Authorities Submission - Acoustics
Healthscope Limited
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Sydney Southwest Private Hospital

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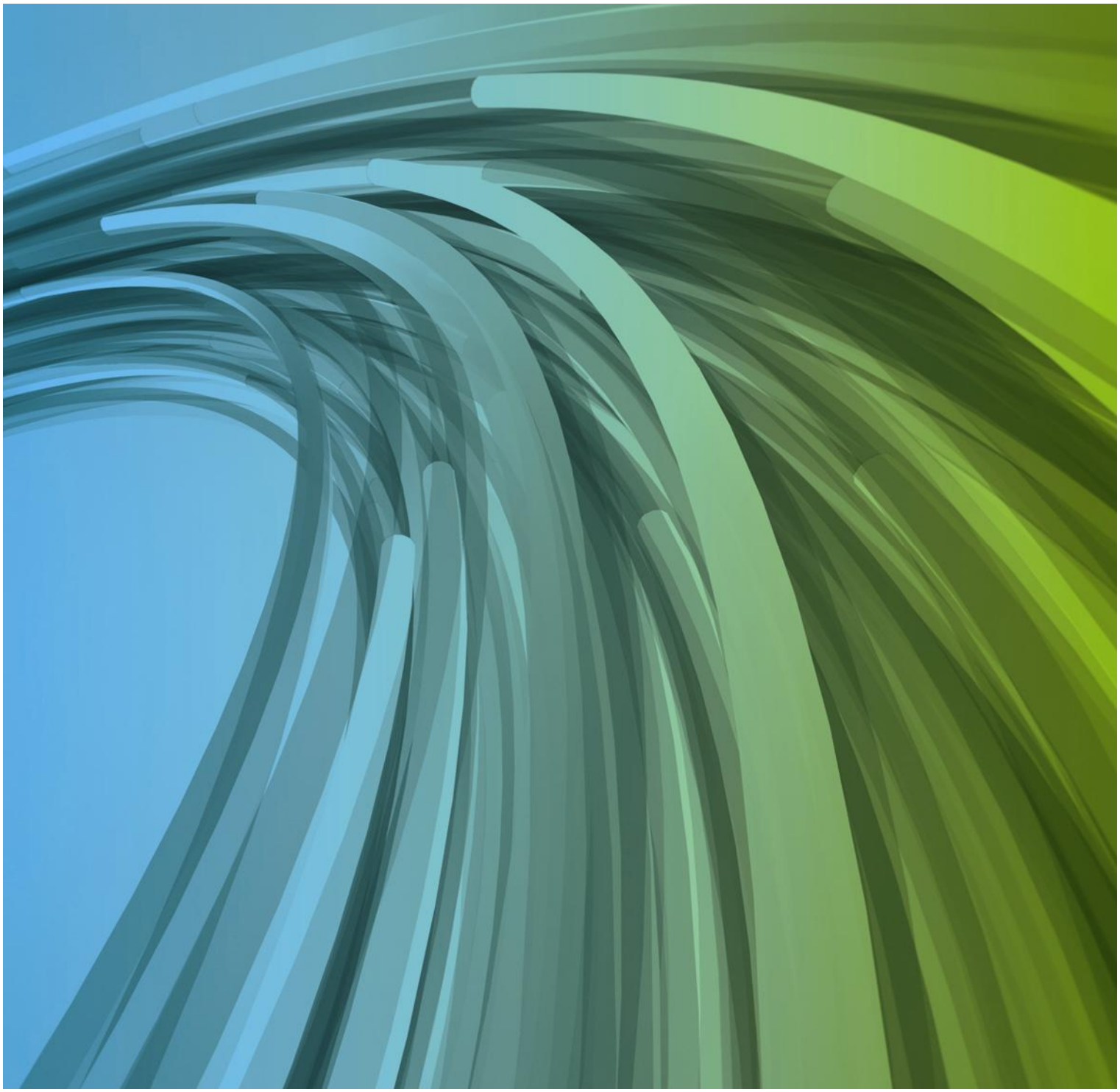

Sydney Southwest Private Hospital

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Quality Information

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Revision History

Revision	Revision Date	Details	Authorised	
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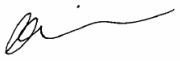
00	16-Sep-2010		Laura Allison Acoustic Engineer	
01	24-Sep-2010	Revision 01	Laura Allison Acoustic Engineer	

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1.0 Introduction

This acoustic report details the requirements and recommended treatments for the proposed redevelopment of Sydney Southwest Private Hospital, Liverpool, NSW.

The main acoustic issues addressed in this report are:

- Speech Privacy;
- Control of mechanical services noise; and
- Control of environmental noise emission.

A glossary of acoustic terminology used in this report is presented in Appendix A.

1.1 Site description

Sydney Southwest Private Hospital is located on Bigge Street, Liverpool. It is bounded by Bigge Street to the west, commercial developments to the north and south and commercial and residential developments to the east. The nearest residential receivers are located adjacent to Sydney Southwest Private hospital to the east and directly across Bigge Street to the west. The extension of the hospital will occur to the north of the existing hospital building. The site location is shown in Figure 1 below.

Figure 1 Location plan

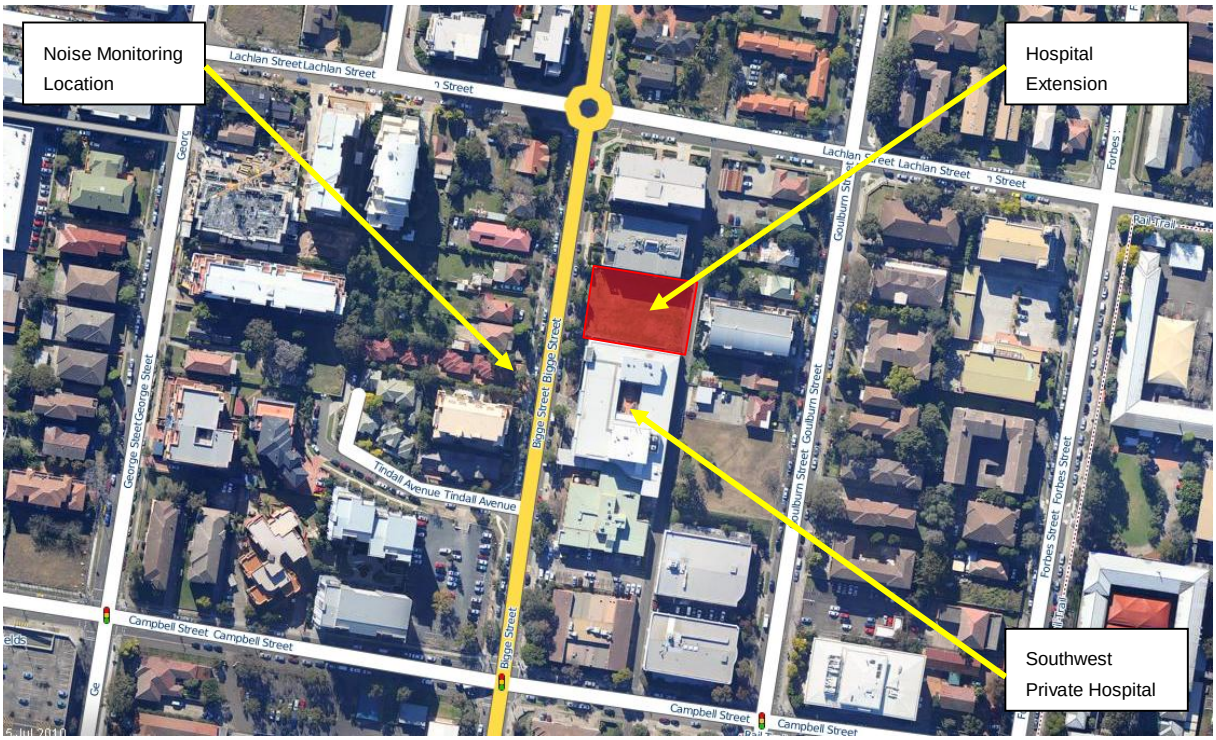


Image Courtesy of Nearmap

1.2 Development description

The redevelopment will consist of an extension to the north of the current hospital building.

The extension will consist of:

- Two basement carparking levels accommodating 88 car spaces;
- Four operating theatres;
- Medical consulting suites; and
- 60 bed In Patient Unit (IPU)

2.0 Environmental Noise Monitoring

2.1 Ambient noise level measurements

An Infobyte noise logger was used to continuously measure existing ambient noise levels at 25 Bigge Street, Liverpool. The logger measured ambient noise levels. The major ambient noise source in the area is road traffic. The logger was set for a sample period of 15 minutes and continuously logged from 17 June to 25 June 2010. The instruments were calibrated both prior to and after the measurements and no significant drift in calibration was observed.

A noise logger measures the noise levels over the sample period and then determines the L_{A1}, L_{A10}, L_{A90}, L_{Amax} and L_{Aeq} levels of the noise environment. The L_{A1}, L_{A10} and L_{A90} levels are the levels exceeded for 1%, 10% and 90% of the sample period respectively. The L_{Amax} is indicative of maximum noise levels due to individual noise events such as the pass-by of a heavy vehicle. The L_{A90} is taken as the background noise level. The L_{Aeq} level is the equivalent continuous noise level and has the same sound energy over the sample period as the actual noise environment with fluctuating noise levels.

The background noise level is defined by the Department of Environment, Climate Change and Water (DECCW) as "the underlying level of noise present in ambient noise when all unusual extraneous noise is removed". It can include sounds that are normal features of a location and may include birds, traffic, insects etc. The background noise level is considered to be represented by the $L_{A90,15\ min}$ descriptor. The L_{A90} noise level is the level exceeded for 90% of the sample period and represents the average minimum noise level in the local acoustic environment over the measurement period.

The graphical recorded outputs from the noise monitoring are given in Appendix B. The results used to develop the graphs given in Appendix B were also analysed to determine a single Assessment Background Level (ABL) for each day, evening and night period, in accordance with the NSW Industrial Noise Policy (INP).

The ABL is established by determining the lowest ten-percentile level of the L_{A90} noise data acquired over each period of interest i.e. day, evening and night. Table 1 presents individual ABLs for each day's assessment periods.

The overall background noise level for the site or Rating Background Level (RBL) representing the day, evening and night assessment periods is based on the median of the individual ABLs determined over the entire monitoring period. Table 1 also presents the existing L_{Aeq} ambient noise level, selected for each day, evening and night period, in accordance with INP procedures. An overall representative L_{eq} noise level is determined by logarithmically averaging each assessment period for the entire monitoring duration.

Table 1 Existing background (L_{A90}) and ambient (L_{Aeq}) noise levels

Measurement Times	L_{A90} Background Noise Levels, dB(A)			L_{Aeq} Ambient Noise Levels, dB(A)		
	Day	Evening	Night	Day	Evening	Night
Thursday 17 June 2010	-	43	39	-	56	57
Friday 18 June 2010	47	43	39	66	54	51
Saturday 19 June 2010	46	43	39	64	54	61
Sunday 20 June 2010	44	41	39	67	54	51
Monday 21 June 2010	47	43	38	68	54	52
Tuesday 22 June 2010	48	43	39	66	56	57
Wednesday 23 June 2010	49	42	38	68	58	53
Thursday 24 June 2010	48	44	37	68	57	54
Friday 25 June 2010	48	42	-	67	55	-
RBL	**47**	**43**	**39**	**-**	**-**	**-**
Log Average	**-**	**-**	**-**	**67**	**56**	**56**

Notes:

1) Day is defined as 7:00am to 6:00pm Monday to Saturday and 8:00am to 6:00pm Sundays and Public Holidays.
2) Evening is defined as 6:00pm to 10:00pm Monday to Sunday and Public Holidays.
3) Night is defined as 10:00pm to 7:00am Monday to Saturday and 10:00pm to 8:00am Sundays and Public Holidays.

3.0 Acoustic Design Criteria

3.1 Recommended ambient internal noise levels

Internal noise levels in the development will mainly be generated by vehicles using surrounding roads and by mechanical ventilation and air conditioning plant. It is important that an appropriate noise level is established.

A reduced level of ambient noise is required in certain spaces (e.g. the consulting rooms) to achieve good communication through the space. A higher level of ambient noise is generally preferable in open plan spaces to ensure a moderate level of acoustic privacy between areas. Too loud a background noise level, however, may lead to communication difficulties and fatigue.

Table 1 of Australian Standard AS/NZ 2107:2000 "Acoustics – Recommended design sound levels and reverberation times for building interiors" recommends satisfactory and maximum internal noise levels for building interiors based on room designation and location of the development relevant to external noise sources. Internal noise levels due to air conditioning and mechanical ventilation plant should not exceed the maximum levels recommended in this Standard. The levels for areas relevant to this development are given in Table 2. The midpoint of the internal noise level range has been adopted as the internal design noise criteria for mechanical plant noise.

Table 2 Recommended design sound levels AS/NZS 2107:2000

Type of Occupancy/Activity	Recommended Design Sound Level, L_{Aeq}, dB(A)	
	Satisfactory	Maximum
Casualty areas	40	45
Corridors and lobby spaces	40	50
Consulting rooms	40	45
Delivery suites	45	50
Dental clinics	40	45
Geriatric rehabilitation	40	45
Intensive care wards	40	45
Kitchens, sterilising and service areas	50	55
Nurses' stations	40	45
Office areas	40	45
Pharmacies	45	50
Sterilising areas in operating theatres	40	45
Surgeries	40	45
Wards	35	40
Waiting rooms, reception areas	40	50

The recommended noise levels are given in terms of equivalent continuous A-weighted noise levels (L_{Aeq}).

3.2 Recommended reverberation times

A room's 'liveliness' can be quantified through the measurements of its 'reverberation time'. In layman terms, reverberation is the build up of sound within a room due to multiple reflections from the room's surfaces. The reverberation time is a measure of how long it takes for a burst of sound to decay 60 dB and is given the abbreviation of RT_{60}. A 'lively' room (e.g. a tiled bathroom with lots of hard surfaces) has a long reverberation time, and an acoustically 'dead' room (e.g. a carpeted office with mineral fibre ceiling tiles) has a short reverberation time.

Reverberation control is necessary for two important reasons:

- Excessive reverberation makes speech more difficult to follow as the sounds of one word are blurred into the next. In extreme cases it may be necessary to talk more slowly in order to be understood; and
- A noise source, such as air conditioning equipment or even people talking, will generate greater sound pressure levels in a reverberant space because the sound energy takes longer to decay.

A noise source in a 'lively' room can be up to approximately 5-7 dB(A) louder than in an acoustically dead room. Therefore, it is important when designing 'quiet' spaces that the surface area of sound absorptive finishes is optimised.

Table 3 gives the recommended reverberation times for the different areas in the redevelopment based upon the recommendations given in AS/NZ 2107:2000.

Table 3 Recommended reverberation times AS/NZS 2107:2000

Type of Occupancy/Activity	Recommended Reverberation Time (s)
Casualty areas	0.4 to 0.6
Corridors and lobby spaces	0.4 to 0.6
Consulting rooms	0.4 to 0.6
Delivery suites	0.4 to 0.6
Dental clinics	0.4 to 0.6
Geriatric rehabilitation	0.4 to 0.6
Intensive care wards	0.4 to 0.6
Kitchens, sterilising and service areas	0.6 to 0.8
Nurses' stations	0.4 to 0.7
Office areas	0.4 to 0.7
Pharmacies	0.4 to 0.7
Sterilising areas in operating theatres	Note 1
Surgeries	0.4 to 0.7
Wards	0.4 to 0.7
Waiting rooms, reception areas	0.4 to 0.7

Notes:

1) Reverberation time should be minimised as far as practicable for noise control.

3.3 Speech privacy

The degree of speech privacy between spaces is primarily determined by the following factors:

- The level of background noise in the receiving room;
- The level of speech effort (which itself can be a function of the level of background noise) - speech effort can be conveniently categorised into conversational, raised voice, loud voice and shouting;
- The source and receiving room reverberation times which are determined by the quantity and quality of the sound absorptive finishes – this determines the build up of noise in both rooms; and
- Attenuation between source and receiving spaces (i.e. acoustic performance of partitions, ceilings and doors between rooms).

Generally the higher the background noise level, the lower the transmission loss required of the partitions for the same level of acoustic privacy.

Australian Standard AS2822:1985 "Acoustics – Methods of assessing and predicting speech privacy and speech intelligibility" gives a procedure for determining the acceptability of speech privacy between spaces.

The level of sound insulation required between the rooms is a function of the level of privacy and quality desired. The desired standard of acoustic privacy depends on the client needs and the designated use of each room. Acoustic privacy can be categorised into the following three quality standards:

- Low privacy – conversations can generally be heard and are mostly intelligible. This is the usual privacy level in an open plan office environment where partial height partitioning is used;
- Normal privacy – conversation is mostly unintelligible and although muffled can generally be heard. Normal privacy relates to an articulation index of 0.10 where 80 to 90% of words spoken will be unintelligible; and
- Confidential privacy – conversation is unintelligible but may remain audible in adjacent rooms with low ambient noise. Confidential privacy relates to an articulation index of 0.05 where 90 to 95% of words will be unintelligible.

The level of vocal effort in the source room must also be considered. Vocal effort can be categorised into the following four levels:

- Conversational voice – resulting in a sound pressure level of 60 dB(A) at 1 metre from the talker;
- Raised voice – resulting in a sound pressure level of 66 dB(A) at 1 metre from the talker;
- Stage voice – resulting in a sound pressure level of 72 dB(A) at 1 metre from the talker; and
- Shouting – resulting in a sound pressure level of 78 dB(A) at 1 metre from the talker.

The level of speech privacy which will be used to calculate the required acoustic performance of partitions for various rooms in the fitout are given in Table 4.

Table 4 Recommended speech privacy ratings

Room	Acoustic Privacy Level	Vocal Effort
Operating theatre	Confidential	Raised
Anaesthetic	Confidential	Raised
Consulting suite	Confidential	Raised
Private office	Confidential	Conversational
2 Bed room	Normal	Conversational
1 Bed room	Confidential	Conversational
Ensuite	Normal	Conversational
Group therapy	Confidential	Raised
Interview room	Confidential	Raised
Multipurpose room	Normal	Conversational

3.4 Road traffic noise intrusion

The Department of Environment and Climate Change and Water's (DECCW) Environmental Criteria for Road Traffic Noise (ECRTN) is generally used for the assessment of road traffic noise, therefore noise from traffic using nearby roads intruding into the redevelopment will be assessed using this document.

The ECRTN states that "For commercial and industrial developments, information of desirable noise levels is contained in AS/NZ 2107:2000". These levels are detailed in Table 2.

3.5 Environmental noise emission criteria

Liverpool City Council advise that the Department of Environment and Climate Change and Water's (DECCW) NSW Industrial Noise Policy should be used to assess noise emission from developments.

The Department of Environment and Climate Change and Water (DECCW) provides guidelines for external noise emissions from the development. These guidelines for industrial noise sources are provided in the New South Wales Industrial Noise Policy (INP) and will apply to all mechanical plant installed at the development.

The assessment procedure for industrial noise sources has two components:

- Controlling intrusive noise impacts in the short term for residences; and
- Maintaining noise level amenity for residences and other land uses.

3.5.1 Intrusive noise impacts

The INP states that the noise from any single source should not intrude greatly above the prevailing background noise level. Industrial noises are generally considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (L_{Aeq}), measured over a 15 minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB(A). This is often termed the Intrusiveness Criterion.

The 'Rating Background Level' (RBL) is the background noise level to be used for assessment purposes and is determined by the methods given in the INP. Using the rating background noise level approach results in the intrusiveness criterion being met for 90% of the time. Adjustments are to be applied to the level of noise produced by the source that is received at the assessment point where the noise source contains annoying characteristics such as tonality or impulsiveness.

3.5.2 Protecting noise amenity

To limit continuing increase in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1 of the INP. That is, the ambient L_{Aeq} noise level should not exceed the level appropriate for the particular locality and land use. This is often termed the 'Background Creep' or Amenity Criterion.

For a residential receiver in a urban area, the recommended criteria are shown in Table 5 below.

Table 5 Recommended L_{Aeq} noise levels from industrial sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level, dB(A)	
			Acceptable	Recommended Maximum
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50
Commercial		When in use	65	70

When the existing noise level from *industrial noise sources* is close to the "Acceptable Noise Level" (ANL) given above, noise from the new source must be controlled to preserve the amenity of the area in line with the requirements of the INP. However, industrial noise is not significant at this site. The dominant source of noise is road traffic.

Where existing road traffic noise is high enough to render stationary noise sources effectively inaudible, the ANL can be modified so that the amenity criteria is not unduly stringent in an environment where road traffic noise is the dominant source of environmental noise. If all the conditions below are satisfied, the ANL becomes $L_{Aeq,traffic}$ minus 10dB(A). The conditions are:

- The road traffic noise is the dominant noise source
- The existing noise is 10dB(A) or more above the acceptable ANL for the area
- It is highly unlikely the road traffic noise levels would reduce in the near future

These conditions occur at the development site.

3.5.3 Resultant environmental noise criteria

A summary of the intrusive and amenity criteria is given in Table 6 below.

Table 6 Summary of environmental noise criteria

Period	RBL (L_{A90})	Intrusiveness Criterion = RBL+5	Ambient (L_{Aeq})	Amenity Criteria	Final Environmental Criteria
Residential					
Day	47	52	67	60	52
Evening	43	48	56	50	48
Night	39	44	56	46[1]	44
Commercial					
When in use	-	-	-	65	65

Notes:

1) High traffic noise

These criteria apply to environmental noise emission from mechanical services outdoor plant, loading dock activities and car parking activities.

3.5.4 Emergency services noise emission criteria

It is understood that brown-outs and black-outs are rare for the area and as result of this the use of the emergency generators will be extremely rare.

For this reason and in the absence of any relevant NSW guideline for emergency generators and equipment, it is therefore recommended that noise limits for emergency plant equipment be relaxed. It is recommended that the noise emission from emergency plant and equipment be set to 5 dB(A) above the DECCW INP recommended criteria presented in Table 6.

It is also recommended that all emergency plant and equipment be tested during the day time (7am to 6pm).

Table 7 Environmental noise emission – Emergency equipment

Location	Period	Emergency services noise emission criteria, dB(A)
Residential	Day	57
	Evening	53
	Night	49
Commercial	When in use	70

3.6 Traffic noise criteria

Noise from traffic movements to and from the site including truck and car movements will be assessed using the DECCW's document *Environmental Criteria for Road Traffic Noise* (ECRTN).

The Hume Highway is classified as an arterial road. Elizabeth Street, Campbell Street, Lachlan Street and Bigge Street are classified as collector roads and Goulburn Street and Forbes Street are classified as local roads. Table 8 presents the DECCW's road traffic noise criteria for land use developments with potential to create additional traffic on existing roads. The external criteria are applied at 1 metre from the affected residential building facades.

Table 8 Land use developments with the potential to create additional traffic on existing roads traffic noise criteria

	Period	Parameter	Criterion, dB(A)
Arterial and Sub-Arterial Roads	Day	$L_{Aeq(15hr)}$	60
	Night	$L_{Aeq(9hr)}$	55
Collector Roads	Day	$L_{Aeq(1hr)}$	60
	Night	$L_{Aeq(1hr)}$	55
Local Roads	Day	$L_{Aeq(1hr)}$	55
	Night	$L_{Aeq(1hr)}$	50

Note:

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

In cases where noise from an existing road already exceeds the above criteria, the DECCW recommends that "where feasible, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments." In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB(A).

4.0 Construction Noise and Vibration Criteria

4.1 Summary of acoustic performance requirements

This section will establish criteria in order to address the following acoustical issues:

- Construction noise and vibration management levels; and
- Additional traffic generated by the construction activities on nearby roads.

4.2 Construction noise management levels

In July 2009 the NSW Department of Environment, Climate Change and Water (DECCW) published the *Interim Construction Noise Guidelines (ICNG)* for use in construction noise assessment. This document replaces the previous publication the *Environmental Noise Control Manual (ENCM)* and is used as the basis for establishing construction noise criteria for the proposed development.

Under the guidelines a construction noise management plan is required to be compiled by the Contractor, prior to construction commencing. Noise management level (NML) objectives must be set for the daytime and evening periods, and must be complied with where reasonably practicable. Work that is proposed outside of standard working hours, as defined in the *ICNG*, generally requires strong justification.

The noise management plan should detail the '*best practice*' construction methods to be used, presenting a reasonable and feasible approach. The plan should identify the extent of the residential area affected and assess the impact on residents. The plan should detail any community relation programs that are planned e.g. prior notification for particularly noisy activities, letter box drop regarding out of hours construction work to be undertaken and a 24 hour contact phone number for residents to call should they have any complaints or questions.

The *ICNG* defines what is considered to be feasible and reasonable as follows:

> *"Feasible*
>
> *A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements.*
>
> *Reasonable*
>
> *Selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure."*

The *ICNG* recommends that a quantitative assessment is carried out for all *'major construction projects that are typically subject to the EIA process'*.

Predicted noise levels at nearby sensitive receivers (residential, commercial and industrial premises) are compared to the levels provided in Section 4 of the *ICNG*. Where an exceedance of the NMLs is predicted the *ICNG* advises that the proponent should apply all feasible and reasonable work practises to minimise the noise impact.

4.3 Construction noise management levels

4.3.1 Proposed construction hours

It is understood that construction activities will be generally be undertake during DECCW's recommended standard construction hours:

DECCW's recommended standard hours:

- Monday to Friday 7 am to 6 pm
- Saturday 8 am to 1 pm
- No work on Sundays or public holidays

A summary of construction noise management levels (NMLs) are presented below in Table 9. These have been developed based upon the recommendations contained within the DECCW's ICNG.

Table 9 Construction noise emission management levels

Location		Measured RBL, dB(A)	Noise Management Level, $L_{Aeq,15min}$, dB(A)
Residential receivers	Monday – Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm	47	57
	Saturday 1:00 pm to 6:00 pm Sunday 8:00 am to 6:00 pm	47	52
	Monday – Sunday 6:00 pm to 10:00 pm	43	48
	Monday – Friday 10:00 pm to 7:00 am Saturday – Sunday 10:00 pm to 8:00 am	39	44
Classrooms at schools and other educational institutions – Internal when in use		N/A	45
Hospital wards and operating theatres – Internal when in use		N/A	45
Places of worship – Internal when in use		N/A	45
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion) – When in use		N/A	65
Passive recreation areas(characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation) – When in use		N/A	60
Community centres – When in use		N/A	Refer AS/NZS 2107:2000
Industrial premises – When in use		N/A	75
Commercial and Retail premises – When in use		N/A	70

Notes:

1) Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

4.4 Construction vibration criteria

Unlike the criteria applicable to noise emissions, vibration criteria are the same for both the construction and operational phases of this project. DECCW's '*Assessing Vibration: a technical guideline*', (DECCW, 2006) has been designed to be used in evaluating and assessing the effects on amenity of vibration emissions from industry, transportation and machinery. The guideline is used in assessments of vibration impacts caused by the construction and operation of new developments.

Vibration criteria are set primarily according to whether the particular activities of interest are continuous in nature or intermittent, whether they occur during the daytime or night-time and the type of receiver to be assessed e.g. residential, commercial or other sensitive receivers.

The effects of vibration in buildings can be divided into three main categories:

- Those in which the occupants or users of the building are inconvenienced or possibly disturbed, i.e. human disturbance or discomfort;
- Those in which the integrity of the building or the structure itself may be prejudiced; and
- Those where the building contents may be affected.

Therefore, vibration levels at sensitive receiver locations must be controlled so as to prevent discomfort and regenerated noise, and in some extreme cases, structural damage.

5.0 Noise Assessment and Recommendations

5.1 Mechanical Services

Major external mechanical plant consists of two cooling towers and an emergency generator. Preliminary selections of this equipment and associated sound power levels are provided in Table 10.

Table 10 Preliminary external plant selections and associated sound power levels

Plant	Preliminary Selection	Sound Power Level, dB							
		Octave Band Centre Frequency, Hz							
		63	125	250	500	1k	2k	4k	8k
Cooling Tower x2	Balticare VXT-150	94	93	89	87	86	83	79	76
	Balticare VXT-150 XA Attenuation	95	91	83	78	76	74	71	68
Emergency Generator	Cummins C400 D5	78	97	104	103	106	107	105	98

5.1.1 Cooling tower acoustic treatment

The cooling towers must be fitted with the XA attenuation package to comply with the relevant criteria established in Section 3.5.

5.1.2 Emergency generator acoustic treatment

It is recommended that the emergency generator inlet, outlet and exhaust be fitted with attenuators. The attenuators are to have a minimum insertion loss given in Table 11.

Table 11 Minimum attenuator insertion loss

	Insertion Loss, dB							
	Octave Band Centre Frequency, Hz							
	63	125	250	500	1k	2k	4k	8k
Generator inlet, outlet and exhaust attenuator	5	10	20	34	38	31	22	16

Implementation of the attenuators will result in compliance with the DECCW INP noise emission criteria during the day period established in Section 3.5.3 and a minor exceedence of 2 dB(A) of the emergency night time criteria established in Section 3.5.4. However, a difference of less than 2 dB(A) is not considered perceptible and this exceedence is not considered significant given that the generator will operate in the night-time period only in an emergency.

It is recommended that servicing and testing of the emergency generator be conducted during the day period when noise emission from the generator complies with the DECCW INP criteria at the nearest sensitive receivers.

5.1.3 Conclusion

Implementation of the above recommendations will ensure that noise emission from the major external mechanical plant will comply with the established environmental noise emission criteria at the nearest sensitive receivers. It is therefore considered that there will be no detrimental impacts to adjoining residential and commercial premises as a result of the proposed redevelopment.

5.2 Traffic noise levels

The existing traffic flows and generated traffic data provided by Transport and Traffic Planning Associates in their report *Traffic, Transport and Parking Assessment Report*, dated August 2010 have been studied and it has been concluded that if the proposed development were to go ahead, traffic on surrounding roads would increase as detailed in Table 12 and Table 13. This assessment has been based on a “worst case” scenario of the total generated traffic occurring on all roads.

Table 12 Summary of traffic flow increase – Morning peak

Location		Existing	Nett Increase[1]	% Increase	Increase in Noise Levels, dB(A)
Hume Highway	West of Bigge Street	3629	40	1	0
	East of Bigge Street	3801	40	1	0
	West of Remembrance Avenue	3892	40	1	0
	East of Remembrance Avenue	3968	40	1	0
Lachlan Street	West of Bigge Street	229	40	17	1
	East of Bigge Street	441	40	9	0
	West of Goulburn Street	537	40	7	0
	East of Goulburn Street	837	40	5	0
Campbell Street	West of Bigge Street	614	40	7	0
	East of Bigge Street	539	40	7	0
Bigge Street	South of Hume Highway	990	40	4	0
	North of Lachlan Street	944	40	4	0
	South of Lachlan Street	854	40	5	0
	North of Campbell Street	931	40	4	0
	South of Campell Street	1330	40	3	0
Goulburn Street	North of Lachlan Street	406	40	10	0
	South of Lachlan Street	776	40	5	0

Notes:

1) Worst case scenario of all 40 movements generated by the proposed development occurring on all roads

Table 13 Summary of traffic flow increase – Afternoon peak

Location		Existing	Nett Increase[1]	% Increase	Increase in Noise Levels, dB(A)
Hume Highway	West of Bigge Street	3188	36	1	0
	East of Bigge Street	3582	36	1	0
	West of Remembrance Avenue	3934	36	1	0
	East of Remembrance Avenue	3967	36	1	0
Lachlan Street	West of Bigge Street	346	36	10	0
	East of Bigge Street	417	36	9	0
	West of Goulburn Street	475	36	8	0
	East of Goulburn Street	722	36	5	0
Campbell Street	West of Bigge Street	484	36	7	0
	East of Bigge Street	381	36	9	0
Bigge Street	South of Hume Highway	942	36	4	0
	North of Lachlan Street	1017	36	4	0
	South of Lachlan Street	876	36	4	0
	North of Campbell Street	909	36	4	0
	South of Campell Street	1036	36	3	0
Goulburn Street	North of Lachlan Street	299	36	12	0
	South of Lachlan Street	686	36	5	0

Notes:

2) Worst case scenario of all 36 movements generated by the proposed development occurring on all roads

The increased traffic flows do not result in an increase in traffic noise by more than 2 dB(A) on any roads. The traffic noise emission from the development will therefore comply with the traffic noise emission criteria established in Section 3.6.

5.2.1 Conclusion

Implementation of the above recommendations will ensure that noise emission from the major external mechanical plant will comply with the established environmental noise emission criteria at the nearest sensitive receivers. It is therefore considered that there will be no detrimental impacts to adjoining residential and commercial premises as a result of the proposed redevelopment.

5.3 Loading dock noise

The proposed development does not include a loading dock. Deliveries to the proposed development will occur through the existing loading dock at Southwest Private Hospital. Operations at the existing loading dock are unlikely to change significantly.

5.4 Vibration

Vibration emission to other developments is not considered to be a characteristic of the proposed development.

All plant installed as part of the proposed development must have appropriate vibration isolation mounts to ensure structure-borne noise and vibration are not an issue within the development.

5.5 Construction noise

A construction noise assessment must be compiled by the contractor after construction methodology, traffic and indicative equipment have been determined.

6.0 Conclusion

This report presents the results of a study on environmental noise emission from the proposed Southwest Private Hospital expansion and refurbishment on the Bigge Street, Liverpool. Environmental noise emission criteria for the development have been established and are based upon the measured background noise level, Liverpool City Council guidelines and the Department of Environment, Climate Change and Water's Industrial Noise Policy.

Ambient noise levels were measured in the vicinity of the proposed development site.

Recommendations have been given to ensure environmental noise emissions from mechanical services and the operation of the development do not exceed the relevant criteria. There are no acoustic conditions that would preclude the proposed development from going ahead.

Appendix A

Glossary of Acoustic Terminology

Appendix A Glossary of Acoustic Terminology

The following is a brief description of acoustic terminology used in this report.

Sound power level	The total sound emitted by a source
Sound pressure level	The amount of sound at a specified point
Decibel [dB]	The measurement unit of sound
A Weighted decibels [dB(A])	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:
	0dB(A) Threshold of human hearing
	30dB(A) A quiet country park
	40dB(A) Whisper in a library
	50dB(A) Open office space
	70dB(A) Inside a car on a freeway
	80dB(A) Outboard motor
	90dB(A) Heavy truck pass-by
	100dB(A) Jackhammer/Subway train
	110 dB(A) Rock Concert
	115dB(A) Limit of sound permitted in industry
	120dB(A) 747 take off at 250 metres
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
L_{max}	The maximum sound pressure level measured over the measurement period
L_{min}	The minimum sound pressure level measured over the measurement period
L_{10}	The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L_{10}.
L_{90}	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L_{90}.
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.

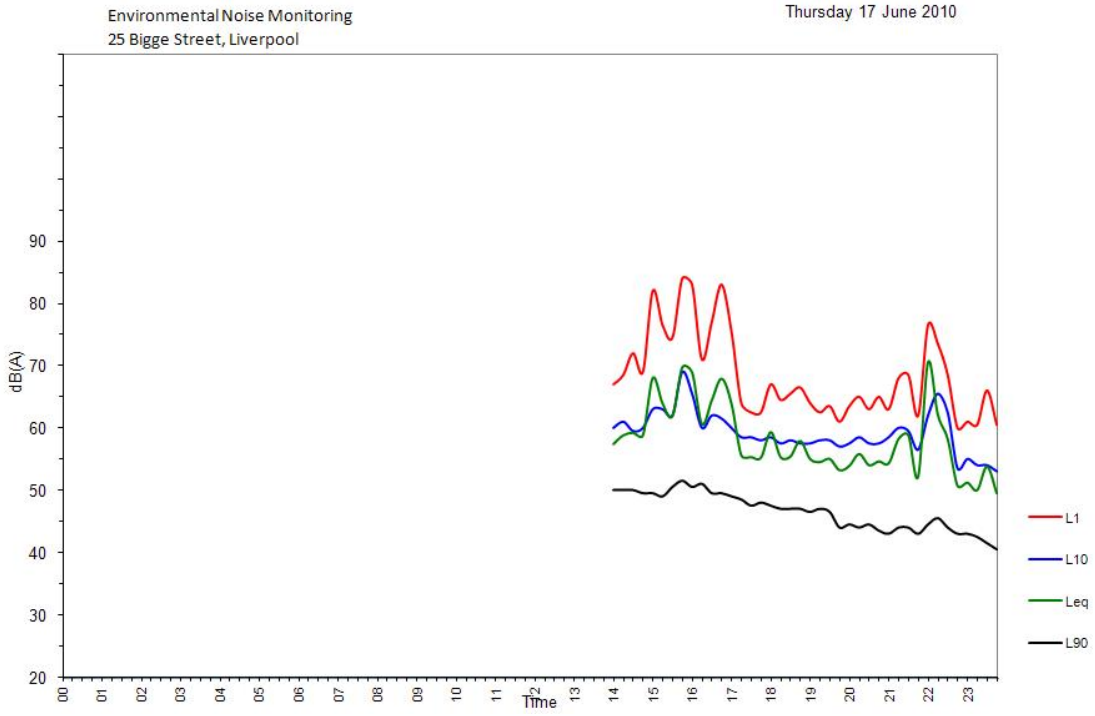
Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L_{90} sound pressure level is used to quantify background noise.
Traffic noise	The total noise resulting from road traffic. The L_{eq} sound pressure level is used to quantify traffic noise.
Day	The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays.
Evening	The period from 1800 to 2200 h Monday to Sunday and Public Holidays.
Night	The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays.
Assessment background level [ABL]	The overall background level for each day, evening and night period for **each day** of the noise monitoring.
Rating background level [RBL]	The overall background level for each day, evening and night period for the **entire length** of noise monitoring.

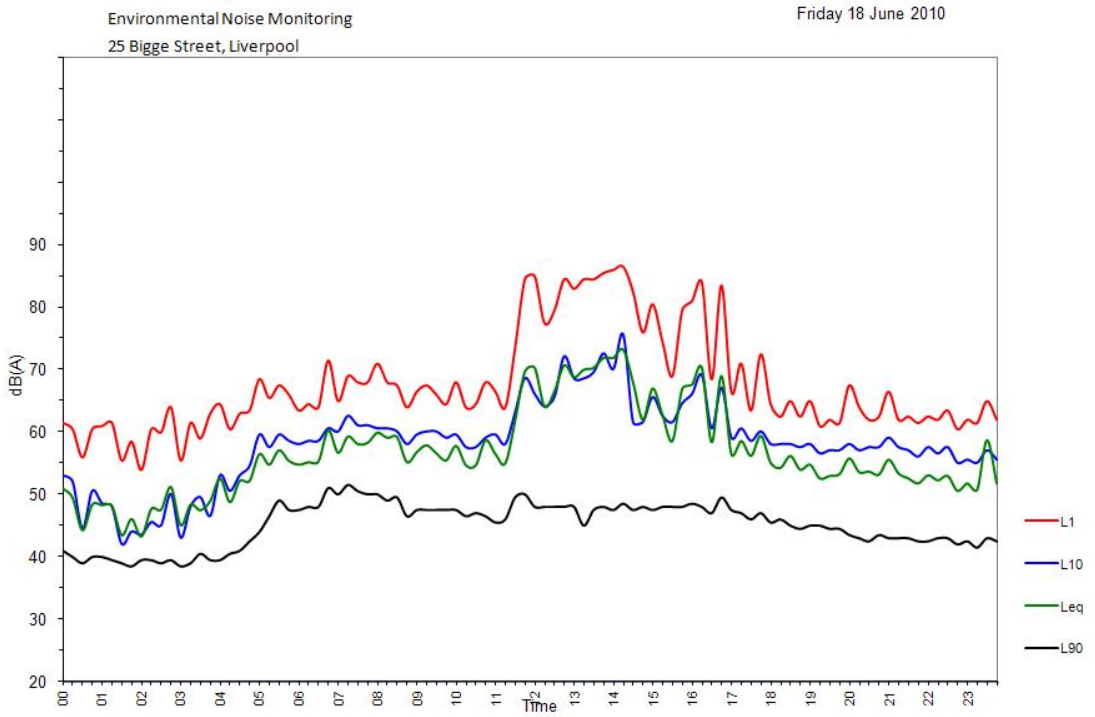
*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 *"Acoustics – Glossary of terms and related symbols"*, the DECC's NSW Industrial Noise Policy and the DECC's Environmental Criteria for Road Traffic Noise.

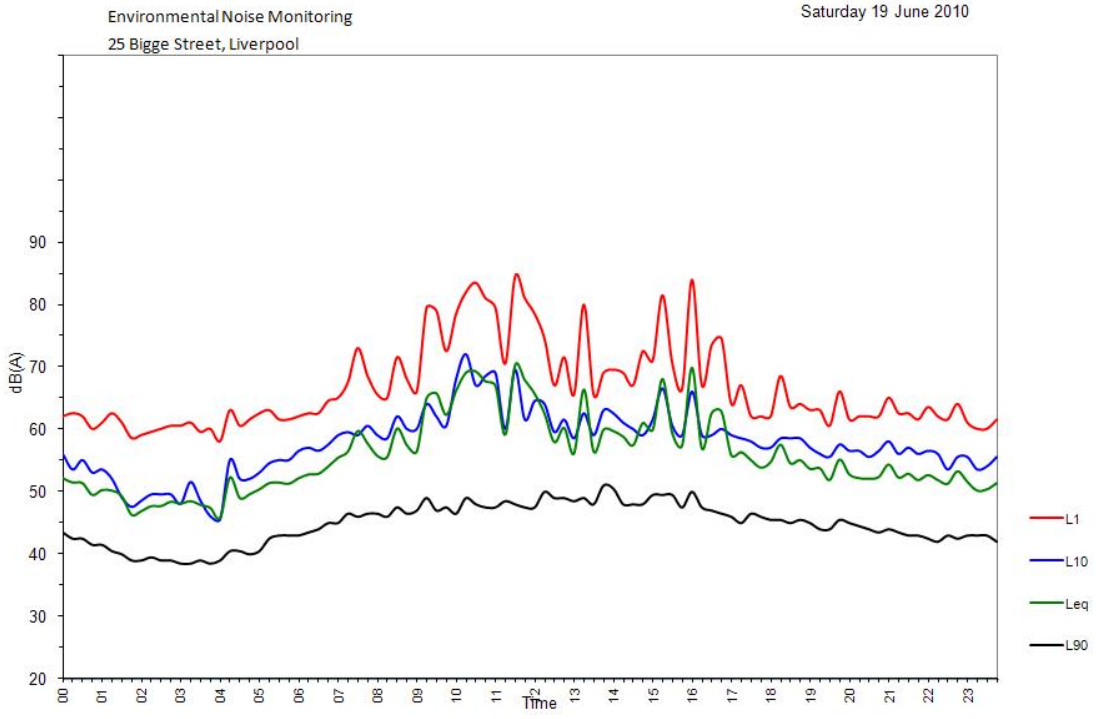
Appendix B

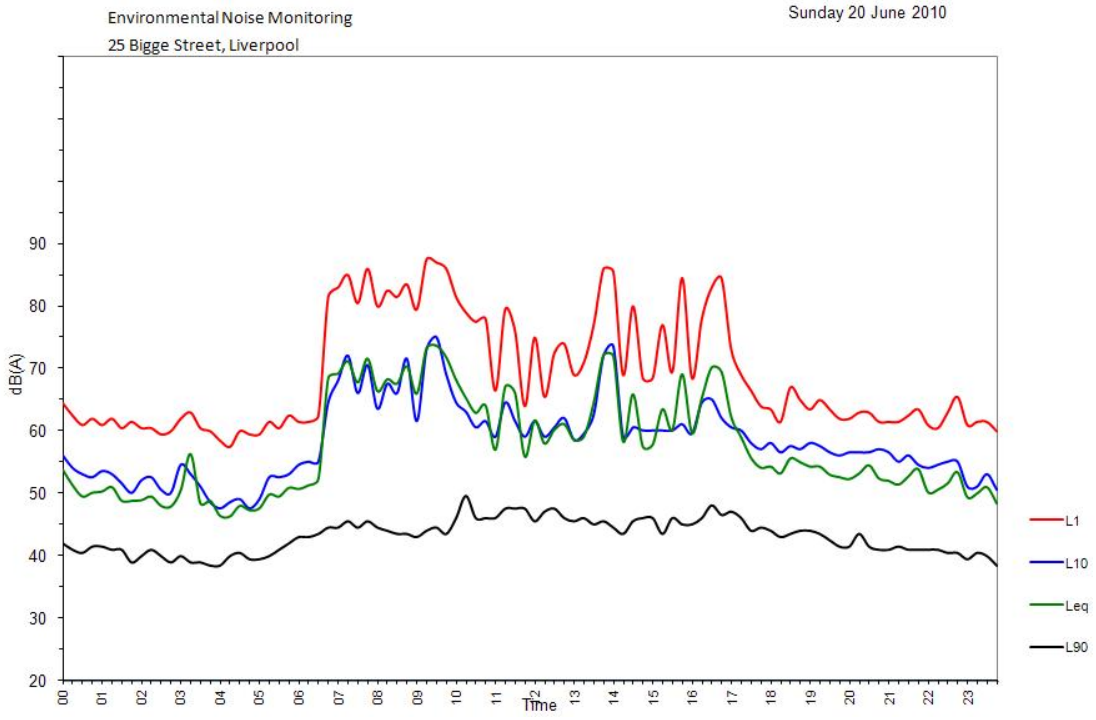
Graphical Noise Monitoring Results

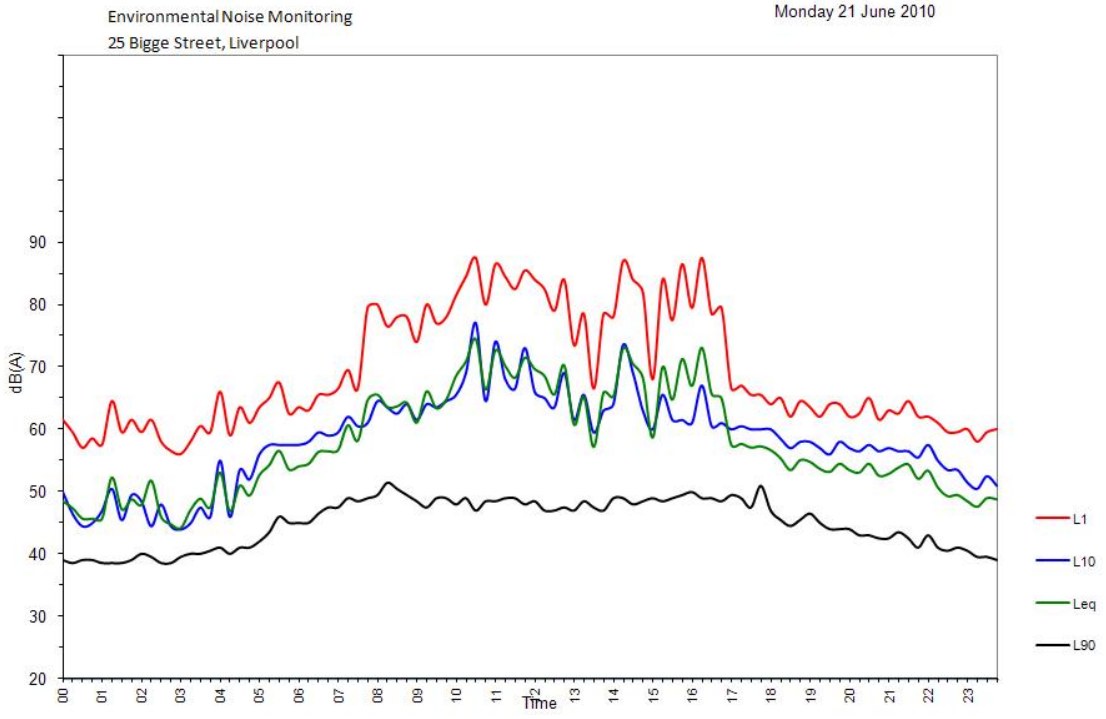
Appendix B Graphical Noise Monitoring Results

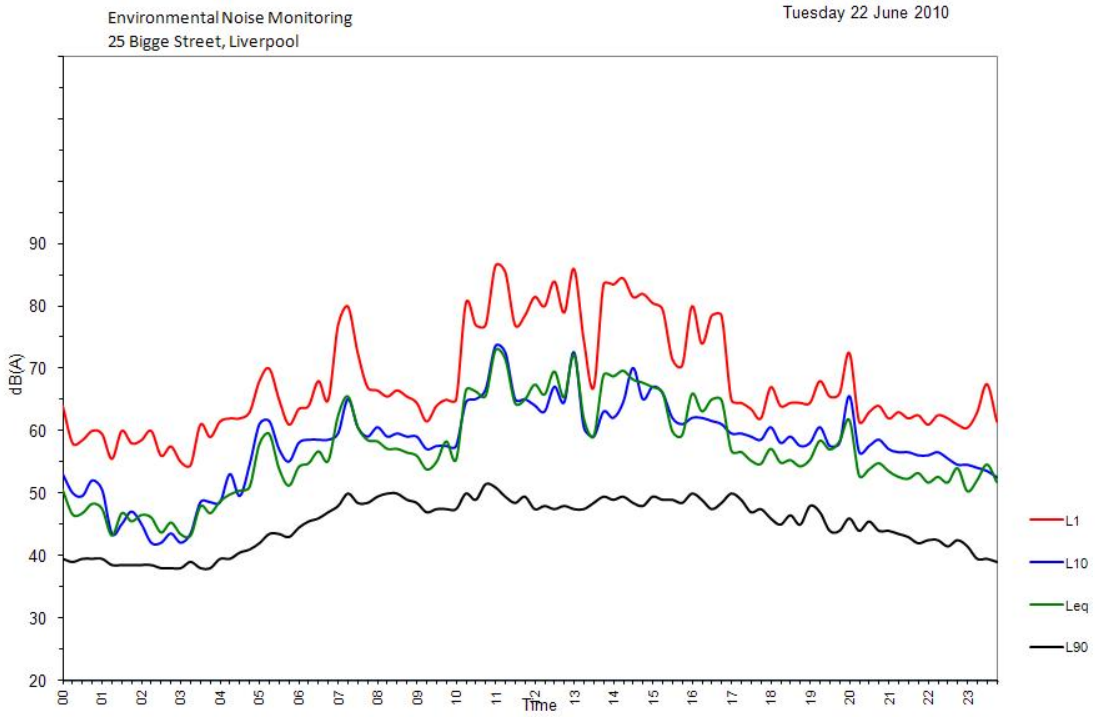


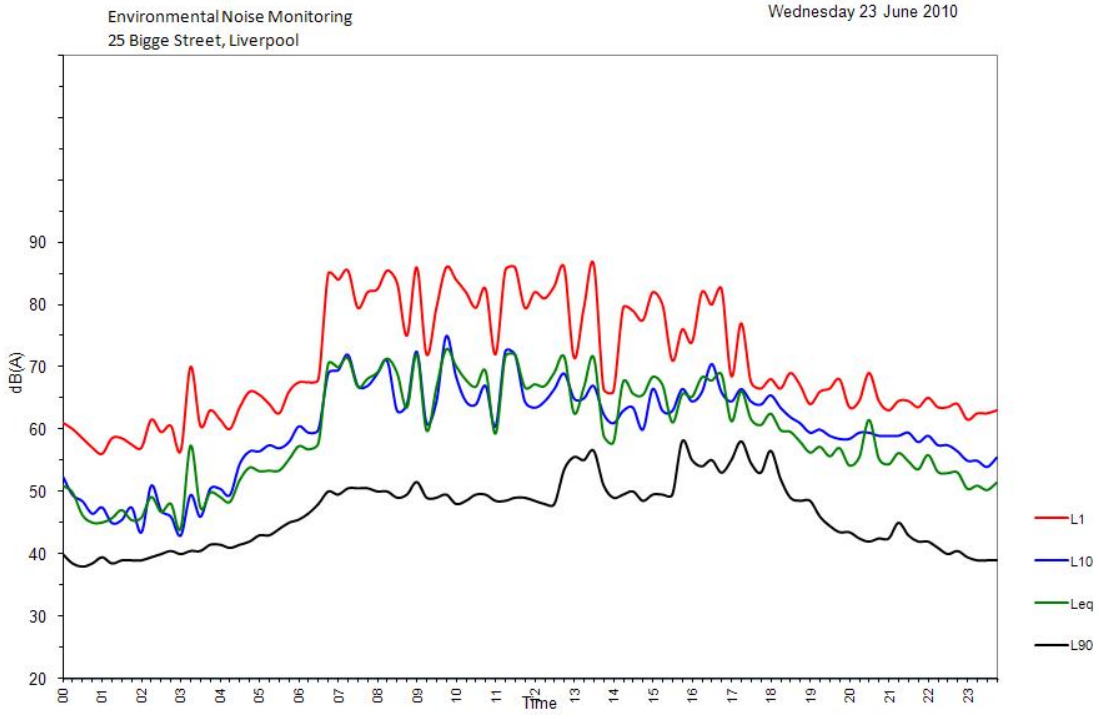


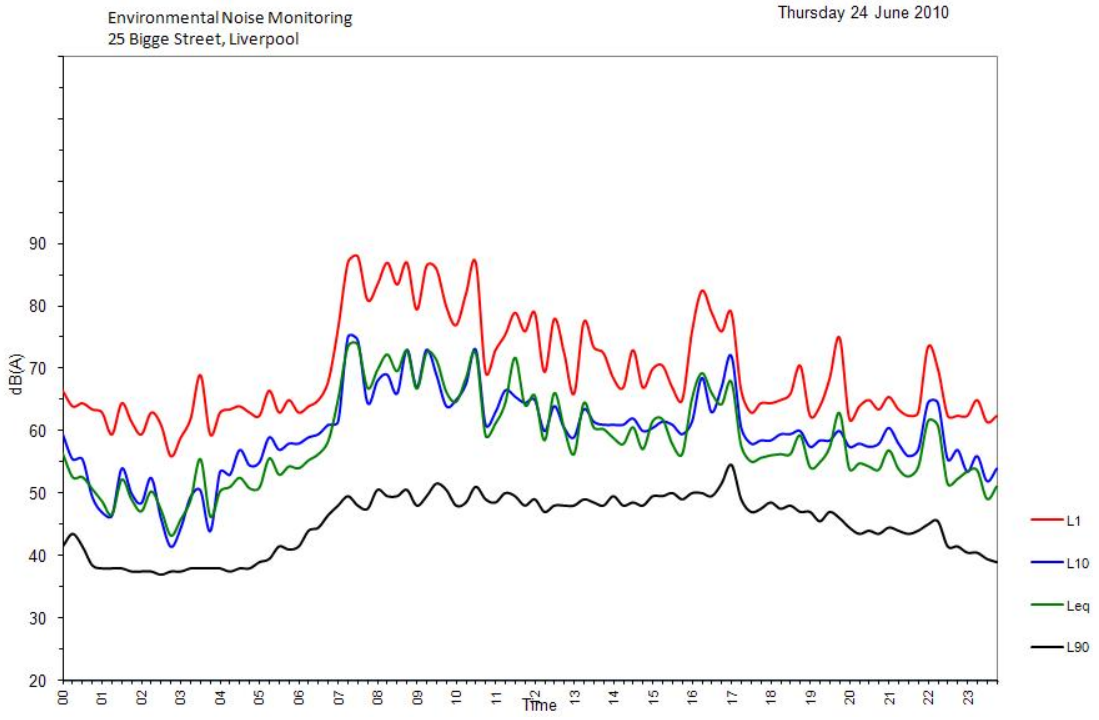

Environmental Noise Monitoring
25 Bigge Street, Liverpool
Saturday 19 June 2010
dB(A)
90
80
70
60
50
40
30
20
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90

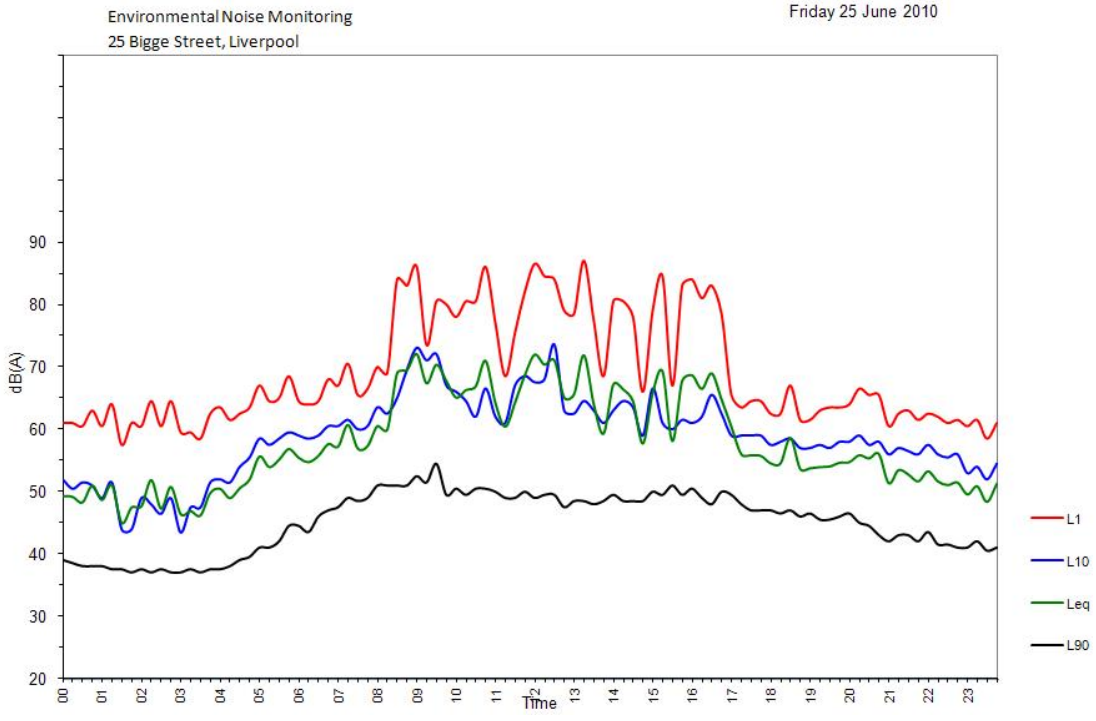

Environmental Noise Monitoring
25 Bigge Street, Liverpool
Sunday 20 June 2010
dB(A)
90
80
70
60
50
40
30
20
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90


Environmental Noise Monitoring
25 Bigge Street, Liverpool
Monday 21 June 2010
dB(A)
90
80
70
60
50
40
30
20
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90


Environmental Noise Monitoring
25 Bigge Street, Liverpool
Tuesday 22 June 2010
dB(A)
90
80
70
60
50
40
30
20
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90


Environmental Noise Monitoring
25 Bigge Street, Liverpool
Wednesday 23 June 2010
dB(A)
90
80
70
60
50
40
30
20
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90


Environmental Noise Monitoring
25 Bigge Street, Liverpool
Thursday 24 June 2010
dB(A)
90
80
70
60
50
40
30
20
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90


Environmental Noise Monitoring
25 Bigge Street, Liverpool
Friday 25 June 2010
dB(A)
90
80
70
60
50
40
30
20
00
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Time
L1
L10
Leq
L90