levels
Unit 8, 501 Glebe Point Road - Thursday 23/02/2012



Sound Insulation Prediction (v6.4.13)

Benbow Environmental - Key No. 3604

Margin of error is generally within Rw +/- 3 dB

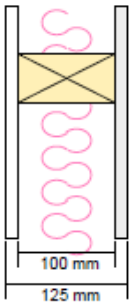
Job Name:

Notes:

Job No.: Page No.:

Date: 9 Mar 12 Initials:ftorres

File Name: Lateral walls.ins



Rw	45 dB
C	-2 dB
C_{tr}	-5 dB

System description

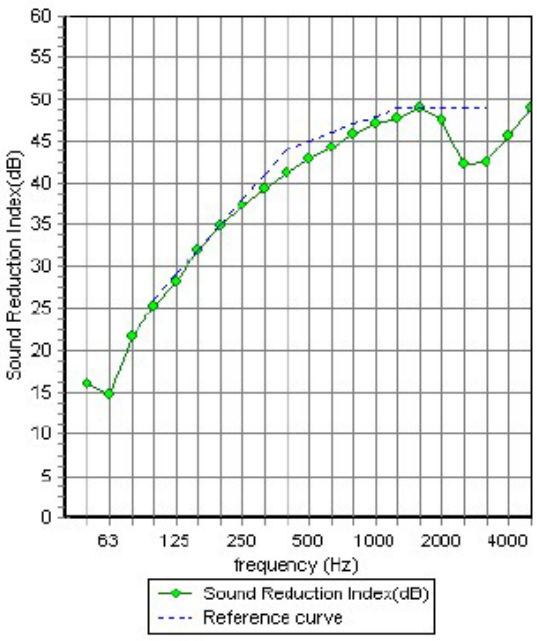
Panel 1 Outer layer: 1 x 12.0 mm CSR fibre cement Wallboard- (m=18.0 kg/m2, fc=2600 Hz, damping=0.01)

Cavity: Timber stud @ 600 mm , Infill Fibre glass (24 kg/m3) Thickness 50 mm
Panel 2 Inner layer: 1 x 13.0 mm Gypsum plasterboard- (m=9.0 kg/m2, fc=2921 Hz, damping=0.01)

Panel Size 2.7x4 m

Mass-air-mass resonant frequency =66 Hz

frequency (Hz)	TL(dB)	TL(dB)
50	16	
63	15	17
80	22	
100	25	
125	28	28
160	32	
200	35	
250	37	37
315	39	
400	41	
500	43	43
630	44	
800	46	
1000	47	47
1250	48	
1600	49	
2000	47	45
2500	42	
3150	42	
4000	46	45
5000	49	



Sound Insulation Prediction (v6.4.13)

Benbow Environmental - Key No. 3604

Margin of error is generally within Rw +/- 3 dB

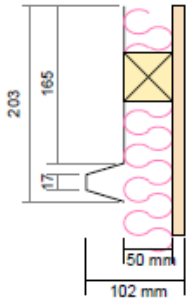
Job Name:

Notes:

Job No.: Page No.:

Date: 9 Mar 12 Initials:ftorres

File Name: Roof.ins



Rw	36 dB
C	-3 dB
C_{tr}	-8 dB

System description

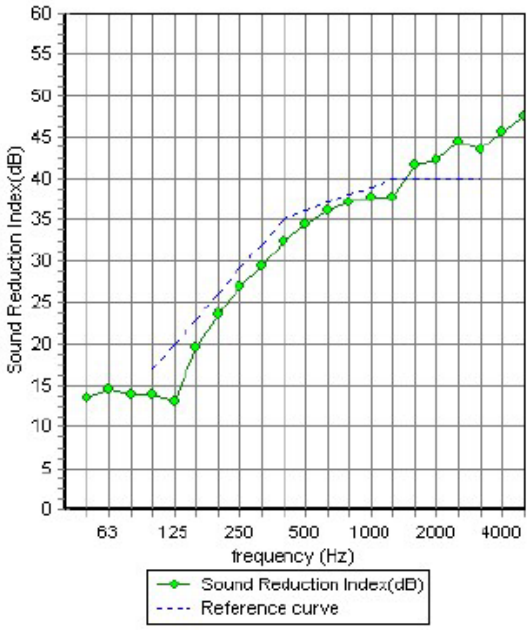
Panel 1 Outer layer: 1 x 0.5 mm Steel-Kliplok (m=4.9 kg/m2, fc1=224 Hz, fc2=25877 Hz, damping=0.01)

Cavity: Timber stud @ 600 mm , Infill Fibre glass (24 kg/m3) Thickness 50 mm
Panel 2 Inner layer: 1 x 12.0 mm Plywood- (m=6.7 kg/m2, fc=1935 Hz, damping=0.01)

Panel Size 2.7x4 m

Mass-air-mass resonant frequency =135 Hz

frequency (Hz)	TL(dB)	TL(dB)
50	14	
63	14	14
80	14	
100	14	
125	13	15
160	20	
200	24	
250	27	26
315	29	
400	32	
500	34	34
630	36	
800	37	
1000	38	37
1250	38	
1600	41	
2000	42	43
2500	44	
3150	43	
4000	46	45
5000	48	



Frequency Hz	4mm 12mm Gap 4mm	6mm 12mm Gap 6mm	6mm 12mm Gap 6.38mm	10mm 12mm Gap 4mm	10mm 12mm Gap 6mm	10mm 12mm Gap 6.38mm
100	25	17	19	23	27	27
125	24	26	24	28	27	28
160	23	22	21	26	24	26
200	21	18	19	19	24	26
250	21	18	19	23	29	30
315	19	24	24	26	31	32
400	22	27	28	31	33	34
500	25	29	32	33	34	36
630	30	33	34	36	37	40
800	33	37	38	39	39	41
1000	36	39	40	41	41	42
1250	38	39	40	41	41	41
1600	40	39	39	41	39	41
2000	41	34	35	45	37	42
2500	35	37	39	45	40	44
3150	31	42	44	42	43	49
4000	40	47	49	44	47	53
R_w	31	33	34	36	38	40
C	-2	-2	-2	-2	-2	-2
C_{tr}	-4	-5	-5	-5	-4	-5
STC	31	33	34	36	38	40

Table A4. Sound Attenuation Data for Double Glazing